# MILITARY INSTITUTE OF SCIENCE AND TECHNOLOGY (MIST)

**SYLLABUS OF**

**BACHELOR OF SCIENCE IN INDUSTRIAL & PRODUCTION ENGINEERING**

**DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING (IPE)**

**MARCH 2024**

## CERTIFICATE

Certified that this syllabus of Bachelor of Industrial and Production Engineering of Military Institute of Science and Technology (MIST) is prepared by the Following committee members and will be implemented from Level-1 (IPE-09) of academic session 2023-24.

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# CHAPTER 1

## GENERAL INFORMATION

### 1.1. Introduction to MIST

The necessity of establishing a technical institute for the Bangladesh Armed Forces was felt in the late eighties. In the absence of such an institution, officers of Bangladesh Armed Forces had been graduating from Bangladesh University of Engineering and Technology (BUET), Bangladesh Institute of Technology (BIT), and other foreign institutions of science and technology. With a view to meet the increasing demand for the development and dissemination of engineering and technological knowledge, Bangladesh Armed Forces established the Military Institute of Science and Technology (MIST) on 19 April 1998. Upholding the motto – "Technology for Advancement", MIST promises to provide facilities for higher technical education both for the officers of Bangladesh Armed Forces as well as for civil students from home and abroad. MIST started its journey on 31 January 1999 by offering a four-year bachelor degree in Civil Engineering (CE). Bachelor degree in Computer Science and Engineering (CSE) course started on 2001**.** Bachelor degree in Electrical, Electronic and Communication Engineering (EECE) and Mechanical Engineering (ME) started from 2003. Bachelor degree in Aeronautical Engineering (AE), and Naval Architecture and Marine Engineering (NAME) started from 2008-2009 and 2012-2013, respectively. Besides, four new departments started their academic session from 2014-2015, which are Nuclear Engineering (NE), Biomedical Engineering (BME), Environmental, Water Resources & Coastal Engineering (EWCE) and Architecture (Arch). From 2016 another two new departments named Industrial and Production Engineering (IPE), and Petroleum and Mining Engineering (PME) have started their journey to fulfill the motto of MIST.

### 1.2 Vision and Mission of MIST

**Vision:** To be a center of excellence for providing quality education in the field of science, engineering and technology and conduct research to meet the national and global challenges.

**Mission:** MIST is working on following missions:

a. Develop as a Centre of Excellence for providing comprehensive education and conduct research in diverse disciplines of science, engineering, technology, and engineering management.

b. Produce technologically advanced intellectual leaders and professionals with highmoral and ethical values to meet the socio-economic development of Bangladesh and global needs.

c. Conduct collaborative research activities with national and international communities for continuous interaction with academia and industry.

d. Provide consultancy, advisory, testing, and other related services to government, non-government and autonomous organization including personal for widening practical knowledge and to contribute in sustainable development of the society.

### 1.3 Motto and Values of MIST

**Motto:** As an institution without gender biasness, MIST is steadily upholding its motto "Technology **for** Advancement" and remains committed to contributing to the wider spectrum of national educational arena, play a significant role in the development of human resources and gradually pursuing its goal to grow into a '**Centre of Excellence**'.

**Values:**

a. **Humanity-** MIST not only makes our students graduates but also strives to make them humane.

b. **Discipline-** Discipline remains the corner stone of continuous success stories of MIST.

c. **Morality -** Morality is innate. MIST helps nurture it and develops our students as Quality Engineers with Morality.

d. **Quality -** MIST keeps focusing on quality education with inspiration to life-long learning so that our graduates are recognized in the world and can prove their acquired skills.

## 1.4 Eligibility of Students for Admission in MIST

The students must fulfill the following requirements:

a. **Bangladeshi Students:** Minimum qualifications to take part in the admission test are as follows:

(1) The applicant must have passed the SSC/Equivalent examination obtaining a minimum GPA of 4.00 (without fourth subject) and HSC/Equivalent examination obtaining minimum total grade point 17 in four subjects (Mathematics, Physics, Chemistry, and English).

(2) The applicant must have passed the GCE 'O' Level obtaining minimum B grade in five subjects including Mathematics, Physics, Chemistry, and English, and GCE 'A' Level obtaining minimum B grade in Mathematics, Physics, and Chemistry.

(3) Applicants who have passed HSC or GCE 'A' Level or Equivalent examination in current year or one year before the notification for admission can apply.

b. **Foreign Students.** Maximum 3% of overall vacancies available will be kept reserved for the foreign students and will be offered to foreign countries through Armed Forces Division (AFD) of the Government of the People's Republic of Bangladesh. Applicants must fulfill the following requirements:

(1) Educational qualifications as applicable for Bangladeshi students or equivalent.

(2) Must have security clearance from respective Embassy/ High Commission in Bangladesh.

In the event of non-availability of foreign students, the vacancies will be filled up by Bangladeshi civil students as per merit.

## 1.5 Seat Capacity.

Department wise seat allotment for four years Bachelor Degree in Engineering programs (Unit – A) and five years Bachelor Degree of Architecture programs are as follows:

**Seat Allocation**

| Ser | Unit | Department | Seats |
|---|---|---|---|
| 1 | **A** | Civil Engineering (CE) | 60 |
| 2 | | Computer Science and Engineering (CSE) | 60 |
| 3 | | Electrical, Electronic and Communication Engineering (EECE) | 60 |
| 4 | | Mechanical Engineering (ME) | 60 |
| 5 | | Aeronautical Engineering (AE) | 50 |
| 6 | | Naval Architecture and Marine Engineering (NAME) | 40 |
| 7 | | Biomedical Engineering (BME) | 40 |
| 8 | | Nuclear Engineering (NE) | 40 |
| 9 | | Environmental, Water Resources and Coastal Engineering (EWCE) | 60 |
| 10 | | Industrial and Production Engineering (IPE) | 50 |
| 11 | | Petroleum and Mining Engineering (PME) | 25 |
| 12 | **B** | Architecture (Arch) | 25 |
| | Total | | 570 |

The total number is 570. In general, about 50% seats will be allocated to military officers. However, in case of the requirement of military students vacancy is less in any particular year, the deficient vacancy will be filled up by civil students. MIST also maintains quota as mentioned below:

| Ser | Quota Allocation | Seats |
|---|---|---|
| 1 | General Candidates | 54% |
| 2 | Children of Military Personnel | 40% |
| 3 | Children of Freedom Fighters | 2% |
| 4 | Tribal Citizen | 1% |
| 5 | International Students | 3% |
| | Total | 100% |

## 1.6 Admission Procedure

1.6.1 **Syllabus for admission test.** Admission test will be conducted on the basis of the syllabus of Mathematics, Physics, Chemistry and English subjects of HSC examination. Admission test will be conducted out of 200 marks and the distribution of marks is given below:

| Ser. | Subjects | Marks |
|---|---|---|
| a. | Mathematics | 80 |
| b. | Physics | 60 |
| c. | Chemistry | 40 |
| d. | English | 20 |
| | **Total** | **200** |

1.6.2 **Final Selection**. Students will be selected on the basis of results of the admission test only. Individual choice for selection of departments will be given preference as far as possible. In case of tie in the result of admission test, difference will be judged on the basis of marks obtained in Mathematics, Physics, Chemistry and English respectively in admission test.

**1.6.3** **Medical Checkup.** Civil candidates selected provisionally are to undergo medical check-up at MIST medical centre. They will have to produce test reports of urine for R/E, blood for HBs Ag and blood grouping before the MIST medical authority. The medical authority will decide on the physical fitness of candidates for admission in MIST.

## 1.7 Students Withdrawal Policy

### 1.7.1 For Poor Academic Performance.

The under graduate (B.Sc) Engineering programs for all engineering disciplines are planned for 04 regular levels, comprising of 08 regular terms (for Architecture program it is planned for 5 regular levels, comprising of 10 regular terms). It is expected that all students will earn degree by clearing all the offered courses in the stipulated time. In case of failure the following policies will be adopted:

a. Students failing in any course/subject will have to clear/pass the said course/subject by appearing it in supplementary examination as per examination policy. Students may also retake the failed subject/course in regular term as per the Examination policy.

b. Maximum grading for supplementary examination of failed subjects will be B+ as per examination policy.

c. One student can retake/reappear in a failed subject/course only twice. However, with the Permission of Academic Council of MIST, a student may be allowed for third time as last chance.

d. In case of sickness, which leads to missing of more than 40% classes or miss term final examination (supported by requisite medical documents), students may be allowed to withdraw temporarily from that term and repeat the whole level with the regular level in the next academic session, subject to the approval of Academic Council of MIST. Students may retain sessional courses of that term if applies and approved by Academic council. `VW" as grading of each course to be reflected in concerned tabulation sheet, grade sheet and transcript. However, he/she has to complete the whole undergraduate program within 06 (six) academic years (for Architecture 07 academic years) from the date of his/her registration.

e. Minimum credit requirement for the award of bachelor degree in Engineering (BSc. Engg.) and Architecture (B. Arch) will be decided by the respective department as per the existing rules. However the minimum CGPA requirement for obtaining a bachelor degree in engineering and Architecture is 2.20.

f. Whatever may be the cases, students have to complete the whole undergraduate program within 06 (six) academic years from the date of registration.

g. All other terms and condition of MIST Examination Policy remain valid.

### 1.7.2 Withdrawal on Disciplinary Ground

a. **Unfair Means.** Adoption of unfair means may result in expulsion of a student from the program and so from the Institution. The Academic Council will authorize such expulsion on the basis of recommendation of the Disciplinary Committee, MIST and as per policy approved by the affiliating university. Following would be considered as unfair means adopted during examinations and other contexts:

(1) Communicating with fellow students for obtaining help in the examination.

(2) Copying from another student’s script/ report /paper.

(3) Copying from desk or palm of a hand or from other incrimination documents.

(4) Possession of any incriminating document whether used or not.

c. **Influencing Grades.** Academic Council may expel/withdraw any student for approaching directly or indirectly in any form to influence a teacher or MIST authority for grades.

d. **Other Indiscipline Behaviors.** Academic Council may withdraw/expel any student on disciplinary ground if any form of indiscipline or unruly behavior is seen in him/her which may disrupt the academic environment/program or is considered detrimental to MIST"s image.

e. **Immediate Action by the Disciplinary Committee of MIST.** The Disciplinary Committee, MIST may take immediate disciplinary action against any student of the Institution. In case of withdrawal/expulsion, the matter will be referred to the Academic Council, MIST for post-facto approval.

**1.7.3 Withdrawal on Own Accord.**

a. **Permanent Withdrawal.** A student who has already completed some courses and has not performed satisfactorily may apply for a withdrawal.

b. **Temporary Withdrawal.** A student, if he/she applies, may be allowed to withdraw temporarily from the program, subject to approval of Academic Council of MIST, but he/she has to complete the whole program within 06 (six) academic years (for Architecture 07 academic years) from the date of his/her registration.

# CHAPTER 2

## RULES AND REGULATIONS FOR UNDERGRADUATE PROGRAM AT MIST

### Introduction

**2.1** MIST has started course system for undergraduate studies from the academic session 2017-18. Therefore, the rules and regulations mentioned in this paper will be applicable to students for administering undergraduate curriculum through the Course System. This policy will be introduced with an aim of creating a continuous, even and consistent workload throughout the term for the students.

### The Course System

**2.2** The salient features of the Course System are as follows:

a. Number of theory courses will be generally 06 or as per syllabus in each term. However, with the recommendation of course coordinator and Head of the Department, Commandant MIST may allow up to 07 courses in exceptional cases if department can accommodate within 24 cr hr.

b. Students will not face any level repeat for failing.

c. Students will get scope to improve their grading.

d. Introduction of more optional courses to enable the students to select courses according to their individual needs and preferences.

e. Continuous evaluation of students" performance.

f. Promotion of student-teacher interaction and contact.

**2.3** Beside the professional courses pertaining to each discipline, the undergraduate curriculum gives a strong emphasis on acquiring thorough knowledge in the basic sciences of mathematics, physics and chemistry. Due importance is also given on the study of several subjects in humanities and social sciences.

**2.4** The first two years of bachelor's degree programs generally consist of courses on basic engineering, general science and humanities subjects; while the third and subsequent years focus on specific disciplines.

### Number of Terms in a Year

**2.5** There will be two terms *Spring Term (Jan-Jun) and Fall Term (Jul-Dec)* in an academic year.

### Duration of Terms

**2.6** The duration of each of Spring Term and Fall Term (maximum 22 weeks) may be as under:

| Ser | Events | Durations |
|---|---|---|
| 1. | Classes before Mid Term | 7 weeks |
| 2. | Mid Term Vacation | 1 week |
| 3. | Classes after Mid Term | 7 weeks |
| 4. | Makeup Classes and Preparatory leave | 2/3 weeks |
| 5. | Term Final Examination | 2/3 weeks |
| 6. | Term End Vacation | 1/2 week |

**Course Pattern and Credit Structure**

**2.7** The undergraduate program is covered by a set of theoretical courses along with a set of laboratory (sessional) courses to support them.

**Course Designation System**

**2.8** Each course is designated by a maximum of three/four letter code identifying the department offering the course followed by a three-digit number having the following interpretation:

a. The first digit corresponds to the year/level in which the course is normally taken by the students.
b. The second digit is reserved for departmental use. It usually identifies a specific area/group of study within the department.
c. The last digit is an odd number for theoretical courses and an even number for sessional courses.

**2.9** The course designation system is illustrated as Follows:

**IPE 101** **Introduction to Industrial & Production Engineering**

Course Title
Odd digit designates a theoretical course
Reserved for departmental use
Signifies 1st Year/ 1st Level course
Department identification code

**IPE 202** **Manufacturing Process I Sessional**

Course Title
Even digit designates a sessional course
Reserved for departmental use
Signifies 2nd Year/ 2nd Level course
Department identification code

**Assignment of Credits**

**2.10** The assignment of credits to a theoretical course follows a different rule from that of a sessional course.

a. Theoretical Courses: One lecture per week per term is equivalent to one credit.
b. Sessional Courses: Credits for sessional courses is half of the class hours per week per term.

Credits are also assigned to project and thesis work taken by the students. The amount of credits assigned to such work varies from one discipline to another.

**Types of Courses**

**2.11** The types of courses included in the undergraduate curricula are divided into the following groups:

a. Core Courses: In each discipline, a number of courses are identified as core courses, which form the nucleus of the respective bachelor's degree program. A student has tocomplete all the designated core courses of his/her discipline.
b. Prerequisite Courses: Some of the core courses are identified as prerequisite courses for a specific subject.

c. Optional Courses: Apart from the core courses, the students can choose from a set of optional courses. A required number of optional courses from a specified group have to be chosen.

**Course Offering and Instruction**

**2.12** The courses to be offered in a particular term are announced and published in the Course Catalog along with the tentative Term Schedule before the end of the previous term. The courses to be offered in any term will be decided by Board of Undergraduate Studies (BUGS) of the respective department.

**2.13** Each course is conducted by a course teacher who is responsible for maintaining the expected standard of the course and for the assessment of students' performance. Depending on the strength of registered students (i.e. on the number of students) enrolled for the course, the teacher concerned might have course associates and Teaching Assistants (TA) to aid in teaching and assessment.

**Teacher Student Interaction**

**2.14** The new course system encourages students to come in close contact with the teachers. For promotion of a high level of teacher-student interaction, each student is assigned to an adviser and the student is free to discuss all academic matters with his/her adviser. Students are also encouraged to meet any time with other teachers for help and guidance in academic matters. However, students are not allowed to interact with teachers after the moderation of questions.

**Student Adviser**

**2.15** One adviser is normally appointed for a group of students by the BUGS of the concerned department. The adviser advises each student about the courses to be taken in each term by discussing the academic program of that particular term with the student.

**2.16** However, it is also the student's responsibility to keep regular contact with his/her adviser who will review and eventually approve the student's specific plan of study and monitor subsequent progress of the student.

**2.17** For a student of second and subsequent terms, the number and nature of courses for which he/she can register is decided on the basis of academic performance during the previous terms. The adviser may permit the student to drop 1 or more courses based on previous academic performance.

**Course Registration**

**2.18** Any student who uses classroom, laboratory facilities or faculty-time is required to register formally. Upon admission to the MIST, students are assigned to advisers. These advisers guide the students in choosing and registering courses.

**2.19** **Registration Procedure.** At the commencement of each term, each student has to register for courses in consultation with and under the guidance of his/her adviser. The date, time and venue of registration are announced in advance by the Registrar's Office. Counseling and advising are accomplished at this time. It is absolutely essential that all the students be present for registration at the specified time.

**2.20** **Pre-conditions for Registration.**

a. For first year students, department-wise enrollment/admission is mandatory prior to registration. At the beginning of the first term, an orientation program will be conducted for them where they are handed over with the registration package on submission of the enrolment slip.

b. Any student, other than the new batch, with outstanding dues to the MIST or a hall of residence is not permitted to register. Each student must clear their dues and obtain a clearance certificate, upon production of which, he/she will be given necessary Course Registration Forms to perform course registration.

c. A student is allowed to register in a particular course subject to the class capacity constraints and satisfaction of pre-requisite courses. However, even if a student fails in a pre-requisite course in any term, the concerned department (BUGS) may allow him/her to register for a course which depends upon the pre- requisite course provided that his/her attendance and performance in the continuous assessment of the mentioned pre- requisite course is found to be satisfactory.

**2.21** **Registration Deadline**. Each student must register for the courses to be taken before the commencement of each term. Late registration is permitted only during the first week of classes. Late registration after this date will not be accepted unless the student submits a written application to the registrar through the concerned Head of the department explaining the reasons for delay. Acceptable reasons may be medical problems with supporting documents from the Medical Officer of MIST or some other academic commitments that prohibit enrollment prior to the last date of registration.

**2.22** **Penalty for Late Registration**. Students who fail to register during the designated dates for registration are charged a late registration fee of Tk. 100.00 (One hundred only) per credit hours. Penalty for late registration will not be waived.

**Limits on the Credit Hours to be taken**

**2.23** A student should be enrolled for at least 15 credit hours and is allowed to take a maximum of 24 credit hours. Relaxation on minimum credit hours may be allowed. A student must enroll for the sessional courses prescribed in a particular term within the allowable credit hour limits.

**2.24** In special cases where it is not possible to allot the minimum required 15 credit hours to a student, the concerned department (BUGS) may permit with the approval of the Commandant, a lesser number of credit hours to suit individual requirements. Only graduating students may be allowed to register less than 15 Cr Hr without approval of Commandant. A list of all such cases to be forwarded to the Register Office, ICT Directorate and Controller of Exam Office by the respective Department.

**Course Add/Drop**

**2.25** A student has some limited options to add or drop courses from the registration list. Addition of courses is allowed only within the first two weeks of a regular term. Dropping a course is permitted within the first four weeks of a regular term. Add or drop is not allowed after registration of courses for Supplementary-I and Supplementary-II Examination.

**2.26** Any student willing to add or drop courses has to fill up a Course Adjustment Form. This also has to be done in consultation with and under the guidance of the student’s respective adviser. The original copy of the Course Adjustment Form has to be submitted to the Registrar’s Office, where the required numbers of photocopies are to be made for distribution to the concerned adviser, Head, Dean, Controller of Examinations and the student. All changes must be approved by the adviser and the Head of the concerned department. The Course Adjustment Form has to be submitted after being signed by the concerned persons.

## Withdrawal from a Term

**2.27** If a student is unable to complete the Term Final Examination due to serious illness or serious accident, he/she may apply to the Head of the degree awarding department for total withdrawal from the term before commencement of term final examination. However application may be considered during term final examination in special case. The application must be supported by a medical certificate from the Medical Officer of MIST. The concerned student may opt for retaining the sessional courses of the term. The Academic Council will take the final decision about such applications. However, the total duration for graduation will not exceed 6 academic years.

## The Grading System

**2.28** The total performance of a student in a given course is based on a scheme of continuous assessment, for theory courses this continuous assessment is made through a set of quizzes, class tests, class evaluation, class participation, homework assignment and a term final examination. The assessments for sessional courses are made by evaluating performance of the student at work during the class, viva- voce during laboratory hours and quizzes. Besides that, at the end there will be a final lab test. Each course has a certain number of credits, which describes its corresponding weightages. A student's performance is measured by the number of credits completed satisfactorily and by the weighted average of the grade points earned. A minimum grade point average (GPA) is essential for satisfactory progress. A minimum number of earned credits also have to be acquired in order to qualify for the degree. Letter grades and corresponding grade points will be given as follows:

| **Grading System** | | |
|---|---|---|
| **Numerical Markings** | **Grade** | **Grade Points** |
| 80% and above | A+ | 4.00 |
| 75% to below 80% | A | 3.75 |
| 70% to below 75% | A- | 3.50 |
| 65% to below 70% | B+ | 3.25 |
| 60% to below 65% | B | 3.00 |
| 55% to below 60% | B- | 2.75 |
| 50% to below 55% | C+ | 2.50 |
| 45% to below 50% | C | 2.25 |
| 40% to below 45% | D | 2.00 |
| below 40% | F* | 0.00 |
| | AB | Absent |
| | DC | Dis-collegiate |
| | VW | Voluntary Withdrawn |
| | X | Project/ Thesis Continuation |
| | E | Expelled |
| | S | Satisfactory |

* Subject in which the student gets F grade shall not be regarded as earned credit hours for the calculation of Grade Point Average (GPA).

## Distribution of Marks

**2.29** **Theory.** *Forty percent (40%)* of marks of a theoretical course shall be allotted for Continuous Assessment, i.e. assignments, class tests, pop quizzes, observations, projects and mid-term assessment. These marks must be submitted to Office of the Controller of Examinations before commencement of the final exam. The rest of the marks will be allotted to the Term Final Examination. The duration of final examination will be three (03) hours. The scheme of continuous assessment that a particular teacher would follow for a course will be announced on the first day of the classes. Distribution of marks for a given course per credit is as follows:

| | |
|---|---|
| Class Performance | 5% |
| Class Test/Assignment | 20% |
| Mid-Term Assessment (Exam/Project) | 15% |
| Final Examination (Section A and B) | 60% |
| Total | 100% |

Note:

a. In final exam, each section can be used for achieving not more than two course outcomes (COs). The remaining COs should be attained from mid-term assessment or class tests. Course teacher has to inform the student the beginning of the terms.

b. Course teacher of a particular course has to inform the department whether he/she wants to assess mid-term through exam or project within first two weeks of beginning of a term. The duration of mid-term examination should not be more than 50 minutes which has to be conducted in between $6^{th}$ to $9^{th}$ week of a semester. If mid-term assessment is done through project, then there should be project report and presentation.

c. The weightage of class performance can be assessed through checking attentiveness during classes or arranging unnoticed pop quizzes.

d. The number of class tests shall be n for 3.0 and above credit courses and (n-1) shall be considered for grading where n is the number of credits of the course. However, for courses having credits below 3.0, the considered class tests shall be 2 out of 3.

e. All class test will carry 20 marks each. Exam software system will finally convert these achieved marks into total class test marks as per credit hour i.e. for n=1(20), n=2 (40), n=3 (60), n=4(80), etc.

f. Irrespective of the result of the continuous assessment (class performance, class test, mid-term assessment), a student has to appear in the final examination (where applicable) for qualifying/passing the concern course/ subject.

**2.30 <u>Laboratory/ Sessional/ Practical Examinations.</u>** Laboratory/Sessional courses are designed and conducted by the concerned departments. Examination on laboratory/sessional/practical subjects will be conducted by the respective department before the commencement of term final examination. The date of practical examination will be fixed by the respective department. Students will be evaluated in the laboratory/ sessional courses on the basis of the followings:

| | |
|---|---|
| Conduct of Lab Tests/Class Performance | 25% |
| Report Writing/Programming | 15% |
| Mid-Term Evaluation (exam/project/assignment) | 20% |
| Final Evaluation (exam/project/assignment) | 30% |
| Viva Voce/Presentation | 10% |
| Total | 100% |

Note: the above distribution of percentage is a general guideline. Department can rearrange to some extent if required.

**231** **Sessional Course in English.** The distribution will be as under:

| | |
|---|---|
| Class performance/observation | 10% |
| Written Assignment | 15% |
| Oral Performance | 25% |
| Listening Skill | 10% |
| Group Presentation | 30% |
| Viva Voce | 10% |
| Total | 100% |

**232** **Class attendance.** Class attendance may be considered as a part of continuous assessment. No mark should be allotted for attending classes.

## Collegiate and Non-collegiate

**233** Students having class attendance of 85% or above in individual subject will be treated as collegiate, and less than 85% and up to 70% will be treated as non-collegiate in that subject. The non-collegiate student(s) may be allowed to appear at the examination subject to payment of non-collegiate fee/fine of an amount fixed by MIST/BUP. Students having class attendance below 70% will be treated as dis-collegiate and will not be allowed to appear at the examination and treated as fail. But in a special case such students may be allowed to appear in the examination with the permission of Commandant and it must be approved by the Academic Council.

## Calculation of CGPA

**234** Grade Point Average (GPA) is the weighted average of the grade points obtained of all the courses passed/completed by a student. For example, if a student passes/completes *n* courses in a term having credits of $C_1$, $C_2$, ..., $C_n$ and his grade points in these courses are $G_1$, $G_2$, ...., $G_n$, respectively, then

$$GPA = \frac{\sum_{i}^{n} C_i G_i}{\sum_{i}^{n} C_i}$$

**235** The Cumulative Grade Point Average (CGPA) is the weighted average of the GPA obtained in all the terms passed/completed by a student. For example, if a student passes/ completes n terms having total credits of $TC_1$, $TC_2$, ... , $TC_n$ and his GPA in these terms are $GPA_1$, $GPA_2$,... , $GPA_n$, respectively then

$$CGPA = \frac{\sum_{i}^{n} TC_i GPA_i}{\sum_{i}^{n} TC_i}$$

## Numerical Example

Suppose a student has completed nine courses in a term and obtained the following grades:

| Course | Credit $C_i$ | Grade Points | $G_i$ | $C_i*G_i$ |
|---|---|---|---|---|
| IPE 101 | 3.00 | A | 3.75 | 11.25 |
| EECE 172 | 0.75 | A+ | 4.00 | 3.00 |
| MATH 101 | 3.00 | A- | 3.50 | 10.50 |
| PHY 133 | 3.00 | B+ | 3.25 | 9.75 |
| GEE 101 | 3.00 | A | 3.75 | 11.25 |
| LANG 102 | 1.50 | A | 3.75 | 5.625 |
| CHEM 101 | 3.00 | A | 3.75 | 11.25 |
| GEBS 101 | 3.00 | A- | 3.50 | 10.50 |
| CHEM 102 | 1.50 | B+ | 3.25 | 4.875 |
| **Total** | **21.75** | | | **78.00** |

GPA = 78/21.75 = 3.59

Suppose a student has completed four terms and obtained the following GPA:

| Level | Term | Earned Credit Hours | Earned GPA | $TC_i*GPA_i$ |
|---|---|---|---|---|
| | | $TC_i$ | $GPA_i$ | |
| 1 | I | 21.75 | 3.75 | 81.5625 |
| 1 | II | 20.75 | 3.61 | 74.9075 |
| 2 | I | 19.50 | 3.21 | 62.595 |
| 2 | II | 21.00 | 2.98 | 62.58 |
| **Total** | | **83.00** | | **281.645** |

CGPA = 281.645/83 = 3.39

## Impacts of Grade Earned

**2.36** The courses in which a student has earned a D or a higher grade will be counted as credits earned by him/her. Any course in which a student has obtained an F grade will not be counted towards his/her earned credits or GPA calculation. However, the F grade will remain permanently on the Grade Sheet and the Transcript.

**2.37** A student who obtains an F grade in a core course will have to repeat that particular course. However, if a student gets an F in an optional course, he/she may choose to repeat that course or take a substitute course if available. When a student will repeat a course in which he/she has previously obtained an F, he/she will not be eligible to get a grade better than B+ in that repeated course.

**2.38** If a student obtains a grade lower than B+ in a particular course he/she will be allowed to repeat the course only **once** for the purpose of grade improvement. However, he/she will not be eligible to get a grade better than „B+" for an improvement course.

**2.39** A student will be permitted to repeat for grade improvement purposes a maximum of 6 courses in BSc. Engineering programs and a maximum of 7 courses in B. Arch. Program.

**2.40** If a student obtains a B+ or a better grade in any course he/she will not be allowed to repeat the course for the purpose of grade improvement.

## Classification of Students

**2.41** At MIST, regular students are classified according to the number of credit hours completed/ earned towards a degree. The following classification applies to all the students:

| Level | Credit Hours Earned | |
|---|---|---|
| | Engineering/URP | Architecture |
| Level 1 | 0.0 to 36.0 | 0.0 to 34.0 |
| Level 2 | More than 36.0 to 72.0 | More than 34.0 to 72.0 |
| Level 3 | More than 72.0 to 108.0 | More than 72.0 to 110.0 |
| Level 4 | More than 108.0 | More than 110.0 to 147.0 |
| Level 5 | | More than 147.0 |

**2.42** However, before the commencement of each term all students other than new batch are classified into three categories:

a. **Category 1:** This category consists of students who have passed all the courses described for the term. A student belonging to this category will be eligible to register for all courses prescribed for the upcoming term.

b. **Category 2:** This category consists of students who have earned a minimum of 15 credits but do not belong to category 1. A student belonging to this category is advised to take at least one course less since he might have to register for one or more backlog courses as prescribed by his/her adviser.

c. **Category 3:** This category consists of students who have failed to earn the minimum required 15 credits in the previous term. A student belonging to this category is advised to take at least two courses less than a category 1 student subject to the constraint of registering at least 15 credits. However, he will also be required to register for backlog courses as prescribed by the adviser.

**2.43** **Definition of Graduating Student.** Graduating students are those students who will have ≤ 24 credit hours for completing the degree requirement.

## Performance Evaluation

**2.44** The performance of a student will be evaluated in terms of two indices, viz. Term Grade Point Average and Cumulative Grade Point Average which is the grade average for all the terms completed.

**2.45** Students will be considered to be making normal progress toward a degree if their Cumulative Grade Point Average (CGPA) for all work attempted is 2.20 or higher. Students who regularly maintain a term GPA of 2.20 or better are making good progress toward the degrees and are in good standing with MIST. Students who fail to maintain this minimum rate of progress will not be in good standing. This can happen when any one of the following conditions exists.

a. The term GPA falls below 2.20.

b. The Cumulative Grade Point Average (CGPA) falls below 2.20.

c. The earned number of credits falls below 15 times the number of terms attended.

**2.46** All such students can make up their deficiencies in GPA and credit requirements by completing courses in the subsequent term(s) and supplementary exams, if there are any, with better grades. When the minimum GPA and credit requirements are achieved, the student is again returned to good standing.

**Minimum Earned Credit and GPA Requirement for Obtaining Degree**

**2.47** Minimum credit hour requirements for the award of bachelor's degree in engineering (BSc Engg) and architecture (B. Arch) will be decided by the respective department (BUGS). However, the syllabus of all BSc engineering program must be of minimum 157 credit hours or more, and for architecture program minimum 189 credit hours or more. A student must earn minimum credit hour set in the syllabus by the concerned department for qualifying Bachelor's Degree. The minimum CGPA requirement for obtaining a Bachelor's degree in engineering and architecture is 2.20.

**2.48** A student may take additional courses with the consent of his/her Adviser in order to raise CGPA, but he/she may take a maximum of 15 such additional credits in engineering and 18 such additional credits in architecture beyond respective credit-hour requirements for Bachelor's degree during his/her entire period of study.

**Application for Graduation and Award of Degree**

**2.49** A student who has fulfilled all the academic requirements for Bachelor's degree will have to apply to the Controller of Examinations through his/her Adviser for graduation. Provisional Degree will be awarded by BUP on completion of credit and GPA requirements.

Time Limits for Completion of Bachelor's Degree

**2.50** A student must complete his studies within a maximum period of **six** years for engineering and seven years for architecture bachelor's degree.

**Attendance, Conduct and Discipline**

**2.51** MIST has strict rules regarding the issues of attendance in class and discipline.

**2.52** **Attendance.** All students are expected to attend classes regularly. The university believes that attendance is necessary for effective learning. The first responsibility of a student is to attend classes regularly and one is required to attend the classes as per MIST rules.

**2.53** **Conduct and Discipline**. During their stay in MIST, all students are required to abide by the existing rules, regulations and code of conduct. Students are strictly forbidden to form or be members of student organization or political party, club, society etc., other than those set up by MIST authority in order to enhance student's physical, intellectual, moral and ethical development. Zero tolerance in regards of sexual abuse and harassment in any forms and drug abuse and addiction are strictly observed in the campus.

**Teacher-Student Interaction**

**2.54** The academic system in MIST encourages students to come in close contact with the teachers. For promotion of high level of teacher-student's interaction, a course coordinator (CC) isassigned to each course. Students are free to discuss with CC about all academic matters. Students are also encouraged to meet other teachers any time for help and guidance for academic matters. Heads of the departments, Director of Administration, Director of Students Welfare (DSW), Dean and Commandant address the students at some intervals. More so, monthly Commandant's Parade is organized in MIST where all faculty members, staff and students are formed up, thereby increasing teacher-student interaction.

## Absence during a Term

**2.55** A student should not be absent from quizzes, tests, etc. during the term. Such absence will naturally lead to reduction in points/marks, which count towards the final grade. Absence in the Term Final Examination will result in an „F" grade in the corresponding course. A student who has been absent for short periods, up to a maximum of three weeks due to illness, should approach the course teacher(s) or the course coordinator(s) for make-up quizzes or assignments immediately upon return to classes. Such request has to be supported by medical certificate from competent authority (e.g. CMH/MIST Medical Officer).

## Recognition of Performance

**2.56** As recognition of performance and ensure continued studies MIST awards medals, scholarships and stipends as per existing rules and practices.

## Types of Different Examination

**2.57** Following different types of final examinations will be conducted in MIST to evaluate the students of Undergraduate Programs:

a. **Term Final Examination:** At the end of each normal term (after 22week or so), Term Final Examination will be held. Students will appear in the Term Final Examination for all the theory courses they have taken in the Term.

b. **Supplementary Examination:** It will take place twice in a year. Supplementary-I is defined as provision of giving exam in the first week of Spring Term (Jan-Jun)/Fall Term (Jul-Dec) end break and Supplementary-II in the first week of Fall Term (Jul-Dec)/ Spring Term (Jan-Jun) end break, respectively. Students will be allowed to register for a maximum of **two** theory courses (Failed/ Improvement) in Supplementary-I and maximum of one theory course (Failed/ Improvement) in Supplementary-II.

c. **Improvement Examination:** It will be taken during Supplementary-I and Supplementary-II Examination. Questions will be same as the question of the regular examination of that Supplementary Examination (if any). Student can take maximum two subjects at a time (two subjects in Supplementary-I and one subject in Supplementary-II) and maximum 6 subjects in the whole academic duration. If a student obtains a grade lower than „B+" in a course, he/she will be allowed to repeat the course only once for grade improvement. However, he/she will not be eligible to get a grade better than „B+" for an improvement course. Among the previous result and improvement examination result, best one will be considered as final result for an individual student. However, performance of all examination i.e. previous to improvement examination, shall be reflected in the transcript.

## Rules of Different Examinations

**2.58** **Term Final Examination.** Following rules to be followed:

a. Registration to be completed before commencement of the Term. A student has to register his desired courses paying registration, examination fee and other related fees.

b. Late registration will be allowed without penalty within first two weeks of the term.

c. Within 1st two weeks of a term a student can Add/Drop course/courses. To add a course, in the 3rd week, one has to register the course by paying additional fees. To drop a course, one has to apply within three weeks and paid fees will be adjusted/ refunded. If anyone wants to drop a course after three weeks and within 4 weeks, that will be permitted but paid fees will not be refunded in that case.

d. Registrar office will finalize registration of all courses within 7 (seven) weeks, issue registration slip and that will be followed by issuing Admit Card.

e. Term Final Examination to be conducted in the 18-20th week of the term as per approved Academic Calendar.

**2.59** **Supplementary Examination.** Following rules to be followed:

a. Supplementary-I is defined as provision of giving exam in the first week of Spring Term (Jan-Jun) /Fall Term (Jul-Dec) end break and Supplementary-II in the first week of Fall Term (Jul-Dec) / Spring Term (Jan-Jun) end break, respectively.

b. Students will be allowed to register for a maximum of two theory courses (Failed/ Improvement) in Supplementary-I and maximum of one theory course (Failed/ Improvement) in Supplementary-II.

c. No class will be conducted.

d. 40% marks will be considered from the previous exams.

e. Maximum grading in Supplementary Exam will be B+.

f. No Sessional Exam will be conducted.

g. Examination will be taken on 60% marks like Term Final Examination.

h. If a student fails in a course more than once in regular terms, then for calculating 40% marks, the best one of all continuous assessment marks will be counted.

j. If anyone fails in the Laboratory/ Sessional course, that course cannot be taken in the supplementary examination.

k. If any student fails in a course, he can clear the course retaking it second time or, he can clear the examination appearing at the Supplementary Examination as well. Anyone fails twice in a course, can only retake it in the regular term for appearing third time. But anyone fails even after appearing third time, he/she has to take approval of Academic Council of MIST for appearing 4th (last) time in a course and need to pay extra financial penalty. If any student fails even 4th time in a course, will not be allowed to appear anymore in this same course.

l. Registration of Supplementary-I Exam to be done within 5th week after completion of fall Term (Jul-Dec) and registration of Supplementary-II Exam to be done within the mid- term break of Spring Term (Jan-Jun), paying all the required fees.

m. There will be no provision for add/drop courses after registration.

n. **Thesis:** if a student cannot complete thesis in two consecutive terms, with the recommendation of the supervisor, he/she may continue for next one/two term within six academic years.

**2.60** **Improvement Examination.** Following rules to be followed:

a. Improvement Examination is to be taken during the Supplementary-I and II examinations.

b. For Improvement Examination, registration is to be done during the registration of Supplementary-I and Supplementary-II Examinations by paying all the fees.

c. Question Setting, Moderation and Result Publication to be done with courses of Supplementary-I and Supplementary-II Examinations.

d. Any student gets a grading below ,,B+" and desires to improve that course, he will be allowed to appear the Improvement Examination for that particular course.

e. Highest grade of Improvement Examination will be B+.

f. One student is allowed to appear at Improvement Exam in 6 (six) courses in his whole graduation period taking maximum two courses at a time (two courses at Supplementary-I and one course at Supplementary-II).

**Irregular Graduation**

**2.61** If any graduating student clears his/her failed course in Spring Term /Fall Term/

Supplementary Examinations and his graduation requirements are fulfilled, his graduation will be effective from the result publication date of Spring Term /Fall Term / Supplementary Examinations and that student will be allowed to apply for provisional certificate.

**Minimum Earned Credit and CGPA Requirement for Obtaining Degree**

**2.62** The requirements for award of engineering degree are as follows:

a. Completion of the courses for the minimum required credits of 157 (or as specified in a particular department) in a maximum period of six academic years.

b. Appearing at the final examination in all the required courses as per syllabus of the program.

c. Scoring a CGPA of 2.2 or above.

**Consequences of Failing in Sessional Courses**

**2.63** Any student failing in any sessional course, must re-take that sessional course when offered by the department in any next Regular Term. No Supplementary exam is allowed for sessional course.

**Withdrawal for Poor Performance**

**2.64** A student to remain in reasonable standing must maintain a minimum CGPA of 2.20. Failure to secure/achieve minimum CGPA of 2.20 in two consecutive levels will also lead to withdrawal of the student. A student who fails to maintain a CGPA of 2.20 at the end of a level, but obtains 2.00 or more, will be placed on probation. Failure by a student placed on probation to raise the CGPA to 2.20 in the next level will lead to his withdrawal from the Program. A student failing to maintain a CGPA of 2.20 at the end of the level-4 shall be allowed to repeat courses of the level-4 in which he earned C grades or below. This opportunity will be given only once. Such a student failing to raise CGPA to 2.2 after repeating the courses will be withdrawn from the Program (For further detail MIST Withdrawal Policy" may be consulted).

**2.65** **Voluntary withdrawal for Sickness.** In case of sickness which leads to missing of more than 40% class or miss term final examination (supported by requisite medical documents), students may be allowed to withdraw from that term subject to the approval of the Academic Council of MIST. Students may retain sessional courses of that term if applies and approved by Academic council. VW as grading of each course to be reflected in concerned tabulation sheet, grade sheet and transcript.

**2.66** **Class Tests.** The number of class tests shall be n for 3.0 and above credit courses and (n-1) shall be considered for grading where n is the number of credits of the course. However, for courses having credits below 3.0, the considered class tests shall be 2 out of 3. Class test will be conducted by the subject teacher. Duration of class test should not be more than 30 minutes. Course teacher must announce results within 10 days of holding the examination. Checked script will be shown to the students. If a student misses the class test for acceptable reason the course teacher my take the test of the student.

**2.67** MIST is committed in conferring degrees to the students in time which plays a very vital role in steering all the academic activities in any university/ institute. At the beginning MIST conducted all its examinations under the examination section of the University of Dhaka. In June 2008, MIST got affiliation with BUP. Since then MIST has been conducting all its examinations under the control and authority of BUP. For the need of time, former MIST examination policy was reviewed several times. Present review committee has made necessary amendment/ addition/ deletion to suit the proposed course system. This policy may be reviewed every after 05 (five) years or as and when felt necessary by the authority of MIST.

## 2.68 SUMMARY OF MIST EXAMINATION POLICY-2020

| Serial | Examination Type | Session | Number of Theory Courses | Maximum Grading | Assessment Percentage | Examination Schedule | Courses | Registration Schedule |
|---|---|---|---|---|---|---|---|---|
| 1 | Regular | Spring Term (Jan-Jun) and Fall Term (Jul-Dec) | Maximum 6 Theory Courses | A+ | Assessment on 100% | Regular Examination | Regular | Regular |
| 2 | Retake | Spring Term (Jan-Jun) and Fall Term (Jul-Dec) | | B+ | | | | |
| 3 | Supplementary-I (Fail/Improvement) | Spring Term (Jan-Jun) | Maximum 2 Theory | B+ | Assessment on 60% | 1st week of Spring Term (Jan-Jun)/ Fall Term (Jul-Dec) End Break | Courses of immediate past terms included | 5th week after completion of Fall Term (Previous Year) |
| 4 | Supplementary-II (Fail/Improvement) | Fall Term (Jul-Dec) | Maximum 1 Theory | B+ | Assessment on 60% | 1st week of Fall Term (Jul-Dec)/ Spring Term (Jan-Jun) End Break | Courses of immediate past terms not included | Mid-Term Break of Spring (Jan-Jun) Term (March) |

1. Maximum 24 credit hour in one regular term (excluding Supplementary Exams).
2. Students may register maximum up to 7 (seven) theory courses in exceptional case, if department can accommodate within 24 credit hour.
3. Students can register maximum 6 (six) theory courses for improvement in his whole academic period.
4. Supplementary-I Exam to be considered as part of previous Academic Year.
5. Student appearing in Supplementary-I shall not be included in current graduation ceremony.

# CHAPTER 3

## DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING (IPE)

### 3.1 Introduction to the program

Industrial and production Engineering (IPE) department was established in 2016 under the faculty of Mechanical Engineering to develop much needed professionals required for the growth of modern industries. The focus of undergraduate program in IPE is on manufacturing and quality, process design and productivity improvement, management and host of core subjects to meet the emerging technological needs of the industry. The curriculum has been prepared keeping view with the basic requirements of modern industries, manufacturing factories and in line with the changing trends in this field.

The syllabus is prepared based on BAETE manual -2022 (Editon 2.1) and focused on Outcome Based Education (OBE) conforming to the Washington accord (WA). Whether Industrial and Production engineers are manufacturing superior automobiles, shortening a roller coaster line, streamlining an operating room, or distributing products worldwide, these challenges concentrate on the common goal of saving companies' money and increasing efficiencies. Education in IPE is very much leaned to practical situations and it is not possible to acquire proper knowledge in this field without sufficient exposure to industrial environment. The relationship of the department with the industries will be strengthened through their involvement in curriculum development and various programs such as seminars, visits and student projects. The students will be encouraged to develop themselves through various co- curricular and extra-curricular activities. The department of IPE aims not only to produce efficient engineers, but also well-educated conscientious leaders who can contribute to the development of the country through ameliorating our industries.

A typical under-graduate course on Industrial & Production Engineering emphasizes on manufacturing and improvement of productivity. A student will also learn the trends of dynamics and control and hence will develop a sound knowledge about overall industrial production and management systems. He/she will also learn to analyze the emerging technological trends of the industry.

### 3.2 Vision and Mission of the Program

**Vision:** The department of IPE will be globally recognized as a dynamic contributor to the development and dissemination of advanced knowledge in the diverse field of Industrial and Production Engineering.

**Mission**: IPE department is working on the following missions:

a. To provide comprehensive education in industrial and production engineering and conduct research.

b. To produce technologically advanced graduates and professionals with high moral and ethical values to meet the domestic and global needs in the field of industrial and production engineering.

c. To conduct collaboration and research activities with national and international academia and industry.

d. To provide consultancy, advisory and testing services to public and private organizations including personal in the areas of industrial and production engineering.

### 3.3 Program Outcomes (PO)

The Bachelor in Industrial and Production Engineering (IPE) program will have the following Program Outcomes (POs):

a. **Engineering knowledge:** Apply knowledge of mathematics, natural science, engineering fundamentals and an engineering specialization as specified in K1 to K4 respectively to the solution of complex engineering problems.

b. **Problem analysis:** Identify, formulate, research literature and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences. (K1 to K4)

c. **Design/development of solutions:** Design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations. (K5)

d. **Investigation:** Conduct investigations of complex problems using research-based knowledge (K8) and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.

e. **Modern tool usage:** Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering problems, with an understanding of the limitations. (K6)

f. **The engineer and society:** Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solutions to complex engineering problems. (K7)

g. **Environment and sustainability:** Understand and evaluate the sustainability and impact of professional engineering work in the solution of complex engineering problems in societal and environmental contexts. (K7)

h. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice. (K7)

i. **Individual work and teamwork:** Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.

j. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

k. **Project management and finance:** Demonstrate knowledge and understanding of engineering management principles and economic decision-making and apply these to one"s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

l. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

In addition to incorporating the above-listed POs, MIST also included the following Knowledge Profile (K1-K8) as an educational institution: may include additional outcomes in its learning programs. The ranges of Complex Problem Solving (P1 – P7) and Complex Engineering Activities (A1 – A5) that should be addressed in the program are given in Tables 3.2 and 3.3, respectively.

**Table 3.1: Knowledge Profile (KP)**

| | Attribute |
|---|---|
| K1 | A systematic, theory-based understanding of the natural sciences applicable to the discipline |
| K2 | Conceptually based mathematics, numerical analysis, statistics and the formal aspects of computer and information science to support analysis and modeling applicable to the discipline |
| K3 | A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline |
| K4 | Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline |
| K5 | Knowledge that supports engineering design in a practice area |
| K6 | Knowledge of engineering practice (technology) in the practice areas in the engineering discipline |
| K7 | Comprehension of the role of engineering in society and identified issues in engineering practice in the discipline: ethics and the engineer's professional responsibility to public safety; the impacts of engineering activity; economic, social, cultural, environmental and sustainability |
| K8 | Engagement with selected knowledge in the research literature of the discipline |

**Table 3.2: Range of Complex Engineering Problem Solving**

| Attribute | **Complex Engineering Problems** have characteristic P1 and some or all of P2 to P7: |
|---|---|
| Depth of knowledge required | P1: Cannot be resolved without in-depth engineering knowledge at the level of one or more of K3, K4, K5, K6 or K8 which allows a fundamentals-based, first principles analytical approach |
| Range of conflicting Requirements | P2: Involve wide-ranging or conflicting technical, engineering and other issues |
| Depth of analysis required | P3: Have no obvious solution and require abstract thinking, originality in analysis to formulate suitable models |
| Familiarity of issues | P4: Involve infrequently encountered issues |
| Extent of applicable codes | P5: Are outside problems encompassed by standards and codes of practice for professional engineering |
| Extent of stakeholder involvement and conflicting Requirements | P6: Involve diverse groups of stakeholders with widely varying needs |
| Interdependence | P7: Are high level problems including many component parts or sub-problems |

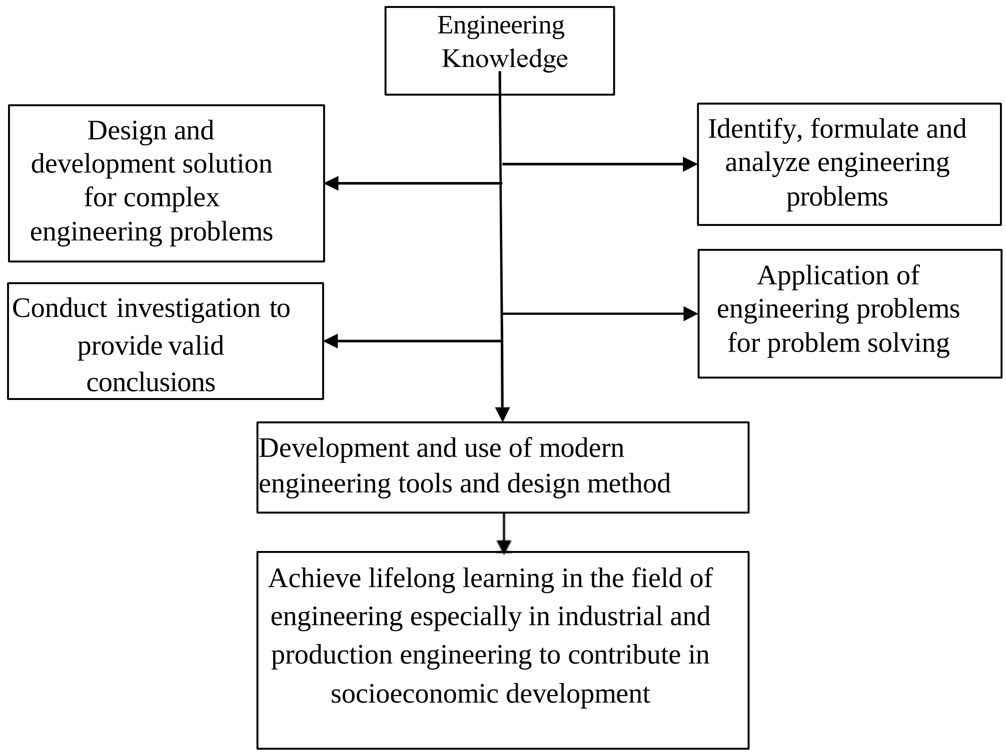
**Table 3.3: Range of Complex Engineering Activities**

| Attribute | **Complex activities** means (engineering) activities or projects that have some or all of the following characteristics: |
|---|---|
| Range of resources | A1: Involve the use of diverse resources (and for this purpose resources include people, money, equipment, materials, information and technologies) |
| Level of interaction | A2: Require resolution of significant problems arising from interactions between wide-ranging or conflicting technical, engineering or other issues |
| Innovation | A3: Involve creative use of engineering principles and research based knowledge in novel ways |
| Consequences for society and the environment | A4: Have significant consequences in a range of contexts, characterized by difficulty of prediction and mitigation |
| Familiarity | A5: Can extend beyond previous experiences by applying principles-based approaches |

## 3.4 Generic Skills

a. Apply the principles and theory of industrial and production engineering knowledge to the requirements, design and development of different industrial and production systems with appropriate understanding.
b. Define and use appropriate research methods and modern tools to conduct a specific project.
c. Learn independently, be self-aware and self-manage their time and workload.
d. Apply critical thinking to solve complex engineering problems.
e. Analyze real time problems and justify the appropriate use of technology.
f. Work effectively with others and exhibit social responsibility.

## 3.5 Curriculum/ Skill mapping:



# CHAPTER 4

## COURSE CURRICULUM FOR BACHELOR DEGREE IN IPE

### 4.1 Introduction

The undergraduate students of the Department of Industrial and Production Engineering have to follow the course schedule given in this chapter. The letter prefix in any course number indicates the department offering the course viz. IPE for Industrial and Production Engineering, ME for Mechanical Engineering, EECE for Electrical & Electronic Engineering, CSE for Computer Science and Engineering, CHEM for Chemistry, PHY for Physics, MATH for Mathematics, GES for General Education Sociology, GEA for General Education Accounting, GEE for General Education Economics, GEBS for General Education Bangladesh Studies, GELM for General Education Leadership and Management, GERM for General Education Research Methodology, GEEM for General Education Engineering Ethics, GESL for General Education Sustainability and Law, LANG for Language, and SHOP for Machine Shop. The first digit in the number indicates the year/level for which the course is intended. Odd number courses are theory courses and even numbered courses are sessional courses.

### 4.2 Course Schedule

Keeping the above-mentioned program outcome, the course schedule for the undergraduate students of the Department of Industrial and Production Engineering is given below:

| Level-Term | Language Cr Hr | General Education Cr Hr | Basic Science Cr Hr | Mathematics Cr Hr | Interdisciplinary Cr Hr | Core Courses Cr Hr | Elective Cr Hr | Total Cr Hr |
|---|---|---|---|---|---|---|---|---|
| 1-I | - | 2.0+0.0 | 6.0+3.0 | 3.0+0.0 | 0.0+1.00 | 3.0+0.0 | - | 18.0 |
| 1-II | 0.0+1.5 | 2.0+0.0 | - | 3.0+0.0 | 3.0+2.25 | 6.0+1.5 | - | 19.25 |
| 2-I | 0.0+1.5 | 2.0+0.0 | - | 3.0+0.0 | 6.0+2.25 | 6.0+2.25 | - | 23.0 |
| 2-II | - | 2.0+0.0 | - | 3.0+0.0 | - | 12.0+3.0 | - | 20.0 |
| 3-I | - | 2.0+2.0 | - | - | - | 15.0+2.25 | - | 21.25 |
| 3-II | - | - | - | - | - | 17.0+4.0 | - | 21.0 |
| 4-I | - | - | - | - | - | 9.0+6.0 | 6.0*+0 | 21.0 |
| 4-II | - | - | - | - | - | 6.0+4.5 | 6.0*+0 | 16.5 |
| **Total** | 0.0+3.0 =3.0 | 10+2.0=12 | 6.0+3.0 =9.0 | 12+0.0= 12.00 | 9.0+5.5 =14.5 | 74+23.5 =97.5 | 12.0+0.0=12.0 | 160.0 |
| % of total Cr Hr | 9.375%% | | 13.125% | | 9.0625% | 60.9375% | 7.5% | |

*To be selected from the List of Elective Courses

### 4.3 Contact Hours and Credit Hours Distribution in Eight Terms

| Level-Term | Contact hours for theory courses | Contact hours for sessional courses | Cumulative contact hours | Cumulative credit hours |
|---|---|---|---|---|
| 1-I | 14 | 8 | 22 | 18.00 |
| 1-II | 14 | 10.5 | 46.5 | 37.25 |
| 2-I | 17 | 12 | 75.5 | 60.25 |
| 2-II | 17 | 6 | 98.5 | 80.25 |
| 3-I | 17 | 8.5 | 124 | 101.5 |
| 3-II | 17 | 6 + 04 Weeks | 147 + 04 Weeks | 122.5 |
| 4-I | 15 | 12 | 174 + 04 Weeks | 143.5 |
| 4-II | 12 | 9 | 195 + 04 Weeks | 160.0 |
| Total | 123 | 72 + 04 Weeks | **195 + 04 Weeks** | **160.0** |

## 4.4 Term-wise Distribution of Courses

### Level 1 Term I

| Course No. | Course Title | Contact Hour | Credit Hour |
|---|---|---|---|
| IPE 101 | Introduction to Industrial and Production Engineering | 3 | 3.00 |
| MATH 101 | Differential and Integral Calculus | 3 | 3.00 |
| GESA 101 | Sociology and Accounting | 2 | 2.00 |
| CHEM 109 | Basic Chemistry | 3 | 3.00 |
| PHY 133 | Waves & Oscillations, Structure of Matter, Heat and Thermodynamics | 3 | 3.00 |
| **Total Theoretical** | | **14** | **14.00** |
| PHY 134 | Physics Sessional | 3 | 1.50 |
| SHOP 172 | Machine Shop Practice | 2 | 1.00 |
| CHEM 110 | Chemistry Sessional | 3 | 1.50 |
| **Total Sessional** | | **8** | **4.00** |
| **Grand Term Total** | | **22.00** | **18.00** |

### Level 1 Term II

| Course No. | Course Title | Contact Hour | Credit Hour |
|---|---|---|---|
| MATH 103 | Differential Equations and Matrix | 3 | 3.00 |
| IPE 105 | Engineering Materials | 3 | 3.00 |
| EECE 171 | Basic Electrical & Electronic Circuit | 3 | 3.00 |
| IPE 107 | Engineering Economy | 3 | 3.00 |
| GEBS 101 | Bangladesh Studies | 2 | 2.00 |
| BAN 1201 | Bangla Language and Literature | 3 | 3.00** |
| **Total Theoretical** | | **14** | **14.00*** ** |
| ME 160 | Engineering Drawing | 3 | 1.50 |
| LANG 102 | Communicative English I | 3 | 1.50 * |
| EECE 172 | Basic Electrical & Electronic Circuit Sessional | 1.50 | 0.75 |
| IPE 106 | Engineering Materials Sessional | 3 | 1.50 |
| **Total Sessional** | | **10.5** | **5.25** |
| **Grand Term Total** | | **24.5** | **19.25** |

*For local students **For foreign students ***For local students

## Level 2 Term I

| Course No. | Course Title | Contact Hour | Credit Hour |
|---|---|---|---|
| MATH 201 | Vector Analysis, Laplace Transformation & Co-ordinate Geometry | 3 | 3.00 |
| EECE 271 | Electrical Machines and Electronics | 3 | 3.00 |
| CSE 281 | Computer Programming | 3 | 3.00 |
| IPE 201 | Manufacturing Processes I | 3 | 3.00 |
| GELM 275 | Leadership and Management | 2 | 2.00 |
| IPE 205 | Probability and Statistics | 3 | 3.00 |
| **Total Theoretical** | | **17** | **17.00** |
| EECE 272 | Electrical Machines and Electronics Sessional | 1.50 | 0.75 |
| CSE 282 | Computer Programming Sessional | 3 | 1.50 |
| IPE 202 | Manufacturing Processes I Sessional | 1.5 | 0.75 |
| IPE 200 | Engineering Graphics and CAD Sessional | 3 | 1.50 |
| LANG 202 | Communicative English II | 3 | 1.50* |
| **Total Sessional** | | **12.0** | **6.0** |
| **Grand Term Total** | | **29.0** | **23.00** |

*For local students

## Level 2 Term II

| Course No. | Course Title | Contact Hour | Credit Hour |
|---|---|---|---|
| IPE 203 | Manufacturing Process II | 3 | 3.00 |
| GEEM 243 | Engineering Ethics and Moral Philosophy | 2 | 2.00 |
| IPE 243 | Mechanics of Solids | 3 | 3.00 |
| IPE 251 | Thermodynamics and Heat Transfer | 3 | 3.00 |
| MATH 215 | Numerical Analysis | 3 | 3.00 |
| IPE 271 | Engineering Mechanics and Mechanics of Machinery | 3 | 3.00 |
| **Total Theoretical** | | **17** | **17.00** |
| IPE 204 | Manufacturing Processes II Sessional | 1.5 | 0.75 |
| IPE 206 | Probability and Statistics Sessional | 1.5 | 0.75 |
| IPE 244 | Mechanics of Solids Sessional | 1.5 | 0.75 |
| IPE 252 | Thermodynamics and Heat Transfer Sessional | 1.5 | 0.75 |
| **Total Sessional** | | **6.0** | **3.00** |
| **Grand Term Total** | | **23.0** | **20.00** |

**Level 3 Term I**

| Course No. | Course Title | Contact Hour | Credit Hour |
|---|---|---|---|
| IPE 351 | Fluid Mechanics & Machinery | 3 | 3.00 |
| IPE 301 | Measurement, Instrumentation and Control | 3 | 3.00 |
| IPE 303 | Product Design I | 3 | 3.00 |
| IPE 305 | Operations Research | 4 | 4.00 |
| IPE 315 | Entrepreneurship Development and Micro Industries | 2 | 2.00 |
| GESL 313 | Environment, Sustainability and Law | 2 | 2.00 |
| **Total Theoretical** | | **17** | **17.00** |
| IPE 352 | Fluid Mechanics & Machinery Sessional | 1.5 | 0.75 |
| IPE 302 | Measurement, Instrumentation and Control Sessional | 1.5 | 0.75 |
| IPE 306 | Operations Research Sessional | 1.5 | 0.75 |
| GERM 352 | Fundamentals of Research Methodology | 4 | 2.00 |
| **Total Sessional** | | **8.5** | **4.25** |
| **Grand Term Total** | | **25.5** | **21.25** |

**Level 3 Term II**

| Course No. | Course Title | Contact Hour | Credit Hour |
|---|---|---|---|
| IPE 309 | Material Handling and Maintenance Management | 3 | 3.00 |
| IPE 311 | Operations Management | 3 | 3.00 |
| IPE 313 | Quality Management | 3 | 3.00 |
| IPE 319 | Data Analytics | 2 | 2.00 |
| IPE 317 | Ergonomics and Safety Management | 3 | 3.00 |
| IPE 307 | Product Design II | 3 | 3.00 |
| **Total Theoretical** | | **17** | **17.00** |
| IPE 308 | Product Design Sessional | 1.5 | 0.75 |
| IPE 310 | Material Handling and Maintenance Management Sessional | 1.5 | 0.75 |
| IPE 314 | Quality Management Sessional | 1.5 | 0.75 |
| IPE 318 | Ergonomics and Safety Management | 1.5 | 0.75 |
| IPE 320 | Industrial Practice | 4 Weeks | 1.00 |
| **Total Sessional** | | **6** | **4.00** |
| **Grand Term Total** | | **23** | **21.00** |

## Level 4 Term I

| Course No. | Course Title | Contact Hour | Credit Hour |
|---|---|---|---|
| IPE 421 | Machine Tools | 3 | 3.00 |
| IPE 419 | Modeling and Simulation | 3 | 3.00 |
| IPE 415 | Project Management | 3 | 3.00 |
| IPE --- | Optional I | 3 | 3.00 |
| IPE --- | Optional II | 3 | 3.00 |
| **Total Theoretical** | | **15** | **15.00** |
| IPE 400 | Final Year Design & Research Project I | 6 | 3.00 |
| IPE 420 | Modeling and Simulation Sessional | 1.5 | 0.75 |
| IPE 422 | Machine Tools Sessional | 3 | 1.50 |
| IPE 450 | Business Communication Seminar | 1.5 | 0.75 |
| **Total Sessional** | | **12** | **6.00** |
| **Grand Term Total** | | **27** | **21.00** |

## Level 4 Term II

| Course No. | Course Title | Contact Hour | Credit Hour |
|---|---|---|---|
| IPE 405 | Supply Chain Management | 3 | 3.00 |
| IPE 411 | CAD/CAM | 3 | 3.00 |
| IPE --- | Optional III | 3 | 3.00 |
| IPE --- | Optional IV | 3 | 3.00 |
| **Total Theoretical** | | **12** | **12.00** |
| IPE 400 | Final Year Design & Research Project II | 6 | 3.00 |
| IPE 412 | CAD/CAM Sessional | 1.5 | 0.75 |
| IPE 418 | Mechatronics and Industrial Automation Sessional | 1.5 | 0.75 |
| **Total Sessional** | | **9** | **4.50** |
| **Grand Term Total** | | **21** | **16.50** |

The grand total credit hours required for the degree of B.Sc. in Industrial and Production Engineering is **160.00**.

### 4.5 List of Optional Courses

| Course No. | Course Title | Contact Hour | Credit Hour |
|---|---|---|---|
| **Optional I (Manufacturing and Production)** | | | |
| IPE 435 | Metal Cutting | 3 | 3.00 |
| IPE 447 | Advanced Material & Process | 3 | 3.00 |
| IPE 451 | Micromanufacturing | 3 | 3.00 |
| IPE 441 | Modern Manufacturing Process | 3 | 3.00 |
| IPE 439 | Green Manufacturing | 3 | 3.00 |
| **Optional II (Automation and Control)** | | | |
| IPE 431 | Computer Integrated Manufacturing | 3 | 3.00 |
| IPE 417 | Industrial Automation | 3 | 3.00 |
| IPE 445 | Machine Learning | 3 | 3.00 |
| IPE 427 | Control Engineering | 3 | 3.00 |
| **Optional III (Management)** | | | |
| IPE 429 | Organizational Behavior | 3 | 3.00 |
| IPE 425 | Marketing Management | 3 | 3.00 |
| IPE 449 | Industrial Fire Safety | 3 | 3.00 |
| IPE 443 | Total Quality Management | 3 | 3.00 |
| **Optional IV (Systems Engineering)** | | | |
| IPE 423 | Robotics | 3 | 3.00 |
| IPE 437 | Mechatronics | 3 | 3.00 |
| CSE 403 | Artificial Intelligence | 3 | 3.00 |

### 4.6 List of Courses Offered to Other Departments

| Course No. | Course Title | Contact Hour | Credit Hour |
|---|---|---|---|
| GELM 275 | Leadership and Management | 2 | 2.00 |
| IPE 351 | Production Process | 4 | 4.00 |
| IPE 352 | Production Process Sessional | 1.5 | 0.75 |
| IPE 353 | Measurement and Quality Control | 3 | 3.00 |
| IPE 354 | Measurement and Quality Control sessional | 1.5 | 0.75 |
| IPE 411 | CAD/CAM | 3 | 3.00 |
| IPE 433 | Production Planning and control | 3 | 3.00 |
| IPE 435 | Metal Cutting Process | 3 | 3.00 |
| IPE 441 | Modern Manufacturing Process | 3 | 3.00 |
| IPE 455 | Machine Tools & Machining | 3 | 3.00 |
| IPE 456 | Machine Tools & Machining Sessional | 1.5 | 0.75 |
| IPE 481 | Industrial Management | 4 | 4.00 |
| IPE 485 | Operations Research | 3 | 3.00 |
| IPE 487 | Material Handling | 3 | 3.00 |

**CHAPTER 5**

# Description of IPE Courses

## 1.1 Detailed Curriculum of IPE Core Courses

**Course Code:** IPE 101 **Course Name:** Introduction to Industrial and Production Engineering
**Credit Hour:** 3.00 **Contact Hour:** 3.00
**Level/Term:** Level 1/ Term I

**Curriculum Structure:** Outcome Based Education (OBE)

**Pre-requisite:** None

**Rationale:**

This course is designed to impart the core concepts of industrial and production engineering and incorporate inquisition about different fields of works of industrial and production engineers.

**Objectives:**

1. To share knowledge of what industrial engineers do
2. To help students explore how the IP engineers can improve an industrial or a production system
3. To show applications of basic industrial engineering tools
4. To guide students in differentiating among various production processes
5. To introduce students with basic concepts of engineering materials

**Course Outcomes (CO) & Generic Skills:**

Upon completion of this course, the student should be able to:

| | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO1 | **Explain** the basic concepts of industrial and production engineering | C1, C2 | | | 1 | CT |
| CO2 | **Sketch** and **analyze** different manufacturing processes | C3, C4 | 1 | | 1 | MT, F, CT |
| CO3 | **Apply** common IE tools to solve real-life problems | C3 | 1 | | 1, 2 | F, CT, MT |
| CO4 | **Define** and **describe** the applications of different engineering materials | C1, C2 | | | 1 | CT, F |
| CO5 | **Assess** different production processes and their applications | C3, C5 | 1 | | 1 | ASG, F |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, CT – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; MT – Midterm Exam, F – Final Exam) | | | | | | |

**Course Contents:**

**a. Main Contents:**

Forecasting, Plant layout, Quality engineering, Production planning and control, Statistics, Computer programming, Lean engineering, Work measurement, Manufacturing, Engineering materials, Solidification processes, Particulate processing, Deformation processes, Material removal process, Material handling and management.

**b. Detailed Contents:**

Introduction to IPE, Career, Input-Process-Output, Efficiency, Life Cycle of Product, **Forecasting** - Simple Moving Average, weighted moving average, exponentially weighted moving average; **Plant Layout:** Line Balancing, cycle time, maximum output, CPM, Locational Economics; **Quality Engineering**: 7 Tools of Quality, Total Quality Management, ISO 9000, Statistical Process Control, Control chart, Control charts for variables and attributes, Process capability assessment, Six Sigma; **Production Planning & Control:** Inventory Control - EOQ, ABC analysis, Value Analysis, Scheduling – forward & backward; **Statistics** - sample & population, sampling, type I, type II error; **Computer Programming:** CAD/CAM, Computer Integrated Manufacturing, **Lean Engineering:** 7 wastes, JIT, 5S, Kaizen, **Work Measurement**: method and time study.

**Manufacturing:** Definition, Manufacturing industries and products, Manufacturing capabilities, Manufacturing system; **Engineering Materials:** Classification, Selection of materials, Manufacturing Processes classification; **Solidification Processes:** Metal Casting, Shaping processes for plastics and polymer matrix composites; **Particulate Processing:** Pressing and Sintering, Processing of plastics; **Deformation Processes:** Metal forming, Sheet metal working; **Material Removal Process:** Machining and part geometry, Turning and related operations, Drilling and related operations, Milling Operations, Shaping and Planning operations; **Material Handling and Management:** Principles, Unit load, Major Equipment Categories.

**Mapping of Course Outcomes and Program Outcomes:**

| Course Learning Outcomes | | Engineering Knowledge | Problem Analysis | Design / Development of Solutions | Investigation | Modern Tool Usage | The Engineer and Society | Environment and Sustainability | Ethics | Communication | Individual and Team Work | Project Management and Finance | Life Long Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | **Explain** the basic concepts of industrial and | √ | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | production engineering | | | | | | | | | | | | |
| **CO2** | **Sketch** and **analyze** different manufacturing processes | √ | | | | | | | | | | | |
| **CO3** | **Apply** common IE tools to solve real-life problems | | √ | | | | | | | | | | |
| **CO4** | **Define** and **describe** the applications of different engineering materials | √ | | | | | | | | | | | |
| **CO5** | **Assess** different production processes and their applications | √ | √ | | | | | | | | | | |

**Teaching-learning and Assessment Strategy:**

| Teaching and learning activities | Engagement (hours) |
|---|---|
| Face-to-face learning | |
| Lecture | 42 |
| Practical/ Tutorial/ Studio | - |
| Student-centred learning | - |
| Self-directed learning | |
| Non face-to-face learning | 18 |
| Revision | 21 |
| Assessment preparations | 20 |
| Formal Assessment | |
| Continuous Assessment | 2 |
| Final Examination | 3 |
| Total | 106 |

**Teaching methodology:**

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

**Lecture Schedule:**

| Week | Lecture | Topics | TEST |
|---|---|---|---|
| **1** | Lec 1 | Introduction to IPE, Career, Input-Process-Output | |
| | Lec 2 | Efficiency, Life Cycle of Product | |
| | Lec 3 | Simple Moving Average, weighted moving average | |
| **2** | Lec 4 | Exponentially weighted moving average | |
| | Lec 5 | Line Balancing, cycle time, maximum output | **Class Test 1** |
| | Lec 6 | CPM | |
| **3** | Lec 7 | Locational Economics | |

| | | | |
|---|---|---|---|
| | Lec 8 | 7 Tools of Quality | |
| | Lec 9 | Total Quality Management, ISO 9000 | |
| **4** | Lec 10 | Statistical Process Control, Control chart, Control charts for variables and attributes. | **Class Test 2** |
| | Lec 11 | Process capability assessment, Six Sigma | |
| | Lec 12 | Inventory Control - EOQ, ABC analysis | |
| **5** | Lec 13 | Value Analysis, Scheduling – forward & backward | |
| | Lec 14 | Sample & population, sampling, type I, type II error | |
| | Lec 15 | CAD/CAM | |
| **6** | Lec 16 | Computer Integrated Manufacturing | |
| | Lec 17 | 7 wastes | |
| | Lec 18 | JIT | |
| **7** | Lec 19 | 5S, Kaizen | |
| | Lec 20 | Method and time study | |
| | Lec 21 | Review class | |
| **8** | Lec 22 | Manufacturing: Definition, Manufacturing industries and products | **Mid Term / Project** |
| | Lec 23 | Manufacturing capabilities, Manufacturing system | |
| | Lec 24 | Engineering Materials: Classification | |
| **9** | Lec 25 | Selection of materials | |
| | Lec 26 | Manufacturing Processes classification | |
| | Lec 27 | Metal Casting | |
| **10** | Lec 28 | Shaping processes for plastics and polymer matrix composites | **Class Test 3** |
| | Lec 29 | Pressing and Sintering | |
| | Lec 30 | Processing of plastics | |
| **11** | Lec 31 | Metal forming | |
| | Lec 32 | Sheet metal working | |
| | Lec 33 | Machining and part geometry | |
| **12** | Lec 34 | Turning and related operations | |
| | Lec 35 | Drilling and related operations | |
| | Lec 36 | Milling Operations | |
| **13** | Lec 37 | Shaping and Planning operations | |
| | Lec 38 | Principles, Unit load | |

| | | | |
|---|---|---|---|
| | Lec 39 | Major Equipment Categories | |
| **14** | Lec 40 | Review class | |
| | Lec 41 | | |
| | Lec 42 | | |

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| Assessment Strategies | | | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| Components | | Grading | | |
| Continuous Assessment (40%) | Class test 1-3 | 20% | CO 1-3 | C 1-4, P 1-2 |
| | Class Performance | 5% | CO 3, CO5 | C3, C5, P 1-2 |
| | Attendance | 5% | | |
| | Mid term | 10% | CO 2,3 | C 1-4, P 1-2 |
| Final Exam | | 60% | CO 1-5 | C 1-5, P 1-2 |
| Total Marks | | 100% | | |

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

**Text and Ref Books:**

1. Industrial Engineering & Management Problem and Policies (Ralph M. Barnes)
2. Industrial Engineering & Production Management 3rd Edition (2018) (Marland T. Telsang)
3. Maynard's Industrial Engineering Handbook (Kjell Zandin, Harold Maynard)
4. Introduction to Industrial and Systems Engineering (Wayne C. Turner, Joe H. Mize, Kenneth E. Case, John W. Nazemtz)

**Course Code:** IPE 105 **Course Title**: Engineering Materials
**Credit Hours:** 3.00 **Contact Hours:** 3.00
**Course Curriculum:** Outcome Based Education (OBE)
**Pre-requisite:** None

**Rationale:**

To conduct in-depth study on atomic structures and bonding, crystallography, phase diagrams, various properties of engineering materials and methods of heat and surface treatments with the objective of laying a strong foundation for core manufacturing courses of program.

**Objective:**

1. To conduct study on atomic and crystal structure of solids.
2. To expose the students the defects in crystal structures of solids.
3. To study the properties of materials and the testing procedures.
4. To expose students to phase diagrams of different binary alloys.
5. To conduct study on TTT diagrams to instill understanding of the methods of phase transformation in metallic systems.

6. To conduct study on methods of heat and surface treatments.
**7.** To study the properties and applications of metallic and non-metallic materials and alloys.

**Course Outcomes (CO):**
Upon completion of the course, the students will be able to:

| | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO1 | **Explain** the crystal structures and crystalline dislocations in metals. | C2-C4 | 1,3 | 2 | 1 | T, M, F |
| CO2 | **Explain** the properties of materials and **Outline** the testing procedures to determine them. | C2-C5 | 1,3 | 2 | 1, 3, 4 | T, M, F |
| CO3 | **Determine** composition and ratios of different phases present binary metallic alloy systems using the respective phase diagrams. | C3-C5 | 1 | 2 | 1, 3 | T, M F |
| CO4 | **Design** cooling rates using TTT diagrams to derive desired combinations of phases in metallic systems. | C3-C5 | 1,3 | 2 | 1, 3, 5 | T, M |
| CO5 | **Select** and **explain** procedures of different heat and surface treatments of metals. | C2-C5 | 1 | 2 | 1, 3 | T, F |
| CO6 | **Explain** the **s**tructures and properties of metals, alloys and composites; and their applications as engineering materials. | C2-C5 | 1,3 | 2 | 1, 3 | T, F |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; M= Midterm exam; F – Final Exam) | | | | | | |

**Course Contents:**

Introduction**:** Engineering materials, materials cycle, application and selection criteria of materials.

Structure of solid materials; atomic structure of materials, crystal structure of solids, Miller indices and Bravais space lattices, density, packing factor, defects in crystals and types of defects, solid solutions and dislocations. Crystallographic points, directions, and planes: theory and problem solving. Amorphous structures: types of solids, poly morphism and allotropy.

Phase diagrams: phase diagrams for Binary metallic system completely soluble in liquid and solid states, Binary metallic system completely soluble in the liquid state but completely insoluble in the solid state; Binary metallic system completely soluble in the liquid state but only partially soluble in the solid state; The Eutectoid Reaction; The Iron-Iron Carbide equilibrium diagram;
Properties of materials: physical, mechanical, chemical, electrical, semi conducting, magnetic, optical chemical and thermal properties of solids; units and testing.

Engineering materials**:** Structures and properties of metals and alloys, ceramics, polymers, rubber, plastics, semiconductors and magnetic materials.

Heat treatment of Steel: Full Annealing; Spheroidizing; Stress-Relief Annealing; Process Annealing; Normalizing; Hardening; Heating temperatures, holding time and Cooling rates in heat treatments. Case Hardening of Steels: Carburizing; Nitriding; Carburbo-Nitriding; Cyaniding; Flame Hardening and Induction Hardening.

**Teaching-learning and Assessment Strategy:**
Lectures, class performances, assignments, class tests, mid-term exam and final exam

**Linkage of CO with Assessment Methods& their Weights:**

| Assessment Strategies | | | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| Components | | Grading | | |
| Continuous Assessment (40%) | Test 1-3 | 20% | CO1 | C2-C4 |
| | | | CO2 | C2-C5 |
| | | | CO3 | C3-C5 |
| | | | CO4 | C3-C5 |
| | | | CO5 | C2-C5 |
| | | | CO6 | C2-C5 |
| | Class Participation | 5% | - | - |
| | Attendance | 5% | - | - |
| | Mid term | 10% | CO1 | C2-C4 |
| | | | CO2 | C2-C5 |
| | | | CO3 | C3-C5 |
| | | | CO4 | C3-C5 |
| Final Exam | | 60% | CO1 | C2-C4 |
| | | | CO2 | C2-C5 |
| | | | CO3 | C3-C5 |
| | | | CO4 | C3-C5 |
| | | | CO5 | C2-C5 |
| | | | CO6 | C2-C5 |
| Total Marks | | 100% | | |

**Mapping of Course Outcomes (CO) and Program Outcomes:**

| Course Learning Outcomes | | Engineering Knowledge | Problem Analysis | Design / Development of Solutions | Investigation | Modern Tool Usage | The Engineer and Society | Environment and Sustainability | Ethics | Communication | Individual and Team Work | Project Management and Finance | Life Long Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | **Explain** the crystal structures and crystalline dislocations in metals. | √ | √ | | | | | | | | | | |
| **CO2** | **Explain** the properties of materials and **Outline** the testing procedures to determine them. | √ | √ | | | | | | | | | | |
| **CO3** | **Determine** composition and ratios of different phases present binary metallic alloy systems using the respective phase diagrams. | √ | √ | | | | | | | | | | |
| **CO4** | **Design** cooling rates using TTT diagrams to derive desired combinations of phases in metallic systems. | √ | √ | √ | | | | | | | | | |
| **CO5** | **Select** and **explain** procedures of different heat and surface treatments of metals. | √ | √ | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO6** | **Explain** the **s**tructures and properties of metals, alloys and composites; and their applications as engineering materials. | √ | √ | | | | | | | | | | |

**Lectures schedule:**

| Week | Lecture | Topics | Remarks |
|---|---|---|---|
| **Week 1** | 1 | Introduction**:** Engineering materials, materials cycle, | **CT 1** |
| | 2 | Application and selection criteria of materials. | |
| **Week 2** | 3 | Structure of solid materials; atomic structure of materials, crystal structure of solids | |
| | 4 | Miller indices and Bravais space lattices | |
| **Week 3** | 5 | Packing factor and density | |
| | 6 | Defects in Crystals: types of defects, solid solutions, dislocation. | |
| **Week 4** | 7 | Crystallographic points, directions, and planes: theory and problem solving. | **CT 2** |
| | 8 | Amorphous structures, types of solids, crystal structure, polymorphism and allotropy | |
| **Week 5** | 9 | **Phase diagrams:** Phase diagrams: phase diagrams for Binary metallic system completely soluble in liquid and solid states, | |
| | 10 | Binary metallic system completely soluble in the liquid state but completely insoluble in the solid state; | |
| **Week 6** | 11 | Binary metallic system completely soluble in the liquid state but only partially soluble in the solid state; The Eutectoid Reaction; | |
| | 12 | The Iron-Iron Carbide equilibrium diagram; | |
| **Week 7** | 13 | Structures and properties of metals and alloys: Ferrous metals – steel | |
| | 14 | Cast iron | |
| **Week 8** | 15 | Non Ferrous metals and alloys, | **Midterm** |
| | 16 | Ceramics | |
| **Week 9** | 17 | Polymers, rubber and plastics | **CT 3** |
| | 18 | Semiconductors and magnetic materials. | |
| **Week 10** | 19 | Properties of materials: physical and mechanical | |
| | 20 | Thermal properties of solids | |
| **Week 11** | 21 | Chemical properties | |
| | 22 | Electrical, semi conducting properties | |
| **Week 12** | 23 | Magnetic and optical properties | **CT 4** |
| | 24 | at treatment of Steel: Full Annealing; Spheroidizing; Stress- | |

| | | | |
|---|---|---|---|
| | | Relief Annealing; | |
| **Week 13** | 25 | at treatment of Steel: Process Annealing; Normalizing; Hardening; Heating temperatures, holding time and Cooling rates in heat treatments. | |
| | 26 | Case Hardening of Steels: Carburizing; Nitriding; Carburbo-Nitriding; Cyaniding; Flame Hardening and Induction Hardening. | |
| **Week 14** | 27 | Case Hardening of Steels: Flame Hardening and Induction Hardening. | |
| | 28 | Course Review | |

**Reference Books:**
**Text Book:**

William D. Callister, ***Materials Science and Engineering an Introduction***, John Wily, 5th Edition.

**Reference Books:**


**1.** Sidney H Avner, ***Introduction to Physical Metallurgy***, Tata Mc Graw – Hill Edition, 2nd edition..

**2.** Ashby, M. F.; Jones, D. R. H., ***Engineering materials 1: an introduction to properties, applications and design***. Elsevier: 2012; Vol. 1.

**3.** Kakani, S., ***Material science. New Age International***: 2006.

**4.** Smallman, R. E.; Ngan, A., ***Physical metallurgy and advanced materials.*** Elsevier: 2011.


**Curse Code:** IPE 106 **Course Title:** Engineering Materials Sessional
**Credit Hour**: 1.50 **Contact Hour:** 3.00
**Course Curriculum:** Outcome Based Education (OBE)
**Pre-requisite:** None.

**Rationale:**
Laboratory course to learn basic experimental skills and to introduce basic instruments in materials science and engineering. Use of optical, electrical, thermal and mechanical techniques to investigate composition, structure, thermodynamic and kinetic processes of materials. Communicate laboratory findings through written reports and oral presentation.

**Objective:**
The overall objective of the course is to provide the students with hands-on experience in (1) basic experimental techniques (2) data analysis and (3) writing journal-quality report. Small groups of about 5 to 6 students work as teams in each laboratory session with the reports prepared independently. The main objectives of the course are

1. To learn the principles of materials science and engineering

though lab investigation;
2. To learn the basic skills required to properly use materials scienceinstruments;
3. To learn to organize the lab results into a logic, concise and accurate report;
4. To develop writing and communications skills for a persuasive presentation of technical materials.

**Course Outcomes (CO) & Generic Skills:**

| | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO1 | **Prepare** formal laboratory reports describing the results of experiments | C4-C5 | | 2 | 1 | Pr, R |
| CO2 | **Operate** basic instruments in materials science and engineering | C3-C6 | 2 | 2 | 1 | ASG, R |
| CO3 | **Interpret** the data from the experiments | C2-C3 | 1 | 1 | 2 | ASG |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam) | | | | | | |

**Course Contents:**

Name of Experiments:

1. Introduction to Metallographic and Metallographic sample specimen preparation.
2. Study of Phase diagram.
3. Microstudy of steels.
4. Study of Heat treatment of Steel-1
5. Study of Heat treatment of Steel-2
6. Study of Microstudy of Cast iron-1
7. Study of Microstudy of Cast iron-2

**Teaching-learning and Assessment Strategy:**

Class Assessment, Class Participation/ Observation, Class Attendance, Lab Exam, Quiz, Viva

**Linkage of CO with Assessment Methods& their Weights:**

| **Assessment Method** | **(100%)** |
|---|---|
| **Class Assessment** | |
| Class performance | 05 |

| | |
|---|---|
| Class Attendance | 05 |
| Lab Exam | 40 |
| Quiz | 40 |
| Viva | 10 |

**Mapping of Course Outcomes (CO) and Program Outcomes:**

| Course Learning Outcomes | | Engineering Knowledge | Problem Analysis | Design / Development of Solutions | Investigation | Modern Tool Usage | The Engineer and Society | Environment and Sustainability | Ethics | Communication | Individual and Team | Project Management and Finance | Life Long Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | Ability to prepare formal laboratory reports describing the results of experiments | | | | | | | | | | ✓ | | ✓ |
| **CO2** | Ability to operate basic instruments in materials science and engineering | ✓ | | | ✓ | ✓ | | | | | | | |
| **CO3** | Ability to interpret the data from the experiments | | ✓ | | ✓ | | | | | | | | |

**Text Books & Ref Books:**

1. Lab Manual
2. W.D. Callister, Jr., "Materials Science and Engineering, An Introduction" Wiley
3. Sedney H Avner,“Introduction to Physical Metallurgy”

**Course Code:** IPE 200 **Course Name:** Engineering Graphics and CAD sessional
**Credit Hour:** 1.50 **Contact Hour:** 3.00
**Level/Term:** L-2, T-1

**Curriculum Structure:** Outcome Based Education (OBE)

**Pre-requisites:** ME 160 Engineering Drawing

**Synopsis/Rationale:**

**Rationale:**
To help students develop skills in the use of computer aided drawing as a tool for visualizing and communicating design intent of components and items using SolidWorks

**Objectives:**

1. To help students create 2D and 3D computer drawings and models for manufacturing and prototyping.
2. To develop the skills in students to Evaluate mechanical designs and select the proper access and materials for production.
3. To instill the skills to evaluate computer aided design models and assemblies based on critical thinking and problem-solving skills.
4. To help them apply design principles and rationale in a realistic and original design project.

**Course Outcomes (CO):**

Upon completion of this course, the student should be able to:

| No. | Course Learning Outcome | Bloom’s Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO1 | **Learn** the skills to create and evaluate mechanical designs and select the proper access and materials for production. | C1-C3 | 2 | 2 | 1 | Q |
| CO2 | **Evaluate** computer aided design models and assemblies based on critical thinking and problem-solving skills. | C3-C5 | 2 | 2 | 2 | ASG, R Pr, Q |
| CO3 | **Apply** design principles and **rationale** in a realistic and original design project. | C3-C6 | 3 | 3 | 3 | PR, Pr |

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

**Course Contents:**

**Introduction to CAD**: Introduction to SolidWorks, Interface, Navigation

**2D Drawings:** 2D Sketch**,** 2D Sketch Advanced Options

**3D Drawings:** 3D Sketch**,** 3D Sketch Advanced Options

**Assemblies:** Assemblies and different types of mates **,** Advanced Mates

**Engineering Drawing:** Creating Engineering, Drawings

**Design Evaluation:** Stress analysis, Design Analysis**,** Animation, Motion analysis**,** Mold Design

**Mapping of Course Outcomes and Program Outcomes:**

| Course Learning Outcomes | | Engineering Knowledge | Problem Analysis | Design / Development of Solutions | Investigation | Modern Tool Usage | The Engineer and Society | Environment and Sustainability | Ethics | Communication | Individual and Team Work | Project Management and Finance | Lifelong Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | **Learn** the skills to create and evaluate mechanical designs and select the proper access and materials for production. | ✓ | | ✓ | | ✓ | | | | | | | ✓ |
| **CO2** | **Evaluate** computer aided design models and assemblies based on critical thinking and problem-solving skills. | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | ✓ | | ✓ |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO3** | **Apply** design principles and rationale in a realistic and original design project. | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | ✓ | ✓ | ✓ |

**Teaching-learning and Assessment Strategy:**

| Teaching and learning activities | Engagement (hours) |
|---|---|
| Face-to-face learning | |
| Lecture | 14 |
| Practical/ Tutorial/ Studio | 28 |
| Student-centred learning | - |
| Self-directed learning | |
| Non face-to-face learning | 0 |
| Revision | 30 |
| Assessment preparations | 30 |
| Formal Assessment | |
| Continuous Assessment | 14 |
| Final Examination | 3 |
| Total | 119 |

**Teaching methodology:**

Lecture and Discussion, Practical Sessions, Co-operative and Collaborative Method, Problem

Based Method, Project Based Learning

**Lecture Schedule:**

| Week | Lecture | Topics | TEST |
|---|---|---|---|
| **1** | Lec 1 | Introduction to CAD, Introduction to SolidWorks, Interface, Navigation | **P, Quiz 1** |
| **2** | Lec 2 | 2D Sketch | |
| **3** | Lec 3 | 2D Sketch Advanced Options | |
| **4** | Lec 4 | 3D Sketch | **P, Q** |
| **5** | Lec 5 | 3D Sketch Advanced Options | |
| **6** | Lec 6 | Assemblies and different types of mates | |
| **7** | Lec 7 | Advanced Mates | |
| **8** | Lec 8 | Project Assignment | **Project** |
| **9** | Lec 9 | Creating Engineering Drawings | |
| **10** | Lec 10 | Stress analysis, Design Analysis | **Q, P, PR** |
| **11** | Lec 11 | Animation, Motion analysis | |
| **12** | Lec 12 | Mold Design | |
| **13** | Lec 13 | Project Submission and Presentation | |
| **14** | Lec 14 | Review | |

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| Assessment Strategies | | | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| Components | | Grading | | |
| Continuous Assessment (40%) | Quiz 1-2 | 25% | CO 1 | C1-C3, P1 |
| | | | CO 2 | C3-C5, P2-P4 |
| | Class Participation | 5% | CO 1 | C1-C3, P2, A1 |
| | | | CO 2 | C3-C5, P4, A2 |
| | Project | 30% | CO 1 | C1-C3, P1 |
| | | | CO 3 | C5-C6, P4-P5 |
| Final Quiz | | 40% | CO 1 | C1-C3, P1 |
| | | | CO 2 | C3-C5, P4-P5 |
| Total Marks | | 100% | | |

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

**Text and Ref Books:**

1. SolidWorks Manual
2. Mastering SolidWorks- Matt Lombard

**Course Code:** IPE 107 **Course Name:** Engineering Economy
**Credit Hour:** 3.00 **Contact Hour:** 3.00
**Level/Term:** L-2, T-1

**Curriculum Structure**: Outcome Based Education (OBE)

**Pre-requisites:** None

**Rationale:**
This course is designed to present engineering students the major concepts and techniques of engineering economic analysis that are needed in the decision making process.

**Objectives:**

1. To prepare engineering students to apply knowledge of mathematics and economics in solving engineering problems.
2. To expose students to the concepts of inflation, depreciation, taxation etc.
3. To develop students' skills in analyzing cash flows in an organization.
4. To familiarize students with concepts of time value of money
5. To develop skills in students for effective communication with management and non-engineers.

**Course Outcomes (CO) & Generic Skills:**
Upon completion of this course, the student should be able to:

| No. | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO1 | **Explain** the economic theories, cost concepts and pricing policies. | C2 | | | 2 | Mid Term |
| CO2 | **Apply** knowledge of mathematics, economics, and engineering principles to solve engineering problems. | C3 | 1 | | 2, 4 | ASG, T, F |
| CO3 | **Solve and Analyze** cash flow models in practical situations. | C3, C4 | 1 | | 2, 4 | ASG , T, Mid Term, F |
| CO4 | **Evaluate** the impact of inflation, taxation, depreciation in financial planning, economic basis for replacement, project scheduling, and legal and regulatory issues. | C5 | 1,2 | | 2, 4 | ASG , F |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam) | | | | | | |

**Course Content:**

Introduction to engineering economic decision making common to engineering, cash flow analysis and basic concepts of discounting, cost of capital, required ROR equivalence, business mathematics, investment appraisal criteria for economic decisions, present worth, internal rate of return, social consideration in investment, benefit-cost ratio, decisions involving taxes, depreciation and inflation and sensitivity analysis

**Mapping of Course Outcomes (CO) and Program Outcomes:**

| Course Learning Outcomes | | Engineering Knowledge | Problem Analysis | Design / Development of Solutions | Investigation | Modern Tool Usage | The Engineer and Society | Environment and Sustainability | Ethics | Communication | Individual and Team Work | Project Management and Finance | Life Long Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | **Explain** the economic theories, cost concepts and pricing policies | √ | | | | | | | | | | | |
| **CO2** | **Apply** knowledge of mathematics, economics, and engineering principles to solve engineering problems | √ | √ | | | | | | | | | | |
| **CO3** | **Solve and Analyze** cash flow models in practical situations | √ | √ | | | | | | | | | | |
| **CO4** | **Evaluate** the impact of inflation, taxation, depreciation in financial planning, economic basis for replacement, project scheduling, and legal and regulatory issues that are introduced and applied to economic investment and project-management problems | √ | √ | | | | | | | | | | |

**Teaching-learning and Assessment Strategy:**

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Face-to-Face Learning | |
| Lecture | 42 |
| Practical / Tutorial / Studio | - |
| Student-Centred Learning | - |
| Self-Directed Learning | |
| Non-face-to-face learning | 40 |
| Revision | 20 |
| Assignment Preparations | 20 |
| Formal Assessment | |
| Continuous Assessment | 2 |
| Final Examination | 3 |
| Total | 127 |

**Teaching Methodology:**

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method, Multi-media Presentation, Class Presentation, Assignments, Class Tests, Exams, Feedback at every step.

**Lecture schedule:**

| | | |
|---|---|---|
| **Week 1** | **Introduction to Engineering Economy** | |
| Class 1 | Economics , Resources, Production Possibility Frontier | |
| Class 2 | Engineering Economy, Origins of Engineering Economy, Principles of Engineering Economy | |
| Class 3 | Examples and Problems Related to the Principles of Engineering Economy | |
| **Week 2** | **Cost Concepts and Design Economics** | |
| Class 4 | Cost Estimating, Cost Estimating Approaches, Top Down and Bottom Up Approach, Cash Cost and Book Cost, Sunk Cost and Opportunity Cost | |
| Class 5 | Fixed, Variable, and Incremental Costs, Recurring and Nonrecurring Costs, Life-cycle Cost | CT 1 |
| Class 6 | Phases of the Life Cycle and Their Relative Cost, Direct, Indirect and Overhead Costs, Standard Costs, Consumer and Producer Goods and Services | |
| **Week 3** | **Cost Concepts and Design Economics (Contd.)** | |
| Class 7 | Utility, Necessities, Luxuries, and Price Demand, Competition, Cost, Volume, and Breakeven Point Relationships, Economic Breakeven Point | |
| Class 8 | Problems Related to Economic Breakeven Point . | |
| Class 9 | Optimizing a Design with Respect to Cost, A Simplified Cost Function and Examples | |
| **Week 4** | **Money-Time Relationships and Equivalence** | |
| Class 10 | Money, Capital, Types of Capital, Time Value of Money, Origins of Interest, Simple Interest | CT 2 |
| Class 11 | Compound Interest, Illustration of Simple vs. Compound Interest, Concept of Equivalence, Notation and Cash-Flow Diagrams and Table | |

| | | |
|---|---|---|
| Class 12 | Mathematical Problems Related to Cash Flow Diagram. | |
| **Week 5** | **Money-Time Relationships and Equivalence (Contd.)** | |
| Class 13 | Arithmetic Calculations with Cash Flows | |
| Class 14 | Arithmetic Calculations with Cash Flows (Contd. ) | |
| Class 15 | Deferred Annuities and Mathematical Problems. | |
| **Week 6** | **Money-Time Relationships and Equivalence (Contd.)** | |
| Class 16 | Equivalence Calculations Involving Multiple Interest Formulas | |
| Class 17 | Uniform (Arithmetic) Gradient of Cash Flows | |
| Class 18 | Nominal and Effective Interest Rates and Related Mathematical Problems. | |
| **Week 7** | **Evaluating a Single Project** | CT 3 |
| Class 19 | Introduction, Determining Minimum Attractive Rate of Return (MARR) | |
| Class 20 | Present Worth Method, Assumptions of the PW Method, Bond Value | |
| Class 21 | The Capitalized-Worth Method, Future Worth Method | |
| **Week 8** | **Evaluating a Single Project (Contd.)** | |
| Class 22 | Annual Worth Method, Capital Recovery (CR) Amount | |
| Class 23 | Annual Worth Formula, Internal Rate of Return (IRR) Method. | |
| Class 24 | Installment Financing | |
| **Week 9** | **Evaluating a Single Project (Contd.)** | |
| Class 25 | Advantages and Disadvantages of IRR method. | |
| Class 26 | External Rate of Return (ERR) Method, Payback (Payout) Period Method | |
| Class 27 | Payback (Payout) Period Method (Contd.). | |
| **Week 10** | **Comparison and Selection among Alternatives** | CT 4 |
| Class 28 | Introduction, Basic Concepts for Comparing Alternatives, Investment and Cost Alternatives | |
| Class 29 | Investment and Cost Alternatives (Contd.), Ensuring a Comparable Basis, The Study (Analysis) Period | |
| Class 30 | Equivalent-Worth Methods, Rate-of-Return Methods | |
| **Week 11** | **Comparison and Selection among Alternatives (Contd.)** | |
| Class 31 | The Inconsistent Ranking Problem, The Incremental Investment Analysis Procedure | |
| Class 32 | The Incremental Investment Analysis Procedure (Contd.), | |
| Class 33 | Mathematical Problems Related to Equivalent Worth Method, Rate-of-Return Analysis | |
| **Week 12** | **Depreciation and Income Taxes** | |

| | | |
|---|---|---|
| Class 34 | Introduction, Depreciation, Concepts Related to Depreciation | |
| Class 35 | The Classical (Historical) Depreciation Methods | |
| Class 36 | Types of Taxes, Before-Tax and After-Tax MARR, Gain (Loss) on Disposal of a Depreciable Tangible Asset, After-tax Economic Analysis | |
| **Week 13** | **Evaluating Projects with the Benefit/Cost ratio method** | |
| Class 37 | Private Versus Public Projects, Benefits, Costs, And Disbenefits, Problems Associated with Multipurpose Projects | |
| Class 38 | Interest Rate Considerations, Benefit / Cost Ratio Method | |
| Class 39 | Criticisms and Shortcomings of Benefit/Cost Ratio Method. | |
| **Week 14** | **Review** | |
| Class 40 | Mathematical Problems Related to Concepts of Engineering Economics | |
| Class 41 | Mathematical Problems Related to Concepts of Engineering Economics (Contd.) | |
| Class 42 | Syllabus Review. | |

(PR – Project ; ASG – Assignment; PR – Presentation; R - Report; F – Final Exam)

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| Assessment Strategies | | | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| Components | | Grading | | |
| Continuous Assessment (40%) | Test 1-3 | 20% | CO 2 | C3 |
| | | | CO 3 | C3, C4 |
| | Attendance | 5% | | |
| | Class Participation | 5% | CO 5 | C3 |
| | Mid term | 10% | CO 1 | C2 |
| | | | CO 3 | C3, C4 |
| | | | CO 4 | C5 |
| Final Exam | | 60% | CO 2 | C3 |
| | | | CO 3 | C3,C3 |
| | | | CO 4 | C5 |
| | | | CO 5 | C3 |
| Total Marks | | 100% | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**Text and Ref Books:**

1. Engineering Economy 16th edition: William G. Sullivan, Elin M. Wicks, C. Patrick Koelling.

**Course Code:** IPE 201 **Course Name:** Manufacturing Process 1
**Credit Hour:** 3.00 **Contact Hour:** 3.00
**Level/Term:** L-2, T-1
**Curriculum Structure**: Outcome Based Education (OBE)

**Pre-requisites:** None

**Synopsis/Rationale:**

This Outcome Based Education (OBE) based course is designed to make the student conversant with various aspects of different manufacturing process such as casting and welding and enable them to analyze the interaction between manufacturing process concerns and design decisions.

**Objectives:**

1. To introduce casting processes for ferrous and non-ferrous metals and alloys.
2. To expose students to casting defects, design of molds, riser, gates, sprues and core systems.
3. To introduce different ceramic and glass product manufacturing processes.
4. To introduce different process and petameters in volved in manufacturing of powder metallurgy product.
5. To introduce different forming and shaping process used in product manufacturing process.
6. To make students familiar with different metal joining processes such as welding process, soldering, brazing and adhesive joining process.

**Course Outcomes (CO) & Generic Skills:**

Upon completion of this course, the student should be able to:

| No. | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO1 | **Explain** the different steps involved in the sand casting process and influence of the casting parameters on cast product quality | C1-C4 | 1 | | 1 | T, Mid Term Exam, F |

| | | | | | | |
|---|---|---|---|---|---|---|
| CO2 | **Explain and Compare** the different casting processes to produce a given part based on its quality and quantity. | C1-C4 | 1 | | 1 | T, F |
| CO3 | **Explain** the processes and parameters involved in abrasive machining and in making ceramic and glass products | C1-C4 | 1 | | 1 | T, F |
| CO4 | **Explain** the processes and parameters involved in manufacturing of powder metallurgy products | C1-C4 | 1 | | 1 | T, Mid Term Exam, F |
| CO5 | **Explain** different forming and shaping processes and essential parameters involved on these processes. | C1-C4 | 1 | 1 | 3, 6 | T, Mid Term Exam, F |
| CO6 | **Explain** different welding processes and the influence of different parameters involved in these processes. | C1-C4 | 1 | 1 | 3, 6 | T, F |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam) | | | | | | |

**Course Contents:**

Classification of manufacturing processes, casting processes for ferrous and non-ferrous metals, sand, die, centrifugal, slush, plaster mold, loam mold, precision investment casting etc.
Casting defects, design of molds, riser, gate sprue and core, cost analysis.

Joining methods: soldering, brazing, welding, conventional welding processes: gas, arc, TIG,
MIG, thermit, resistance, friction, electro slag etc. Special welding processes: LASER, electron beam, submerged arc etc. Precision and non-precision surface finishing operation, hot and cold extrusion, press working operations etc. Manufacturing of ceramic and glass products, powder metallurgy.

## Mapping of Course Outcomes and Program Outcomes:

| Course Learning Outcomes | | Engineering Knowledge | Problem Analysis | Design / Development of Solutions | Investigation | Modern Tool Usage | The Engineer and Society | Environment and stainability | Ethics | Communication | Individual and Team Work | Life Long Learning | Project Management and Finance |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | **Explain** the different steps involved in the sand casting process and influence of the casting parameters on cast product quality | ✓ | ✓ | | | | | | | | | | |
| **CO2** | **Explain and Compare** the different casting processes to produce a given part based on its quality and quantity | | ✓ | ✓ | | | | | | | | | |
| **CO3** | **Explain** the processes and parameters involved in abrasive machining and in making ceramic and glass products | ✓ | | ✓ | | | | | | | | | |
| **CO4** | **Explain** the processes and parameters involved in manufacturing of powder metallurgy products | ✓ | | ✓ | | | | | | | | | |
| **CO5** | **Explain** different forming and shaping processes and essential parameters involved on these processes | ✓ | | ✓ | | | | | | | | | |
| **CO6** | **Explain** different welding processes and the influence of different parameters involved in these processes | ✓ | | ✓ | | | | | | | | | |

**Teaching-learning and Assessment Strategy:**

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Face-to-Face Learning<br>Lecture<br>Practical / Tutorial / Studio<br>Student-Centred Learning | <br>42<br>10<br>- |
| Self-Directed Learning<br>Non-face-to-face learning<br>Revision<br>Assignment Preparations | <br>40<br>20<br>20 |
| Formal Assessment<br>Continuous Assessment<br>Final Examination | <br>2<br>3 |
| Total | 137 |

**Teaching Methodology:**

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method, Multi-media Presentation, Class Presentation, Assignments, Class Tests, Exams, Feedback at every step.

**Lecture Schedule:**

| Week | Lecture | Topics | ASSESSMENT |
|---|---|---|---|
| **1** | Lec 1 | Introduction, Engineering materials,<br>Manufacturing Products | **T, Mid Term, F** |
| | Lec 2 | Classification of manufacturing process, Forging of metals | |
| | Lec 3 | Fundamental of metal casting | |
| **2** | Lec 4 | Categories of casting process, Sand casting,<br>Sand casting defects | |
| | Lec 5 | Sand molding, Shell molding | |
| | Lec 6 | Investment casting, Permanent mold process | |
| **3** | Lec 7 | Hot chamber and cold chamber die casting, molds for die casting | |
| | Lec 8 | Centrifugal, Slush, Squeeze, Furnace casting | |
| | Lec 9 | Plaster mold, Loam mold casting and heat treatment | |

| | | | |
|---|---|---|---|
| **4** | Lec 10 | Molding sand and properties, Casting defects | **T, F** |
| | Lec 11 | Design for casting, Economics of casting | |
| | Lec 12 | Design of molds, riser, gate, sprue and core | |
| **5** | Lec 13 | Pattern making, Pattern material, types of pattern | |
| | Lec 14 | Pattern allowance, Fillet and core design | |
| | Lec 15 | Introduction, Classification, Types of weld and weld joints, Different welding process | |
| **6** | Lec 16 | Arc welding process, TIG, MIG | |
| | Lec 17 | Resistance spot welding, resistance seam welding | |
| | Lec 18 | Friction, Forge, Thermit, electro slag welding | |
| **7** | Lec 19 | Electron beam, Laser beam welding, Submerged arc | |
| | Lec 20 | Robotic welding, Welding defects, Welding profile | |
| | Lec 21 | Gas welding: OAW, OCW, Gas cutting | |
| **8** | Lec 22 | Precision and non-precision surface finishing operation | **T, Mid Term, F** |
| | Lec 23 | Principle operation, advantage, limitation and application of brazing | |
| | Lec 24 | Principle operation, advantage, limitation and application of soldering | |
| **9** | Lec 25 | Sheet metal forming: Cutting operations, Shearing, transfer and progressive dies | |
| | Lec 26 | Sheet metal forming: Bending, Stretch Forming, Deep Drawing | |
| | Lec 27 | Tube bending, Tube-Hydroforming, Explosive forming | |
| **10** | Lec 28 | Bulk deformation process: Hot and cold extrusion | |
| | Lec 29 | Hydrostatic extrusion, Tube drawing | |
| | Lec 30 | Design recommendations, Extrusion defects | |
| **11** | Lec 31 | Rolling of metals: Flat rolling, Defects in flat rolling | |

| | | | |
|---|---|---|---|
| | Lec 32 | Shape, Ring, Thread, Tube rolling | **T, Mid Term, F** |
| | Lec 33 | Roll configuration in rolling mills | |
| **12** | Lec 34 | Steps in Making Powder-Metallurgy Parts, Powder particles, Atomization | |
| | Lec 35 | Mechanical alloying, Bowl Geometries in Blending Metal Powders, Density Variation in Compacting Metal Powders | |
| | Lec 36 | Press for Compacting Metal Powder, Powder Rolling | |
| **13** | Lec 37 | Spray Deposition, Mechanisms for Sintering Metal Powders, Design Considerations for P/M | **T, F** |
| | Lec 38 | Characteristics of Ceramics Processing, Dry or semi-dry pressing, hydroplastic forming, Slip casting, doctor blade process | |
| | Lec 39 | Extruding and Jiggering, Float method, Glass tubing and manufacturing | |
| **14** | Lec 40 | Centrifugal casting of glass, Blowing method, Powder-In-Tube Process | |
| | Lec 41 | Glass fiber drawing method, Plate Glass Drawing Method | |
| | Lec 42 | Review | |

(PR – Project ; ASG – Assignment; PR – Presentation; R - Report; F – Final Exam)

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

<table>
<tr><th colspan="3">Assessment Strategies</th><th rowspan="2">CO</th><th rowspan="2">Bloom's Taxonomy</th></tr>
<tr><th colspan="2">Components</th><th>Grading</th></tr>
<tr><td rowspan="14">Continuous Assessment (40%)</td><td rowspan="6">Test 1-3</td><td rowspan="6">20%</td><td>CO1</td><td>C1-C4</td></tr>
<tr><td>CO2</td><td>C1-C4</td></tr>
<tr><td>CO3</td><td>C1-C4</td></tr>
<tr><td>CO4</td><td>C1-C4</td></tr>
<tr><td>CO5</td><td>C1-C4</td></tr>
<tr><td>CO6</td><td>C1-C4</td></tr>
<tr><td>Class Participation</td><td>5%</td><td>-</td><td>-</td></tr>
<tr><td>Attendance</td><td>5%</td><td>-</td><td>-</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="3">Mid term</td><td rowspan="3">10%</td><td>CO 1</td><td>C1-C4</td></tr>
<tr><td>CO 4</td><td>C1-C4</td></tr>
<tr><td>CO 5</td><td>C1-C4</td></tr>
<tr><td colspan="2" rowspan="6">Final Exam</td><td rowspan="6">60%</td><td>CO1</td><td>C1-C4</td></tr>
<tr><td>CO2</td><td>C1-C4</td></tr>
<tr><td>CO3</td><td>C1-C4</td></tr>
<tr><td>CO4</td><td>C1-C4</td></tr>
<tr><td>CO5</td><td>C1-C4</td></tr>
<tr><td>CO6</td><td>C1-C4</td></tr>
<tr><td colspan="2">Total Marks</td><td>100%</td><td colspan="2"></td></tr>
</table>

**Text and Ref Books:**

1. Manufacturing, Engineering & Technology, $5^{th}$ Edition, by Serope Kalpakjian and Steven R. Schmid
2. Fundamentals of Modern Manufacturing, $6^{th}$ Edition, by Mikell P. Groove

**Course Code:** IPE 202 Sessional

**Course Name:** Manufacturing Process-I

**Credit Hour:** 0.75

**Contact Hour:** 1.50

**Level/Term:** L-2, T-1

**Curriculum Structure**: Outcome Based Education (OBE)

**Pre-requisites:** Concurrent with IPE 201 Manufacturing Process I

**Synopsis/Rational:**
This Outcome Based Education (OBE) based course is designed to enhance ractical knowledge in the field of metal joining and casting methods.

**Objectives:**

1. To study different components and basic operation of lathe machine
2. To perform various welding operations by changing different parameters.
3. To manufacture a sheet metal job and be introduced with various cold working techniques.
4. To conduct a case study on design of a speed gearbox.
5. To review the basic principles for the design of casting patterns, feeding system and gating system
6. To study metal casting technology and mold making

**Course Outcomes (CO) & Generic Skills:**

Upon completion of this course, the student should be able to:

| No. | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO 1 | **Explain** the working principle of lathe machine | C2-C5 | 1 | 2 | 1 | T,Q,R,F |
| CO 2 | **Perform** different metal joining and casting process | C4-C6 | 2 | 2 | 1 | T,Q,R,F |
| CO 3 | **Explain** the comparison among different joining methods | C3-C5 | 1 | 1 | 2 | T,Q,R,F |
| CO 4 | **Investigate** how the accuracy of the job manufactured can be increased | C3 | 2 | 1,2 | 1 | T,Q,R,F |
| CO 5 | **Investigate** the main factors affecting the function of pattern design and casting elements | C6, A3 | 1 | 1 | | T,Q,R,F |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam) | | | | | | |

**Course Contents:**

1. Study of lathe machine and its operation.
2. Study of TIG and MIG welding operation
3. Study of design and making of pattern for casting.
4. Study of welding joints and welding positions.
5. Mold Making, Casting and Assembly of final product

**Mapping of Course Outcomes and Program Outcomes:**

| Course Learning Outcomes | | Engineering Knowledge | Problem Analysis | Design / Development of Solutions | Investigation | Modern Tool Usage | The Engineer and Society | Environment and | Ethics | Communication | Individual and Team Work | Project Management and | Life Long Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | Explain the working principle of lathe machine | ✓ | ✓ | | | | | | | | | | |
| **CO2** | Perform different metal joining and casting process | ✓ | ✓ | | | | | | | | | | |
| **CO3** | Explain the comparison among different joining methods | ✓ | ✓ | | | | | | | | | | |
| **CO4** | Investigate how the accuracy of the job manufactured can be increased | ✓ | ✓ | | ✓ | | | | | | | | |
| **CO5** | Investigate the main factors affecting the function of pattern design and casting elements | ✓ | ✓ | | ✓ | | | | | | | | |

**Teaching-learning and Assessment Strategy:**

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Face-to-Face Learning | |
| Lecture | 16 |
| Practical / Tutorial / Studio | 16 |
| Student-Centred Learning | 10 |
| Self-Directed Learning | |
| Non-face-to-face learning | 40 |
| Revision | 10 |
| Assignment Preparations | 20 |
| Formal Assessment | |
| Continuous Assessment | 5 |
| Final Examination | 1 |
| Total | 118 |

**Teaching Methodology:**

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method, Multi-media Presentation, Class Presentation, Exams, Feedback at every step.

**Lecture Schedule:**

| **Week 1** | **Introduction** |
|---|---|
| Class 1 | Introduction to manufacturing process sessional |
| **Week 2** | **Lathe Machine operations** |
| Class 2 | Study of lathe machine and its operation. |
| **Week 3** | **TIG and MIG welding operation** |
| Class 3 | Study of TIG and MIG welding operation |
| **Week 4** | **Welding Parameters** |
| Class 4 | Study of welding joints and welding positions. |
| **Week 5** | **Casting** |
| Class 5 | Study of design and making of pattern for casting. |
| **Week 6** | **Casting (contd.)** |
| Class 6 | Mold Making, Casting and Assembly of final product |
| **Week 7** | **Conclusion** |
| Class 7 | Review |

(PR – Project ; ASG – Assignment; PR – Presentation; R - Report; F – Final Exam)

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| Assessment Strategies | | | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| Components | | Grading | | |
| Continuous Assessment (70%) | Weekly Reports | 20% | CO 1 | C2-C5 |
| | | | CO 2 | C4-C6 |
| | | | CO 4 | C3 |
| | | 10% | CO 2 | C4-C6 |
| | Class Participation | | CO 3 | C3-C5 |
| | Viva | 30% | CO 1 | C2-C5 |
| | | | CO 2 | C4-C6 |
| | | | CO 5 | C6, A3 |
| Final Exam | | 40% | CO 1 | C2-C5 |
| | | | CO 2 | C4-C6 |
| | | | CO 4 | C3 |
| | | | CO 5 | C6, A3 |
| Total Marks | | 100% | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**Text and Ref Books:**

1. Manufacturing, Engineering & Technology, Fifth Edition, by Serope Kalpakjian and Steven R. Schmid

2. Fundamentals of Modern Manufacturing, Forth Edition, by Mikell P. Groover

**Reference Site:**

https://classroom.google.com/ (To be announced)

**Course Code:** IPE 203 **Course Name:** Manufacturing Process II
**Credit Hour:** 3.00 **Contact Hour:** 3.00
**Level/Term:** L-2, T-2

**Curriculum Structure**: Outcome Based Education (OBE)
**Pre-requisites:** None

**Synopsis/Rationale:**

To enable the student to select manufacturing process on the basis of product characteristics.

**Objectives:**

1. To examine the principles associated with different machining process including turning, drilling, planning, milling, grinding etc.
2. To analyze the advantages and limitations of each process and its influence on the product finishing
3. To interpret the processing sequence for any given product in terms of specification and cost
4. To study design of cutting tool and designation of cutting tool within different standards.
5. To understand the basic features and methods of plastic manufacturing.

**Course Outcomes (CO) & Generic Skills:**

Upon completion of this course, the student should be able to:

| No. | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO1 | **Explain** major aspects of conventional and non-conventional machining operations. | C1-C4 | 1 | | 1 | T, Mid Term Exam, F |
| CO2 | **Compare** which machining process is better to produce a given part. | C1-C4 | 1 | | 1 | T, Mid Term Exam, F |
| CO3 | **Select** manufacturing process on the basis of product characteristics and manufacturing economy. | C3, C4 | 2 | 1 | 2 | T, Mid Term Exam, F |
| CO4 | **Formulate** chip reduction coefficient and shear strain for various metal removing process. | C2-C4 | | | 1 | T, Mid Term Exam, F |
| CO5 | **Derive** relationship among different velocities during chip formation, proper allowance and pattern design | C2-C4 | 1 | | | T, Mid Term Exam, F |
| CO6 | **Analyze** machining economics to achieve maximum production rate. | C2-C4 | | | 1 | T, Mid Term Exam, F |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam) | | | | | | |

**Course Contents:**

Classification of manufacturing processes, casting processes for ferrous and non-ferrous metals, sand, die, centrifugal, slush, plaster mold, loam mold, precision investment casting etc.
Casting defects, design of molds, riser, gate sprue and core, cost analysis.

Joining methods: soldering, brazing, welding, conventional welding processes: gas, arc, TIG, MIG, thermit, resistance, friction, electro slag etc. Special welding processes: LASER, electron beam, submerged arc etc. Precision and non-precision surface finishing operation, hot and cold extrusion, press working operations etc. Manufacturing of ceramic and glass products, powder metallurgy.

**Mapping of Course Outcomes and Program Outcomes:**

| Course Learning Outcomes | | Engineering Knowledge | Problem Analysis | Design / Development of Solutions | Investigation | Modern Tool Usage | The Engineer and Society | Environment and Sustainability | Ethics | Communication | Individual and Team Work | Project Management and | Life Long Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | Explain major aspects of conventional and non- conventional machining operations. | √ | √ | | | | | | | | | | |
| **CO2** | Compare which machining process is better to produce a given part. | √ | √ | | | | | | | | | | |
| **CO3** | Select manufacturing process on the basis of product characteristics and manufacturing economy. | √ | √ | | √ | | | | | | | | |
| **CO4** | Formulate chip reduction coefficient and shear strain for various metal removing process. | √ | √ | | √ | | | | | | | | |
| **CO5** | Derive relationship among different velocities during chip formation, proper allowance and pattern design | √ | | √ | √ | | | | | | | | |
| **CO6** | Analyze machining economics to achieve maximum production rate. | √ | | | √ | | | | | | | | |

**Teaching-learning and Assessment Strategy:**

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Face-to-Face<br>Learning<br>Lecture<br>Practical / Tutorial /<br>Studio Student-Centred<br>Learning | <br>42<br>10<br>- |
| Self-Directed Learning<br>Non-face-to-face<br>learning Revision<br>Assignment Preparations | <br>40<br>20<br>20 |
| Formal Assessment<br>Continuous Assessment<br>Final Examination | <br>2<br>3 |
| Total | 137 |

**Teaching Methodology:**

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method, Multi-media Presentation, Class Presentation, Assignments, Class Tests, Exams, Feedback at every step.

**Lecture Schedule:**

| Week | Lecture | Topics | Assessment |
|---|---|---|---|
| **1** | Lec 1 | Introduction, Engineering materials, Fundamentals of Manufacturing, Classification of Manufacturing Processes | **ASG, Class Test 1, F** |
| | Lec 2 | Introduction to conventional machining, Generating and Forming Shape | |
| | Lec 3 | Basic Turning Operations, Types of lathe, Lathe component, Lathe terminology, CNC Lathe | |
| **2** | Lec 4 | Reaming, Boring, Broaching Cutting tools for lathe, Lathe centers, Chuck, Collets | |
| | Lec 5 | Drilling and related operations | |
| | Lec 6 | Milling and Related Operations | |
| **3** | Lec 7 | Shaping and related operations, Quick return mechanism | |

| | | | |
|---|---|---|---|
| | Lec 8 | Planning and related operations | |
| | Lec 9 | Grinding and related Operations | |
| **4** | Lec 10 | Introduction, AJM , WJM, USM | **ASG, Class Test 2, F** |
| | Lec 11 | ECM, EDM | |
| | Lec 12 | LBM, EBM | |
| **5** | Lec 13 | Methods of Machining, Cutting Tool Geometry, Tool-in-hand Nomenclature, Single Point Cutting Tool | |
| | Lec 14 | Designation of Cutting Tools, American Standard Association System (ASA), Orthogonal Rake System (ORS) | |
| | Lec 15 | Interconversion Between ASA and ORS | |
| **6** | Lec 16 | Interconversion Between ASA and ORS (contd.) | |
| | Lec 17 | Chip Formation, Types of Chips, Chip Forms and Classifications, Chip Formation in Metal Machining, Deformation of Uncut Layer | |
| | Lec 18 | Chip Reduction Coefficient, Velocity Relationships, Shear angle and shear strain | |
| **7** | Lec 19 | Mechanics of Metal Cutting, Merchant Circle Diagram, Earnest-Merchant Theory | |
| | Lec 20 | Merchant Theory, Lee and Shaffer Theory, Thermal Aspect of Chip Formation | |
| | Lec 21 | Tool Wear, Mechanism of Tool Wear, Tailor Tool Life Equation | |
| **8** | Lec 22 | Cutting Tool Materials for Machining, Cutting Fluid | **ASG, Mid Term, F** |
| | Lec 23 | Machining economics, Process parameter optimization | |
| | Lec 24 | Processing of plastics, Extrusion, Lamination, Thermoforming | |
| **9** | Lec 25 | Casting, Blow Molding | |
| | Lec 26 | Compounding, Extrusion, Compression Molding process of plastic manufacturing | |
| | Lec 27 | Vacuum forming and hand layup | |
| **10** | Lec 28 | Injection Molding, Press Parameters, Clamping Mechanism Shaping | |

| | | | |
|---|---|---|---|
| | Lec 29 | Injection Molding Defects, Common Polymers | |
| | Lec 30 | Shaping Processes for Thermoplastics and Thermosets | |
| **11** | Lec 31 | Matrix-Reinforced Plastics, Molding Reinforced Plastics | **ASG, Class Test 3, F** |
| | Lec 32 | Selection of Manufacturing Process on the basis of product characteristics | |
| | Lec 33 | Manufacturing of threads and gears | |
| **12** | Lec 34 | Slip casting, doctor blade process | |
| | Lec 35 | Extruding and Jiggering, Float method, Glass tubing and manufacturing | |
| | Lec 36 | Centrifugal casting of glass, Blowing method, Powder-In-Tube Process | |
| **13** | Lec 37 | Bulk deformation, | **ASG, F** |
| | Lec 38 | Rolling | |
| | Lec 39 | Sheet metal forging process | |
| **14** | Lec 40 | Tailor's tool life equation | |
| | Lec 41 | Influence of cutting parameters on tool life | |
| | Lec 42 | Review | |

(PR – Project ; ASG – Assignment; PR – Presentation; R - Report; F – Final Exam)

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| Assessment Strategies | | | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| Components | | Grading | | |
| Continuous Assessment (40%) | Test 1-3 | 20% | CO 1 | C1-C4 |
| | | | CO 3 | C2-C4 |
| | | | CO 4 | C2 |
| | Class Participation | 5% | CO 2 | C3, C4 |
| | | | CO 5 | A3 |
| | Mid term | 15% | CO 1 | C1-C4 |
| | | | CO 2 | C3, C4 |
| | | | CO 3 | C2-C4 |
| Final Exam | | 60% | CO 1 | C1-C4 |
| | | | CO 2 | C3, C4 |
| | | | CO 3 | C2-C4 |
| | | | CO 4 | C2 |
| Total Marks | | 100% | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**Text and Ref Books:**

1. Materials and Processes in Manufacturing- *E.P. Degarmo, J.T. Black & R.A. Kohser*
2. Fundamentals of Modern Manufacturing- *M.P. Groover*
3. Processes and Design for Manufacturing- *S.D.EI Wakil*
4. Manufacturing Processes for Engineering Materials- *S. Kalpakjian & S. R. Schmid*
5. Metal Cutting: Theory & Practice - *A. Bhattacharyya*

**Reference Site:**

https://classroom.google.com/ (To be announced)

**Course Code:** IPE 204 **Course Name:** Manufacturing Process II Sessional
**Credit Hour:** 0.75 **Contact Hour:** 1.50
**Level/Term:** L-2, T-2

**Curriculum Structure**: Outcome Based Education (OBE)

**Pre-requisites:** Concurrent with IPE 203 Manufacturing Process II

**Synopsis/Rationale:**

This Outcome Based Education (OBE) based course is designed to enhance practical knowledge in the field of conventional, non-conventional machining and metal cutting.

**Objectives:**

1. To study different types of chips
2. To study and determine tool wear
3. To operate milling machine to manufacturing a spur and helical gear
4. To conduct a study on different parts and functions of a CNC Milling Machine
5. To study the process of resistance spot welding, EDM, Soldering and Brazing

**Course Outcomes (CO) & Generic Skills:**

Upon completion of this course, the student should be able to:

| No. | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO1 | **Determine** chip reduction co-efficient and temperature (θ) at chip tool interface | C2-C5 | 1 | 2 | 1 | T,Q,R,F |
| CO2 | **Examine** causes of tool wear and flank wear with time | C4-C6 | 2 | 2 | 1 | T,Q,R,F |
| CO3 | **Develop** G- code for CNC milling operation | C3-C5 | 1 | 1 | 2 | T,Q,R,F |
| CO4 | **Investigate** the impact of different parameters on welding joint. | C3 | 2 | 1,2 | 1 | T,Q,R,F |
| CO5 | **Determine** material removal rate (MRR) and the Wear ratio | C6, A3 | 1 | 1 | | T,Q,R,F |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam) | | | | | | |

**Course Contents:**

1. Study of Chips and Cutting Zone Temperature in Turning Medium Carbon Steel by Uncoated Carbide Insert
2. Study and Determination of Tool Wear
3. Manufacturing of a Spur and Helical Gear on a Column & Knee Type Milling Machine
4. Study of CNC Milling machine.
5. Study of Spot Welding Machine.
6. Study of Electrical-Discharge Machining (EDM) Process
7. Study of Soldering, Brazing operation.

**Mapping of Course Outcomes and Program Outcomes:**

| Course Learning Outcomes | | Engineering Knowledge | Problem Analysis | Design / Development of Solutions | Investigation | Modern Tool Usage | The Engineer and Society | Environment and | Ethics | Communication | Individual and Team Work | Project Management and | Life Long Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | Determine chip reduction co-efficient and temperature (θ) at chip tool interface | ✓ | ✓ | | | | | | | | | | |
| **CO2** | Examine causes of tool wear and flank wear with time | ✓ | ✓ | | | | | | | | | | |
| **CO3** | Develop G- code for CNC milling operation | ✓ | | ✓ | | | | | | | | | |
| **CO4** | Investigate the impact of different parameters on welding joint. | ✓ | ✓ | | | | | | | | | | |
| **CO5** | Determine material removal rate (MRR) and the Wear ratio | ✓ | | | ✓ | ✓ | | | | | | | |

**Teaching-learning and Assessment Strategy:**

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Face-to-Face Learning | |
| Lecture | 16 |
| Practical / Tutorial / Studio | 16 |
| Student-Centred Learning | 10 |
| Self-Directed Learning | |
| Non-face-to-face learning | 40 |
| Revision | 10 |

| | |
|---|---|
| Assignment Preparations | 20 |
| Formal Assessment<br>Continuous<br>Assessment Final<br>Examination | <br>5<br>1 |
| Total | 118 |

**Teaching Methodology:**

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method, Multi- media Presentation, Class Presentation, Exams, Feedback at every step.

**Lecture Schedule:**

| **Week 1** | **Chip and temperature** |
|---|---|
| Class 1 | Study of Chips and Cutting Zone Temperature in Turning Medium Carbon Steel by Uncoated Carbide Insert |
| **Week 2** | **Tool wear** |
| Class 2 | Study and Determination of Tool Wear |
| **Week 3** | **Gear production in milling machine** |
| Class 3 | Manufacturing of a Spur and Helical Gear on a Column & Knee Type Milling Machine |
| **Week 4** | **CNC milling machine** |
| Class 4 | Study of CNC Milling machine. |
| **Week 5** | **Spot welding** |
| Class 5 | Study of Spot Welding Machine. |
| **Week 6** | **EDM** |
| Class 6 | Study of Electrical-Discharge Machining (EDM) Process |
| **Week 7** | **Soldering and Brazing** |
| Class 7 | Study of Soldering, Brazing operation. |

(PR – Project ; ASG – Assignment; PR – Presentation; R - Report; F – Final Exam)

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| Assessment Strategies | | | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| Components | | Grading | | |
| Continuous Assessment (70%) | Weekly Reports | 20% | CO 1 | C2-C5 |
| | | | CO 2 | C4-C6 |
| | | | CO 4 | C3 |
| | | 10% | CO 2 | C4-C6 |
| | Class Participation | | CO 3 | C3-C5 |
| | Viva | 30% | CO 1 | C2-C5 |
| | | | CO 2 | C4-C6 |
| | | | CO 5 | C6, A3 |
| Final Exam | | 40% | CO 1 | C2-C5 |
| | | | CO 2 | C4-C6 |
| | | | CO 4 | C3 |
| | | | CO 5 | C6, A3 |
| Total Marks | | 100% | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**Text and Ref Books:**

1. Manufacturing, Engineering & Technology, Fifth Edition, by Serope Kalpakjian and Steven R. Schmid

2. Fundamentals of Modern Manufacturing, Forth Edition, by Mikell P. Groover

**Reference Site:**

https://classroom.google.com/ (To be announced)

**Course Code:** IPE 205 **Course Name:** Probability and Statistics
**Credit Hour:** 3.00 **Contact Hour:** 3.00
**Level/Term:** Level 2/Term II

**Curriculum Structure:** Outcome Based Education (OBE)

**Pre-requisite:** None

**Rationale:**
With probability and statistics, Industrial & Production Engineers make intelligent decisions to

develop and manage their processes and businesses by finding optimal solution of real-world problems. In this course, students will learn powerful modeling and data analysis techniques for decision-making problems that are used by many successful companies.

**Objectives:**

1. To share basic probability and statistics concepts
2. To help students perform basic statistical analysis to explore, visualize and predict situations using data
3. To guide students to the applications and analysis of probability distributions
4. To make students adept in developing mathematical and computational models of real decision-making problems

**Course Outcomes (CO) & Generic Skills:**

Upon completion of this course, the student should be able to:

| | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO1 | **Explain** basic probability and statistics concepts | C1, C2 | | | 2 | F |
| CO2 | **Perform** basic statistical analysis to explore, visualize and predict situations using data | C3-C5 | 1 | | 2,4 | T, MT |
| CO3 | **Apply** probability distributions and **analyze** data for further analysis | C3, C4 | 1 | | 2,4 | T, MT, F |
| CO4 | **Develop** mathematical and computational modeling of real decision-making problems | C5 | 1, 2 | | 2,4 ,5 | T, F, ASG |
| (CP – Complex Problems, CA – Complex Activities, KP – Knowledge Profile, T –Test; MT – Mid Term; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam) | | | | | | |

**Course Contents:**

**a. Main Contents:**

Introduction to probability, discrete probability distributions, continuous probability distribution, describing data, sampling, hypothesis testing, analysis of variance, regression analysis, design of experiments, non-parametric methods.

**b. Detailed Contents:**

**Introduction to probability:** probability, Bayes' rule, random variables, mathematical expectation, variance and covariance of random variables; **Discrete probability distributions:** binomial distribution, multinomial distribution, negative binomial distribution, hypergeometric distribution, Poisson distribution; **Continuous probability distribution:** normal distribution, applications of normal distribution, normal approximation to binomial, gamma and exponential distribution, chi-squared distribution; **Describing data:** graphical presentation, numerical measures, displaying and exploring of data; **Sampling:** sampling methods, sampling errors, sampling distributions, estimates and confidence interval, t-distribution; **Hypothesis testing:** procedures for hypothesis testing, one-sample test of hypothesis, two-sample test of hypothesis; **Analysis of variance:** F-distribution, ANOVA assumptions, ANOVA test, one-way ANOVA, two-way ANOVA; **Regression analysis:** least square principle, simple liner regression, coefficient of correlation and determination, multiple linear regression; **Design of experiments:** experimental designs, randomized block design, factorial design; **Non-parametric methods:** Chi-square distribution; goodness-of-fit test, equal expected frequencies, unequal expected frequency.

**Mapping of Course Outcomes (CO) and Program Outcomes (PO):**

| Course Learning Outcomes | | Engineering Knowledge | Problem Analysis | Design / Development of Solutions | Investigation | Modern Tool Usage | The Engineer and Society | Environment and Sustainability | Ethics | Communication | Individual and Team Work | Project Management and Finance | Life Long Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | **Explain** basic probability and statistics concepts | √ | | | | | | | | | | | |
| **CO2** | **Perform** basic statistical analysis to explore, visualize and predict situations using data | √ | √ | | | | | | | | | | |
| **CO3** | **Apply** probability distributions and **analyze** data for further analysis | √ | √ | | | | | | | | | | |
| **CO4** | **Develop** mathematical and computational modeling of real decision-making problems | √ | √ | √ | | | | | | | | | |

**Teaching-learning and Assessment Strategy:**

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Face-to-Face Learning | |
| Lecture | 42 |

| | |
|---|---|
| Practical / Tutorial / Studio | - |
| Student-Centred Learning | - |
| Self-Directed Learning | |
| Non-face-to-face learning | 40 |
| Revision | 20 |
| Assignment Preparations | 20 |
| Formal Assessment | |
| Continuous Assessment | 2 |
| Final Examination | 3 |
| Total | 127 |

**Teaching Methodology:**

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method, Multi-media Presentation, Class Presentation, Assignments, Class Tests, Exams, Feedback at every step.

**Lecture Schedule:**

| Week | Lecture | Topics | TEST |
|---|---|---|---|
| **1** | Lec 1 | Probability | **Class Test 1, F** |
| | Lec 2 | Bayes' rule | |
| | Lec 3 | Random variables | |
| | Lec 4 | Mathematical expectation | |
| **2** | Lec 5 | Variance and covariance of random variables | |
| | Lec 6 | Binomial distribution | |
| | Lec 7 | | |
| | Lec 8 | | |
| **3** | Lec 9 | Multinomial distribution | |
| | Lec 10 | Negative binomial distribution | |
| | Lec 11 | Poisson distribution | |
| | Lec 12 | | |
| **4** | Lec 13 | Hypergeometric distribution | **Class Test 2, F** |
| | Lec 14 | Normal distribution | |
| | Lec 15 | | |
| | Lec 16 | Normal approximation to binomial | |
| **5** | Lec 17 | Applications of normal distribution | |
| | Lec 18 | | |
| | Lec 19 | Gamma and exponential distribution | |
| | Lec 20 | | |
| **6** | Lec 21 | Chi-squared distribution | |
| | Lec 22 | | |
| | Lec 23 | Graphical presentation | |
| | Lec 24 | | |

| | | | |
|---|---|---|---|
| **7** | Lec 25 | Numerical measures | |
| | Lec 26 | Displaying and exploring of data | |
| | Lec 27 | | |
| | Lec 28 | Sampling methods, Sampling errors | |
| **8** | Lec 29 | Sampling distributions | **Mid Term, F** |
| | Lec 30 | | |
| | Lec 31 | | |
| | Lec 32 | Estimates and confidence interval | |
| **9** | Lec 33 | t-distribution | |
| | Lec 34 | Procedures for hypothesis testing | |
| | Lec 35 | One-sample test of hypothesis | |
| | Lec 36 | | |
| **10** | Lec 37 | Two-sample test of hypothesis | **Class Test 3, F** |
| | Lec 38 | | |
| | Lec 39 | F-distribution | |
| | Lec 40 | ANOVA assumptions, ANOVA test | |
| **11** | Lec 41 | One-way ANOVA | |
| | Lec 42 | | |
| | Lec 43 | Two-way ANOVA | |
| | Lec 44 | | |
| **12** | Lec 45 | Least square principle, simple liner regression | |
| | Lec 46 | | |
| | Lec 47 | | |
| | Lec 48 | Coefficient of correlation and determination | |
| **13** | Lec 49 | Multiple linear regression | **Class Test 4, F** |
| | Lec 50 | Experimental designs, randomized block design | |
| | Lec 51 | Factorial design | |
| | Lec 52 | | |
| **14** | Lec 53 | Chi-square distribution, | |
| | Lec 54 | Goodness-of-fit test | |
| | Lec 55 | Equal expected frequencies | |
| | Lec 56 | Unequal expected frequency | |

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| Assessment Strategies | | | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| Components | | Grading | | |
| Continuous Assessment (40%) | Test 1-3 | 20% | CO 2 | C3-C5 |
| | | | CO 3 | C3, C4 |
| | | | CO 4 | C5 |
| | Class Participation | 5% | CO 1 | C1, C2 |
| | | | CO 3 | C3, C4 |

| | | | | |
|---|---|---|---|---|
| | Attendance | 5% | - | - |
| | | | | |
| | Mid term | 10% | CO 2 | C3-C5 |
| | | | CO 3 | C3, C4 |
| Final Exam | | 60% | CO 1 | C1, C2 |
| | | | CO 3 | C3, C4 |
| | | | CO 4 | C5 |
| Total Marks | | 100% | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**Reference Books:**

1. Probability and Statistics for Engineers & Scientists – Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, and Keying Ye
2. Statistical Techniques in Business & Economics – Douglas A. Lind, William G. Marchal, and Samuel A. Wathen

**Reference Site:**

https://classroom.google.com/ (To be announced)

**Course Code:** IPE 206
**Course Name:** Probability and Statistics Sessional
**Credit Hour:** 0.75
**Contact Hour:** 1.50
**Level/Term:** L-2, T-II

**Curriculum Structure:** Outcome Based Education (OBE)

**Pre-requisites:** Concurrent with IPE 205: Probability and Statistics

**Synopsis/Rationale:**

This sessional course, concurrent with IPE 205: Probability and Statistics, follows the Outcome Based Education (OBE) guidelines. The course is designed to teach the students about the fundamentals of quantitative research, and accustom to strategies for data analysis, hypothesis testing, and statistical inference.

**Objectives:**

1. To perform exploratory data analysis using IBM SPSS Statistics software
2. To develop and evaluate predictive data analysis models
3. To gain insights of the applied aspects of hypothesis testing
4. To apply knowledge of probability to solve engineering problem

**Course Outcomes (CO) & Generic Skills:**

| | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO1 | **Visualize** and **interpret** data to make proper engineering decisions | C4-C5 | | 2 | 1 | Pr, R |
| CO2 | **Analyze** data to predict their future patterns with significant level of confidence | C3-C6 | 2 | 2 | 1 | ASG, R |
| CO3 | **Implement** the data analysis tools and techniques to test statistical hypothesis | C2-C3 | 1 | 1 | 2 | ASG |
| CO4 | **Apply** the knowledge of both discrete and continuous probability distribution to improve reliability of engineering decision | C3 | 2 | 1,2 | 1 | ASG |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam) | | | | | | |

**Course Contents:**

Name of the experiments:

1. Introduction to IBM SPSS Statistics software
2. Data visualization using SPSS
3. Study of simple linear regression, multiple linear regression, and time series analysis.
4. Study of bivariate statistics- ANOVA, t-test, non-parametric and test.
5. Study of one-sample and two-sample test of hypothesis
6. Study of normal probability distribution

**Mapping of Course Outcomes and Program Outcomes:**

| **No.** | **Course Outcomes (CO) of the Course** | **Program Outcome** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| CO1 | **Visualize** and **interpret** data to make proper engineering decisions **(PO: 1, 2, 4, 5)** | ✓ | ✓ | | ✓ | ✓ | | | | | | | |
| CO2 | **Analyze** data to predict their future patterns with significant level of confidence **(PO: 1, 2, 5)** | ✓ | ✓ | | | ✓ | | | | | | | |
| CO3 | **Implement** the data analysis tools and techniques to test statistical hypothesis **(PO: 3, 5)** | | | ✓ | | ✓ | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO4 | **Apply** the knowledge of both discrete and continuous probability distribution to improve reliability of engineering decision **(PO: 1, 4, 5)** | ✓ | | | ✓ | ✓ | | | | | | | |

**Teaching-learning and Assessment Strategy:**

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Face-to-Face Learning | |
| Lecture | - |
| Practical / Tutorial / Studio | 21 |
| Student-Centred Learning | - |
| Self-Directed Learning | |
| Non-face-to-face learning | 14 |
| Revision | 14 |
| Assignment/Report Preparations | 14 |
| Formal Assessment | |
| Continuous Assessment | 3 |
| Final Examination | - |
| Total | 68 |

**Teaching Methodology:**

Lectures, class work, weekly reports, Software based, Problem Based Method, Assignments

**Lecture Schedule:**

| | |
|---|---|
| **Week 1** | Introduction to IBM SPSS Statistics software |
| **Week 3** | Data visualization using SPSS |
| **Week 5** | Study of simple linear regression, multiple linear regression, and time series analysis. |
| **Week 7** | Study of bivariate statistics- ANOVA, t-test, non-parametric and test. |
| **Week 9** | Study of one-sample and two-sample test of hypothesis |
| **Week 11** | Study of normal probability distribution |
| **Week 13** | Final Quiz |

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| Assessment Strategies | | | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| Components | | Grading | | |
| Continuous Assessment (40%) | Assignment | 20% | CO 1 | C2-C5 |
| | | | CO 2 | C4-C6 |
| | | | CO 3 | C3 |
| | Class Participation | 5% | CO 2 | C4-C6 |
| | Mid-term Quiz | 15% | CO 1 | C2-C5 |
| | | | CO 2 | C4-C6 |
| Final Quiz | | 60% | CO 1 | C2-C5 |
| | | | CO 2 | C4-C6 |
| | | | CO 3 | C3 |
| | | | CO 4 | C6, A3 |
| Total Marks | | 100% | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**Text and Ref Books:**

1. Probability and Statistics for Engineers & Scientists – Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, and Keying Ye
2. Statistical Techniques in Business & Economics – Douglas A. Lind, William G. Marchal, and Samuel A. Wathen

**Reference Site:**

https://classroom.google.com/ (To be announced)

**Course Code:** IPE 243 **Course Name: Mechanics of Solids**
**Credit Hour:** 3.00 **Contact Hour:** 3.00
**Level/Term:** L-2, T-1

**Curriculum Structure**: Outcome Based Education (OBE)

**Pre-requisites:** None
**Rationale:**
This course will familiarize students with different kinds of loads and the internal reactions in materials (ductile, brittle,

composite) due to the loads, the concept of stress as a tensor quantity is introduced along with the relevant materials properties which relate it to strain. In addition, various loading conditions.

**Objectives:**

1. Introduction to the calculations concerned with the mechanical properties of materials.
2. To characterize and calculate the magnitude of combined stresses in individual members and complete structures.
3. To analyze various situations involving structural members subjected to combined stresses by application of Mohr's circle of stress.
4. To calculate and analyze the deflection at any point on a beam subjected to a combination of loads

**Course Outcomes (CO) & Generic Skills:**

Upon completion of this course, the student should be able to:

| No. | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO1 | **Explain** the types of loads and stress in different loaded members and development of skills to determine them. | C1-C2 | | | 1 | T, Mid Term, Final |
| CO2 | **Define** the characteristics and calculate the magnitude of minimum safe load and stresses to operate individual members and structures without failure. | C1-C3 | 1 | | 1, 4 | Mid Term, F |
| CO3 | **Calculate** the deflection at any point on a beam subjected to a combination of loads and clear understanding of shear force and bending moment diagram | C3-C4 | 1 | | 1, 4 | T, Mid Term, F |
| CO4 | **Analyze** various situations involving structural members subjected to combined stresses by application of Mohr's circle of stress. | C4-C5 | 1,2 | | 1, 4 | T, F |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam) | | | | | | |

**Course Content:**

**a. Main Contents:**

Stress and strain introduction; Stress analysis; Modulus of elasticity and rigidity; Pressure vessels; Beams; Deflections of beams; Torsion formula and review of torque; Combined stresses and strains; Columns; Introduction to experimental stress analysis and failure; Problem-based applications.

**b. Detailed Contents:**

**1. Stress and Strain introduction**: concept of types of loads and internal reaction forces in resisting materials; tensile, compressive and shear stress; axial stress in composites; concept of strain and deformation; stress-strain concept and their inter-relationship for linearly elastic and isotropic materials, stress-strain diagrams for ductile and brittle

materials, elasticity and elastic limits, Young's modulus, material properties from tensile test; introduction to theories of yield;
**2. Stress analysis**: axially loaded members, statically indeterminate axially loaded members, maximum normal stresses at a cross-section; thermal and centrifugal stresses; concept of stress as tensor quantity, generalized Hooke's Law for 2-D and 3-D stress states and failure under these conditions, graphical representations using stress elements; analysis of elastic behavior of materials under multi-axial loading;
**3. Modulus of Elasticity and Rigidity:** Definition of important mechanical properties of materials, Poisson's ratio, volumetric strain and bulk modulus; relation between modulus of elasticity and bulk modulus;
**4. Pressure Vessels:** biaxial stress states due to pressure difference, analysis of bi-axial stresses occurring in thin-walled pressure vessels; stresses in thick walled cylinders and spheres, graphical representation of the distributions of these stresses across vessel's skin thickness; initial yield and plastic collapse in pressure vessels;
**5. Beams:** types of beam supports (simply supported, cantilevered, fixed ends); pure bending and normal stress, transverse loading and shear stress; mixed loading conditions, shear force and bending moment diagrams; various types of stresses in beams: i.e. bending, torsion, shear etc.; Flexure formula, stress variation in a rectangular cross-section for positive and negative bending moments; curved beams and hooks, concept of the Neutral Axis.
**6. Deflection of beams:** integration and area moment methods; shearing stress and deflection in continuous and composite beams, introduction to reinforced concrete beams and slabs;
**7. Torsion formula and review of torque:** torsional stress, angle of twist of solid and hollow shafts; torsional stiffness and equivalent shaft, modulus of rupture; helical springs;
**8. Combined stresses and strains:** concept of combined loading, principal stress and principal planes, combined axial and bending stresses, stress at a point, stress on inclined cutting planes, analytical method for the determination of stresses on oblique section; Mohr's Circle and its application in combined loading problems; transformation of strain components, strain rosette;
**9. Columns:** concept of axial and eccentric loading of columns, introduction to elastic stability, Euler's formula, slenderness ratio and classification of columns, intermediate column formulas, the Secant formula; concept of buckling and bracing; critical load for columns with different end conditions, total maximum stress for a column with initial curvature;
**10. Introduction to experimental stress analysis and failure:** introduction to techniques; strain energy; stress concentration due to geometric features, brittle fracture, crack growth under repeated or cyclic loading, fatigue, failure theories; 11. Problem-based applications: using basic Finite Element Analysis (FEA) principles of computation for simple FEA model development in aerospace, mechanical, naval and biomedical engineering; results interpretation and validation

**Mapping of Course Outcomes (CO) and Program Outcomes:**

| Course Learning Outcomes | Engineering Knowledge | Problem Analysis | Design / Development of Solutions | Investigation | Modern Tool Usage | The Engineer and Society | Environment and Sustainability | Ethics | Communication | Individual and Team Work | Project Management and Finance | Life Long Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

| | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **Explain** the types of loads and stress in different loaded members and development of skills to determine them. | ✓ | ✓ | | | | | | | | | | |
| **CO2** | **Define** the characteristics and calculate the magnitude of minimum safe load and stresses to operate individual members and structures without failure. | ✓ | ✓ | | | | | | | | | | |
| **CO3** | **Calculate** the deflection at any point on a beam subjected to a combination of loads and clear understanding of shear force and bending moment diagram | ✓ | ✓ | | | | | | | | | | |
| **CO4** | **Analyze** various situations involving structural members subjected to combined stresses by application of Mohr's circle of stress. | ✓ | ✓ | | | | | | | | | | |

**Teaching-learning and Assessment Strategy:**

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Face-to-Face Learning | |
| Lecture | 42 |
| Practical / Tutorial / Studio | - |
| Student-Centred Learning | - |
| Self-Directed Learning | |
| Non-face-to-face learning | 40 |
| Revision | 20 |
| Assignment Preparations | 20 |
| Formal Assessment | |
| Continuous Assessment | 2 |
| Final Examination | 3 |
| Total | 127 |

**Teaching Methodology:**

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method, Multi-media Presentation, Class Presentation, Assignments, Class Tests, Exams, Feedback at every step.

**Lecture schedule:**

| Week | Lecture | Topics | Remarks |
|---|---|---|---|
| Week 1 | 1 | Stress analysis: statically indeterminate axially loaded member | CT 1 |
| | 2 | Stress analysis: statically indeterminate axially loaded member | |
| Week 2 | 3 | Axially loaded member | |
| | 4 | Axially loaded member | |
| Week 3 | 5 | Thermal and centrifugal stresses | |
| | 6 | Thermal and centrifugal stresses | |
| Week 4 | 7 | Stresses in thin and thick walled cylinders and spheres | CT 2 |
| | 8 | Stresses in thin and thick walled cylinders and spheres | |
| Week 5 | 9 | Beams: Shear force and bending moment diagrams; various types of stresses in beams | |
| | 10 | Beams: Shear force and bending moment diagrams; various types of stresses in beams | |
| Week 6 | 11 | Beams: Shear force and bending moment diagrams; various types of stresses in beams | |
| | 12 | Beams: Shear force and bending moment diagrams; various types of stresses in beams | |
| Week 7 | 13 | Flexural formula; Deflection of beams: integration and area moment methods | |
| | 14 | Flexural formula; Deflection of beams: integration and area moment methods | |
| Week 8 | 15 | Introduction to reinforced concrete beams and slabs | Midterm |
| | 16 | Introduction to reinforced concrete beams and slabs | |
| Week 9 | 17 | Torsion formula; Angle of twist; Modulus of rupture | CT 3 |
| | 18 | Torsion formula; Angle of twist; Modulus of rupture | |
| Week 10 | 19 | Helical springs | |
| | 20 | Helical springs | |
| Week 11 | 21 | Combined stresses: principal stress, Mohr's Circle | |
| | 22 | Combined stresses: principal stress, Mohr's Circle | |
| Week 12 | 23 | Columns: Euler's formula, intermediate column formulas, the Secant formula | CT 4 |
| | 24 | Columns: Euler's formula, intermediate column formulas, the Secant formula | |
| Week 13 | 25 | Flexure formula of curved beams. Introduction to experimental stress analysis techniques | |

| | | | |
|---|---|---|---|
| | 26 | Flexure formula of curved beams. Introduction to experimental stress analysis techniques | |
| | 27 | Strain energy; Failure theories | |

**Week 14**

**COURSE INFORMATION**

| | | | |
|---|---|---|---|
| | 28 | Strain energy; Failure theories | |
| **Reference Books** | | **Text Book:**<br>1. A Textbook of Strength of Materials – R K Bansal<br>2. Mechanics of material with solved problems A C Mandal & M. Quamrul Islam, published by IUT, OIC, 2011<br>3. Strength of Materials (4th edition) – Andrew Pytel, Ferdinand L. Singer.<br>4. Strength of Materials – Beer and Johnston.<br>5. Mechanics of Materials (10th edition) - R. C. Hibbeler<br>6. A Textbook of Strength of Materials - R.S. Khurmi | |

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| Assessment Strategies | | | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| Components | | Grading | | |
| Continuous Assessment (40%) | Test 1-3 | 20% | CO1 | C1-C2 |
| | | | | |
| | | | CO3 | C3, C4 |
| | | | CO4 | C4-C5 |
| | Attendance | 5% | | |
| | Class Participation | 5% | | |
| | Mid term | 10% | CO1 | C1-C2 |
| | | | CO2 | C1-C3 |
| | | | CO3 | C3, C4 |
| Final Exam | | 60% | CO1 | C1-C2 |
| | | | CO2 | C1-C3 |
| | | | CO3 | C3, C4 |
| | | | CO4 | C4-C5 |
| Total Marks | | 100% | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

| | | | |
|---|---|---|---|
| Course Code<br>Course Title | : IPE 244<br>: Mechanics of Solids Sessional | Lecture Contact Hours<br>Credit Hours | : 1.50<br>: 0.75 |

**PRE-REQUISITE**

IPE 243

**CURRICULUM STRUCTURE**

Outcome Based Education (OBE)

**SYNOPSIS/RATIONALE**

his is the foundation unit in the study of structures. By applying the knowledge gained in Statics and combining it with the concepts gained in Materials Technology the students are introduced to fundamental theories and techniques required to analyze the state of stress and strain in structural members subjected to external loads. This knowledge will allow students to perform the engineering calculations required to ensure that a structural member meets strength, stiffness and stability requirements.

**OBJECTIVE**

1. Students will be able to instill a basic knowledge of the statistical aspects of mechanics of materials.

2. Develop the formal theory of solid mechanics: the equilibrium, kinematic, and constitutive equations.

3. Introduce the atomistic mechanisms underlying the mechanical behavior of materials.

4. Establish process - structure - property - performance relationships in materials engineering.

**LEARNING OUTCOMES & GENERIC SKILLS**

| No. | Course Outcome | Corresponding PO | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|---|
| CO1 | **Apply** the fundamentals of Solid Mechanics. | 1 | C3 | | | 1 | R, Q, LT |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CO2 | **Analyze** the fundamentals of stresses and strains. | 1 | C4 | | | 1 | R, Q, LT |
| CO3 | **Identify** and express the principles of Solid Mechanics in obtaining the solutions for applications in real life engineering problems. | 2 | C3 | | | 5 | R, Q, LT |
| CO4 | **Identify** and express the principles of Solid Mechanics in design problems. | 4 | C3 | | | 3 | R, Q, LT |

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, LT – Lab Test, PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

**COURSE CONTENT**

**Experiments:**

1) **a. Study and calibration of Universal Testing Machine (UTM)**

   **b. Tensile Test of mild steel specimens.**
2) **Hardness test of metal specimen.**
3) **Impact test of metal specimen.**
4) **Support reaction of a point loaded for a simple supported beam.**
5) **Column test of a mild steel specimen.**

**CO-PO MAPPING**

| No. | Course Learning Outcome | PROGRAM OUTCOMES (PO) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | **Apply** the fundamentals of Solid Mechanics | ✓ | | | | | | | | | | | |
| CO2 | **Analyze** the fundamentals of stresses and strains. | ✓ | | | | | | | | | | | |
| CO3 | **Identify** and express the principles of Solid Mechanics in obtaining the solutions for applications in real life engineering problems. | | ✓ | | | | | | | | | | |
| CO4 | **Identify** and express the principles of Solid Mechanics in design problems. | | | | ✓ | | | | | | | | |

**Justification for CO-PO mapping:**

| Mapping | Corresponding Level of matching | Justifications |
|---|---|---|
| CO1-PO1 | **3** | In order to identify the basics of solid mechanics, the knowledge of engineering fundamental would be required. |
| CO2-PO1 | **3** | In order to perform the experiments, the fundamental knowledge of stress strain would be required |
| CO3-PO2 | **2** | In order to solve the solid mechanics problems, the knowledge of engineering fundamentals is also required. |
| CO4-PO4 | **3** | For performing the experiments, design problems are needed in this laboratory. |

**TEACHING LEARNING STRATEGY**

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Face-to-Face Learning | |
| Lecture | 14 |
| Practical | 28 |
| | tal 42 |
| Self-Directed Learning | |
| Preparation of Lab Reports | 10 |
| Preparation of Lab Test | 10 |
| Preparation of presentation | 5 |
| Preparation of Quiz | 10 |
| Engagement in Group Projects | 20 |
| Formal Assessment | |
| Continuous Assessment | 14 |
| Final Quiz | 1 |
| Total | 112 |

| **TEACHING METHODOLOGY** |
|---|
| Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method |

| **COURSE SCHEDULE** | |
|---|---|
| Week-1 | Introduction class |
| Week-3 | Exp 1: a. Study and calibration of Universal Testing Machine (UTM)<br>b. Tensile Test of mild steel specimens. |

| | |
|---|---|
| Week-5 | Exp 2: Hardness test of metal specimen. |
| Week-7 | Exp 3: Impact test of metal specimen. |
| Week-9 | Exp 4: Support reaction of a point loaded for a simple supported beam. |
| Week-11 | Exp 5: Column test of a mild steel specimen. |
| Week-13 | Quiz/Test, Viva |

| **Components** | | **Grading** |
|---|---|---|
| Continuous Assessment (60%) | Lab participation and Report | 30% |
| | Labtest-1, Labtest-2 | 30% |
| Lab Quiz | | 40% |
| Total Marks | | 100% |

**REFERENCE BOOKS**


1. Strength of materials (4th edition) William Nash, Publisher Mcgraw-hill International Editions, Schaum's Outline Series.

2. Mechanics of material with solved problems A C Mandal & M. Quamrul Islam 2011.

3. Strength of Materials (4th edition) – Andrew Pytel, Ferdinand L. Singer.

4. Strength of Materials – Beer and Johnston.

5. Strength of Materials – E. P. Popov.

6. Mechanics of Solids Laboratory Practice- A.C. Mandal & M.Q. Islam

**Course Code:** IPE 251 **Course Name:** Thermodynamics and Heat Transfer
**Credit Hour:** 3.00 **Contact Hour:** 3.00
**Level/Term:** L-2, T-2

**Curriculum Structure**: Outcome Based Education (OBE)

**Pre-requisites:** None

**Rationale:**
This course explores all fundamental laws of Thermodynamics and use them to evaluate the effectiveness of different air standard and steam cycles. It also delves into the principles of heat and its conversion into power, providing comprehensive coverage of energy and its transfer. It encompasses various topics such as power generation, refrigeration, and the relationship between properties of substances.

**Objective:**
1. To introduce students in analyzing air standard cycles, such as reciprocating piston engines and gas turbine engines, and vapor power cycles, such as those used in power plants and refrigeration units.
2. To provide students with a comprehensive understanding of various thermodynamic properties, the laws governing thermodynamics, and the limitations associated with them.
3. To develop understanding of the concepts of enthalpy, entropy, availability and irreversibility etc.
4. To make students familiar with fundamental heat transfer concepts: conservation of energy, mechanisms of energy conversion, and mechanisms of heat transfer (conduction, convection, and radiation)
5. To familiarize students with thermal circuit analysis for engineering systems and calculations for conduction, convection, and radiation thermal resistances.

**Course Outcomes (CO):**

| No. | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|

| | | | | | | |
|---|---|---|---|---|---|---|
| CO1 | **Explain** the Zeroth, First, Second and Third Laws of thermodynamics, and use the laws of thermodynamics to solve a variety of problems, such as the expansion of gases and the efficiency of heat engines. | C1-C3 | 1 | | 1,3 | T, Mid Term Exam |
| CO2 | **Analyze** efficiency and properties of thermodynamic cycles for heat engines, refrigerators and heat pumps and other important mechanical devices. | C4, C5 | 1,2 | | 1,3 | F, Mid Term Exam |
| CO3 | **Apply** the first and second laws to examine the behaviour of internal combustion engines (air–standard cycles), Carnot cycle, Brayton cycle, Ericsson cycle, Rankine power cycles (basic, regeneration, reheat), combined powerplant cycles and Vapor pressure refrigeration cycles. | C3, C5 | 1,2 | | 1,3 | T, F |
| CO4 | **Apply** the 1D and 3D heat transfer equations involving conduction, convection, and radiation, and solve for the heat transfer and thermal resistance rate. | C3, C5 | 1,3 | 3 | 1,3 | T, Mid Term Exam, F |
| CO5 | **Identify, formulate, and solve** engineering problems involving forced convection heat transfer, and natural convection heat transfer. | C2, C3, C6 | 1,3 | 3 | 1,3 | F |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam) | | | | | | |

**Course Contents:**

**a. Main Contents:** Introduction to Thermodynamics; First law of thermodynamics; Pure substances; Second law of thermodynamics; Perfect gases; Thermodynamics relations and cycles; Vapor power cycles; Refrigeration cycle; Conductive heat transfer; Convective heat transfer; Radiation heat transfer; Heat exchangers.

**b. Detailed Contents:**

**1. Introduction to Thermodynamics:** Definition and the calculus of thermodynamics; Fundamental concepts: thermodynamic system and control volume, classes of systems, thermodynamic properties, flow and non-flow processes, reversible and irreversible processes, constant volume, constant pressure, isothermal, adiabatic, polytrophic and isentropic processes, thermodynamic equilibrium; Zeroth law of thermodynamics;

**2. First Law of Thermodynamics:** Energy and energy transfer, total energy of a system, concept of temperature and heat, thermodynamic temperature scale; heat and work, modes of work; concept of continuum, macroscopic approach; property, state, path and process; determination of the state of a system from given properties; non-flow energy equation; internal energy, specific heat capacities, relation between specific heats; enthalpy: concept of ideal and real gases; law of conservation of energy; corollaries of first law; application in thermodynamic systems: closed, open and isolated; steady flow energy equation and its applications;

**3. Pure Substances:** Definition and properties of pure substances; phase changes; single component phase equilibrium (vaporization, melting, sublimation); p-T, p-v, T-s and h-s diagrams; triple point and critical point; tables of thermodynamic properties of steam; Mollier diagram;

**4. Second Law of Thermodynamics:** Limitation of the first law of thermodynamics; concept of entropy and exergy analysis; Kelvin, Planck and Clausius statements of second law; heat engines and heat pumps; Corollaries of the 2nd law; efficiencies of reversible engines; temperature-entropy diagrams for gases and vapors, entropy changes for a perfect gas for reversible processes; energy analysis: control mass and control volume systems;

**5. Perfect Gases:** Ideal and real gases, equation of the state of a perfect gas; internal energy, enthalpy and specific heat capacities of a perfect gas; coefficient of volume expansion and isothermal compressibility for a perfect gas; reversible processes of perfect gas; perfect gas mixtures; Gibbs-Dalton law; relations involving pressure, volume and composition; internal energy, enthalpy and specific heats of gaseous and gas-vapour mixtures;

**6. Thermodynamics Relations and Cycles:** Carnot cycle; gas power cycles; ideal cycles; Otto cycles, Diesel cycle, Brayton cycle; p-v and T-s diagrams of cycles;

**7. Vapor Power Cycles:** Rankine cycle; Reheat cycle; calculations of cycle efficiency;

**8. Refrigeration Cycle:** Simple vapor compression refrigeration cycle; p-h and T-s diagrams; Actual cycle and its analysis; study of compressor, condenser, expansion device and evaporator in refrigeration systems; efficiency and COP; Psychrometrics;

**9. Conductive heat transfer:** General conduction equation; steady-state conduction, unsteady-state conduction, conduction-convection systems, convection boundary conditions; straight fins of rectangular and triangular profiles;

**10. Convective heat transfer:** Natural convection heat transfer; Heat and momentum transfer associated with laminar and turbulent flows of fluids in forced convection; dimensional analysis of forced and natural convections; Velocity and thermal boundary layer developments over flat plate and through tubes (ducts), Thermal Boundary Layer, Relation Between Fluid Friction and Heat Transfer, Turbulent-Boundary-Layer; General methods for estimation of convective heat transfer coefficient; Reynolds and Nusselt Numbers for heat transfer rate;

**11. Radiation heat transfer:** Laws of radiation heat transfer; blackbody and gray body emissions; radiactive properties of surfaces; radiation shape factor; radiation interchange between two surfaces;

**12. Heat exchangers:** Basic types, Log Mean Temperature Difference (LMTD) of concentric tube heat exchangers, temperature profiles for different configurations and operating parameters of concentric tube heat exchangers; exchanger effectiveness-NTU relations; techniques of heat transfer augmentation; heat exchanger devices;

**Teaching-learning and Assessment Strategy:**

Lectures, class performances, class tests, midterm and final exam.

**Linkage of CO with Assessment Methods& their Weights:**

| Assessment Strategies | | | CO | Bloom’s Taxonomy |
|---|---|---|---|---|
| Components | | Grading | | |
| Continuous Assessment (40%) | Test 1-3 | 20% | CO1 | C1-C3 |
| | | | CO3 | C3, C5 |
| | | | CO4 | C3, C5 |

| | | | | |
|---|---|---|---|---|
| | Class Participation | 5% | - | - |
| | Attendance | 5% | - | - |
| | | | | |
| | Mid term | 10% | CO1 | C1-C3 |
| | | | CO2 | C3, C4 |
| | | | CO4 | C4, C5 |
| Final Exam | | 60% | CO2 | C3, C4 |
| | | | CO3 | C3, C5 |
| | | | CO4 | C3, C5 |
| | | | CO5 | C2, C3, C6 |
| Total Marks | | 100% | | |

**Mapping of Course Outcomes (CO) and Program Outcomes:**

| Course Learning Outcomes | | Engineering Knowledge | Problem Analysis | Design / Development of Solutions | Investigation | Modern Tool Usage | The Engineer and Society | Environment and Sustainability | Ethics | Communication | Individual and Team Work | Project Management and Finance | Life Long Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | **Explain** the Zeroth, First, Second and Third Laws of thermodynamics, and use the laws of thermodynamics to solve a variety of problems, such as the expansion of gases and the efficiency of heat engines. | √ | √ | | | | | | | | | | |
| **CO2** | **Analyze** efficiency and properties of thermodynamic cycles for heat engines, refrigerators and heat pumps and other important mechanical devices. | √ | | | | | | | | | | | |
| **CO3** | **Apply** the first and second laws to examine the behaviour of internal combustion engines (air–standard cycles), Carnot cycle, Brayton cycle, Ericsson cycle, Rankine power cycles (basic, regeneration, reheat), combined powerplant | √ | √ | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | cycles and Vapor pressure refrigeration cycles. | | | | | | | | | | | | |
| **CO4** | **Apply** the 1D and 3D heat transfer equations involving conduction, convection, and radiation and solve for the heat transfer and thermal resistance rates. | √ | √ | | | | | | | | | | |
| **CO5** | **Identify, formulate, and solve** engineering problems involving forced convection heat transfer and natural convection heat transfer. | √ | √ | | | | | | | | | | |

**Lectures schedule:**

| Week | Lecture | Topics | Remarks |
|---|---|---|---|
| **Week 1** | 1 | Definition and the calculus of thermodynamics; Fundamental concepts: thermodynamic system and control volume. | **CT 1** |
| | 2 | Thermodynamic properties, flow, and non-flow processes; reversible and irreversible processes, constant volume, constant pressure, isothermal, adiabatic, polytropic, and isentropic processes; thermodynamic equilibrium; Zeroth law of thermodynamics | |
| **Week 2** | 3 | Energy and energy transfer, total energy of a system, concept of temperature and heat, thermodynamic temperature scale; heat and work, modes of work. | |
| | 4 | Macroscopic approach; property, state, path and process; determination of the state of a system from given properties; non-flow energy equation; internal energy, specific heat capacities, relation between specific heats. | |
| **Week 3** | 5 | Enthalpy: concept of ideal and real gases; law of conservation of energy; corollaries of first law; | |
| | 6 | Application in thermodynamic systems: closed, open and isolated; steady flow energy equation and its applications. | |
| **Week 4** | 7 | Definition and properties of pure substances; phase changes; single component phase equilibrium (vaporization, melting, sublimation). | **CT 2** |
| | 8 | p-T, p-v, T-s and h-s diagrams; triple point and critical point; tables of thermodynamic properties of steam; Mollier diagram. | |
| **Week 5** | 9 | Limitation of the first law of thermodynamics; concept of entropy and exergy analysis; | |
| | 10 | Kelvin, Planck and Clausius statements of second law; heat engines and heat pumps | |
| **Week 6** | 11 | Corollaries of the 2nd law; efficiencies of reversible engines; temperature-entropy diagrams for gases and vapors. | |

| | | | |
|---|---|---|---|
| | 12 | Entropy changes for a perfect gas for reversible processes; energy analysis: control mass and control volume systems. | |
| **Week 7** | 13 | Ideal and real gases, equation of the state of a perfect gas; internal energy, enthalpy and specific heat capacities of a perfect gas; coefficient of volume expansion and isothermal compressibility for a perfect gas; reversible processes of perfect gas; perfect gas mixtures. | |
| | 14 | Gibbs-Dalton law; relations involving pressure, volume and composition; internal energy, enthalpy and specific heats of gaseous and gas-vapour mixtures. | |
| **Week 8** | 15 | Carnot cycle; gas power cycles; ideal cycles; Otto cycles, Diesel cycle. | **Midterm** |
| | 16 | Brayton cycle; p-v and T-s diagrams of cycles. | |
| **Week 9** | 17 | Rankine cycle; Reheat cycle. | **CT 3** |
| | 18 | Calculations of cycle efficiency. | |
| **Week 10** | 19 | Simple vapor compression refrigeration cycle; p-h and T-s diagrams; Actual cycle and its analysis; study of compressor, condenser. | |
| | 20 | Expansion device and evaporator in refrigeration systems; efficiency and COP; Psychrometrics. | |
| **Week 11** | 21 | General conduction equation; steady-state conduction, unsteady-state conduction, conduction-convection systems. | |
| | 22 | Convection boundary conditions; straight fins of rectangular and triangular profiles. | |
| **Week 12** | 23 | Natural convection heat transfer; Heat and momentum transfer associated with laminar and turbulent flows of fluids in forced convection; dimensional analysis of forced and natural convections. | **CT 4** |
| | 24 | Velocity and thermal boundary layer developments over flat plate and through tubes (ducts), Thermal Boundary Layer, Relation Between Fluid Friction and Heat Transfer, Turbulent-Boundary-Layer; General methods for estimation of convective heat. | |
| **Week 13** | 25 | Laws of radiation heat transfer; blackbody and gray body emissions; radiactive properties of surfaces. | |
| | 26 | Radiation shape factor; radiation interchange between two surfaces. | |
| **Week 14** | 27 | Basic types, Log Mean Temperature Difference (LMTD) of concentric tube heat exchangers, temperature profiles for different configurations and operating parameters of concentric tube heat exchangers. | |
| | 28 | Exchanger effectiveness-NTU relations; techniques of heat transfer augmentation; heat exchanger devices. | |

| | | | |
|---|---|---|---|
| **Reference Books** | | **Text Book:**<br>1. Thermodynamics: An Engineering Approach - Yunus A. Cengel, Michael A. Boles<br>2. Heat and Mass Transfer, Fundamentals & Applications – Yunus A. Cengel, Afshin J. Ghajar.<br>3. Heat and Mass Transfer - R.K. Rajput<br>**Reference Books:**<br>1. Fundamentals of Engineering Thermodynamics- Michael J. Moran & Howard N. Shapiro<br>2. Thermal Engineering-Mahesh M. Rathore<br>3. Fundamental of Heat & Mass Transfer – Frank P. Incropera.<br>4. Heat Transfer – J. P. Holman | |

**COURSE INFORMATION**

Course Code : IPE 252
Course Title : Thermodynamics & Heat Transfer Sessional
Lecture Contact Hours : 1.50
Credit Hours : 0.75

**PRE-REQUISITE**

None

**CURRICULUM STRUCTURE**

Outcome Based Education (OBE)

**SYNOPSIS/RATIONALE**

Thermodynamics sessional deals with the relations between heat and other forms of energy such as mechanical, electrical, or chemical energy. In this course, students will learn and apply a range of thermodynamic laws and principles so that they can analyze a given thermodynamic problem (such as the combustion of fuels to release heat and energy, and the translation of this release of energy into movement) and discuss operational features of various thermodynamic systems and components.

This course enables students to apply the understanding of heat transfer mechanisms such as conduction, convection and radiation for understanding the performance of various heat transfer equipment such as heat exchangers, condensers, boilers, evaporators etc. used in almost all industries.

**OBJECTIVE**

1. Students will be able to apply thermodynamic laws and principles to the analysis of processes, cycles and thermodynamic hardware
2. They will explain and investigate the laws and principles of thermodynamics and use to solve problems

3. They can solve thermodynamics problems by appraising given information, determining which concepts apply, and then provide and verify an appropriate solution
4. They will learn to use basic tools to design process operations involving heat transfer.

**LEARNING OUTCOMES & GENERIC SKILLS**

| No. | Course Outcome | Corresponding PO | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|---|
| CO 1 | **Apply** thermodynamic laws and principles to the analysis of processes, cycles and thermodynamic hardware | 1 | C3 | | | 1 | R, Q, LT |
| CO 2 | **Analyze** and investigate the laws and principles of thermodynamics and use to solve problems | 1 | C4 | | | 1 | R, Q, LT |
| CO 3 | **Solve** thermodynamics problems by appraising given information, determining which concepts apply, and then provide and verify an appropriate solution | 2 | C3 | | | 5 | R, Q, LT |
| CO 4 | **Analyze** heat transfer by conduction, convection and radiation. | 1 | C4 | | | 4 | R, Q, LT |
| CO 5 | **Analyze** and calculate heat and mass transfer in complex systems involving several heat transfer mechanisms | 2,3 | C4 | | | 5 | R, Q, LT |

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, LT – Lab Test, PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

**COURSE CONTENT**

**Experiments:**

1) **(a) Determination of flash point of liquid gel**

   **(b) Study of sling psychrometer**

2) **Viscosity test of liquid substance**
3) **Study and calibration of pressure gauge by dead weight tester**
4) **(a)Concept of pressure and pressure sensor behavior**

   **(b) Study of different Speed Measuring devices**

5) **Determination of thermal conductivity of a metal by steady state method**
6) **Study of heat transfer by radiation and convection**
7) **Study of heat exchanger**

**CO-PO MAPPING**

| No. | Course Learning Outcome | PROGRAM OUTCOMES (PO) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| CO1 | **Apply** thermodynamic laws and principles to the analysis of processes, cycles and thermodynamic hardware | ✓ | | | | | | | | | | | |
| CO2 | **Analyze** and investigate the laws and principles of thermodynamics and use to solve problems | ✓ | | | | | | | | | | | |
| CO3 | **Solve** thermodynamics problems by appraising given information, determining which concepts apply, and then provide and verify an appropriate solution | | ✓ | | | | | | | | | | |
| CO4 | **Analyze** heat transfer by conduction, convection and radiation. | | ✓ | | | | | | | | | | |
| CO5 | **Analyze** and calculate heat and mass transfer in complex systems involving several heat transfer mechanisms | | | ✓ | | | | | | | | | |

**Justification for CO-PO mapping:**

| **Mapping** | **Corresponding Level of matching** | **Justifications** |
|---|---|---|
| CO1-PO1 | **3** | In order to identify the basics of thermodynamic tools and equipment, the knowledge of engineering fundamental would be required. |
| CO2-PO1 | **3** | In order to perform the experiments, the law of thermodynamics knowledge would be required |

| | | |
|---|---|---|
| CO3-PO2 | **2** | In order to solve the thermodynamics problems, the knowledge of engineering fundamentals is also required. |
| CO4-PO2 | **3** | In order to analyze heat and mass transfer in complex systems problem analysis skills are required. |
| CO5-PO3 | **2** | To analyze and calculate heat transfer in complex syst ems involving several heat transfer mec nisms design and development of solutions is required. |

| **TEACHING LEARNING STRATEGY** | |
|---|---|
| Teaching and Learning Activities | Engagement (hours) |
| Face-to-Face Learning | |
| Lecture | 14 |
| Practical | 28 |
| | Total 42 |
| Self-Directed Learning | |
| Preparation of Lab Reports | 10 |
| Preparation of Lab Test | 10 |
| Preparation of presentation | 5 |
| Preparation of Quiz | 10 |
| Engagement in Group Projects | 20 |
| Formal Assessment | |
| Continuous Assessment | 14 |
| Final Quiz | 1 |
| Total | 112 |

| **TEACHING METHODOLOGY** |
|---|
| Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method |

| **COURSE SCHEDULE** | |
|---|---|
| Week-1 | Expt-01: (a) Determination of flash point of liquid gel<br>(b) Study of sling psychrometer |
| Week-3 | Expt-02: Viscosity test of liquid substance |
| Week-5 | Expt-03: Study and calibration of pressure gauge by dead weight tester |
| Week-7 | Expt-04: (a)Concept of pressure and pressure sensor behavior<br>(b) Study of different Speed Measuring devices |
| Week-9 | Expt-05: Determination of thermal conductivity of a metal by steady state method |
| Week-11 | Expt-06: Study of heat transfer by radiation and convection |
| Week-13 | Expt-07: Study of heat exchanger |
| Week-14 | Quiz Test |

| **Components** | **Grading** |
|---|---|

| | | |
|---|---|---|
| Continuous Assessment (60%) | Lab participation and Report | 30% |
| | Labtest-1, Labtest-2 | 30% |
| Lab Quiz | | 40% |
| Total Marks | | 100% |

**REFERENCE BOOKS**

1. Thermodynamics: An Engineering Approach - Yunus A. Cengel, Michael A. Boles
2. Fundamentals of Engineering Thermodynamics- Michael J. Moran &Howard N. Shapiro.
3. Fundamentals of Thermodynamics – R E Sonntag, C. Borgnakke, G J. Van Wylen.
4. Heat and Mass Transfer, Fundamentals & Applications –Yunus A. Cengel, Afshin J. Ghajar.
5. Heat Transfer Laboratory Practice-A.C. Mandal & M.Q. Islam

**Course Code:** IPE 271**Course Name:** Engineering Mechanics & Mechanics of Machinery
**Credit Hour:** 3.00 **Contact Hour:** 3.00
**Level/Term:** L-2, T-2
**Curriculum Structure**: Outcome Based Education (OBE)
**Pre-requisites:** None
**Rationale:**
To familiarize students with the principles of static equilibrium by applying Newton's laws of motion to solve engineering problems. Topics incorporate an introduction to forces, 2D equilibrium of particles and rigid bodies, the center of gravity and centroids, friction, analysis of truss structures, and moments of inertia.
**Objective:**
1. To familiarize students with the "Free Body Diagrams" of real-world problems and apply Newton's Laws of motion and vector operations to assess the equilibrium of particles and bodies.
2. To apply the principles of equilibrium of particles and bodies to analyze the forces in planar truss members and structures.
3. To expose students to the concepts of center of gravity, centroids and moment of inertia and apply the concepts to compute their location for bodies of arbitrary shape
4. To familiarize students with the basic kinematics concepts – displacement, velocity and acceleration (and their angular counterparts)
5. To familiarize students with the application of other basic dynamics concepts - the Work-Energy principle, Impulse-Momentum principle and the coefficient of restitution

**Course Outcomes (CO):**

| No. | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO1 | **Explain** the force systems of planar truss members, structures | C1-C2 | 1 | | 1, 3 | F |
| CO2 | **Determine** location of center of gravity, centroids and moment of inertia of bodies of arbitrary shape. | C3, C5 | 1 | | 1, 3 | T, F |
| CO3 | **Apply** fundamental concepts of kinematics and kinetics of particles and rigid bodies to the analysis of simple, practical problems. | C2, C3 | 1 | 3 | 1, 3 | T, Mid Term Exam, F |
| CO4 | **Develop** the capacity to predict the effects of force and motion while carrying out the creative design functions of engineering. | C2, C3, C6 | 1 | | 1, 3, 5 | Mid Term Exam |
| CO5 | **Explain** gears and gear trains and solve different problems of gear trains, cams, and dynamometer. | C2, C3, C5 | 1,3 | | 1, 3, 5 | T, Mid Term Exam, F |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam) | | | | | | |

**Course Contents:**

**a. Main Contents:** Basic concepts of mechanics; Properties of forces; Analysis of structures; Equilibrium of rigid bodies; Statical determinacy; Power transmission; Moments of inertia; Kinematics; Mechanisms; Cams and cam followers.

**b. Detailed Contents:**

**1. Basic concepts of mechanics:** Free body diagrams; statics of particles and rigid bodies; centroids of lines, areas (planar areas, composite areas) and volumes;

**2. Properties of forces:** Concurrent / coplanar / non-coplanar force systems, resultant of forces, resolution of forces, rectangular and polar components of forces in plane and 3-D space;

**3. Analysis of structures:** Forces in trusses, frames and machines, zero force members; forces in cables; friction;

**4. Equilibrium of rigid bodies:** Conditions for maintaining equilibrium in 2 and 3-D;

**5. Statical determinacy:** Identification of known forces and solution of unknown reactions for a structure, combined loads, application of equilibrium equations for statical determinacy

**6. Power transmission:** By belts and ropes, analysis of slippage (dry friction)

**7. Moments of inertia:** Of areas and masses; moments of force in vector notation; equivalent force system; parallel-axis theorem for determination of rotational inertia about a different axis; polar moments of inertia; couples and resultant of force-couple systems; principal axes and principal moments of inertia;
**8. Kinematics:** Kinematics of particles; Kinetics of particles: Newton’s second law; energy and momentum method; System of particles; Kinematics of rigid bodies; Plane motion of rigid bodies: forces and acceleration; Energy and momentum methods; Velocity and acceleration in mechanism.
**9. Mechanisms:** Turning moment: inertia and kinetic energy of reciprocating and rotating parts; Static and dynamic balancing: reciprocating and rotating parts, multi-cylinder in-line and V-engines, radial engines, and opposed-piston engines; Balancing machines.
**10. Study of cams and cam followers;** Clutches and brakes; Dynamometers; Study of gears and gear trains; Gyroscope; Principles and applications.
**Teaching-learning and Assessment Strategy:**
Lectures, class performances, class tests, midterm and final exam.
**Linkage of CO with Assessment Methods& their Weights:**

| Assessment Strategies | | | CO | Bloom’s Taxonomy |
|---|---|---|---|---|
| Components | | Grading | | |
| Continuous Assessment (40%) | Test 1-3 | 20% | CO2 | C3, C5 |
| | | | CO3 | C2-C3 |
| | | | CO5 | C2, C3, C5 |
| | Class Participation | 5% | - | - |
| | Attendance | 5% | - | - |
| | | | | |
| | Mid term | 10% | CO3 | C2-C3 |
| | | | CO4 | C2, C3, C6 |
| | | | CO5 | C2, C3, C5 |
| Final Exam | | 60% | CO1 | C1-C2 |
| | | | CO2 | C3, C5 |
| | | | CO3 | C2-C3 |
| | | | CO5 | C2, C3, C5 |
| Total Marks | | 100% | | |

**Mapping of Course Outcomes (CO) and Program Outcomes:**

| Course Learning Outcomes | | Engineering Knowledge | Problem Analysis | Design / Development of Solutions | Investigation | Modern Tool Usage | The Engineer and Society | Environment and Sustainability | Ethics | Communication | Individual and Team Work | Project Management and | Life Long Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | **Explain** the force systems of planar truss members, structures | √ | √ | | | | | | | | | | |
| **CO2** | **Determine** location of center of gravity, centroids and moment of inertia of bodies of arbitrary shape. | √ | | | | | | | | | | | |
| **CO3** | **Apply** fundamental concepts of kinematics and kinetics of particles and rigid bodies to the analysis of simple, practical problems. | √ | √ | | | | | | | | | | |
| **CO4** | **Develop** the capacity to predict the effects of force and motion while carrying out the creative design functions of engineering | √ | √ | | | | | | | | | | |
| **CO5** | **Explain** gears and gear trains and solve different problems of gear trains, cams, and dynamometer. | √ | √ | | | | | | | | | | |

**Teaching-learning and Assessment Strategy:**

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Face-to-Face Learning | |
| Lecture | 42 |
| Practical / Tutorial / Studio | 10 |
| Student-Centred Learning | - |
| Self-Directed Learning | |
| Non-face-to-face learning | 40 |
| Revision | 20 |
| Assignment Preparations | 20 |
| Formal Assessment | |
| Continuous Assessment | 2 |
| Final Examination | 3 |
| Total | 137 |

**Lectures schedule:**

| Week | Lecture | Topics | Remarks |
|---|---|---|---|
| **Week 1** | 1 | Free body diagrams; statics of particles and rigid bodies | **CT 1** |
| | 2 | Free body diagrams; statics of particles and rigid bodies | |
| **Week 2** | 3 | Centroids of lines, areas (planar areas, composite areas) and volumes; | |
| | 4 | Centroids of lines, areas (planar areas, composite areas) and volumes; | |
| **Week 3** | 5 | Concurrent / coplanar / non-coplanar force systems, resultant of forces, resolution of forces, rectangular and polar components of forces in plane and3- D space; | |
| | 6 | Concurrent / coplanar / non-coplanar force systems, resultant of forces, resolution of forces, rectangular and polar components of forces in plane and3- D space; | |
| **Week 4** | 7 | Forces in trusses, frames and machines, zero force members; forces in cables; friction; | **CT 2** |
| | 8 | Forces in trusses, frames and machines, zero force members; forces in cables; friction; | |
| **Week 5** | 9 | Conditions for maintaining equilibrium in 2 and 3-D | |
| | 10 | Conditions for maintaining equilibrium in 2 and 3-D | |
| **Week 6** | 11 | Identification of known forces and solution of unknown reactions for a structure, combined loads, application of equilibrium equations for statical determinacy | |
| | 12 | Identification of known forces and solution of unknown reactions for a structure, combined loads, application of equilibrium equations for statical determinacy | |
| **Week 7** | 13 | Power transmission by belts and ropes, analysis of slippage (dry friction) | |
| | 14 | Power transmission by belts and ropes, analysis of slippage (dry friction) | |
| **Week 8** | 15 | Moments of inertia of areas and masses; moments of force in vector notation; equivalent force system; parallel-axis theorem for determination of rotational inertia about a different axis; | **Midterm** |
| | 16 | Moments of inertia of areas and masses; moments of force in vector notation; equivalent force system; parallel-axis theorem for determination of rotational inertia about a different axis; | |
| **Week 9** | 17 | Polar moments of inertia; couples and resultant of force-couple systems; principal axes and principal moments of inertia; | **CT 3** |
| | 18 | Polar moments of inertia; couples and resultant of force-couple systems; principal axes and principal moments of | |

| | | | |
|---|---|---|---|
| | | inertia; | |
| **Week 10** | 19 | Kinematics of particles; Kinetics of particles: Newton's second law; energy and momentum method; System of particles; Kinematics of rigid bodies; | |
| | 20 | Kinematics of particles; Kinetics of particles: Newton's second law; energy and momentum method; System of particles; Kinematics of rigid bodies; | |
| **Week 11** | 21 | Plane motion of rigid bodies: forces and acceleration; Energy and momentum methods; Velocity and acceleration in mechanism. | |
| | 22 | Plane motion of rigid bodies: forces and acceleration; Energy and momentum methods; Velocity and acceleration in mechanism. | |
| **Week 12** | 23 | Turning moment: inertia and kinetic energy of reciprocating and rotating parts; Static and dynamic balancing: reciprocating and rotating parts, multi-cylinder in-line and V-engines, radial engines, and opposed-piston engines; Balancing machines | **CT 4** |
| | 24 | Turning moment: inertia and kinetic energy of reciprocating and rotating parts; Static and dynamic balancing: reciprocating and rotating parts, multi-cylinder in-line and V-engines, radial engines, and opposed-piston engines; Balancing machines | |
| **Week 13** | 25 | Study of cams and cam followers; Clutches and brakes; Dynamometers; | |
| | 26 | Study of cams and cam followers; Clutches and brakes; Dynamometers; | |
| **Week 14** | 27 | Study of gears and gear trains; Gyroscope; Principles and applications | |
| | 28 | Study of gears and gear trains; Gyroscope; Principles and applications | |
| **Reference Books** | | **Text Book:**<br>4. Engineering Mechanics Statics (10th Edition)– R.C. Hibbeler<br>5. Engineering Mechanics Dynamics (10th Edition)– R.C. Hibbeler.<br>6. Theory of Machines (S. I. Units) – R. S. Khurmi, J. K. Gupta, Publisher – Eurasia Publishing house (Pvt) Ltd.<br>**Reference Books:**<br>5. Vector Mechanics for Engineers: Statics– Ferdinand P. Beer, E Russell Johnston, Jr; Publisher – McGraw-Hill Companies, 5th edition 1988. | |

| | | | |
|---|---|---|---|
| | | 6. Vector Mechanics for Engineers: Dynamics – Ferdinand P. Beer, E Russell Jr. Johnston Engineering Mechanics, Statics and Dynamics – Joseph F Shelley<br>7. Mechanics of Machines (Advanced theory and examples) 2nd edition (SI units) – John Hannah and R. C. Stephens. | |

**Course Code:** IPE 301 **Course Name:** Measurements, Instrumentation and Control
**Credit Hour:** 3.00 **Contact Hour:** 3.00
**Level/Term:** L-3, T-1
**Curriculum Structure**: Outcome Based Education (OBE)
**Pre-requisites:** None

**Rationale:**

To Develop understanding to collaborate the mechanical instrumentation & control system knowledge with electrical measurement concepts.

**Objective:**

1. To familiarize students with the basic system models, control, and measurement system models.
2. To educate students on the techniques of conducting a case study that focuses on developing an accurate model utilizing the model-reference system.
3. To expose students to the methods of calculation and measurement of efficiency level of control system elements.
4. To familiarize students with the logic and programming language utilized in control system.

**Course Outcomes (CO):**

Upon completion of the course, the students will be able to:

| No. | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO1 | **Explain** the principles, techniques and instruments used in engineering measurement. | C1-C3 | 1 | | 1, 2, 3 | T, Mid Term Exam, F |
| CO2 | **Perform** calibration of measuring instruments to reduce error in engineering measurement. | C1-C4 | 1, 2 | | 3, 6 | T, F |
| CO3 | **Apply** the working principle of different types of mechanical and electrical controllers in resolving real-life issues regarding industrial control and automation systems. | C1- C4 | 1, 2 | | 3, 4 | T, Mid Term Exam, F |

| | | | | | | |
|---|---|---|---|---|---|---|
| CO4 | **Analyze** the logic and programming language utilized in control and automation process. | C1-C4 | 1 | | 3, 4 | T, F |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam) | | | | | | |

**Course Content:**

Introduction to fundamentals of engineering measurements, study and use of instrumentation, and control systems. Linear measuring system, instruments limits, fits and gauges: ISO system of limits and fits.

Instrument Types and Performance Characteristics. Measurement Uncertainty, Sensor and Transducer Technologies. Calibration of Measuring Sensors and Instruments. Sensors for measuring stress, strain, pressure, temperature, position, velocity etc. Generalized measurement systems, Temperature, Humidity, Pressure, Flow, Stress-Strain, Vibration, Translational and Rotational Motion.

Precision dimensional measurement of length and angles, roundness profiles and flatness, surface roughness and texture, wear Taylor's principles on limit gauges, Abbey's principle, measuring threads, gears, measurement, ultrasonic measurement, measurement by light-wave interference, electrical and electronic measurement, digital recording by LASER beam dimension measuring system, opto-electronic, dimensional gauging, non-destructive testing methods (NDT methods), inspection and kinds of inspection, dynamic measurement.

The characteristics and use of analogue and digital instrumentation applicable to industrial engineering problems, statistical methods for developing system specifications, basic concepts of modern instrumentation.

Different types of Actuators. hydraulic, pneumatic, electrical etc;

Control Action and Industrial Automatic Controls; Classification of control systems: Concepts and importance of control system, control system description, state variable and transfer function representation, sensitivity, concepts of the feedback control system, electromechanical controls, digital computer control.

Proportional (P), Proportional Derivative (PD), Proportional Integral (PI) and Proportional Integral Derivative (PID) Controllers:. Data Acquisition and Signal Processing and Signal Transmission. Operational amplifiers, digital-to-analog converter, analog-to-digital converter etc.; Signal conditioning techniques using Wheatstone bridge;
Programmable Logic Controller–components, inputs, outputs and programming with Ladder Diagram; Hydraulic, Pneumatic, electrical and electronics Control systems

**Mapping of Course Outcomes (CO) and Program Outcomes:**

| Course Learning Outcomes | | Engineering Knowledge | Problem Analysis | Design / Development of Solutions | Investigation | Modern Tool Usage | The Engineer and Society | Environment and Sustainability | Ethics | Communication | Individual and Team Work | Life Long Learning | Project Management and Finance |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | **Explain** the principles, techniques and instruments used in engineering measurement. | √ | √ | | | √ | | | | | | | |
| **CO2** | **Perform** calibration of measuring instruments to reduce error in engineering measurement. | √ | | | | √ | | | | | | | |
| **CO3** | **Apply** the working principle of different types of mechanical and electrical controllers in resolving real-life issues regarding industrial control and automation systems. | √ | | | | √ | | | | | | | |
| **CO4** | **Analyze** the logic and programming language utilized in control and automation process. | √ | | | | | | | | | | | |

(H – High, M- Medium, L-low)

**Teaching-learning and Assessment Strategy:**

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Face-to-Face Learning | |
| Lecture | 42 |
| Practical / Tutorial / Studio | 10 |
| Student-Centred Learning | - |
| Self-Directed Learning | |
| Non-face-to-face learning | 40 |
| Revision | 20 |
| Assignment Preparations | 20 |

| | |
|---|---|
| Formal Assessment<br>Continuous Assessment<br>Final Examination | <br>2<br>3 |
| Total | 137 |

**Teaching Methodology:**

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method, Multi-media Presentation, Class Presentation, Assignments, Class Tests, Exams, Feedback at every step.

**Lecture schedule:**

| **Week 1** | **Introduction** | **ASSESSMENT** | |
|---|---|---|---|
| Class 1 | Introduction to fundamentals of engineering measurements | **ASG, Class Test 1, F** | CT 1 |
| Class 2 | Basic concept of instrumentation | | |
| Class 3 | Basic concept of instrumentation | | |
| **Week 2** | | | |
| Class 4 | Types of instruments | | |
| Class 5 | Performance Characteristics of instruments | | |
| Class 6 | Performance Characteristics of instruments | | |
| **Week 3** | | | |
| Class 7 | Basic Structures of Sensors and transducers. | | |
| Class 8 | Working principles of different types of sensors | **ASG, Class Test 2, F** | |
| Class 9 | Working principles of different types of transducers | | |
| **Week 4** | | | CT 2 |
| Class 10 | Measurement error | | |
| Class 11 | Calibration of instruments | | |
| Class 12 | Reduction of systematic errors | | |
| **Week 5** | | | |
| Class 13 | Reduction of systematic errors | | |

| | | | |
|---|---|---|---|
| Class 14 | Different measurement systems | | |
| Class 15 | Pressure measurement systems | | |
| **Week 6** | **System models** | | |
| Class 16 | Pressure measurement systems | | |
| Class 17 | Temperature measurement systems | **ASG, Mid Term, F** | |
| Class 18 | Temperature measurement systems | | |
| **Week 7** | | | CT 3 |
| Class 19 | Flow measurement systems | | |
| Class 20 | Flow measurement systems | | |
| Class 21 | Humidity measurement systems | | |
| **Week 8** | | **ASG, Class Test 3, F** | |
| Class 22 | Stress-Strain measurement systems | | |
| Class 23 | Translational and rotational measurement systems | | |
| Class 24 | Translational and rotational measurement systems | | |
| **Week 9** | | | |
| Class 25 | Temperature and process controller | | |
| Class 26 | Proportional (P), Proportional Derivative (PD), Proportional Integral (PI), PID controller | | |
| Class 27 | Proportional (P), Proportional Derivative (PD), Proportional Integral (PI), PID controller | | |
| **Week 10** | | | CT 4 |
| Class 28 | Feedback control system | **ASG, F** | |
| Class 29 | Electromechanical controls | | |
| Class 30 | Digital computer control | | |
| **Week 11** | | | |
| Class 31 | Data Acquisition and Signal Processing and Signal Transmission. | | |
| Class 32 | Operational amplifiers, digital-to-analog converter, analog-to-digital | | |

| | | | |
|---|---|---|---|
| | converter etc.; | | |
| Class 33 | Signal conditioning techniques using Wheatstone bridge; | | |
| **Week 12** | | | |
| Class 34 | Basic Pricipal and application of PLC | | |
| Class 35 | Basic Stucture of PLC | | |
| Class 36 | Basic Stucture of PLC | | |
| **Week 13** | | | |
| Class 37 | Programming of PLC | | |
| Class 38 | Programming of PLC | | |
| Class 39 | Programming of PLC | | |
| **Week 14** | | | |
| Class 40 | Hydraulic Control systems | | |
| Class 41 | Pneumatic Control systems | | |
| Class 42 | Electrical and electronics Control systems | | |

(PR – Project ; ASG – Assignment; PR – Presentation; R - Report; F – Final Exam)

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| Assessment Strategies | | | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| Components | | Grading | | |
| Continuous Assessment (40%) | Test 1-3 | 20% | CO 1 | C1-C4 |
| | | | CO 3 | C2-C4 |
| | | | CO 2 | C2 |
| | Class Participa tion | 5% | CO 2 | C3, C4 |
| | | | CO 3 | A3 |
| | Mid term | 15% | CO 1 | C1-C4 |
| | | | CO 2 | C3, C4 |
| | | | CO 3 | C2-C4 |
| Final Exam | | 60% | CO 1 | C1-C4 |
| | | | CO 2 | C3, C4 |
| | | | CO 3 | C2-C4 |
| | | | CO 2 | C2 |
| Total Marks | | 100% | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**Text and Reference Books:**


1. W.Bolton, *Industrial control and instruentation,* Longman Scientific &Technical.
2. J. P. Holman, Publisher, *Experimental Methods for Engineers (6th edition),* Mc Graw – Hill Inc.
3. ThomasG.Beckwith, RoyD. Marangoni, John H. Lientar, *Mechanical Measurements (5th edition).*


**Course Code:** IPE 302 **Course Name:** Measurements and Instrumentation Sessional

**Credit Hour:** 0.75 **Contact Hour:** 1.50

**Level/Term:** L-3, T-1

**Curriculum Structure**: Outcome Based Education (OBE)

**Pre-requisites:** Concurrent with IPE 301 Measurements and Instrumentation

**Rationale:**

To create the opportunity to have the full knowledge of electrical control system and mechanical engineering.

**Objective:**

1. To expose students to different mechanical and electrical instrumentation system along with their applicability.
2. To conduct detailed study on the applicability of computer based digital control technique, through electronic and electric interfaces, to mechanical engineering problems.
3. To introduce the various tools used in electrical and mechanical machines and their performance.

**Course Outcomes (CO) & Generic Skills:**

Upon completion of this course, the student should be able to:

| No. | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO 1 | **Differentiate** mechanical and electrical system along with their applicably | C2-C5 | 1 | 2 | 1 | T,Q,R,F |
| CO 2 | **Derive** expressions for computer based digital control technique through electronic and electric interfaces, to mechanical engineering problems.. | C4-C6 | 2 | 2 | 1 | T,Q,R,F |
| CO 3 | **Explain** with reference to tools used in electrical and mechanical machines and their performance. | C3-C5 | 1 | 1 | 2 | T,Q,R,F |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam) | | | | | | |

**Course Content:**

Sessional work based on course IPE 301.

**Mapping of Course Outcomes (CO) and Program Outcomes:**

| Course Learning Outcomes | | Engineering Knowledge | Problem Analysis | Design / Development of Solutions | Investigation | Modern Tool Usage | The Engineer and Society | Environment and Sustainability | Ethics | Communication | Individual and Team Work | Life Long Learning | Project Management and |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | Differentiate mechanical and electrical system along with their applicably | ✓ | | ✓ | | | | ✓ | | | | | |
| **CO2** | Derive expressions for computer based digital control technique through electronic and electric interfaces, to mechanical engineering problems.. | | ✓ | | | ✓ | | | | | | | |
| **CO3** | Explain with reference to tools used in electrical and mechanical machines and their performance. | ✓ | | | ✓ | | | | | | | | |

**Teaching-learning and**

**Assessment Strategy:** Lab performances, Lab Report/Assignment/Presentation, Lab Test/ Quiz

**Teaching-learning and Assessment Strategy:**

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Face-to-Face Learning | |
| Lecture | 16 |
| Practical / Tutorial / Studio | 16 |
| Student-Centred Learning | 10 |
| Self-Directed Learning | |
| Non-face-to-face learning | 40 |
| Revision | 10 |
| Assignment Preparations | 20 |
| Formal Assessment | |
| Continuous Assessment | 5 |
| Final Examination | 1 |
| Total | 118 |

**Teaching Methodology:**

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method, Multi-media Presentation, Class Presentation, Exams, Feedback at every step.

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| Assessment Strategies | | | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| Components | | Grading | | |
| Continuous | Weekly Reports | 20% | CO 1 | C2-C5 |
| | | | CO 2 | C4-C6 |
| | Class | | CO 2 | C4-C6 |

| | | | | |
|---|---|---|---|---|
| Assessment (70%) | Participation | 10% | CO 3 | C3-C5 |
| | Viva | 30% | CO 1 | C2-C5 |
| | | | CO 2 | C4-C6 |
| Final Exam | | 40% | CO 1 | C2-C5 |
| | | | CO 2 | C4-C6 |
| | | | CO 3 | C6, A3 |
| Total Marks | | 100% | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**Text & Reference Books:**


1. W.Bolton, Industrial control and instrumentation, Longman Scientific &Technical.
2. J. P. Holman, Publisher, Experimental Methods for Engineers (6 th edition), Mc Graw – Hill Inc.
3. ThomasG.Beckwith, RoyD. Marangoni, John H. Lientar, Mechanical Measurements (5 th edition).


**Course Code:** IPE 303 **Course Name:** Product Design I
**Credit Hour:** 3.00 **Contact Hour:** 3.00
**Level/Term:** L-3, T-1

**Curriculum Structure**: Outcome Based Education (OBE)

**Pre-requisites:**
(1) IPE 105: Engineering Materials
(2) IPE 107: Engineering Economy
(3) ME 160: Engineering Drawing
(4) IPE 243: Mechanics of Solids
(5) IPE 271: Engineering Mechanics and Theory of Machines

**Synopsis/Rationale:**

This Outcome Based Education (OBE) based course, with its co-requisite laboratory sessional IPE 304, is part of a series of two courses IPE 303 and IPE 307 (Product Design II) designed to introduce students to the systematic engineering approach to developing new/re-designed products of utility. It emphasizes economic, functional, aesthetic, market-demand etc. factors involved in successful product design. In addition environmental and human aspects are highlighted. The unique combination of theory and hands-on sessional work engenders, among the students, the concept of sustainable, ethical and economic design of useful engineering products for societal benefit.

**Objectives:**

1. To analyze functional characteristics of a product to be designed
2. To design and assess solutions to existent complex problems and societal needs
3. To analyze the societal and environmental impacts of a designed product or service
4. To critically review extant literature and case studies in order to explicate product, process or service failure, and suggest remedies
5. To develop and demonstrate ethical judgment based on moral principles

**Course Outcomes (CO) & Generic Skills:**

Upon completion of this course, the student should be able to:

| No. | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO 1 | **Interpret and explain** the functional aspects and characteristics of a product using the basic principles of science and engineering. | C1-C4 | 1 | | 1 | T, Mid Term Exam, F |
| CO 2 | **Propose** optimum design solutions to complex mechanical engineering problems and **assess** their viability in terms of societal, economic and environmental benefits. | C3, C4 | 1 | | 1 | ASG, Mid Term Exam, F |
| CO 3 | **Review and analyze** the impact of engineering products, processes or services on society and environment by applying knowledge of | C2-C4 | 2 | 1 | 2 | ASG, Mid Term Exam, F |
| | engineering, basic economic analysis and environmental science. | | | | | |
| CO 4 | **Review** practical engineering case studies from extant literature to **identify** probable effective solutions to posed problems and **explain** reasons of failure in engineering design. | C2 | | | 1 | T, ASG, R, F |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam) | | | | | | |

**Course Contents:**

**Functional Aspects:** product functionality, environment and human factors in design, value engineering, design morphology, quality function development, understanding customer needs, establishing product function specification, specification development, concept generation and evaluation.

**Industrial Product Development:** The process of product development, Product planning, Managing customer and technical specifications, Revision of product concept development materials selection, Product architecture development. Product Rendering techniques: sketching and editing, Applied design with model building, Advanced solid modeling and surface modeling in 3D-CAD and SolidWorks, Simulation of mechanical movement, animation, photo rendering, top-down-design and generating drawings.

**Mechanical Design and Failure Analysis:** Designing of machine elements: Temporary and Permanent joints; Screw and nut-bolt joints, welding and soldering; Strength analysis of joints, Design and analysis of clamps and fixtures, Design and analysis of power and line shafts, bearings, supports, Design and analysis of power and line shafts, bearings, supports, Keys and coupling design and analysis, Gear and power-train design, Categorization and analysis of failure types: tensile, brittle, fatigue etc., Analysis of product failure and stress concentrations

**Mapping of Course Outcomes and Program Outcomes:**

| Course Learning Outcomes | | Engineering Knowledge | Problem Analysis | Design / Development of Solutions | Investigation | Modern Tool Usage | The Engineer and Society | Environment and Sustainability | Ethics | Communication | Individual and Team Work | Project Management and Finance | Life Long Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | **Interpret and explain** the functional aspects product using the basic principles of science and engineering. (**PO: 1**) | √ | | | | | | | | | | | |
| **CO2** | **Propose** optimum design solutions to complex mechanical engineering problems and **assess** their viability in terms of societal, | | √ | √ | | √ | | | | | √ | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | economic and environmental benefits. (**PO: 2, 3, 5, 10**) | | | | | | | | | | | | |
| **CO3** | **Review and analyze** the impact of engineering products, processes or services on society and environment by applying knowledge of engineering, basic economic analysis and environmental science. (**PO: 2, 6, 7**) | | √ | | | | √ | √ | | | | | |
| **CO4** | **Review** practical engineering case studies from extant literature to **identify** probable effective solutions to posed problems and **explain** reasons of failure in engineering design. (**PO: 1, 2, 4, 11, 12**) | √ | √ | | √ | | | | | | | √ | √ |

**Teaching-learning and Assessment Strategy:**

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Face-to-Face Learning<br>Lecture<br>Practical / Tutorial / Studio<br>Student-Centred Learning | <br>42<br>-<br>- |
| Self-Directed Learning<br>Non-face-to-face learning<br>Revision<br>Assignment Preparations | <br>40<br>20<br>20 |
| Formal Assessment<br>Continuous Assessment<br>Final Examination | <br>2<br>3 |
| Total | 127 |

**Teaching Methodology**

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method, Multi-media Presentation, Class Presentation, Visualization using Computer Simulations, Assignments, Class Tests, Exams, Feedback at every step.

| Week | Lecture | Topics | ASSESSMENT |
|---|---|---|---|
| **1** | Lec 1<br>Lec 2<br>Lec 3 | Introduction: Functional aspects of a product, environment and human factors in design, value engineering | **Class Test 1, ASG** |
| **2** | Lec 4<br>Lec 5<br>Lec 6 | Design morphology, quality function development, understanding customer needs | |
| **3** | Lec 7<br>Lec 8<br>Lec 9 | Establishing product function specification, specification development | |
| **4** | Lec 10<br>Lec 11<br>Lec 12 | Concept generation and evaluation | **Class Test 2, ASG, PR** |
| **5** | Lec 13<br>Lec 14<br>Lec 15 | Industrial product development: The process of product development, Product planning, Managing customer and technical specifications | |
| **6** | Lec 16<br>Lec 17<br>Lec 18 | Revision of product concept development and materials selection, Product architecture development.<br>Product Rendering techniques: sketching and editing | |
| **7** | Lec 19<br>Lec 20<br>Lec 21 | Applied design with model building, Advanced solid modeling and surface modeling in 3D-CAD<br>**Review for Mid-term Exam** | |
| **8** | Lec 22<br>Lec 23<br>Lec 24 | Designing of machine elements: Temporary and Permanent joints; Screw and nut-bolt joints, welding and soldering; Strengthanalysis of joints | **Mid Term** |
| **9** | Lec 25<br>Lec 26<br>Lec 27 | Design and analysis of clamps and fixtures | |
| **10** | Lec 31<br>Lec 32<br>Lec 33 | Design and analysis of power and line shafts, bearings, supports | |
| **11** | Lec 28<br>Lec 29 | Keys and coupling design and analysis, Gear and power-train design | |
| | Lec 30 | | **Class Test 3, ASG,** |

| | | | |
|---|---|---|---|
| **12** | Lec 34<br>Lec 35<br>Lec 36 | Categorization and analysis of failure types: tensile, brittle, fatigue etc. | **R, PR, F** |
| **13** | Lec 37<br>Lec 38<br>Lec 39 | SolidWorks designing and Simulation of mechanical movement, animation, photo rendering, top-down-design and generating drawings.<br>Analysis of product failure and stress concentrations | |
| **14** | Lec 40<br>Lec 41<br>Lec 42 | Reporting and presentation of preliminary product ideas using multi-media resources and simulation<br>**Review for Final Exam** | |

(PR – Project ; ASG – Assignment; PR – Presentation; R - Report; F – Final Exam)

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| Assessment Strategies | | | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| Components | | Grading | | |
| Continuous Assessment (40%) | Test 1-3 | 20% | CO 1 | C1-C4 |
| | | | CO 3 | C2-C4 |
| | | | CO 4 | C2 |
| | Class Participation | 5% | CO 2 | C3, C4 |
| | | | CO 5 | A3 |
| | Mid term | 15% | CO 1 | C1-C4 |
| | | | CO 2 | C3, C4 |
| | | | CO 3 | C2-C4 |
| Final Exam | | 60% | CO 1 | C1-C4 |
| | | | CO 2 | C3, C4 |
| | | | CO 3 | C2-C4 |
| | | | CO 4 | C2 |
| Total Marks | | 100% | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**Text and Ref Books:**

a) Fundamentals of Mechanical Component Design - Kenneth S. Edwards, Robert B. McKee
b) Shigley's Mechanical Engineering Design - Richard Budynas, Keith Nisbett
c) Operations Research

**Reference Site:**

https://classroom.google.com/ (To be announced)

**Course Code:** IPE 307**Course Name:** Product Design-II
**Credit Hour:** 3.00 **Contact Hour:** 3.00
**Level/Term:** L-3, T-2

**Curriculum Structure**: Outcome Based Education (OBE)

**Pre-requisites:**
(1) IPE 105: Engineering Materials
(2) IPE 107: Engineering Economy
(3) ME 160: Mechanical Engineering Drawing
(4) IPE 243: Mechanics of Solids
(5) IPE 271: Engineering Mechanics and Theory of Machines
(6) IPE 303: Product Design-I

**Synopsis/Rationale:** In this course, student will get the opportunity to learn practical knowledge about different machine elements used in wide range of engineering applications.

**Objectives:**

1. to acquire knowledge about different types of stress conditions in machine elements.
2. to understand the mechanical and material failures related to different machine elements used in engineering applications.
3. to gain knowledge about the function of different machine elements such shaft, gear, brake systems etc. used in engineering applications.
4. to develop design skills of these machine elements.

**Course Outcomes (CO) & Generic Skills:**

Upon completion of this course, the student should be able to:

| No. | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO1 | **Explain** the mechanical and material failures of different machine elements used in product design. | C1-C3 | 1 | | 2, 3 | T, Mid Term Exam, F |
| CO2 | **Explain** the function of different machine elements such as shaft, gear, brake, belt-pulley etc. in industrial applications. | C1-C3 | 1 | | 3 | T, F |
| CO3 | **Explore** the application of different machine elements for new product development. | C2-C4 | 2 | 2 | 3, 6 | T, Mid Term Exam, F |
| CO4 | **Design** machine elements based on product development criteria. | C3-C5 | 1, 2 | 2 | 5 | T, F |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam) | | | | | | |

**Course Contents:**

**Mechanical Design and Failure Analysis:**

Design approaches, Factor of safety, Design of simple machine elements; Design for static strength; Material Specifications. Stress analysis, Stress concentration. Fatigue strength reduction factor, Notch Sensitivity. Variable Load.

**Designing of Machine Elements:**

**Shaft:** Shaft Materials, and Shaft layout, Shaft Design for Stress, Deflection Consideration, Critical speed for shaft, Limits and fits.

**Gears-general:** Types of gears, Involute properties, Fundamentals, Contact ratio, Tooth system, Forming of gear teeth, Gear train.

**Spur and Helical Gear:** The Lwis bending equation, Surface durability, AGMA stress concentration, AGMA strength equation, Geometry factor, Overload factor, Dynamic factor
Surface condition factor, Size factor, Load distribution, Reliability factor, Design of a gear mesh.

**Bevel and Worm Gear:** Strength and stress analysis, AGMA equation factors, Straight bevel gear analysis, Design of straight bevel gear mesh, Worm gear analysis, Designing of worm gear mesh, Buckingham wear load.

**Clutch, Brakes, Couplings and Flywheels:** Static analysis of clutches and brakes, Internal compounding rim clutches and brakes, External compounding rim clutches and brakes, Bend type clutch and brakes, Energy consideration, Temperature rise, Friction materials, Flywheels.

**Flexible Machine Elements:** Flat and round belt drive, V belts, Timing belts, Wire rope, Flexible shafts, Chain drive.

**Mapping of Course Outcomes and Program Outcomes:**

| No. | Course Outcomes (CO) of the Course | Program Outcomes (PO) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Engineering Knowledge | Problem Analysis | Design / Development of Solutions | Investigation | Modern Tool Usage | The Engineer and Society | Environment and Sustainability | Ethics | Communication | Individual and Team Work | Life Long Learning | Project Management and Finance |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| **CO1** | **Explain** the mechanical and material failures of different machine elements used in product design. | ✓ | ✓ | | | | | | | | | | |
| **CO2** | **Explain** the function of different machine elements such as shaft, gear, brake, belt-pulley etc. in industrial applications. | ✓ | | | | | | | | | | | |
| **CO3** | **Explore** the application of different machine elements for new product development. | | ✓ | | | | | | | | | | |
| **CO4** | **Design** machine elements based on product development criteria. | | ✓ | ✓ | | | | | | | | | |

**Lecture Schedule:**

| Week | Lecture | Topics | ASSESSMENT |
|---|---|---|---|

| | | | |
|---|---|---|---|
| **1** | Lec 1-Lec3 | Study of different stress conditions in machine elements, Shear force and Bending moment, Torsion, Stress concentration, Mohr;s Circle and Temperature effect. | **Class Test 1, ASG** |
| **2** | Lec4-Lec-6 | Study of different failures theories related to mechanical and material failures of different machine elements. | |
| **3** | Lec7-Lec-9 | Study of Shaft, Shaft Materials, and Shaft layout, Shaft Design for Stress. | |
| **4** | Lec10-Lec12 | Deflection Consideration, Critical speed for shaft, Limits and fits. | **Class Test 2, ASG, PR** |
| **5** | Lec13-Lec15 | Types of gears, Involute properties, Fundamentals, Contact ratio, Tooth system, Forming of gear teeth, Gear train. | |
| **6** | Lec16-Lec18 | Study of Spur and Helical gear. The Lewis bending equation, Surface durability, AGMA stress concentration, AGMA strength equation, Geometry factor, Overload factor. | |
| **7** | Lec19-Lec21 | Dynamic factor Surface condition factor, Size factor, Load distribution, Reliability factor, Design of a gear mesh. | |
| **8** | Lec22-Lec24 | Study of Bevel and Worm Gear, Strength and stress analysis, AGMA equation factors, Straight bevel gear analysis. | **Mid Term** |
| **9** | Lec25-Lec27 | Design of straight bevel gear mesh, Worm gear analysis, Designing of worm gear mesh, Buckingham wear load. | |
| **10** | Lec28-Lec30 | Static analysis of clutches and brakes, Internal compounding rim clutches and brakes, External compounding rim clutches and brakes, | |
| **11** | Lec31-Lec33 | Bend type clutch and brakes, Energy consideration, Temperature rise, Friction materials, Flywheels. | **Class Test 3 & 4, ASG, R, PR, F** |
| **12** | Lec34-Lec36 | Keys and coupling design and analysis, Gear and power-train design | |
| **13** | Lec37-Lec39 | Flat and round belt drive, V belts. | |
| **14** | Lec40-Lec42 | Timing belts, Wire rope, Flexible shafts, Chain drive. | |

(PR – Project ; ASG – Assignment; PR – Presentation; R - Report; F – Final Exam)

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| Assessment Strategies | | | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| Components | | Grading | | |
| Continuous Assessment (40%) | Test 1-3 | 20% | CO1 | C1-C3 |
| | | | CO2 | C1-C3 |
| | | | CO3 | C2-C4 |
| | | | CO4 | C3-C5 |
| | Class Participation | 5% | - | - |
| | Attendance | 5% | - | - |
| | | | | |
| | Mid term | 10% | CO 1 | C1-C3 |
| | | | CO 3 | C2-C4 |
| Final Exam | | 60% | CO 1 | C1-C3 |
| | | | CO 2 | C1-C3 |
| | | | CO 3 | C2-C4 |
| | | | CO 4 | C3-C5 |
| Total Marks | | 100% | | |

**Text and Ref Books:**

a) Fundamentals of Mechanical Component Design (7th edition) - Kenneth S. Edwards, Robert B. McKee
b) Shigley's Mechanical Engineering Design (SI edition) - Richard Budynas, Keith Nisbett
c) The Mechanical Design Process (6th edition) - David Ullman

**Course Code:** IPE 308 **Course Name:** Product Design Sessional
**Credit Hour:** 1.50 **Contact Hour:** 0.75
**Level/Term:** L-3, T-2
**Curriculum Structure:** Outcome Based Education (OBE)

**Pre-requisites:** IPE 303 Product Design I
IPE 307 Product Design II

**Synopsis/Rationale:**

This sessional course, follows the Outcome Based Education (OBE) guidelines. It is designed to reinforce the concept of systematic engineering approach to developing new/re-designed products and to give hands-on training to students of third year.

The sessional course is aligned with the theory course IPE 303 and builds students' skills in identifying customer requirements through effective questionnaire development and to use concepts such as functional decomposition, house of quality, applied mechanics, aesthetics, and economic viability in order to design a product to meet customer's expectations. Therefore, this course addresses on of the most important challenges an industrial engineer might face in his/her career, i.e. to design and develop new products and services for the marketplace and society.
As all engineering disciplines and outcomes of engineering activities have impact on the society and environment, this course also strives to inculcate moral values and ethical decision making in its systematic product design approach.

**Objectives:**

1. To analyze and understand functional characteristics and necessary considerations, based on customers' expectation, in the systematic design of a product
2. To model and evaluate probable design options in a systematic manner using physical tests and computer software in order to address customer and societal needs
3. To gain practical experience in the fabrication of products and in the use of materials
4. To develop and inculcate ethical judgment in students pertaining to product design with regards to societal and environmental impacts

**Course Outcomes (CO) Generic Skills:**
Upon completion of this course, the student should be able to:

| No. | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO1 | **Interpret** and **evaluate** customer requirements and **transform** them into engineering specifications for **determining** required process and materials to realize the specifications using engineering knowledge and computer tools | C2-C5 | 1 | 2 | 1 | Pr, R |
| CO2 | **Design** the product by solid modeling and **analyze** its structural performance using Finite Element Analysis (FEA) | C4-C6 | 2 | 2 | 1 | ASG, R Pr |
| CO3 | **Apply** cost analysis to select the appropriate material and production process for fabrication in order to meet customer, societal and environmental requirements | C3-C5 | 1 | 1 | 2 | ASG |

| | | | | | | |
|---|---|---|---|---|---|---|
| CO4 | **Implement** lean manufacturing and other viable existent techniques throughout the design and production process | C3 | 2 | 1,2 | 1 | R |
| CO5 | **Function** in group setting to **fabricate** the final product and **communicate** its benefits and limitations to stakeholders; while being | C6, A3 | 1 | 1 | | PR, Pr, R |
| | cognizant of the product's environmental impact | | | | | |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam) | | | | | | |

**Course Contents:**

Name of the sessions:

1. Introduction, Understanding Customer Requirements
2. Quality Function Deployment (QFD), Functional Decomposition
3. Design Analysis
4. Material Selection, Process Selection
5. Finite Element Analysis using Ansys, Ansys Software Practice
6. Cost Analysis
7. Final Presentation & Project Submission

**Mapping of Course Outcomes and Program Outcomes:**

| **No.** | **Course Outcomes (CO) of the Course** | **Program Outcome** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| CO1 | **Interpret** and **evaluate** customer requirements and **transform** them into engineering specifications for **determining** required process and materials to realize the specifications using engineering knowledge and computer tools **(PO: 1, 2, 5, 9)** | ✓ | ✓ | | | ✓ | | | | ✓ | | | |
| CO2 | **Design** the product by solid modeling and **analyze** its structural performance using Finite Element Analysis (FEA) **(PO: 1, 3, 5)** | ✓ | | ✓ | | ✓ | | | | | | | |
| CO3 | **Apply** cost analysis to select the appropriate material and production process for fabrication in order to meet customer, societal and environmental requirements **(PO: 2, 7)** | | ✓ | | | | | ✓ | | | | | |

| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO4 | **Implement** lean manufacturing and other viable existent techniques throughout the design and production process **(PO: 1, 3, 5)** | ✓ | | ✓ | | ✓ | | | | | | | |
| CO5 | **Function** in group setting to **fabricate** the final product and **communicate** its benefits and limitations to stakeholders; while being cognizant of the product's environmental impact **(PO: 8-10)** | | | | | | | | ✓ | ✓ | ✓ | | |

**Teaching-learning and Assessment Strategy:**

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Face-to-Face Learning<br>Lecture<br>Practical / Tutorial / Studio<br>Student-Centred Learning | <br>-<br><br>2<br>8<br>10 |
| Self-Directed Learning<br>Non-face-to-face learning<br>Revision<br>Assignment/Report Preparations | <br>40<br>10<br>20 |
| Formal Assessment<br>Continuous Assessment<br>Final Examination | <br>5<br>- |
| Total | 113 |

**Teaching Methodology:**

Lectures, class work, weekly reports, presentation, final report, Problem Based Method, Multi-media Presentation, Visualization using Computer Simulations, Assignments, Feedback at every step.

**Lecture Schedule:**

| | |
|---|---|
| **Week 1** | **Introduction, Understanding Customer Requirements** |
| | Understanding Customer needs, Gathering & prioritizing needs |
| **We** | **Quality Function Deployment (QFD), Functional Decomposition** |
| | Incorporating the Voice of Customer in product design with Quality Function Deployment (QFD), Functional decomposition, Modular design-Basic Clustering method |
| **Week 5** | **Design Analysis** |
| | Design analysis of a product |

| | |
|---|---|
| **Week 7** | **Material Selection, Process Selection** |
| | Alternative material and manufacturing process selection & select best with weighted average method |
| **Week 9** | **Finite Element Analysis using Ansys, Ansys Software Practice** |
| | Finite Element method & introduction to Ansys Software, Other mechanical testing |
| **Week 11** | **Cost Analysis** |
| | Cost Analysis |
| **Week 13** | **Final Presentation & Project Submission** |
| | Final Presentation, project submission |

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| Assessment Strategies | | | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| Components | | Grading | | |
| Continuous Assessment (70%) | Weekly Reports | 20% | CO 1 | C2-C5 |
| | | | CO 2 | C4-C6 |
| | | | CO 4 | C3 |
| | Class Participation | 10% | CO 2 | C4-C6 |
| | | | CO 3 | C3-C5 |
| | Presentation | 40% | CO 1 | C2-C5 |
| | | | CO 2 | C4-C6 |
| | | | CO 5 | C6, A3 |
| Final Report | | 30% | CO 1 | C2-C5 |
| | | | CO 2 | C4-C6 |
| | | | CO 4 | C3 |
| | | | CO 5 | C6, A3 |
| Total Marks | | 100% | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**Text and Ref Books:**

1. Product Design - Kevin Otto & Krinstin wood
2. Product Design - Mike Baxter
3. Mechanical Design Process - David G. Ullmean
4. Mechanical Design - Peter R. N. Childs
5. Shigley's Mechanical Engineering Design - Richard Budynas, Keith Nisbett

**Reference Site:**

https://classroom.google.com/ (To be announced)

**Course Code:** IPE 305 **Course Name:** Operations Research
**Credit Hour:** 4.00 **Contact Hour:** 4.00
**Level/Term:** L-3, T-1
**Curriculum Structure**: Outcome Based Education (OBE)
**Pre-requisites:**
(1) MATH 103: Differential Equation and Matrix
(2) MATH 201: Vector Analysis, Laplace Transformation and Co-ordinate geometry
(3) CSE 281: Computer Programming Techniques
(4) IPE 205: Probability and Statistics

**Rationale:**

The purpose of this course is to provide students with optimization techniques to get the most out of any engineering endeavors and minimize cost, time, and resources and maximize benefits of engineering projects.

**Objectives:**

1. To familiarize students with the origins and nature of Operations Research studies.
2. To appraise students about organization problems including specifying the objectives and parts of the system that must be analyzed before the problem is solved.
3. To develop students' skills in solving complex real-world problems using acquired knowledge.
4. To develop students aptitude in assessing the robustness of optimization models.

**Course Outcomes (CO) & Generic Skills:**

Upon completion of this course, the student should be able to:

| No. | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO1 | **Explain** the fundamental concepts of mathematical optimization | C1-C3 | 1 | | 2 | T, F |
| CO2 | **Apply** optimization techniques to formulate and solve real-world problems | C2-C4 | 1 | | 2 | ASG, T, Mid Term Exam, F |
| CO3 | **Analyze** complex engineering projects mathematically and minimize costs while maximizing benefits | C3-C6 | 2 | 1 | 4 | PR, T, Mid Term Exam, F |
| CO4 | **Assess** the effectiveness of diverse optimization methods for addressing problems in real-world scenarios. | C2-C5 | 1,3 | | 4 | ASG, F |

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; PR – Presentation; R - Report; F – Final Exam)

**Course Contents:**

**Introduction to Operations Research:** Origins and Nature of OR Studies, OR Modelling Approach, **Introduction to Linear Programming**: Prototype Example, The Linear Programming Model, Formulating Linear Programming Model
**Introduction to Simplex Method**: Graphical Method, The Algebra of Simplex Method, Simplex Method in Tabular Form, Post Optimality Analysis, Duality Theory: Introduction to Duality Theory, Primal Dual Relationships, The Role of Duality Theory, Sensitivity Analysis, Other Algorithms for Linear Programming, Linear Programming Practice
**Transportation and Assignment Problem:** Introduction to Transportation Problems , Case Studies and Properties Of, Transportation Problem , Transportation Simplex , Methods for BF Solution, Assignment Problem , Case Study and Hungarian Method , Practice Problems , **Network Optimization**: Shortest Path Problem , Minimum Spanning Trees , Maximum Flow Problem
**Integer Programming:** Introduction to Integer Programming, Prototype Example, The Branch and Bound Algorithm, Branch and Bound In MIP
**Nonlinear Programming**: One, Variable Unconstrained Optimization, Multivariable Unconstrained Optimization, Constraint Program, The Karush Kuhn Tucker Condition, Case Studies and Practice
**Game Theory**: Case Study and Two Person Zero Sum Game, Solving Simple Games, Games with Mixed Strategies
**Markov Chains:** Introduction to Markov Chains, Stochastic Processes, Chapman-Kolmogorov Equation
**Queueing Theory:** Introduction to Queuing Theory, the Birth and Death Process, Case Studies and, Practice Problems.

**Mapping of Course Outcomes and Program Outcomes:**

| Course Learning Outcomes | Engineering Knowledge | Problem Analysis | Design / Development of Solutions | Investigation | Modern Tool Usage | The Engineer and Society | Environment and Sustainability | Ethics | Communication | Individual and Team Work | Project Management and Finance | Life Long Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **Explain** the fundamental concepts of mathematical optimization | √ | √ | | | | | | | | | | |
| **CO2** | **Apply** optimization techniques to formulate and solve real-world problems | | √ | | | | | | | | | | |
| **CO3** | **Analyze** complex engineering projects mathematically and minimize costs while maximizing benefits | | √ | √ | | | | | | | | | |
| **CO4** | **Assess** the effectiveness of diverse optimization methods for addressing problems in real-world scenarios. | | √ | | | | | | | | | √ | |

**Teaching-learning and Assessment Strategy:**

| Teaching and learning activities | Engagement (hours) |
|---|---|
| Face-to-face learning | |
| Lecture | 56 |
| Practical/ Tutorial/ Studio | - |
| Student-centered learning | - |

| | |
|---|---|
| Self-directed learning | |
| Non face-to-face learning | 18 |
| Revision | 23 |
| Assessment preparations | 20 |
| Formal Assessment | |
| Continuous Assessment | 4 |
| Final Examination | 3 |
| Total | 124 |

**Teaching methodology:**

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

**Lecture Schedule:**

| Week | Lecture | Topics | TEST |
|---|---|---|---|
| **1** | Lec 1 | Introduction to Operations Research | **Class Test 1, F** |
| | Lec 2 | Origins and Nature of OR Studies | |
| | Lec 3 | OR Modelling Approach | |
| | Lec 4 | OR Modelling Approach (Contd.) | |
| **2** | Lec 5 | Introduction to Linear Programming | |
| | Lec 6 | Prototype Example | |
| | Lec 7 | The Linear Programming Model | |
| | Lec 8 | Formulating Linear Programming Model | |
| **3** | Lec 9 | Introduction to Simplex Method | |
| | Lec 10 | Graphical Method | |
| | Lec 11 | The Algebra of Simplex Method | |
| | Lec 12 | Simplex Method in Tabular Form | |
| **4** | Lec 13 | Simplex Method Continued | **Class Test 2, Mid Term/F** |
| | Lec 14 | Post Optimality Analysis | |
| | Lec 15 | Introduction to Duality Theory | |
| | Lec 16 | Primal Dual Relationships | |
| **5** | Lec 17 | The Role of Duality Theory | |
| | Lec 18 | Sensitivity Analysis | |

| | | | |
|---|---|---|---|
| | Lec 19 | Other Algorithms for Linear Programming | |
| | Lec 20 | Linear Programming Practice | |
| **6** | Lec 21 | Introduction to Transportation Problems | |
| | Lec 22 | Case Studies and Properties Of Transportation Problem | |
| | Lec 23 | Transportation Simplex | |
| | Lec 24 | Methods for BF Solution | |
| **7** | Lec 25 | Transportation Simplex Continued | |
| | Lec 26 | Assignment Problem | |
| | Lec 27 | Case Study and Hungarian Method | |
| | Lec 28 | Practice Problems | |
| **8** | Lec 29 | Network Optimization | **Project, F** |
| | Lec 30 | Shortest Path Problem | |
| | Lec 31 | Minimum Spanning Trees | |
| | Lec 32 | Maximum Flow Problem | |
| **9** | Lec 33 | Introduction to Integer Programming | |
| | Lec 34 | Prototype Example | |
| | Lec 35 | The Branch and Bound Algorithm | |
| | Lec 36 | Branch and Bound In MIP | |
| **10** | Lec 37 | Nonlinear Programming | **Class Test 3, F** |
| | Lec 38 | One Variable Unconstrained Optimization | |
| | Lec 39 | Multivariable Unconstrained Optimization | |
| | Lec 40 | Constraint Program | |
| **11** | Lec 41 | The Karush Kuhn Tucker Condition | |
| | Lec 42 | Case Studies and Practice | |
| | Lec 43 | Game Theory | |
| | Lec 44 | Case Study and Two Person Zero Sum Game | |
| **12** | Lec 45 | Solving Simple Games | |
| | Lec 46 | Games With Mixed Strategies | |
| | Lec 47 | Introduction to Markov Chains | **Class test 4, F** |
| | Lec 48 | Stochastic Processes | |
| **13** | Lec49 | Chapman-Kolomorogov Equation | |
| | Lec50 | Introduction to Queuing Theory | |
| | Lec51 | The Birth and Death Process | |
| | Lec 52 | Case Studies and Practice Problems | |
| **14** | Lec 53 | Review and Practice | |
| | Lec 54 | | |
| | Lec 55 | | |
| | Lec 56 | | |

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| Assessment Strategies | | | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| Components | | Grading | | |
| Continuous Assessment (40%) | Class test 1-4 | 20% | CO 1 | C1-C3 |
| | | | CO 2 | C2-C4 |
| | Class Participation/Assignment | 5% | CO3 | C4 |
| | Attendance | 5% | | |
| | Mid term | 10% | CO 2 | C2-C4 |
| | | | CO 3 | C3-C6 |
| Final Exam | | 60% | CO 1 | C1-C3 |
| | | | CO 2 | C2-C4 |
| | | | CO 3 | C3-C6 |
| | | | CO4 | C2-C5 |
| Total Marks | | 100% | | |

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domai

**Text and Ref Books:**

1. Introduction to Operations Research-9th edition- Hillier Lieberman, 2010

2. Operations Research-Hamdy A.Taha-10$^{th}$ edition, 2017

**Course Code:** IPE 306
**Course Name:** Operations Research Sessional
**Credit Hour:** 0.75
**Contact Hour:** 1.50
**Level/Term:** L-3, T-1

**Curriculum Structure:**Outcome Based Education (OBE)

**Pre-requisites:**Concurrent with IPE 305 Operations Research

**Synopsis/Rationale:**

This sessional course, concurrent with IPE 305 Operations Research, follows the Outcome Based Education (OBE) guidelines. The course is intended to give students the skills necessary to implement optimization models and solve those models using various solution techniques. Students will use computer software and programming language to implement the modeling and solving techniques taught in IPE 305 theory course.

**Objectives:**

1. To achieve the necessary skills to use computer modeling languages.
2. To solve those models using various optimization solvers.
3. To gain practical experience in modelling of a physical process and data collection, analysis, and wrangling.

1. To develop the skills in students to interpret the results and implement those results in a practical scenario.

**Course Outcomes (CO) Generic Skills:**

Upon completion of this course, the student should be able to:

| No. | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO1 | **Analyze** practical business and industry problems to develop mathematical model | C2-C5 | 1 | 2 | 1 | PR, Pr, Q |
| CO2 | **Implement** the models using a computer modelling language | C4-C6 | 2 | 2 | 1 | ASG, PR,Q |
| CO3 | **Apply** a suitable solver software to solve the aforementioned problems | C3-C5 | 1 | 1 | 2 | ASG, Q |
| CO4 | **Analyze** the results of the model and **interpret** their implication in a practical scenario | C3 | 2 | 1,2 | 1 | P. PR |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam) | | | | | | |

**Course Contents:**
**Introduction to modelling**: Introduction to AMPL and its interface, CPLEX and its functions

**Linear Programming:** simplex method, duality theory, sensitivity analysis

**Integer Programming:** Binary programming, mixed integer programming, pure integer programming

**Transportation Problems:** Transportation simplex, assignment problem, Hungarian method

**Network Optimization**: Shortest Path Problem , Minimum Spanning Trees , Maximum Flow Problem

**Nonlinear Programming**: One, Variable Unconstrained Optimization, Multivariable Unconstrained Optimization, Constraint Programming

**Game Theory**: Two Person Zero Sum Game, Solving Simple Games, Games with Mixed Strategies

**Markov Chains:** Introduction to Markov Chains, Stochastic Processes, Chapman-Kolomorogov Equation

**Queueing Theory:** Introduction to Queuing Theory, The Birth and Death Process

**Mapping of Course Outcomes and Program Outcomes:**

| No. | Course Outcomes (CO) of the Course | Program Outcome | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| CO1 | **Analyze** practical business and industry problems to develop mathematical model | ✓ | | | ✓ | ✓ | ✓ | | | | | ✓ | ✓ |
| CO2 | **Implement** the models using a computer modelling language | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ |
| CO3 | **Apply** a suitable solver software to solve the aforementioned problems | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ |
| CO4 | **Analyze** the results of the model and **interpret** their implication in a practical scenario | ✓ | | ✓ | | ✓ | | | | ✓ | ✓ | ✓ | ✓ |

(H – High, M- Medium, L-low)

**Teaching-learning and Assessment Strategy:**

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Face-to-Face Learning | |
| Lecture | - |
| Practical / Tutorial / Studio | 14 |
| Student-Centred Learning | 5 |
| Self-Directed Learning | |
| Non-face-to-face learning | 20 |
| Revision | 5 |
| Assignment/Report Preparations | 20 |
| Formal Assessment | |
| Continuous Assessment | 5 |
| Final Examination | - |
| Total | 71 |

**Teaching Methodology:**

Lectures, class work, project, presentation, final report, Problem Based Method, Multi-media Presentation, Assignments, Feedback at every step.

**Lecture Schedule:**

| **Week 1** | **Introduction to modelling** |
|---|---|
| Class 1 | Introduction to AMPL and its interface, CPLEX and its functions |
| **Week 2** | **Linear Programming** |
| Class 2 | simplex method, duality theory, sensitivity analysis |
| **Week 3** | **Integer Programming** |
| Class 3 | Binary programming, mixed integer programming, pure integer programming |

| | |
|---|---|
| **Week 4** | **Transportation Problems** |
| Class 4 | Transportation simplex, assignment problem, Hungarian method |
| **Week 5** | **Network Optimization** |
| Class 5 | Shortest Path Problem, Minimum Spanning Trees , Maximum Flow Problem |
| **Week 6** | **Nonlinear Programming** |
| Class 6 | One, Variable Unconstrained Optimization, Multivariable Unconstrained Optimization, Constraint Programming |
| **Week 7** | **Project Proposal** |
| Class 7 | Project Proposal |
| **Week 8** | **Quiz** |
| Class 8 | Quiz |
| **Week 9** | **Game Theory** |
| Class 9 | Two Person Zero Sum Game, Solving Simple Games, Games with Mixed Strategies |
| **Week 10** | **Markov Chains** |
| Class 10 | Introduction to Markov Chains, Stochastic Processes, Chapman-Kolomorogov Equation |
| **Week 11** | **Queueing Theory** |
| Class 11 | Introduction to Queuing Theory, The Birth and Death Process |
| **Week 12** | **Review** |
| Class 12 | Review Class |
| **Week 13** | **Quiz** |
| Class 13 | Final Quiz |
| **Week 14** | **Project submission and Presentation** |
| Class 14 | Final Presentation |

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| Assessment Strategies | | | CO | Bloom’s Taxonomy |
|---|---|---|---|---|
| Components | | Grading | | |
| Continuous Assessment (70%) | Weekly Assignments | 15% | CO 1 | C1-C3, P1-P2 |
| | | | CO 2 | C4-C5, P3-P4 |
| | | | CO 4 | C2, P2 |
| | Class Participation | 5% | CO 2 | C4, P5 |
| | | | CO 3 | C1-C3, P1-P2 |
| | Project and Presentation | 40% | CO 4 | C4-C5, P3-P4 |
| | | | CO 5 | C5-C6, P5 |
| | | | CO 6 | C1-C3, P1-P2 |
| Quiz | | 40% | CO 1 | C2-C5 |
| | | | CO 2 | C4-C6 |
| | | | CO 3 | C3 |
| Total Marks | | 100% | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**Text and Ref Books:**

2.Introduction to Operations Research 8th edition- Hillier Lieberman

3.Operations Research-Hamdy A.Taha

**Reference Site:**

https://classroom.google.com/ (To be announced)

**Course Code:** IPE 309 **Course Name:** Material Handling and Maintenance Management
**Credit Hour:** 3.00 **Contact Hour:** 3.00
**Level/Term:** L-3, T-2
**Curriculum Structure:** Outcome-Based Education (OBE)
**Pre-requisites:** None
**Synopsis/Rationale:**
This Outcome-Based Education (OBE) based course is designed to introduce students to the systematic materials handling approach. It emphasizes a feasible process to conduct an in-depth study on the movement, protection, storage and control of materials and products throughout manufacturing, warehousing, distribution, consumption, and disposal, also different types of maintenance and their feasibility.

**Objectives:**

1. To introduce students to the issues and importance of handling of materials.
2. To expose students to handling processes based on materials.
3. To develop students' ability to perform a detailed study on designing concepts of common handling and transfer equipment.
4. To introduce students to different types of the maintenance process.
5. To make students familiar with the feasibility study of different processes of particular maintenance work.

**Course Outcomes (CO) & Generic Skills:**

Upon completion of this course, the student should be able to:

| No. | **Course Learning Outcome** | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| **CO1** | Explain the issues and importance of different materials handling systems. | C1-C3 | | | 1-3 | T, F |
| **CO2** | Analyze performance of different types of conveyors and their power consumption. | C2-C4 | 3 | | 1-3 | T, Mid Term |
| **CO3** | Evaluate various warehouse facilities appropriate for relevant handling and transfer devices. | C1-C5 | 3 | | 2,3 | Mid Term, F |
| **CO4** | Apply the concepts of maintenance and importance of maintenance management. | C1-C3 | 2 | | 2,4 | T, F |
| **CO5** | Compare various maintenance strategies for better production planning. | C1-C4 | 3 | | 2,4 | F |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; PR– Presentation; R - Report; MT – Midterm Exam, F – Final Exam) | | | | | | |

**Course Contents:**

Issues and importance of handling materials: analysis of material handling problems, classification of materials, unit load, bulk loads, a study of material handling systems and their efficiency, selection, and classification of material conveying equipment.

Product handling: design system configuration conforming to various kinds of product features and layout characteristics.

Designing concepts of common handling and transfer equipment, different types of conveyors such as belt, screw, chain, flight, bucket elevators, pneumatic hydraulic cranes and forklifts, design of warehouse facilities appropriate for relevant handling and transfer device, automatic packaging devices: testing procedure of packages: vibration test, drop test, performance limits and testing machines,

algorithms to design and analyze discrete parts material storage and flow system such as automated storage/retrieval system (ASRS), order picking, automated guided vehicle system (AGVS).
Maintenance management: the concept of maintenance and value of maintenance management, maintenance organization and department structure (resource and administration), types of maintenance, fixed time replacement, condition-based maintenance, preventive and corrective maintenance, replacement strategies, documentation and computer control in maintenance management, Implementation of maintenance planning, plant asset management, human factors in a maintenance environment.

**Mapping of Course Outcomes and Program Outcomes:**

| Course Learning Outcomes | | Engineering Knowledge | Problem Analysis | Design / Development of Solutions | Investigation | Modern Tool Usage | The Engineer and Society | Environment and Sustainability | Ethics | Communication | Individual and Team Work | Project Management and Finance | Life Long Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | Explain different material handling systems and their efficiency. | √ | √ | | | | | | | | | | |
| **CO2** | Outline different types of conveyors and their power consumption. | √ | √ | | | | | | | | | | |
| **CO3** | Evaluate various warehouse facilities appropriate for relevant handling and transfer devices. | √ | √ | √ | | | | | | | | √ | √ |
| **CO4** | Relate the concept of maintenance and value of maintenance management. | √ | √ | | | | | | | | | | |
| **CO5** | Implement different maintenance planning. | √ | √ | √ | | | | | | | | √ | |

**Teaching-learning and Assessment Strategy:**

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Face-to-Face Learning<br>Lecture<br>Practical / Tutorial / Studio<br>Student-Centred Learning | <br>42<br>-<br>- |
| Self-Directed Learning<br>Non-face-to-face learning<br>Revision<br>Assignment Preparations | <br>40<br>20<br>20 |
| Formal Assessment<br>Continuous Assessment<br>Final Examination | <br>2<br>3 |
| Total | 127 |

**Teaching Methodology:**

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method, Multi-media Presentation, Class Presentation, Assignments, Class Tests, Exams, Feedback at every step.

**Lecture Schedule:**

| Week | Lecture | Topics | ASSESSMENT |
|---|---|---|---|
| 1 | 1 | Issues and importance of handling of materials: analysis of material handling problems. | CT 1 to be held on these topics |
| | 2 | Issues and importance of handling of materials: analysis of material handling problems (continued). | |
| 2 | 1 | Issues and importance of handling of materials: analysis of material handling problems (continued). | |
| | 2 | Classification of materials, unit load, bulk loads, a study of material handling systems, and their efficiency. | |
| 3 | 1 | Classification of materials, unit load, bulk loads, a study of material handling systems, and their efficiency (continued). | |
| | 2 | Classification of materials, unit load, bulk loads, a study of material handling systems, and their efficiency (continued). | |
| 4 | 1 | Selection and classification of material conveying equipment. | |
| | 2 | Selection and classification of material conveying equipment (continued). | |
| 5 | 1 | Selection and classification of material conveying equipment (continued). | |

| | | | |
|---|---|---|---|
| | 2 | Product handling: design system configuration conforming to various kinds of product features and layout characteristics. | CT 2 to be held on these topics |
| 6 | 1 | Product handling: design system configuration conforming to various kinds of product features and layout characteristics (continued). | |
| | 2 | Product handling: design system configuration conforming to various kinds of product features and layout characteristics (continued). | |
| 7 | 1 | Designing concepts of common handling and transfer equipment, different types of conveyors such as belt, screw, chain, flight, bucket elevators, pneumatic hydraulic cranes, and forklifts. | |
| | 2 | Designing concepts of common handling and transfer equipment, different types of conveyors such as belt, screw, chain, flight, bucket elevators, pneumatic hydraulic cranes, and forklifts (continued). | |
| 8 | 1 | Designing concepts of common handling and transfer equipment, different types of conveyors such as belt, screw, chain, flight, bucket elevators, pneumatic hydraulic cranes, and forklifts. (continued). | |
| | 2 | Designing concepts of common handling and transfer equipment, different types of conveyors such as belt, screw, chain, flight, bucket elevators, pneumatic hydraulic cranes, and forklifts (continued). | |
| 9 | 1 | Design of warehouse facilities appropriate for relevant handling and transfer device, automatic packaging devices: testing procedure of packages. | |
| | 2 | Design of warehouse facilities appropriate for relevant handling and transfer device, automatic packaging devices: testing procedure of packages (continued). | |
| 10 | 1 | Algorithms to design and analyze discrete parts material storage and flow system such as automated storage/retrieval system (ASRS), order picking, automated guided vehicle system (AGVS). | |
| | 2 | Maintenance management: the concept of maintenance and value of maintenance management, maintenance organization, and department structure. | |
| 11 | 1 | Maintenance management: the concept of maintenance and value of maintenance management, maintenance organization, and department structure (continued). | |
| | 2 | Types of maintenance, fixed time replacement, condition-based maintenance, preventive and corrective | |

| | | | |
|---|---|---|---|
| | | maintenance. | CT 3 to be held on these topics |
| 12 | 1 | Types of maintenance, fixed time replacement, condition-based maintenance, preventive and corrective maintenance (continued). | |
| | 2 | Replacement strategies, documentation, and computer control in maintenance management. | |
| 13 | 1 | Replacement strategies, documentation, and computer control in maintenance management (continued). | |
| | 2 | Implementation of maintenance planning, plant asset management, human factors in motivation skills in a maintenance environment. | |
| 14 | 1 | Implementation of maintenance planning, plant asset management, human factors in motivation skills in a maintenance environment (continued). | |
| | 2 | Course Review. | |

(PR – Project; ASG – Assignment)

**Linkage of CO with Assessment Methods& their Weights:**

| Assessment Strategies | | | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| Components | | Grading | | |
| Continuous Assessment (40%) | Test 1-3 | 20% | CO1 | C1-C3 |
| | | | CO2 | C2-C4 |
| | | | CO4 | C1-C3 |
| | Class Participation | 5% | CO 3 | C1-C5 |
| | | | CO5 | C1-C4 |
| | Attendance | 5% | - | - |
| | Mid term | 10% | CO 2 | C2-C4 |
| | | | CO 3 | C1-C5 |
| Final Exam | | 60% | CO 1 | C1-C3 |
| | | | CO 3 | C1-C5 |
| | | | CO 4 | C1-C3 |
| | | | CO 5 | C1-C4 |
| Total Marks | | 100% | | |

**CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**Text and Ref Books:**

1. Manufacturing Facilities Design & Material Handling: Fifth Edition - Fred E. Meyers
2. Conveyors and Related Equipment - A. SPIVAKOVSKY & V. DYACHKOV, First Edition
3. Maintenance, Replacement, and Reliability: Theory and Applications – Andrew K.S. Jardine, Third Edition

**Reference Site:**

https://classroom.google.com/ (**To be announced**)

**Course Code:** IPE 310 **Course Name:** Material Handling and Maintenance Management Sessional

**Credit Hour:** 0.75 **Contact Hour:** 3.00 (per 2 weeks)

**Level/Term:** L-3, T-2

**Curriculum Structure:** Outcome-Based Education (OBE)

**Pre-requisites:** None

**Synopsis/Rationale:**

This Outcome-Based Education (OBE) based course is designed to introduce students to the systematic materials handling approach. It emphasizes feasible handling processes to conduct in a study on the control and storage of materials and products throughout manufacturing, warehousing, distribution, consumption, and disposal in an industry.

**Objectives:**

1. To characterize the properties of materials and explain their impact on the design of storage and conveying systems.
2. To introduce the student with design and select conveyor for designated material handling systems.
3. To expose students to handling processes based on materials.
4. To explain the feasibility study of different processes of particular maintenance work.
5. To familiarize with different types of conveyor.

**Course Outcomes (CO) & Generic Skills:**

| No. | **Course Learning Outcome** | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| **CO1** | Familiar with different types of conveyors and their power consumption. | C1-C3 | 1 | | 3 | DW, DR |
| **CO2** | Explain different material handling systems and their efficiency. | C4 | 2 | 2 | | DW, DR |

| | | | | | | |
|---|---|---|---|---|---|---|
| **CO3** | Design system configuration conforming to various kinds of product features and layout characteristics. | C1, C4 | 3 | 2 | 2 | DW, DR |
| **CO4** | Design of a conveyor for a specific material | C4 | 2 | 5 | 2, 6 | PR |
| **CO5** | Familiar with the concept of maintenance and their feasibility. | C1, C4 | 3 | 5 | 3 | DW, DR |
| (DW- Daily Work, DR – Daily Report, PR – Project, ASG – Assignment, Pr – Presentation, R – Report) | | | | | | |

**Course Contents:**

Issues and importance of handling materials: analysis of material handling problems, classification of materials, unit load, bulk loads, a study of material handling systems and their efficiency, selection, and classification of material conveying equipment.

Product handling: design system configuration conforming to various kinds of product features and layout characteristics.

Designing concepts of common handling and transfer equipment, different types of conveyors such as belt, screw, chain, flight, bucket elevators, pneumatic hydraulic cranes and forklifts, design of warehouse facilities appropriate for relevant handling and transfer device, automatic packaging devices: testing procedure of packages: vibration test, drop test, performance limits and testing machines, algorithms to design and analyze discrete parts material storage and flow system such as automated storage/retrieval system (ASRS), order picking, automated guided vehicle system (AGVS).

Maintenance management: the concept of maintenance and value of maintenance management, maintenance organization and department structure (resource and administration), types of maintenance, fixed time replacement, condition-based maintenance, preventive and corrective maintenance, replacement strategies, documentation and computer control in maintenance management, Implementation of maintenance planning, plant asset management, human factors in a maintenance environment.

**Mapping of Course Outcomes and Program Outcomes:**

| Course Learning Outcomes | | Engineering Knowledge | Problem Analysis | Design / Development of | Investigation | Modern Tool Usage | The Engineer and Society | Environment and Sustainability | Ethics | Communication | Individual and Team Work | Life-Long Learning | Project Management and |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | Familiar with different types of conveyors and their power consumption. | ✓ | | | ✓ | | | | | | | | |
| **CO2** | Explain different material handling systems and their efficiency. | | ✓ | ✓ | | ✓ | | | | | ✓ | | |
| **CO3** | Design system configuration conforming to various kinds of product features and layout characteristics. | | ✓ | ✓ | ✓ | | | | | | | | |
| **CO4** | Design of a conveyor for a specific material | | | ✓ | | | | | | | | ✓ | ✓ |
| **CO5** | Familiar with the concept of maintenance and their feasibility. | ✓ | ✓ | | | | | | | ✓ | | | |

**Teaching-learning and Assessment Strategy:**

| | |
|---|---|
| Face-to-Face Learning<br>Lecture | 21 |
| Self-Directed Learning<br>Non-face-to-face learning<br>Revision<br>Assessment Preparations | <br>7<br>14<br>7 |
| Formal Assessment<br>Continuous Assessment<br>Final Examination | <br>2<br>3 |
| Total | 54 |
| Teaching and Learning Activities | Engagement (hours) |

**Teaching Methodology:**

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method, Multimedia Presentation, Class Presentation, Assignments, Class Tests, Exams, Feedback at every step.

**Lecture Schedule:**

| Week | Lecture | Topics |
|---|---|---|
| 1 | 1 | Study and Determination of the Capacity of a Belt Conveyer. |
| 3 | 3 | Study and Determination of the parameters of a bucket conveyor. |
| 5 | 5 | Study and Determination of the Capacity of a screw Conveyer. |

| | | |
|---|---|---|
| 7 | 7 | Study and Determination of the parameters of a roller conveyor. |
| 9 | 9 | Maintenance management and control |
| 11 | 11 | Final Assessment & Viva |
| 13 | 13 | Final Quiz |

(PR – Project; ASG – Assignment; Pr – Presentation; R- Report)

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| Components | | Grading | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| Continuous Assessment (70%) | Weekly Reports | 20% | CO 1 | C2 - C4 |
| | | | CO 2 | C4 – C6 |
| | | | CO 4 | C3 |
| | Class Participation | 10% | CO 2 | C4 – C6 |
| | | | CO 3 | C3 – C5 |
| | Presentation | 40% | CO 1 | C2 – C5 |
| | | | CO 5 | C6, A3 |
| Final Report | | 30% | CO 1 | C2- C5 |
| | | | CO 2 | C3, C4 |
| | | | CO 3 | C4 – C6 |
| | | | CO 4 | C3 |
| | | | CO 5 | C6, A3 |
| Total Marks | | 100% | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**Text and Ref Books:**

1. Manufacturing Facilities Design & Material Handling - Fred E. Meyers.
2. Conveyors and Related Equipment - A. SPIVAKOVSKY & V. DYACHKOV.
3. Maintenance, Replacement, and Reliability – A K S Jardine.

**Reference Site:**

https://classroom.google.com/ (**To be announced**)

**Course Code:** IPE 311 **Course Name:** Operations Management
**Credit Hour:** 3.00 **Contact Hour:** 3.00
**Level/Term:** L-3, T-2

**Curriculum Structure**: Outcome Based Education (OBE)

**Pre-requisites:** None

**Rationale:**
To develop an understanding of and an appreciation for the production and operations management function in any organization.

**Objective:**

1. To appraise students of the strategic role of operations management in creating and enhancing a firm's competitive advantages
2. To introduce the key concepts and issues of OM in both manufacturing and service organizations
3. To develop students' skills of comprehending the interdependence of the operations function with the other key functional areas of a firm
4. To enhance students' aptitude in apply analytical skills and problem-solving tools to the analysis of the operations problems

**Course Outcomes (CO) & Generic Skills:**
Upon completion of this course, the student should be able to:

| No. | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO1 | **Identify** and **describe** the processes, tools and principles of operations management to better understand the logistics and supply chain operations. | C1, C2 | 1 | | 3 | T, F |
| CO2 | **Apply and Evaluate** the quality processes in manufacturing and service sector to improve the operational performance. | C3, C5 | 1 | | 3,4 | ASG, T, F |
| CO3 | **Assess** future challenges and directions that relate to operations management to effectively and efficiently respond to market changes. | C5 | 1 | | 4 | ASG, Mid Term Exam, F |
| CO4 | **Identify and Compare** the processes needed to develop a new product from identifying the customer needs to delivering the final product. | C2, C4 | 2 | 2 | 4 | T, ASG, F |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, CT – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; MT – Midterm Exam, F – Final Exam) | | | | | | |

**Course Content:**

Integrated purchase-production-marketing system, production systems, product/service life cycle, forecasting models, bill of materials, material and inventory management: inventory models, ABC analysis, coding and standardization, aggregate planning, MPS, MRP, capacity planning, operating scheduling.

Work study: MRP II, optimized production technology, group technology, TQC and JIT.

**Mapping of Course Outcomes (CO) and Program Outcomes:**

| Course Learning Outcomes | Engineering Knowledge | Problem Analysis | Design / Development of Solutions | Investigation | Modern Tool Usage | The Engineer and Society | Environment and Sustainability | Ethics | Communication | Individual and Team Work | Project Management and Finance | Life Long Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **Identify** and **describe** the processes, tools and principles of operations management to better understand the logistics and supply chain operations. | √ | | | | | | | | | | | |
| **CO2** | **Apply and Evaluate** the quality processes in manufacturing and service sector to improve the operational performance. | √ | √ | | | | | | | | | | |
| **CO3** | **Assess** future challenges and directions that relate to operations management to effectively and efficiently respond to market changes. | √ | √ | | | | | | | | | | |
| **CO4** | **Identify and Compare** the processes needed to develop a new product from identifying the customer needs to delivering the final product. | √ | √ | | | | | | | | | | |

**Teaching-learning and Assessment Strategy:**

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Face-to-Face Learning | |
| Lecture | 42 |
| Practical / Tutorial / Studio | - |
| Student-Centred Learning | - |
| Self-Directed Learning | |
| Non-face-to-face learning | 40 |
| Revision | 20 |
| Assignment Preparations | 20 |
| Formal Assessment | |
| Continuous Assessment | 2 |
| Final Examination | 3 |
| Total | 127 |

**Teaching Methodology:**

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method, Multi- media Presentation, Class Presentation, Assignments, Class Tests, Exams, Feedback at every step.

**Lecture schedule:**

| **Week 1** | **Introduction to Operations Management** | |
|---|---|---|
| Class 1 | Concept and definition of Operations Management. | |
| Class 2 | The Scope of Operations Management | |
| Class 3 | Operations Management and Decision Making | |
| **Week 2** | **Forecasting** | |

| | | |
|---|---|---|
| Class 4 | Features Common to All Forecasts | CT 1 |
| Class 5 | Steps in the Forecasting Process | |
| Class 6 | Approaches to Forecasting | |
| **Week 3** | **Forecasting** | |
| Class 7 | Forecasts Based on Time-Series Data | |
| Class 8 | Associative Forecasting Techniques | |
| Class 9 | Choosing a Forecasting Technique | |
| **Week 4** | **Work Design and Measurement** | CT 2 |
| Class 10 | Job Design | |
| Class 11 | Motion Study | |
| Class 12 | Work Measurement | |
| **Week 5** | **Aggregate Planning and Master Scheduling** | |
| | | |

| | | |
|---|---|---|
| Class 13 | Introduction and Basic Strategies for Meeting Uneven<br><br>Demand, | |
| Class 14 | Techniques for Aggregate Planning, | |
| Class 15 | Master Scheduling | |
| **Week 6** | **MRP** | |
| Class 16 | An Overview of MRP | |
| Class 17 | MRP Inputs, MRP Processing, MRP Outputs | |
| Class 18 | MRP II, Capacity Requirements Planning | |
| **Week 7** | **ERP** | CT 3 |
| Class 19 | An Overview of MRP | |
| Class 20 | ERP in Services. | |
| Class 21 | An Overview of SAP | |
| **Week 8** | **Inventory Management** | |
| Class 22 | An Overview of Inventory Management | |
| Class 23 | Inventory Ordering Policies | |
| Class 24 | How Much to Order: Economic Order Quantity Models | |
| **Week 9** | **Inventory Management** | |
| Class 25 | How Much to Order: Fixed-Order-Interval Model, | |
| Class 26 | The Single-Period Model | |
| Class 27 | Operations Strategy | |
| **Week 10** | **JIT and Lean Operations** | CT 4 |
| Class 28 | Lean Tools | |
| Class 29 | Transitioning to a Lean System | |
| Class 30 | An Overview of JIT | |
| **Week** | **Scheduling** | |

| | | |
|---|---|---|
| **11** | | |
| Class 31 | Scheduling in Low-Volume Systems, | |
| Class 32 | Scheduling Services | |
| Class 33 | Operations Strategy | |
| **Week 12** | **Location Planning and Analysis** | |
| Class 34 | Global Locations | |
| Class 35 | Identifying a Country, Region, Community, and Site | |
| Class 36 | Evaluating Location Alternatives | |
| **Week 13** | **Quality Control** | |
| Class 37 | Statistical Process Control | |
| Class 38 | Process Capability | |
| Class 39 | Inspection | |
| **Week 14** | **Management of Quality** | |
| Class 40 | The Foundations of Modern Quality<br><br>Management: The Gurus | |
| Class 41 | 1st Review Class | |
| Class 42 | 2nd Review Class | |

**Outcomes with Assessment Methods and their Weights:**

| Assessment Strategies | | | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| Components | | Grading | | |
| Continuous Assessment (40%) | Test 1-3 | 20% | CO 1 | C1-C5 |
| | | | CO 2 | C2,C4,C5 |
| | | | CO 4 | C2 |
| | Class Participation | 5% | CO 2 | C3, C4 |

| | | | | |
|---|---|---|---|---|
| | Mid term | 15% | CO 3 | C2 |
| Final Exam | | 60% | CO 1 | C1-C5 |
| | | | CO 2 | C2, C4,C5 |
| | | | CO 3 | C2 |
| | | | CO 4 | C2 |
| Total Marks | | 100% | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**Text and Reference Books:**

Stevenson, W. J., Hojati, M., & Cao, J. (2007). *Operations management* (Vol. 8). Boston: McGraw-Hill/Irwin.

Render, B., & Heizer, J. (1997). *Principles of operations management* (pp. 518-520). Prentice Hall.

**Reference Site:**
https://classroom.google.com/ (To be announced)

**Course Code: IPE 313 Course Name: Quality Management**
**Credit Hour: 3.00 Contact Hour: 3.00**
**Level/Term: L-3, T-2**
Curriculum Structure: Outcome Based Education (OBE)
Pre-requisites: IPE 205 (Probability and Statistics)
Rationale:
The main course's objective is to teach students the fundamentals of quality management system and facilitate professional exposure.
Objectives:
1. To introduce students to the principles and methodologies used in quantifying quality within various industries, including understanding how quality metrics are defined, measured, and evaluated to make informed decisions.
2. To guide students through an in-depth exploration of the phases of quality management, including planning, assurance, control, and improvement
3. To equip students with the analytical skills necessary to identify and evaluate critical parameters of quality control

4. To foster students' ability to apply their knowledge of quality management principles and techniques to solve complex real-world problems

Course Outcomes (CO) & Generic Skills:

Upon completion of this course, the student should be able to:

| No. | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO1 | **Examine** various tools and techniques of quality control through comprehensive analysis | C1-C4 | 1 | | 2 | T, Mid Term Exam, F |
| CO2 | **Distinguish** the applications of quality tools and techniques in both the manufacturing and service industries | C1-C4 | 1 | | 2 | T, Mid Term Exam, F |
| CO3 | **Explain** the concepts required for preparation for the Six Sigma Yellow Belt (SSYB) professional certification exam | C3, C4 | 2 | | 4 | ASG, T, F |
| CO4 | **Apply** quality engineering knowledge in real world problem and solve with different statistical software | C2-C4 | 2 | | 1 | T, F |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; PR – Presentation; R - Report; F – Final Exam) | | | | | | |

**Course Content:**

Emergence of modern concept of quality and its management, Deming's principle on quality and productivity, quality costs and their interpretation, DMAIC

Methodologies: Six Sigma, Lean Manufacturing, 8D, FMEA, Control Plan, 7 tools for Quality, 7 wastes.

Control and measurement concept of quality: elementary SPC tools-PDCA cycle, Pareto's law, cause and effect (fishbone), control charts-attribute control chartzs and variable control charts, design of experiments-identification of key variables for major variations, Acceptance sampling plans

Failure mode and effect analysis, reliability testing. Quality standards and their compliance, ISO 9000 and ISO 14000, foundations of quality revised – total quality management (TQM), application of TQM philosophy, frontiers of quality.

**Mapping of Course Outcomes (CO) and Program Outcomes:**

| Course Learning Outcomes | | Engineering Knowledge | Problem Analysis | Design / Development of Solutions | Investigation | Modern Tool Usage | The Engineer and Society | Environment and Sustainability | Ethics | Communication | Individual and Team Work | Project Management and Finance | Life Long Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO 10** | **PO11** | **PO 12** |
| **CO1** | **Examine** various tools and techniques of quality control through comprehensive analysis. | √ | | √ | | | | | | | | | |
| **CO2** | **Distinguish** the applications of quality tools and techniques in both the manufacturing and service industries | | √ | √ | √ | | | | | | | | |
| **CO3** | **Explain** the concepts required for preparation for the Six Sigma Yellow Belt (SSYB) professional certification exam- | | | | | | √ | | | | | √ | √ |
| **CO4** | **Apply** quality engineering knowledge in real world problem and solve with different statistical software | √ | | √ | √ | | | | | | | | |

**Teaching-learning and Assessment Strategy:**

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Face-to-Face Learning | |
| Lecture | 42 |
| Practical / Tutorial / Studio | 10 |
| Student-Centred Learning | - |
| Self-Directed Learning | |
| Non-face-to-face learning | 40 |
| Revision | 20 |
| Assignment Preparations | 20 |
| Formal Assessment | |
| Continuous Assessment | 2 |
| Final Examination | 3 |
| Total | 137 |

**Teaching Methodology:**

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method, Multi-media Presentation, Class Presentation, Assignments, Class Tests, Exams, Feedback at every step.

**Lecture Schedule:**

| Week | Course Content | ASSESSMENT |
|---|---|---|
| **Week 1** | **Management & Quality tools** | |
| Class 1 | Introduction | |
| Class 2 | Different Aspects of Quality | |
| Class 3 | Basic Tools of TQM | |
| **Week 2** | | |
| Class 4 | Lean Manufacturing | |
| Class 5 | Control Plan | **Class Test 1, F** |
| Class 6 | Control Plan | |
| **Week 3** | | |
| Class 7 | 7 wastes | |
| Class 8 | PDCA | |
| Class 9 | Root cause | |
| **Week 4** | | **ASG, Class Test 2, F** |
| Class 10 | QFD | |
| Class 11 | ISO 9001, ISO 14001 | |
| Class 12 | SPC tools – 7 tools of Quality (Pareto law, Fishbone diagram & so on) | |

| | | |
|---|---|---|
| **Week 5** | **Control Chart** | |
| Class 13 | Attribute & Variable Control Chart | |
| Class 14 | Attribute & Variable Control Chart | |
| Class 15 | Attribute & Variable Control Chart | |
| **Week 6** | | |
| Class 16 | Special Control Chart | |
| Class 17 | Special Control Chart | |
| Class 18 | Special Control Chart | |
| **Week 7** | **Process Capability & Specifications** | |
| Class 19 | $C_p, C_{pk}$ | |
| Class 20 | Quality of design, conformance and performance, Deming‟s principle on quality and productivity, quality costs and their interpretation | |
| Class 21 | Deming‟s principle on quality and productivity, quality costs and their interpretation | |
| **Week 8** | **Sampling Plan** | **ASG, Mid Term, F** |
| Class 22 | Acceptance sampling plans: OC curves, | |
| Class 23 | Acceptance sampling plans: OC curves, | |
| Class 24 | Single and double sampling plants | |
| **Week 9** | | |
| Class 25 | Single and double sampling plants | |
| Class 26 | Sequential and rectifying inspection plans AOQ. | |
| Class 27 | Sequential and rectifying inspection plans AOQ. | |
| **Week 10** | **Design of Experiments** | |
| Class 28 | Introduction to Design of Experiments | |
| Class 29 | Full Factorial Analysis | |
| Class 30 | Multi Vari Chart | **Class Test 3,- ASG, F** |
| **Week 11** | | |
| Class 31 | **Variable Search Method** | |
| Class 32 | Surplus and waste management ANOVA | |
| Class 33 | Surplus and waste management ANOVA | |
| **Week 12** | **Six Sigma Management** | |
| Class 34 | DMAIC | |
| Class 35 | Six Sigma | |

| | | |
|---|---|---|
| Class 36 | Six Sigma | |
| **Week 13** | **Taguchi Loss Function** | |
| Class 37 | Introduction | |
| Class 38 | Quality Loss Function | |
| Class 39 | Traditional GoaI Post View of Quality | |
| **Week 14** | **Review** | |
| Class 40 | Review | |
| Class 41 | Review | |
| Class 42 | Review | |

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| Assessment Strategies | | | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| Components | | Grading | | |
| Continuous Assessment (40%) | Test 1-3 | 20% | CO 1 | C1-C4 |
| | | | CO 2 | C1-C4 |
| | | | CO 3 | C3, C4 |
| | Class Participation | 5% | CO 2 | C1- C4 |
| | | | CO 3 | C3, C4 |
| | Attendance | 5% | | |
| | Mid term | 10% | CO 1 | C1-C4 |
| | | | CO 2 | C1-C4 |
| | | | CO 3 | C3, C4 |
| Final Exam | | 60% | CO 1 | C1-C4 |
| | | | CO 2 | C1-C4 |
| | | | CO 3 | C3, C4 |
| | | | CO 4 | C2-C4 |
| Total Marks | | 100% | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**Text and Ref Books:**

1. *Industrial Engineering: FE Review Manual*, Brightwood Engineering Education
2. Thomas & Paul, *Six Sigma Handbook*, 3rd Edition, 2010
3. Dr. M. Ahsan Akhtar Hasin, Quality Control and Management, 3rd Edition, 2017

**Course Code:** IPE 314
**Course Name:** Quality Management Sessional
**Credit Hour:** 0.75
**Contact Hour:** 1.50
**Level/Term:** Level 3/ Term II

**Curriculum Structure:** Outcome Based Education (OBE)

**Pre-requisite:** None

**Rationale:**
This course is concurrent with IPE 313: Quality Management, and its objective is to teach students the methods of analyzing data to make decisions related to quality control processes in industries.

**Objectives:**

1. To describe different patterns observed in data.
2. To generate visual representation of data.
3. To analyze the critical performance parameters of quality.
4. To make concise decisions on quality control.
5. To apply quality control tools and techniques.

**Course Outcomes (CO) & Generic Skills:**

| | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO1 | **Explain** how data analysis helps making quality control decisions | C4-C5 | | 1 | 1 | Pr, R |
| CO2 | **Apply** quality control tools to assess production/service industries | C3-C6 | 1 | 2 | 1 | Q, ASG, R |
| CO3 | **Outline** and **explain** different methodologies of quality control | C2-C3 | 1 | 1 | 2 | Q, ASG |
| CO4 | **Analyze** and **compare** different process options to decide on the best one | C1-C2 | | 1 | 1 | Q, F |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam) | | | | | | |

**Course Contents:**

Name of the experiments:

1. Introduction to Quality Control & Minitab installation
2. Describing distributions – histogram, boxplot, stem plot, time series plot, normal quartile plot, etc.
3. Familiarities with DOE
4. Inference from Regression – fits, ANOVA, correlations
5. Assessing the Quality

**Mapping of Course Outcomes and Program Outcomes:**

| No. | Course Outcomes (CO) of the Course | Program Outcome | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| CO1 | **Explain** how data analysis helps making quality control decisions **(PO: 1, 2, 4, 5)** | ✓ | ✓ | | ✓ | ✓ | | | | | | | |
| CO2 | **Apply** quality control tools to assess production/service industries **(PO: 1, 2, 5)** | ✓ | ✓ | | | ✓ | | | | | | | |
| CO3 | **Outline** and **explain** different methodologies of quality control **(PO: 3, 5)** | | | ✓ | | ✓ | | | | | | | |
| CO4 | **Analyze** and **compare** different process options to decide on the best one **(PO: 1, 4, 5)** | ✓ | | | ✓ | ✓ | | | | | | | |

**Teaching-learning and Assessment Strategy:**

| Teaching and learning activities | Engagement (hours) |
|---|---|
| Face-to-face learning | |
| Lecture | - |
| Practical/ Tutorial/ Studio | 14 |
| Student-centred learning | - |
| Self-directed learning | |
| Non face-to-face learning | 9 |
| Revision | 14 |
| Assessment preparations | 18 |

| | |
|---|---|
| Formal Assessment<br>Continuous Assessment<br>Final Examination | <br>1.5<br>1.5 |
| Total | 58 |

**Teaching methodology:**
Lecture and Discussion, Software Applications Based, Co-operative and Collaborative Method, Problem Based Method

**Lecture Schedule:**

| Week | Topics |
|---|---|
| 1 | Experiment 1: Introduction to Quality Control & Minitab installation |

| | |
|---|---|
| **3** | Experiment 2: Describing distributions – histogram, boxplot, stem plot, time series plot, normal quartile plot, etc. |
| **5** | Experiment 3: Familiarities with DOE |
| **7** | Mid-term Quiz |
| **9** | Experiment 4: Inference from Regression – fits, ANOVA, correlations |
| **11** | Experiment 5: Assessing the Quality |
| **13** | Final Quiz |

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| Assessment Strategies | | | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| Components | | Grading | | |
| Continuous Assessment (40%) | Assignment | 20% | CO 1-2 | C 3, C 4, P 1, P 2 |
| | Class Participation | 5% | CO 2-3 | C 1, A 2, P 2 |
| | Mid Term Quiz | 15% | CO 3-4 | C 3-6, P 3 |
| Final Quiz | | 60% | CO 3-4 | C 3-6, P 3 |
| Total Marks | | 100% | | |

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

**Text and Ref Books:**

1. Quality Control and Management – Ahsan Akhtar Hasin

**Reference Site:**

https://classroom.google.com/ (To be announced)

**Course Code:** IPE 315 **Course Name:** Entrepreneurship Development and Micro Industries
**Credit Hour:** 2.00 **Contact Hour:** 2.00
**Level/Term:** L-3, T-2
**Curriculum Structure**: Outcome Based Education (OBE)
**Pre-requisites:** None
**Synopsis/Rationale:**

Entrepreneurship Development and Micro Industries is an interdisciplinary theory course designed to demonstrate students how to think and act entrepreneurial. Students will learn how to start-up and operate a micro industry. The course will build on cross-curricular academic skills, by integrating inquiry-based learning and business tools that will enable students to analyze, create, develop, and pilot small businesses.

**Objectives:**

6. To understand the basic concepts in the area of entrepreneurship.
7. To recognize the role and significance of entrepreneurship for economic growth.
8. To analyze the societal and environmental impacts of entrepreneurship and micro industries.
9. To realize the stages of the entrepreneurial process and the resources needed for the successful development of entrepreneurial ventures.
10. To develop the mindset of developing micro industry and create job sector for unemployed youth.

**Course Outcomes (CO) & Generic Skills:**

Upon completion of this course, the student should be able to:

| No. | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO1 | **Create** the ability of **analyzing** various aspects of entrepreneurship especially of taking over the risk, and the specificities as well as the pattern of entrepreneurship development and, finally, to **contribute** to their entrepreneurial and managerial potentials. | C3, C6 | 1 | 1 | 3 | T, Mid Term Exam, F |
| CO2 | **Propose** optimum business solutions to complicated business problems and **evaluate** that problem based on societal and environmental prospects. | C3, C4 | 1 | 2 | 7 | ASG, Mid Term Exam, F |

| | | | | | | |
|---|---|---|---|---|---|---|
| CO3 | **Establish** their own business as an entrepreneur which can help to reduce the unemployment problem as well as **improve** their risking handling ability. | C3-C5 | 3 | 2 | 6 | ASG, Mid Term Exam, F |
| CO4 | **Review and analyses** real life business case studies from external sources and create proper plan for their own business from past data analysis. | C4 - C6 | 7 | 5 | 5 | T, ASG, R, F |
| CO5 | **Demonstrate** loyalty in the direction of business ethics. | C3 – C6 | 4 | 1 | 7 | ASG, PR, R |

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

**Course Contents:**

Conceptual definition of entrepreneurs and entrepreneurship, Entrepreneurship in economic theory, Historical development of entrepreneurship, The importance of small business, Type of Entrepreneurship, Entrepreneur and small business, Features and types of businesses and entrepreneurs, Sources of business ideas, The role of entrepreneurship in economic development, Terms of entrepreneurship, Innovation and entrepreneurship, Entrepreneurship and small business, The life cycle of a small company, Small business sector in Bangladesh, Forms of entrepreneurial organization, Analysis on sources of capital, Entrepreneurial process, Entrepreneurial strategies, Starting a new company or buying an existing business decision making, Defining the business concept. Writing a business plan, Basics of Venture Marketing. Fundamentals of entrepreneurial management, Small industries. Business process: product design, operational art, stock management. Technical and technological analysis of entrepreneurial projects. Designing a business investment, Knowledge Economy, Entrepreneur biographies - the actual successes and failures, Business results in SMEs. Fostering the development of entrepreneurship, Entrepreneurship in Bangladesh, Entrepreneurship in transition countries, Strategic guidelines, and objectives for the development of SMEs in Developing Countries like Bangladesh.

**Mapping of Course Outcomes and Program Outcomes:**

| | | **Program Outcomes (PO)** |
|---|---|---|

| No. | Course Outcomes (CO) of the Course | Engineering Knowledge | Problem Analysis | Design / Development of Solutions | Investigation | Modern Tool Usage | The Engineer and Society | Environment and Sustainability | Ethics | Communication | Individual and Team | Project Management and Finance | Life Long Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| CO1 | **Create** the ability of **analyzing** various aspects of entrepreneurship especially of taking over the risk, and the specificities as well as the pattern of entrepreneurship development and, finally, to **contribute** to their entrepreneurial and managerial potentials. | | √ | | √ | | | | | | √ | | |
| CO2 | **Propose** optimum business solutions to complicated business problems and **evaluate** that problem based on societal and environmental prospects. | | √ | √ | √ | | | √ | | | | | |
| CO3 | **Establish** their own business as an entrepreneur which can help to reduce the unemployment problem as well as **improve** their risking handling ability. | | √ | √ | √ | | √ | | | | | | |
| CO4 | **Review and analyses** real life business case studies from external sources and create proper plan for their own business from past data analysis. | | √ | √ | | | | | | | | | √ |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO5 | **Demonstrate** loyalty in the direction of business ethics. | | | | | | | | √ | | | | |

**Teaching-learning and Assessment Strategy:**

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Face-to-Face Learning | |
| Lecture | 28 |
| Practical / Tutorial / Studio | - |
| Student-Centred Learning | - |
| Self-Directed Learning | |
| Non-face-to-face learning | 20 |
| Revision | 10 |
| Assignment Preparations | 10 |
| Formal Assessment | |
| Continuous Assessment | 2 |
| Final Examination | 3 |
| Total | 118 |

**Teaching Methodology:**

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method, Multi-media Presentation, Class Presentation, Visualization using Computer Simulations, Assignments, Class Tests, Exams, Feedback at every step.

**Lecture Schedule:**

| Week | Lecture | Topics | ASSESSMENT |
|---|---|---|---|
| **1** | Lec 1<br>Lec 2 | Introduction to entrepreneurs and entrepreneurship,<br>Entrepreneurship in economic theory,<br>Historical development of entrepreneurship | **Class Test 1, ASG, F** |
| **2** | Lec 3<br>Lec 4 | The importance of small business,<br>Type of Entrepreneurship,<br>Entrepreneur and small business | |
| **3** | Lec 5<br>Lec 6 | Features and types of businesses and entrepreneurs,<br>Sources of business ideas,<br>The role of entrepreneurship in economic development | |

| | | | |
|---|---|---|---|
| **4** | Lec 7<br>Lec 8 | Terms of entrepreneurship,<br>Innovation and entrepreneurship,<br>Entrepreneurship, and small business,<br>The life cycle of a small company | |
| **5** | Lec 9<br>Lec 10 | Small business sector in Bangladesh,<br>Forms of entrepreneurial organization,<br>Analysis on sources of capital, | |
| **6** | Lec 11<br>Lec 12 | Entrepreneurial process, Entrepreneurial strategies,<br>Starting a new company or buying an existing business decision making | |
| **7** | Lec 13<br>Lec 14 | Defining the business concept.<br>Writing a business plan,<br>Basics of Venture Marketing | |
| **8** | Lec 15<br>Lec 16 | Fundamentals of entrepreneurial management,<br>Small industries. | **Mid Term, F** |

| | | | |
|---|---|---|---|
| **9** | Lec 17<br>Lec 18 | Business process: product design, operational art, stock management,<br>Technical and technological analysis of entrepreneurial projects | |
| **10** | Lec 19<br>Lec 20 | Designing a business investment,<br>Knowledge Economy,<br>Entrepreneur biographies - the actual successes and failures | |
| **11** | Lec 21<br>Lec 22 | Business results in SMEs.<br>Fostering the development of entrepreneurship, | **Class Test 2, ASG, PR, F** |
| **12** | Lec 23<br>Lec 24 | Entrepreneurship in Bangladesh,<br>Entrepreneurship in transition countries | |
| **13** | Lec 25<br>Lec 26 | Strategic guidelines, and objectives for the development of SMEs in Developing Countries like Bangladesh. | |
| **14** | Lec 27<br>Lec 28 | **Review Classes** | |

(PR – Project ; ASG – Assignment; PR – Presentation; R - Report; F – Final Exam)

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| Assessment Strategies | | | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| Components | | Grading | | |
| Continuous Assessment (40%) | Test 1, 2 | 20% | CO 1 | C3, C6 |
| | | | CO 3 | C3 – C6 |
| | | | CO 4 | C4 – C6 |
| | Class Participation | 5% | CO 1 | C3, C6 |
| | | | CO 2 | C3, C4 |
| | Mid term | 15% | CO 1 | C3, C6 |
| | | | CO 2 | C3, C4 |
| | | | CO 4 | C4 – C6 |
| Final Exam | | 60% | CO 1 | C3, C6 |
| | | | CO 2 | C3, C4 |
| | | | CO 3 | C3 – C6 |
| | | | CO 4 | C4 – C6 |
| | | | CO 5 | C3 – C6 |
| Total Marks | | 100% | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**Text and Ref Books:**

1. Essentials of Entrepreneurship and Small Business management (5/ed.): Thomas W.
2. Zimmerer, and Norman M. Scarborough. PHI Entrepreneurship: Strategies and Resources, 3/E -: Marc Dollinger; Prentice Hall
3. Entrepreneurship in Action, 2/E - Mary Coulter; Prentice Hall

**Reference Site:**

1. http://ediindia.ac.in/e-policy/ [ Entepreneurial Policy India]
2. http://en.wikipedia.org/wiki/List_of_venture_capital_companies_in_India [Venture Capital]
3. indiavca.org/venture-capital-in-india.html [Venture Capital]
4. www.indianangelnetwork.com/ [ Angel Investing]
5. www.startbizindia.in/angel_investors_india.php [ANGEL INVESTING]
6. economictimes.indiatimes.com/...of...entrepreneurs/.../20912945.cms [ Leadership] [ Innovation]
7. www.bplans.com/ [ BUSINESS PLAN]
8. www.entrepreneur.com/businessplan [ BUSINESS PLAN]

https://classroom.google.com/ (To be announced)

**Course Code:** IPE 317 **Course Name:** Ergonomics and Safety Management

**Credit Hour:** 3.00 **Contact Hour:** 3.00
**Level/Term:** L-3, T-2

**Curriculum Structure**: Outcome Based Education (OBE)

**Pre-requisites:** None

**Synopsis/Rationale:**

To design and use ergonomic principles for design a better working environment for workers so that they complete their task more effectively and safely.

**Objectives:**

1. To encourage students about the need and role of ergonomics in occupational health.
2. To familiarize students with the application of ergonomic principles to design of industrial workplaces and the prevention of occupational injuries
3. Explain the psychology of human behavior as it relates to workplace safety.

4. To provide students' knowledge of safety management concepts and develop students' knowledge to accept and oversee the key components of an SMS, including their implementation.

**Course Outcomes (CO) & Generic Skills:**

Upon completion of this course, the student should be able to:

| No. | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO1 | **Evaluate** the impact of various personal attributes and physical environment factors on proper safe working practice. | C1, C2, C5 | 1,3 | | 1,2 | T, F |
| CO2 | **Apply** principles of good ergonomic design of work areas and equipment to a range of occupational settings. | C3-C4 | 1,4 | | 1,2 | ASG, Mid Term Exam, F |
| CO3 | **Explain** the rationale for having laws and regulations in the workplace, including federal safety standards (OSHA) and consensus standards. | C2 | 1 | | 1 | T, F |
| CO4 | **Employ** safety principles for improving the overall health and safety of the workplace in any industries. | C3, C6 | 1,5 | | 5,6 | T, F, Mid Term |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; PR – Presentation; R - Report; F – Final Exam) | | | | | | |

**Course Contents:**

Man-machine-material interfaces in manufacturing: physical and cognitive aspects, comparative advantages of man and machine, physical work and human muscular effort, bio-mechanics and bio-engineering.
Anthropometry, work place design and work place layout, human performance under environment temperature, illumination, vibration, noise, pollution radiation static and dynamic conditions.
Evolution of modern safety concepts, industrial hazard, safety and risk management, productivity, worker health and safety, proactive management techniques for safety management, safety standards and regulations for engineering works, case studies.

**Mapping of Course Outcomes and Program Outcomes:**

| No. | Course Outcomes | Program Outcomes (PO) |
|---|---|---|

| | (CO) of the Course | Engineering Knowledge | Problem Analysis | Design / Development of Solutions | Investigation | Modern Tool Usage | The Engineer and Society | Environment and Sustainability | Ethics | Communication | Individual and Team Work | Life Long Learning | Project Management and Finance |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| CO1 | **Evaluate** the impact of various personal attributes and physical environment factors on proper safe working practice. | √ | √ | √ | | | | | | | | | |
| CO2 | **Apply** principles of good ergonomic design of work areas and equipment to a range of occupational settings. | | | √ | √ | | | √ | | | √ | | |
| CO3 | **Explain** the rationale for having laws and regulations in the workplace, including federal safety standards (OSHA) and consensus standards. | √ | | √ | | | | | √ | | | | |
| CO4 | **Employ** safety principles for improving the overall health and safety of the workplace in any industries. | | | √ | | √ | | √ | | √ | √ | | |

(H – High, M- Medium, L-low)

**Teaching-learning and Assessment Strategy:**

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Face-to-Face Learning | |
| Lecture | 42 |
| Practical / Tutorial / Studio | - |
| Student-Centred Learning | - |

| | |
|---|---|
| Self-Directed Learning<br>Non-face-to-face learning<br>Revision<br>Assignment Preparations | <br>40<br>20<br>20 |
| Formal Assessment<br>Continuous Assessment<br>Final Examination | <br>2<br>3 |
| Total | 127 |

**Teaching Methodology:**

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method, Multi-media Presentation, Class Presentation, Visualization using Computer Simulations, Assignments, Class Tests, Exams, Feedback at every step.

**Lecture Schedule:**

| Week | Lecture | Topics | ASSESSMENT |
|---|---|---|---|
| **1** | Lec 1<br>Lec 2<br>Lec 3 | Course overview, importance of this course for industrial engineers.<br>Understanding the concept of ergonomics<br>Man machine system and its components | **Class Test 1, ASG, F** |
| **2** | Lec 4<br>Lec 5<br>Lec 6 | Concepts of anthropometry and its uses.<br>Anthropometry in workstation design.<br>Design of work surfaces and seats. | |
| **3** | Lec 7<br>Lec 8<br>Lec 9 | Design of work surfaces and seats.<br>Concepts of stress and strain.<br>Study of metabolisom. | |
| **4** | Lec 10<br>Lec 11<br>Lec 12 | Introduction of physiological functions.<br>Concepts of workload and energy consumption.<br>Biomechanics. | **Class Test 2, ASG, PR, F** |
| **5** | Lec 13<br>Lec 14<br>Lec 15 | Types of body movements of different body members.<br>Strength and endurance.<br>Speed of movements | |
| **6** | Lec 16<br>Lec 17<br>Lec 18 | Concepts of the terms related to NIOSH lifting Equation.<br>Explanation of NIOSH lifting equation.<br>Lifting index and maximum acceptable weight and forces, application of NIOSH lifting equation. | |
| **7** | Lec 19<br>Lec 20<br>Lec 21 | Distal upper extremities risk factors, Starin index.<br>Rapid Upper Limb Assessment (RULA), Rapid Entire Body Assessment (REBA) | |

| | | | |
|---|---|---|---|
| | | **Review Class 1** | |
| **8** | Lec 22<br>Lec 23<br>Lec 24 | Introduction to office ergonomics.<br>Importance of study of office ergonomics.<br>Concepts of Visual display terminals (VDT)<br>Design consideration for VDT workstation design.<br>Visual displays in static information, authority, display and controls.<br>Effects of vibration, noise, temperature, and illumination on performance. | **Mid Term, F** |
| **9** | Lec 25<br>Lec 26<br>Lec 27 | Introduction to existing safety codes.<br>Ideas about safety standards.<br>Concepts about accident prevention and control ways.<br>Fire safety.<br>Electrical safety. | |
| **10** | Lec 31<br>Lec 32<br>Lec 33 | Safety in material handling.<br>Safety in storage.<br>Safety in hand portable power tools. | |
| **11** | Lec 28<br>Lec 29<br>Lec 30 | Introduction to industrial hygiene.<br>General concepts of workers protection.<br>Understanding industrial hygiene.<br>Various hazards in workplace. | **Class Test 3, ASG, R, PR, F** |
| **12** | Lec 34<br>Lec 35<br>Lec 36 | Concepts of personal protective equipment.<br>Types of personal protective equipment.<br>Design standards of personal protective equipment.<br>Selection criteria of personal protective equipment. | |
| **13** | Lec 37<br>Lec 38<br>Lec 39 | Introduction to risk management.<br>Risk management process.<br>The Risk Event Graph<br>Principles of risk management. | |
| **14** | Lec 40<br>Lec 41<br>Lec 42 | Export risk management<br>Insurance and its application as risk distribution.<br>**Review Class 2** | |

(PR – Project ; ASG – Assignment; PR – Presentation; R - Report; F – Final Exam)

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| Assessment Strategies | | | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| Components | | Grading | | |
| Continuous Assessment (40%) | Test 1, 2 | 20% | CO 1 | C1, C2, C5 |
| | | | CO 3 | C3-C4 |
| | | | CO 4 | C4 |
| | Class Participation | 5% | CO 1 | C1, C2, C5 |
| | | | CO 2 | C4 |
| | Attendance | 5% | | |
| | Mid term | 10% | CO 1 | C1, C2, C5 |
| | | | CO 2 | C4 |
| | | | CO 4 | C4 |
| Final Exam | | 60% | CO 1 | C1, C2, C5 |
| | | | CO 2 | C4 |
| | | | CO 3 | C3-C4 |
| | | | CO 4 | C4 |
| | | | CO 5 | C4 |
| | | | CO 6 | C3, C6 |
| Total Marks | | 100% | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**Text and Ref Books:**


1. Helander, M. (2005). A guide to human factors and ergonomics. Crc Press.Elian Stone, Jean A Samples, "Fashion Merchandising". McGraw Hill Book company, New York, 1985.
2. Salvendy, G. (2012). Handbook of human factors and ergonomics. John Wiley & Sons.
3. Reese, C. D. (2008). Occupational health and safety management: a practical approach. CRC press.


**Course Code:** IPE 318 Sessional | **Course Name:** Ergonomics and Safety Management

**Credit Hour:** 0.75 | **Contact Hour:** 1.5

**Level/Term:** L-3, T-2

**Curriculum Structure:** Outcome Based Education (OBE)

**Pre-requisites:** Concurrent with IPE 317

**Rationale:**

To provide support for both research and teaching activities related to ergonomics, safety and methods engineering.

**Objective:**

1. To increase awareness of the need for and role of ergonomics in occupational health
2. To obtain basic knowledge in the application of ergonomic principles to design of industrial workplaces and the prevention of occupational injuries
3. To understand the breadth and scope of occupational ergonomics.
4. To provide students knowledge of safety management concepts and develop students' knowledge to accept and oversee the key components of an SMS, including their implementation.

**Course Outcomes (CO) Generic Skills:**
Upon completion of this course, the student should be able to:

| No. | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO1 | **Design and conduct** experiments, as well as to analyse and interpret data | C3-C6 | 1 | 1,3 | 1,2 | R |
| CO2 | **Design** a system, component, or process to meet accepted human factors and workplace ergonomics standards within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability | C3-C6 | 1, 2 | 1,2 | 5,6 | R |
| CO3 | **Use** the techniques, skills, and modern human factors and workplace ergonomics tools necessary for industrial and systems engineering practice. Apply tools and knowledges for creating the formal letters in career opportunities procedure. | C3-C4 | 1, 2 | 1 | 5,6 | ASG,R |
| CO4 | **Implement** safety principles in any industries. . | C4 – C6 | 1 | 5 | 6,7 | PR,ASG, R |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam) | | | | | | |

**Course Content:**

Measurement of anthropometric data using anthropometer and analysis of dada, Measurement of the ambience noise in road side hospitals or clinics using sound level meter and its consequences., Assessment of luminance in different work places using lux meter and its consequences, Measurement of pinch grip strength s data and their application in product/hand tool design and drafting, Study of industrial safety signs, types and their purposes.

**Mapping of Course Outcomes (CO) and Program Outcomes:**

| Course Learning Outcomes | | Engineering Knowledge | Problem Analysis | Design / Development of Solutions | Investigation | Modern Tool Usage | The Engineer and Society | Environment and Sustainability | Ethics | Communication | Individual and Team | Life Long Learning | Project Management and Finance |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | **Design and conduct** experiments, as well as to analyse and interpret data | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | |
| **CO2** | **Design** a system, component, or process to meet accepted human factors and workplace ergonomics standards within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability | ✓ | ✓ | ✓ | | | | | | | | | |
| **CO3** | **Use** the techniques, skills, and modern human factors and workplace ergonomics tools necessary for industrial and systems engineering practice. | | ✓ | ✓ | | | | | | | | ✓ | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Apply tools and knowledges for creating the formal letters in career opportunities procedure. | | | | | | | | | | | | |
| **CO4** | **Implement** safety principles in any industries. | ✓ | | ✓ | | | | ✓ | | | | | |

**<u>Lecture schedule:</u>**

| **Week No** | **Content** | **Remark** |
|---|---|---|
| 1 | Course overview, Group Selection | |
| 3 | Measurement of anthropometric data using anthropometer and analysis of dada. | |
| 5 | Measurement of the ambience noise in road side hospitals or clinics using sound level meter and its consequences. | Submit Report 1 |
| 7 | Assessment of luminance in different work places using lux meter and its consequences. | Submit Report 2 |
| 9 | Measurement of pinch grip strength s data and their application in product/hand tool design and drafting. | Submit Report 3 |
| 11 | Study of industrial safety signs, types and their purposes. | Submit Report 4 |
| 13 | **Final Quiz / Presentation** | Submit Report 5 + Final Project Report Submission |

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| Assessment Strategies | | CO | Bloom's Taxonomy |
|---|---|---|---|
| Components | Grading | | |

| | | | | |
|---|---|---|---|---|
| Continuous Assessment (70%) | Weekly Reports | 20% | CO 1 | C3-C6 |
| | | | CO 2 | C3-C6 |
| | | | CO 3 | C3-C4 |
| | | | CO 4 | C4 – C6 |
| | Class Participation | 40% | CO 1 | C3-C6 |
| | Presentation | 10% | CO 1 | C3-C6 |
| | | | CO 2 | C3-C6 |
| | | | CO 3 | C3-C4 |
| Final Project Report | | 30% | CO 1 | C3-C6 |
| | | | CO 2 | C3-C6 |
| | | | CO 3 | C3-C4 |
| | | | CO 4 | C4 – C6 |
| Total Marks | | 100% | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**Text and Ref Books:**


1. Helander, M. (1995). A Guide to the Ergonomics of Manufacturing. London: Taylor & Francis.
2. Pheasant, S. (1991). Ergonomics, work and health. Macmillan International Higher Education.


**Reference Site:**

https://classroom.google.com/ (To be announced)

**Course Code:** IPE 319 **Course Name:** Data Analytics
**Credit Hour:** 2.00 **Contact Hour:** 2.00
**Level/Term:** L-3, T-2

**Curriculum Structure**: Outcome Based Education (OBE)

**Pre-requisites:** None

**Rationale:**
This course is designed to provide a comprehensive understanding of key concepts, methodologies, and tools within the field of data analytics.

**Objectives:**

1. To familiarize students with diverse machine learning frameworks

2. To enhance students' proficiency in computational abilities, analytical aptitude, data stewardship expertise, and project design skills', aiming to bolster one's professional profile as a data scientist.
3. To develop students' skills in data visualization and visual analytics and the ability to communicate complex analytical findings effectively.
4. To encourage students to critically evaluate the robustness and validity of predictive models, considering factors such as model accuracy, interpretability, and ethical implications

**Course Outcomes (CO) & Generic Skills:**

| No. | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO1 | **Identify** the application areas of quantitative modeling in industrial engineering through visualization | C1, C2 | 2 | | 2 | ASG, T, Mid Term Exam |
| CO2 | **Develop** statistical learning techniques to analyze engineering data. | C3 | 3 | | 2 | ASG, T, Mid Term Exam, F |
| CO3 | **Analyze** data for practical data science applications by using different software | C4 | 1,3 | | 3 | PR, T, F |
| CO4 | **Compare** different machine learning methods for modeling relationships in data. | C4-C5 | 1,3 | | 4 | ASG, F |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; PR – Presentation; R - Report; F – Final Exam) | | | | | | |

**Course Contents:**

Introduction to data science and analytics: data science concepts, application areas of quantitative modeling, Basics of Google Colab and Python Programming

Introduction to statistical learning: Data Manipulation, Data Loading & Storage, Plotting and Visualization

Introduction to Predictive and Inference Analytics;

Types of Machine Learning Systems, Working Principle of Machine Learning;

Regression Analysis: Linear regression, Logistic regression;

Supervised and unsupervised learning: Naive Bayes, K-NN, Support Vector Machines (SVM) and Kernel Methods, Multiple Linear Regression, Lasso and Ridge Regression, Tree-based Models, Ensemble Learning using Bagging and Boosting, Clustering and Principal Component

Analysis

Data Inference Techniques: Uncertainty Quantification, Active Learning, Bayesian Belief Networks (BBN)

Common methods for dimensionality reduction: Principal Component Analysis, Linear Discriminant Analysis (LDA), Multidimensional Scaling;

Introduction to Neural Networks: Overview of artificial neural networks (ANNs), Historical background and evolution, Basic concepts: neurons, activation functions, weights, and biases.

Deep Learning and Deep Neural Networks: Introduction to deep learning, Architecture of deep neural networks, Benefits and challenges of deep learning

Convolutional Neural Networks (CNNs): Basics of image processing and computer vision, Architecture of CNNs, Applications in image classification and object detection

Practice and analysis with data science software: Python, MATLAB, and R Programming**.**

| Course Learning Outcomes | | Engineering Knowledge | Problem Analysis | Design / Development of Solutions | Investigation | Modern Tool Usage | The Engineer and Society | Environment and Sustainability | Ethics | Communication | Individual and Team Work | Life Long Learning | Project Management and Finance |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | **Identify** the application areas of quantitative modeling in industrial engineering through visualization | √ | √ | √ | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO2** | **Develop** statistical learning techniques to analyze engineering data. | √ | √ | √ | | | | | | | √ | | |
| **CO3** | **Analyze** data for practical data science applications by using different software | √ | √ | √ | | | | | | | √ | | |
| **CO4** | **Compare** different machine learning methods for modeling relationships in data. | √ | √ | √ | | | | | | | √ | | |

(H – High, M- Medium, L- Low)

**Teaching-learning and Assessment Strategy:**

| Teaching and learning activities | Engagement (hours) |
|---|---|
| Face-to-face learning<br>Lecture<br>Practical/ Tutorial/ Studio<br>Student-centered learning | <br>42<br>30<br>- |
| Self-directed learning<br>Non face-to-face learning | <br>18 |

| | |
|---|---|
| Revision<br>Assessment preparations | 21<br>20 |
| Formal Assessment<br>Continuous Assessment<br>Final Examination | <br>2<br>3 |
| Total | 136 |

**Teaching methodology:**

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method, Visualization using Computer Software, Assignments, Class Tests, Exams, Feedback at every step.

**Lecture Schedule:**

| Week | Lecture | Topics | TEST |
|---|---|---|---|
| **1** | Lec 1 | Introduction to data science and analytics | |
| | Lec 2 | Data Science Concepts | |
| | Lec 3 | Application areas of quantitative modeling, Basics of Google Colab and Python Programming | |
| **2** | Lec 4 | Introduction to statistical learning: Data Manipulation, Data Loading & Storage, | |
| | Lec 5 | Introduction to statistical learning: Plotting and Visualization | |
| | Lec 6 | Introduction to Predictive and Inference Analytics | **ASG, Class Test 1, F** |
| **3** | Lec 7 | Types of Machine Learning Systems, Working Principle of Machine Learning; | |
| | Lec 8 | Regression Analysis: Linear regression, | |
| | Lec 9 | Regression Analysis: Logistic regression | |
| **4** | Lec 10 | Introduction to Supervised and unsupervised learning | **ASG, Class Test 2, F** |

| | | | |
|---|---|---|---|
| | Lec 11 | Supervised learning: Naive Bayes | |
| | Lec 12 | Supervised learning: K-NN | |
| **5** | Lec 13 | Supervised learning: Support Vector Machines (SVM) and Kernel Methods | |
| | Lec 14 | Supervised learning: Support Vector Machines (SVM) and Kernel Methods | |
| | Lec 15 | Supervised learning: Multiple Linear Regression | |
| **6** | Lec 16 | Supervised learning: Lasso and Ridge Regression | **ASG, Mid Term, F** |
| | Lec 17 | Supervised learning: Tree-based Models | |
| | Lec 18 | Supervised learning: Ensemble Learning using Bagging and Boosting | |
| **7** | Lec 19 | Unsupervised learning: Clustering | |
| | Lec 20 | Unsupervised learning: Principal Component Analysis | |
| | Lec 21 | Unsupervised learning: Principal Component Analysis | |
| **8** | Lec 22 | Introduction to Data Inference | |
| | Lec 23 | Uncertainty Quantification | |
| | Lec 24 | Active Learning | |
| **9** | Lec 25 | Bayesian Belief Networks (BBN) | |
| | Lec 26 | Common methods for dimensionality reduction | |
| | Lec 27 | Linear Discriminant Analysis (LDA) | |
| **10** | Lec 28 | Multidimensional Scaling | |
| | Lec 29 | Introduction to Neural Networks, Historical | |

| | | | |
|---|---|---|---|
| | | background and evolution | PR, Class Test 3, F |
| | Lec 30 | Overview of artificial neural networks (ANNs), | |
| **11** | Lec 31 | Basic concepts: neurons, activation functions, weights, and biases | |
| | Lec 32 | Solving practical problems related to ANN | |
| | Lec 33 | Solving practical problems related to ANN | |
| **12** | Lec 34 | Deep Learning and Deep Neural Networks: Introduction to deep learning | |
| | Lec 35 | Benefits and challenges of deep learning | |
| | Lec 36 | Architecture of deep neural networks | |
| **13** | Lec 37 | Solving Problems with deep learning | ASG, F |
| | Lec 38 | Convolutional Neural Networks (CNNs): | |
| | Lec 39 | Basics of image processing and computer vision | |
| **14** | Lec 40 | Architecture of CNNs | |
| | Lec 41 | Review | |
| | Lec 42 | Review | |

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| Components | | Grading | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| Continuous Assessment (40%) | Class test 1-3 | 20% | CO1 | C1, C2 |
| | | | CO2 | C3 |
| | | | CO3 | C4 |
| | Class Participation | 5% | CO1 | C1, C2 |
| | | | CO3 | C4 |
| | Attendance | 5% | | |
| | Mid term | 10% | CO2 | C3 |
| | | | CO3 | C4 |
| | | | CO4 | C4-C5 |
| Final Exam (60%) | | 60% | CO1 | C1, C2 |

| | | | |
|---|---|---|---|
| | | CO2 | C3 |
| | | CO3 | C4 |
| | | CO4 | C4-C5 |
| Total Marks | 100% | | |

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

**Reference Books:**


2. Gareth James, Daniela Witten., Trevor Hastie, Robert Tibshirani, An Introduction to Statistical Learning with Applications in R

2. Jake VanderPlas, Python Data Science Handbook

3. William McKinney, Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython


**Course Code:** IPE 320 **Course Name:** Industrial Attachment
**Credit Hour:** 1.00 **Contact Hour:** 4 weeks

**Level/Term:** L-3, T-2

**Curriculum Structure**: Outcome Based Education (OBE)

**Pre-requisites:** None

**Synopsis/Rationale:**

To gain the experience of interrelating theoretical knowledge with practical experiences at industries along with developing lifetime interpersonal skills like communication, leadership, and team management and so on.

**Objective:**

1. To acquire knowledge of what industrial engineers do
2. To know how the Industrial and Production engineers can improve a production system
3. To be able to apply basic industrial engineering tools
4. To be able to differentiate among different production processes

**Course Outcomes (CO) and Genetic Skills:**

| No. | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO 1 | **Implement** industrial and production engineering degree knowledge at industries. | C1-C4 | 1 | 2 | 1 | PR, R |
| CO 2 | **Analyze** basic structure of industries and processes in practice. | C1-C4 | 1 | 2 | 1 | PR, R |
| CO 3 | **Explain** how production planning, quality control and supply chain system works. | C3, C4 | 2 | 1 | 2 | PR, R |
| CO 4 | **Develop** communication, team working and other interpersonal skills. | C2-C4 | 2 | 2 | 1 | PR, R |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam) | | | | | | |

**Course Contents:**
Students have to go to different industries by some groups to know the production process and have to submit a report and also have to give an oral presentation both in the industry (if needed) and IPE department (Must). Each group has to find a case in the industry and they have to provide suitable solution to that case.

**Mapping of Course Outcomes (CO) and Program Outcomes:**

| Course Learning Outcomes | | Engineering Knowledge | Problem Analysis | Design / Development of Solutions | Investigation | Modern Tool Usage | The Engineer and Society | Environment and Sustainability | Ethics | Communication | Individual and Team Work | Life Long Learning | Project Management and |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | **Implement** industrial and production engineering degree knowledge at industries. | ✓ | ✓ | | | | | ✓ | | | | | |
| **CO2** | **Analyze** basic structure of industries and processes in practice. | | | ✓ | | | | | | | | | ✓ |
| **CO3** | **Explain** how production planning, quality control and supply chain system works. | | | | ✓ | | ✓ | | | | | | |
| **CO4** | **Develop** communication, team working and other interpersonal skills. | | | | | | | | | ✓ | ✓ | ✓ | |

**Teaching-learning and Assessment Strategy:**

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Daily assessment by supervisor at industries | 60 |
| Presentation, Interview | 3 |
| Assessment of Industrial consulates | 14 |
| Report submitting<br>Assessment by supervisor at Department | 20<br>3 |
| Total | 100 |

**Teaching Methodology:**

Daily assessment by supervisor at industries, Presentation, Interview, Assessment of Industrial consulates, Assessment by supervisor at department, Report submitting.

**<u>Attachment schedule:</u>**

| **Week 1** | **Introduction** |
|---|---|
| **Week 2** | **Individual projects assigned by industrial supervisor** |
| **Week 3** | **Individual projects assigned by industrial supervisor** |
| **Week 4** | **Presentation, Report Submitting** |

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| Assessment Strategies | | | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| Components | | Grading | | |
| | Daily assessment by supervisor at industries | 20% | CO 1 | C1-C4 |
| | | | CO 3 | C2-C4 |

| | | | | |
|---|---|---|---|---|
| Continuous Assessment (50%) | | | CO 4 | C2 |
| | Assessment of Industrial consulates | 10% | CO 2 | C3, C4 |
| | | | CO 4 | A3 |
| | Assessment by supervisor at Department | 20% | CO 1 | C1-C4 |
| | | | CO 2 | C3, C4 |
| | | | CO 3 | C2-C4 |
| Presentation, Interview, Report (50%) | | 50% | CO 1 | C1-C4 |
| | | | CO 2 | C3, C4 |
| | | | CO 3 | C2-C4 |
| | | | CO 4 | C2 |
| Total Marks | | 100% | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**Text and Reference Books**

As per requirements from the books suggested to important courses covered in the program.

**Course Code:** IPE 351 **Course Name:** Fluid Mechanics and Machinery
**Credit Hour:** 3.00 **Contact Hour:** 3.00
**Level/Term:** Level 3/ Term I
**Curriculum Structure:** Outcome Based Education (OBE)

**Pre-requisite:** None

**Rationale:**

To introduce the students to different Fluid flow patterns and the fundamental flow cases such as free shear flows, Specific applications of these flow cases are then given through the study of internal flow systems and external flows around air, different fluid power driven machineries and components, Fluid turbo-machinery theory, performance characteristics of centrifugal and axial flow fans, compressors, pumps and turbines, fluid vibrations and sound, water hammer, introduction to fluid power controls and fluid amplifiers, operating principle and design.

**Objectives:**

1. To familiarize students with the essential ideas of fluid mechanics
2. To familiarize students with the conservation principles governing fluid streams
3. To be able to compute forces on bodies in liquid flows
4. To analyze the familiarity with current practice in fluid and aerodynamic measurement
5. To study the principles to a variety of real-world engineering applications including simple flow networks and pump & turbine design
6. To analyze different practical engineering machineries

**Course Outcomes (CO) & Generic Skills:**

| | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO 1 | **Identify** how properties of fluids change with temperature and their effect on pressure and fluid flow | C1-C2 | | | 1, 4, 6 | T, M, F |
| CO 2 | **Define** the relationship between pressure and elevation as it relates to manometers, barometers and other pressure measuring devices | C1 | 1 | | 4, 6 | F |
| CO 3 | **Calculate** forces on a plane and buoyancy on a body submerged in a static fluid | C1-C2 | 1 | | 2, 5, 6 | T, M, F |
| CO 4 | **Demonstrate** knowledge on different type of flows and determine sonic velocity in a fluid | C1-C3 | | | | T, M, F, ASG |
| CO 5 | **Explain** the different fluid machines such as turbines, pumps etc. | C1-C2 | 1 | | 4, 6 | T, M, F, ASG |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; M- Mid; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam) | | | | | | |

**Course Contents:**

**a. Main Contents:**

Fundamental concepts; Fluid statics; Hydrostatic forces; Pressure distribution; Continuity, momentum and energy equation; Fluid kinematics; Fluid flow; Turbines; Pumps.

**b. Detailed Contents:**

**1. Fundamental concept:** Of fluid as a continuum; Fluid properties: classification of fluid flows (laminar, turbulent, real flows), density and specific gravity, compressibility and bulk modulus, viscosity, surface tension and capillarity;

**2. Fluid statics:** Basic hydrostatic equation, concept of hydrostatic pressure distributions in static incompressible and compressible fluids, manometry;

**3. Hydrostatic forces:** On floating and submerged surfaces, buoyant force, Metacenter and metacentric height, stability and buoyancy of floating and submerged bodies; Forces on plane and curved surfaces;

**4. Pressure distribution:** Of a fluid in a rotating system; relation between system approach and control volume approach;

**5. Continuity, momentum and energy equations:** special forms of energy and momentum equations and their applications (Bernoulli's equations, limitations and applications);

**6. Fluid kinematics:** Pressure, velocity and flow measurement devices, Lagrangian and Eulerian descriptions of fluid flow, deformation of fluid elements, Reynolds transport theorem and Reynolds number regimes, one dimensional fluid flow, incompressible and in viscid flow, two dimensional fluid flow, laminar and turbulent flows, developing and developed pipe flows, flow through converging-diverging nozzles, vorticity and rotationality;

**7. Fluid flow:** fundamental relations of compressible flow; Speed of sound wave; Stagnation states for the flow and ideal gas; Flow through converging – diverging nozzles; Normal shock; Real fluid flow

**8. Turbines:** Rotodynamic and positive displacement machines; Velocity diagrams and Euler pump/turbine equation; Impulse and reaction turbines; Centrifugal and axial flow pumps; Deep well turbine pumps; Dimensional analysis applied to fluid machinery: specific speed, unit power, unit speed, unit discharge;

**9. Pumps:** Performance and characteristics of turbines and pumps; Design of pumps; Cavitation; Reciprocating pump, gear and screw pumps

**Mapping of Course Outcomes and Program Outcomes:**

| Course Learning Outcomes | Engineering Knowledge | Problem Analysis | Design / Development of Solutions | Investigation | Modern Tool Usage | The Engineer and Society | Environment and Sustainability | Ethics | Communication | Individual and Team Work | Project Management and Finance | Life Long Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

| | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **Identify** how properties of fluids change with temperature and their effect on pressure and fluid flow | √ | √ | | √ | | | | | | | | |
| **CO2** | **Define** the relationship between pressure and elevation as it relates to manometers, barometers and other pressure measuring devices | √ | √ | | √ | | | | | | | | |
| **CO3** | **Calculate** forces on a plane and buoyancy on a body submerged in a static fluid | √ | √ | √ | | | | | | | | | |
| **CO4** | **Demonstrate** knowledge on different type of flows and determine sonic velocity in a fluid | √ | √ | | | | | | | | | | |
| **CO5** | **Explain** the different fluid machines such as turbines, pumps etc. | √ | √ | | | | | | | | √ | | |

**Teaching-learning and Assessment Strategy:**

| Teaching and learning activities | Engagement (hours) |
|---|---|
| Face-to-face learning | |
| Lecture | 42 |
| Practical/ Tutorial/ Studio | - |
| Student-centred learning | - |
| Self-directed learning | |
| Non face-to-face learning | 14 |
| Revision | 21 |
| Assessment preparations | 20 |
| Formal Assessment | |
| Continuous Assessment | 2 |
| Final Examination | 3 |
| Total | 122 |

**Teaching methodology:**
Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

**Lecture Schedule:**

| Week | Topics |
|---|---|
| 1 | Of fluid as a continuum; Fluid properties: classification of fluid flows (laminar, turbulent, real flows), density and specific gravity, compressibility and bulk modulus, viscosity, surface tension and capillarity; |
| 2 | Basic hydrostatic equation, concept of hydrostatic pressure distributions in static incompressible and compressible fluids, manometry; |
| 3 | Hydrostatic forces- on floating and submerged surfaces, buoyant force, Metacenter and metacentric height, stability and buoyancy of floating and submerged bodies; |
| 4 | Forces on plane and curved surfaces |
| 5 | Pressure distribution - Of a fluid in a rotating system; relation between system approach and control volume approach; |

| | |
|---|---|
| 6 | Special forms of energy and momentum equations and their applications (Bernoulli's equations, limitations and applications); |
| 7 | Pressure, velocity and flow measurement devices |
| 8 | Lagrangian and Eulerian descriptions of fluid flow, deformation of fluid elements, Reynolds transport theorem and Reynolds number regimes, |
| 9 | One dimensional fluid flow, incompressible and in viscid flow, two dimensional fluid flow, laminar and turbulent flows, developing and developed pipe flows, |
| 10 | Flow through converging-diverging nozzles, vorticity and rotationality; |
| 11 | Fundamental relations of compressible flow; Speed of sound wave; Stagnation states for the flow and ideal gas; |
| 12 | Flow through converging – diverging nozzles; Normal shock; Real fluid flow |
| 13 | Rotodynamic and positive displacement machines; Velocity diagrams and Euler pump/turbine equation; Impulse and reaction turbines; Centrifugal and axial flow pumps; Deep well turbine pumps; Dimensional analysis applied to fluid machinery: specific speed, unit power, unit speed, unit discharge; |
| 14 | Performance and characteristics of turbines and pumps; Design of pumps; Cavitation; Reciprocating pump, gear and screw pumps |

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| Assessment Strategies | | | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| Components | | Grading | | |
| Continuous Assessment (40%) | Class test 1-3 | 20% | CO 1-4 | C 1-4, A 1-2, P 1-2 |
| | Class Participation | 5% | CO 1-2 | C 1-4, A 1-2, P 1-2 |
| | Mid term | 15% | CO 1-4 | C 1-6, P 1-4 |
| Final Exam | | 60% | CO 1-5 | C 1-6, P 1-4 |
| Total Marks | | 100% | | |

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

**Text and Ref Books:**

1. Fluid Mechanics: Fundamentals and Applications by Yunus A. Cengel, John Cimbala.
2. Mechanics of Fluids by Irving Herman Shames.
3. Fluid Mechanics through Worked out Problems- A.C. Mandal & M.Q. Islam
4. Fluid Mechanics (including Hydraulic Machines) by Jain A.K
5. Hydraulic Machines – Dr. Md. Quamrul Islam

**Reference Site:**

Google Classroom (to be announced)

| COURSE INFORMATION | | | |
|---|---|---|---|
| Course Code<br>Course Title | : IPE 352<br>: Fluid Mechanics & Machinery Sessional | Lecture Contact Hours<br>Credit Hours | : 1.50<br>: 0.75 |
| **PRE-REQUISITE** | | | |
| None | | | |
| **CURRICULUM STRUCTURE** | | | |
| Outcome Based Education (OBE) | | | |

**SYNOPSIS/RATIONALE**

This course provides an introduction to the principles of fluid mechanics of mechanical systems. The focus is to illustrate practical engineering applications of these principles in relation to simple fluid systems. The learning approach is to apply engineering principles to performance analysis and prediction of simple fluid systems. This will provide a basis for understanding how performance can be improved. Student will acquire an understanding of the essential theoretical basis of the fluid mechanic sciences and their application to a range of problems of relevance to practical engineering.

**OBJECTIVE**

1. This course provides an introduction to the principles of fluid mechanics of mechanical systems.
2. The focus is to illustrate practical engineering applications of these principles in relation to simple fluid systems.
3. By the end of this course students should be able to understand the basic principles and analysis of both static and dynamic fluid systems

**LEARNING OUTCOMES & GENERIC SKILLS**

| No. | Course Outcome | Corresponding PO | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|---|
| CO1 | **Identify** how properties of fluids change with temperature and their effect on pressure and fluid flow. | 1 | C3 | | | 1 | R, Q, LT |
| CO2 | **Illustrate** practical engineering applications of these principles in relation to simple fluid systems. | 1 | C2 | | | 1 | R, Q, LT |
| CO3 | **Evaluate** and design fluid engineering systems | 2 | C5 | | | 5 | R, Q, LT |
| CO4 | **Build** simple solutions to a range of problems in basic fluid flows. | 4 | C3 | | | 3 | R, Q, LT |

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, LT – Lab Test, PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

## COURSE CONTENT

**Experiments:**

Expt-01: Verification of Bernoulli's Equation

Expt-02: (a) Calibration of rectangular notch

(b) Calibration of triangular notch (V notch)

Expt-03: Study of flow through an Orifice meter and Venturi Meter (Combined)

Expt-04: Study of Pipe friction (Merged with below two)

(b) Determination of Pressure losses in different types of elbows (Different types of pipe bent)

Expt-05: (a) Introduction to Centrifugal Pump Characteristics (Merged with below three)

(b) Performance test of a single centrifugal pump

(c) Performance test of centrifugal pumps connected in series

(d) Performance test of centrifugal pumps connected in parallel

Expt-06: (a) Study of Propeller Turbine Characteristics

(b) Performance test of a Pelton wheel and Francis Turbine.

Expt-07: Study about, compressor (Single Stage and Multistage) and Blowers

## CO-PO MAPPING

| No. | Course Learning Outcome | PROGRAM OUTCOMES (PO) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| CO1 | **Identify** how properties of fluids change with temperature and their effect on pressure and fluid flow. | ✓ | | | | | | | | | | | |
| CO2 | **Illustrate** practical engineering applications of these principles in relation to simple fluid systems. | ✓ | | | | | | | | | | | |
| CO3 | **Evaluate** and design fluid engineering systems | | ✓ | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO4 | **Build** simple solutions to a range of problems in basic fluid flows. | | | | ✓ | | | | | | | | |

**Justification for CO-PO mapping:**

| Mapping | Corresponding Level of matching | Justifications |
|---|---|---|
| CO1-PO1 | **3** | In order to identify the basics of fluid mechanics, the knowledge of engineering fundamental would be required. |
| CO2-PO1 | **3** | In order to perform the experiments, practical engineering applications of these principles in relation to simple fluid systems knowledge would be required |
| CO3-PO2 | **2** | In order to solve and design fluid engineering system, the knowledge of engineering fundamentals is also required. |
| CO4-PO4 | **3** | For performing the experiments, basic simple solutions to a range of problems in basic fluid flows is needed. |

**TEACHING LEARNING STRATEGY**

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Face-to-Face Learning | |
| Lecture | 14 |
| Practical | 28 |
| | Total 42 |
| Self-Directed Learning | |
| Preparation of Lab Reports | 10 |
| Preparation of Lab Test | 10 |
| Preparation of presentation | 5 |
| Preparation of Quiz | 10 |
| Engagement in Group Projects | 20 |
| Formal Assessment | |
| Continuous Assessment | 14 |

| | |
|---|---|
| Final Quiz | 1 |
| Total | 112 |

| |
|---|
| **TEACHING METHODOLOGY** |
| Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method |

| **COURSE SCHEDULE** | |
|---|---|
| Week-1 | Expt-01: Verification of Bernoulli's Equation |
| Week-3 | Expt-02: (a) Calibration of rectangular notch<br>(b) Calibration of triangular notch (V notch) |
| Week-5 | Expt-03: Study of flow through an Orifice meter and Venturi Meter (Combined) |
| Week-7 | Expt-04: Study of Pipe friction (Merged with below two)<br>(b) Determination of Pressure losses in different types of elbows (Different types of pipe bent) |
| Week-9 | Expt-05: (a) Introduction to Centrifugal Pump Characteristics (Merged with below three)<br>(b) Performance test of a single centrifugal pump<br>(c) Performance test of centrifugal pumps connected in series<br>(d) Performance test of centrifugal pumps connected in parallel |
| Week-11 | Expt-06: (a) Study of Propeller Turbine Characteristics<br>(b) Performance test of a Pelton wheel and Francis Turbine. |
| Week-13 | Expt-07: Study about, compressor (Single Stage and Multistage) and Blowers |
| Week-14 | Quiz Test |

| **Components** | | **Grading** |
|---|---|---|
| Continuous Assessment (60%) | Lab participation and Report | 30% |
| | Labtest-1, Labtest-2 | 30% |
| Lab Quiz | | 40% |
| Total Marks | | 100% |

**REFERENCE BOOKS**

1. Fluid Mechanics-1, Victor, L. Streeter.
2. Fluid Mechanics: Fundamentals and Applications by Yunus A. Cengel, John Cimbala.
3. Mechanics of Fluids by Irving Herman Shames.
4. Fluid Mechanics Through Worked out Problems- A.C. Mandal & M.Q. Islam

**Course Code:** IPE 400 **Course Title:** Final Year Design & Research Project

**Credit Hour:** 3.00 (6.00 in 2 consecutive semesters in L-4)**;** **Contact Hour:** 6.00

**Course Curriculum:** Outcome Based Education (OBE)

**Pre-requisites:**
(1) IPE 105: Engineering Materials
(2) IPE 107: Engineering Economy
(3) ME 160: Engineering Drawing
(4) IPE 243: Mechanics of Solids
(5) IPE 271: Engineering Mechanics and Theory of Machines
(6) IPE 303: Product Design

## Synopsis/Rationale:

The Final Year Design and Research Project (FYDRP) aims to further develop the skills of students to analyze and solve engineering problems in scientific way. It provides students the opportunities to apply all the engineering knowledge obtained through previous course works. They will get the opportunity to execute the innovative and goal-oriented research approach in solving complex scientific problems by working in a team of two, three or more members. Throughout these research experiences, not only they will strengthen their research skills, but they will also realize the significance of scientific research on our society.

## Objectives:

1. To develop skills in critical review of relevant research literature and gain in-depth understanding of the related work and research findings.
2. To be able to identify gaps in the current knowledge and its impact on society, environment and sustainability.
3. To be able to design experiments and/or develop models to breeze the research gap.
4. To understand the theoretical underpinnings and procedures to be employed forcompleting a project or research thesis.
5. To be able to design and perform experiments and utilize obtained results for deriving at research conclusions.
6. To use modern tools for simulation, modeling, experimentation and validation inorder to achieve project or research goals.
7. To be competent in oral presentations to be delivered in public to convince the examiners.
8. To work effectively in a team to successfully complete the project wok
9. To be competent in oral presentations to be delivered in public to convince the examiners.
10. To work effectively in a team to successfully complete the project wok
11. To observe ethical norms at the stage of literature review and during the performance of the entire project and thesis work
12. To exhibit engineering management and financial management skills in executing the project and thesis work

## Course Outcomes (CO):

Upon completion of this course, the student should be able to:

| No. | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO1 | **Search** and critically **review** relevant research literature to evaluate existing research and technologies relevant to the field of research to gain an in-depth understanding of the related work and research findings. | C2-C5 | 1 | 1 | 8 | R |
| CO2 | **Identify** the research gaps in existing research and **formulate** research objectives and hypotheses to solve these gaps. | C4-C6 | 1 | 2 | 7, 8 | R, Pr |
| CO3 | **Explore** the impact of proposed research on society, environment and sustainability. | C1-C4 | | | 6 | R |
| CO4 | **Demonstrate** the theory, methods and procedures to be employed to complete the research project. | C2, C3 | 2 | 3 | 1, 7, 8 | R |
| CO5 | **Develop** experimental setups to perform experiments to acquire experimental results for validation of research hypotheses. | C3, C4 | 1 | 3 | 5, 6 | R |
| CO6 | **Apply** modern tools (hardware and software) for modeling, simulation and experimentation in order to achieve research goals. | C3-C6 | 1 | 1 | 4, 6 | R, Pr |

| | | | | | | |
|---|---|---|---|---|---|---|
| CO7 | **Develop** proficiency in technical writing by summarizing the research findings. | C5 | 1 | 2 | 6 | R |
| CO8 | **Demonstrate** mastery of oral presentations to convince the examiners. | C3 | 1 | | 6, 7 | Pr |
| CO9 | **Demonstrate** the ability to work successfully as a member of a team of two, three or more members to successfully complete the research project. | C3 | | | 7 | R, Pr |
| CO 10 | **Demonstrate** adherence to ethical norms throughout the entire period of project performance and thesis writing. | C3 | | | 7 | R, Pr |
| CO1 1 | **Apply** project and financial management skills in accomplishing the research project. | C4 | | | 7 | R, Pr |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam) | | | | | | |

## Course Contents:

Working in groups of two under the direction and continuing guidance of a project supervisor, the research project/thesis requires independent thought and action. It will simulated professional context where students, as engineers, have to investigate a particular problem in some depth and produce both an analysis of the problem and its innovative solution. The basis of the solution must include a formal thesis and a presentation.

The contents and skills needed to be reviewed or mastered by the students will depend on the type of project or research. Some will focus primarily on laboratory work and can involve substantial liaison with local industry, while others may be more analytical or computational and involve working with research institutes. It must be noted that individual grades are awarded for this research project/thesis based on continuous and formative performance.

## Teaching-learning and Assessment Strategy:

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Face-to-Face Learning | |
| Consultation with Supervisor | 42 |
| Practical / Tutorial / Studio | 20 |
| Student-Centred Learning | - |

| | |
|---|---|
| Self-Directed Learning | |
| Non-face-to-face learning | 40 |
| Consultation with collaborators | 20 |
| Presentation and Report Preparations | 40 |
| Formal Assessment | |
| Continuous Assessment (mini presentations, preliminary reports) | 5 |
| Final Presentations | 0.5 |
| Total | 167.5 |

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| Assessment Strategies | | | Course Outcome | Bloom's Taxonomy |
|---|---|---|---|---|
| | Components | Grading | | |
| Final Year Thesis | Literature Review | 20% | CO1 | C2-C5 |
| | Significance of research project on society | 8% | CO2 | C1-C4, C6 |
| | Impact of research on environment and sustainability | 5% | CO3 | C1-C4 |
| | Methodology | 10% | CO4 | C2-C5 |
| | Model formulation and design of experiment | 10% | CO5 | C3, C4 |
| | Application of modern tools in thesis | 8% | CO6 | C3, C4, C6 |
| | Final thesis report writing | 10% | CO7 | C5 |
| | Practice of ethical norms in accomplishment of thesis | 5% | CO8 | C3 |
| | Team work | 8% | CO10 | C3 |

| | | | | |
|---|---|---|---|---|
| | Time management and financial management | 6% | CO11 | C4 |
| | Thesis defense presentation | 10% | CO9 | C3 |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**Mapping of Course Outcomes and Program Outcomes:**

| **No.** | **Course Outcomes (CO) of the Course** | Engineering Knowledge | Problem Analysis | Design / Development of Solutions | Investigation | Modern Tool Usage | The Engineer and Society | Environment and Sustainability | | Communication | Individual and Team Work | Project Management and Finance | Life Long Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| CO1 | **Search** and critically **review** relevant research literature to evaluate existing research and technologies relevant to the field of research and to gain an in-depth understanding of the related work and research findings. | | | | ✓ | | | | | | | | |
| CO2 | **Identify** the research gaps in existing research and formulate research hypotheses to solve these gaps. | ✓ | | | ✓ | | | | | | | | |
| CO3 | **Explore** the impact of proposed research hypotheses on society, environment and sustainability. | | | | | | | ✓ | | | | | |
| CO4 | **Demonstrate** the theory, methods and procedures to be employed to complete the research project. | ✓ | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO5 | **Develop** experimental setups to perform experiments to acquire experimental results for validation of research hypotheses. | | | ✓ | | | | | | ✓ | | | |
| CO6 | **Apply** modern tools (hardware and software) for modeling, simulation and experimentation in order to achieve research goals. | | | ✓ | | ✓ | | ✓ | | | | | |
| CO7 | **Develop** proficiency in technical writing by summarizing the research findings. | | | | | | | | | ✓ | ✓ | | |
| CO8 | **Demonstrate** mastery of oral presentations by being able to deliver public presentation to convince examiners. | | | | | | | | | ✓ | | | ✓ |
| CO9 | **Demonstrate** the ability to work in a team of two, three or more members to successfully complete the research project. | | | | | | | | | | ✓ | | ✓ |
| CO10 | **Demonstrate** commitment towards ethics in all affairs pertaining to project or thesis. | | | | | | ✓ | | ✓ | | | | |
| CO11 | **Ensure** the time management and financial management skills in accomplishing research project successfully. | | | | | | | | | | | ✓ | ✓ |

## Lecture Schedule:

| Week | Consultation with supervisor | Topics | Assessment |
|---|---|---|---|
| **1** | Meeting 1 | Introductory meeting, norming, group dynamics discussion, guidance | R |
| **2** | Meeting 1 | Feedback on progress, consultation on problems | |
| **3** | Meeting 1 | Discussion with collaborators (if any), reviewing and modifying approach | |
| **4** | Meeting 1 | Feedback | |
| **5** | Meeting 1 | Discussion and consultation | |

| | | | |
|---|---|---|---|
| **6** | Mock Presentation | Suggestions on improving write-up and presentation | R, Pr |
| **7** | **Mid term Presentation** | Evaluation of students' performance and **feedback on improvement. Guidance if needed.** | |
| **8** | Meeting 1 | Consultation of project report/thesis writing of relevant chapters | |
| **9** | Meeting 1 | Feedback on writing and findings | R |
| **10** | Meeting 1 | Feedback and consultation | |
| **11** | Meeting 1 | Final adjustments and validation of work | |
| **12** | Meeting 1 | Review of current progress and guidance on meeting the expected deadlines and future work. | |
| **13** | Mock Presentation | Consultation for preparation of final report/thesis and final presentation | R, Pr |
| **14** | **Final Review meeting 1** | Review and feedback of students' **performance. Appreciation of goals and targets met. Preparation of final report and presentation** | |

(PR – Project; ASG – Assignment; PR – Presentation; R - Report; F – Final Exam)

## Teaching Methodology:

Consultation, discussion based on meetings, feedback on presentation and thesis etc.

## Text and Ref Books:

g) Research Design: Qualitative, Quantitative and Mixed Methods Approaches, 4th Edition, John W. Creswell
h) Shigley's Mechanical Engineering Design, SI edition - Richard Budynas, Keith Nisbett
i) The Mechanical Design Process, 7th edition, David Ullman
j) The Research Methods Knowledge Base, 3rd Edition, William M. K. Trochim & James P. Donnelly

**Course Code:** IPE 405 **Course Name:** Supply Chain Management
**Credit Hour:** 3.00 **Contact Hour:** 3.00
**Level/Term:** Level 4/Term I

**Curriculum Structure:** Outcome Based Education (OBE)

**Pre-requisite:** None

**Rationale:**

The main course's objective is to teach students the fundamentals of a supply chain management system and facilitate professional exposure. This course provides an introduction to the supply chain. Supply Chain Management is about the management of material, information, and finance flows in multi-stage production-distribution networks.

**Objectives:**

1. To introduce students to procedure of supply chain system
2. To expose students to supply chain networks based on transportation systems
3. To develop students' ability to analyze the critical performance parameters of a supply chain system
4. To make students familiarize about suppliers and selection of the best ones
5. To introduce students to the detailed phases of supply chain and their long-term control

**Course Outcomes (CO) & Generic Skills:**

Upon completion of this course, the student should be able to:

| | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO1 | **Explain** the major areas of supply chain | C1-C3 | | | 4,7 | T, MT |
| CO2 | **Apply** the knowledge of fundamentals of supply chain to make procurement decisions | C2-C4 | 1 | | 2-4 | MT |
| CO3 | **Evaluate** different modes of transportation with respect to minimum cost | C2-C5 | 1 | | 2-4 | T, F |
| CO4 | **Apply** the inventory analysis knowledge to prepare optimum inventory policy | C2-C4 | 1 | | 2-4 | T, F |
| CO5 | **Analyze** multiple warehousing and material handling options to choose the most appropriate one depending on the facility | C3 | 2 | | 2-4 | F, ASG |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; MT – Mid Term; PR – Project; Q – Quiz; ASG – Assignment; PR – Presentation; R - Report; F – Final Exam) | | | | | | |

**Course Contents:**

**a. Main Contents:**

Introduction to supply chain management, Materials planning, Procurement management, Inventory systems management, Stores management, Physical distribution

**b. Detailed Contents:**

Introduction to supply chain management: supply chain, systems approach to management, materials management, major areas of supply chain management, forward and backward linkage; Materials planning: role of forecasting, market demand estimation.; Procurement management: procurement cycle, materials sourcing, vendor evaluation and selection, make-buy decision, multi-criteria decision making in supplier selection, negotiation, transportation, logistics, incoming materials inspection; Inventory systems management: different types of product structures for materials planning, management of raw materials, work-in-process (WIP), finished goods and spare parts inventories, lead time management, cycle time reduction; Stores management: stores layout planning, addressing systems, codification systems, traceability, physical verification and counting, surplus and waste management; Physical distribution: network planning, packaging, materials handling, carrier systems, distribution inventory, legal aspects and common rules of transportation.

**Mapping of Course Outcomes and Program Outcomes:**

| Course Learning Outcomes | | Engineering Knowledge | Problem Analysis | Design / Development of Solutions | Investigation | Modern Tool Usage | The Engineer and Society | Environment and Sustainability | Ethics | Communication | Individual and Team Work | Project Management and Finance | Life Long Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | Explain the major areas of supply chain**.** | √ | √ | | | | | √ | | | | | |
| **CO2** | Apply the knowledge of fundamentals of supply chain to make procurement decisions. | √ | √ | | | | | | | | | | |
| **CO3** | Evaluate different modes of transportation with respect to minimum cost**.** | √ | √ | | | | | | | | | | |
| **CO4** | Apply the inventory | √ | √ | | | | | | | √ | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | analysis knowledge to prepare optimum inventory policy. | | | | | | | | | | | | |
| **CO5** | Analyze from multiple warehousing and material handling options to choose the appropriate one depending on the facility. | √ | √ | | | | | | | | √ | | |

**Teaching-learning and Assessment Strategy:**

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Face-to-Face Learning | |
| Lecture | 42 |
| Practical / Tutorial / Studio | - |
| Student-Centred Learning | - |
| Self-Directed Learning | |
| Non-face-to-face learning | 40 |
| Revision | 20 |
| Assignment Preparations | 20 |
| Formal Assessment | |
| Continuous Assessment | 2 |
| Final Examination | 3 |
| Total | 127 |

**Teaching Methodology:**

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method, Multi-media Presentation, Class Presentation, Assignments, Class Tests, Exams, Feedback at every step.

**Lecture Schedule:**

| Week | Lecture | Topics | TEST |
|---|---|---|---|
| **1** | Lec 1 | Supply chain, systems approach to management | |
| | Lec 2 | Materials management | |
| | Lec 3 | Major areas of supply chain management | |
| **2** | Lec 4 | Forward and backward linkage | |
| | Lec 5 | Role of forecasting, market demand estimation | |
| | Lec 6 | Procurement cycle | |
| **3** | Lec 7 | Materials sourcing | **Class Test 1** |
| | Lec 8 | Make-buy decision | |
| | Lec 9 | Multi-criteria decision making in supplier selection | |

| | | | |
|---|---|---|---|
| **4** | Lec 10 | Negotiation | |
| | Lec 11 | Transportation | |
| | Lec 12 | | |
| **5** | Lec 13 | Logistics | |
| | Lec 14 | | |
| | Lec 15 | Incoming materials inspection | |
| **6** | Lec 16 | Different types of product structures for materials planning | **Class Test 2** |
| | Lec 17 | Management of raw materials | |
| | Lec 18 | Work-in-process (WIP) | |
| **7** | Lec 19 | Finished goods and spare parts inventories | |
| | Lec 20 | Cycle time reduction | |
| | Lec 21 | | |
| **8** | Lec 22 | Lead time management | **Mid Term / Project** |
| | Lec 23 | | |
| | Lec 24 | | |
| **9** | Lec 25 | Stores layout planning | |
| | Lec 26 | | |
| | Lec 27 | | |
| **10** | Lec 28 | Addressing systems | **Class Test 3** |
| | Lec 29 | Codification systems | |
| | Lec 30 | Traceability | |
| **11** | Lec 31 | Physical verification and counting | |
| | Lec 32 | Surplus and waste management | |
| | Lec 33 | | |
| **12** | Lec 34 | Network planning | |
| | Lec 35 | | |
| | Lec 36 | | |
| **13** | Lec 37 | Packaging, materials handling | |
| | Lec 38 | Carrier systems, distribution inventory | |
| | Lec 39 | Legal aspects and common rules of transportation. | |
| **14** | Lec 40 | Review class | |
| | Lec 41 | | |
| | Lec 42 | | |

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| Assessment Strategies | | | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| Components | | Grading | | |
| Continuous Assessment (40%) | Test 1-3 | 20% | CO 1 | C1-C3 |
| | | | CO 3 | C2-C5 |
| | | | CO 4 | C2-C4 |
| | Class Participation | 5% | CO 2 | C2-C4 |
| | | | CO 5 | C3 |
| | Attendance | 5% | - | - |
| | Mid term | 10% | CO 1 | C1-C3 |
| | | | CO 2 | C2-C4 |
| Final Exam | | 60% | CO 3 | C2-C5 |
| | | | CO 4 | C2-C4 |
| | | | CO 5 | C3 |
| Total Marks | | 100% | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**Text and Ref Books:**

1. "Supply chain Management" by *Sunil Chopra, Peter Meindl, 2016*
2. "Principles of Supply Chain Management: A Balanced Approach" by *J. D. Wisner, 2018*
3. Green Supply Chain Management, "Logistics & Transportation — A Canadian Perspective", *2009*

**Reference Site:**

https://classroom.google.com/ (To be announced)

**Course Code:** IPE 411 **Course Name:** CAD/CAM
**Credit Hour:** 3.00 **Contact Hour:** 3.00
**Level/Term:** L-4, T-1

**Curriculum Structure**: Outcome Based Education (OBE)

**Pre-requisites:** None

**Synopsis/Rationale:**

To design, analyze and select commonly used robots and implement NC, CNC program based manufacturing using computer controlled machines and rapid tooling techniques.

**Objectives:**

1. To introduce the essential components of computer graphics systems such as coordinate systems, transformation of 2D and 3D objects, projections and views of 2D and 3D objects.
2. To introduce the different types of mathematical representation procedures of geometric modeling such as mathematical representation of curves, surfaces and solids.
3. To develop skills for designing and integrating industrial robots into manufacturing processes.
4. To investigate diverse applications of industrial robots, gaining experience in applications of automation.
5. To examine and apply foundational principles to design and optimize automated production for enhanced efficiency.

**Course Outcomes (CO) & Generic Skills:**

Upon completion of this course, the student should be able to:

| No. | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO1 | **Explain** the basic concepts of the computer graphics display used in CAD. | C4-C6 | 1, 2 | | 2 | T, M, F |
| CO2 | **Explain** the basic concepts of the geometric modeling used in CAD. | C3-C6 | 1, 2 | 3 | 2, 3 | T, F |
| CO3 | **Design**, apply and integrate industrial robots, integrating them into production line for flexible automation. | C3, C4 | 3 | 3 | 3,4, 5 | T, M, F |
| CO4 | **Explore** fundamental principles for designing and optimizing automated production lines, to enhance efficiency. | C4, C5, C6 | 3 | 3 | 3-6 | T, F |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, CT – Class Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; Midterm exam-M; F – Final Exam) | | | | | | |

**Course Contents:**

**Computer Graphics:** Coordinate systems, 2D and 3D Transformation of object: translation, scaling, reflection or mirror, rotation; Projection and views: parallel projection and view, oblique projection and view, perspective projection and view.

**Geometric Modeling:** requirements of geometric modeling, designing and drafting, representation of geometric modeling, wireframe modeling, mathematical representation of curves, parametric and non-parametric representation of curve, analytical curves, synthetic curves, polynomial curves, Hermite cubic spline curve, Bezier curve, b-spline curve, non-uniform rational b-spline curve, mathematical representation of surfaces, analytical surfaces, synthetic surfaces, Bezier surface, b-spline surface, solid modeling, topology and geometry, solid representation, set operations in solid modeling, solid modeling schemes: constructive solid geometry (CSG), boundary representation (b-rep), sweeping.

**Industrial Automation**: Robot anatomy, Drive systems of robots, Electrical and hydraulic systems, AC and DC drives, Servo drives using voltage control, current control and direct torque control, PID control systems and performance issues. Feedback systems, Single loop and multi-loop, DSP based motion control systems, Sensors for industrial robots, encoders, resolvers, hall-effect sensors, acoustic sensors, ultrasonic and optical/infrared sensors, Elements of robot vision, Integration using PLCs, digital motion planning systems

**Computer Control Machines**: Introduction, classification, design features and control features of CNC machines; Programming: G and M Code programming, Offline (APT-like) programming; free form surface machining: Isoparametric, Isoplanar and Isoscallop machining strategies.

**Mapping of Course Outcomes and Program Outcomes:**

| **No.** | **Course Outcomes (CO) of the Course** | **Program Outcomes (PO)** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Engineering Knowledge | Problem Analysis | Design / Development of Solutions | Investigation | Modern Tool Usage | The Engineer and Society | Environment and Sustainability | Ethics | Communication | Individual and Team Work | Project Management and Finance | Life Long Learning |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| CO1 | **Explain** the basic concepts of the computer graphics display used in CAD. | ✓ | ✓ | ✓ | | | | | | | | | |
| CO2 | **Explain** the basic concepts of the geometric modeling used in CAD. | ✓ | ✓ | ✓ | | | | | | | | | |
| CO3 | **Design**, apply and | ✓ | | ✓ | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | integrate industrial robots, integrating them into production line for flexible automation. | | | | | | | | | | | | |
| CO4 | **Explore** fundamental principles for designing and optimizing automated production lines, to enhance efficiency. | ✓ | | ✓ | | ✓ | | | | | | | |

**Teaching-learning and Assessment Strategy:**

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Face-to-Face Learning | |
| Lecture | 42 |
| Practical / Tutorial / Studio | - |
| Student-Centred Learning | - |
| Self-Directed Learning | |
| Non-face-to-face learning | 40 |
| Revision | 20 |
| Assignment Preparations | 20 |
| Formal Assessment | |
| Continuous Assessment | 2 |
| Final Examination | 3 |
| Total | 127 |

**Teaching Methodology:**

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method, Multi-media Presentation, Class Presentation, Visualization using Computer Simulations, Assignments, Class Tests, Exams, Feedback at every step.

**Lecture Schedule:**

| Week | Lecture | Topics | ASSESSMENT |
|---|---|---|---|
| **1** | Lec 1<br><br>Lec 2<br><br>Lec3 | Introduction to Computer-Aided Design (CAD) and Computer-Aided Manufacturing (CAM).<br><br>Introduction to computer graphics. Different types of coordinate systems considered in CAD. Transformations between coordinate systems.<br>Different types of geometric transformation of 2D object in coordinate systems. | **Class Test 1, ASG, F** |
| **2** | Lec 4<br><br>Lec 5-6 | Different types of geometric transformation of 3D object in coordinate systems.<br>Different types of projections and views of object. | |
| **3** | Lec 7<br><br>Lec 8<br><br>Lec 9 | Introduction to geometric modeling and different types of three-dimensional representations of geometric model.<br>Wireframe modelling: wireframe data base, wireframe entities, construction of objects wireframe modelling.<br>Introduction to mathematical representation of curve. | |
| **4** | Lec 10<br><br>Lec 11-12 | Parametric and non-parametric representation of curve and Introduction to curve fitting.<br>Analytic and synthetic curves. Hermite cubic spline curve. | **Class Test 2, ASG, PR, F** |
| **5** | Lec 13<br>Lec 14<br><br>Lec 15 | Bezier curve.<br>B-spline curve.<br>Topology and Geometry. Solid entities. | |
| **6** | Lec 16<br><br>Lec 17<br>Lec 18 | Solid representation. Set operations used in solid modelling.<br>Solid modelling scheme: Constructive Solid Geometry (CSG) method | |
| **7** | Lec 19<br>Lec 20<br>Lec 21 | Constructive Solid Geometry (CSG) method<br>Boundary representation (b-rep) method.<br>Sweeping method. | |
| **8** | Lec 22<br>Lec 23<br>Lec 24 | Introduction to Automation, CAD/CAM/CAE: Overview of product life cycle, Essential components of soft automation (CAD and CAM).<br>NC Machine tool: Historical Development, Principle of Numerical Control, Classification of Numerical Control, Numerical Control System. | **Mid Term, F** |

| | | | |
|---|---|---|---|
| | | Principle of Numerical Control, Classification of Numerical Control, Numerical Control System. | |
| **9** | Lec 25<br>Lec 26<br>Lec 27 | Coordinate system, NC Program storage media,<br>Symbolic codes NC words, part programming, tool radius compensation.<br>G&M code applications and NC Par Programming examples and problem solving. | |
| **10** | Lec 31<br>Lec 32<br>Lec 33 | APT programming features<br>Definition of Geometry statements<br>Geometry statement (examples) | |
| **11** | Lec 28<br>Lec 29<br>Lec 30 | Definition of Motion statements<br>Definition of Motion statements<br>Motion statement (examples) | **Class Test 3, ASG, R, PR, F** |
| **12** | Lec 34<br>Lec 35<br>Lec 36 | Geometry definition for turning and 21/2 axis milling<br>Tool path generation, simulation and verification<br>free form surface machining | |
| **13** | Lec 37<br>Lec 38<br>Lec 39 | Overview, specific, RP &M process,<br>Application of RP and M, Stereo lithography process,<br>Selective Laser Sintering, 3D Printing, Direct Tooling example | |
| **14** | Lec 40<br>Lec 41<br>Lec 42 | Geometry input, Support Structure, Slice and Merge<br>Software technology for RP&M<br>**Review** | |

(PR – Project ; ASG – Assignment; PR – Presentation; R - Report; F – Final Exam)

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| Assessment Strategies | | | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| Components | | Grading | | |
| Continuous Assessment (40%) | Test 1-3 | 20% | CO1 | C4-C6 |
| | | | CO2 | C3-C6 |
| | | | CO3 | C3, C4 |
| | | | CO4 | C4, C5, C6 |

| | | | | |
|---|---|---|---|---|
| | Class Participation | 5% | - | - |
| | Attendance | 5% | - | - |
| | | | | |
| | Mid term | 10% | CO 1 | C4-C6 |
| | | | CO 3 | C3, C4 |
| Final Exam | | 60% | CO 1 | C4-C6 |
| | | | CO 2 | C3-C6 |
| | | | CO 3 | C3, C4 |
| | | | CO 4 | C4, C5, C6 |
| Total Marks | | 100% | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**Text and Ref Books:**

d) CAD/CAM: Computer-aided Design and Manufacturing - Mikell Groover
e) CAD/CAM theory and practice - Ibrahim Zeid
f) CAD/CAM/CIM - P. Radhakrishnan, S. Subramanyan, and V. Raju

**Course Code: IPE 412** **Course Name: CAD / CAM Sessional**
**Credit Hour: 0.75** **Contact Hour: 1.5**
**Level/Term: L-4, T-2**
Curriculum Structure: Outcome Based Education (OBE)
Pre-requisites: Concurrent with IPE 411

**Rationale:**
The main aim is the use of computer systems to aid in the creation, modification, analysis or optimization of a design.

**Objective:**

1. Create 2D and 3D computer drawings and models for manufacturing and prototyping.
2. Evaluate mechanical designs and select the proper access and materials for production.
3. Evaluate computer aided design models and assemblies based on critical thinking and problem-solving skills.
4. Apply design principles and rationale in a realistic and original design project.
5. Develop and present drawings and prototypes to the class.

**Course Outcomes (CO) Generic Skills:**
Upon completion of this course, the student should be able to:

| No. | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO1 | **Create** 2D and 3D computer drawings and **model** for manufacturing and prototyping. | C6 | 1 | 1,3 | 1,2 | R |
| CO2 | **Evaluate** mechanical designs and **select** the proper access and materials for production. | C3, C5 | 1, 2 | 1,2 | 5,6 | R |
| CO3 | **Evaluate** computer aided design models and assemblies based on critical thinking and problem solving skills. | C5 | 1, 2 | 1 | 5,6 | ASG,R |
| CO4 | **Apply** design principles and **rationale** in a realistic and original design project. | C3, C4 | 1 | 5 | 2 | ASG, R |
| CO5 | **Develop** and **present** drawings and prototypes to the class. | C4 – C6 | 1 | 5 | 6,7 | PR,ASG, R |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam) | | | | | | |

**Course Content:**

Introduction to CAD/CAM, Geometric modeling, Computer graphics, Product Design and development using CATIA, Future directions for CAD/CAM, CAD/CAM Programming using MASTERCAM, Solid works CAD/CAM package.

**Mapping of Course Outcomes (CO) and Program Outcomes:**

| Course Learning Outcomes | | Engineering Knowledge | Problem Analysis | Design / Development of Solutions | Investigation | Modern Tool Usage | The Engineer and Society | Environment and Sustainability | Ethics | Communication | Individual and Team | Life Long Learning | Project Management and Finance |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | To **create** 2D and 3D computer drawings and **models** for manufacturing and prototyping. | ✓ | | | | | | | | | | | |
| **CO2** | **Evaluate** mechanical designs and select the proper access and materials for production. | | ✓ | ✓ | | | | | | | | | |
| **CO3** | **Evaluate** computer aided design models and assemblies based on critical thinking and problem solving skills. | | ✓ | ✓ | | | | | | | | | |
| | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO4** | **Apply** design principles and **rationale** in a realistic and original design project. | ✓ | | ✓ | | | | | | | | | |
| **CO5** | **Develop** and **present** drawings and prototypes to the class. | | | ✓ | ✓ | | | | | | | ✓ | |

**Lecture schedule:**

| **Week No** | **Content** | **Remark** |
|---|---|---|
| 1 | Intro | |
| 2 | CATIA | Assignment (Extra) |
| 3 | CATIA | Submit Assignment 1 |
| 4 | CATIA | Submit Assignment 2 |
| 5 | CATIA | |
| 6 | **Quiz 1** | Submit Assignment 3 |
| 7 | CATIA | Submit Assignment 4, 5<br><br>20% Drawing of the presentation should be completed (will be discussed in class for specific need/struggle you are facing to draw the product assigned) |
| 8 | CATIA | Submit Assignment 6, Draft submission of the report |
| 9 | CATIA | Submit Assignment 7, **Report submission, report Friday** |
| 10 | **Quiz 2** | Submit Assignment 8 |
| 11 | CATIA | Initial submission of the SolidWorks drawing (Group wise) for the *presentation*. At least 80% of the drawing should be completed by this time |

| | | |
|---|---|---|
| 12 | CATIA | Submit Assignment 9, Submit an initial Draft of the Presentation |
| 13 | **Presentation** | Submit Assignment 10 |
| 14 | **Viva** | |

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

<table>
<tr><th colspan="3">Assessment Strategies</th><th rowspan="2">CO</th><th rowspan="2">Bloom’s Taxonomy</th></tr>
<tr><th colspan="2">Components</th><th>Grading</th></tr>
<tr><td rowspan="10">Continuous Assessment (70%)</td><td rowspan="5">Weekly Reports</td><td rowspan="5">20%</td><td>CO 1</td><td>C6</td></tr>
<tr><td>CO 2</td><td>C3, C5</td></tr>
<tr><td>CO 3</td><td>C5</td></tr>
<tr><td>CO 4</td><td>C3, C4</td></tr>
<tr><td>CO 5</td><td>C4 – C6</td></tr>
<tr><td rowspan="4">Class Participation</td><td rowspan="4">40%</td><td>CO 1</td><td>C6</td></tr>
<tr><td>CO 2</td><td>C3, C5</td></tr>
<tr><td>CO 3</td><td>C5</td></tr>
<tr><td>CO 4</td><td>C3, C4</td></tr>
<tr><td>Presentation</td><td>10%</td><td>CO 5</td><td>C4 – C6</td></tr>
<tr><td colspan="2" rowspan="5">Final Report</td><td rowspan="5">30%</td><td>CO 1</td><td>C6</td></tr>
<tr><td>CO 2</td><td>C3, C5</td></tr>
<tr><td>CO 3</td><td>C5</td></tr>
<tr><td>CO 4</td><td>C3, C4</td></tr>
<tr><td>CO 5</td><td>C4 – C6</td></tr>
<tr><td colspan="2">Total Marks</td><td>100%</td><td colspan="2"></td></tr>
</table>

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**Text and Ref Books:**
l. CAD/CAM Lab Manual Book by Sathish D

**Reference Site:**

https://classroom.google.com/ (To be announced)

**Course Code:** IPE 418 **Course Name:** Mechatronics & Industrial Automation Sessional
**Credit Hour:** 0.75 **Contact Hour:** 1.50
**Level/Term:** L-4, T-2

**Curriculum Structure:** Outcome Based Education (OBE)

**Pre-requisites:** NA

**Rationale:**

This sessional course follows the Outcome Based Education (OBE) guidelines. The objective of this course is to instill in students the practical knowledge and skill to automate planning, production, material handling and control in the era of Industry 4.0. This course provides hands on experience on designing and maintaining automation system that have become part and parcel of modern industries.

**Objectives:**

1. To help students identify the basic components of manufacturing automation and categorize different types of automated production processes
2. Make students understand the performance and dynamic characteristics of industrial robots and the principles of industrial sensors
3. To develop the skills to apply electrical, mechanical and pneumatic actuators, design elementary mechanisms for automated machinery
4. Understand the operation of common industrial controllers (PLCs)

**Course Outcomes (CO):**

Upon completion of this course, the student should be able to:

| No. | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO 1 | **Knowledge** to **apply** principles of industrial automation to the solution of specific manufacturing challenges | C1-C3 | 1 | 2 | 2 | Pr, R, Q |
| CO 2 | **Program** and **operate** an industrial robot, setup and implement pneumatic circuits, **setup and implement** computer vision systems, material handling systems | C4-C6 | 2 | 2 | 1 | ASG, R Pr, Q |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | |
| CO 3 | **Integrate** a number of these manufacturing technologies in an automated work cells | C3-C6 | 2 | 2 | 2 | ASG, Q |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam) | | | | | | |

**Course Contents:**

**Industrial robotics:** Industrial sensors and switches, PLC, Assembly machines (continuous transfer, intermittent transfer), Industrial control

**Automated material handling system:** Transportation devices ,Feeding and orientation devices (in-bowl tooling, feed tracks, escapements), Assembly systems , Machine vision system

**Mapping of Course Outcomes and Program Outcomes:**

| Course Learning Outcomes | | Engineering Knowledge | Problem Analysis | Design / Development of Solutions | Investigation | Modern Tool Usage | The Engineer and Society | Environment and Sustainability | Ethics | Communication | Individual and Team Work | Lifelong Learning | Project Management and Finance |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | Students will be able to apply principles of industrial automation to the solution of specific manufacturing challenges | ✓ | ✓ | ✓ | ✓ | ✓ | | | | ✓ | ✓ | ✓ | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO2** | They will be able to program and operate an industrial robot, setup and implement pneumatic circuits, setup and implement computer vision systems, material handling systems | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | ✓ | ✓ | |
| **CO3** | Integrate a number of these manufacturing technologies in an automated work cells | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | ✓ | |

**Teaching-learning and Assessment Strategy:**

| Teaching and learning activities | Engagement (hours) |
|---|---|
| Face-to-face learning | |
| Lecture | 7 |
| Practical/ Tutorial/ Studio | 14 |
| Student-centred learning | - |
| Self-directed learning | |

| | |
|---|---|
| Non face-to-face learning<br>Revision<br>Assessment preparations | 10<br>5<br>7 |
| Formal Assessment<br>Continuous Assessment<br>Final Examination | <br>3.5<br>1.5 |
| Total | 48 |

**Teaching methodology:**

Lecture and Discussion, Practical Sessions, Co-operative and Collaborative Method,

**Lecture Schedule:**

| Week | Lecture | Topics | TEST |
|---|---|---|---|
| **1** | Lec 1 | Industrial robotics | **Q,P,Pr** |
| **2** | Lec 2 | Industrial robotics (contd.) | |
| **3** | Lec 3 | Industrial sensors and switches | |
| **4** | Lec 4 | PLC | **Q, P, Pr** |
| **5** | Lec 5 | PLC (contd.) | |
| **6** | Lec 6 | PLC (contd.) | |
| **7** | Lec 7 | Assembly machines | |
| **8** | Lec 8 | Industrial control | **Q, ASG** |

| | | | |
|---|---|---|---|
| **9** | Lec 9 | Transportation devices | |
| **10** | Lec 10 | Transportation devices (Contd.) | |
| **11** | Lec 11 | Feeding and orientation devices | |
| **12** | Lec 12 | Machine vision system | |
| **13** | Lec 13 | Assembly systems | |
| **14** | Lec 14 | Review | |

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| Components | | Grading | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| Continuous Assessment (40%) | Quiz 1-2 | 50% | CO 1 | C1-C3, P1 |
| | | | CO 2 | C3-C5, P2 |
| | Class Participation | 10% | CO 1 | C1-C3, P1 |
| | | | CO 2 | C3-C5, P2 |
| Final Quiz | | 40% | CO 2 | C1-C3, P2 |
| | | | CO 3 | C3-C6, P4-P5 |
| Total Marks | | 100% | | |

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

**Text and Ref Books:**

5. James A. Rehg, Introduction to Robotics in CIM Systems, 5th edition

**Course Code:** IPE 419 **Course Name:** Modeling and Simulation

**Credit Hour:** 3.00 **Contact Hour:** 3.00

**Level/Term:** L-4, T-2

**Curriculum Structure:** Outcome-Based Education (OBE)

**Pre-requisites:** None

**Synopsis/Rationale:**

This Outcome-Based Education (OBE) based course is designed to introduce students to the modeling and simulation approach. It emphasizes feasible processes to conduct an in-depth study on the use of models as a basis for simulations to develop data utilized for managerial or technical decision making.

**Objectives:**

1. To explain feasible solutions to discrete event problems.
2. To expose students to various models and their feasibility.
3. To conduct a detailed study of simulation modeling, simulation experimentation, and analysis.
4. To introduce students to Monte Carlo simulation.
5. To conduct feasibility study on network system simulation.

**Course Outcomes (CO) & Generic Skills:**

**At the end of the course the students will be able to:**

| No. | **Course Learning Outcome** | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| **CO1** | **Prepare** feasible solutions to discrete event problems. | C1-C3 | 1 | | 2, 3 | T, Mid Term, |
| **CO2** | **Derive** simulation modeling using the arena package. | C1, C4 | 2 | 2 | 2, 3 | T, F |
| **CO3** | **Derive** the most feasible layout of an existing production line. | C3, C4 | 3 | 5 | 2, 3 | T, Mid Term Exam, F |

| | | | | | | |
|---|---|---|---|---|---|---|
| **CO4** | **Prepare** multi-resolution and multi-aspect modeling. | C1- C3 | 3 | 2 | 2, 3 | T, F |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T-Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam) | | | | | | |

**Course Contents:**

Basic concepts of simulation (definitions and types of simulations), Mechanism of discrete event simulation, Random number generation, Input data analysis (input distribution modeling), Simulation modeling using Arena package, Review of probability and statistics, Simulation output analysis, Monte Carlo simulation, Verification and validation of simulation models, Other simulation approaches (Time driven simulations), Component-based simulation and modeling tools, Simulation protocol concepts, designs, and implementations, Simulation experimentation and analysis, Network system simulation modeling, Multiresolution, multi-aspect modeling, Parallel simulation modeling concepts, and methods.

**Mapping of Course Outcomes and Program Outcomes:**

| Course Learning Outcomes | | Engineering Knowledge | Problem Analysis | Design / Development of Solutions | Investigation | Modern Tool Usage | The Engineer and Society | Environment and Sustainability | Ethics | Communication | Individual and Team Work | Project Management and Finance | Life Long Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | **Prepare** feasible solutions to discrete event problems. | ✓ | ✓ | | | | | | | | | | |
| **CO2** | **Derive** simulation modeling using the arena package. | | | ✓ | | ✓ | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO3** | **Derive** the most feasible layout of an existing production line. | | ✓ | | ✓ | | | | | | | ✓ | |
| **CO4** | **Prepare** multi-resolution and multi-aspect modeling. | | ✓ | ✓ | | | | | | | | ✓ | ✓ |

**Teaching-learning and Assessment Strategy:**

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Face-to-Face Learning | |
| Lecture | 42 |
| Practical / Tutorial / Studio | - |
| Student-Centered Learning | - |
| Self-Directed Learning | |
| Non-face-to-face learning | 20 |
| Revision | 19 |
| Assessment Preparations | 20 |
| Formal Assessment | |
| Continuous Assessment | 2 |
| Final Examination | 3 |
| Total | 106 |

**Teaching Methodology:**

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method, Multimedia Presentation, Class Presentation, Assignments, Class Tests, Exams, Feedback at every step.

**Lecture Schedule:**

| Week | Lecture | Topics | ASSESSMENT |
|---|---|---|---|

| | | | |
|---|---|---|---|
| 1 | 1 | Basic concepts of simulation (definitions and types of simulations). | CT 1 to be held on these topics |
| | 2 | Mechanism of discrete event simulation. | |
| 2 | 1 | Mechanism of discrete event simulation (continued). | |
| | 2 | Random number generation. | |
| 3 | 1 | Input data analysis (input distribution modeling). | |
| | 2 | Input data analysis (input distribution modeling) (continued). | |
| 4 | 1 | Simulation modeling using the Arena package. | |
| | 2 | Simulation modeling using the Arena package (continued). | |
| 5 | 1 | Simulation modeling using the Arena package (continued). | CT 2 to be held on these topics, ASG, PR |
| | 2 | Review of probability and statistics. | |
| 6 | 1 | Simulation output analysis. | |
| | 2 | Simulation output analysis (continued). | |
| 7 | 1 | Monte Carlo simulation. | |
| | 2 | Monte Carlo simulation (continued). | |
| 8 | 1 | Monte Carlo simulation (continued). | CT 3 to be held on these topics |
| | 2 | Verification and validation of simulation models. | |
| 9 | 1 | Verification and validation of simulation models (continued). | |
| | 2 | Time driven simulations. | |
| 10 | 1 | Time driven simulations (continued). | |

| | | | |
|---|---|---|---|
| | 2 | Component-based simulation and modeling tools. | |
| 11 | 1 | Component-based simulation and modeling tools (continued). | CT 4 to be held on these topics, ASG, PR |
| | 2 | Simulation protocol concepts, designs, and implementations. | |
| 12 | 1 | Simulation experimentation and analysis. | |
| | 2 | Simulation experimentation and analysis (continued). | |
| 13 | 1 | Network system simulation modeling, Multiresolution, multi-aspect modeling. | |
| | 2 | Network system simulation modeling, Multiresolution, multi-aspect modeling (continued). | |
| 14 | 1 | Parallel simulation modeling concepts and methods. | |
| | 2 | Parallel simulation modeling concepts and methods (continued) and Course Review. | |

(PR – Project; ASG – Assignment)

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| Components | | Grading | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| Continuous Assessment (40%) | Test 1-3 | 20% | CO 1 | C1-C3 |
| | | | CO 2 | C1, C4 |
| | | | CO 3 | C3, C4 |
| | | | CO 4 | C1- C3 |
| | Class Participation | 5% | CO 1 | C3, C4 |
| | | | CO 6 | A3 |
| | Class | 5% | - | - |

| | | | | |
|---|---|---|---|---|
| | attendance | | | |
| | Midterm | 10% | CO 1 | C1 - C4 |
| | | | CO 3 | C3, C4 |
| Final Exam | | 60% | CO 1 | C1-C3 |
| | | | CO 2 | C1, C4 |
| | | | CO 3 | C3, C4 |
| | | | CO 4 | C1- C3 |
| Total Marks | | 100% | | |

**Text and Ref Books:**


1. Theory of Modeling and Simulation, 3rd edition, Bernard P. Zeigler, Alexandre Muzy, Ernesto Kofman. Third Edition.

2. Principle of Modeling and Simulation, A multidisciplinary approach – John A. Sokolowski, Catherine M. Banks.


**Course Code:** IPE 420
**Course Name:** Modeling and Simulation Sessional
**Credit Hour:** 1.50
**Contact Hour:** 3.00
**Level/Term:** L-4, T-1

**Curriculum Structure:** Outcome Based Education (OBE)

**Pre-requisites:** Concurrent with IPE 419 Modeling and Simulation

**Rationale:**
The course is intended to develop the necessary skills in students to develop a simulation of a manufacturing or service organization.

**Objective:**

1. To make students familiar with the concepts and tools of industrial simulation
2. To develop the students' ability to model a complex manufacturing or service process.
3. To make students adept at coding simulation in MALAB
4. To make students proficient at developing complex industrial simulation at ARENA

**Course Outcomes (CO) Generic Skills:**
Upon completion of this course, the student should be able to:

| No. | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO 1 | **Explain** the concept of simulation and **develop** and **analyze** a simulation model | C2-C6 | 1 | 2 | 1,3 | R |
| CO 2 | **Explain** the logic, structure, components and management of simulation modeling | C2 | 1 | 1 | 1 | R |
| CO 3 | **Demonstrate** knowledge of MATLAB and ARENA | C3 | 1 | 1 | 2 | ASG,R |
| CO 4 | **Build** a simple simulation model using MATLAB | C6 | 1 | 1,2 | 2 | ASG, R |
| CO 5 | **Build** a complex industrial simulation model using ARENA | C6 | 1,2 | 1,2, 3 | 2 | PR,ASG, R |
| CO 6 | **Analyze** the output data and **demonstrate** the various findings to management | C3, C4 | 2 | 3 | 1 | ASG, R |
| CO 7 | Do reverse calculation and determine the amount of input(s) to generate the required output | C2 | 2 | 1 | 1,2 | ASG, R |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam) | | | | | | |

**Course Content:**

Basic flow simulation, Random numbers, Modelling methodology, Modelling of complex systems, Different kinds of statistical distributions, Basic queue theory, Single server systems, Parallel server systems, Attributes, Batch/bulk arrival, Modelling of AGV and conveyor belts, Statistical analysis of the results from simulations

**Mapping of Course Outcomes (CO) and Program Outcomes:**

| Course Learning Outcomes | | Engineering Knowledge | Problem Analysis | Design / Development of Solutions | Investigation | Modern Tool Usage | The Engineer and Society | Environment and Sustainability | Ethics | Communication | Individual and Team Work | Life Long Learning | Project Management and Finance |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| CO1 | **Explain** the concept of simulation and **develop** and **analyze** a simulation model | ✓ | | | | | | | | | | | |
| CO2 | **Explain** the logic, structure, components and management of simulation modeling | ✓ | | | | ✓ | | | | | | | |
| CO3 | **Demonstrate** knowledge of MATLAB and ARENA | ✓ | ✓ | ✓ | | ✓ | | | | | | | |
| CO4 | **Build** a simple simulation model using MATLAB | ✓ | ✓ | ✓ | | ✓ | | | | | | | |
| CO5 | **Build** a complex industrial simulation model using ARENA | ✓ | ✓ | ✓ | | ✓ | | | | | ✓ | | |
| CO6 | **Analyze** the output data and **demonstrate** the various findings to management | | | | ✓ | ✓ | | | | ✓ | | | |
| CO7 | Do reverse calculation and determine the amount of input(s) to generate the required output | | | ✓ | ✓ | ✓ | | | | | | | |

**Lecture schedule:**

| | | |
|---|---|---|
| **Week 1** | **Introduction** | |
| Class 1 | Introduction to MATLAB, Discrete Event Simulation | |
| **Week 2** | **Fundamental Simulation Concepts** | |
| Class 2 | Simulating Service and Manufacturing Industry using MATLAB | |
| **Week 3** | **Quiz 1** | |
| Class 3 | Quiz 1 | |
| **Week 4** | **Introduction to ARENA** | |
| Class 4 | A guided tour through ARENA simulation software | |
| **Week 5** | **Modelling Advanced Operations** | |
| Class 5 | Modelling advanced operations using ARENA | |
| **Week 6** | **ARENA Animation** | |
| Class 6 | Animating a simulation model using ARENA | |
| **Week 7** | **Course Review and Quiz 2** | |
| Class 7 | A review of the entire course and final quiz | |

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| Assessment Strategies | | | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| Components | | Grading | | |
| Continuous Assessment (70%) | Weekly Reports | 20% | CO 1 | C2-C6 |
| | | | CO 2 | C2 |
| | | | CO 3 | C3 |
| | | | CO 4 | C6 |
| | | | CO 5 | C6 |
| | | | CO 6 | C3, C4 |
| | | | CO 7 | C2 |
| | | 40% | CO 1 | C2-C6 |
| | | | CO 2 | C2 |

| | | | | |
|---|---|---|---|---|
| | Class ipa tion | | CO 3 | C3 |
| | | | CO 4 | C6 |
| | | | CO 7 | C2 |
| | Presentat | 10% | CO 5 | C6 |
| Final Report | | 30% | CO 5 | C6 |
| | | | CO 6 | C3, C4 |
| | | | CO 7 | C2 |
| Total Marks | | 100% | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**Text and Ref Books:**

l. Kelton, W. David, Sadowski, Randall P., and Swets, Nancy B. (2010).- Simulation with Arena

**Reference Site:**

https://classroom.google.com/ (To be announced)

**Course Code:** IPE 422 **Course Name:** Machine Tools Sessional
**Credit Hour:** 1.50 **Contact Hour:** 3.00
**Level/Term:** L-4, T-1
**Curriculum Structure**: Outcome Based Education (OBE)
**Pre-requisites:** Concurrent with IPE 421 Machine Tools

**Synopsis/Rationale:**

This Outcome Based Education (OBE) based course is designed to enhance practical knowledge of internal kinematic structures of machine tools.

**Objectives:**

To study basic components of an Engine Lathe and their working principles
To study the kinematic diagram of an Engine Lathe
To conduct a study on different parts and functions of a CNC Milling Machine
To study the operation and components of a Shaper Machine
To study the indexing and manufacturing of a spur and helical gear
To study basic components of a Grinding Lathe and their working principles

**Course Outcomes (CO) & Generic Skills:**

Upon completion of this course, the student should be able to:

| No. | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO 1 | **Explain** working principles of basic components of Engine Lathe | C2-C5 | 1 | 2 | 1 | T,Q,R,F |
| CO 2 | **Draw** and **explain** kinematic diagram of Engine Lathe | C4-C6 | 2 | 2 | 1 | T,Q,R,F |
| CO 3 | **Develop** G- code for CNC milling operation | C3-C5 | 1 | 1 | 2 | T,Q,R,F |
| CO 4 | **Explain** operations of Shaper Machine | C3 | 2 | 1,2 | 1 | T,Q,R,F |
| CO 5 | **Set up** different types of indexing in milling machine | C6, A3 | 1 | 1 | | T,Q,R,F |
| CO 6 | **Explain** working principles of basic components of Grinding Lathe | C3 | 2 | 1,2 | 1 | T,Q,R,F |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam) | | | | | | |

**Course Contents:**
Name of the experiments:

1. (a) Study of Engine Lathes
(b) Study the Kinematic Diagram of an Engine Lathe
2. Study of CNC Milling machine.
3. Study of Shaper Machine.
4. Study of Milling Machine and Dividing Head
5. Study and Operation of Surface Grinding Machine.

**Mapping of Course Outcomes and Program Outcomes:**

| Course Learning Outcomes | | Engineering Knowledge<br>**PO1** | Problem Analysis<br>**PO2** | Design / Development of Solutions<br>**PO3** | Investigation<br>**PO4** | Modern Tool Usage<br>**PO5** | The Engineer and Society<br>**PO6** | Environment and<br>**PO7** | Ethics<br>**PO8** | Communication<br>**PO9** | Individual and Team Work<br>**PO10** | Project Management and<br>**PO11** | Life Long Learning<br>**PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | Explain working principles of basic components of Engine Lathe | √ | √ | | | | | | | | | | |
| **CO2** | Draw and explain kinematic diagram of Engine Lathe | √ | √ | | | | | | | | | | |
| **CO3** | Develop G- code for CNC milling operation | √ | √ | √ | | | | | | | | | |
| **CO4** | Explain operations of Shaper Machine | √ | | | | | | | | | | | |
| **CO5** | Set up different types of indexing in milling machine | √ | √ | | | | | | | | | | |
| **CO6** | Explain working principles of basic components of Grinding Lathe | √ | | | | | | | | | | | |

**Teaching-learning and Assessment Strategy:**

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Face-to-Face Learning | |
| Lecture | 16 |
| Practical / Tutorial / Studio | 16 |
| Student-Centred Learning | 10 |
| Self-Directed Learning | |
| Non-face-to-face learning | 40 |
| Revision | 10 |

| | |
|---|---|
| Assignment Preparations | 20 |
| Formal Assessment<br>Continuous Assessment<br>Final Examination | <br>5<br>1 |
| Total | 118 |

**Teaching Methodology:**

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method, Multi-media Presentation, Class Presentation, Exams, Feedback at every step.

**Lecture Schedule:**

| **Week 1** | **Introduction** |
|---|---|
| Class 1 | Introduction to machine tools sessional |
| **Week 2** | **Engine Lathe** |
| Class 2 | Study of Engine Lathes |
| **Week 3** | **Engine Lathe (contd.)** |
| Class 3 | Study of Engine Lathes |
| **Week 4** | **Kinematic Diagram** |
| Class 4 | Study the Kinematic Diagram of an Engine Lathe |
| **Week 5** | **Kinematic Diagram (contd.)** |
| Class 5 | Study the Kinematic Diagram of an Engine Lathe |
| **Week 6** | **CNC Milling machine** |
| Class 6 | Study of CNC Milling machine. |
| **Week 7** | **CNC Milling machine (contd.)** |
| Class 7 | Study of CNC Milling machine. |
| **Week 8** | **Shaper Machine** |
| Class 8 | Study of Shaper Machine. |
| **Week 9** | **Shaper Machine (contd.)** |
| Class 9 | Study of Shaper Machine. |
| **Week 10** | **Milling Machine and Dividing Head** |
| Class 10 | Study of Milling Machine and Dividing Head |
| **Week 11** | **Milling Machine and Dividing Head (contd.)** |
| Class 11 | Study of Milling Machine and Dividing Head |
| **Week 12** | **Surface Grinding Machine** |
| Class 12 | Study and Operation of Surface Grinding Machine. |
| **Week 13** | **Surface Grinding Machine (contd.)** |
| Class 13 | Study and Operation of Surface Grinding Machine. |
| **Week 14** | **Final Exam** |

| | |
|---|---|
| Class 14 | Final Quiz |

(PR – Project ; ASG – Assignment; PR – Presentation; R - Report; F – Final Exam)

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| Assessment Strategies | | | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| Components | | Grading | | |
| Continuous Assessment (70%) | Weekly Reports | 20% | CO 1 | C2-C5 |
| | | | CO 2 | C4-C6 |
| | | | CO 4 | C3 |
| | Class Participation | 10% | CO 2 | C4-C6 |
| | | | CO 3 | C3-C5 |
| | Viva | 30% | CO 1 | C2-C5 |
| | | | CO 2 | C4-C6 |
| | | | CO 5 | C6, A3 |
| Final Exam | | 40% | CO 1 | C2-C5 |
| | | | CO 2 | C4-C6 |
| | | | CO 4 | C3 |
| | | | CO 5 | C6, A3 |
| Total Marks | | 100% | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**Text and Ref Books:**


1. Krar, S.F., (1998), *Technology of Machine Tools*, McGraw Hill Book Co.
2. Chernov, N., (1979), *Machine Tools*, Mir Publishers.
3. Kibbe, R.R., Neely, J.E., Meyer, R.O., et. al., (1999), *Machine Tool Practices*, Prentice Hall.
4. Boothroyd, G., & Knight W.A. *Fundamentals of Machining and Machine Tools*. $2^{nd}$ Edition, Marcel Dekker Inc.


**Reference Site:**

https://classroom.google.com/ (To be announced)

**Course Code:** IPE 450 **Course Name:** Business Communication Seminar
**Credit Hour:** 0.75 **Contact Hour:** 1.5
**Level/Term:** Level 4/ Term II

**Curriculum Structure:** Outcome Based Education (OBE)

**Pre-requisite:** None

**Rationale:**

The course is designed to develop in students interpersonal and communication skills required for their professional life.

**Objectives:**

1. To learn how to prepare and present business presentation and job interviews.
2. To learn how to prepare professional CV, resume, and cover letter.
2. To develop business writing skills while communicating via letters.
3. To create entrepreneurship skills by innovating business ideas.

**Course Outcomes (CO) & Generic Skills:**

| | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO1 | **Develop** the verbal communication skills while presenting a business presentation, or appearing in debate competition and job interviews | C4-C5 | | 2 | 1 | Pr, R |
| CO2 | **Prepare** business letters, curriculum vitae, resume and cover letters | C3-C6 | 2 | 2 | 1 | ASG, R |
| CO3 | **Analyze** and **evaluate** business proposals and **create** new endeavors of entrepreneurship | C2-C3 | 1 | 1 | 2 | F, ASG |
| CO4 | **Prepare** themselves for effective communication in any business-world setting | C3 | | | 3 | Pr |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam) | | | | | | |

**Course Contents:**

Name of the sessions:

1. Preparing CV, resume, and cover letter.
2. Preparing business letters.
3. How to present a business presentation.
4. How to prepare for job interview.
5. Preparing business proposals.

**Teaching-learning and Assessment Strategy:**

| Teaching and learning activities | Engagement (hours) |
|---|---|

| | |
|---|---|
| Face-to-face learning<br><br>Lecture<br><br>Practical/ Tutorial/ Studio<br><br>Student-centred learning | <br><br>-<br><br>28<br><br>- |
| Self-directed learning<br><br>Non face-to-face learning<br><br>Revision<br><br>Assessment preparations | <br><br>9<br><br>14<br><br>18 |
| Formal Assessment<br><br>Continuous Assessment<br><br>Final Examination | <br><br>1.5<br><br>1.5 |
| Total | 72 |

**Teaching methodology:**

Lecture and Discussion, Formal Presentation, Formal Interview, Co-operative and Collaborative Method, Problem Based Method

**Mapping of Course Outcomes and Program Outcomes:**

| No. | Course Outcomes (CO) of the Course | Program Outcome | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| CO1 | **Develop** the verbal communication skills while presenting a business presentation, or appearing in debate competition and job interviews **(PO: 1, 2, 4, 5)** | √ | √ | | √ | √ | | | | | | | |
| CO2 | **Prepare** business letters, curriculum vitae, resume and cover letters **(PO: 1, 2, 5)** | √ | √ | | | √ | | | | | | | |
| CO3 | **Analyze** and **evaluate** business proposals and **create** new endeavors of entrepreneurship **(PO: 3, 5)** | | | √ | | √ | | | | | | | |
| CO4 | **Prepare** themselves for effective communication in anybusiness-world setting **(PO: 1, 4, 5)** | √ | | | √ | √ | | | | | | | |

**Lecture Schedule:**

| Week | Topics |
|---|---|
| **1** | Preparing CV, resume, and cover letter. |
| **3** | Preparing business letters. |
| **5** | How to prepare for job interview. |
| **7** | Mock Interview |
| **9** | How to present a business presentation. |
| **11** | Preparing business proposals. |
| **13** | Final Interview |

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| Assessment Strategies | | | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| Components | | Grading | | |
| Continuous Assessment (40%) | Assignment | 20% | CO 1-2 | C 3, C 4, P 1, P 2 |
| | Class Participation | 5% | CO 2-3 | C 1, A 2, P 2 |
| | Mock Presentation & Interview | 15% | CO 3-4 | C 6, A 3, P 4, P 5 |
| Final Presentation and Interview | | 60% | CO 3-4 | C 6, A 3, P 4, P 5 |
| Total Marks | | 100% | | |

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

**Text and Ref Books:**


1. Essentials of Business Communication - Mary Ellen Guffey
2. Excellence in Business Communication - Courtland L Bovee
3. Business Presentations - Anne Freitag-Lawrence


**Reference Site:**

https://classroom.google.com/ (To be announced)

## 1.2 Detailed Curriculum of IPE Optional Courses

**Course Code:** IPE 417 **Course Name:** Industrial Automation
**Credit Hour:** 3.00 **Contact Hour:** 3.00
**Level/Term:** L-4, T-2

**Curriculum Structure**: Outcome Based Education (OBE)

**Pre-requisites:** IPE 411 (CAD/CAM)

**Synopsis/Rationale:**

Provides the students with basic knowledge of industrial automation systems designs, installation, modifications, maintenance, and repair.

**Objectives:**

1. To provide the student with basic skills useful in identifying the concepts of automated machines and equipment and describe the terms and phrases associated with industrial automation.
2. To introduce preventative maintenance, identify or solve problems in machines, and other technologies.
3. To demonstrate competence in maintaining and troubleshooting technology includes identifying, understanding, and performing routine preventative maintenance and service on technology.
4. To introduce different motion control systems using various types of sensors, encoders, and methods of integration by using PLCs.
5. To expose students to data acquisition and control system.

**Course Outcomes (CO) & Generic Skills:**

Upon completion of this course, the student should be able to:

| No. | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO1 | **Explain** the general function of industrial automation and **identify** safety in industrial automation. | C1,C2 | 1 | 1 | 1 | T, Mid Term Exam, F |
| CO2 | **Identify** practical programmable logic controller applications as well as **recognize** fundamentals of programming. | C1,C2 | 3 | 1 | 3,5 | ASG, Mid Term Exam, F |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | |
| CO3 | **Use** arithmetic and advanced instructions in industrial automation including common arithmetic instructions, add, subtract, multiply, divide, and compare function, logical, operators, average, standard deviation, trigonometric, numbering system conversion sequencers and shift register prepare part program using programming languages such as APT. | C3 | 3 | 3 | 6 | ASG, Mid Term Exam, F |
| CO4 | **Explain** fundamentals of process control including process and control, proportional, integral, derivative (PID) control and tuning. | C1 | 1 | 1 | 1,2 | T, ASG, R, F |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam) | | | | | | |

**Course Contents:**

Robot: Robot anatomy, Drive systems of robots, Electrical and hydraulic systems, AC and DC drives, Servo drives using voltage control, current control and direct torque control, PID control systems and performance issues. Feedback systems, Single loop and multi-loop, DSP based motion control systems, Sensors for industrial robots, encoders, resolvers, hall-effect sensors, acoustic sensors, ultrasonic and optical/infrared sensors, Elements of robot vision, Integration using PLCs, digital motion planning systems

Computer Control Machines: Introduction, classification, design features and control features of CNC machines; Programming: G and M Code programming, Offline (APT-like) programming; free form surface machining: Isoparametric, Isoplanar and Isoscallop machining strategies.

**Mapping of Course Outcomes and Program Outcomes:**

| **No.** | **Course Outcomes (CO) of the Course** | **Program Outcomes (PO)** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Engineering Knowledge | Problem Analysis | Design / Development of | Investigation | Modern Tool Usage | The Engineer and Society | Environment and Sustainability | Ethics | Communication | Individual and Team Work | Project Management and Finance | Life Long Learning |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | **Explain** the general function of industrial automation and **identify** safety in industrial automation. | √ | √ | √ | | √ | | | | | | | |
| CO2 | **Identify** practical programmable logic controller applications as well as **recognize** fundamentals of programming. | √ | √ | √ | | | | | | | | | |
| CO3 | **Use** arithmetic and advanced instructions in industrial automation including common arithmetic instructions, add, subtract, multiply, divide, and compare function, logical, operators, average, standard deviation, trigonometric, numbering system conversion sequencers and shift register prepare part program using programming languages such as APT. | √ | | √ | | | | | | | √ | | |
| CO4 | **Explain** fundamentals of process control including process and control, proportional, integral, derivative (PID) control and tuning. | √ | | √ | | | | | | | | | |

**Teaching-learning and Assessment Strategy:**

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Face-to-Face Learning<br>Lecture<br>Practical / Tutorial / Studio<br>Student-Centred Learning | <br>42<br>-<br>- |

| | |
|---|---|
| Self-Directed Learning<br>Non-face-to-face learning<br>Revision<br>Assignment Preparations | <br>40<br>20<br>20 |
| Formal Assessment<br>Continuous Assessment<br>Final Examination | <br>2<br>3 |
| Total | 127 |

**Teaching Methodology:**

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method, Multi-media Presentation, Class Presentation, Visualization using Computer Simulations, Assignments, Class Tests, Exams, Feedback at every step.

**Lecture Schedule:**

| Week | Lecture | Topics | ASSESSMENT |
|---|---|---|---|
| **1** | Lec 1<br>Lec 2<br>Lec 3 | Introduction<br>Automation system utilized in manufacturing industries<br>Basic control systems: in pressure, flow, level, temperature etc | **Class Test 1, ASG, F** |
| **2** | Lec 4<br>Lec 5<br>Lec 6 | Pumps, valves, indicators,<br>Switches, recorders. transmitters<br>Signal conditioners, drives etc. | |
| **3** | Lec 7<br>Lec 8 | Drive systems of robots: AC and DC drives, | |

| | | | |
|---|---|---|---|
| | Lec 9 | Typical electronic controls used to position pneumatic found in many mechanical processes, actuators, servo valves etc.<br>Typical electronic controls used to hydraulic cylinders found in many mechanical processes, actuators, servo valves etc. | |
| **4** | Lec 10<br>Lec 11<br>Lec 12 | Introduction to system sensors<br>Use of sensor in automation image and vision processing<br>Web-based manufacturing monitoring system | |
| **5** | Lec 13<br>Lec 14<br>Lec 15 | Sensors for industrial robots, encoders<br>Resolvers, hall-effect sensors<br>Acoustic sensors, ultrasonic and optical/infrared sensors, | |
| **6** | Lec 16<br>Lec 17<br>Lec 18 | Basic principles of operation and programming of PLC/PID<br>Computer-based PLC simulation and real plcs for programming practice<br>PLC programming and control knowledge in typical industrial operation | **Class Test 2, ASG, PR, F** |
| **7** | Lec 19<br>Lec 20<br>Lec 21 | Integration using PLCs<br>Digital motion planning systems<br>**Review Class 1** | |
| **8** | Lec 22<br>Lec 23<br>Lec 24 | Introduction to Data acquisition<br>Control system<br>Multiple Human Machine Interface | |
| **9** | Lec 25<br>Lec 26<br>Lec 27 | Computer software programs<br>Computer software programs and today's industry<br>Modern Uses of Software | **Mid Term, F** |
| **10** | Lec 31<br>Lec 32<br>Lec 33 | PC hardware interfacing<br>PC communications<br>data acquisition | |
| **11** | Lec 28<br>Lec 29<br>Lec 30 | Data acquisition (Cntd)<br>Data acquisition and display | |
| **12** | Lec 34<br>Lec 35<br>Lec 36 | Introduction to Supervisory Control and Data Acquisition (SCADA)<br>Supervisory Control and Data Acquisition (SCADA)Techniques | **Class Test 3, ASG, R, PR, F** |
| **13** | Lec 37<br>Lec 38<br>Lec 39 | Introduction to Distributed Control System (DCS)<br>Control System (DCS) and data highways | |
| **14** | Lec 40<br>Lec 41<br>Lec 42 | Presentation<br>**Review Class 2** | |

(PR – Project ; ASG – Assignment; PR – Presentation; R - Report; F – Final Exam)

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| Assessment Strategies | | | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| Components | | Grading | | |
| Continuous Assessment (40%) | Test 1-3 | 20% | CO 1 | C1,C2 |
| | | | CO 3 | C3 |
| | | | CO 4 | C1 |
| | Class Participation | 5% | CO 2 | C1,C2 |
| | | | CO 1 | C1,C2 |
| | Mid term | 15% | CO 1 | C1,C2 |
| | | | CO 2 | C1,C2 |
| | | | CO 3 | C3 |
| Final Exam | | 60% | CO 1 | C1,C2 |
| | | | CO 2 | C1,C2 |
| | | | CO 3 | C3 |
| | | | CO 4 | C1 |
| Total Marks | | 100% | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**Text and Ref Books:**

1. Industrial Control Electronics Devices, Systems, & Applications - Terry Bartlet
2. Industrial Automation: Hands On - Frank Lamb

**Reference Site:**

https://classroom.google.com/ (To be announced)

**Course Code:** IPE 423 **Course Name:** Robotics
**Credit Hour:** 3.00 **Contact Hour:** 3.00
**Level/Term:** L-4, T-1

**Curriculum Structure**: Outcome Based Education (OBE)

**Pre-requisites:**
(1) CSE 281: Computer Programming Techniques
(2) IPE 271: Engineering Mechanics and Theory of Machines
(3) CSE 282: Computer Programming Techniques Sessional
(4) IPE 243: Mechanics of Solids
(5) IPE 301: Measurement, Instrumentation and Control
(6) IPE 302: Measurement, Instrumentation and Control Sessional

**Synopsis/Rationale:**

This Outcome Based Education (OBE) based course, is designed to introduce the concepts of Robotic system, its components and instrumentation and control related to robotics and to prepare the students to be able to recognize the suitability and implications of applying the robotics technology to specific industrial applications. This curricular unit aims to provide the students with the necessary tools so they can be able to understand, characterize, specify and use of robotic manipulators, as well as to program and operate industrial robotic manipulators.

**Objectives:**

1. To develop the student's knowledge in various robot structures and their workspace
2. To develop student's skills in performing spatial transformations associated with rigid body motions
3. To develop student's skills in perform kinematics analysis of robot systems
4. To provide the student with knowledge of the singularity issues associated with the operation of robotic systems
5. To provide the student with some knowledge and analysis skills associated with trajectory planning
6. To provide the student with some knowledge and skills associated with robot control

**Course Outcomes (CO) & Generic Skills:**

Upon completion of this course, the student should be able to:

| No. | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO 1 | **Define** and **describe** the fundamentals of robotics and its components, kinematics and dynamics of robotics and **explain** the need and implementation of related instrumentation & control in robotics. | C1,C2 | 1 | | 1 | T, Mid Term Exam, F |
| CO 2 | **Discuss, model and solve** the math and computational methods related to kinematic problems involving robot manipulators and mobile robots. | C2-C6 | 1 | | 1,2 | T, ASG, F |
| CO 3 | **Appraise** the computational challenges inherent in fundamental mobile robotic tasks (e.g. localization, mapping, motion planning). | C2-C5 | 1 | | 2,3 | T, F |

| | | | | | | |
|---|---|---|---|---|---|---|
| CO 4 | **Use** robot inputs and outputs to control operation sequence and create, modify, and **execute** different robot programs. | C3,C4 | 1 | | 1,3 | T, Mid Term Exam, ASG, F |
| CO 5 | **Develop** simple robot control systems integrating perception, planning, and action. | C6 | 1,3 | 1,2 | 3 | ASG, Pr, R |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam) | | | | | | |

**Course Contents:**

**Basic Concepts in Robotics:** Automation and robotics, Robot anatomy, Basic structure of robots Resolution, Accuracy and repeatability, and Classification and Structure of robots, Point to point and continuous path systems.

**Robotic System and Control Systems:** Components of robotic system, Hydraulic systems, DC servo motors, Basic control systems concepts and models, Control system analysis, Robot activation and feedback components, Positional and velocity sensors, actuators. Power transmission systems

**Robot arm Kinematics and Dynamics:** Robot joints, The direct kinematics problem, The inverse kinematics solution, Lagrange-Euler formation, Generalized D'Alembert equations of motion, Denavit-Hartenberg convention and its applications

**Sensors and Instrumentation in robotics:** Tactile sensors, proximity and range sensors, Force and torque sensors, Uses of sensors in robotics, Vision equipment, Image processing, Concept of low level and high level vision

**Robot control:** Decoupling of nonlinear systems, feed forward and feedback control, control models and strategies, position control and simple feedback synthesis, adaptive control and force control

**Computer based Robotics:** Method of robots programming, GUI based robotic arm control, Introduction to Artificial Intelligence, Interfacing with computer, communication and data processing

**Mobile robots kinematics:** Path planning and control, Research in robotics, Future of robotics

**Mapping of Course Outcomes and Program Outcomes:**

| Course Learning Outcomes | | Engineering Knowledge | Problem Analysis | Design / Development of Solutions | Investigation | Modern Tool Usage | The Engineer and Society | Environment and Sustainability | Ethics | Communication | Individual and Team Work | Project Management and Finance | Life Long Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO** | **PO** | **PO 10** | **PO 11** | **PO 12** |
| **CO1** | **Define** and **describe** the fundamentals of robotics and its components, kinematics and dynamics of robotics and **explain** the need and implementation of related instrumentation & control in robotics. | √ | | | | | | | | | | | |
| **CO2** | **Discuss, model and solve** the math and computational methods related to kinematic problems involving robot manipulators and mobile robots. | √ | √ | | | | | | | | | | |
| **CO3** | **Appraise** the computational challenges inherent in fundamental mobile robotic tasks (e.g. localization, mapping, motion planning)**.** | √ | | | √ | | | | | | | | |
| **CO4** | **Use** robot inputs and outputs to control operation sequence and create, modify, and | √ | | √ | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **execute** different robot programs. | | | | | | | | | | | | |
| **CO5** | **Develop** simple robot control systems integrating perception, planning, and action. | √ | √ | √ | | | | | | | √ | | |

**Teaching-learning and Assessment Strategy:**

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Face-to-Face Learning | |
| Lecture | 42 |
| Practical / Tutorial / Studio | - |
| Student-Centred Learning | - |
| Self-Directed Learning | |
| Non-face-to-face learning | 40 |
| Revision | 20 |
| Assignment Preparations | 20 |
| Formal Assessment | |
| Continuous Assessment | 2 |
| Final Examination | 3 |
| Total | 127 |

**Teaching Methodology:**

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method, Multi-media Presentation, Class Presentation, Visualization using Computer Simulations, Assignments, Class Tests, Exams, Feedback at every step.

**Lecture Schedule:**

| Week | Lecture | Topics | ASSESSMENT |
|---|---|---|---|
| **1** | Lec 1<br>Lec 2<br>Lec 3 | Basic Concepts in Robotics: Automation and robotics, Robot anatomy, Basic structure of robots | |
| **2** | Lec 4<br>Lec 5<br>Lec 6 | Resolution, Accuracy and repeatability, and Classification and Structure of robots, Point to point and continuous path systems. | **Class Test 1** |

| | | | |
|---|---|---|---|
| **3** | Lec 7<br>Lec 8<br>Lec 9 | Robotic System and Control Systems: Components of robotic system, Hydraulic systems, DC servo motors | |
| **4** | Lec 10<br>Lec 11<br>Lec 12 | Basic control systems concepts and models Control system analysis, Robot activation and feedback components | |
| **5** | Lec 13<br>Lec 14<br>Lec 15 | Positional and velocity sensors, actuators. Power transmission systems | |
| **6** | Lec 16<br>Lec 17<br>Lec 18 | Robot arm Kinematics and Dynamics: Robot joints, The direct kinematics problem, The inverse kinematics solution | **Class Test 2** |
| **7** | Lec 19<br>Lec 20<br>Lec 21 | Lagrange-Euler formation, Generalized D'Alembert equations of motion, Denavit-Hartenberg convention and its applications. | |
| **8** | Lec 22<br>Lec 23<br>Lec 24 | Sensors and Instrumentation in robotics: Tactile sensors, proximity and range sensors, Force and torque sensors, Uses of sensors in robotics. | |
| **9** | Lec 25<br>Lec 26<br>Lec 27 | Vision equipment, Image processing, Concept of low level and high level vision. | |
| **10** | Lec 31<br>Lec 32<br>Lec 33 | Robot control: decoupling of nonlinear systems, feed forward and feedback control, control models and strategies, position control and simple feedback synthesis, adaptive control and force control. | **Mid Term Exam** |
| **11** | Lec 28<br>Lec 29<br>Lec 30 | Computer based Robotics: Method of robots programming | |
| **12** | Lec 34<br>Lec 35<br>Lec 36 | GUI based robotic arm control,<br>Introduction to Artificial Intelligence | **Class Test 3, ASG, R, F** |
| **13** | Lec 37<br>Lec 38<br>Lec 39 | Interfacing with computer,<br>communication and data processing | |
| **14** | Lec 40<br>Lec 41<br>Lec 42 | Mobile robots kinematics, path planning and control, Research in robotics, Future of robotics **Review for Final Exam** | |

(PR – Project; ASG – Assignment; PR – Presentation; R - Report; F – Final Exam)

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| Assessment Strategies | | | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| Components | | Grading | | |
| Continuous Assessment (40%) | Test 1-3 | 20% | CO 1 | C1,C2 |
| | | | CO 2 | C2-C6 |
| | | | CO 3 | C2-C5 |
| | Class Participation | 5% | CO 2 | C2-C6 |
| | | | CO4 | C3,C4 |
| | Mid term | 15% | CO 1 | C1,C2 |
| | | | CO 4 | C3,C4 |
| Final Exam | | 60% | CO 1 | C1,C2 |
| | | | CO 2 | C2-C6 |
| | | | CO 3 | C2-C5 |
| | | | CO 4 | C3,C4 |
| Total Marks | | 100% | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**Text and Ref Books:**

2 CAD/CAM principles of application - P.N. Rao
3 Robot Manipulators, Mathematics, Programming and Control - Richard Paul
4 Introduction to Robotics - John J. Craig

**Reference Site:**
https://classroom.google.com/ (To be announced)

**Course Code:** IPE 425 **Course Name:** Marketing Management
**Credit Hour:** 3.00 **Contact Hour:** 3.00
**Level/Term:** L-4, T-2

**Curriculum Structure**: Outcome Based Education (OBE)

**Pre-requisites:** (1) IPE 107: Engineering Economy

**Synopsis/Rationale:**

This Outcome Based Education (OBE) based course, which introduces students to concepts of marketing. This course focuses on various marketing strategies, including segmentation, targeting, positioning, and marketing mix (product, price, place and promotion) strategies and to explore how those strategies contribute to the company's competitive advantage in the marketplace.

**Objectives:**

- **4.2** The overall objective of the course is to provide students with the basic understanding of marketing concepts and theories
- **4.3** To give students the basic knowledge of the marketing discipline.
- **4.4** To cover the major topics of classical marketing.

**Course Outcomes (CO) & Generic Skills:**

Upon completion of this course, the student should be able to:

| No. | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO 1 | **Outline** the key marketing concepts and fields of their application | C1-C4 | | | 1 | T, Mid Term Exam, F |
| CO 2 | **Develop** marketing mix for different markets (b2b, b2c, services) | C3, C4 | 1 | 1 | 1 | ASG, Mid Term Exam, F |
| CO 3 | **Apply** marketing theories and approaches during class discussions and work on group projects | C2-C4 | 2 | 2 | 2 | ASG, Mid Term Exam, F |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam) | | | | | | |

**Course Contents:**

**The role and understanding of marketing:** Course introduction, Defining marketing, What is marketing/marketing process, Marketing principles

**Different types of markets** (consumer markets – b2c, industrial markets – b2b, service markets)

**Market analysis**: The marketing environment and markets, B2C markets and consumer buying behavior, B2B markets and services, Marketing research and marketing information systems, Strategic marketing, Segmentation, Targeting and Positioning (STP),

**Operational marketing**: Marketing Mix, The product mix, The price mix, The distribution mix, The communication mix, The Marketing mix principle, Products, services and branding decisions, Price decisions, Channel management and retailing

**Marketing communications**: tools and techniques. Managing marketing communications

**Marketing organization and controlling:** Marketing implementation and control, Marketing Metrics

**Marketing management in Emerging markets:** The impact of Emerging markets on marketing development, Contemporary marketing practices. Principles of relational marketing

**Mapping of Course Outcomes and Program Outcomes:**

| **No.** | **Course Outcomes (CO) of the Course** | **Program Outcomes (PO)** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| **CO1** | **Outline** the key marketing concepts and fields of their application | √ | | | | √ | | | | | | √ | √ |
| **CO2** | **Develop** marketing mix for different markets (b2b, b2c, services) | | √ | | | | | | √ | √ | √ | √ | √ |
| **CO3** | **Apply** marketing theories and approaches during class discussions and work on group projects | | √ | | √ | | | | | √ | | √ | √ |

**Teaching-learning and Assessment Strategy:**

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Face-to-Face Learning | |
| Lecture | 42 |
| Practical / Tutorial / Studio | - |
| Student-Centred Learning | - |
| Self-Directed Learning | |
| Non-face-to-face learning | 18 |
| Revision | 21 |
| Assignment Preparations | 20 |
| Formal Assessment | |
| Continuous Assessment | 2 |
| Final Examination | 3 |
| Total | 106 |

**Teaching Methodology:**

Lecture and Discussion, Co-operative and Collaborative Method, Assignments, Class Tests, Exams, Feedback at every step.

**Lecture Schedule:**

| Week | Lecture | Topics | TEST |
|---|---|---|---|
| **1** | Lec 1 | **The role and understanding of marketing:** Course introduction. | **ASG, Class Test 1** |
| | Lec 2 | Presentation of main course topics. Explanation of learning outcomes | |
| | Lec 3 | Defining marketing. What is marketing / marketing process? | |
| **2** | Lec 4 | Marketing principles | |
| | Lec 5 | **Different types of markets** | |
| | Lec 6 | **Market analysis** | |
| **3** | Lec 7 | The marketing environment and markets | |
| | Lec 8 | B2c markets and consumer buying behavior | |
| | Lec 9 | B2B markets and services | |
| **4** | Lec 10 | Marketing research and marketing information systems | **ASG, Class Test 2** |
| | Lec 11 | **Strategic marketing** | |
| | Lec 12 | Segmentation, Targeting and Positioning (STP) | |
| **5** | Lec 13 | Marketing strategy | |
| | Lec 14 | Marketing strategy (Contd.) | |
| | Lec 15 | Marketing strategy (Contd.) | |
| **6** | Lec 16 | Segmentation | |
| | Lec 17 | Targeting and Positioning (STP) | |
| | Lec 18 | **Operational marketing** | |
| **7** | Lec 19 | Marketing Mix | |
| | Lec 20 | Marketing Mix (Contd.) | |
| | Lec 21 | Marketing Mix (Contd.) | |
| **8** | Lec 22 | The product mix | |
| | Lec 23 | The product mix (Contd.) | |

| | | | |
|---|---|---|---|
| | Lec 24 | The product mix (Contd.) | **Mid Term** |
| **9** | Lec 25 | The price mix | |
| | Lec 26 | The price mix | |
| | Lec 27 | The distribution mix | |
| **10** | Lec 28 | The communication mix | **ASG, Class Test 3** |
| | Lec 29 | The communication mix | |
| | Lec 30 | The Marketing mix principle | |
| **11** | Lec 31 | The Marketing mix principle | |
| | Lec 32 | The Marketing mix principle | |
| | Lec 33 | Products, services and branding decisions | |
| **12** | Lec 34 | Price decisions | |
| | Lec 35 | Channel management and retailing | |
| | Lec 36 | Marketing communications | |
| **13** | Lec 37 | Managing marketing communications | **ASG,F** |
| | Lec 38 | Marketing implementation and control | |
| | Lec 39 | Marketing implementation and control, Marketing Metrics | |
| **14** | Lec 40 | The impact of Emerging markets on marketing development | |
| | Lec 41 | Contemporary marketing practices | |
| | Lec 42 | Principles of relational marketing | |

(PR – Project ; ASG – Assignment; PR – Presentation; R - Report; F – Final Exam)

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| Components | | Grading | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| Continuous Assessment (40%) | Class test 1-3 | 20% | CO 1 | C1-C3 |
| | | | CO 2 | C4, P4 |
| | | | CO 3 | P4,C1,C4 |
| | | 5% | CO 1 | C1-C3, A2 |

| | | | | |
|---|---|---|---|---|
| | Class Participation | | CO 2 | C4, P4 |
| | Mid term | 15% | CO 1 | C1-C3 |
| | | | CO 2 | C4, P4 |
| Final Exam | | 60% | CO 1 | C1-C3 |
| | | | CO 2 | C4, P4 |
| | | | CO 3 | P4, C1, C4 |
| Total Marks | | 100% | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**Text and Ref Books:**


i. Marshall & Johnston, Marketing Management, McGraw Hill
ii. Kotler & Keller, 14th ed., Marketing Management, Prentice Hall
iii. Chernev & Kotler, 5th ed., Strategic Marketing Management, Brightstar Media


**Reference Site:**

https://classroom.google.com/ (To be announced)

**Course Code:** IPE 427 **Course Title:** Control Engineering
**Credit Hour:** 3.00 **Contact Hour:** 3.00 (Lecture)
**Course Curriculum:** Outcome Based Education (OBE)

**Pre-requisites:**
(1) IPE 301: Measurement, Instrumentation and Control
(2) MATH-201: Differential Equations and Laplace Transform
(3) CSE 281: Computer Programming Techniques
(4) EECE 171: Basic Electrical and Electronic Circuit
(5) IPE 271: Engineering Mechanics and Theory of Machines

**Synopsis/Rationale**

This course follows the Outcome Based Education (OBE) approach and introduces students to the concept of dynamic systems modeling and control systems design. Mathematical representations of control systems by different equations and Laplace transformations, block diagrams and transfer functions are emphasized as well as visualization using MATLAB programming. Salient aspects of control systems such system input and response (time and frequency domain), control action, system types, Lead-Lag compensators etc. are analyzed analytically. Analogues of control systems (mechanical, fluids, thermal and electrical) as well as orientation with electro-hydro-pneumatic and electromechanical controls help students understand the scope of the subject and its real world applications. Concurrent with the theory, some physical demonstrations and computer simulations in MATLAB aid in cementing students' grasp of the subject matter. Finally, digital and robust control systems are introduced which are the current approaches to control and automation in the industry.

**Objectives:**

i. To understand the application of physical laws and differential equations in order to create mathematical models of dynamic systems
ii. To apply concepts of transfer function and Laplace transforms in order to analyze system response
iii. To analyze control system stability and to evaluate robustness of comparable systems under standard inputs
iv. To apply PLC and PID based control protocols to design simulated control systems of real world applications
v. To evaluate the performance of digital and robust systems using time and frequency domain outputs and simulation in MATLAB

**Course Outcomes (CO):**

Upon completion of this course, the student should be able to:

| No. | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO 1 | **Explain** the basics of mathematical modeling of systems, apply relevant physical and engineering principles and develop suitable models. (**PO: 1, 2, 3, 9**) | C2-C6 | 1,2 | 2 | 1 | Group ASG, Mid-Term Exam, F |
| CO 2 | **Outline** the fundamental tenets of linearization and Laplace transformation, apply transformations and complex frequency 's' variables to analyze and visualize responses of dynamic systems to standard inputs: impulse, step, ramp and parabolic. (**PO: 1, 2, 5, 9**) | C2-C4 | 1 | 1, 2 | 1 | ASG, T, Mid Term Exam |

| | | | | | | |
|---|---|---|---|---|---|---|
| CO 3 | **Apply** the analytical tools and MATLAB simulation to analyze stability of control systems and use it to evaluate the performance of various such systems in order to decide the best controller for a particular problem. (**PO: 1, 2, 5, 9, 10**) | C3-C5, P3 | 2 | 1 | 2 | ASG, Mid Term Exam, F |
| CO 4 | **Explain** the basics of PID and PLC control algorithms, analyze requirements, apply software/analytical approach to design control systems for real world problems. (**PO: 1-5, 9, 12**) | C2-C4, P3, P4 | 1 | 2 | 1 | T, ASG, PR, F |
| CO 5 | **Interpret** the use of time and frequency domain plots of control systems, analyze the outputs of MATLAB based control simulations, evaluate the stability and robustness of concerned control systems. (**PO: 1, 2, 5**) | C2-C5, P3, P4 | 1 | 1, 2 | 1 | ASG, PR, R, T, F |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam) | | | | | | |

**Course Contents:**

i. **Control Systems:** Open and closed loop control systems; Feedback and feed-forward control architectures, their basics and performance evaluation, limitations, robustness and stability; Fundamentals of modeling dynamic systems using the laws of physics and differential equations, linear approximation using Taylor series.

ii. **Block Diagrams:** Fundamentals of block diagram representations of control systems, their simplifications and applications in designing control system architecture; Signal Flow graph models; Simulation of control systems using MATLAB.

iii. **Mass-Spring-Damper Systems:** Analogies of single and multi-body systems, natural and forced responses, damping ratios, resonant peaks and band widths; Applications in real world including active vehicle suspension system control with demonstration, and simulation via MATLAB.

iv. **RLC Circuit based Control**: Concept, mathematical models and control applications of RLC circuits including Operational Amplifiers, Demonstration, MATLAB simulation.

v. **State Variable Approach:** State variables of a dynamic system, state differential equation, system response using state transition matrix, simulation of state variable models of control systems using MATLAB.

vi. **Inputs and Responses of Control Systems:** Standard inputs (unit impulse, rectangular, step, ramp, parabolic etc.); Responses of dynamic systems (natural, forced, transient, steady-state etc.); Percentage overshoot, Lead-Lag.

vii. **Stability Analysis:** Basic concept for linear systems using the Routh array test, marginal stability, control design constraints, applications in feedback systems.

viii. **Evans Root Locus techniques:** Mathematical basis and application in control design for real world systems.

ix. **Gain and Phase margins:** Basic concept, polar plots, computation from Bode diagrams and Nyquist plots, implications in terms of robust stability of control systems.

x. Actuator Control: Pneumatic, hydro-pneumatic, electro-hydro-pneumatic actutators, study of pneumatic circuits with physical demonstration, electro-hydro-pneumatic control system demonstration and mathematical modeling for 4 post car lift, simulation using MATLAB; D.C. and servo motors control methods and mathematical models, their analysis using block diagrams and transfer functions.

xi. **Design of Feedback Control Systems:** Phase Lead and Lag-Design using Bode diagrams and root locus; Lead-Lag compensators based on frequency data for open-loop linear systems; PLC based control fundamentals, physical demonstration using trainer and MATLAB simulation; PID controller basics, algorithms for control including ladder diagrams, designing PID controllers based on empirical tuning rules, physical demonstration and modeling of water level control in water reservoir and temperature control in heating set-ups.

**Teaching-learning and Assessment Strategy:**

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Face-to-Face Learning | |
| Lecture | 30 |
| Computer Lab based simulation tutorials | 10 |
| Physical demonstrations of mechanical, thermal, fluid and electrical dynamic systems and their control | 5 |
| Student-Centred Learning (MIT's Open Courseware study, online blogs and class open discussion (life long learning) | 5 |
| Self-Directed Learning | |
| Non-face-to-face learning | 40 |
| Revision | 10 |
| Assignment Preparations | 20 |
| Formal Assessment | |
| Continuous Assessment | 2.5 |
| Final Examination | 3 |
| Total | 125.5 |

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| Assessment Strategies | | | CO | Blooms Taxonomy |
|---|---|---|---|---|
| Components | | Grading | | |
| Continuous Assessment (40%) | Test 1-3 | 20% | CO 2 | C2-C4 |
| | | | CO 4 | C2-C4, P3, P4 |
| | | | CO 5 | C2-C5, P3, P4 |
| | Class Participation | 5% | CO 2 | C2-C4 |
| | | | CO 4 | C2-C4, P3, P4 |
| | Mid term | 15% | CO 1 | C2-C6 |
| | | | CO 2 | C2-C4 |
| | | | CO 3 | C3-C5, P3 |
| Final Exam | | 60% | CO 1 | C2-C6 |
| | | | CO 3 | C3-C5, P3 |
| | | | CO 4 | C2-C4, P3, P4 |
| | | | CO 5 | C2-C5, P3, P4 |
| Total Marks | | 100% | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**Mapping of Course Outcomes and Program Outcomes:**

| **No.** | **Course Outcomes (CO) of the Course** | **Program Outcome** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| CO1 | **Explain** the basics of mathematical modeling of systems, apply relevant | √ | √ | √ | | | | | | √ | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | physical and engineering principles and develop suitable models. **(PO: 1, 2, 3, 9)** | | | | | | | | | | | | |
| CO2 | **Outline** the fundamental tenets of linearization and Laplace transformation, apply transformations and complex frequency 's' variables to analyze and visualize responses of dynamic systems to standard inputs: impulse, step, ramp and parabolic. **(PO: 1, 2, 5, 9)** | √ | √ | | | √ | | | | √ | | | |
| CO3 | **Apply** the analytical tools and MATLAB simulation to analyze stability of control systems and use it to evaluate the performance of various such systems in order to decide the best controller for a particular problem. **(PO: 1, 2, 5, 9, 10)** | √ | √ | | | √ | | | | √ | √ | | |
| CO4 | **Explain** the basics of PID and PLC control algorithms, analyze requirements, apply software/analytical approach to design control systems for real world problems**. (PO: 1-5, 9, 12)** | √ | √ | √ | √ | √ | | | | √ | | | √ |
| CO5 | **Interpret** the use of time and frequency domain plots of control systems, analyze the outputs of MATLAB based control simulations, evaluate the stability and **robustness of concerned control systems. (PO: 1, 2, 5)** | √ | √ | | | √ | | | | | | | |

**Lecture Schedule:**

| Week | Lecture | Topics | ASSESSMENT |
|---|---|---|---|
| **1** | Lec 1<br>Lec 2<br>Lec 3 | Dynamic systems introduction and their modeling using ODEs | |
| **2** | Lec 4<br>Lec 5 | Control systems introduction and types: feedback and feed forward, open and closed | **Class Test 1, ASG** |

| | | | |
|---|---|---|---|
| | Lec 6 | loop control; their importance, demonstration using automobile ECU. | |
| **3** | Lec 7<br>Lec 8<br>Lec 9 | Mass-spring-damper systems for single and multi-body, ODEs, Laplace transforms, demonstration via vehicle active suspension, visualization using MATLAB | |
| **4** | Lec 10<br>Lec 11<br>Lec 12 | Resistor, Inductor and Capacitor (RLC) circuit basics, analogy with mechanical systems, RLC control, visualization using MATLAB | |
| **5** | Lec 13<br>Lec 14<br>Lec 15 | State Variable Approach to control engineering, state differential equation, system response using state transition matrix, simulation in MATLAB | |
| **6** | Lec 16<br>Lec 17<br>Lec 18 | Inputs of Control Systems: Standard inputs (unit impulse, rectangular, step, ramp, parabolic etc.); Responses of dynamic systems (natural, forced, transient, steady-state etc.); Lead-Lag. | **Class Test 2, ASG, PR** |
| **7** | Lec 19<br>Lec 20<br>Lec 21 | Stability Analysis of linear systems, concept of marginal stability, control design constraints, applications in feedback systems;<br>**Review for Mid-term Exam** | |
| **8** | Lec 22<br>Lec 23<br>Lec 24 | Root Locus: Mathematical basis, plots and application in control system design | |
| **9** | Lec 25<br>Lec 26<br>Lec 27 | Gain and Phase margins: Basic concept, polar plots, Bode diagrams and Nyquist plots, robust stability of control systems, MATLAB simulations | |
| **10** | Lec 31<br>Lec 32<br>Lec 33 | Actuator Control for pneumatic, hydro-pneumatic, electro-hydro-pneumatic actutators, demonstrations using pneumatic circuits and 4 post car lift, simulations in MATLAB; D.C. and servo motors control, block diagrams and transfer functions methods | **Mid Term** |

| | | | |
|---|---|---|---|
| **11** | Lec 28<br>Lec 29<br>Lec 30 | Design of Feedback Control Systems for Phase Lead and Lag-Design using Bode diagrams and root locus; Lead-Lag compensators, MATLAB visualization | **Class Test 3, ASG, R, PR, Pr, F** |
| **12** | Lec 34<br>Lec 35<br>Lec 36 | PLC based control systems, physical demonstration using PLC trainer, and MATLAB simulation. | |
| **13** | Lec 37<br>Lec 38<br>Lec 39 | PID controller basics, ladder diagrams, PID design using empirical tuning rules, physical demonstration using water level control in water reservoir and temperature control in heating set-ups, MATLAB visualization | |
| **14** | Lec 40<br>Lec 41<br>Lec 42 | Control system design and evaluation using MATLAB;<br>**Review for Final Exam** | |

(PR – Project ; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

**Teaching Methodology:**

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method, Multi-media Presentation, Class Presentation, Visualization using Computer Simulations in MATLAB, Physical demonstrations of systems in laboratory, Open discussion & blogs, Assignments, Class Tests, Exams, Feedback at every step.

**Text and Ref Books:**

a) Modern Control Systems, 12th Edition, by Dorf and Bishop (Text Book)
b) Control System Engineering, 6th Edition, by Norman Nise (Reference Book & Further Reading)
c) Introduction to Automatic Controls, 2nd Edition, by Howard L. Harrison and John G. Bollinger (Reference)

**Course Code:** IPE 431 **Course Name:** Computer Integrated Manufacturing
**Credit Hour:** 3.00 **Contact Hour:** 3.00
**Level/Term:** L-4, T-1

**Curriculum Structure**: Outcome Based Education (OBE)

**Pre-requisites:** (1) IPE 201: Manufacturing Process I
(2) IPE 203: Manufacturing Process II

**Synopsis/Rationale:**

This course emphasizes the integration of manufacturing enterprise using computer-integrated manufacturing (CIM) technologies. It employs CAD/CAM interface and other CIM sub-systems, database management, facility layout, product documentation, process planning, production planning and control, Group technology, teamwork, and manufacturing operations and management to bring about a student's-designed CIM-oriented enterprise.

**Objectives:**

1. To develop an understanding of classical and state-of-the-art production systems, control systems, management technology, cost systems, and evaluation techniques.
2. To develop an understanding of computer-integrated manufacturing (CIM) and its impact on productivity, product cost, and quality.
3. To obtain an overview of computer technologies including computers, database and data collection, networks, machine control, etc., as they apply to factory management and factory floor operations.
4. To describe the integration of manufacturing activities into a complete system
5. To acquire sensitivity to human-factors related issues as they affect decision making in the factory environment.

**Course Outcomes (CO) & Generic Skills:**

Upon completion of this course, the student should be able to:

| No. | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO1 | **Explain** the merit and demerits of applying group technology and cellular manufacturing in any kind of industry and analyze the feasibility of cellular manufacturing in that industry. | C2, C3 | 1 | 1 | 2,3 | T, Mid Term Exam, F |
| CO2 | **Design and Propose** an automated material handling system that ensure the minimum movement of the material even after satisfying every demand. | C3, C6 | 1,3 | 3 | 3,4 | ASG, Mid Term Exam, F |
| CO3 | **Review and analyze** the production system of any industry and identify the areas where | C4 - C6 | 1 | 1 | 5,6,8 | ASG, Mid Term Exam, F |

| | | | | | | |
|---|---|---|---|---|---|---|
| | automation can reduce the production time and unit production cost. | | | | | |
| CO4 | **Demonstrate** the application of data management and its importance for decision making in CIMS environment. | C3 – C6 | 3 | 1 | 5 | T, ASG, R, F |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam) | | | | | | |

**Course Contents:**

**Introduction:** Scope, islands of automation, architecture of CIM, information flow in CIM, elements of CIM, benefits, limitations, obstacles in implementation., Product Design and CAD, application of computers in design, CAM - manufacturing planning and control, scope of CAD / CAM and CIM, concurrent engineering, design for manufacturing and assembly.
Concept, design and manufacturing attributes, part families, composite part, methods of grouping, PFA, Classification and coding system- OPITZ, Relevance of GT in CIM, GT and CAD, benefits and limitations of GT.
**Computer Aided Process Planning and Control:** need, retrieval and generative type CAPP, role of CAPP in CIM.
**Flexible Manufacturing Systems:** Concept, flexible & rigid manufacturing cell and FMS structure, types, components of FMS, Distributed Numerical Control (DNC), Building Blocks of FMS, Flexible Assembly System.
**Computer Aided Production Planning and Control:** Computer integrated production management system, aggregate planning, master production schedule, shop floor control, materials requirement planning, capacity planning, manufacturing resource planning and enterprise resource planning.
**Computer Aided Quality Control:** Objectives, non-contact inspection methods, equipment; contact type inspection: Co-ordinate Measuring Machines (CMM), construction, working principle and applications, Inspection robots.
**Production Support Machines and Systems in CIM:** Industrial robots for load/unload, automated material handling, automatic guided vehicles, automated storage and retrieval system.
**Data Acquisition and Database Management Systems:** (a) Data acquisition system,type of data, automatic data identification methods, bar code technology, machine vision.(b) Data and database management system, database design requirements, types of DBMS models- hierarchical, network and relational models and their applications.
**Planning and Implementation of CIMS:** Planning for CIMS, need for planning, Phases of CIM implementation, incremental implementation and one time implementation, CIM benchmarking, Economic and social justification of CIM.

**Mapping of Course Outcomes and Program Outcomes:**

| No. | | Program Outcomes (PO) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Course Outcomes (CO) of the Course** | Engineering Knowledge | Problem Analysis | Design / Development of | Investigation | Modern Tool Usage | The Engineer and Society | Environment and Sustainability | Ethics | Communication | Individual and Team Work | Project Management and Finance | Life Long Learning |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| CO1 | **Explain** the merit and demerits of applying group technology and cellular manufacturing in any kind of industry and analyze the feasibility of cellular manufacturing in that industry. | √ | √ | √ | √ | | | | | | | | |
| CO2 | **Design and Propose** an automated material handling system that ensure the minimum movement of the material even after satisfying every demand. | √ | | √ | √ | | | | | | √ | | |
| CO3 | **Review and analyze** the production system of any industry and identify the areas where automation can reduce the production time and unit production cost. | | √ | | √ | √ | | | | | | | |
| CO4 | **Demonstrate** the application of data management and its importance for decision making in CIMS environment. | √ | √ | √ | | | | | | | | | |

**Teaching-learning and Assessment Strategy:**

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Face-to-Face Learning<br>Lecture<br>Practical / Tutorial / Studio<br>Student-Centred Learning | <br>42<br>-<br>- |
| Self-Directed Learning<br>Non-face-to-face learning<br>Revision<br>Assignment Preparations | <br>40<br>20<br>20 |
| Formal Assessment<br>Continuous Assessment<br>Final Examination | <br>2<br>3 |
| Total | 127 |

**Teaching Methodology:**

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method, Multi-media Presentation, Class Presentation, Visualization using Computer Simulations, Assignments, Class Tests, Exams, Feedback at every step.

**Lecture Schedule:**

| Week | Lecture | Topics | ASSESSMENT |
|---|---|---|---|
| **1** | Lec 1<br>Lec 2<br>Lec 3 | Introduction: Scope, islands of automation, architecture of CIM, information flow in CIM, elements of CIM, benefits, limitations, obstacles in implementation. | **Class Test 1, ASG** |
| **2** | Lec 4<br>Lec 5<br>Lec 6 | Product Design and CAD, application of computers in design, CAM - manufacturing planning and control, scope of CAD / CAM and CIM, concurrent engineering, design for manufacturing and assembly. | |
| **3** | Lec 7<br>Lec 8<br>Lec 9 | Concept, design and manufacturing attributes, part families, composite part, methods of grouping, PFA | |
| **4** | Lec 10<br>Lec 11<br>Lec 12 | Classification and coding system- OPITZ, Relevance of GT in CIM, GT and CAD, benefits and limitations of GT. | **Class Test 2, ASG, PR** |
| **5** | Lec 13<br>Lec 14<br>Lec 15 | Computer Aided Process Planning and Control: need, retrieval and generative type CAPP, role of CAPP in CIM. | |
| **6** | Lec 16<br>Lec 17<br>Lec 18 | Flexible Manufacturing Systems: Concept, flexible & rigid manufacturing cell and FMS structure, types, components of FMS | |

| | | | |
|---|---|---|---|
| **7** | Lec 19<br>Lec 20<br>Lec 21 | Distributed Numerical Control (DNC), Building Blocks of FMS, Flexible Assembly System. | |
| **8** | Lec 22<br>Lec 23<br>Lec 24 | Computer Aided Production Planning and Control: Computer integrated production management system, aggregate planning, master | **Mid Term** |
| **9** | Lec 25<br>Lec 26<br>Lec 27 | Production schedule, shop floor control, materials requirement planning, capacity planning, manufacturing resource planning and enterprise resource planning. | |
| **10** | Lec 31<br>Lec 32<br>Lec 33 | Computer Aided Quality Control: Objectives, non-contact inspection methods, equipment; contact type inspection: Co-ordinate Measuring Machines (CMM), construction, working principle and applications, Inspection robots. | |
| **11** | Lec 28<br>Lec 29<br>Lec 30 | Production Support Machines and Systems in CIM: Industrial robots for load/unload, automated material handling, automatic guided vehicles, automated storage and retrieval system. | **Class Test 3, ASG, R, PR, F** |
| **12** | Lec 34<br>Lec 35<br>Lec 36 | Data Acquisition and Database Management Systems: (a) Data acquisition system,type of data, automatic data identification methods, bar code technology, machine vision.(b) Data and database management system, database design requirements, types of DBMS models-hierarchical, network and relational modelsand their applications. | |
| **13** | Lec 37<br>Lec 38<br>Lec 39 | Planning and Implementation of CIMS: Planning for CIMS, need for planning, Phases of CIM implementation, incremental implementation and one time implementation, CIM benchmarking, Economic and social justification of CIM. | |
| **14** | Lec 40<br>Lec 41<br>Lec 42 | **Review for Final Exam** | |

(PR – Project ; ASG – Assignment; PR – Presentation; R - Report; F – Final Exam)

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| Assessment Strategies | CO | Bloom's Taxonomy |
|---|---|---|

| Components | | Grading | | |
|---|---|---|---|---|
| Continuous Assessment (40%) | Test 1-3 | 20% | CO 1 | C2, C3 |
| | | | CO 3 | C4 - C6 |
| | | | CO 4 | C3 – C6 |
| | Class Participation | 5% | CO 2 | C3, C6 |
| | | | CO 1 | C1-C4 |
| | Mid term | 15% | CO 1 | C2, C3 |
| | | | CO 2 | C3, C6 |
| | | | CO 3 | C4 - C6 |
| Final Exam | | 60% | CO 1 | C2, C3 |
| | | | CO 2 | C3, C6 |
| | | | CO 3 | C4 - C6 |
| | | | CO 4 | C3 – C6 |
| Total Marks | | 100% | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**Text and Ref Books:**

5 Automation, Production Systems, and Computer-integrated Manufacturing - Mikell P. Groover

6 Computer-integrated manufacturing technology and systems - Rembold, Ulrich, Christian Blume, and Ruediger Dillmann.

**Reference Site:**

https://classroom.google.com/ (To be announced)

**Course Code:** IPE 429 **Course Name:** Organizational Behavior

**Credit Hour:** 3.00 **Contact Hour:** 3.00

**Level/Term:** L-4, T-1

**Curriculum Structure**: Outcome Based Education (OBE)

**Pre-requisites:** None

**Rationale:**

The main objective of Organizational Behavior course is to help the students to acquire and develop skill to take rational decisions in the process of Organizational Behavior by understanding the human interactions in an organization, finding what is driving it and influencing it for getting better results in attaining business goals. It details the impact of individual, group and organizational factors on human behavior. It highlights the significance of Challenges and Opportunities of OB, perception, attribution, learning, organizational change, organizational culture, motivation, leadership and conflict management.

**Objectives:**

1. To explain the organizational behavioral challenges in the Bangladeshi work environment.
2. To illustrate the impact of perception, personality and emotions.
3. To articulate the impact of values, attitudes and the influence of diversity.
4. To explain interpersonal conflict and conflict resolution.
5. To critique the most popular bases of power in organizations.

**Course Outcomes (CO) & Generic Skills:**

Upon completion of this course, the student should be able to:

| No. | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO 1 | **List** and **define** basic organizational behavior principles, and **analyze** how these influence behavior in the workplace. | C1,C4 | | | 1 | T, Mid Term Exam, F |
| CO 2 | **Analyze** individual human behavior in the workplace as influenced by personality, values, perceptions, and motivations. | C4 | 1 | | 1 | T,Mid Term Exam, F |
| CO 3 | **Outline** the elements of group behavior including group dynamics, communication, leadership, power & politics and conflict & negotiation. | C1 | | | 1 | Mid Term Exam, F |
| CO 4 | **Demonstrate** your own management style as it relates to influencing and managing behavior in the organization systems. | C2 | | | 1 | T, ASG, R, F |

| | | | | | | |
|---|---|---|---|---|---|---|
| CO 5 | **Demonstrate** critical thinking and analysis skills through the use of management case studies, personal application papers and small group exercises. | C3 | 1,3 | 1 | 1 | ASG, PR, R |
| CO 6 | Strengthen research, writing and presentation skills. | C1,C2 | | | | ASG,PR,R |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam) | | | | | | |

**Course Content:**

Behavior of individuals in organizations: values and attitudes, motivation, group and group processes: group dynamics, communication, power & conflict, organizational system: structure, job design, appraisal of performance, processes of organizational change and development.

**Mapping of Course Outcomes (CO) and Program Outcomes:**

| Course Learning Outcomes | Engineering Knowledge | Problem Analysis | Design / Development of Solutions | Investigation | Modern Tool Usage | The Engineer and Society | Environment and Sustainability | Ethics | Communication | Individual and Team Work | Project Management and Finance | Life Long Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **List** and **define** basic organizational behavior principles, and **analyze** how these influence behavior in the workplace. | | | | √ | | | | | | | | |
| **CO2** | **Analyze** individual human behavior in the workplace as influenced by personality, values, perceptions, and motivations. | | | | √ | | | | | | | | |
| **CO3** | **Outline** the elements of group behavior including group dynamics, communication, leadership, power & politics and conflict & negotiation. | | | | | | | | √ | √ | | | |
| **CO4** | **Demonstrate** your own management style as it relates to influencing and managing behavior in the organization systems. | | | | √ | | | | | | | | √ |
| **CO5** | **Demonstrate** critical thinking and analysis skills through the use of management case studies, personal application papers and small group exercises. | | √ | √ | √ | | | | | √ | √ | | |
| **CO6** | Strengthen research, writing and presentation skills. | | | | | | | | | √ | √ | | |

**Teaching-learning and Assessment Strategy:**

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Face-to-Face Learning | |
| Lecture | 42 |
| Practical / Tutorial / Studio | - |
| Student-Centred Learning | - |
| Self-Directed Learning | |
| Non-face-to-face learning | 40 |
| Revision | 20 |
| Assignment Preparations | 20 |
| Formal Assessment | |
| Continuous Assessment | 2 |
| Final Examination | 3 |
| Total | 127 |

**Teaching Methodology:**

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method, Multi-media Presentation, Class Presentation, Assignments, Class Tests, Exams, Feedback at every step.

**Lecture schedule:**

| **Week 1** | **Organizational Behaviour:** Introduction | |
|---|---|---|
| Class 1 | Concept and definition of Organizational Behaviour. | |
| Class 2 | Making sense of behaviour in organizations | Class Test 1 |
| Class 3 | Challenges in the Bangladeshi workplace | |
| **Week 2** | **Perception, Personality, and Emotions** | |
| Class 4 | Perception | |

| | | |
|---|---|---|
| Class 5 | Personality | |
| Class 6 | Emotions | |
| **Week 3** | **Values, Attitudes, and Their Effects in the Workplace** | |
| Class 7 | Values, Assessing cultural values | |
| Class 8 | Values in the Bangladeshi workplace | |
| Class 9 | Attitudes | |
| **Week 4** | **Motivating Self and Others** | Class Test 2 |
| Class 10 | Needs theories of motivation | |
| Class 11 | Process theories of motivation | |
| Class 12 | Responses to the reward system | |
| **Week 5** | **Motivating Self and Others** | |
| Class 13 | Creating a motivating workplace: rewards and job redesign | |
| Class 14 | Caveat emptor | |
| Class 15 | Apply motivation theories wisely | |
| **Week 6** | **Working in Teams** | |
| Class 16 | Teams versus groups | |
| Class 17 | Stages of group and team development | |
| Class 18 | Twenty-first century teamwork: virtual teams | |
| **Week 7** | **Communication** | Mid Term Exam |
| Class 19 | Communication process | |
| Class 20 | Barriers to effective communication | |
| Class 21 | Current issues in communication | |
| **Week 8** | **Conflict, and Negotiation** | |
| Class 22 | How communication breakdown leads to conflict | |
| Class 23 | Conflict resolution | |
| Class 24 | Negotiation | |
| **Week 9** | **Power and Politics** | |

| | | |
|---|---|---|
| Class 25 | Bases of power | |
| Class 26 | Dependency: the key to power | |
| Class 27 | Influence tactics | |
| **Week 10** | **Power and Politics** | Class Test 3 |
| Class 28 | Empowerment: giving power to employees | |
| Class 29 | Abuse of power: harassment in the workplace | |
| Class 30 | Politics: power in action | |
| **Week 11** | **Leadership** | |
| Class 31 | Leadership as supervision | |
| Class 32 | Inspirational leadership | |
| Class 33 | Contemporary leadership roles | |
| **Week 12** | **Decision Making, Creativity, and Ethics** | |
| Class 34 | Group decision making | |
| Class 35 | Creativity in organizational decision making | |
| Class 36 | Corporate social responsibility | |
| **Week 13** | **Organizational Culture and Change** | |
| Class 37 | Concept and definition of Organizational culture and change. | |
| Class 38 | Creating and sustaining an organization's culture | |
| Class 39 | Liabilities of organizational culture | |
| **Week 14** | **Organizational Culture and Change** | |
| Class 40 | Approaches to managing change | |
| Class 41 | Resistance to change | |
| Class 42 | Review | |

(PR – Project ; ASG – Assignment; PR – Presentation; R - Report; F – Final Exam)

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| Assessment Strategies | | | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| Components | | Grading | | |
| Continuous Assessment (40%) | Test 1-3 | 20% | CO 1 | C1,C4 |
| | | | CO 2 | C4 |
| | | | CO 4 | C2 |
| | Class Participation | 5% | CO 6 | C1,C2 |
| | Mid term | 15% | CO 3 | C1 |
| Final Exam | | 60% | CO 1 | C1,C4 |
| | | | CO 2 | C4 |
| | | | CO 3 | C1 |
| | | | CO 4 | C2 |
| Total Marks | | 100% | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**Text and Reference Books:** Langton, Robbbins and Judge, Fundamentals of Organizational Behaviour, 4th Canadian Edition, Pearson.

Bounce Back, Nelson Press.

**Reference Site:**

https://classroom.google.com/ (To be announced)

**Course Code:** IPE 435 **Course Name:** Metal Cutting Process
**Credit Hour:** 3.00 **Contact Hour:** 3.00
**Level/Term:** L-4, T-2

**Curriculum Structure**: Outcome Based Education (OBE)

**Pre-requisites:**
(1) IPE 201: Manufacturing Process I
(2) IPE 202: Manufacturing Process I Sessional
(3) IPE 203: Manufacturing Process II
(4) IPE 203: Manufacturing Process II Sessional

**Synopsis/Rationale:**

This Outcome Based Education (OBE) based course is designed to conduct in depth study on metal cutting, geometry of cutting tool, chip tool interface, cutting forces, heat generation in metal cutting, cutting tool materials and machinability.

**Objectives:**

i. To conduct study on geometry of metal cutting tool.
ii. To expose students to theory of metal cutting.
iii. To conduct study on cutting forces.
iv. To conduct study on heat generation in metal cutting.
v. To expose students to various cutting tool materials and machinability of materials.

**Course Outcomes (CO) & Generic Skills:**

Upon completion of this course, the student should be able to:

| No. | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO 1 | **Define** and explain geometry of metal cutting tool | C1-C4 | 1 | | 1-4 | T, Mid Term |
| CO 2 | **Explain** various theories related to metal cutting. | C1-C4 | 1 | | 1-4 | T, Mid Term |
| CO 3 | **Explain** the influence of various factors on forces in metal cutting. | C3, C4, C5 | 2 | 1 | 1-4 | T, Mid Term Exam, F |
| CO 4 | **Derive** expressions for generation of heat in metal cutting. | C2-C5 | | | 1-4 | T, F |
| CO 5 | **Analyze** machinability of materials based on the machinability criteria. | C2-C5 | 1 | | 1-4 | T, F |

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

**Course Contents:**

Introduction, historical background, essential features of metal cutting, turning: tool point reference system; Geometry of single point cutting tool; Mechanism of chip formation; Classification of chips.

Chip-tool interface; Chip flow under the condition of seizure, built-up edge, machined surface; Forces acting on the cutting tool, stress on the shear plane, minimum energy theory, stress on the tool, work done and power consumption in metal cutting; Effect of various factors on cutting forces, formulae for calculating components of cutting force, measurement of cutting force and dynamometry.

Heat generation in metal cutting: sources of heat and its distribution, temperature field of the chip and the tool, formulae for calculation of cutting temperatures, effect of various factors on cutting temperature, heat flow, methods of tool temperature measurement, temperature distribution in tool, relationship of tool temperature and cutting speed;

Cutting tool materials: tool life, conditions of use, HSS, cemented carbide, ceramic tools. Ultra-hard tool materials: alumina based composites, sialon, diamond, cubic boron nitride. Machinability: magnesium, aluminum, copper, steel and cast iron, nickel, zirconium, titanium and their alloys; Methods of machinability improvement. Coolants and lubricants.

**Mapping of Course Outcomes and Program Outcomes:**

| Course Learning Outcomes | | Engineering Knowledge | Problem Analysis | Design / Development of Solutions | Investigation | Modern Tool Usage | The Engineer and Society | Environment and Sustainability | Ethics | Communication | Individual and Team Work | Project Management and Finance | Life Long Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | **Define** and explain geometry of metal cutting tool | √ | √ | | | | | | | | | | |
| **CO2** | **Explain** various theories related to metal cutting. | √ | √ | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO3** | **Explain** the influence of various factors on forces in metal cutting. | √ | √ | | | | | | | | | | |
| **CO4** | **Derive** expressions for generation of heat in metal cutting. | √ | √ | | | | | | | | | | |
| **CO5** | Analyze machinability of materials based on the machinability criteria. | √ | √ | | | | | | | | | | |

**Teaching-learning and Assessment Strategy:**

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Face-to-Face Learning | |
| Lecture | 42 |
| Practical / Tutorial / Studio | - |
| Student-Centred Learning | - |
| Self-Directed Learning | |
| Non-face-to-face learning | 40 |
| Revision | 20 |
| Assignment Preparations | 20 |
| Formal Assessment | |
| Continuous Assessment | 2 |
| Final Examination | 3 |
| Total | 127 |

**Teaching Methodology:**

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method, Multi-media Presentation, Class Presentation, Assignments, Class Tests, Exams, Feedback at every step.

**Lecture Schedule:**

| **Week** | **Lecture** | **Topics** | **ASSESSMENT** |
|---|---|---|---|
| **1** | Lec 1 | Introduction, | **ASG, Class Test 1, F** |
| | Lec 2 | historical background | |
| | Lec 3 | essential features of metal cutting | |
| **2** | Lec 4 | Tool nomenclature of single point cutting tool | |
| | Lec 5 | tool point reference system | |
| | Lec 6 | Geometry of single point cutting tool; | |
| **3** | Lec 7 | Mechanism of chip formation; | |
| | Lec 8 | Classification of chips. | |

| | | | |
|---|---|---|---|
| | Lec 9 | Chip-tool interface; | |
| **4** | Lec 10 | Chip flow under the condition of seizure | **ASG, Class Test 2, F** |
| | Lec 11 | built-up edge, | |
| | Lec 12 | machined surface; | |
| **5** | Lec 13 | Forces acting on the cutting tool, | |
| | Lec 14 | stress on the shear plane, | |
| | Lec 15 | minimum energy theory, | |
| **6** | Lec 16 | stress on the tool, | |
| | Lec 17 | work done and power consumption in metal cutting; | |
| | Lec 18 | Effect of various factors on cutting forces, | |
| **7** | Lec 19 | formulae for calculating components of cutting force, | |
| | Lec 20 | Measurement of cutting force and dynamometry. | |
| | Lec 21 | Revision | |
| **8** | Lec 22 | Heat generation in metal cutting: | **ASG, Mid Term, F** |
| | Lec 23 | sources of heat and its distribution, | |
| | Lec 24 | temperature field of the chip and the tool, | |
| **9** | Lec 25 | formulae for calculation of cutting temperatures, | |
| | Lec 26 | effect of various factors on cutting temperature, | |
| | Lec 27 | methods of tool temperature measurement, | |
| **10** | Lec 28 | temperature distribution in tool, | **ASG, Class Test 3, F** |
| | Lec 29 | relationship of tool temperature and cutting speed; | |
| | Lec 30 | Cutting tool life, | |
| **11** | Lec 31 | conditions of use, | |
| | Lec 32 | HSS, cemented carbide, ceramic tools. | |
| | Lec 33 | Ultra-hard tool materials: | |
| **12** | Lec 34 | alumina based composites, | |
| | Lec 35 | sialon, diamond, cubic boron nitride. | |

| | | | |
|---|---|---|---|
| | Lec 36 | Machinability | |
| **13** | Lec 37 | magnesium, aluminum, copper, | **ASG, F** |
| | Lec 38 | steel and cast iron, | |
| | Lec 39 | nickel, zirconium, titanium and their alloys; | |
| **14** | Lec 40 | Methods of machinability improvement. | |
| | Lec 41 | Coolants and lubricants. | |
| | Lec 42 | Review | |

(PR – Project ; ASG – Assignment; PR – Presentation; R - Report; F – Final Exam)

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| Assessment Strategies | | | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| Components | | Grading | | |
| Continuous Assessment (40%) | Test 1-3 | 20% | CO1 | C1-C4 |
| | | | CO3 | C2-C4 |
| | | | CO4 | C2-C4 |
| | Class Participation | 5% | CO 3 | C2-3 |
| | | | CO5 | C2-4 |
| | Attendance | 5% | - | - |
| | | | | |
| | Mid term | 10% | CO 1 | C1-C4 |
| | | | CO 2 | C3, C4 |
| | | | CO 3 | C2-C4 |
| Final Exam | | 60% | CO 1 | C1-C4 |
| | | | CO 3 | C3, C5 |
| | | | CO 4 | C2-C5 |
| | | | CO 5 | C2-C5 |
| Total Marks | | 100% | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**Text and Ref Books:**

g) Metal Cutting: Theory & Practice - *A. Bhattacharyya*
h) "Fundamentals of Metal Cutting and Machine Tools" by *B L Juneja and G S Sekhon*

i) "Metal Cutting Principles" by *M C Shaw*

j) "Metal Cutting and Tool Design" by *Dr B J Ranganth*

*k)* "Metal Cutting Theory and Practice" by *David A Stephenson*

**Reference Site:**

https://classroom.google.com/ (To be announced)

**Course Code:** IPE 439 **Course Name:** Green Manufacturing
**Credit Hour:** 3.00 **Contact Hour:** 3.00

**Level/Term:** L-4, T-1

**Curriculum Structure:** Outcome-Based Education (OBE)

**Pre-requisites:** None

**Synopsis/Rationale:**

This Outcome-Based Education (OBE) based course is designed to provide an overview of green technologies and green jobs in manufacturing. Students will develop the skills necessary to preserve and restore environmental quality and create a green working environment for the industry. This course introduces students to local, state, and national green/clean/lean/sustainable resources, share industry success stories (learn how business neighbors are implementing sustainable practices) and gather input from industries on what educators should be doing to prepare the current/future green workforce.

**Objectives:**

1. To offer a comprehensive overview of green manufacturing.
2. To provide practice-oriented information to help students find the green manufacturing methods for the intended applications.
3. To introduce and explain the design concepts, methods, tools, and some technologies, and operations of sustainable lean and green manufacturing systems and processes.
4. To design and maintenance of sustainable green manufacturing products, processes, service systems, and leads towards the entire greening process of multi-lifecycle manufacturing operations, factories, and their supply chains.

5. To understand the structures of sustainable manufacturing, environmental, and management practice.

**Course Outcomes (CO) & Generic Skills:**

| No. | **Course Learning Outcome** | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| **CO1** | **Explain** the design concepts, methods, tools, the key technologies, and the operation of sustainable green manufacturing. | C1-C3 | 1 | | 3 | T, Mid Term, F |
| **CO2** | **Apply** the principles, techniques, and methods to customize the learned generic concepts to meet the needs of a particular industry/enterprise. | C4 | 3 | 2 | | Mid Term Exam, F, R |
| **CO3** | **Identify** the strategies to satisfy a set of given sustainable green manufacturing requirements. | C1, C4 | 2 | 5 | 3 | Mid Term Exam,F,PR ,Pr |
| **CO4** | **Design** the rules and processes to meet the market need and the green manufacturing requirements by selecting and evaluating suitable technical, managerial / project management, and supply chain management schemes. | C4 | 3 | 5 | 1, 3 | Mid Term Exam,F |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T-Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam) | | | | | | |

**Course Contents:**

Introduction to lean sustainable green manufacturing. Analytical methods and computational assessment and design tools for evaluating and designing green manufacturing sustainability processes, requirements, and risks. The sustainable lean and green audit process. International green manufacturing standards and compliance. Green rapid prototyping and rapid manufacturing.

Green flexible automation. Globally green manufacturing supply chains and logistic networks. Sustainable green manufacturing system design and project management.

Life Cycle Assessment in Sustainable Green Manufacturing. Statistics in sustainability (for quantification). Optimization for sustainability. Optimization for sustainability continued. Design of Experiments for Green Manufacturing Systems. Value Engineering Green Plan. Design for Sustainability and Maintenance. Green transportation models. Sustainable Manufacturing facility development. Design of Higher Education for Sustainable development.

**Mapping of Course Outcomes and Program Outcomes:**
**Teaching-learning and Assessment Strategy:**

| Course Learning Outcomes | | Engineering Knowledge | Problem Analysis | Design / Development of | Investigation | Modern Tool Usage | The Engineer and Society | Environment and Sustainability | Ethics | Communication | Individual and Team Work | Project Management and Finance | Life-Long Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | **Explain** the design concepts, methods, tools, the key technologies, and the operation of sustainable green manufacturing. | √ | | √ | | √ | | √ | | | | | |
| **CO2** | **Apply** the principles, techniques, and methods to customize the learned generic concepts to meet the needs of a particular industry/enterprise. | | √ | | √ | | | | | | √ | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO3** | **Identify** the strategies to satisfy a set of given sustainable green manufacturing requirements. | | | | √ | | √ | | | | | | √ |
| **CO4** | **Design** the rules and processes to meet the market need and the green manufacturing requirements by selecting and evaluating suitable technical, managerial / project management, and supply chain management schemes. | | | √ | | | | √ | | | | √ | √ |

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Face-to-Face Learning | |
| Lecture | 42 |
| Practical / Tutorial / Studio | - |
| Student-Centred Learning | - |
| Self-Directed Learning | |
| Non-face-to-face learning | 40 |
| Revision | 20 |
| Assessment Preparations | 19 |
| Formal Assessment | |
| Continuous Assessment | 2 |
| Final Examination | 3 |
| Total | 126 |

**Teaching Methodology:**

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method, Multimedia Presentation, Class Presentation, Assignments, Class Tests, Exams, Feedback at every step.

**Lecture Schedule:**

| Week | Lecture | Topics | ASSESSMENT |
|---|---|---|---|
| 1 | 1 | Introduction to Advanced Green Manufacturing Systems. | CT 1 to be held on these topics |
| | 2 | General Concepts in Sustainable Green Manufacturing. | |
| 2 | 1 | Life Cycle Assessment in Sustainable Green Manufacturing. | |
| | 2 | Statistics in sustainability (for quantification) | |
| 3 | 1 | Statistics in sustainability (for quantification) (cont.) | |
| | 2 | Mechanical/Manufacturing Engineering Technology Curriculum Concerns | |
| 4 | 1 | Optimization for sustainability | |
| | 2 | Optimization for sustainability (cont.) | |
| 5 | 1 | Optimization for sustainability continued | |
| | 2 | Optimization for sustainability continued (cont.) | |
| 6 | 1 | Design of Experiments for Green Manufacturing Systems | |
| | 2 | Design of Experiments for Green Manufacturing Systems (cont.) | CT 2 to be held on these topics, ASG, PR |
| 7 | 1 | Value Engineering Green Plan | |
| | 2 | Value Engineering Green Plan (cont.) | |
| 8 | 1 | Design for Sustainability and Maintenance | |
| | 2 | Design for Sustainability and Maintenance (cont.) | |
| 9 | 1 | Green transportation models | |

| | | | |
|---|---|---|---|
| | 2 | Green transportation models (cont.) | CT 3 to be held on these topics |
| 10 | 1 | Green Manufacturing techniques | |
| | 2 | Green Manufacturing techniques (cont.) | |
| 11 | 1 | Life Cycle Assessment (software demonstration) | CT 4 to be held on these topics, ASG, PR |
| | 2 | Life Cycle Assessment (software demonstration) (cont.) | |
| 12 | 1 | Sustainable Manufacturing facility development | |
| | 2 | Sustainable Manufacturing facility development (cont.) | |
| 13 | 1 | Design of Higher Education for Sustainable development | |
| | 2 | Design of Higher Education for Sustainable development (cont.) | |
| 14 | 1 | Description of Proposed Course for Sustainable Green Manufacturing | |
| | 2 | Course Review for Final Exam | |

(PR – Project; ASG – Assignment)

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| Components | | Grading | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| | Test 1-3 | 20% | CO 1 | C1 - C4 |
| Continuous Assessment (40%) | | | CO 2 | C2 - C4 |
| | | | CO 4 | C2 |
| | Class Participation | 5% | CO 1 | C3, C4 |
| | | | CO 5 | A3 |
| | Mid-term | 15% | CO 3 | C1 - C4 |
| | | | CO 4 | C3, C4 |
| | | | CO 1 | C1- C4 |

| | | | |
|---|---|---|---|
| Final Exam | 60% | CO 2 | C3, C4 |
| | | CO 3 | C2 - C4 |
| | | CO 4 | C2 |
| Total Marks | 100% | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**Text and Ref Books:**

1. Dornfeld and David, Green Manufacturing Fundamentals and Applications.
2. **Davim J** and Paulo, Green Manufacturing Processes and Systems.
3. **<u>David A. Dornfeld</u>**, Green Manufacturing: Fundamentals and Applications.

**Reference Site:**

https://classroom.google.com/ (**To be announced**)

**Course Code:** IPE 441 **Course Name:** Modern Manufacturing Process

**Credit Hour:** 3.00 **Contact Hour:** 3.00

**Level/Term:** L-4, T-2

**Curriculum Structure:** Outcome Based Education (OBE)

**Pre-requisites:** 1. IPE 105: Engineering Materials

2. IPE 107: Engineering Economy

3. IPE 201: Manufacturing Processes I

4. IPE 203: Manufacturing Processes II

**Synopsis/Rationale:**

This Outcome Based Education (OBE) based course is designed to introduce students to the systematic modern manufacturing approach. It emphasizes feasible manufacturing processes which are used in modern industries. A better understanding of the modern manufacturing process provides better visualization to the unique difficulties of manufacturing and their feasible solution.

**Objectives:**

1. To offer a comprehensive overview of advanced materials manufacturing processes

2. To provide practice-oriented information to help students find the right manufacturingmethods for the intended applications

3. To critically review extant literature and case studies in order to explicate product and suggest remedies

4. To assess solutions for material science problems in industry

5. To differ the traditional manufacturing processes from nontraditional, emerging, modern and innovative manufacturing technologies, some of which have been used only recently in mass production

**Course Outcomes (CO) & Generic Skills:**

| No. | **Course Learning Outcome** | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| **CO1** | Model the material removal in various modern manufacturing processes. | C1-C3 | 1 | | 3 | T, Mid Term ,F |
| **CO2** | Analyze the processes and evaluate the role of each process parameter during machining of various advanced materials. | C4 | 3 | 2 | | Mid Term Exam,F,R |

| | | | | | | |
|---|---|---|---|---|---|---|
| **CO3** | Solve the various problems for the given profiles to be imparted on the work specimens. | C1, C4 | 2 | 5 | 3 | Mid Term Exam,F,PR ,Pr |
| **CO4** | Select the best process out of the available various advanced manufacturing processes for the given job assignment. | C4 | 3 | 5 | 1, 3 | Mid Term Exam,F |
| **CO5** | Explain requirements to achieve maximum material removal rate and best quality of machined surface while machining various industrial engineering materials. | C1, C4 | 3 | 2 | 2 | Mid Term Exam,F, T,ASG |
| **CO6** | Demonstrate commitment towards class ethics. | A3 | 1 | | | ASG, PR, R |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam) | | | | | | |

**Course Contents:**

**Ultrasonic Machining (USM):** Introduction, equipment, tool materials & tool size, abrasive slurry, cutting tool system design: - Effect of parameters on Material removal rate, tool wear, Accuracy, surface finish, applications, advantages & Disadvantages of USM.

**Abrasive Jet Machining (AJM):** Introduction, Equipment, Variables in AJM: Carrier Gas, Type of abrasive work material, standoff distance (SOD), nozzle design, shape of cut. Process characteristics-Material removal rate, Nozzle wear, Accuracy & surface finish. Applications, advantages & Disadvantages of AJM. Water Jet Machining: Principle, Equipment, Operation, Application, Advantages and limitations of Water Jet machining.

**Electrochemical Machining (ECM):** Introduction, study of ECM machine, elements of ECM process: ECM Process characteristics – Material removal rate, Accuracy, surface finish, Applications, Electrochemical turning, Grinding, Honing, deburring, Advantages, Limitations.

**Chemical Machining (CHM):** Introduction, elements of process, chemical blanking process, process characteristics of CHM: material removal rate, accuracy, surface finish, Hydrogen embrittlement, advantages & application of CHM.

**Electrical Discharge Machining (EDM):** Introduction, mechanism of metal removal, dielectric fluid, spark generator, EDM tools (electrodes) Electrode feed control, EDM process characteristics: metal removal rate, accuracy, surface finish, Heat Affected Zone. Machine tool selection, Application, electrical discharge grinding, wire EDM.

**Plasma Arc Machining (PAM):** Introduction, equipment, non-thermal generation of plasma, selection of gas, Mechanism of metal removal, PAM parameters, process characteristics. Applications, Advantages and limitations.

**Laser Beam Machining (LBM):** Introduction, equipment of LBM mechanism of metal removal, LBM parameters, Process characteristics, Applications, Advantages & limitations.

**Electron Beam Machining (EBM):** Principles, equipment, operations, applications, advantages and limitation of EBM.

**Introduction to Surface engineering**: High speed machining and grinding: Application of advanced coatings in high performance modern cutting tools and high performance super abrasive grinding wheels, Micro and nano machining of glasses and ceramics. Theory and application of chemical processing: Chemical Machining, aching of semi-conductors, Coating and Electroless forming, PVD and CVD.

**Rapid prototyping:** Basic Principle of Rapid Prototyping Processes, Rapid Prototyping Processes, Selective Laser Sintering, Fused Deposition Modeling, Applications of RP Technologies.

**Mapping of Course Outcomes and Program Outcomes:**

(H – High, M- Medium, L-low)

**Teaching-learning and Assessment Strategy:**

| Course Learning Outcomes | Engineering Knowledge | Problem Analysis | Design / Development of | Investigation | Modern Tool Usage | The Engineer and Society | Environment and Sustainability | Ethics | Communication | Individual and Team Work | Project Management and Finance | Life Long Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | Model the material removal in various modern manufacturing processes. | √ | √ | | √ | | | | | | | | |
| **CO2** | Analyze the processes and evaluate the role of each process parameter during machining of various advanced materials. | | | √ | | √ | | | | | √ | | |
| **CO3** | Solve the various problems for the given profiles to be imparted on the work specimens. | | √ | | √ | | √ | | | | | | √ |
| **CO4** | Select the best process out of the available various advanced manufacturing processes for the given job assignment. | √ | √ | √ | | | | | | | | √ | √ |
| **CO5** | Explain requirements to achieve maximum material removal rate and best quality of machined surface while machining various industrial engineering materials. | √ | √ | | | √ | | | | | | | |
| **CO6** | Demonstrate commitment towards class ethics. | | | | | | | | √ | | | | |

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Face-to-Face Learning | |
| Lecture | 42 |
| Practical / Tutorial / Studio | - |
| Student-Centred Learning | - |

| | |
|---|---|
| Self-Directed Learning | |
| Non-face-to-face learning | 40 |
| Revision | 22 |
| Assessment Preparations | 18 |
| Formal Assessment | |
| Continuous Assessment | 2 |
| Final Examination | 3 |
| Total | 127 |

**Teaching Methodology:**

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method, Multimedia Presentation, Class Presentation, Assignments, Class Tests, Exams, Feedback at every step.

**Lecture Schedule:**

| Week | Lecture | Topics | ASSESSMENT |
|---|---|---|---|
| 1 | 1 | **Ultrasonic Machining (USM):** Introduction, equipment, tool materials & tool size, abrasive slurry. | |
| | 2 | **Ultrasonic Machining (USM):** Cutting tool system design: - Effect of parameters on Material removal rate, tool wear. | |
| 2 | 1 | **Ultrasonic Machining (USM):** Accuracy, surface finish, applications, advantages & Disadvantages of USM. | |
| | 2 | **Abrasive Jet Machining (AJM):** Introduction, Equipment, Variables in AJM: Carrier Gas, Type of abrasive work material, standoff distance (SOD). | |
| 3 | 1 | **Abrasive Jet Machining (AJM):** Nozzle design, shape of cut. Process characteristics-Material removal rate. | |
| | 2 | **Abrasive Jet Machining (AJM):** Nozzle wear, Accuracy & surface finish. Applications, advantages & Disadvantages of AJM. Water Jet Machining: Principle, | |

| | | | |
|---|---|---|---|
| | | Equipment, Operation, Application, Advantages and limitations of Water Jet machining. | CT 1 to be held on these topics |
| 4 | 1 | **Electrochemical Machining (ECM):** Introduction, study of ECM machine, elements of ECM process: ECM Process characteristics – Material removal rate. | |
| | 2 | **Electrochemical Machining (ECM):** Accuracy, surface finish, Applications, Electrochemical turning. | |
| 5 | 1 | **Electrochemical Machining (ECM):** Electrochemical Grinding, Honing, deburring, Advantages, Limitations. | |
| | 2 | **Chemical Machining (CHM):** Introduction, elements of process, chemical blanking process. | |
| 6 | 1 | **Chemical Machining (CHM):** Process characteristics of CHM: material removal rate, accuracy. | |
| | 2 | **Chemical Machining (CHM):** Surface finish, Hydrogen embrittlement, advantages & application of CHM. | |
| 7 | 1 | **Electrical Discharge Machining (EDM):** Introduction, mechanism of metal removal, dielectric fluid. | CT 2 to be held on these topics, ASG, PR |
| | 2 | **Electrical Discharge Machining (EDM):** Spark generator, EDM tools (electrodes) Electrode feed control, EDM process characteristics. | |
| 8 | 1 | **Electrical Discharge Machining (EDM):** Metal removal rate, accuracy, surface finish, Heat Affected Zone. Machine tool selection, Application, electrical discharge grinding, wire EDM. | |
| | 2 | **Plasma Arc Machining (PAM):** Introduction, equipment, non-thermal generation of plasma. | |
| 9 | 1 | **Plasma Arc Machining (PAM):** Selection of gas, Mechanism of metal removal. | |
| | 2 | **Plasma Arc Machining (PAM):** PAM parameters, process characteristics. Applications, Advantages and limitations. | |

| | | | |
|---|---|---|---|
| 10 | 1 | **Laser Beam Machining (LBM):** Introduction, equipment of LBM mechanism of metal removal. | CT 3 to be held on these topics |
| | 2 | **Laser Beam Machining (LBM):** LBM parameters, Process characteristics, Applications, Advantages & limitations. | |
| 11 | 1 | **Electron Beam Machining (EBM):** Principles, equipment, operations. | CT 4 to be held on these topics, ASG, PR |
| | 2 | **Electron Beam Machining (EBM):** Process, applications, advantages and limitation of EBM. | |
| 12 | 1 | **Introduction to Surface engineering**: High speed machining and grinding. | |
| | 2 | Application of advanced coatings in high performance modern cutting tools and high performance super abrasive grinding wheels. | |
| 13 | 1 | Micro and nano machining of glasses and ceramics. Theory and application of chemical processing: Chemical Machining, aching of semi-conductors, Coating and Electroless forming, PVD and CVD. | |
| | 2 | **Rapid prototyping:** Basic Principle of Rapid Prototyping Processes, Rapid Prototyping Processes. | |
| 14 | 1 | **Stereolithography:** Selective Laser Sintering, Fused Deposition Modeling, Applications of RP Technologies. | |
| | 2 | Course Review for Final Exam | |

(PR – Project; ASG – Assignment)

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| Components | | Grading | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| | Test 1-3 | 20% | CO 1 | C1 - C4 |

| | | | | |
|---|---|---|---|---|
| Continuous Assessment (40%) | | | CO 2 | C2 - C4 |
| | | | CO 4 | C2 |
| | Class Participation | 5% | CO 1 | C3, C4 |
| | | | CO 6 | A3 |
| | Mid term | 15% | CO 3 | C1 - C4 |
| | | | CO 4 | C3, C4 |
| Final Exam | | 60% | CO 1 | C1- C4 |
| | | | CO 2 | C3, C4 |
| | | | CO 3 | C2 - C4 |
| | | | CO 4 | C2 |
| | | | CO 5 | C3, C4 |
| Total Marks | | 100% | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**Text and Ref Books:**


1. Pandey, P.C. and Shan H.S., Modern Machining Processes, Tata McGraw Hill (2004).
2. Mishra, P.K., Non-Conventional Machining, Narosa Publications (2006).
3. Hofy, H.E., Advanced Manufacturing Process, B and H Publication (1998).
4. Jain, V.K., Advanced Machining processes, Allied Publishers Private Limited (2004).
5. Ghosh, A. and Mullik, A., Manufacturing Science, East –West private Limited (2010).


**Reference Site:**

https://classroom.google.com/ (**To be announced**)

**Course Code:** IPE 443 **Course Name:** Total Quality Management
**Credit Hour:** 3.00 **Contact Hour:** 3.00

**Level/Term:** L- 4, T-1

**Curriculum Structure**: Outcome Based Education (OBE)

**Pre-requisites:** None

**Rationale:**

The objectives of this course is to generate knowledge and skills of students to use models and quality management methodology for the implementation of total quality management in any sphere of business and public sector.

**Objective:**

1. Implement the principles and concepts inherent in a Total Quality Management (TQM) approach to managing a manufacturing or service organization.
2. Understand the philosophies--including similarities and differences--of the gurus of TQM in order to better evaluate TQM implementation proposals offered by quality management organizations and consultants.
3. Successfully implement process improvement teams trained to use the various quality tools for identifying appropriate process improvements.
4. Assess exactly where an organization stands on quality management with respect to the ISO 9000 quality management standard and the Baldrige Award criteria.

**Course Outcomes (CO):**

| No. | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO1 | **Outline** business excellence models and be able assess organization's performance making reference to their criteria | C1-C4 | 1 | 2 | 1 | T, Mid Term Exam, F |
| CO2 | **Implement** the principles of total quality management and understand peculiarities of their implementation | C1-C4 | 1 | 1 | 1 | T, Mid Term Exam, F |

| | | | | | | |
|---|---|---|---|---|---|---|
| CO3 | **Analyze** quality management methods and solve problems of organization | C3, C4 | 2 | 1 | 2 | T, Mid Term Exam, F |
| CO4 | **Explain** prerequisites of evolution of total quality management and significance of quality gurus' works to the management of modern organizations. | C2,C3 | 1 | 2 | 2 | T, Mid Term Exam, F |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam) | | | | | | |

**Course Content:**

TQM definition, origins and growth of TQM, benefits of TQM, philosophies of TQM: quality circle approach, Deming's approach, Juran's approach, Philip Crosby's approach.

Planned implementation of TQM: planning and commitment, participation, continuous improvement.

**Mapping of Course Outcomes (CO) and Program Outcomes:**

| Course Learning Outcomes | Engineering Knowledge | Problem Analysis | Design / Development of Solutions | Investigation | Modern Tool Usage | The Engineer and Society | Environment and Sustainability | Ethics | Communication | Individual and Team Work | Project Management and | Life Long Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

| | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **Outline** business excellence models and be able assess organization's performance making reference to their criteria | √ | | √ | | √ | | | | | | | |
| **CO2** | **Implement** the principles of total quality management and understand peculiarities of their implementation | | √ | | √ | | | | | | | | |
| **CO3** | **Analyze** quality management methods and solve problems of organization | | √ | √ | | | | | | | √ | | |
| CO4 | **Explain** prerequisites of evolution of total quality management and significance of quality gurus' works to the management of modern organizations. | √ | | | | √ | | | | | | | |

**Teaching-learning and Assessment Strategy:**

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Face-to-Face Learning | |
| Lecture | 42 |
| Practical / Tutorial / Studio | 10 |
| Student-Centred Learning | - |
| Self-Directed Learning | |
| Non-face-to-face learning | 40 |
| Revision | 20 |
| Assignment Preparations | 20 |
| Formal Assessment | |
| Continuous Assessment | 2 |

| | |
|---|---|
| Final Examination | 3 |
| Total | 137 |

**Teaching Methodology:**

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method, Multi-media Presentation, Class Presentation, Assignments, Class Tests, Exams, Feedback at every step.

**Lecture schedule:**

| **Week 1** | | **ASSESSMENT** |
|---|---|---|
| Class 1 | Orientation and Course Preview | **ASG, Class Test 1, F** |
| Class 2 & 3 | Overview of Quality and Total Quality Management | |
| **Week 2** | | |
| Class 4 & 5 | The TQM Gurus: Crosby, Deming, and Juran<br>. | |
| Class 6 | Organization for total quality, process management | |
| **Week 3** | | |
| Class 7 | Leadership and empowerment | **ASG, Class Test 2, F** |
| Class 8 & 9 | Quality teams and teamwork processes | |
| **Week 4** | | |
| Class 10,11,12 | Cost of Quality | |
| **Week 5** | | |
| Class 13, 14,15 | Organization for total quality, process management | |
| **Week 6** | **System models** | |
| Class 16,17,18 | Quality teams and teamwork processes | **ASG, Mid** |

| | | |
|---|---|---|
| | | **Term, F** |
| **Week 7** | | |
| Class 19,20,21 | Basic problem solving tools for quality improvement | |
| **Week 8** | | **ASG, Class Test 3, F** |
| Class 22,23,24 | Quality through planning and design: QFD, policy deployment, design for six sigma. | |
| **Week 9** | | |
| Class 25,26,27 | Quality through improvement: Six sigma, lean six sigma, kaizen, 5S, SPC | |
| **Week 10** | | |
| Class 28,29,30 | Quality standards and award models | **ASG, F** |
| **Week 11** | | |
| Class 31,32,33 | TQM implementation and case studies | |
| **Week 12** | **Programmable Logic Controller** | |
| Class 34,35,36 | Sustaining Leadership Through Quality | |
| **Week 13** | | |
| Class 37,38,39 | SPECIAL TOPIC (TO BE ASSIGNED) | |
| **Week 14** | | |
| Class 40,41,42 | Review | |

(PR – Project ; ASG – Assignment; PR – Presentation; R - Report; F – Final Exam)

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| Assessment Strategies | | | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| Components | | Grading | | |
| | Test 1-3 | 20% | CO 1 | C1-C4 |

| | | | | |
|---|---|---|---|---|
| Continuous Assessment (40%) | | | CO 3 | C2-C4 |
| | | | CO 2 | C2 |
| | Class Participation | 5% | CO 2 | C3, C4 |
| | | | CO 3 | A3 |
| | Mid term | 15% | CO 1 | C1-C4 |
| | | | CO 2 | C3, C4 |
| | | | CO 3 | C2-C4 |
| Final Exam | | 60% | CO 1 | C1-C4 |
| | | | CO 2 | C3, C4 |
| | | | CO 3 | C2-C4 |
| | | | CO 2 | C2 |
| Total Marks | | 100% | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**Text and Reference Books:**


1. Oakland G. F. Total Quality Management, Oxford, 2003. (Text)
2. Evans, J.R., Quality and Performance Excellence: Management, Organization and Strategy, Thomson South-Western, 2007.
3. Goetsch, D.L. and Davis, S.B. Quality Management, Prentice Hall, 2006


**Course Code:** IPE 449 **Course Name:** Industrial Fire Safety

**Credit Hour:** 3.00 **Contact Hour:** 3.00
**Level/Term:** L-4, T-2

**Curriculum Structure**: Outcome Based Education (OBE)

**Pre-requisites:** None

**Synopsis/Rationale:**

This course is aimed to imparting knowledge to and development of skills for students, by giving a strong base for industrial and building fire safety.

**Objectives:**

1. To introduce the concepts of fire protection/suppression principles & systems currently followed in industrial sector
2. To brief the legislation requirements-national/international codes/ standards from fire & safety perspective
3. To provide students with knowledge about how to reduce fire risks, deal with fires if appropriate and escape safely in the event of fire.

**Course Outcomes (CO) & Generic Skills:**

Upon completion of this course, the student should be able to:

| No. | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO1 | **Explain** the causations and extinguishment of different kinds of fire | C1, C2 | 1 | | 1 | T, Mid Term Exam, F |
| CO2 | **Describe** different stages of fire, harmful products-health effects & behavior and **demonstrate** the usage of various fire extinguishers | C2, C3 | 1 | 1 | 1,6 | ASG, Mid Term Exam, F |
| CO3 | **Identify** & **explain** different types of fire protection systems/ installations in industry | C2 | 1, EP 2 | 1 | 1,6 | T, ASG, F |
| CO4 | **Elucidate** various hazards & safety measures associated with flammable/combustible workspace materials | C1-C3 | 1 | 1,4 | 1,7 | T, Mid Term Exam, ASG, R, F |
| CO5 | **Explicate** types, cusses & consequences of explosions and associated safety measures | C1, C2 | 1 | | 1 | ASG, PR, R, F |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam) | | | | | | |

**Course Contents:**

Course overview, Importance of this course for industrial engineers, Fire, History of fires, Classifications of fires, Recognition of possible fire sources and their causes, National Fire Protection Association and Occupational Safety and Health Administration standards, Human behaviour in fire, The measures needed to overcome behavioural problems and to ensure the safe evacuation of people in the event of fire, Fire risk assessment, Fire Alarms & fire detection, Fire resisting construction & compartmentation, Active fire safety for building Protection, Fire suppression & protection, Fire Protection system, Prevention of failure, fire prevention Measures.

**Mapping of Course Outcomes and Program Outcomes:**

| No. | Course Outcomes (CO) of the Course | Program Outcomes (PO) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Engineering Knowledge | Problem Analysis | Design / Development of Solutions | Investigation | Modern Tool Usage | The Engineer and Society | Environment and Sustainability | Ethics | Communication | Individual and Team Work | Project Management and Finance | Life Long Learning |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| CO1 | **Explain** the causations and extinguishment of different kinds of fire | √ | √ | | | √ | | | | | | | |
| CO2 | **Describe** different stages of fire, harmful products-health effects & behavior and **demonstrate** the usage of various fire extinguishers | √ | | | √ | √ | | | | | | | |
| CO3 | **Identify** & **explain** different types of fire protection systems/ installations in industry | √ | | √ | | √ | | | | | | | √ |
| CO4 | **Elucidate** various hazards & safety measures associated with flammable/combustible workspace materials | √ | √ | √ | √ | √ | | √ | | | | | |
| CO5 | **Explicate** types, cusses & consequences of explosions and | √ | | | | | | | | | | | √ |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | associated safety measures | | | | | | | | | | | | |

**Teaching-learning and Assessment Strategy:**

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Face-to-Face Learning<br>Lecture<br>Practical / Tutorial / Studio<br>Student-Centred Learning | <br>42<br>-<br>- |
| Self-Directed Learning<br>Non-face-to-face learning<br>Revision<br>Assignment Preparations | <br>40<br>20<br>20 |
| Formal Assessment<br>Continuous Assessment<br>Final Examination | <br>2<br>3 |
| Total | 127 |

**Teaching Methodology:**

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method, Multi-media Presentation, Class Presentation, Visualization using Computer Simulations, Assignments, Class Tests, Exams, Feedback at every step.

**Lecture Schedule:**

| **Week** | **Lecture** | **Topics** | **ASSESSMENT** |
|---|---|---|---|
| **1** | Lec 1<br><br>Lec 2<br>Lec 3 | Course overview, Importance of this course for industrial engineers.<br>Fire, History of fires, Classifications of fires<br>Recognition of possible fire sources and their causes | **Class Test 1, ASG, F** |
| **2** | Lec 4 | National Fire Protection Association and | |
| | Lec 5<br>Lec 6 | Occupational Safety and Health Administration standards (BNBC, NIOSH, OSHA) | |
| **3** | Lec 7<br>Lec 8<br><br><br>Lec 9 | Understanding fire: Human behaviour in fire<br>The measures needed to overcome behavioural problems and to ensure the safe evacuation of people in the event of fire<br>Devising procedures in the event of fire, Assisting disabled people to escape | |

| | | | |
|---|---|---|---|
| **4** | Lec 10<br>Lec 11<br>Lec 12 | Fire risk assessment structure and layout,<br>Means of escape principles and requirements<br>Fire signage: National requirements | **Class Test 2, ASG, PR, F** |
| **5** | Lec 13<br>Lec 14<br>Lec 15 | Fire Alarms & fire detection: Basic components, and testing<br>Emergency lighting: When it is required, Basic components, and testing, Alternatives to emergency lighting | |
| **6** | Lec 16<br>Lec 17<br>Lec 18 | Emergency Plans & Staff Training<br>Highly Flammables & LPG<br>Fire-fighting equipment requirements | |
| **7** | Lec 19<br>Lec 20<br>Lec 21 | Fire resisting construction & compartmentation<br>Active fire safety for building<br>Protection<br>Automatic roof vents | |
| **8** | Lec 22<br>Lec 23<br>Lec 24 | Fire suppression & protection, Classification of fire protection systems-Active & Passive:<br>Active FPS- Definitions, classifications- Water Based (Vs) Non water based & Fixed (Vs) Portable/Mobile | **Mid Term, F** |
| **9** | Lec 25<br>Lec 26<br>Lec 27 | Fire Extinguishers, Fire hydrants, Sprinklers standpipe systems, water spray systems<br>Water as an extinguishing agent | |
| **10** | Lec 31<br>Lec 32<br>Lec 33 | Basic Components of a Fire Protection system<br>Fire water supply systems-Types, Design philosophy acc.to OISD, Foam, DCP & other gaseous extinguishing agents | |
| **11** | Lec 28<br>Lec 29<br>Lec 30 | Passive FPS- Fire Resistance: Basic Concepts(philosophy)<br>Materials used & their Fire Resistance ratings, Fire Resistance tests<br>Fire Proofing: Introduction, materials used in coatings & paintings | **Class Test 3, ASG, R, PR, F** |
| **12** | Lec 34<br>Lec 35 | Concrete as a fire proofing material; Exit & Egress Arrangements: Basic definitions | |
| | Lec 36 | Exit, Means of Egress system, Exit door, Refuge area, Safe area & other related as per standard<br>Installation & maintenance as per relevant national and international standards | |

| | | | |
|---|---|---|---|
| **13** | Lec 37<br>Lec 38<br>Lec 39 | The process of fire risk assessment<br>Fire risk assessment recording and review procedures<br>The potential for pollution arising from fires, Measures to prevent and reduce fire pollution | |
| **14** | Lec 40<br><br>Lec 41<br>Lec 42 | Prevention of failure, fire prevention Measures<br>**Review Class 1**<br>**Review Class 2** | |

(PR – Project; ASG – Assignment; PR – Presentation; R - Report; F – Final Exam)

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| Assessment Strategies | | | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| Components | | Grading | | |
| Continuous Assessment (40%) | Test 1, 2 | 20% | CO 1 | C1, C2 |
| | | | CO 3 | C2 |
| | | | CO 4 | C1-C3 |
| | Class Participation | 5% | CO 1 | C1, C2 |
| | | | CO 2 | C2 |
| | Mid term | 15% | CO 1 | C1, C2 |
| | | | CO 2 | C2 |
| | | | CO 4 | C1-C3 |
| Final Exam | | 60% | CO 1 | C1, C2 |
| | | | CO 2 | C2, C3 |
| | | | CO 3 | C2 |
| | | | CO 4 | C1-C3 |
| | | | CO 5 | C1, C2 |
| Total Marks | | 100% | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**Text and Ref Books:**

1. Principles of Fire Safety Engineering and Management-(Understanding Fire & Fire Protection)- by A.K. Das, First edition, 2014.

2. Handbook of Fire Technology- by R.S. Gupta

3. Industrial Fire Protection- R. Craig Schroll

**Reference Site:**

https://classroom.google.com/ (To be announced)

**Course Code:** IPE 451 **Course Name:** Micromanufacturing

**Credit Hour:** 3.00 **Contact Hour:** 3.00
**Level/Term:** L-4, T-2

**Curriculum Structure**: Outcome Based Education (OBE)

**Pre-requisites:** None

**Synopsis/Rationale:**

This course covers applications and various microfabrication methods to design and fabricate MEMS devices. Methods include, patterning based on photolithography, deposition, etching (wet & dry), nanofabrication technologies, next-generation fabrication technologies, and the physics behind them.

**Objectives:**

4. To acquire the baseline knowledge about the theory and methods of various microfabrication techniques based on photolithography, and the ability to apply for developing the MEMS devices.
5. To design the basic level of MEMS devices.

**Course Outcomes (CO) & Generic Skills:**

Upon completion of this course, the student should be able to:

| No. | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO1 | **Learn** and **understand** the operation of micro devices, micro systems and their applications | C1 | | | 1 | T, Mid Term Exam, F |
| CO2 | **Study** and **design** the micro devices, micro systems using the MEMS fabrication process | C1-C6 | 1,7 | 1,3 | 1, 4-6 | ASG, Mid Term Exam, F |
| CO3 | **Learn, understand** and **apply** of basic approaches for various sensor and actuator design | C1-C3 | 1 | 1,3 | 1,4 ,5 | T, ASG, F |
| CO4 | **Develop** experience on micro-systems for photonics | C1,C2 | | | 1 | T, Mid Term Exam, ASG, R, F |
| CO5 | **Obtain** technical knowledge required for computer-aided design, fabrication, analysis and characterization of micro-structured materials, micro-scale devices | C1,C2 | 1 | | 1 | ASG, PR, R, F |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam) | | | | | | |

**Course Contents:**
Fundamental of micro and nano technology, Micro elements: design and fabrication; Basics of micro-fabrication technology: thin film growth and deposition, photolithography, X-ray lithography, wet and dry chemical etching, Nano machining and Finishing, Concepts of micro forming and welding, micromachining, electrochemical machining, ultrasonic machining, plasma machining and laser machining.

**Mapping of Course Outcomes and Program Outcomes:**

| **No.** | **Course Outcomes (CO) of the Course** | **Program Outcomes (PO)** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Engineering Knowledge | Problem Analysis | Design / Development of Solutions | Investigation | Modern Tool Usage | The Engineer and Society | Environment and Sustainability | Ethics | Communication | Individual and Team Work | Project Management and Finance | Life Long Learning |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | **Understand** the operation of micro devices, micro systems and their applications | √ | | | | | | | | | | | |
| CO2 | **Study** and **design** the micro devices, micro systems using the MEMS fabrication process | √ | | √ | | √ | | | | | √ | | |
| CO3 | **Learn, understand** and **apply** of basic approaches for various sensor and actuator design | √ | √ | √ | | √ | | | | | √ | | |
| CO4 | **Develop** experience on micro-systems for photonics | √ | | | | | | | | | | | |
| CO5 | **Obtain** technical knowledge required for computer-aided design, fabrication, analysis and characterization of micro-structured materials, micro-scale devices | √ | | | | | | | | | | | |

**Teaching-learning and Assessment Strategy:**

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Face-to-Face Learning<br>Lecture<br>Practical / Tutorial / Studio<br>Student-Centred Learning | <br>42<br>-<br>- |
| Self-Directed Learning<br>Non-face-to-face learning<br>Revision<br>Assignment Preparations | <br>40<br>20<br>20 |
| Formal Assessment<br>Continuous Assessment<br>Final Examination | <br>2<br>3 |
| Total | 127 |

**Teaching Methodology:**

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method, Multi-media Presentation, Class Presentation, Visualization using Computer Simulations, Assignments, Class Tests, Exams, Feedback at every step.

**Lecture Schedule:**

| Week | Lecture | Topics | ASSESSMENT |
|---|---|---|---|
| **1** | Lec 1<br>Lec 2<br>Lec 3 | Fundamental of micro and nano technology, Micro-fabrication, concepts of micro and Microsystems Products, Microsystems and Microelectronics , Application of Microsystems, Standardization and Commercialization Issues of Micro-Nano Systems | **Class Test 1, ASG, F** |
| **2** | Lec 4<br>Lec 5<br>Lec 6 | Introduction to MEMS<br>Basic design and fabrication techniques of MEMs<br>Micro sensors, micro/nano biosensors: Classification of physical sensors | |
| **3** | Lec 7<br>Lec 8<br>Lec 9 | Integrated, Intelligent or Smart sensors, Bio sensing Principles and sensing methods<br>Biosensors arrays and Implantable devices<br>Innovative Applications on Present Devices: Nano chips, Nanotubes and Nanowires, Integration of chips and microprocessors | |
| **4** | Lec 10<br>Lec 11<br>Lec 12 | Introduction to Micro actuation<br>MEMS with Micro actuators<br>Micro actuators with mechanical Inertia – Micro fluidics | **Class Test 2, ASG, PR, F** |
| **5** | Lec 13<br>Lec 14<br>Lec 15 | Basics of micro-fabrication technology<br>Thin film growth and deposition<br>Sputtering | |
| **6** | Lec 16<br>Lec 17<br>Lec 18 | Fundamentals on Deposition techniques<br>Atomic Layer Deposition I<br>Atomic Layer Deposition II | |
| **7** | Lec 19<br>Lec 20<br>Lec 21 | Chemical Vapour Deposition I<br>Chemical Vapour Deposition II<br>Thermal evaporation | |

| | | | |
|---|---|---|---|
| **8** | Lec 22<br>Lec 23<br>Lec 24 | Ultra Sonic Micro Machining, Abrasive Water Jet Micro Machining – Tool based Micro-machining, Chemical and Electro Chemical Micro Machining – Electric Discharge Micro machining. Electron and Laser Beam Micro Machining, Hybrid Micro machining, Electro Chemical Discharge micro machining, Machining of Micro gear, micro nozzle, micro pins and its applications. Tool based micromachining (TBMM) | **Mid Term, F** |
| **9** | Lec 25<br>Lec 26<br>Lec 27 | Nano machining and Finishing<br>Plasma Beam Machining<br>electrochemical machining | |
| **10** | Lec 31<br>Lec 32<br>Lec 33 | Abrasive Flow finishing<br>Magnetic Float polishing<br>Elastic Emission Machining | |
| **11** | Lec 28<br>Lec 29<br>Lec 30 | Chemo-Mechanical Polishing<br>Magnetic Abrasive Finishing<br>Focused Ion Beam Machining | **Class Test 3, ASG, R, PR, F** |
| **12** | Lec 34<br>Lec 35<br>Lec 36 | Concepts of micro forming and welding<br>Micro extrusion<br>Roller Imprinting | |
| **13** | Lec 37<br>Lec 38<br>Lec 39 | Micro bending and micro welding with LASER<br>Electron beam for micro welding<br>Metrology for micro machined components. | |
| **14** | Lec 40<br><br>Lec 41<br>Lec 42 | Micro and Nano structured surface development by Nano plastic forming<br>**Review Class 1**<br>**Review Class 2** | |

(PR – Project; ASG – Assignment; PR – Presentation; R - Report; F – Final Exam)

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| Assessment Strategies | | | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| Components | | Grading | | |
| Continuous Assessment (40%) | Test 1, 2 | 20% | CO 1 | C1 |
| | | | CO 3 | C1-C3 |
| | | | CO 4 | C1,C2 |
| | Class Participation | 5% | CO 2 | C1-C6 |
| | | | CO 3 | C1-C3 |
| | | | CO 4 | C1,C2 |
| | Mid term | 15% | CO 1 | C1 |
| | | | CO 2 | C1-C6 |
| | | | CO 4 | C1,C2 |

| | | | |
|---|---|---|---|
| Final Exam | 60% | CO 1 | C1 |
| | | CO 2 | C1-C6 |
| | | CO 3 | C1-C3 |
| | | CO 4 | C1,C2 |
| | | CO 5 | C1,C2 |
| Total Marks | 100% | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**Text and Ref Books:**

1. Advanced Machining Process - Hassan El-hofy
2. Non traditional machining process – Golam Kibria

**Reference Site:**

https://classroom.google.com/ (To be announced)

**Course Code:** IPE 433 **Course Name:** Production Planning and Control
**Credit Hour:** 3.00 **Contact Hour:** 3.00
**Level/Term:** L-4, T-2

**Curriculum Structure**: Outcome Based Education (OBE)

**Pre-requisites:**

1. IPE 107: Engineering Economy
2. IPE 205: Probability and Statistics
3. IPE 305: Operations Research
4. IPE 311: Operations Management

**Synopsis/Rationale:**

The course covers production planning and scheduling systems. The emphasis of the course is on implementing effective production planning and scheduling systems to industrial applications. Heavy emphasis is placed on developing mathematical models such as linear programming for solving manufacturing related scheduling problems.

**Objectives:**

1. To provide students with the basic concepts related to the operations management systems and their impact on production and inventory control system design.
2. To provide students with methodology and models for the generation of company forecasts, materials management cost elements, business operations analysis, productivity,

operations strategies for competitive advantage, location strategies, and supply-chain management.

3. To provide students with information on the design and management of operations and production planning/control systems including capacity planning, materials requirements planning, inventory models, scheduling and sequencing, and line balancing for various aspects of the manufacturing and service industry.

**Course Outcomes (CO) & Generic Skills:**

Upon completion of this course, the student should be able to:

| No. | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO1 | **Analyze** operations performance measurements and analysis for continuous improvement. | C1-C4 | 2 | 2 | 1 | T, Exam, F |
| CO2 | **Apply** and **analyze** forecasting models to develop business enterprise forecasts for product demand, profits, sales, material requirements, capacity requirements, etc | C1-C5 | 2 | 2 | 1 | ASG, Mid Term Exam, F |
| CO3 | **Develop** and **analyze** production and inventory planning/control systems, and scheduling techniques by using engineering techniques for a complete production facility | C2-C4,C6 | 2 | 2 | 2 | ASG, Mid Term, F |
| CO 4 | **Design**, **develop**, and **analyze** a Master Production Schedule and a resultant Materials Requirement Plan (MRP) for a complete production facility. | C2-C6 | | | | F, ASG |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam) | | | | | | |

**Course Contents:**

**Introduction:** Overview, and Reasons for Production Planning and Scheduling

**Forecasting**: Regression, Moving Average, and Exponential Smoothing Techniques, Aggregate Production , Graphical Models, Linear Models, Disaggregation

**Master Production Scheduling and Capacity Planning**: Inventory Modeling, Cost Components and Terminology, ABC Analysis, Economic Order Quantity and Economic Production Quantity, Dynamic Lot Sizing Techniques, Safety Stock Analysis

**Material Requirements Planning**: Factory Floor Scheduling , Definitions and Performance Measures, Gantt Charts, Single Machine Scheduling, Flowshop Scheduling

**Jobshop Scheduling**: Dispatching Rules: SPT, EDD, SLACK, SLACK/OPN, FCFS, RANDOM, Release Rules: Workload Regulating, Starvation Avoidance

**Integrated Production Planning and Control**: Just-in-time, KANBAN, Push Systems, Pull Systems, and Theory of Constraints

**Mapping of Course Outcomes and Program Outcomes:**

| No. | Course Outcomes (CO) of the Course | Program Outcomes (PO) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| **CO1** | **Analyze** operations performance measurements and analysis for continuous improvement. | √ | √ | √ | √ | √ | | | | | | √ | √ |
| **CO2** | **Apply** and **analyze** forecasting models to develop business enterprise forecasts for product demand, profits, sales, material requirements, capacity requirements, etc | √ | √ | | | √ | | | | | √ | √ | √ |
| **CO3** | **Develop** and **analyze** production and inventory planning/control systems, and scheduling techniques by using engineering techniques for a complete production facility | √ | √ | √ | √ | √ | | | | √ | √ | √ | √ |
| **CO4** | **Design**, **develop**, and **analyze** a Master Production Schedule and a resultant Materials Requirement Plan (MRP) for a complete production facility. | √ | √ | √ | √ | √ | | | | √ | √ | √ | √ |

(H – High, M- Medium, L-low)

**Teaching-learning and Assessment Strategy:**

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Face-to-Face Learning<br>Lecture | <br>42 |

| | |
|---|---|
| Practical / Tutorial / Studio | - |
| Student-Centred Learning | - |
| Self-Directed Learning | |
| Non-face-to-face learning | 18 |
| Revision | 21 |
| Assignment Preparations | 20 |
| Formal Assessment | |
| Continuous Assessment | 2 |
| Final Examination | 3 |
| Total | 106 |

**Teaching Methodology:**

Lecture and Discussion, Co-operative and Collaborative Method, Assignments, Class Tests, Exams, Feedback at every step.

**Lecture Schedule:**

| Week | Lecture | Topics | TEST |
|---|---|---|---|
| **1** | Lec 1 | **Introduction and Overview** | **ASG, Class Test 1** |
| | Lec 2 | Reasons for Production Planning and Scheduling | |
| | Lec 3 | **Forecasting** | |
| **2** | Lec 4 | Regression | |
| | Lec 5 | Moving Average, and | |
| | Lec 6 | Exponential Smoothing Techniques | |
| **3** | Lec 7 | Exponential Smoothing Techniques (contd.) | |
| | Lec 8 | **Aggregate Production Planning** | |
| | Lec 9 | Graphical Model | |
| **4** | Lec 10 | Linear Models | **ASG, Class Test 2** |
| | Lec 11 | Chemical Processing Paper | |
| | Lec 12 | Disaggregation | |
| **5** | Lec 13 | **Master Production Scheduling and Capacity Planning** | |
| | Lec 14 | **Inventory Modeling** | |
| | Lec 15 | Cost Components and Terminology | |
| **6** | Lec 16 | Cost Components and Terminology | |
| | Lec 17 | ABC Analysis | |
| | Lec 18 | ABC Analysis | |
| **7** | Lec 19 | Economic Order Quantity and | |

| | | | |
|---|---|---|---|
| | Lec 20 | Economic Production Quantity | |
| | Lec 21 | Dynamic Lot Sizing Techniques | |
| **8** | Lec 22 | Safety Stock Analysis | **Mid Term** |
| | Lec 23 | **Material Requirements Planning** | |
| | Lec 24 | **Factory Floor Scheduling** | |
| **9** | Lec 25 | Definitions and Performance Measures | |
| | Lec 26 | Gantt Charts | |
| | Lec 27 | Single Machine Scheduling | |
| **10** | Lec 28 | Flowshop Scheduling | **ASG, Class Test 3** |
| | Lec 29 | Jobshop Scheduling | |
| | Lec 30 | Dispatching Rules: SPT, EDD, SLACK, SLACK/OPN, FCFS, RANDOM | |
| **11** | Lec 31 | Release Rules: Workload Regulating, | |
| | Lec 32 | Starvation Avoidance | |
| | Lec 33 | Integrated Production Planning and Control | |
| **12** | Lec 34 | Just-in-time | |
| | Lec 35 | Channel management and retailing | |
| | Lec 36 | KANBAN | |
| **13** | Lec 37 | Push Systems | **ASG,F** |
| | Lec 38 | Pull Systems | |
| | Lec 39 | Theory of Constraints | |
| **14** | Lec 40 | **Review** | |
| | Lec 41 | | |
| | Lec 42 | | |

(PR – Project ; ASG – Assignment; PR – Presentation; R - Report; F – Final Exam)

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| Components | | Grading | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| Continuous Assessment (40%) | Class test 1-3 | 20% | CO 1 | C1-C3 |
| | | | CO 2 | C4, P4 |
| | | | CO 3 | P4, C1,C4 |

| | | | | |
|---|---|---|---|---|
| | Class Participation | 5% | CO 1 | C1-C3, A2 |
| | | | CO 2 | C4, P4 |
| | Mid term | 15% | CO 1 | C1-C3 |
| | | | CO 2 | C4, P4 |
| Final Exam | | 60% | CO 1 | C1-C3 |
| | | | CO 2 | C4, P4 |
| | | | CO 3 | P4, C1, C4 |
| | | | CO 4 | C3-C6 |
| Total Marks | | 100% | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**Text and Ref Books:**

1. Manufacturing Planning and Control Systems for Supply Chain Management, Vollman, Berry, Whybark, and Jacobs, McGraw-Hill, 6th Edition, 2011

**Reference Site:**

https://classroom.google.com/ (To be announced)

**Course Code:** IPE 447 **Course Name:** Advanced Material and Process
**Credit Hour:** 3.00 **Contact Hour:** 3.00
**Level/Term:** L-4, T-2
**Curriculum Structure**: Outcome Based Education (OBE)
**Pre-requisites:** (1) IPE 105: Engineering Materials

**Synopsis/Rationale:**

This Outcome Based Education (OBE) based course is designed to conduct in depth study on super alloys, composites, biodegradable plastics, ceramic materials, various properties of advanced engineering materials and methods of heat and surface treatments with the objective of laying a strong foundation for core manufacturing courses of program.

**Objectives:**

i. To conduct study on super alloys.
ii. To expose students to various composite materials.
iii. To conduct study on powder metallurgy and particulate materials.
iv. To conduct study on biodegradable plastics.
v. To expose students to electronic materials.
vi. To conduct study on smart materials.
vii. To apply advanced concepts of engineering materials to the analysis, design and development of materials, components, or processes to meet desired needs of material processing and working condition.

**Course Outcomes (CO) & Generic Skills:**

Upon completion of this course, the student should be able to:

| No. | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO 1 | **Explain** properties and processing of super alloys. | C1-C4 | 1 | | 1 | T, Mid Term Exam, F |
| CO 2 | **Outline** the properties of various composites and their processing methods. | C1-C4 | 1 | | 1 | T, Mid Term Exam, F |
| CO 3 | **Explain** fundamentals of ceramic processing. | C3, C4 | 2 | 1 | 2 | T, Mid Term Exam, F |
| CO 4 | **Explain** the structure and application of smart materials. | C2-C4 | | | 1 | T, Mid Term Exam, F |
| CO 5 | **Describe** the application of biodegradable plastics. | C2-C4 | 1 | | | T, Mid Term Exam, F |
| CO 6 | **Outline** the properties of electronic materials and their application. | C2 | | | 1 | T, Mid Term Exam, F |
| CO 7 | **Describe** the fundamentals of powder metallurgy and particulate materials. | A3 | 1 | | 1 | T, Mid Term Exam, F |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam) | | | | | | |

**Course Contents:**

Super alloys; Metal matrix composites, Ceramic matrix composites, other composites;

Polymers; Biodegradable plastics: Ceramics: Electronic materials. Powder metallurgy and particulate materials. Smart Materials.

**Mapping of Course Outcomes and Program Outcomes:**

| Course Learning Outcomes | | Engineering Knowledge | Problem Analysis | Design / Development of Solutions | Investigation | Modern Tool Usage | The Engineer and Society | Environment and | Ethics | Communication | Individual and Team Work | Project Management and | Life Long Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | Explain properties and processing of super alloys. | √ | √ | | | | | | | | | | |
| **CO2** | Outline the properties of various composites and their processing methods. | √ | √ | √ | | | | | | | | | |
| **CO3** | Explain fundamentals of ceramic processing. | √ | | | | | | | | | | | |
| **CO4** | Explain the structure and application of smart materials. | √ | √ | | | | | | | | | | |
| **CO5** | Describe the application of biodegradable plastics. | √ | √ | | | | | √ | | | | | |
| **CO6** | Outline the properties of electronic materials and their application. | √ | √ | | | | | | | | | | |
| **CO7** | Describe the fundamentals of powder metallurgy and particulate materials. | √ | | | | | | | | | | | |

**Teaching-learning and Assessment Strategy:**

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Face-to-Face Learning | |
| Lecture | 42 |
| Practical / Tutorial / Studio | - |
| Student-Centred Learning | - |
| Self-Directed Learning | |
| Non-face-to-face learning | 40 |
| Revision | 20 |
| Assignment Preparations | 20 |
| Formal Assessment | |
| Continuous Assessment | 2 |
| Final Examination | 3 |
| Total | 127 |

**Teaching Methodology:**

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method, Multi-media Presentation, Class Presentation, Assignments, Class Tests, Exams, Feedback at every step.

**Lecture Schedule:**

| **Week/class** | **Topics** | **Assessment** |
|---|---|---|
| **Week 1** | **Introduction to superalloys** | CT, ASG |
| Class 1 | Introduction to materials for high-temperature applications | |
| Class 2 | Physical metallurgy of superalloys | |
| Class 3 | High temperature mechanical properties of superalloys | |
| **Week 2** | **Application and processing of super alloys** | |
| Class 4 | Processing and manufacturing of superalloys | |
| Class 5 | Failure analysis of superalloys | |
| Class 6 | Future trends in structural alloy design and development | |
| **Week 3** | **Introduction to composite materials** | |
| Class 7 | Classification and properties of composite materials | |

| | | |
|---|---|---|
| Class 8 | Reinforcement and manufacturing of composite materials | |
| Class 9 | Processing of metal matrix composites | |
| **Week 4** | **composite materials** | CT, ASG |
| Class 10 | properties and application of metal matrix composites | |
| Class 11 | processing of ceramic matrix composites. | |
| Class 12 | Properties and application of ceramic matrix composites. | |
| **Week 5** | **biodegradable plastics** | |
| Class 13 | Introduction to biodegradable plastics | |
| Class 14 | Rationale for biodegradable plastics - the biological carbon cycle | |
| Class 15 | Composting biodegradable plastics | |
| **Week 6** | **biodegradable plastics** | |
| Class 16 | Design & engineering of biodegradable plastics | |
| Class 17 | Polyester based and natural polymer based biodegradable plastics | |
| Class 18 | Markets and business opportunities | |
| **Week 7** | **Ceramics** | Mid, ASG |
| Class 19 | Ceramic Raw Materials and their processing | |
| Class 20 | Ceramic forming: dry forming and wet forming processes | |
| Class 21 | Firing of ceramics | |
| **Week 8** | **Ceramics (contd.)** | |
| Class 22 | Statics and Kinetics of Firing, Kiln Design and Operation. Specialised Sintering Processes. | |
| Class 23 | Glass Making Technology: Glass Compositions & Structure; Glazes & Enamels. | |
| Class 24 | Cement and Concrete Processing | |
| **Week 9** | **Electronic materials** | |
| Class 25 | Overview of electronic materials | |
| Class 26 | Integrated circuit, PWB | |
| Class 27 | Solid state structure | |
| **Week 10** | **Electronic materials (contd.)** | |
| Class 28 | Electrical and thermal properties | |
| Class 29 | Optical and magnetic properties | |

| | | |
|---|---|---|
| Class 30 | Applications | |
| **Week 11** | **Powder metallurgy and particulate materials** | |
| Class 31 | Steps in Making Powder-Metallurgy Parts, Powder particles, Atomization | |
| Class 32 | Mechanical alloying, Bowl Geometries in Blending Metal Powders, Density Variation in Compacting Metal Powders | |
| Class 33 | Press for Compacting Metal Powder, Powder Rolling | |
| **Week 12** | **Powder metallurgy and particulate materials** | |
| Class 34 | Spray Deposition, Mechanisms for Sintering Metal Powders, Design Considerations for P/M | |
| Class 35 | Characteristics of Ceramics Processing, Dry or semi-dry pressing, hydroplastic forming, Slip casting, doctor blade process | CT, ASG, F |
| Class 36 | Extruding and Jiggering, Float method, Glass tubing and manufacturing | |
| **Week 13** | **Smart materials** | |
| Class 37 | Introduction to smart materials | |
| Class 38 | State-of-the-Art in Smart Materials & Structures (SM&S) Development | |
| Class 39 | Shape Memory Alloy Materials and Actuators: control design, Designing with MR Fluids | |
| **Week 14** | **Smart materials (contd.)** | |
| Class 40 | Smart Rubber, Fiber Optic Sensors, MEMS | |
| Class 41 | Piezoceramics and Finite Element Modeling of Piezoceramic Smart Structure, Health Monitoring using Smart Materials | |
| Class 42 | Review | |

(PR – Project ; ASG – Assignment; PR – Presentation; R - Report; F – Final Exam)

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

<table>
<tr><th colspan="3">Assessment Strategies</th><th rowspan="2">CO</th><th rowspan="2">Bloom’s Taxonomy</th></tr>
<tr><th colspan="2">Components</th><th>Grading</th></tr>
<tr><td rowspan="2"></td><td rowspan="2">Test 1-3</td><td rowspan="2">20%</td><td>CO 1</td><td>C1-C4</td></tr>
<tr><td>CO 3</td><td>C2-C4</td></tr>
<tr><td rowspan="5">Continuous Assessment (40%)</td><td></td><td></td><td>CO 4</td><td>C2</td></tr>
<tr><td rowspan="2">Class Participation</td><td rowspan="2">5%</td><td>CO 2</td><td>C3, C4</td></tr>
<tr><td>CO 5</td><td>A3</td></tr>
<tr><td rowspan="2">Mid</td><td rowspan="2"></td><td>CO 1</td><td>C1-C4</td></tr>
<tr><td>CO 2</td><td>C3, C4</td></tr>
</table>

| | | | | |
|---|---|---|---|---|
| | term | 15% | CO 3 | C2-C4 |
| Final Exam | | 60% | CO 1 | C1-C4 |
| | | | CO 2 | C3, C4 |
| | | | CO 3 | C2-C4 |
| | | | CO 4 | C2 |
| Total Marks | | 100% | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**Text and Ref Books:**


1. William D. Callister, ***Materials Science and Engineering an Introduction***, John Wily, 5th Edition.
2. Sidney H Avner, ***Introduction to Physical Metallurgy***, Tata Mc Graw – Hill Edition, 2nd edition..
3. Ashby, M. F.; Jones, D. R. H., ***Engineering materials 1: an introduction to properties, applications and design***. Elsevier: 2012; Vol. 1.
4. Kakani, S., ***Material science. New Age International***: 2006.
5. Smallman, R. E.; Ngan, A., ***Physical metallurgy and advanced materials.*** Elsevier: 2011.


| **COURSE INFORMATION** | | | |
|---|---|---|---|
| Course Code<br><br>Course Title | : CSE 403<br><br>: Artificial Intelligence | Lecture Contact urs<br><br>Credit Hours | : 3.00<br><br>: 3.00 |
| **PRE-REQUISITE** | | | |
| Course Code: Nil<br><br>Course Title: Nil | | | |
| **CURRICULUM STRUCTURE** | | | |
| Outcome Based Education (OBE) | | | |

| RATIONALE |
|---|
| Artificial intelligence is the beginning of revolution for rational behaviour of intelligent agents along with knowledge perception, representation, planning, reasoning, learning and understanding ideas to solve real life complex situations. |

| OBJECTIVE |
|---|
| 1. To discuss and distinguish the notions of rational behaviour and intelligent agents.<br>2. To develop a general appreciation of the goals, subareas, achievements and difficulties of AI.<br>3. To have knowledge of methods of blind as well as informed search in case of knowledge representation, planning, learning, robotics and other AI areas and ability to practically apply the corresponding techniques. |

**LEARNING OUTCOMES& GENERIC SKILLS**

| No. | Course Learning Outcome (Upon completion of the course, the students will be able to) | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO 1 | Remembering and understanding the notions of rational behaviour, goals, subareas, achievements and difficulties of AI agents. | C1, C2 | 1 | | 1 | T |
| CO 2 | Able to apply problem solving methods (informed, uninformed, local search, adversarial search and CSP) of single or multi agents to solve real life problems. | C2, C6 | 3 | | 5, 6 | T, MT, F |
| CO 3 | Able to apply major concepts and approaches of knowledge representation, planning and learning for improving machine intelligence. | C6, P3 | 2, 7 | | 5, 8 | T, MT, F |
| CO 4 | Able to develop the communication skill by presenting topics on Artificial Intelligent. | A2 | | 1 | | Pr |

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile,T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam, MT- Mid Term Exam)

**COURSE CONTENT**

**Introduction:** Overview of AI and intelligent agents; **Problem Solving:** Review of Uninformed Search Strategies and game playing; Informed search Strategies: A*, Heuristic functions, Memory Bounded Search (IDA*, SMA*), Iterative improvement Search, adversarial search, local search Constraint satisfaction problems; **Knowledge representation:** Review of Propositional logic, first order Logic, **Planning:** Introduction to Planning, Partial Order Planning; **Reasoning:** Bayesian Rule and its use in probabilistic reasoning; **Learning:** Belief Networks and Decision Networks; Learning Decision Trees; Learning General Logical descriptions-Hypothesis. Introduction to Natural Language Processing.

## Course Outcomes:

| No. | Course Learning Outcome | PROGRAM OUTCOMES (PO) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| CO1 | Remembering and understanding the notions of rational behaviour, goals, subareas, achievements and difficulties of AI agents. | √ | | | | | | | | | | | |
| CO2 | Able to apply problem solving methods (informed, uninformed, local search, adversarial search and CSP) of single or multi agents to solve real life problems. | | | √ | | | | | | | | | |
| CO3 | Able to apply major concepts and approaches of knowledge representation, planning and learning for improving machine intelligence. | | | √ | | | | | | | | | |
| CO4 | Able to develop the communication skill by presenting topics on Artificial Intelligent. | | | | | | | | | | √ | | |

**JUSTIFICATION FOR CO-PO MAPPING**

| Mapping | Level | Justifications |
|---|---|---|
| CO1-PO1 | High | As graduates will have to acquire knowledge on different types of agent architecture and working procedure. |
| CO2-PO3 | High | As the graduates will have to design solutions for real life engineering problems which can be solved by agent using different search techniques that meet specified needs with appropriate consideration. |
| CO3-PO3 | High | As the graduates will have to design solutions for real life engineering problems which can be solved by agent which is capable of representing |

| | | |
|---|---|---|
| | | knowledge, reasoning information, able to plan and learn in different scenario along with appropriate consideration. |
| CO4-PO10 | Low | By presenting on different recent innovation of artificial intelligent embedded machine, graduates will have improved communication skill. |

| **TEACHING LEARNING STRATEGY** | |
|---|---|
| Teaching and Learning Activities | Engagement (hours) |
| Face-to-Face Learning | |
| Lecture | 42 |
| Practical / Tutorial / Studio | - |
| Student-Centred Learning | - |
| Self-Directed Learning | |
| Non-face-to-face learning | 42 |
| Revision | 21 |
| Assessment Preparations | 21 |
| Formal Assessment | |
| Continuous Assessment | 2 |
| Final Examination | 3 |
| Total | 131 |

| **TEACHING METHODOLOGY** |
|---|
| Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method |

## COURSE SCHEDULE

| Week | Lecture | Topics | Assessment Methods |
|---|---|---|---|
| 1. | Lec 1<br>Lec 2<br>Lec 3 | Introduction to AI<br>Agent Architecture<br>Solving Problems by Searching | Class Test - 1 |
| 2. | Lec 1<br>Lec 2, 3 | Uninformed Search I<br>Uninformed Search II | |
| 3. | Lec 1<br>Lec 2, 3 | Informed Search I<br>Informed Search II | |
| 4. | Lec 1<br>Lec 2, 3 | Memory Bounded Search I<br>Memory Bounded Search II | |
| 5. | Lec 1<br>Lec 2, 3 | Beyond Classical Search I<br>Beyond Classical Search II | Class Test - 2 |
| 6. | Lec 1<br>Lec 2, 3 | Adversarial Search I<br>Adversarial Search II | |
| 7. | Lec 1<br>Lec 2, 3 | Constraint Satisfaction Problems I<br>Constraint Satisfaction Problems II | |
| 8. | Lec 1<br>Lec 2<br>Lec 3 | Planning with State Space Search<br>Planning with Partial Order Search<br>Graph Search | |
| 9. | Lec 1 | Uncertainty and Probabilities | |

| | | | |
|---|---|---|---|
| | Lec 2<br>Lec 3 | Propositional Logic<br>First Oder Logic | |
| 10. | Lec 1-3 | Second Oder Logic | Mid Term Exam |
| 11. | Lec 1<br>Lec 2<br>Lec 3 | Bayesian Rule<br>Probabilistic reasoning<br>Bayes Net | |
| 12. | Lec 1<br>Lec 2 | Naive Bayes<br>Belief Networks<br>Decision Networks | Class Test-3 |
| 13. | Lec 1<br>Lec 2 | Perceptions<br>Kernels and Clustering | |
| 14. | Lec 1-3 | Learning General Logical descriptions-Hypothesis.<br>Introduction to Natural Language Processing. | |

**ASSESSMENT STRATEGY**

| Components | | Grading | CO | Blooms Taxonomy |
|---|---|---|---|---|
| Continuous | Test 1-3 | 20% | CO1 | C1, C2 |
| | | | CO2 | C2, C6 |

| | | | | |
|---|---|---|---|---|
| Assessment (40%) | | | CO3 | C6, P3 |
| | Class Participation | 5% | CO4 | A2 |
| | Mid term | 15% | CO2 | C2, C6 |
| | | | CO3 | C6, P3 |
| Final Exam | | 60% | CO2 | C2, C6 |
| | | | CO3 | C6, P3 |
| Total Marks | | 100% | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**REFERENCE BOOKS**


1. Artificial Intelligence: A Modern Approach (4th Edition) – Stuart Jonathan Russell, Peter Norvig; Prentice Hall (2020)
2. Artificial Intelligence: A New synthesis – Nils J. Nilsson; Routledge


**REFERENCE SITE**

**Google Classroom**

# CHAPTER 6

## DESCRIPTION OF THE BASIC SCIENCE, MATHEMATICS, LANGUAGE, AND GENERAL EDUCATION COURSES

### 6.1 Detailed Curriculum of Basic Science Courses

| COURSE INFORMATION | | | |
|---|---|---|---|
| Course Code | : **PHY 133** | Lecture Contact Hours | : **3.00** |
| Course Title | : Waves and Oscillations, Structure of Matter, Heat and Thermodynamics | Credit Hours | : **3.00** |

**PRE-REQUISITE**

N/A

**CURRICULUM STRUCTURE**

Outcome Based Education (OBE)

**SYNOPSIS/RATIONALE**

This course covers the basics of physics in the fields of waves and oscillations, structure of matter, heat and thermodynamics. The course will emphasize the basic concepts, theories, and solving quantitative problems that can be applicable in a wide spectrum of engineering disciplines.

**OBJECTIVE**

1. To define the different parameters, concepts, logical and critical thinking with scientific knowledge of waves and oscillations, structure of matter, heat and thermodynamics.
2. To explain the basic theories and laws of waves and oscillations, structure of matter, heat and thermodynamics.
3. To solve numerical and analytical problems regarding waves and oscillations, structure of matter, heat and thermodynamics.

**LEARNING OUTCOMES & GENERIC SKILLS**

| No. | Course Outcomes<br>At the end of the course, a student should be able to | Corresponding POs | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|---|

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CO1 | **Define** different basic laws and parameters in the field of waves and oscillations, structure of matter, heat and thermodynamics such as simple harmonic motion, damped oscillations, crystal structure, crystal defects, thermometer, thermodynamics laws, entropy etc. etc. | PO1 | C1 | - | - | 1 | T, MT, F |
| CO2 | **Explain** different basic theories in the field of waves and oscillations, structure of matter, heat and thermodynamics such as the SHM, damped motion, wave motion, Bragg's law, bonding energy, kinetic theory of gases, Carnot cycle, thermodynamic function etc. | PO1 | C2 | - | - | 1 | T, MT, F |
| CO3 | **Solve** quantitative problems in the field of waves and oscillations, structure of matter, heat and thermodynamics such as SHM, damped motion, wave motion, packing factor, Miller indices, heat and thermodynamics etc. | PO1 | C3 | - | - | 2 | T, ASG, MT, F |
| (CP – Complex Problems, CA – Complex Activities, KP – Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, CS – Case study, MT- Mid Term Exam, F – Final Exam) | | | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| C1 - Remember | C2 – Understand | C3 - Apply | C4 - Analyze | C5 – Evaluate | C6 – Create |

**COURSE CONTENT**

**Waves and Oscillations:** Simple Harmonic Motion (SHM) and its properties, differential equation of a SHM and its solution, total energy and average energy of a body executing SHM, simple pendulum, torsional pendulum, spring-mass system, LC oscillatory circuit, two body oscillation and reduced mass, Composition of SHM, Damped oscillations, and its different condition, forced oscillations and its different condition, resonance, Wave motion : expression for a plane progressive wave, differential equation of wave motion, energy density of wave motion, average kinetic and potential energy of wave motion, Stationary wave.

**Structure of matter** : Crystalline and non-crystalline solids, single crystal and poly-crystal solids, unit cell, crystal systems, co-ordinations number, crystal planes and directions, NaCl and CsCl structure, packing factor, Miller indices, relation between inter-planar spacing and Miller indices, Bragg's law, methods of determination of inter-planar spacing from diffraction patterns; defects in solids: point defects, line defects, surface defects, bonds in solids, band theory of solids: distinction between metal, semiconductor and insulator, inter-atomic distances, calculation of cohesive and bonding energy.

**Heat and Thermodynamics** : Platinum resistance and thermo-electric thermometer, Calorimetry : Newton’s law of cooling, specific heat, $C_p$, $C_v$, relation between $C_p$ & $C_v$, different process, Kinetic theory of gases, pressure equation, RMS speed, Kinetic interpretation of temperature, degrees of freedom, equipartition of energy, mean free path, Laws of thermodynamics, zeroth law, first law of thermodynamics, thermodynamic equilibrium, PV diagram, Carnot Cycle, entropy, calculation of change in entropy, entropy and the second law of thermodynamics, reversible and irreversible process, temperature entropy diagram, Maxwell’s thermodynamic relations, Clausius Clapeyron equation, thermodynamic function.

**CO-PO MAPPING**

| No. | Course Outcome | PROGRAM OUTCOMES (PO) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| CO1 | Be able to Define different basic parameters in the field of waves and oscillations, structure of matter, heat and thermodynamics such as periodic motion, simple harmonic motion, undamped oscillations, crystal structure, crystal defects, heat, entropy, Carnot’s cycle etc. | √ | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO2 | Be capable to Explain different basic theories in the field of waves and oscillations, structure of matter, heat and thermodynamics such as the wave motion for different systems along with energy, packing factor, Bragg's law, thermodynamics laws, entropy, etc. | √ | | | | | | | | | | | |
| CO3 | Be skilled to Solve quantitative problems in the field of waves and oscillations, structure of matter, heat and thermodynamics such as energy of wave motion, wavelength, packing factor, Miller indices, thermodynamics laws, Carnot's cycle, entropy, etc. | √ | | | | | | | | | | | |

| **TEACHING LEARNING STRATEGY** | |
|---|---|
| **Teaching and Learning Activities** | **Engagement (hours)** |
| **Face-to-Face Learning** | |
| Lecture | 42 |
| Practical / Tutorial / Studio | - |
| Student-Centered Learning | - |
| **Self-Directed Learning** | |
| Non-face-to-face learning | 42 |
| Revision of the previous lecture at home | 21 |
| Preparation for test and examination | 21 |
| **Formal Assessment** | |
| Class Test / Mid-Term Exam | 3 |
| Final Examination | 3 |
| Total | **132** |

**TEACHING METHODOLOGY**

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

**COURSE SCHEDULE**

| Weeks | Lect | Topics | Remarks |
|---|---|---|---|
| Week -1 | 1 | Introductory class: Brief discussion on total syllabus, basic requirements of the course, assessment of the course | CT-1/ Assignment |
| | 2 | Periodic motion, oscillatory motion, simple harmonic motion (SHM), properties of SHM, differential equations, general solution of SHM, graphical representation of SHM | |
| | 3 | Velocity, acceleration, phase and epoch, time period, frequency and angular frequency of SHM | |
| Week -2 | 4 | Total energy and average energy of SHM, problems | |
| | 5 | Simple pendulum, torsional pendulum, spring-mass system | |
| | 6 | LC oscillatory circuit, two body oscillations, reduced mass | |
| Week -3 | 7 | Composition of SHM | |
| | 8 | Composition of SHM, problems | |
| | 9 | Damped oscillations and its differential equation | |
| Week -4 | 10 | Displacement equation of damped oscillations and its different conditions, electric damped oscillatory circuit | CT-2 /Assignment |
| | 11 | Forced oscillations and its differential equation, displacement equation of forced oscillations, resonance | |
| | 12 | Wave motion : expression for a plane progressive wave, differential equation of wave motion, particle velocity, wave velocity | |
| Week -5 | 13 | Energy density of a plane progressive wave, average energy in a plane progressive wave, problems | |
| | 14 | Stationary wave : node, anti-node, problems | |
| | 15 | Classification of solids, types of crystalline solids, crystal, lattice, basis, crystal structure, plane lattice, space lattice, Bravais and non-Bravais lattices | |
| Week -6 | 16 | Unit cell, lattice parameters, primitive and non-primitive cells and their distinctions, lattice symbols, crystal structure of NaCl and CsCl | |
| | 17 | Unit face, axial units: linear and numerical parameters and, Miller indices | |
| | 18 | Atomic radius, packing factor and coordination number for different structures | |

| | | | |
|---|---|---|---|
| Week -7 | 19 | Relation between lattice constant and density of solids and related numerical problems | Mid Term/ Assignment |
| | 20 | Inter-planer spacing, relation between inter-planar spacing and Miller indices, problems | |
| | 21 | X-ray diffraction, Bragg's law, methods of determination of inter-planar spacing from diffraction patterns, problems | |
| Week -8 | 22 | Defects in solids: point defects, line defects, surface defects | |
| | 23 | Defects in solids: point defects, line defects, surface defects | |
| | 24 | Atomic arrangement in solid: different types of bonds in solids | |
| Week -9 | 25 | Band theory of solids : valence band, conduction band, energy gap, distinction between metal, semiconductor and insulator | |
| | 26 | Potential, cohesive energy, binding energy, Madelung constant, inter-atomic distance, calculation of total potential energy of a pair of atoms | |
| | 27 | Calculation of total potential energy at the equilibrium separation of an ionic crystal, problems | |
| Week -10 | 28 | Introduction of thermometry : Platinum resistance thermometer | |
| | 29 | Thermocouple : See-beck effect, neutral temperature and temperature of inversion of a thermocouple, | |
| | 30 | Thermo-electric thermometer | |
| Week -11 | 31 | Calorimetry : Newton's law of cooling, specific heat of gases, isothermal change, adiabatic change; isochoric and isobaric processes | CT-3 / Assignment |
| | 32 | $C_p$, $C_v$, relation between $C_p$ and $C_v$, problems | |
| | 33 | Adiabatic equation of a perfect gas, adiabatic and isothermal curves, work done during expansion or compression of a gas, problems | |
| Week -12 | 34 | Postulates of kinetic theory of gases, expression for pressure exerted by a gas, kinetic interpretation of temperature | |
| | 35 | RMS speed, degrees of freedom of a gas, principle of equipartition of energy, ratio of specific heats of gases ($\gamma$) | |
| | 36 | Mean free path, problems | |
| Week -13 | 37 | Laws of thermodynamics, thermodynamic equilibrium, reversible and irreversible process, heat engine P-V diagram, efficiency of heat engines, Carnot's cycle | |

| | | | |
|---|---|---|---|
| | 38 | Efficiency of Carnot engine, refrigerator, 2nd law of thermodynamics, Carnot's theorem, problems | |
| | 39 | Entropy : properties of entropy, change in entropy for a reversible & irreversible process | |
| Week -14 | 40 | Calculation of entropy change in reversible process : when heated at constant volume, constant pressure, isothermal expansion and general manner, Problems | |
| | 41 | Thermodynamic relations : Maxwell's thermodynamic relations : one to sixth relation | |
| | 42 | Thermodynamic function : Internal energy (U), Helmholtz free energy function (F) or free energy, Significance of free energy, Gibbs' free energy function (G), Enthalpy (H), Clausius and Clapeyron equation | |

**ASSESSMENT STRATEGY**

| Components | | Grading | COs | Blooms Taxo |
|---|---|---|---|---|
| Continuous Assessment (40%) | Class Test 1-3/ Assignment | 20% | CO1, CO2, CO3 | C1, C2, |
| | Class Attendance | 5% | | |
| | Class Performance | 5% | | |
| | Mid term | 10% | CO1, CO2, CO3 | C1, C2, |
| Final Exam (Section A & B) | | 60% | CO1 | C1 |
| | | | CO2 | C2 |
| | | | CO3 | C3 |
| Total Marks | | 100% | | |

(CO = Course Outcome, C = Cognitive Domain, A = Affective Domain, P = Psychomotor Domain)

**REFERENCE BOOKS**

1. Physics for Engineers : Part-I and Part-II : Dr Giasuddin Ahmad
2. Physics, Volume I and Volume II : Resnick and Halliday
3. Fundamentals of Physics : Halliday, Resnick and Walker
4. Physics for Scientists and Engineers: Serway and Jewett
5. Waves and Oscillations : Brij Lal and Subramannyam
6. Introduction to Solid State Physics: Charles Kittle
7. Solid State Physics: S. O. Pillai
8. Solid State Physics: Ali Omar
9. Fundamentals of Solid State Physics : B.S. Saxena, R.C. Gupta, P.N. Saxena

10. B.Sc Physics : C. L. Arora.
11. Heat & Thermodynamics : Brijlal and N. Subrahmanyam
12. A Text Book of Heat : T. Hossain


| **COURSE INFORMATION** | | | |
|---|---|---|---|
| Course Code | : **PHY 134** | Lecture Contact Hours | : **3.00** |
| Course Title | : **Physics Sessional** | Credit Hours | : **1.50** |

| **PRE-REQUISITE** |
|---|
| N/A |
| **CURRICULUM STRUCTURE** |
| Outcome Based Education (OBE) |
| **SYNOPSIS/RATIONALE** |
| This is a laboratory course in basic physics in the fields of waves and oscillations, optics, mechanics, electricity, modern physics, and thermal physics. The course will emphasize the fundamental experiments in different fields of physics that can be applicable to a wide spectrum of engineering disciplines. This laboratory course will enable students to understand basic physics practically as well as work with a team or individual. |
| **OBJECTIVE** |
| 1. To develop basic physics knowledge practically<br>2. To practice use of basic scientific instrument |
| **LEARNING OUTCOMES & GENERIC SKILLS** |

| No. | Course Outcomes<br>At the end of the course, a student should be able to | Corresponding POs | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|---|

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CO1 | **Define** the different parameters regarding waves and oscillations, optics, mechanics, electricity, modern physics and thermal physics etc. | PO1 | C1 | | | K1 | R, Q, F |
| CO2 | **Describe** the different phenomena regarding waves and oscillations, optics, mechanics, electricity, modern physics and thermal physics etc. | PO1 | C1 | | | K1 | R, Q, T, F |
| CO3 | **Skilled** to Construct Experiments by an individual or by a group to determine different phenomena regarding waves and oscillations, optics, mechanics, electricity, modern physics and thermal physics etc. | PO1 | C2 | | | K2 | R, Q, T, F |
| CO4 | **Prepare** a report for an experimental work. | PO1 | C2 | | | K2 | R |

(CP – Complex Problems, CA – Complex Activities, KP – Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, CS – Case study, MT- Mid Term Exam, F – Final Exam)

**COURSE CONTENT**

Quantitative measurement of different parameters in the field of waves and oscillations, optics, mechanics, electricity, modern physics and thermal physics such as:
Specific resistance of materials, high resistance, resistance of a galvanometer, Electrochemical equivalent (ECE) of copper, comparison of the E.M.F's of two cells, radius of curvature, wavelength of light, focal length of lens, specific rotation of sugar, refractive index of a liquid, frequency of a tuning fork, acceleration due to gravity, spring constant, rigidity modulus, young's modulus, moment of inertia, conservation of linear momentum, thermal conductivity of a bad conductor, temperature co-efficient of resistance, pressure co-efficient of a gas, specific heat of a liquid, surface tension, Planck's constant.

**CO-PO MAPPING**

| No. | Course Outcome | PROGRAM OUTCOMES (PO) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| CO1 | Be able to Define the different parameters regarding waves and oscillations, optics, mechanics, electricity, modern physics and thermal physics etc. | √ | | | | | | | | | | | |
| CO2 | Be capable to Describe the different phenomena regarding waves and oscillations, optics, mechanics, electricity, modern physics and thermal physics etc. | √ | | | | | | | | | | | |
| CO3 | Be skilled to Construct Experiments by an individual or by a group to determine different phenomena regarding waves and oscillations, optics, mechanics, electricity, modern physics and thermal physics etc. | √ | | | | | | | | | | | |
| CO4 | Be able to Prepare a report for an experimental work. | √ | | | | | | | | | | | |

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

**TEACHING LEARNING STRATEGY**

| **Teaching and Learning Activities** | Engagement (hours) |
|---|---|
| **Face-to-Face Learning** | |
| Lecture | 7 |
| Experiment | 35 |
| **Self-Directed Learning** | |
| Preparation of Lab Reports | 20 |
| Preparation for the Lab Test | 13 |
| Preparation of Quiz | 9 |

| | |
|---|---|
| Preparation of viva | 9 |
| **Formal Assessment** | |
| Continuous Assessment | 14 |
| Final Quiz | 1 |
| Final viva | 1 |
| Final lab exam | 3 |
| **Total** | **112** |

**TEACHING METHODOLOGY**

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

**COURSE SCHEDULE**

| **Weeks** | **Topics** | Remarks |
|---|---|---|
| Week-1 | Introductory class: Brief discussion on total syllabus, basic requirements of the course, evaluation system of the course, grouping, visit different section of the laboratory, introduction to different basic equipment | |
| Week-2 | Determination of the specific resistance of a wire using meter bridge or determination of ECE of copper by using copper voltameter | |
| Week-3 | Determination of high resistance by the method of deflection and determination of resistance of a galvanometer by half deflection method or comparison of the E.M.F's of two cells by a potentiometer | |
| Week-4 | Determination of the wavelength of sodium light by a spectrometer using a plane diffraction grating or determination of the specific rotation of sugar by polarimeter | |
| Week-5 | Determination of the radius of curvature of a plano-convex lens by Newton's ring method or determination of focal length of a concave lens by auxiliary lens method | |
| Week-6 | Determination of the frequency of a tuning fork by Melde's experiment or determination of the Planck's constant using photoelectric effect | |
| Week-7 | Determination of the value of g acceleration due to gravity by means of a compound pendulum | |

| | | |
|---|---|---|
| Week-8 | Determination of the spring constant, effective mass and the rigidity modulus of the spring or determination of the Young's modulus of bar by bending method | |
| Week-9 | Determination of the moment of inertia of a Fly-wheel about its axis of rotation or verification of the law of conservation of linear momentum | |
| Week-10 | Determination of the thermal conductivity of a bad conductor by Lee's method or determination of specific heat of a liquid by the method of cooling | |
| Week-11 | Determination of the pressure co-efficient of a gas at constant volume by constant volume air thermometer or determination of the temperature co-efficient of resistance of the material of a wire using a meter-bridge | |
| Week-12 | Viva & lab final experimental exam | |
| Week-13 | Viva & lab final experimental exam | |
| Week-14 | Quiz exam | |

**ASSESSMENT STRATEGY**

| Components | | Grading | CO | Blooms Taxonomy |
|---|---|---|---|---|
| Continuous Assessment (40%) | Class performance/ Assignment | 10% | | |
| | Report Writing/ Assignment | 30% | CO1, CO4 | C1, C2 |
| Final Exam (60%) | Lab test | 30% | CO1, CO2, CO3 | C1, C2 |
| | Viva | 10% | | |
| | Quiz | 20% | | |
| Total Marks | | 100% | | |

(CO = Course Outcome, C = Cognitive Domain, A = Affective Domain, P = Psychomotor Domain)

**REFERENCE BOOKS**


1. Practical physics for degree students : Dr Giasuddin Ahmad and Md. Sahabuddin
2. Practical Physics: G. L. Squires
3. B.Sc. Practical Physics: C. L Arora
4. Practical Physics: S.L. Gupta and V. Kumar

| COURSE INFORMATION | | | |
|---|---|---|---|
| Course Code<br>Course Title | : CHEM 109<br>: Basic Chemistry | Contact Hours<br>Credit Hours | : 3.00<br>: 3.00 |

**PRE-REQUISITE**

None

**CURRICULUM STRUCTURE**

Outcome Based Education (OBE)

**SYNOPSIS/RATIONALE**

To learn the basic concepts of inorganic, organic and physical chemistry

**OBJECTIVE**

1. To define the different parameters and concepts of inorganic, organic and physical chemistry
2. To apply different chemical theory to evaluate structure of molecules
3. To describe basic reaction mechanism of the organic reactions
4. To solve quantitative problems regarding inorganic and physical chemistry

**COURSE OUTCOMES AND GENERIC SKILLS**

| No. | Course Outcomes | Corresponding PO | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|---|
| CO1 | Be able to define the different parameters and concepts regarding inorganic, organic, and physical chemistry. | 1 | C1 | | | 1 | MID, T/Asg, F |
| CO2 | Be able to apply different theory on chemical bonding and hybridization to determine structure of molecules. | 1 | C3 | | | 1,2 | T/ASG, F, MID |
| CO3 | Be able to explain the selective topics on organic chemistry. | 1 | C2 | | | 1,2 | T/ASG, F, MID |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CO4 | Solve quantitative problems in the field of inorganic, and physical chemistry | 1 | C3 | | | 1,2 | MID,T/ASG , F |

| |
|---|
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; MID-Mid term exam, R - Report; F – Final Exam) |
| **COURSE CONTENT** |

**Atomic Structure:** Concepts of atomicstructure, Different atom models, Quantum theory and electronic configurations, Heisenberg's uncertainty principle

**Periodic Table:** Periodic classification of elements, Periodic properties of elements, Properties and uses of noble gases

**Chemical Bonding:** Types and properties,VBT, MOT, Hybridization and shapes of molecules

Selective topics on Organic chemistry: Different types of organic reractions (Addition, elimination, substitution, polymerization), Introduction to organic polymer, basic concepts of dyes, color and constitution

**Acids-Bases/Buffer Solution:** Different concepts of acids-bases, Buffer solution, Mechanism of buffer solution, Henderson-Hasselbalch equation, Water chemistry and pH of water

Corrosion: Nature, forms and types of corrosion, electrochemical mechanism and prevention of corrosion

**Solutions:** Solutions and their classification, Unit expressing concentration, Colligative properties and dilute solutions, Raoult’s law,Van’t Hoff’s law of osmotic pressure

**Thermochemistry:** Laws of thermochemistry, Enthalpy, Heat of reaction, Heat of formation, Heat of neutralization, Kirchoff’s equations, Hess'slaw

**Electrochemistry:** Conductors and nonconductors, Difference between electrolytic and metallic conduction, Electrolytic conductance, Factors influencing the conductivity of electrolytes, Kohlrausch Law and conductometric titrations, Different types of electrochemical cells

**Chemical Equilibria:** Equilibrium law/constant, $K_p$ and $K_c$, Homogeneous and heterogeneous equilibrium,Van’t Hoff’s reaction isotherm, Le Chatelier's principle

**Phase Rule:** Basic terms and phase rule derivation, Phase diagram of an one component system

**Chemical Kinetics:** Order and rate of reaction, Pseudo and zero order reaction, Half-life, Determination and factors affecting the rate of a reaction, First order reaction, Second order reaction, Collision theory, Transition state theory

## CO-PO MAPPING

| No. | Course Outcome | PROGRAM OUTCOMES (PO) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| CO1 | Be able to **define** the different parameter and concepts regarding inorganic, organic, and physical chemistry. | 1 | | | | | | | | | | | |
| CO2 | Be able to **apply** different theory on chemical bonding and hybridization to determine structure of molecules. | 2 | | | | | | | | | | | |
| CO3 | Be able to **explain** the selective topics on organic chemistry. | 2 | | | | | | | | | | | |
| CO4 | **Solve** quantitative problems in the field of inorganic, and physical chemistry | 2 | | | | | | | | | | | |

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

## TEACHING LEARNING STRATEGY

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Face-to-Face Learning | |
| Lecture | 42 |
| Class Performance | - |
| | - |
| Self-Directed Learning | |
| Assignments | 42 |
| Revision of the previous lecture at home | 21 |
| Preparation for final examination | 21 |
| Formal Assessment | |
| Continuous Assessment | 2 |
| Final Examination | 3 |
| Total | 131 |

## TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

| COURSESCHEDULE | | |
|---|---|---|
| **Week 1** | **Atomic Structure** | **CT** |
| **Class 1** | General introduction, Concepts of atomic structure | **CT-1** |
| **Class 2** | Concepts of atomic structure, Different atom models | |
| **Class 3** | Hydrogen spectral lines, Heisenberg's uncertainty principle, de broglies equation | |
| **Week 2** | **Atomic Structure/Periodic Table** | |
| **Class 4** | Schrondinger equation, Quantum numbers, Electronic configuration | |
| **Class 5** | Periodic law, Features of Periodic table | |
| **Class 6** | Classification of elements according to electronic configurations, periodicity, Periodic properties of elements, | |
| **Week 3** | **PeriodicTable/Chemical Bonding** | |
| **Class 7** | Properties and uses of noble gases | |
| **Class 8** | Chemical bonding (types, properties) | |
| **Class 9** | Valence Shell Electron Pair Repulsion Theory, VBT | |
| **Week 4** | **Chemical Bonding** | **CT-2** |
| **Class 10** | Hybridization of molecules | |
| **Class 11** | Shapes of the molecule | |
| **Class 12** | Molecular orbital Theory | |
| **Week 5** | **Chemical Bonding/Selected Topics on Organic Chemistry** | |
| **Class 13** | Molecular orbital Theory | |
| **Class 14** | Different types of organic reractions (Addition, elimination, substitution, polymerization) | |
| **Class 15** | Introduction to organic polymer, basic concepts of dyes, color and constitution | |
| **Week 6** | **Selected Topics on Organic Chemistry/ Acids-Bases** | |

| | | |
|---|---|---|
| **Class 16** | Basic comcepts of dye and constituents | |

| | | |
|---|---|---|
| **Class 17** | Different concepts of acids-bases | |
| **Class 18** | pH, pH scale, pH of water | |
| **Week 7** | **Acids-Bases/Corrosion** | **CT-3/Mid Term** |
| **Class 19** | Buffer solution, Mechanism of buffer solution, common ion effect | |
| **Class 20** | Henderson-Hasselbalch equation | |
| **Class 21** | Corrosion: Nature, forms and types of corrosion | |
| **Week 8** | **Corrosion/ Solutions** | |
| **Class 22** | Electrochemical mechanism and prevention of corrosion | |
| **Class 23** | Solutions and their classification, Unit expressing concentration | |
| **Class 24** | Effect of temperature and pressure on solubility, Validity and limitations Of Henry'slaw | |
| **Week 9** | **Solutions/Thermochemistry** | |
| **Class 25** | Colligative properties and dilute solutions, Raoult's law, deviation from Raoult's law, | |
| **Class 26** | Elevation of boiling point, Freezing point depression, Van't Hoff's law of osmotic pressure | |
| **Class 27** | Laws of thermo chemistry, Enthalpy | |
| **Week 10** | **Thermochemistry/Electrochemistry** | |
| **Class 28** | Heat of reaction, Heat of formation, Heat of neutralization | |
| **Class 29** | Hess's law, Kirchoff's equations | |
| **Class 30** | Conductor, semiconductor, non conductor, Electrolytic conduction and its mechanism | |
| **Week 11** | **Electrochemistrym** | **CT-4** |
| **Class 31** | Faraday's law, Factors influencing the conductivity of electrolytes | |
| **Class 32** | Conductrometric titrations | |

| | | |
|---|---|---|
| **Class 33** | Different types of electrochemical cells | |
| **Week 12** | **Chemical Equilibrium** | |
| **Class 34** | Reversible reactions, Characteristics of chemical quilibrium, Law of mass action, Equilibrium constant, Units of equilibrium constant | |
| **Class 35** | Relation between $K_p$ and $K_c$,van't Hoff's reaction isotherm, vant' Hoff equation | |
| **Class 36** | Free energy and its significance, Heterogeneous equilibrium, Le Chatelier's principle | |
| **Week 13** | **PhaseRule/ChemicalKinetics** | |
| **Class 37** | Phase Rule: Basic terms and phase rule derivation | |
| **Class 38** | Phase Diagram of an one component sytem | |
| **Class 39** | Pseudo and zero order reaction, Half-life | |
| **Week 14** | **Chemical Kinetics** | |
| **Class 40** | Determination and factors affecting the rate of a reaction | |
| **Class 41** | First order reaction, Second order reaction | |
| **Class 42** | Collision theory, Transition state theory | |

**ASSESSMENTSTRATEGY**

| Components | | Grading | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| ContinuousAssessment (40%) | Class Test/Assignment | 20% | CO1 | C1 |
| | | | CO2 | C3 |
| | | | CO3 | C2 |
| | | | CO4 | C3 |
| | Class Performance | 5% | CO1 | C1 |
| | | | CO2 | C3 |
| | | | CO3 | C2 |
| | | | CO4 | C3 |
| | Mid term | 15% | CO1 | C2 |
| | | | CO2 | C1 |

| | | | | |
|---|---|---|---|---|
| | | | CO3 | C3 |
| | | | CO4 | C2 |
| Final Exam | | 60% | CO1 | C1 |
| | | | CO2 | C3 |
| | | | CO3 | C2 |
| | | | CO4 | C3 |
| Total Marks | | 100% | | |

**(CO=Course Outcome, C=Cognitive Domain, P=Psychomotor Domain, A=Affective Domain)**

**TEXTANDREFERENCEBOOKS**


1. Modern Inorganic Chemistry–S.Z. Haider
2. Concise Inorganic Chemistry–J.D. Lee
3. A Text book of Organic Chemistry–Arun Bahl And B. S. Bahl
4. Organic Chemistry–Morrisonand Boyd
5. Principles of Physical Chemistry–Haque and Nawab
6. Essentials of Physical Chemistry–Bahl and Tuli
7. Physical Chemistry–Atkins

| COURSE INFORMATION | | | |
|---|---|---|---|
| Course Code<br>Course Title | : CHEM 110<br>: Chemistry Sessional | Contact Hours<br>Credit Hours | : 3.00<br>: 1.50 |

| PRE-REQUISITE |
|---|
| Course Code: N/A<br>Course Title: |

| CURRICULUM STRUCTURE |
|---|
| Outcome Based Education (OBE) |

| SYNOPSIS/RATIONALE |
|---|
| To implement the basic concepts of inorganic and physical chemistry in a laboratory environment. |

| OBJECTIVE |
|---|
| 1) To familiarize the students with experimentation of acid and base neutralization, titration and quantitative analysis of metals etc.<br>2) To make students proficient in iodimetric and iodometric analysis and complexometric titration etc.<br>3) To develop students' ability in estimating zinc, ferrous content in water sample by using various titrimetric methods. |

**LEARNING OUTCOMES AND GENERIC SKILLS**

| No. | Course Outcomes | Corresponding PO | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|---|
| CO1 | Be able to **describe** the different parameters regarding acid and base neutralization, titration and quantitative analysis of metals etc. and others key words like primary standard substances, secondary standard substances, molarity, normality, indicator, equivalent weights and so on. | 1 | P1 | | | 1,2 | R, Q, V, F |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CO2 | Be able to **perform** experimentation regarding iodimetric and iodometric method, Complexometric titration etc. | 1,5,10 | P2, P3, P4, P5 | | | 1,2 | R, Q, T |
| CO3 | Be able to **measure** calcium, ferrous content in water Sample by using various methods. | 1,5,10 | P3, P4, P5 | | | 1,2 | R, Q, T, Pr |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam; V-viva) | | | | | | | |
| **COURSE CONTENT** | | | | | | | |
| Quantitative chemical analysis in the field of inorganic and physical chemistry such as:<br>Acid-base titration, Redox titration, Iodometric and Iodimetric titration, Complexometric titration. | | | | | | | |

**CO-PO MAPPING**

| No. | Course Outcome | PROGRAM OUTCOMES (PO) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| CO 1 | Be able to **describe** the different parameters regarding acid and base neutralization, titration and quantitative analysis of metals etc. and others key words like primary standard substances, secondary standard substances, molarity, normality, indicator, equivalent weights and so on. | 2 | | | | | | | | | | | |
| CO 2 | Be able to **perform** experimentation regarding iodimetric and iodometric method, complexometric titration etc. | 2 | | | | 2 | | | | 3 | | | |
| CO 3 | Be able to **measure** calcium, ferrous contentin water sample by using various methods. | 2 | | | | 2 | | | | 3 | | | |

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

| TEACHING LEARNING STRATEGY | |
|---|---|
| Teaching and Learning Activities | Engagement (hours) |
| Face-to-Face Learning<br>Lecture<br>Experiment | <br>12<br>30 |
| Self-Directed Learning<br>Preparation of Lab Reports<br>Preparation of Lab-test<br>Preparation of Quiz | <br>24<br>10<br>10 |
| Preparation of Presentation | 6 |
| Formal Assessment<br>Continuous Assessment<br>Final Quiz | <br>10<br>1 |
| Total | 103 |

| TEACHING METHODOLOGY |
|---|
| Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method |

| COURSE SCHEDULE | |
|---|---|
| **Class/ Week** | **Intended topics to be covered** |
| **Class 1** | Introduction |
| **Class 2** | Standardization of Sodium Hydroxide (NaOH) Solution with Standard Oxalic Acid dihydrate ($C_2H_2O_4.2H_2O$) Solution. |
| **Class 3** | Standardization of Hydrochloric Acid (HCl) Solution with Standard Sodium Hydroxide (NaOH) Solution. |
| **Class 4** | Standardization of Hydrochloric Acid (HCl) Solution with Standard Sodium Carbonate ($Na_2CO_3$) Solution. |
| **Class 5** | Determination of Calcium (Ca) Content in a Calcium Chloride dihydrate ($CaCl_2.2H_2O$) Solution with Standard Di-Sodium Ethylene Diammine Tetra Acetic Acid ($Na_2$-EDTA) Solution. |
| **Class 6** | Standardization of Sodium Thiosulphate Pentahydrate ($Na_2S_2O_3.5H_2O$) Solution with Standard Potassium Dichromate ($K_2Cr_2O_7$) Solution. |
| **Class 7** | Estimation of Copper (Cu) Content in a Copper Sulphate Pentahydrate ($CuSO_4.5H_2O$) (Blue Vitriol) Solutions by Iodometric Method with Standard Sodium Thiosulphate Pentahydrate ($Na_2S_2O_3.5H_2O$) Solution. |
| **Class 8** | Standardization of Potassium Permanganate ($KMnO_4$) Solution with Standard Oxalic Acid dihydrate ($C_2H_2O_4.2H_2O$) Solution. |

| | |
|---|---|
| **Class 9** | Determination of Ferrous (Fe) Content in a Ammonium Ferrous Sulphate (Mohr`s Salt) $[FeSO_4.(NH_4)_2SO_4.6H_2O]$ Solution with Standard Potassium Permanganate ($KMnO_4$) Solution. |
| **Class 10** | Determination of Ferrous content by 1,10-phenanthroline using UV-visible spectroscopy |
| **Class 11** | Practice Lab |
| **Class 12** | Lab Test |
| **Class 13** | Quiz Test |
| **Class 14** | Viva |

**ASSESSMENT STRATEGY**

| Components | | Grading | CO | Blooms Taxonomy |
|---|---|---|---|---|
| Continuous Assessment (40%) | Lab participation | 10% | CO 1 | P1 |
| | | | CO 2 | P2,P3,P4,P5 |
| | | | CO 2 | P3,P4,P5 |
| | Report writing | 30% | CO 1 | P1 |
| | | | CO 2 | P2,P3,P4,P5 |
| | | | CO 2 | P3,P4,P5 |
| Quiz | | 15% | CO 1 | P1 |
| | | | CO 2 | P2,P3,P4,P5 |
| | | | CO 2 | P3,P4,P5 |
| Viva | | 10% | CO 1 | P1 |
| | | | CO 2 | P2,P3,P4,P5 |
| | | | CO 2 | P3,P4,P5 |
| Final evaluation | | 35% | CO 1 | P1 |
| | | | CO 2 | P2,P3,P4,P5 |
| | | | CO 2 | P3,P4,P5 |
| TotalMarks | | 100% | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psycho motor Domain, A=Affective Domain)**

**TEXTANDREFERENCEBOOKS**

1. G.H. Jeffery, J. Bassett, J. Mendham, R.C. Denney,Vogel's Text book of Quantitative Chemical Analysis, 5th Edition, Longman Scientific and Technical, 1989
2. G.D.Christian.,AnalyticalChemistry,6th Edition,Wiley India Pvt. Limited,2007
3. A.Jabbar Mian and M. Mahbubul Haque- Practical Chemistry


## 6.2 Detailed Curriculum of Mathematics Courses

**Spring Semester L-1, T-I**

| **COURSE INFORMATION** | | | |
|---|---|---|---|
| Course Code<br>Course Title | **MATH 101**<br>**Differential and Integral Calculus** | Lecture Contact Hours<br>Credit Hours | 3.00<br>3.00 |
| **PRE-REQUISITE** | | | |
| N/A | | | |
| **CURRICULUM STRUCTURE** | | | |
| Outcome Based Education (OBE) | | | |
| **SYNOPSIS/RATIONALE** | | | |
| Purpose of this course is to introduce basic knowledge of Differential Calculus and use it in engineering study. | | | |
| **OBJECTIVE** | | | |
| 1. Be able to impart basic knowledge on differential and Integral Calculus to solve engineering problems and other applied problems.<br>2. Developing understanding some of the important aspects of rate of change, area, tangent, normal and volume.<br>3. Be expert in imparting in depth knowledge of functional analysis such as increasing, decreasing, maximum and minimum values of a function | | | |

**LEARNING OUTCOMES & GENERIC SKILLS**

| No. | Course Outcome | Corresponding PO | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|---|
| CO 1 | **Know** the rate of change of a function with respect to independent variables and the different techniques of evaluating indefinite and definite integrals. | 1 | C1 | 1 | | 1 | T, F, ASG |
| CO 2 | **Apply** the concepts or techniques of differentiation and integration to solve the | 1 | C3 | 1 | | 1 | T, Mid Term Exam, F |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | problems related to engineering study. | | | | | | |
| CO 3 | **Calculate** the length, area, volume, center of gravity and average value related to engineering study | 1 | C3 | 1 | | 1 | Mid Term Exam, F, ASG |

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

**COURSE CONTENT**

**Differential Calculus:** Introduction, Differential Calculus for Engineering, Function and Limit, Continuity and Differentiability, Successive Differentiation, Leibnittz's Theorem, Rolle's Theorem, Mean Value Theorem, Taylor's theorem, Expansion of Finite and Infinite forms, Lagrange's form of remainder, Cauchy's form of remainder, Expansion of functions differentiation and integration, Indeterminate form, Cartesian differentiation, Euler's theorem, Tangent, sub tangent and Normal, sub normal, Maxima and Minima, Curvature, Asymptotes, Partial differentiation.

**Integral Calculus:** Definition of Integration, Importance of Integration in Eng., Integration by substitution, Integration by parts, Standard integrals, Integration by successive reduction, Definite integrals and its use, Integration as a limit of sum, summing series, Walli's formula, Improper Integrals, beta and gamma function, multiple integral and its application, Area, volume of solid revolution, Area under a plain curve, Area of the region enclosed by two curves, Arc lengths of curves.

**CO-PO MAPPING**

| No. | Course Learning Outcome | PROGRAM OUTCOMES (PO) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| CO1 | **Know** the rate of change of a function with respect to independent variables and the different techniques of evaluating indefinite and definite integrals. | 3 | | | | | | | | | | | |
| CO2 | **Apply** the concepts or techniques of differentiation and integration to solve the problems related to engineering study. | 3 | | | | | | | | | | | |
| CO3 | **Calculate** the length, area, volume, center of Gravity and average value related to engineering study. | 3 | | | | | | | | | | | |

| **Justification for CO-PO mapping:** | | |
|---|---|---|
| **Mapping** | **Corresponding Level of matching** | **Justifications** |
| CO1-PO1 | 3 | Knowledge of mathematics, science and engineering sciences has to be applied to describe the complete concept of differential and integral calculus. |
| CO2-PO1 | 3 | To apply proper and improper integral in the field of Engineering study, knowledge of mathematics, science and engineering sciences are required. |
| CO3-PO1 | 3 | In order to calculate volume, average, center of gravity and area of any solid revolution object, the knowledge of Mathematics and engineering sciences are needed. |

## COURSE SCHEDULE

| **ASSESSMENT STRATEGY** | | | | |
|---|---|---|---|---|
| **Components** | | **Grading** | **CO** | **Blooms Taxonomy** |
| **Continuous Assesment (40%)** | **Class test/ Assignment 1-3** | 20% | CO1 CO2 CO2 | C1, C2 |
| | | | | C3 |
| | **Class Participation** | 5% | CO3 | C3 |
| | **Mid term** | 15% | CO2, CO3 | C3 |
| **Final Exam** | | **60%** | **CO1** | **CO1** |
| | | | **CO2** | **CO2** |
| | | | **CO3** | **CO3** |
| **Total Marks** | | **100%** | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

| | | |
|---|---|---|
| **Week 1** | | |
| Class 1 | Introduction to Differential Calculus for Engineering study, Limit of a function and its properties. | CT 1 |
| Class 2 | Basic limit theorems with proofs, Limit of infinity and infinite limit, Sandwich (Squeezing) theorem with problems. | |
| Class 3 | Concept of Differentiation, definition, classification of discontinuity and solving problems | |
| **Week 2** | | |
| Class 4 | Basic concept of Differentiability, definition, derivative of a function, differentiable function. | |
| Class 5 | Differentiability – one sided derivatives (R.H.D and L.H.D), solving problems | |
| Class 6 | Successive differentiation – Concept and problem solving | |
| **Week 3** | | |
| Class 7 | Leibnitz's theorem and its applications | |
| Class 8 | Determination of $(y_n)_0$ | |
| Class 9 | Mean Value theorem, Taylor theorem | |
| **Week 4** | | CT 2 |
| Class 10 | Expansion of finite and infinite forms, Lagrange's and Cauchy's form of remainder. | |
| Class 11 | Indeterminate forms – concept and problem solving, | |
| Class 12 | L'Hospital's rules with application | |
| **Week 5** | | |
| Class 13 | Partial differentiation - partial derivatives of a function of two variables and problems | |
| Class 14 | Partial differentiation - partial derivatives of a homogeneous function of two variables, Euler's theorem for two variables and problems | |
| Class 15 | Partial differentiation - partial derivatives of a homogeneous function of several variables, Euler's theorem for several (three and m) variables and problem solving | |
| **Week 6** | | |
| Class 16 | Tangents and Normals – Tangents and Normals in Cartesian, equation of tangent at the origin, equation of normal of functions of explicit and implicit forms, Angle between two intersection of two curves; problem solving | |
| Class 17 | Tangents and Normals – Tangents and Normals in polar, Angle between two intersection of two curves; problem solving | |
| Class 18 | Tangents and Normals – Subtangent and subnormals in Cartesian and polar coordinate; problem solving | |
| **Week 7** | | |

| | | |
|---|---|---|
| Class 19 | maxima and minima of functions of single variables – concept,Increasing and decreasing function, Concave up and down with problems | Mid Term |
| Class 20 | Curvature | |
| Class 21 | Asymptotes | |
| **Week 8** | | |
| Class 22 | Introduction to integral calculus | |
| Class 23 | Standard integrals – concept of definite and indefinite integrals, applications. | |
| Class 24 | Indefinite integrals – Method of substitution, Techniques of integration | |
| **Week 9** | | |
| Class 25 | Indefinite integrals – Integration by parts, Special types of integration, integration by partial fraction, | |
| Class 26 | Integration by the method of successive reduction | |
| Class 27 | Definite integrals – definite integrals with properties and problems | |
| **Week 10** | | CT 4 |
| Class 28 | Definite integrals – Reduction formula, Walli's formula | |
| Class 29 | Definite integrals – definite integral as the limit of the sum | |
| Class 30 | Beta function – concept and problem solving | |
| **Week 11** | | |
| Class 31 | Gamma function - concept and problem solving | |
| Class 32 | Relation between beta and gamma function, Legendre duplication formula, problems and applications | |
| Class 33 | Multiple integrals – double integrals | |
| **Week 12** | | |
| Class 34 | Multiple integrals – triple integrals | |
| Class 35 | Multiple integrals – successive integration for two and three variables | |
| Class 36 | Area in Cartesian | |
| **Week 13** | | |
| Class 37 | Area in polar | |
| Class 38 | Volume of solid revolution | |
| Class 39 | Area under a plain curve in Cartesian and polar coordinates | |
| **Week 14** | | |
| Class 40 | Area of a region enclosed by two curves in Cartesian and polar coordinates | |
| Class 41 | Arc lengths of curves in Cartesian coordinates | |
| Class 42 | Arc lengths of curves in polar coordinates | |

| REFERENCE BOOKS |
|---|
| 1. Calculus (9th Edition) by Howard Anton (Author), Irl C. Bivens (Author), Stephen Davis.<br>2. Calculus: An Intuitive and Physical Approach By Morris Kline. |

**Fall Semester L-1, T-II**

| COURSE INFORMATION | | | |
|---|---|---|---|
| Course Code<br>Course Title | **MATH 103**<br>**Differential Equation and Matrix** | Lecture Contact Hours<br>Credit Hours | : 3.00<br>: 3.00 |

| PRE-REQUISITE |
|---|
| N/A |
| **CURRICULUM STRUCTURE** |
| Outcome Based Education (OBE) |
| **SYNOPSIS/RATIONALE** |
| Purpose of this course is to introduce basic knowledge to identify and solve differential equations and concept of matrix. |
| **OBJECTIVE** |
| 1. Be able to impart basic knowledge on ordinary and partial differential equations.<br>2. Developing understanding some of the important aspects of ordinary and partial differential equations.<br>3. Be able to provide knowledge on using concept of Differential equations and matrix in engineering problems and solve other applied problems.<br>4. Be expert in imparting in depth knowledge on inverse matrix. |

**LEARNING OUTCOMES & GENERIC SKILLS**

| No. | Course Outcomes | Corresponding PO | Bloom's Taxonomy | KP | CP | CA | Assessment Methods |
|---|---|---|---|---|---|---|---|
| CO1 | **Define** various types of differential equations and the classifications of partial differential equations. | 1 | C1, C2, C3 | 1 | 1 | | T, F, ASG |
| CO2 | **Solve** ordinary and partial differential equations by using different rules | 1 | C1, C2, C3 | 1 | 1 | | T, Mid Term Exam, F |
| CO3 | **Apply** the technique of inverse matrix and echelon form to get the solution of System of Linear Equation. | 1 | C1, C2, C3 | 1 | 1 | | Mid Term Exam, F, ASG |

(CP – Complex Problems, CA – Complex Activities, KP – Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, CS – Case study, F – Final Exam)

## COURSE CONTENT

**Differential Equations:** Introduction & Formulation of DE in Engg, Degree and order of ODE, solution of first order but higher degree DE by various methods, solution of general DEs of second and higher order, Solution of Euler's homogeneous linear DEs, Solution of DEs by methods based on factorization, Frobenious methods, Bessel's functions, Legendre's polynomial, linear first order PDE, Non linear first order PDE, Standard form DEs of higher order and wave equation, particular solutions with boundary and initial condition, Non-linear PDE of order one, Charpit's method, Linear PDE with constant coefficients, Applications of DE

**Matrix:** Definition of Matrix, different types of matrices, Algebra of Matrices, Transpose and adjoint of a matrix and inverse matrix, rank and elementary transformation, solution of linear equation or System of Linear Equation, Matrix polynomials determination characteristic roots and vectors, characteristic subspace of matrix and Eigen values and Eigen Vectors, Cayley Hamilton theorem.

## CO-PO MAPPING

| No. | Course Outcome | PROGRAM OUTCOMES (PO) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| CO1 | **Define** various types of differential equations and the classifications of partial differential equations. | 3 | | | | | | | | | | | |
| CO2 | **Solve** ordinary and partial differential equations by using different rules | 3 | | | | | | | | | | | |
| CO3 | **Apply** the technique of inverse matrix and echelon form to get the solution of System of Linear Equation. | 3 | | | | | | | | | | | |

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

## JUSTIFICATION FOR CO-PO MAPPING

| Mapping | Level of Matching | Justification |
|---|---|---|
| CO1-PO1 | 3 | The knowledge of mathematics, science and engineering sciences has to be applied to describe for the physical explanation of differential equations. |
| CO2- PO1 | 3 | The application of differential equations needs the knowledge of mathematics, science and engineering for describing exponential growth and decay, the population growth of species or change in investment return over time. |

| | | |
|---|---|---|
| CO3- PO1 | 3 | In order to establish for finding the technique to obtain the inverse matrix of mathematics and natural science is required. |

| **TEACHING LEARNING STRATEGY** | |
|---|---|
| Teaching and Learning Activities | Engagement (hours) |
| Face-to-Face Learning | 42 |
| Self-Directed Learning | 75 |
| Formal Assessment | 5.5 |
| Total | **122.5** |

**TEACHING METHODOLOGY**

Class Lecture, Pop quiz, Case study, Problem solving

**COURSE SCHEDULE**

| | | |
|---|---|---|
| **Week 1** | | CT 1 |
| Class 1-3 | Introduction & Formulation of DE in Engg, Degree and order of ODE | |
| **Week 2** | | |
| Class 4-6 | Solution of first order but higher degree DE by various methods | |
| **Week 3** | | |
| Class 7-9 | Solution of general DEs of second and higher order, Solution of Euler's homogeneous linear DEs | |
| **Week 4** | | CT 2 |
| Class 10-12 | Solution of DEs by methods based on factorization, Frobenious methods, Bessel's functions, Legendre's polynomial | |
| **Week 5** | | |
| Class 13-15 | Linear first order PDE, Non linear first order PDE | |
| **Week 6** | | |
| Class 16-18 | Particular solutions with boundary and initial condition, Non-linear PDE of order one: Charpit's method | |
| **Week 7** | | Mid Ter m |
| Class 19-21 | Linear PDE with constant coefficients, Applications of DE | |
| **Week 8** | | |
| Class 22-24 | Wave equations, Particular solutions with boundary and initial conditions | |
| **Week 9** | | |
| Class 25-27 | Second order PDE and classifications to canonical (standard)- parabolic, elliptic, hyperbolic solution by separation of variables. | |
| **Week 10** | | CT 3 |
| Class 28 | Application of OD and PDE in Eng study | |
| Class 29 | Definition of Matrix, different types of matrices, Algebra of Matrices, | |

| | |
|---|---|
| Class 30 | Transpose and adjoint of a matrix and inverse matrix |
| **Week 11** | |
| Class 31-33 | Solution of linear equation or System of Linear Equation |
| **Week 12** | |
| Class 34-36 | Solution of linear equation using Inverse Matrix, Rank, Nullity and elementary transformation |
| **Week 13** | |
| Class 37-39 | Dependent and independent of vectors, Matrix polynomials determination characteristic roots and vectors |
| **Week 14** | |
| Class 40-42 | Characteristic subspace of matrix and Eigen values and Eigen Vectors, Cayley Hamilton theorem and its application. Finding inverse matrix using this theorem. |

**ASSESSMENT STRATEGY**

| COs | Assessment Method | (100%) | Remarks |
|---|---|---|---|
| | **Class Assessment** | | |
| 1 | Assignment | **20** | |
| 2 | Assignment | **20** | |
| | **Exam** | | |
| 1 | Final Exam, CT | **80** | |
| 2 | Final Exam, CT, MID | **80** | |
| 3 | Final Exam, CT | **100** | |

**REFERENCE BOOKS**


1. Elementary Linear Algebra $10^{th}$ Edition by Howard Anton (Author).
2. Ordinary and Partial Differential Equations By Dr. M.D. Raisinghania , S. Chand Publishing version) – Wiley


**Spring Semester L-2, T-I**

**COURSE INFORMATION**

| | | | |
|---|---|---|---|
| Course Code<br>Course Title | **MATH 201**<br>**Vector Analysis, Laplace Transformation and Coordinate Geometry** | Lecture Contact Hours<br>Credit Hours | : **3.00**<br>: **3.00** |

**PRE-REQUISITE**

MATH 101 and MATH 103

**CURRICULUM STRUCTURE**

| Outcome Based Education (OBE) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **SYNOPSIS/RATIONALE** | | | | | | | |
| Purpose of this course is to introduce basic knowledge to identify and solve vector mathematical problems, to demonstrate practical applications of Laplace Transform and analyze co-ordinate geometry. | | | | | | | |
| **OBJECTIVE** | | | | | | | |
| 1. Be able to impart basic knowledge on ordinary and partial differential equations.<br>2. Developing understanding some of the important aspects of ordinary and partial differential equations.<br>3. Be able to provide knowledge on using concept of Differential equations and matrix in engineering problems and solve other applied problems.<br>4. Be expert in imparting in depth knowledge on inverse matrix. | | | | | | | |
| **LEARNING OUTCOMES & GENERIC SKILLS** | | | | | | | |
| No. | Course Outcomes | Corresponding PO | Bloom's Taxonomy | KP | CP | CA | Assessment Methods |
| CO1 | **Know** the physical explanation of different vector notation and Laplace transform, inverse Laplace transform, some properties and definition of Geometry. | 1 | C1 - C2 | 1 | | | T,F,ASG |
| CO2 | **Explain** the characteristics of conics and familiarize with straight lines, pair of straight lines, circles, radical axis and center in 2D and 3D co-ordinate systems. | 1 | C2 | 1 | | | T, Mid Term Exam, F |
| CO3 | **Calculate** length, volume and area of objects related to engineering study by using vector. | 1 | C3 | 1 | | | Mid Term Exam, F, ASG |
| CO4 | **Apply** Laplace transform to ODE and PDEs and the knowledge of geometry specially the pair of straight lines, circles, system of circles, parabola, ellipse etc in | 1 | C3 | 1 | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | engineering study. | | | | | | |

(CP – Complex Problems, CA – Complex Activities, KP – Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, CS – Case study, F – Final Exam)

## COURSE CONTENT

**Vector Analysis:** Definition of Vector and scalers & vector algebra, Scaler and vector products of two vectors and their geometrical interpretation, Triple products and multiple products, Linear dependence and independence of vectors, Differentiation of vectors, Gradient of scaler functions, Divergence and curl of point functions, physical significance of gradient, divergence and curl, Definition of line, surface and volume integral, Integration of Vectors, Green's theorem and its application, Stoke's theorem and its application, Gauss theorem and its application in Engineering.

**Laplace Transform:** Definition of LT and Application of LT for Engineering, LT of some elementary functions and properties of LT, Sufficient condition for existence of LT, Inverse LT, LT of derivatives, Unit step function, Periodic function, Some special theorems on LT, Partial fraction, Solution of DEs by LT, Heaviside expansion formula, Convolution theorem, Evaluation of improper integral, Application of LT.

**Co-ordinate Geometry:** Introduction to geometry for Engineering and Rectangular co-ordinates, Transformation of co-ordinates, changes of axes, pair of straight lines, general equation of second degree and reduction to its standard forms and properties, circles (tangents, normal, chord of contact, pole and polar), Equation of conics, homogeneous equations of second degree, angle between straight lines, pair of lines joining the origin to the point of intersection of two given curves, equations of parabola, ellipse in Cartesian and polar coordinates, system of circles (radical axes, coaxial circles, limiting points), Three dimensional co-ordinate system, direction cosines, projections, the plane (angle between two planes, parallel & perpendicular plane, distance of a point from a plane) and the straight line (coplanar lines, shortest distance between two given straight lines), standard equation of sphere, ellipsoid, hyperboloid straight lines, standard equation of coincides, sphere and ellipsoid.

## SKILL MAPPING

| No. | Course Outcome | PROGRAM OUTCOMES (PO) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| CO1 | **Know** the physical explanation of different vector notation and Laplace transform, inverse Laplace transform, some properties and definition of Geometry. | 3 | | | | | | | | | | | |
| CO2 | **Explain** the characteristics of conics and familiarize with straight lines, pair of straight lines, circles, radical axis and center in 2D and 3D co-ordinate systems. | 3 | | | | | | | | | | | |
| CO3 | **Calculate** length, volume and area of objects related to engineering study by using vector. | 3 | | | | | | | | | | | |
| CO4 | **Apply** Laplace transform to ODE and PDEs and the knowledge of geometry specially the pair of straight lines, circles, system of circles, parabola, ellipse etc in engineering study. | 3 | | | | | | | | | | | |

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

**Justification for CO-PO mapping:**

| **Mapping** | **Corresponding Level of matching** | **Justifications** |
|---|---|---|
| CO1- PO1 | 3 | The knowledge of mathematics, science and engineering sciences has to be applied to describe the operation of being able to identify the physical explanation of different vector notation, explain the complete concept about Laplace transform, 2D and 3D geometry. |
| CO2- PO1 | 3 | To explain the differentiation and integration of a vector valued functions in Cartesian, cylindrical and spherical geometry and to solve the problems of the pair of straight lines, circles, system of circles, parabola, ellipse etc. The concept of mathematics and engineering sciences is required. |
| CO3- PO1 | 3 | In order to construct and calculate the area and volume of objects related to engineering study by using vector, solve the differential equations by Laplace transform is needed the concept of mathematics, physics and engineering sciences. |

**TEACHING LEARNING STRATEGY**

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Face-to-Face Learning<br>Lecture | <br>42 |

| | |
|---|---|
| Practical / Tutorial / Studio<br>Student-Centred Learning | -<br>- |
| Self-Directed Learning<br>Non-face-to-face learning<br>Revision of the previous lecture at home<br>Preparation for final examination | <br>42<br>21<br>21 |
| Formal Assessment<br>Continuous Assessment<br>Final Examination | <br>2<br>3 |
| Total | 131 |

**TEACHING METHODOLOGY**

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

**COURSE SCHEDULE**

| | | |
|---|---|---|
| Week 1 | | CT 1 |
| Class 1-3 | Definition of Vector and scalers & vector algebra, Scaler and vector products of two vectors and their geometrical interpretation | |
| Week 2 | | |
| Class 4 | Triple products and multiple products, Linear dependence and independence of vectors, Differentiation of vectors | |
| Class 5 | Gradient of scaler functions, Divergence and curl of point functions | |
| Class 6 | Physical significance of gradient, divergence and curl | |
| Week 3 | | |
| Class 7-9 | Definition of line, surface and volume integral, Integration of Vectors, Green's theorem and application | |
| Week 4 | | CT 2 |
| Class 10 | Gauss theorem and application in Engineering | |
| Class 11 | Stoke's theorem and it's application. | |
| Class 12 | Introduction to geometry for Engineering and Rectangular co-ordinates, Transformation of co-ordinates | |
| Week 5 | | |
| Class 13-15 | Introduction to geometry for Engineering and Rectangular co-ordinates, Transformation of co-ordinates, changes of axes, pair of straight lines, general equation of second degree and reduction to its standard forms and properties | |
| Week 6 | | |

| | | |
|---|---|---|
| Class 16-18 | Circles (tangents, normal, chord of contact, pole and polar), Equation of conics, homogeneous equations of second degree, angle between straight lines, pair of lines joining the origin to the point of intersection of two given curves | |
| Week 7 | | Mid Term |
| Class 19-21 | Circles (tangents, normal, chord of contact, pole and polar), Equation of conics, homogeneous equations of second degree, angle between straight lines, pair of lines joining the origin to the point of intersection of two given curves | |
| Week 8 | | |
| Class 22-24 | Equations of parabola, ellipse in Cartesian and polar coordinates, system of circles (radical axes, coaxial circles, limiting points | |
| Week 9 | | |
| Class 25-24 | Three dimensional co-ordinate system, direction cosines, projections, the plane (angle between two planes, parallel & perpendicular plane, distance of a point from a plane) and the straight line (coplanar lines, shortest distance between two given straight lines), standard equation of sphere, ellipsoid, hyperboloid | |
| Week 10 | | CT 3 |
| Class 28 | Three dimensional co-ordinate system, direction cosines, projections, the plane (angle between two planes, parallel & perpendicular plane, distance of a point from a plane) and the straight line (coplanar lines, shortest distance between two given straight lines), standard equation of sphere, ellipsoid, hyperboloid | |
| Class 29-30 | Definition of LT and Application of LT for Engineering, LT of some elementary functions and properties of LT | |
| Week 11 | | |
| Class 31-33 | Sufficient condition for existence of LT, LT of derivatives and it's application, LT of Integration with application, LT of sine and cosine integral | |
| Week 12 | | |
| Class 34 | Unit step function and it's application | |
| Class 35 | Periodic function with examples, LT of some special function. | |
| Class 36 | Definition of inverse Laplace Transform and it's properties | |
| Week 13 | | |
| Class 37 | Partial fraction and it's application in inverse Laplace Transform | |
| Class 38 | Heaviside formula and it's application | |
| Class 39 | Convoulution theorem, Evaluation of improper integral, Application of LT | |
| Week 14 | | |
| Class 40-42 | Solve ODE s by Laplace transform | |

| | |
|---|---|
| | |

**ASSESSMENT STRATEGY**

| COs | Assessment Method | (100%) | Remarks |
|---|---|---|---|
| | **Class Assessment** | | |
| 1 | Assignment | **20** | |
| 2 | Assignment | **20** | |
| | **Exam** | | |
| 1 | Final Exam, CT | **80** | |
| 2 | Final Exam, CT, MID | **80** | |
| 3 | Final Exam, CT | **100** | |

**REFERENCE BOOKS**


1. Vector Analysis, $2^{nd}$ Edition $2^{nd}$ Edition by Murray Spiegel, Seymour Lipschutz, Dennis Spellman
2. Schaum's Outline of Laplace Transforms by Murray R. Spiegel.
3. Engineering Mathematics, Volume Two 2 II: Containing Coordinate Geometry of Two Dimensions, Co-ordinate Geometry of Three Dimensions, Matrices.
4. Theory of Equations and Vector Calculus by K. Kandasamy, P.; Thilagavathy, K.; Gunavathy
5. A Text Book on Co-ordinate Geometry with Vector Analysis - Rahman & Bhattacharjee.


| OURSE INFORMATION | | | |
|---|---|---|---|
| Course Code | : LANG 102 | Contact Hours | : 3.00 |
| Course Title | : Communicative English -I | Credit Hours | : 1.50 |

**PRE-REQUISITE**

None

**CURRICULUM STRUCTURE**

Outcome Based Education (OBE)

**SYNOPSIS/RATIONALE**

| |
|---|
| The English language course is designed for the students to develop their competence in communication skills for academic purposes emphasizing speaking, reading, listening and writing. The approach will be communicative and interactive and will involve individual, pair and group work. Students will be exposed to diverse text types to refine their reading skills, engaging in activities and discussions that foster effective writing type. The course incorporates a wide range of reading texts to develop students' critical thinking which is one of the most essential elements required to write a good piece of academic writing. Special emphasis is placed on the various forms of essay including descriptive, narrative, cause-effect, compare-contrast, and argumentative. Upon completion of this course, student should demonstrate proficiency in communication across diverse contexts, engage in group activities, and deliver formal speech for academic, professional and social purposes. This course also incorporates classroom instructions to provide guidelines on presentations and communication skills.Addionally, the couse emphasizes providing constructive feedback on students' oral performances. |
| **OBJECTIVES** |
| • To develop the four basics skills of English language, i.e. listening, speaking, reading and writing.<br>• To enhance students' interpersonal skills through participation in various group interactions and activities.<br>• To improve students' pronunciation to enhance comprehensibility in both speaking and listening.<br>• To gain proficiency in crafting well- organized paragraphs and learn to edit and revise both their own as well as peer's writing. |
| **COURSE CONTENT** |
| **Speaking:** Introduction to Language: Introducing basic skills of language. English for Science and Technology Self-introduction and introducing others: How a speaker should introduce himself to any stranger / unknown person / a crowd. Name, family background, education, experience, any special quality/interest, likings/disliking, etc. Asking and answering questions, Expressing likings and disliking; (food, fashion etc.) Asking and giving directions Discussing everyday routines and habits, Making requests/offers/invitations/excuses/apologies/complaints Describing personality, discussing and making plans(for a holiday or an outing to the cinema), Describing pictures / any incident / event Practicing storytelling, Narrating personal experiences/Anecdotes Telephone conversations (role play in group or pair) Situational talks / dialogues: Practicing different professional conversation (role play of doctor-patient conversation, teacher –student conversation)<br>**Listening:** Listening and understanding: Listening, note taking and answering questions; Students will listen to recorded text, note down important information and later on will answer to some questions Difference between different accents: British and American accents; Documentaries from BBC and CNN will be shown and students will try to understand; Listening to short conversations between two persons/more than two.<br>**Reading:** Reading techniques: scanning, skimming, predicting, inference; Reading Techniques: analysis, summarizing and interpretation of texts.<br>**Writing:** Introductory discussion on writing, prewriting, drafting; Topic sentence, paragraph |

| |
|---|
| development, paragraph structure, describing a person/scene/picture, narrating an event Paragraph writing, Compare-contrast and cause- effect paragraph. |

| COURSE OUTCOMES AND SKILL MAPPING | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| No. | COURSE OUTCOMES (COs) | PROGRAMME OUTCOMES (POs) | | | | | | | | | | | |
| | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| 1 | **Communicate** in English quickly and smartly using the techniques learnt in the class. | ✓ | | | | | | | | | | | |
| 2 | **Understand** the techniques of academic reading and writing | ✓ | | | | | | | | | | | |
| 3 | **Communicate** ideas and opinions effectively within the shortest possible time | | | | | | | | | | ✓ | | |
| 4 | **Excel** in oral and written communication/ Presentation competency | | | | | | | | | | ✓ | | |

| COURSE OUTCOMES AND GENERIC SKILLS | | | | | | | |
|---|---|---|---|---|---|---|---|
| No. | Course Outcomes | Corresponding POs | Bloom's Taxonomy | CP(WP) | CA(EA) | KP(WK) | Assessment Methods |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CO1 | **Communicate** in English quickly and smartly using the techniques learnt in the class. | PO1 | L2 | - | - | 1 | Assignment, Quiz |
| CO2 | **Understand** the Techniques of academic reading and writing | PO1 | L3 | - | - | 1 | Project/ Assignment, Quiz |
| CO3 | **Communicate** ideas and opinions effectively within the shortest possible time | PO10 | L4 | - | - | 1 | Project, Assignment, Quiz |
| CO4 | **Excel** in oral and written communication/ Presentation competency | PO10 | L5 | - | - | 2 | Project/ Assignment, Quiz |

WP= Washington Accord Complex Problem Solving/ CP= Complex Problem Solving; EA= Engineering Activities/ CA= Complex Activities; WK= Washington Accord Knowledge Profile/ KP= Knowledge Profile

| **TEACHING LEARNING STRATEGY** | |
|---|---|
| Teaching and Learning Activities | Engagement (hours) |
| **Face to Face Learning**<br>Lecture<br>Practical / Tutorial / Studio<br>Student-Centered Learning | - 42<br>42 |
| **Guided Learning**<br>Assignment Preparation | 30<br>- |
| **Independent Learning**<br>Individual learning Preparation<br>for Report | -<br>- |
| **Assessment** | |
| Continuous assessment (Descriptive writing<br>Reading Test, Listening Test,<br>Public Speaking)<br>Report Submission<br>Presentation | 04<br>-<br>- |
| **Total** | 88 |

| TEACHING METHODOLOGY |
|---|
| Lecture and Discussion, Tutorial, Assignment, Report |
| **TEACHING SCHEDULE** |

| Week | Topics | Remarks |
|---|---|---|
| 1 | Introduction to Language: Introducing basic skills of language; English for Science and Technology | Assignment , Project, Quiz |
| | Self-introduction and introducing others: How a speaker should introduce himself to any stranger / unknown person / a crowd; Name, family background, education, experience, any special quality/interest, likings/disliking, etc. | |
| | Self-introduction and introducing others: How a speaker should introduce himself to any stranger / unknown person / a crowd; Name, family background, education, experience, any special quality/interest, likings/disliking, etc. | |
| 2 | Asking and answering questions, Expressing likings and disliking; (food, fashion etc.) Asking and giving directions | |
| 3 | Discussing everyday routines and habits, making requests/ offers/ invitations/ excuses/ apologies/ complaints | |
| 4 | Describing personality, discussing and making plans (for a holiday or an outing to the cinema), Describing pictures / any incident / event | |
| 5 | Practicing storytelling, Narrating personal experiences/Anecdotes | |
| 6 | Telephone conversations (role play in group or pair); Situational talks / dialogues: Practicing different professional conversation (role play of doctor-patient conversation, teacher –student conversation) | |
| 7 | Listening and understanding: Listening, note taking and answering questions; Students will listen to recorded text, note down important information and later on will answer to some questions | |
| 8 | Difference between different accents: British and American accents; Documentaries from BBC and CNN will be shown and students will try to understand | |
| 9 | Listening to short conversations between two persons/more than two | |
| 10 | Reading techniques: scanning, skimming, predicting, inference; | |
| 11 | Reading techniques: scanning, skimming, predicting, inference; | |
| 12 | Introductory discussion on writing, prewriting, drafting; | |

| | |
|---|---|
| 13 | Topic sentence, paragraph development, paragraph structure, describing a person/scene/picture, narrating an event |
| 14 | Paragraph writing, Compare-contrast and cause- effect paragraph |

| ASSESSMENT STRATEGY | | | |
|---|---|---|---|
| **Components** | **Grading** | **CO** | **Blooms Taxonomy** |
| **Continuous Assessment (Compulsory)**<br>Descriptive writing<br>Reading Test<br>Listening Test<br>Public Speaking | <br>20%<br>15%<br>15%<br>20% | CO1, CO2, CO3, CO4 | L2, L3, L4, L5 |
| Group Presentation | 30% | CO1, CO2, CO3, CO4 | L2, L3, L4, L5 |
| **Total Marks** | 100% | | |

**REFERENCE BOOKS**


1. Langan, J. (2005). College Writing Skills with Readings (6th Ed). McGraw-Hill Publication.
2. Interactions 1 (Reading), John Langan, Latest edition, McGraw-Hill Publication
3. Jones, L. (1981). Functions of English. (Student's Book, 2nd Ed.) Melbourne, Australia: Cambridge University Press.
4. Dixon, R.J. (1987). Complete course in English. (Book 4). New Delhi, India: Prentice Hall of India. (For book presentation).
5. From Paragraph to Essay - Maurice Imhoof and Herman Hudson Headway Series – Advanced Level (2 parts with CDs): Oxford University Press Ltd.
6. Speak like Churchill stand like Lincoln - James C. Humes.
7. Cambridge IELTS Practice Book.
8. Selected Sample Reports and Selected Research Articles.

## Communicative English II

| COURSE INFORMATION | | | |
|---|---|---|---|
| Course Code | : LANG 202 | Lecture Contact Hours | : 3.00 |
| Course Title | : Communicative English -II | Credit Hours | : 1.50 |
| **PRE-REQUISITE** | | | |
| LANG 102 | | | |
| **CURRICULUM STRUCTURE** | | | |
| Outcome Based Education (OBE) | | | |
| **SYNOPSIS/RATIONALE** | | | |
| The English language course is designed for the students to develop their competence in communication skills for academic purposes emphasizing speaking, reading, listening and writing. The approach will be communicative and interactive and will involve individual, pair and group work. Students will be exposed to diverse text types to refine their reading skills, engaging in activities and discussions that foster effective writing type. The course incorporates a wide range of reading texts to develop students' critical thinking which is one of the most essential elements required to write a good piece of academic writing. Special emphasis is placed on the various forms of essay including descriptive, narrative, cause-effect, compare-contrast, and argumentative. Upon completion of this course, student should demonstrate proficiency in communication across diverse contexts, engage in group activities, and deliver formal speech for academic, professional and social purposes. This course also incorporates classroom instructions to provide guidelines on presentations and communication skills.Addionally, the couse emphasizes providing constructive feedback on students' oral performances. | | | |
| **OBJECTIVES** | | | |
| • To develop English language skills to communicate effectively and professionally.<br>• To strengthen students' presentation skills.<br>• To develop competency in academic reading and writing. | | | |
| **COURSE CONTENT** | | | |
| **Reading:** Reading Comprehension: Practice using different techniques Academic reading: comprehension from departmental or subject related passages; Vocabulary for Engineers (some common Engineering terms for both general and dept specific); Reading subject specific text to develop vocabulary<br>**Writing:** Writing semi-formal, Formal/official letters, Official E-mail Applying for a job: Writing Cover Letter and Curriculum Vitae; Essay writing: writing steps, principles and techniques, outlining, revising, editing, proofreading; Narrative and descriptive writing: comparison-contrast and cause – effect, argumentative and opinion expression, assignment writing; Analyzing and describing graphs or charts; Practicing analytical and argumentative writing<br>**Speaking:** Public Speaking: Basic elements and qualities of a good public speaker; Set Speech and Extempore Speech: How to get ready for any speech – set or extempore. Individual / Group presentation: How to be ready for presentation, prepare script for good speech, preparing power point | | | |

slides, etc. Selected books/Selected stories for presentation.

**Listening:** Listening to long lecture on some topics, Listening and understanding speeches/lectures of different accent.

**COURSE OUTCOMES AND SKILL MAPPING**

| No. | COURSE OUTCOMES (COs) | PROGRAMME OUTCOMES (POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| 1 | **Understand** the techniques of academic reading and become familiar with technical vocabularies. | ✓ | | | | | | | | | | | |
| 2 | **Understand** the techniques of effective academic writing including research article/report writing. | ✓ | | | | | | | | | | | |
| 3 | **Communicate** effectively to present their reports and research work within the shortest possible time | | | | | | | | | | ✓ | | |
| 4 | **Analyze** any problem critically, interpret data and synthesize information to provide valid conclusions. | | | | | | | | | | ✓ | | |

**COURSE OUTCOMES AND GENERIC SKILLS**

| No. | Course Outcomes | Corresponding POs | Bloom's Taxonomy | CP(WP) | CA(EA) | KP(WK) | Assessment Methods |
|---|---|---|---|---|---|---|---|
| CO1 | **Understand** the techniques of academic reading and become familiar with technical vocabularies. | PO1 | L2 | - | - | 1 | Assignment, Quiz |
| CO2 | **Understand** the techniques of effective academic writing including research article/report writing. | PO1 | L3 | - | - | 1 | Project/ Assignment, Quiz |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CO3 | **Communicate** effectively to present their reports and research work within the shortest possible time | PO10 | L4 | - | - | 1 | Project, Assignment, Quiz |
| CO4 | **Analyze** any problem critically, interpret data and synthesize information to provide valid conclusions. | PO10 | L5 | - | - | 2 | Project/ Assignment , Quiz |

WP= Washington Accord Complex Problem Solving/ CP= Complex Problem Solving; EA= Engineering Activities/ CA= Complex Activities; WK= Washington Accord Knowledge Profile/ KP= Knowledge Profile

**TEACHING LEARNING STRATEGY**

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| **Face to Face Learning**<br>Lecture<br>Practical / Tutorial /<br>Studio Student-Centered<br>Learning | -<br>4<br>2<br>42 |
| **Guided Learning**<br>Assignment Preparation | 30<br>- |
| **Independent Learning**<br>Individual learning<br>Preparation for Report | -<br>- |
| **Assessment**<br>Continuous assessment (Writing Test<br>Reading Test Listening Test<br>Public Speaking)<br>Report Submission<br>Presentation | 04<br>-<br>- |
| **Total** | 88 |

**TEACHING METHODOLOGY**

Lecture and Discussion, Problem Based Learning (PBL)

**TEACHING SCHEDULE**

| Week | Topics | Remarks |
|---|---|---|
| 1 | Reading Comprehension: Practice using different techniques | Assignment, Project, Quiz |
| 2 | Academic reading: comprehension from departmental or subject related passages | |

| | | |
|---|---|---|
| 3 | Vocabulary for Engineers (some common Engineering terms for both general and dept specific)<br>Reading subject specific text to develop vocabulary | |
| 4 | Writing semi-formal, Formal/official letters, Official E-mail | |
| 5 | Applying for a job: Writing Cover Letter and Curriculum Vitae Practicing storytelling, Narrating personal experiences/Anecdotes | |
| 6 | Essay writing: writing steps, principles and techniques, outlining, revising, editing, proofreading; | |
| 7 | Narrative and descriptive writing: comparison-contrast and cause – effect, argumentative and opinion expression, assignment writing; | |
| 8 | Analyzing and describing graphs or charts | |
| 9 | Practicing analytical and argumentative writing | |
| 10 | Public Speaking: Basic elements and qualities of a good public speaker | |
| 11 | Set Speech and Extempore Speech: How to get ready for any speech – set or extempore. | |
| 12 | Individual / Group presentation: How to be ready for presentation, prepare script for good speech, preparing power point slides, etc.<br>Selected books/Selected stories for presentation. | |
| 13 | Listening to long lecture on some topics | |
| 14 | Listening and understanding speeches/lectures of different accents | |

**ASSESSMENT STRATEGY**

| Components | Grading | CO | Blooms Taxonomy |
|---|---|---|---|
| **Continuous Assessment** Class participation Writing Test<br>Reading Test<br>Listening Test<br>Public Speaking | -<br>20 %<br>15%<br>15%<br>20% | CO1, CO2, CO3, CO4 | L2, L3, L4, L5 |
| Group Presentation | 30% | CO1, CO2, CO3, CO4 | L2, L3, L4, L5 |
| **Total Marks** | 100% | | |

**REFERENCE BOOKS**

1. Jones, L. (1981). Functions of English. (Student's Book, 2nd Ed.) Melbourne, Australia: Cambridge University Press.
2. Dixon, R.J. (1987). Complete course in English. (Book 4). New Delhi, India: Prentice Hall of India. (For book presentation).
3. Langan, J. (2005). College Writing Skills with Readings (6th Ed). McGraw-Hill Publication.
4. Interactions 1 (Reading), John Langan, Latest edition, McGraw-Hill Publication
5. Headway Series – Advanced Level (2 parts with CDs): Oxford University Press Ltd.
6. Speak like Churchill stand like Lincoln - James C. Humes.
7. Cambridge IELTS Practice Book h. Selected Sample Reports and Selected Research Articles.

## 6.3 Detailed Curriculum of General Education Courses

**Course Code:** GESA 101 **Course Name:** Sociology and Accounting
**Credit Hour:** 2.0 **Contact Hour:** 2.0

**Level/Term: 1/II**

**Pre-requisite: Nil**

**Objectives:**

1. To equip students with factual knowledge that will enable them to understand the basic nature, scope, and perspective of sociology; the stages of the social research process, and methodologies.
2. To analyze different social problems, economic life, and environmental issues for sustainable development.
3. Introduce fundamental principles and concepts of accounting, including the accounting equation and the double-entry bookkeeping system.
4. Explain the preparation and interpretation of financial statements, such as Statement of Financial Position, Statement of Comprehensive Income, Statement of Changes in Equity.

**Course Outcomes (CO):**

a. **Understand** the fundamental principles of financial and cost accounting
b. **Understand** financial reporting and analysis Understand financial reporting and analysis
c. **Understand** the basic nature,scope, and perspectives of sociology
d. **Analyze** different cultures, civilizations, social stratification, social systems, socialism, capitalism and different social problems.

**Course Contents:**

a. **Sociology:** Nature and scope of Sociology, Sociological imagination, Perspectives of sociology, Culture and civilization, Socialization and self-development, Globalization and social changes, Social organizations and social problems, social stratification, the industrial revolution, Capitalism and socialism, Environment, and human activities, Climate change and global risk.

b. **Accounting:** History & Definition of Accounting, Objectives and Importance of Accounting, Accounting & Engineering, International Financial Reporting Standard (IFRS), Generally Accepted Accounting Principles (GAAP), Ethics in Accounting, Accounting Equation (Math), Journal, Ledger, T-account and Trial balance, Adjusting Entries , Adjusted Trial Balance, Income Statement, Retained Earnings Statement and Statement of Financial Position (Balance Sheet) , Worksheet, Horizontal Analysis, Vertical Analysis and Ratio Analysis.

**Teaching-learning and Assessment Strategy:**

| COMPONENTS | TEACHING AND LEARNING ACTIVITIES | STUDENT LEARNING TIME (SLT) |
|---|---|---|
| Face to Face | Lecture (2 hours/week x 14 weeks) | 28 |
| Guided Learning | Tutorial/ Assignments (2 hours/week x 5 weeks) | 10 |
| Independent Learning | Individual learning (1-hour lecture ≈ 1 hour learning) Preparation for tests and examination | 24<br>13 |
| Assessment | Pop Quiz/Class Test/Mid-Term Exam<br>Final examination | 2<br>3 |
| | **TOTAL SLT** | **80** |
| | **CREDIT = SLT/40** | **2** |

Note: 40 notional hours= 1 Credit

| | |
|---|---|
| Assessment Methods*<br><br>Methodologies for Feedback on Performance | Continuous assessment : 40%<br><br>Final examination:60%<br><br>1. Discussions in class<br>2. Returning graded assignments and tests<br>3. Final grades are announced |

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| COs | Assessment Method | (100%) | Remarks |
|---|---|---|---|
| | **Class Assessment** | | |
| 1 | Class Assessment | 60 | |
| 2 | Class Assessment | 40 | |
| 3 | Class Assessment | 60 | |
| 4 | Class Assessment | 40 | |
| | **Exam** | | |
| 1 | Exam | 40 | |
| 2 | Exam | 60 | |
| 3 | Exam | 40 | |
| 4 | Exam | 60 | |

**Mapping of Course Outcomes and Program Outcomes:**

| COURSE OUTCOMES (COs) | PROGRAMME OUTCOMES (POs) | | | | | | | | | | | | Bloom's **taxonomy domain/ level** | **Assessment tools** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | | |
| **Understand** the basic nature, scope, and perspectives ofsociology. | | | | | | √ | | | | | | | L2 | Assignment, Final Exam |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Analyze** different cultures, civilizations, and different social problems and apply contextual knowledge to assess societal and cultural issues. | | | | | | √ | | | | | | | L3 | Mid-Term,Final Exam |
| **Understand** the fundamental principles of financial and cost accounting | | | | | | | | | | | √ | | L2 | Assignment, Final Exam |
| **Understand** financial reporting and analysis Understand financial reporting and analysis | | | | | | | | | | | √ | | L2 | Mid- Term, Final Exam |

**Lecture Schedule:**

| Lectures | Lecture/Tutorial/Assignment Topic | CT | Remarks |
|---|---|---|---|
| **Week-1** | | | |
| 1 | Definition, nature, and scope of sociology, orientation of Sociological Theories | | |
| 2 | Sociological imagination, perspectives of Sociology | | |
| **Week**-2 | | | |
| 3 | Introducing culture and its variations, Civilization | | |
| 4 | Socialization process and development of self | | |
| **Week-3** | | | |
| 5 | Introducing globalization and its impact on human life | **1** | |
| 6 | Addressing the social problems in Bangladesh | | |
| **Week-4** | | | |
| 7 | Introducing social groups and organizations | | |
| 8 | Introducing bureaucracy and good governance | | |
| **Week-5** | | | |
| 9 | Industrial revolution and aftermath | | |
| 10 | Capitalism and Socialism: features and influence | | |
| **Week-6** | | | |
| 11 | Environment and human activities | | |
| 12 | Climate change and global risk | | |
| **Week-7** | | | |
| 13 | Population of Bangladesh: problem or prospect | | |
| 14 | Crime and deviance: a brief analysis | **MT** | |
| **Week-8** | | | |
| 15 | Meaning, history and definition of accounting | | |
| 16 | The users and uses of accounting. | | |
| **Week-9** | | | |

| | | | |
|---|---|---|---|
| 17 | Ethics in financial reporting | | |
| 18 | The cost principle, monetary unit assumption and the economic entity assumption | 2 | |
| **Week-10** | | | |
| 19 | Accounting equation and its components | | |
| 20 | The effects of business transactions on the accounting equation. | | |
| **Week-11** | | | |
| 21 | Four financial statements and how they are prepared. | | |
| 22 | Journal | | |
| **Week-12** | | 3 | |
| 23 | Journal | | |
| 24 | T-account, Ledger, Trial balance | | |
| **Week-13** | | | |
| 25 | Adjusting Accounts | | |
| 26 | Worksheet. | | |
| **Week-14** | | | |
| 27 | Completion of the Accounting cycle. | | |
| 28 | Financial Statement Analysis | | |

**Text and Ref Books:**


a. Financial Accounting IFRS edition by Weygand, Kimmel & Kieso (3th)
b. Accounting Principles by Weygandt, Kieso & Kimmel (IFRS Latest edition)
c. Sociology in Modules: by – Richard Schaefer, 2nd edition, 2013
d. Sociology - Primary Principles: by CN Shankar Rao
e. Anthony Giddens- 7th edition

| COURSE INFORMATION | |
|---|---|
| Course Code: GEBS 101 | Credit Hour: 2.0 |
| Course Title: Bangladesh Studies | Contact Hour: 2.0 |
| PRE-REQUISITE | |
| None | |
| CURRICULUM STRUCTURE | |
| Outcome Based Education (OBE) | |
| SYNOPSIS/ RATIONALE | |
| This course has been designed for undergraduate engineering students to help them learn the rich history of Bangladesh, and to provide them with basic knowledge of historical events which eventually led to the formation of Bangladesh and constitution of Bangladesh, current trends in economic development, legislation, citizen charter, cultural aspects which will make them responsible citizen. | |

OBJECTIVE

1. To equip students with factual knowledge that will enable them to learn the history of Bangladesh.
2. To trace the historical roots of Bangladesh as an independent state focusing on the social, cultural and economic developments that have taken place since its independence.
3. To promote an understanding of the development of Bangladesh and its culture.
4. To create an awareness among the students about the Geography, Economy, Politics and Culture of Bangladesh.

COURSE OUTCOMES & GENERIC SKILLS

| No | Course Outcome | Corresponding POs | Bloom's Taxonomy* | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|---|
| CO1 | Be able to **identify** specific stages of Bangladesh's political history, through the ancient, medieval, colonial and post-colonial periods and variety of cultural identities of Bangladesh. | PO – 6 | L1, L2 | 1 | | 7 | T, F |
| CO2 | Be proficient to **explain** the economy and patterns of economic changes through qualitative and quantitative analysis. | PO – 6 | L2 ,L4 | 7 | | 7 | T, F |

**Level of Bloom's Taxonomy:*

<u>C1 – Remember</u> <u>C2 – Understand</u> <u>C6 - Create</u> <u>C3- Apply</u> <u>C4 – Analyze</u> <u>C5 - Evaluate</u> <u>C6 - Create</u>

(CP – Complex Problems, CA – Complex Activities, KP – Knowledge Profile, T – Test, PR – Project, Q – Quiz, M – Mid Term Exam, Asg – Assignment, Pr – Presentation, R – Report,F – Final Exam)

COURSE CONTENT

a. Main Contents: Impact of Geography, History, Environment, Economy, Constitution and Culture of Bangladesh in Engineering Application

b. Detail Contents:
Bangladesh Geography: Location, Area, Boundary, Physiography, River system, Forest and Climate, Demography of Bangladesh, Maritime zones.

History: Overview of the ancient Bengal, anthropological identity of the Bengali race, main trends in the history of medieval Bengal, Bengal under the East India Company, religious and social reform movements, nationalist movements, division of the Indian sub-continent, language movement 1948-1952, education movement of 1962, six-point movement of 1966, mass uprising of 1969, war of independence and emergence of Bangladesh in 1971, Constitution of Bangladesh, Pre and post liberation development in the field of engineering and technology, Bangladesh's contribution to world peace and its security, engineering developments in Bangladesh (Kaptai Dam, Padma bridge, power plants, Karnaphuli River Tunnel etc.) and its impact on socio-economic aspect. Environment, Economy and Culture : Land, Characteristics of tropical monsoon climate, Forests and biomass, Fish, Minerals, Health, Education, Agriculture, Industries, NGOs, Population, Sociological and Cultural aspects of Bangladesh, Economy and National development, Development and Progress of the Millennium Development Goals (MDGs), Public Administration in Bangladesh, State of Good Governance in Bangladesh, Art and Literature, Main traditional cultural events, Vision-2021, Digitalization, Tourism and Natural Resources, Bangladesh and International Relations.

SKILL MAPPING (CO – PO MAPPING)

| No | Course Outcome | PROGRAM OUTCOMES (POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| CO1 | Be able to identify specific stages of Bangladesh's political history, through the ancient, medieval, colonial and post-colonial periods and variety of cultural identities of Bangladesh. | | | | | | 3 | | | | | | |
| CO2 | Be proficient to explain the economy and patterns of economic changes through qualitative and quantitative analysis. | | | | | | 3 | | | | | | |

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO – PO MAPPING

| | Mapping | Corresponding Level of Matching | Justifications |
|---|---|---|---|
| | CO1 – PO6 | 3 | Ability to identify specific stages of Bangladesh's political history, through the ancient, medieval, colonial and post-colonial periods and variety of cultural identities of Bangladesh. |
| | CO2 – PO6 | 3 | Ability to explain the economy and patterns of economic changes through qualitative and quantitative analysis. |

TEACHING AND LEARNING STRATEGY

| | Teaching and Learning Activities | Engagement (Hours) |
|---|---|---|
| | Face-to-face Learning<br>• Lecture<br>• Practical/ Tutorial/ Studio<br>• Student – Centered Learning | <br>28<br>10<br>-- |

| | | |
|---|---|---|
| | Self- Directed Learning<br>• Non-face-to-face learning<br>• Revision of the previous lecture at home<br>• Preparation for final examination | <br>8<br>10<br>18 |
| | Formal Assessment<br>• Continuous Assessment(Pop Quiz/Class Test/Mid Term Exam)<br>• Final Examination | 3<br><br>3 |
| | Total | 80 |

TEACHING METHODOLOGY

Lecture, Tutorial, Problem Based Method

COURSE SCHEDULE

| | | Intended Topics to be Covered | Assessment |
|---|---|---|---|
| **Week 1** | | | CT 1 |
| | Class 1 | Introductory class: Brief discussion on the total syllabus, basic requirements of the course, methods of assessment of the course | |
| | Class 2 | Bangladesh Geography: Location, Area, Boundary, Physiography, River System, Forest and Climate, Demography of Bangladesh. | |
| **Week 2** | | | |
| | Class 3 | Overview of the ancient Bengal, anthropological identity of the Bengali race, main trends in the history of medieval Bengal | |
| | Class 4 | Bengal under the East India Company | |
| **Week 3** | | | |
| | Class 5 | Religious and Social reform movements | |
| | Class 6 | Nationalist movements, division of the Indian subcontinent | |
| **Week 4** | | | Mid Term Exam |
| | Class 7 | Language movement 1948-1952, Education movement of 1962 | |
| | Class 8 | Language movement 1948-1952, Education movement of 1962 | |
| **Week 5** | | | |
| | Class 9 | Six-point movement of 1966, Mass uprising of 1969 | |
| | Class 10 | War of Independence and Emergence of Bangladesh in 1971 | |
| **Week 6** | | | |
| | Class 11 | Constitution of Bangladesh | |
| | Class 12 | Constitution of Bangladesh | |
| **Week 7** | | | |
| | Class 13 | Bangladesh's contribution to world peace and security, Pre and post liberation development of engineering and technology | |
| | Class 14 | Bangladesh's contribution to world peace and security, Pre and post liberation development of engineering | |

| | | | |
|---|---|---|---|
| | | and technology | |
| **Week 8** | | | |
| | Class 15 | Land, Characteristics of tropical Monsoon climate, Forests and biomass, Fish | |
| | Class 16 | Engineering development in Bangladesh ( Kaptai Dam, Padma bridge, power plants, Karnaphuli River Tunnel etc. ) and its impact on socio-economic aspect | |
| **Week 9** | | | |
| | Class 17 | Minerals, Health and Education, | |
| | Class 18 | Agriculture, Industries | |
| **Week 10** | | | CT 2 |
| | Class 19 | NGOs, Population, Sociological and Cultural aspects of Bangladesh | |
| | Class 20 | Economy and national development, | |
| **Week 11** | | | |
| | Class 21 | Development and Progress of the Millennium Development Goals (MDGs) | |
| | Class 22 | Ultimate Disposal of Solid Waste: Method Public Administration in Bangladesh, State of Good Governance in Bangladesh | |
| **Week 12** | | | |
| | Class 23 | Art and Literature | |
| | Class 24 | Traditional cultural events | |
| **Week 13** | | | CT 3 |
| | Class 25 | Vision-2021, Digitalization | |
| | Class 26 | Tourism and Natural Resources | |
| **Week 14** | | | |
| | Class 27 | Bangladesh and International Relations | |
| | Class 28 | Revision of the course | |

ASSESSMENT STRATEGY

| Components | | Grading | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| Continuous Assessment (40%) | Class Test/ Assignment (1-3) | 20% | CO1, CO2 | L1, L2 |
| | Class Participation | 5% | CO2 | L2 |
| | Mid Term | 15% | CO2 | L2, L4 |
| Final Exam | | 60% | CO1 | L1, L2 |
| | | | CO2 | L1, L2, L4 |
| Total Marks | | 100% | | |

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCES BOOKS

| |
|---|
| 1. Bangladesh Studies: Md. Shamsul Kabir Khan and Daulatunnahar Khanam<br>2. The Constitution of the People's Republic of Bangladesh<br>3. Discovery of Bangladesh: Akbar Ali Khan<br>4. History of Bangladesh, Vols, 1-3: Sirajul Islam<br>5. History of Modern Bengal, Vol, 1: R C Majumdar<br>6. Dynastic History of Bengal: Dr. Abdul Mumin Chowdhury<br>7. A History of Bangladesh: William Van Schendel<br>8. Geography of Bangladesh: Harun Er Rashid<br>9. Banglapedia: National Encyclopedia of Bangladesh, Vols, 1-10: Sirajul Islam<br>10. History of Bengal: (Mughal Period 1526-1765): R. A. Chandra<br>11. Land of Two Rivers: Nitesh Sengupta<br>12. A History of Bangladesh: Cambridge University Press<br>13. Bengali Nationalism and the Emergence of Bangladesh: A.F Salahuddin Ahmed 14. Language Movement and The Making of Bangladesh: Safar Ali Akanda |
| REFERENCE SITE |
| http://www.google.com |


**Course: Bangla Language and Literature**
**Course Code: BAN-1201**
**Credit Hour: 03**
**Total Marks: 100**

১। **সাধারণ।** বাংলা আমাদের মাতৃভাষা। বাংলা শুধু একটি ভাষাই নয়, বরং এর সাথে বাংলাভাষী মানুষদের সংস্কৃতি, ইতিহাস এবং স্বকীয়তা ওতপ্রোতভাবে জড়িত। এই ভাষা শেখার মাধ্যমে এ অঞ্চলের মানুষদের ঐতিহ্য, মূল্যবোধ এবং জীবনপ্রক্রিয়া সম্পর্কে সম্যক ধারণা লাভ করা যায়। সর্বোপরি 'বাংলা ভাষা ও সাহিত্য' বিষয়টি অধ্যয়নের মাধ্যমে স্নাতক (সম্মান) প্রোগ্রামের ছাত্রছাত্রীগণ এর তাত্ত্বিক বিষয়ে যেমন দক্ষতা অর্জন করবে তেমনি এই কোর্স হতে লব্ধ ধারণা তাদের জ্ঞানের পরিধি ও সংস্কৃতি সম্পর্কে ধারণা বৃদ্ধি এবং এর প্রায়োগিক কৌশলসমূহ আরও ভালোভাবে রপ্ত করতে সাহায্য করবে।

2z **<u>fË¢nr-Zl E-ŸnÉz</u>**

Lz h¡wm¡ i¡o¡, hÉ¡LlZ J p¡¢q-aÉl ®j±¢mL ¢hou pÇf-LÑ d¡lZ¡ fËc¡e z

Mz j¡a«i¡o¡l öÜ EµQ¡lZ ¢nr¡z

Nz f¢Wa ¢ho-ul i¡h Ae¤d¡he Ll¡ Hhw a¡ fËL¡-n cr L-l ®a¡m¡z

Oz h¡wm¡ i¡o¡u ®fn¡Na c¡ç¢lL fœ¡m¡f (Official Correspondence) Hhw pªSen£m lQe¡l SeÉ fË¡¢aù¡¢eL ¢nr¡ fËc¡e z

3z **<u>fË-u¡¢NL E-ŸnÉz</u>**

Lz pªSen£m lQe¡u h¡wm¡ i¡o¡l cr fË-u¡Nz

Mz j¡a«i¡o¡u öÜ EµQ¡l-Z hš²hÉ fËc¡-e cra¡ ASÑez

Nz ¢m¢Ma J ®j±¢ML fË-uj-N ijoil ®p±LkÑ lrj Llįz

Oz jia«ijoju ci¢ç¢lL fœjmj-f craj ASÑez

4z **fjWÉp§Q£z**

Lz pj¢qaÉ (fËhå, NÒf J L¢haj) - 40 eðl

Mz hÉjLlZ, ijoj ¢nrj J ¢hlQe - 60 eðl

**(fËhå, NÒf J L¢hajpj§q YjLj ¢hnÄ¢hcÉjmu Hhw CE¢S¢p'l ¢p-mhjp q-a pwNªq£a)**

Nz **¢ehÑj¢Qa fËhå** - 15 eðl

(1) hj‰jmj ijoj - h¢ˆjQ¾â Q-—jfjdÉju

(2) °am - qlfÐpjc njÙ»£

Oz **¢ehÑj¢Qa NÒf** - 15 eðl

(1) fy¤CjjQj - ¢hi§¢ai§oZ h-¾cjfjdÉju

(2) eueQjlj - °puc Jujm£EõjÕq

Pz **¢ehÑj¢Qa L¢haj** - 10 eðl

(1) ¢h-cËjq£ - LjS£ eSl¦m Cpmjj

(2) h‰ijoj - jjC-Lm jd¤p§ce cš

Qz **hÉjLlZ J ijoj ¢nrj** - 25 eðl

(1) fË¢ja hjwmj hjej-el ¢eujz

(2) Aö¢Ü pw-njdez

(3) hjNÚdjljz

(4) fËhjc fËhQez

(5) HL Lbju fËLjnz

(6) fËnjp¢eL f¢ljijojz

(7) fËju p-jjµQj¢la ¢ieÀjbÑL në z

(8) ¢h¢ieÀ n-ël ¢h¢nøj-bÑ fË-ujN z

Rz **EµQjlZ¢h¢d** - 05 eðl

Sz **¢hlQe** - 30 eðl

(1) Cw-l¢S ®b-L hjwmj Ae¤hjc/Ae¤-µRc lQejz

(2) ijh pÇfËpjlZ/pjljwn/pjljjÑz

(3) fœ/fË¢a-hce lQej z

(4) fËhå lQei z

**5z ¢hÙ¹i¢la fiWÉp§¢Q z ®jiV ®œ²¢XV - 3 (45¢f¢luX):**

| œ¦/ew | ®LiX ew | fiWÉ ¢hou | ¢f¢luX pwMÉi | ji¿¹hÉ |
|---|---|---|---|---|
| | | **pi¢qaÉ (21 ¢f¢luX)** | | |
| 1z | hiwmi:1-4 | fÐhå: hi‰imi iioi | 4 | |
| 2z | hiwmi:5-7 | fÐhå: °am | 3 | |
| 3z | hiwmi:8-11 | NÒf: fy¤CjiQi | 4 | |
| 4z | hiwmi:12-14 | NÒf: eueQili | 3 | |
| 5z | hiwmi:15-18 | L¢hai: ¢h-âiq£ | 4 | |
| 6z | hiwmi:19-21 | L¢hai: h‰iioi | 3 | |
| | | **hÉiLlZ, iioi ¢nri J ®j±¢ML fÊLin rjail Eæue (13 ¢f¢luX)** | | |
| 7z | hiwmi:22-24 | fÐ¢ja hiwmi hiei-el ¢euj | 3 | |
| 8z | hiwmi:25-26 | Aö¢Ü pw-nide | 2 | |
| 9z | hiwmi:27 | hiNÚdili | 1 | |
| 10z | hiwmi:28 | fÐhic fÐhQe | 1 | |
| 11z | hiwmi: 29 | HL Lbiu fÐLin | 1 | |
| 12z | hiwmi: 30 | fÐnip¢eL f¢liioi | 1 | |
| 13z | hiwmi: 31 | fÐiu pj¤µQi¢la ¢iæibÑL në | 1 | |
| 14z | hiwmi: 32 | ¢h¢iæ n-ël ¢h¢nøi-bÑ fÐ-uiN | 1 | |
| 15z | hiwmi:33-34 | EµQilZ ¢h¢d | 2 | |
| | | **¢hlQe (05 ¢f¢luX)** | | |
| 16z | hiwmi: 35-36 | Cw-l¢S ®b-L hiwmi Ae¤hic/Ae¤-µRc lQei | 2 | |
| 17z | hiwmi: 37 | iihpÇfÐpilZ/pilіwn/piljjÑ | 1 | |
| 18z | hiwmi: 38 | fœ/fÐ¢a-hce lQei | 1 | |
| 19z | hiwmi: 39 | fÐhå lQei | 1 | |
| | | **fl£ri (06 ¢f¢luX)** | | |
| 20z | hiwmi: 40-45 | **fl£ri (2+4)** | **6** | |
| | | **®jiV ¢f¢luX =** | **45** | |

৬। পাঠদান কৌশল। প্রশিক্ষণের ক্ষেত্রে নিম্নলিখিত পদ্ধতি/উপায়সমূহ অনুসরণ করা হবে:

ক। বক্তৃতা।

খ। দলগত আলোচনা।

গ। মাল্টিমিডিয়া প্রেজেন্টেশান।

ঘ। নোট/সহায়কসামগ্রী প্রদান।

ঙ। ল্যাংগুয়েজ ল্যাবে প্রশিক্ষণ।

চ। স্পট/ক্লাস টেস্ট ইত্যাদি।

৭। মূল্যায়নপদ্ধতি। মূল্যায়ন পদ্ধতি নিম্নরূপ:

| ক্র. নং | বিষয় | নম্বর | মন্তব্য |
|---|---|---|---|
| ১। | ১ ✕ মিড টার্ম পরীক্ষা | ২০% | ১ ঘণ্টা, ২০ নম্বর |
| ২। | ক্লাস টেস্ট | ১০% | ৩টি (২টির নম্বর জমা দেয়া হবে, ৫%+৫%) |
| ৩। | অ্যাসাইনমেন্ট/ দলগত উপস্থাপনা/ ক্লাস পারফরমেন্স | ১০% | |
| ৪। | উপস্থিতি | ১০% | |
| ৫। | সেমিস্টার ফাইনাল পরীক্ষা | ৫০% | ৩ ঘণ্টা, ১০০ নম্বর |
| | সর্বমোট | ১০০% | |

৮। <u>সহায়ক পাঠ্যবই</u>। সহায়ক গ্রন্থাবলি নিম্নরূপঃ

ক। বিএমএ ক্যাডেট প্রেসি - বাংলা।

খ। বাংলা ব্যাকরণ - ড. শাহজাহান মুনীর, স্টুডেন্টস পাবলিকেশনস।

গ। প্রবন্ধসংগ্রহ - ঢাকা বিশ্ববিদ্যালয়।

ঘ। গল্পসংগ্রহ - ঢাকা বিশ্ববিদ্যালয়।

ঙ। কবিতাসংগ্রহ - ঢাকা বিশ্ববিদ্যালয়।

চ। বাংলা বানান অভিধান - বাংলা একাডেমি কর্তৃক প্রকাশিত।

ছ। বাংলা উচ্চারণ অভিধান - বাংলা একাডেমি কর্তৃক প্রকাশিত।

জ। প্রমিত বাংলা ব্যাকরণ ও নির্মিতি (তৃতীয় খণ্ড) - অধ্যাপক ড. হায়াৎ মামুদ ও অধ্যাপক ড. মোহাম্মদ আমীন।

ঝ। বাংলা ভাষার প্রয়োগ ও অপপ্রয়োগ - বাংলা একাডেমি কর্তৃক প্রকাশিত।

**Course Code:** GELM 275 **Course Name:** Leadership and Management
**Credit Hour:** 2.00 **Contact Hour:** 2.00
**Course Curriculum:** Outcome Based Education (OBE)
**Pre-requisite:** None

**Level/Term: 2/I**

**Rationale:**

The course is designed to make students understand the overlapping connection between engineering and management in an organization through the study of varied management practices and leadership traits as an engineer.

**Objectives:**

1. To introduce different management functions and approaches.
2. To expose students to different views and styles of leadership
3. To understand how an organization functions collaboratively with managers and engineers.
4. To understand various personality traits and its impact on leadership and management.
5. To solve real-world management problems as an engineer.

**Course Outcomes (CO) & Generic Skills:**

Upon completion of this course, the student should be able to:

| No. | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO1 | **Familiarize** with the fundamental concepts of leadership and management skills | C1-C2 | | | 1 | T, R, F |
| CO2 | **Explain** the role and contribution of a leader in achieving organizational goals | C1-C2 | | | 1 | T, ASG, R, F |
| CO3 | **Outline** the contribution of leadership traits and management skills in decision making and solving real life problems | C1-C2 | | | 1 | T, ASG, R, F |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam) | | | | | | |

**Course Contents:**

**a. Main Contents:**

Introduction to Leadership and Management; Management Fundamentals; Leadership & Motivation; Organizational Management; Planning and goal setting; Control; Change and Innovation; Attitude; Personality; Perception and Individual Decision Making; Understanding Work Team; HR Management; Operations Management; Information Technology and Management; Case studies.

**b. Detailed Contents:**

**Introduction to Leadership and Management:** Definition of leadership and management; basic difference between a leader and a manager; relation of leaders and managers with respect to efficiency and effectiveness; qualities of leader and managers with examples from history.

**Management Fundamentals:** Definition of management & manager; levels of management; management functions and skills; Mintzberg's managerial roles; Henri Fayol's management principles; strategic management.

**Leadership & Motivation**: Motivation, Maslow's hierarchy needs; theory of X & Y; motivators and hygiene factors; goal setting theory; reinforcement theory; equity theory; expectancy theory; Leadership styles; leadership trait theory; managerial grid; contemporary leadership; conflicts negotiation; leadership issues in 21st century; cross cultural leadership; engineer as a leader and some simple case discussions on leadership (positive and toxic leadership) in the class (Interactive Learning).

**Organizational Management:** Organization; departmentalization; chain of command; unity of command; cross functional area; authority; centralization and decentralization; traditional & contemporary organization; matrix project structure; learning structure; organizing collaboration.

**Planning and goal setting:** Foundation of planning; goals of plan; types of goal; types of goal & plan; goal setting; MBO; well written goal.

**Control:** Controlling process; controlling for organizational performance; types of control: (feed-forward, feedback & concurrent); balanced scorecard; contemporary issues in control; workplace concern & workplace violence.

**Change and Innovation:** Change and innovation; internal and external for change; changing process; creativity vs innovation.

**Attitude:** Components of Attitude; behavior model and characteristics model; behavior vs. attitude; job attitude; job involvement; job satisfaction and customer satisfaction.

**Personality:** Personality determinants: heredity and environment; Myers-Briggs Type Indicator; Big five personality model; personality traits (core self-evaluation, Machiavellianism, narcissism, self-monitoring, risk taking, proactive personality).

**Perception and Individual Decision Making**: Factors influencing perception; attribution theory; errors/biases in attribution; Factors of individual decision making; rational decision making; bounded rationality; satisfice; common errors in decision making; creativity in decision making.

**Understanding Work Team:** Work group; work team; problem solving team; self-managed work team; cross functional team; virtual team; team effectiveness; team challenges.

**HR Management:** Process of Human Resource Planning; forecasting demand for labor; staffing; internal supply of labor; performance appraisal.

**Operations Management:** Project managing basics; goals and boundary of project; WBS; scheduling a project; Demand and supply forecasting; inventory control.

**Information Technology and Management:** Management Information System (MIS); Enterprise Resource Planning (ERP) - For introductory knowledge

**Teaching-learning and Assessment Strategy:**

**Teaching learning strategy:**

| Teaching and learning activities | Engagement (hours) |
|---|---|
| Face-to-face learning | |
| Lecture | 28 |
| Practical/ Tutorial/ Studio | - |
| Student-centred learning | - |
| Self-directed learning | |
| Non face-to-face learning | 10 |
| Revision | 14 |
| Assessment preparations | 14 |
| Formal Assessment | |
| Continuous Assessment | 2 |
| Final Examination | 3 |
| Total | 71 |

**Teaching methodology:**
Lecture and Discussion, Co-operative and Collaborative Method, Case Study Based Method

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| Assessment strategies | | | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| Components | | Grading | | |
| Continuous Assessment (40%) | Class test 1-2 | 20% | CO 1 | C1-C2, P1 |
| | | | CO 2 | C1-C2 |
| | Class Participation | 5% | CO 1 | C1-C2, P1, A1 |
| | | | CO 2 | C1-2, P1-P2, A1 |
| | Mid term | 15% | CO 1 | C1-C2, P1, A1 |
| | | | CO 2 | C1-C2, P1-P2, A1-A2 |
| | | | CO 3 | C1-C2, P1-P2, A1-A2 |
| Final Exam | | 60% | CO 1 | C1-C2, P1, A1 |
| | | | CO 2 | C1-C2, P1-P2, A1-A2 |
| | | | CO 3 | C1-C2, P1-P2, A1-A2 |
| Total Marks | | 100% | | |

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

**Mapping of Course Outcomes and Program Outcomes:**

| Course Learning Outcomes | | Engineering Knowledge | Problem Analysis | Design / Development of Solutions | Investigation | Modern Tool Usage | The Engineer and Society | Environment and Sustainability | Ethics | Communication | Individual and Team Work | Life Long Learning | Project Management and Finance |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | **Familiarize** with the fundamental concepts of leadership and management skills | | | | | | | | | H | H | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO2** | **Explain** the role and contribution of a leader in achieving organizational goals | | | | | | | | | H | H | M | |
| **CO3** | **Outline** the contribution of leadership traits and management skills in decision making and solving real life problems | | M | | | | | | M | H | H | M | M |

(H – High, M- Medium, L- Low)

**Lecture Schedule:**

| Week | Lecture | Topics | TEST |
|---|---|---|---|
| **1** | Lec 1 | **Introduction to Leadership and Management:** Definition of leadership and management; basic difference between a leader and a manager; relation of leaders and managers with respect to efficiency and effectiveness; qualities of leader and managers with examples from history. | **Class Test 1** |
| | Lec 2 | **Management Fundamentals:** Definition of management & manager; levels of management; management functions and skills; Mintzberg's managerial roles; Henri Fayol's management principles; strategic management. | |
| **2** | Lec 3<br>Lec 4 | **Leadership & Motivation**: Motivation, Maslow's hierarchy needs; theory of X & Y; motivators and hygiene factors; goal setting theory; reinforcement theory; equity theory; expectancy theory | |
| **3** | Lec 5<br>Lec 6 | **Leadership:** Leadership styles; leadership trait theory; managerial grid; contemporary leadership; conflicts negotiation; leadership issues in 21st century; cross cultural leadership; engineer as a leader and some simple case discussions on leadership (positive and toxic leadership) in the class (Interactive Learning). | |
| **4** | Lec 7<br>Lec 8 | **Case Study – I : Engineer as Great Leaders** | |

| | | | |
|---|---|---|---|
| **5** | Lec 9 | **Organizational Management:** Organization; departmentalization; chain of command; unity of command; cross functional area; authority; centralization and decentralization; traditional & contemporary organization; matrix project structure; learning structure; organizing collaboration. | |
| | Lec 10 | **Planning and goal setting:** Foundation of planning; goals of plan; types of goal; types of goal & plan; goal setting; MBO; well written goal. | |
| **6** | Lec 11 | **Control:** Controlling process; controlling for organizational performance; types of control: (feed-forward, feedback & concurrent); balanced scorecard; contemporary issues in control; workplace concern & workplace violence. | |
| | Lec 12 | **Change and Innovation:** Change and innovation; internal and external for change; changing process; creativity vs innovation. | |
| **7** | Lec 13 | **Case Study – II : Planning and Goal Setting; A Managerial Approach: Engineer as Great Managers (Interactive Discussions in the Class)** | |
| | Lec 14 | **Attitude:** Components of Attitude; behavior model and characteristics model; behavior vs. attitude; job attitude; job involvement; job satisfaction and customer satisfaction. | |
| **8** | Lec 15 | **Personality:** Personality determinants: heredity and environment; Myers-Briggs Type Indicator; Big five personality model; personality traits (core self-evaluation, Machiavellianism, narcissism, self-monitoring, risk taking, proactive personality). | **Mid Term / Project** |
| | Lec 16 | **Perception and Individual Decision Making**: Factors influencing perception; attribution theory; errors/biases in attribution | |
| **9** | Lec 17 | **Perception and Individual Decision Making**: Factors of individual decision making; rational decision making; bounded rationality; satisfice; common errors in decision making; creativity in decision making. | |
| | Lec 18 | **Case Study – III : A Case on Decision Making – Involves both leadership and managerial skills (Interactive Discussion in the Class)** | |
| **10** | Lec 19 | **Understanding Work Team:** Work group; work team; problem solving team; self-managed work team; cross functional team; virtual team; team effectiveness; team challenges. | **Class Test 2** |
| | Lec 20 | **HR Management:** Process of Human Resource Planning; forecasting demand for labor; staffing. | |

| | | | |
|---|---|---|---|
| **11** | Lec 21 | **HR Management:** Internal supply of labor; performance appraisal. | |
| | Lec 22 | **Operations Management:** Project managing basics; goals and boundary of project; WBS; scheduling a project. | |
| **12** | Lec 23 | **Operations Management:** Demand and supply forecasting; inventory control. | |
| | Lec 24 | **Exercise – Use of Microsoft Project (MSP) for scheduling a project at student level** | |
| **13** | Lec 25<br>Lec 26 | **Case Study – IV:** A case that covers all relevant theories taught throughout the course and involves both leadership and management issues, e.g., Columbia's Final Mission. (This may be given as group assignment followed by in class short presentations/discussions) | |
| **14** | Lec 27 | **Information Technology and Management:** Management Information System (MIS); Enterprise Resource Planning (ERP) - For introductory knowledge. | |
| | Lec 28 | **Revision** | |

**Text and Reference Books:**

1. Students must be provided with SOLID reading material instead of referring text books. However, course teacher may select any text book as per his choice.
2. Engineering Management (Revised Edition) – A.K. Gupta
3. Industrial Engineering and Production Management - Martand T. Telsang
4. Leadership in Organizations – Gary Yukl
5. Developing Management Skills – David A. Whetten and Kim S. Cameron

**Reference Site:**
https://classroom.google.com/ (To be announced)

| | | | |
|---|---|---|---|
| | **COURSE INFORMATION** | | |
| Course Code<br>Course Title | : GERM 352<br>: Fundamentals of Research Methodology | Contact Hours<br>Credit Hours | : 4.00<br>: 2.00 |
| | **PRE-REQUISITE** | | |
| | None | | |
| | **CURRICULUM STRUCTURE** | | |
| | Outcome Based Education (OBE) | | |
| | SYNOPSIS/RATIONALE | | |
| | This course is essential for students to conduct research as well as for keeping abreast on the latest development in science, engineering, and technology fields. | | |

| | OBJECTIVES |
|---|---|
| | 1. To understand the basic concepts of research and familiarize with various research methodologies<br>2. To expose students to techniques for reviewing research materials<br>3. To develop appropriate research problems, ideas, provide solution and recognize their limitations<br>4. To prepare a project and research proposals<br>5. To develop writing and presentation skills<br>6. To discuss research management and ethics |
| | **LEARNING OUTCOMES** |
| | 1. Identify research problems, objectives and research questions.<br>2. Write effectively a literature review in relevant research areas.<br>3. Identify the key components of scientific and technical style, and the pitfalls associated with that style.<br>4. Present research reports both orally and in writing and evaluate research reports and finding.<br>5. Apply ethical code in research management and publications. |
| | **COURSE OUTCOMES & GENERIC SKILLS** |

| No. | Course Learning Outcome | Corresponding POs | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|---|
| CO1 | **Identify** research problems, objectives and research questions. | PO1, PO2 | C1- C3 | - | - | 3 | ASG |
| CO2 | **Write** effectively a literature review in relevant research areas. | PO5 | C4 | - | - | 4 | ASG |
| CO3 | **Identify** the key components of scientific and technical style, and the pitfalls associated with that style. | PO7 | C4 | - | - | 5 | PR |
| CO4 | **Present** research reports both orally and in writing and evaluate research reports and finding. | PO3 | C5-C6 | 1 | | 6 | Pr |
| CO5 | **Apply** ethical code in research management and publications. | PO-3 | C4 | 1 | | 6 | R |

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam, MT- Mid Term Exam)

| | COURSE CONTENT |
|---|---|

Definition of research, Objectives of research, Significance of research, Research characteristics, Types of research, Fundamental research, Applied research, Qualitative and Historical research, Quantitative research (Descriptive research, Experimental research, Quasi-Experimental research, Mixed-Methods research), Research process, Research design, Methodologies to do engineering research, Descriptions and characteristics of Theoretical, Experimental, and Computational research, Review of related literature and contemporary scientific information, Methods of data collections, Data analyses and Uncertainty analyses, Making effective Charts, Graphs, Tables, Gantt chart, Survey & Interview methods for research, Case study research, Case studies formation, Case study exercises, Research planning, Research proposals, Budget preparation, Research ethics, Plagiarism, Copyright, Intellectual Property (IP) rights, Thesis/Dissertation/Report/Paper writing format & style, Review paper structure, Importance of Literature review, References, Bibliography, End Note, Foot note, Reference styles, Reference management tools, Presentation skills (Oral, Poster), Editing and proofreading strategies, Research paper authorships.

**SKILL MAPPING(CO-PO MAPPING)**

| No. | Course Learning Outcome | PROGRAM OUTCOMES (PO) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| CO1 | **Identify** research problems, objectives and research questions. | 3 | | | | | | | | | | | |
| CO2 | **Write** effectively a literature review in relevant research areas | 3 | | | | | | | | | | | |
| CO3 | **Identify** the key components of scientific and technical style, and the pitfalls associated with that style. | | 2 | | | | | | | | | | |
| CO4 | **Present** research reports both orally and in writing and evaluate research reports and finding. | | | | 2 | | | | | | 2 | | |
| CO5 | **Apply** ethical code in research management and publications. | | | | 2 | | | | 2 | | | 2 | |

(3 – High, 2- Medium, 1-low)

**Justification for CO-PO Mapping:**

| **Mapping** | **Corresponding Level of Matching** | **Justification** |
|---|---|---|
| CO1-PO1 | 3 | In order to identify research problems, objectives and research questions, the knowledge of mathematics, natural science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems is to be applied. |
| CO2-PO1 | 3 | In order to write effectively a literature review in relevant research areas, the knowledge of mathematics, natural science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems is to be applied. |

| | | |
|---|---|---|
| CO3-PO2 | 3 | In order to identify the key components of scientific and technical style, and the pitfalls associated with that style, identification, formulation, research literature and analysis of complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences are required. |
| CO4-PO4 | 2 | In order to present research reports both orally and in writing and evaluate research reports and finding, it is required to conduct investigations of complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions. |
| CO4-PO10 | 2 | In order to present research reports both orally and in writing and evaluate research reports and finding, it is required to communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions. |
| CO5-PO4 | 2 | In order to apply ethical code in research management and publications, it is required to conduct investigations of complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions. |
| CO5-PO8 | 2 | In order to apply ethical code in research management and publications, application of ethical principles and commit to professional ethics and responsibilities and norms of engineering practice is required. |
| CO5-PO11 | 2 | In order to apply ethical code in research management and publications, it is required to demonstrate knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments. |

**TEACHING LEARNING STRATEGY**

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Face-to-Face Learning | |
| Lecture | 14 |
| Practical / Tutorial / Studio | 14 |
| Student-Centred Learning | - |
| Self-Directed Learning | |
| Non-face-to-face learning | 28 |
| Revision | - |
| Formal Assessment | |
| Continuous Assessment (Assignment) | 14 |
| Mini Projects | 28 |
| Presentation | 01 |
| Report | 28 |
| Mid-Term | 01 |
| Final Examination | |

| Total | 102 |
|---|---|

## TRASNFERABLE SKILLS

*Skills and how they are developed and assessed:*

| Skills | Development | Assessment |
|---|---|---|
| Technical | Lectures | Written Assessment |
| Analytical | Projects | Report |

## ASSESSMENT METHODS AND TYPE/COURSE ASSESSMENT

*Weightage of each type of assessment is stated:*

| CO | Method | Grading (%) |
|---|---|---|
| CO 1, CO 2 | Assignments | 20 |
| CO 3 | Projects | 30 |
| CO 4 | Presentation | 20 |
| CO 5 | Report | 30 |
| Total Marks | | 100 |

## TEACHING METHODOLOGY

Lectures and Presentation, Co-operative and Collaborative Method, Problem Based Method

## COURSE SCHEDULE

| Weeks | Topics | Remarks |
|---|---|---|
| Week-1 | **Introduction to research**: Research and its purposes, main elements and process of research, qualitative and quantities approach. | |
| Week-2 | Paradigms in research knowledge, processes and strategies for a specific piece of research, knowledge dissemination | |
| Week-3 | **Literature Review Procedures**: Reasons of surveying literature; sources of literatures: journal, conference paper, thesis and dissertations, professional periodicals, indexes, catalogues, Encyclopaedias, etc. | |
| Week-4 | **Reviewing Research Paper**: Process of acquiring literature; Assessing literature relevance, classify and categorizing, keeping records, commenting and critiquing; | |
| Week-5 | **Reviewing Research Paper**: Structure of writing review reports; | |

| | | |
|---|---|---|
| | Evaluating and reviewing reports.<br>**Case Study** | |
| Week-6 | **Research Objectives and Methodologies**:<br>Identifying relevant research problems based on literature survey, selection of a target research topic;<br>Explore and determine the objectives, assumptions, methods and scopes. | |
| Week-7 | Design of experiments, simulation studies, performance evaluation.<br>**Case study**: Choose a highly cited paper for critical review. | |
| Week-8 | **Data acquisition and Analysis:**<br>Experimental setup, error analysis. | |
| Week-9 | Statistical analysis & data validation. | |
| Week-10 | **Guidelines to preparation of research presentation**: Presentation outline, organization of material, hyperlinks, animation, video clip etc. | |
| Week-11 | **Research Planning**:<br>Reasons for a research plan, benefits and problems of planning, sustainability, techniques of planning: hierarchical task decomposition, Gantt chart, monitoring progress, research expenses, budgeting. Case Study | |
| Week-12 | **Research presentation from researchers** | |
| Week-13 | **Ethical Research Issues**:<br>Ethical and legal issues in conducting research, plagiarism; Patenting, Intellectual Property Rights (IPR),<br>Case Study<br>**Effective Report Writing**: Reports writing, style and format of writing, data analysis software, standard presentation software, justifying and defending the critics by reviewers. | |
| Week-14 | **Research Presentation**:<br>Oral presentation of a research, selection of journal and conference for presentation/submission,<br>Oral Presentation of research proposal. | |

**ASSESSMENT STRATEGY**

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**REFERENCE BOOKS**


[1] P.D. Leedy and J.E. Ormond, *Practical Research: Planning and Design*, Pearson Education, New Jersey (USA), 2013

[2] C.R Kothari, *Research Methodology: Methods & Techniques*, New Age International (P) Ltd Publishers, New Delhi, 2004.

[3] R. Panneerselvam, *Research Methodology*, Prentice Hall of India, New Delhi, 2012.

[4] S. Melville and W. Goddard, *Research Methodology: An Introduction for Science & Engineering Students*, Juta & Co Ltd, 1996.

[5] K. N. Krishnaswamy, A. I. Sivakumar, and M. Mathirajan, *Management Research Methodology, Integration of Principles*, Pearson Education, New Delhi, 2009.
[6] D. Chawla, and N. Sondhi, *Research Methodology – Concepts & Cases*, Vikas Publishing House, 2018.
[7] G. M. Hall, *How to write a paper*, 4th ed., Malden, Mass.: BMJ Books, 2008.

**REFERENCE SITE**

Google classroom

**Course Code:** IPE 415 **Course Name:** Project Management
**Credit Hour:** 3.00 **Contact Hour:** 3.00
**Level/Term:** L-4, T-1

**Curriculum Structure**: Outcome Based Education (OBE)

**Pre-requisites:** None

**Rationale:** This course provides the students with the ability to predict as many problems as possible and to plan, organize and control activities so that one project can be completed as successfully as possible in spite of all the risks.

**Objective:**

1. To expose students to the principles of project management and organizational dynamics
2. To guide students in analyzing various project appraisal techniques
3. To familiarize students with application and assessment of project planning, scheduling and resource allocation methods
4. To develop students' skills in breaking down projects and making informed decisions
5. To explain effective organizational leadership skills to students

**Course Outcomes (CO) & Generic Skills:**

Upon completion of this course, the student should be able to:

| No. | Course Learning Outcome | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO1 | **Explain** concepts of project management and organizations | C1, C2 | | | | T, F |
| CO2 | **Analyze** projects using various project appraisal technics | C3, C4 | 1 | | 2 | Mid Term Exam, F |

| | | | | | | |
|---|---|---|---|---|---|---|
| CO3 | **Apply** and **assess** project planning, scheduling and resource allocation methods | C3, C4 | 1 | | 2,4 | T, F, Mid Term |
| CO4 | **Evaluate** projects to determine the most suitable approach amidst conflicting alternatives | C4,C5 | 1,2 | | 2,4 | F, T, ASG |
| CO5 | **Explain** effective organizational leadership and change skills for financial management, managing projects, projects teams and stakeholders. | C2 | | | 2,4 | F |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; PR – Presentation; R - Report; F – Final Exam) | | | | | | |

**Course Contents:**

Identification, planning, appraisal, project implementation, project organization, budgeting, scheduling, using bar diagram, CPM, PERT, resource allocation, information system and project control, project termination, project organizations, matrix organization, project manager, contract negotiation and conflict resolution, case study, planning and evaluation of an investment project.

**Mapping of Course Outcomes (CO) and Program Outcomes:**

| Course Learning Outcomes | | Engineering Knowledge | Problem Analysis | Design / Development of Solutions | Investigation | Modern Tool Usage | The Engineer and Society | Environment and Sustainability | Ethics | Communication | Individual and Team Work | Life Long Learning | Project Management and Finance |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| CO1 | **Explain** concepts of project management and organizations | | | | | | | | | | | | √ |
| CO2 | **Analyze** projects using various project appraisal technics | √ | √ | | | | | | | | | | |
| CO3 | **Apply** and **assess** project planning, scheduling and resource allocation methods | √ | √ | | | | | | | | | | |
| CO4 | **Evaluate** projects to | √ | √ | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | determine the most suitable approach amidst conflicting alternatives. | | | | | | | | | | | | |
| CO5 | **Explain** effective organizational leadership and change skills for financial management and managing projects | | | | | | √ | | | | | | |

(H – High, M- Medium, L-low)

**Teaching-learning and Assessment Strategy:**

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Face-to-Face Learning<br>Lecture<br>Practical / Tutorial / Studio<br>Student-Centred Learning | <br>42<br>-<br>- |
| Self-Directed Learning<br>Non-face-to-face learning<br>Revision<br>Assignment Preparations | <br>40<br>20<br>20 |
| Formal Assessment<br>Continuous Assessment<br>Final Examination | <br>2<br>3 |
| Total | 127 |

**Teaching Methodology:**

**Lecture Schedule:**

| **Week 1** | **Projects in Contemporary Organizations** | **CT 1** |
|---|---|---|
| Class 1 | Introduction to Project management | |
| Class 2 | Project and Project management, | |
| Class 3 | Project Life Cycle | |
| **Week 2** | **Project initiation** | |
| Class 4 | Project management maturity and project selection models | |
| Class 5 | Project Portfolio Process | |
| Class 6 | Projects Bids and RFP | |
| **Week 3** | **Project manager** | |
| Class 7 | Project management and Project Manager | |
| Class 8 | Project management and Project Manager | |
| Class 9 | Attributes of effective Project Manager | |
| **Week 4** | **Managing conflicts and the art of negotiation** | **CT 2** |
| Class 10 | Introduction to Conflict | |

| | | |
|---|---|---|
| Class 11 | Introduction to negotiation | |
| Class 12 | The nature of negotiation | |
| **Week 5** | **The project in the organizational structure** | |
| Class 13 | Projects in different types of organization I | |
| Class 14 | Projects in different types of organization II | |
| Class 15 | Project management team | |
| **Week 6** | **Project planning** | |
| Class 16 | Project plan, WBS | |
| Class 17 | Project risk management | |
| Class 18 | RACI matrix and agile projects | |
| **Week 7** | **Budgeting: estimating costs and risks** | **ASG, Mid Term Exam** |
| Class 19 | Estimating project budget | |
| Class 20 | Cost estimation, Risk estimation | |
| Class 21 | Risk estimation | |
| **Week 8** | **Scheduling** | |
| Class 22 | Introduction to Scheduling | |
| Class 23 | Scheduling Algorithms | |
| Class 24 | Network techniques | |
| **Week 9** | **Resource allocation** | |
| Class 25 | Critical path method | |
| Class 26 | Resource allocation problem | |
| Class 27 | Resource loading, leveling | |
| **Week 10** | **Continued…** | **Final Exam, CT3, ASG** |
| Class 28 | Constrained resource scheduling | |
| Class 29 | Goldratt's Critical Chain | |
| Class 30 | Multi project Scheduling and Resource allocation | |
| **Week 11** | **Project execution** | |
| Class 31 | Fundamentals of project execution | |
| Class 32 | Monitoring and information system | |
| Class 33 | Monitoring and information system | |
| **Week 12** | **Project auditing** | |
| Class 34 | Fundamentals of project controls II | |
| Class 35 | Fundamentals of project controls II | |
| Class 36 | Fundamentals of project controls II | |
| **Week 13** | **Project auditing and termination** | |
| Class 37 | Project audit life cycle | |
| Class 38 | Some essentials of an Audit/Evaluation | |

| | | |
|---|---|---|
| Class 39 | The Termination Process and Final Report | |
| **Week 14** | **Review classes** | |
| Class 40 | Review class 01 | |
| Class 41 | Review class 02 | |
| Class 42 | Review class 03 | |

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| Assessment Strategies | | | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| Components | | Grading | | |
| Continuous Assessment (40%) | Test 1-3 | 20% | CO 1 | C1, C2 |
| | | | CO 2 | C3, C4 |
| | | | CO 3 | C3, C4 |
| | Class Participation | 5% | CO 2 | C3, C4 |
| | | | CO 3 | C3, C4 |
| | Attendance | 5% | | |
| | Mid term | 10% | CO 1 | C1, C2 |
| | | | CO 2 | C3, C4 |
| | | | CO 3 | C3, C4 |
| Final Exam | | 60% | CO 1 | C1, C2 |
| | | | CO 2 | C3, C4 |
| | | | CO 4 | C4, C5 |
| | | | CO 5 | C2 |
| Total Marks | | 100% | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**Text and Ref Books:**

1. Jack R. Meredith, Samuel J. Mantel, Jr. "Project Management- A Managerial Approach", 7th Edition, 2009

2. Eugene R. Brigham and Joel F. Houston- Fundamentals of Financial Management, 11th Edition, 2005

**Course Code:** GESL 313 **Course Name:** Environment, Sustainability and Law
**Credit Hour:** 2.00 **Contact Hour:** 2.00

**Level/Term:** L-3, T-1

**Curriculum Structure:** Outcome-Based Education (OBE)

**Pre-requisites:** None

**Synopsis/Rationale:**

This Outcome-Based Education (OBE) based course is designed to provide an introduction to the concepts and principles which underpin environmental law from the international to the local level. The course will address Constitutional responsibilities and roles relating to the environment; sustainable development and the law; environmental planning through environmental impact assessment and land-use law; environmental protection principles, climate change water resources law; heritage issues and the protection of biological diversity.

**Objectives:**

1. To offer a comprehensive overview of environment sustainability.

2. To provide practice-oriented information to help students find the sustainable methods for the intended environment applications.

3. To understand and appreciate the ethical dimensions of the role of lawyers, and the functioning of law and legal systems.

4. To understand the structures of sustainable environmental, and management practice.

**Course Outcomes (CO) & Generic Skills:**

| No. | **Course Learning Outcome** | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| **CO1** | **Explain** an awareness of the incompleteness of law and the continuous state of development of legal principles. | C1-C3 | 1 | | 3 | T, Mid Term, F |

| | | | | | | |
|---|---|---|---|---|---|---|
| **CO2** | **Apply** the principles, techniques, and methods to problem-solving exercises. | C4 | 3 | 2 | | Mid Term Exam, F, R |
| **CO3** | **Identify** an ability to critically analyse and apply legislation, rules and cases in context. | C1, C4 | 2 | 5 | 3 | Mid Term Exam,F,PR ,Pr |
| **CO4** | **Develop** the capacity to analyse, evaluate and synthesise information from a wide variety of sources and experiences. | C4 | 3 | 5 | 1, 3 | Mid Term Exam,F |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T-Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam) | | | | | | |

**Course Contents:**

Introduction to Environmental Sustainability & Law. Domestic and international law. Traditional environmental issues and broader development. International environmental law: Principles and Sustainable development. Environmental Law: National Perspectives Common Law & Constitutional Law. Commonwealth Environmental Assessment and Approval. Regulating and Assessing Development.

Regulation of Activities of Environmental Significance. Climate Change and Greenhouse issues. Water Resources –Law and Policy issues. Public participation in defending the environment. Conservation of Biological Diversity.

**Mapping of Course Outcomes and Program Outcomes:**
(H – High, M- Medium, L-low)
**Teaching-learning and Assessment Strategy:**

| Teaching and Learning Activities | Engagement (hours) |
|---|---|

| Course Learning Outcomes | | Engineering Knowledge | Problem Analysis | Design / Development of | Investigation | Modern Tool Usage | The Engineer and Society | Environment and Sustainability | Ethics | Communication | Individual and Team Work | Life-Long Learning | Project Management and |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | **Explain** an awareness of the incompleteness of law and the continuous state of development of legal principles. | H | | H | | H | | H | | | | | |
| **CO2** | **Apply** the principles, techniques, and methods to problem-solving exercises. | | H | | H | | | | | | H | | |
| **CO3** | **Identify** an ability to critically analyse and apply legislation, rules and cases in context. | | | | H | | M | | | | | M | |
| **CO4** | **Develop** the capacity to analyse, evaluate and synthesise information from a wide variety of sources and experiences. | | | H | | | | H | | | | M | H |

| | |
|---|---|
| Face-to-Face Learning | |
| Lecture | 28 |
| Practical / Tutorial / Studio | - |
| Student-Centred Learning | - |

| | |
|---|---|
| Self-Directed Learning<br>Non-face-to-face learning<br>Revision<br>Assessment Preparations | <br>40<br>20<br>19 |
| Formal Assessment<br>Continuous Assessment<br>Final Examination | <br>2<br>3 |
| Total | 112 |

**Teaching Methodology:**

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method, Multimedia Presentation, Class Presentation, Assignments, Class Tests, Exams, Feedback at every step.

**Lecture Schedule:**

| Week | Lecture | Topics | ASSESSMENT |
|---|---|---|---|
| 1 | 1 | Introduction to Environmental Sustainability & Law | |
| | 2 | Introduction to Environmental Sustainability & Law (cont.) | |
| 2 | 1 | International environmental law: Principles and Sustainable development | |
| | 2 | International environmental law: Principles and Sustainable development (cont.) | |
| 3 | 1 | Environmental Law: National Perspectives<br>Common Law & Constitutional Law | CT 1 to be held on these topics |
| | 2 | Environmental Law: National Perspectives<br>Common Law & Constitutional Law (cont.) | |
| 4 | 1 | Commonwealth Environmental Assessment and Approval | |

| | | | |
|---|---|---|---|
| | 2 | Commonwealth Environmental Assessment and Approval (cont.) | |
| 5 | 1 | Regulating and Assessing Development: State Level – Part 1 | CT 2 to be held on these topics, ASG, PR |
| | 2 | Regulating and Assessing Development: State Level – Part 1 (cont.) | |
| 6 | 1 | Regulating and Assessing Development: State level – Part 2 | |
| | 2 | Regulating and Assessing Development: State level – Part 2 (cont.) | |
| 7 | 1 | Regulation of Activities of Environmental Significance | |
| | 2 | Regulation of Activities of Environmental Significance (cont.) | |
| 8 | 1 | Climate Change and Greenhouse issues | ASG |
| | 2 | Climate Change and Greenhouse issues (cont.) | |
| 9 | 1 | Water Resources –Law and Policy issues | |
| | 2 | Water Resources –Law and Policy issues (cont.) | |
| 10 | 1 | Public participation in defending the environment | |
| | 2 | Public participation in defending the environment (cont.) | |
| 11 | 1 | Conservation of Biological Diversity | |
| | 2 | Conservation of Biological Diversity (cont.) | |
| 12 | 1 | Heritage issues-protection of built, natural and aboriginal heritage | ASG \ |
| | 2 | Heritage issues-protection of built, natural and aboriginal heritage (cont.) | |
| 13 | 1 | Problem-based practice in the application of the law | |

| | | | |
|---|---|---|---|
| | 2 | Problem-based practice in the application of the law (cont.) | |
| 14 | 1 | Problem-based practice in the application of the law (cont.) | |
| | 2 | Course Review for Final Exam | |

(PR – Project; ASG – Assignment)

**Linkage of Course Outcomes with Assessment Methods and their Weights:**

| Components | | Grading | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| Continuous Assessment (40%) | Test 1-2 | 20% | CO 1 | C1 - C4 |
| | | | CO 2 | C2 - C4 |
| | | | CO 4 | C2 |
| | Class Participation | 5% | CO 1 | C3, C4 |
| | | | CO 5 | A3 |
| | Mid-term | 15% | CO 3 | C1 - C4 |
| | | | CO 4 | C3, C4 |
| Final Exam | | 60% | CO 1 | C1- C4 |
| | | | CO 2 | C3, C4 |
| | | | CO 3 | C2 - C4 |
| | | | CO 4 | C2 |
| Total Marks | | 100% | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**Text and Ref Books:**

1. DE Fisher, Australian Environmental Law (2nd ed, Thomson Reuters, 2010).
2. Bates and Lipman, Corporate Liability for Pollution (LBC Information Services, 1998).
3. Godden, Lee & Peel, Jacqueline, Environmental Law: Scientific,Policy and Regulatory dimensions, Oxford University Press, 2009.

**Reference Site:**

https://classroom.google.com/ (**To be announced**)

| **COURSE INFORMATION** | | | |
|---|---|---|---|
| Course Code<br>Course Title | : GEEM 243<br>: Engineering Ethics and Moral Philosophy | Contact Hours<br>Credit Hours | : 2.00<br>: 2.00 |
| **PRE-REQUISITE** | | | |
| None | | | |
| **CURRICULUM STRUCTURE** | | | |
| Outcome Based Education (OBE) | | | |
| **RATIONALE** | | | |
| This course motivates engineers to perform under a standard of professional behaviour that requires adherence to the highest principles of ethical conduct and manage the resources and decisions effectively. Part of professional ethics is the understanding of the ethics of other professions: how they interact and what can be expected from them as correct ethical behaviour. It elevates the profession and raises future standards and imprints on individual moral mindsets and behaviours. | | | |
| **OBJECTIVE** | | | |

1. To develop a firm ethical base.
2. To gain the ability to continue professional development with an understanding of the legal issues, and to critically assess the codes of professional conduct for IPE professionals.
3. To identify and analyze practical legal problems commonly encountered in computing industry.

**LEARNING OUTCOMES & GENERIC SKILLS**

| No. | Course Learning Outcome (Upon completion of the course, the students will be able to) | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO1 | **Explain** the theoretical aspects of ethics and moral philosophy in professional fields. | C1-C2 | 1 | | 1 | T, F |
| CO2 | **Identify** practical and legal problems commonly encountered by engineers in their professional industry. | C3 | 1 | | 7 | MT |
| CO3 | **Develop** foundation knowledge of ethics to be and apply them to solve engineering problems. | C3-C6 | 3, 5 | | 3 | F |
| CO4 | **Develop** the communication skill by presenting topics on Engineering Ethics and Moral Philosophy. | A2 | | 1 | | Pr |

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile,T – Test ; PR – Project ; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam, MT- Mid Term Exam)

**COURSE CONTENT**

Engineering Ethics: **Introduction to Ethics**; Theories of Ethics; **Principles of Engineering Ethics**; Ethical expectation: Employers and employees, Inter-professional relationship, **Standards and codes**: Institutionalization of ethical conduct. Ethical Dilemmas, Choices, **Industrial Ethics**: Roles of IPE engineers to society, BNBC in industries, Ethical Challenges for IPE Engineers, The Rights and Responsibilities of Engineers Safety, Risk and Liability; **Case studies** related to ethical issues in IPE and other Engineering disciplines. Introduction to **Philosophy of Engineering**, metaphysics, epistemology, axiology, and logic

**SKILL MAPPING.**

| No. | Course Learning Outcome | PROGRAM OUTCOMES (PO) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| CO1 | Explain the theoretical aspects of ethics and moral philosophy in professional fields. | M | | | | | | | | | | | |
| CO2 | Identify practical and legal problems commonly encountered by engineers in their professional industry. | | H | | | | | | | | | | |
| CO3 | Develop foundation knowledge of ethics to be and apply them to solve engineering problems. | | | | | | | | M | | | | |
| CO4 | Develop the communication skill by presenting topics on Engineering Ethics and Moral Philosophy. | | | | | | | | | | L | | |

(H – High, M- Medium, L-low)

**JUSTIFICATION FOR CO-PO MAPPING**

| Mapping | Level | Justifications |
|---|---|---|
| CO1-PO1 | Medium | Understand theoretical aspects of ethics and moral philosophy in professional fields. |
| CO2-PO2 | High | Analyze & identify practical and legal problems commonly encountered by engineers in their professional industry. |
| CO3-PO8 | Medium | Build foundation knowledge of ethics to be and apply them to solve engineering problems. |
| CO4-PO10 | Low | Develop communication skills through participating in quiz, presentation etc. |

**TEACHING LEARNING STRATEGY**

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Face-to-Face Learning | |
| Lecture | 28 |
| Practical / Tutorial / Studio | - |
| Student-Centred Learning | - |
| Self-Directed Learning | |
| Non-face-to-face learning | 28 |
| Revision | 14 |
| Assessment Preparations | 14 |
| Formal Assessment | |
| Continuous Assessment | 2 |
| Final Examination | 3 |
| Total | 89 |

| **TEACHING METHODOLOGY** |
|---|
| Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method |

| **COURSE SCHEDULE** |
|---|

| Week | Lecture | Topics | Assessment Methods |
|---|---|---|---|
| **1** | Lec 1<br>Lec 2 | Introduction to Ethics<br>Principles of Engineering Ethics | **Class Test 1** |
| **2** | Lec 3<br>Lec 4 | Ethical expectation Employers and Employees Relationship Obligation of an Engineer to Clients | |
| **3** | Lec 5<br>Lec 6 | Professional Organization: Standards and Codes Institutionalization of Ethical Conduct | |
| **4** | Lec 7<br>Lec 8 | BNBC in industries | **Class Test 2** |
| **5** | Lec 9<br>Lec 10 | Ethical Problem Solving Techniques | |
| **6** | Lec 11<br>Lec 12 | Case study methodology, different case studies | |
| **7** | Lec 13<br>Lec 14 | Roles of IPE engineers to society | **Mid Term** |
| **8** | Lec 15<br>Lec 16 | Ethical Dilemmas<br>Choices (Whistle Blowing) | |
| **9** | Lec 17<br>Lec 18 | Ethical Challenges for IPE Engineers | |
| **10** | Lec 19<br>Lec 20 | The Rights and Responsibilities of Engineers<br>Safety, Risk and Liability | |
| **11** | Lec 21<br>Lec 22 | | |
| **12** | Lec 23 | Case study methodology, different case studies | |

| | | | |
|---|---|---|---|
| | Lec 24 | | |
| **13** | Lec 25<br>Lec 26 | Introduction to Philosophy of Engineering<br>Metaphysics | |
| **14** | Lec 27<br>Lec 28 | Epistemology, Axiology and logic | |

**SSESSMENT STRATEGY**

| Components | | Grading | CO | Blooms Taxonomy |
|---|---|---|---|---|
| Continuous Assessment (40%) | Test 1-2 | 20% | CO 1 | C1-C2 |
| | Class Participation | 5% | CO 4 | A2 |
| | Mid term | 15% | CO 2 | C3 |
| Final Exam | | 60% | CO 1 | C1-C2 |
| | | | CO 3 | C3-C6 |
| Total Marks | | 100% | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**REFERENCE BOOKS**


1. Engineering Ethics: Concepts and Cases (4th Edition) - Charles E. Harris
2. Engineering Ethics (4th Edition) - Charles B. Fleddermann,
3. The Elements Of Moral Philosophy – James Rachels & Stuart Rachels


**REFERENCE SITE**

# CHAPTER 7

# DESCRIPTION OF OTHER ENGINEERING COURSES

## 7.1 Detailed Curriculum of CSE Courses

| COURSE INFORMATION | | | |
|---|---|---|---|
| Course Code<br>Course Title | : CSE 281<br>: Computer Programming | Lecture Contact Hours<br>Credit Hours | : 3.00<br>: 3.00 |
| **PRE-REQUISITE** | | | |
| Course Code: Nil<br>Course Title: Nil | | | |
| **CURRICULUM STRUCTURE** | | | |
| Outcome Based Education (OBE) | | | |
| **RATIONALE** | | | |
| The Computer programming Technique course is designed to introduce the fundamental principles, mechanism of programming skills and develop basic programming skills to program design and development. The course begins with introductory concepts of structured programming language and then covers other important topics related to structured programming language. It also deals with basic data structures like stack and queue. | | | |
| **OBJECTIVE** | | | |
| 1. Describe algorithm and solve problems using computers.<br>2. To know about various syntax, semantics of computer programming languages.<br>3. Develop basic programming skills with respect to program design and development. | | | |

**LEARNING OUTCOMES& GENERIC SKILLS**

| No. | Course Learning Outcome (Upon completion of the course, the students will be able to) | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO1 | Describe algorithm and solve problems using computers. | C1-C3 | 1 | | 1 | T |
| CO2 | Analyse the fundamental principles, typical characteristics and mechanisms of computer programming techniques. | C4 | 3 | | 2 | T, F, MT |
| CO3 | Develop basic programming skills with respect to program design and development. | C6 | 1,3 | | 5 | F |
| CO4 | Able to develop the communication skill by presenting topics on Computer Programming Techniques. | A2 | | 1 | | PR |

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile,T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam, MT- Mid Term Exam)

## COURSE CONTENT

**Introduction to computer programming:** Programming Concepts, Program Development Stages, Structured Programming Language; **Number System:** binary, octal, decimal and hexadecimal systems; **Basic programming Structures:** Data types and their memory allocation, Operators, Expressions, Basic Input/output; **Control Structure:** “if else”, “switch”, Flow Charts, Loop, Nested Loop; **Arrays:** One-dimensional array, Multi-dimensional array, Character array/ string; **Function:** Function definition, Function declaration, Function call; **Pointer:** Different types of pointers, Pass pointer as arguments, Call by value vs call by reference; **Dynamic Memory Allocation:** Malloc, Calloc, Free, Realloc; **User defined data types:** Structures, Unions, Enumerations; **Bitwise operations:** AND, OR, NOT, XOR, Left shift, Right Shift; File I/O; Header files, Preprocessor; Error Handling; **Introduction to C++:** Basic Ideas of OOP-encapsulation, inheritance and polymorphism, Classes and objects;

## SKILL MAPPING

| No. | Course Learning Outcome | PROGRAM OUTCOMES (PO) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| CO1 | Describe algorithm and solve problems using computers. | H | | | | | | | | | | | |
| CO2 | Analyse the fundamental principles, typical characteristics and mechanisms of computer programming techniques. | | H | | | | | | | | | | |
| CO3 | Develop basic programming skills with respect to program design and development. | | | H | | | | | | | | | |
| CO4 | Able to develop the communication skill by presenting topics on Computer programming Technique. | | | | | | | | | | L | | |

(H – High, M- Medium, L-low)

## JUSTIFICATION FOR CO-PO MAPPING

| Mapping | Level | Justifications |
|---|---|---|
| CO1 – PO1 | High | In order to solve complex engineering problems, knowledge of algorithms and computer usage is very important. |
| CO2 – PO2 | High | To analyse the complex engineering problems one need to analyse the fundamental principles, typical characteristics and mechanisms of a structured programming language. |
| CO3 – PO3 | High | To design and develop solutions for complex engineering problems, one need to develop basic programming skills. |
| CO4-PO10 | Low | In order to give presentation on the selective topics from the course taught we need strong communication skills. |

## TEACHING LEARNING STRATEGY

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Face-to-Face Learning | |
| Lecture | 42 |
| Practical / Tutorial / Studio | - |
| Student-Centred Learning | - |
| Self-Directed Learning | |
| Non-face-to-face learning | 42 |
| Revision | 21 |
| Assessment Preparations | 21 |
| Formal Assessment | |
| Continuous Assessment | 2 |
| Final Examination | 3 |
| Total | 131 |

## TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

## COURSE SCHEDULE

| Week | Lecture | Topics | Assessment Methods |
|---|---|---|---|
| **1** | Lec 1<br>Lec 2<br>Lec 3 | Programming Concepts, Program Development Stages, Structured Programming Language | **Class Test – 1** |
| **2** | Lec 4<br>Lec 5<br>Lec 6 | Number System: binary, octal, decimal and hexadecimal systems; Data types and their memory allocation | |
| **3** | Lec 7<br>Lec 8<br>Lec 9 | Operators, expressions, Basic Input/output; Control Structure: "if else", "switch", Flow Charts | |
| **4** | Lec 10<br>Lec 11<br>Lec 12 | Control Structures: Loop | **Class Test – 2** |
| **5** | Lec 13<br>Lec 14<br>Lec 15 | Control Structures: Nested Loop | |
| **6** | Lec 16<br>Lec 17<br>Lec 18 | Arrays, Multidimensional Arrays | |
| **7** | Lec 19<br>Lec 20<br>Lec 21 | String | |
| **8** | Lec 22<br>Lec 23<br>Lec 24 | Function, parameter passing convention | **Mid Term** |
| **9** | Lec 25<br>Lec 26 | Pointer | |

| | | | |
|---|---|---|---|
| | Lec 27 | | |
| **10** | Lec 31<br>Lec 32<br>Lec 33 | Dynamic Memory Allocation | |
| **11** | Lec 28<br>Lec 29<br>Lec 30 | User defined data types: structures, unions, enumerations. File I/O; Header files, Preprocessor | **Class Test – 3** |
| **12** | Lec 34<br>Lec 35<br>Lec 36 | Error Handling; Bitwise Operations | |
| **13** | Lec 37<br>Lec 38<br>Lec 39 | Introduction to C++: Basic Ideas of OOP-encapsulation, inheritance and polymorphism | |
| **14** | Lec 40<br>Lec 41<br>Lec 42 | Introduction to C++: Classes and objects | |

**ASSESSMENT STRATEGY**

| Components | | Grading | CO | Blooms Taxonomy |
|---|---|---|---|---|
| Continuous Assessment (40%) | Test 1-3 | 20% | CO1 | C1-C3 |
| | | | CO2 | C4 |
| | Class Participation | 5% | CO4 | A2 |
| | Mid term | 15% | CO2 | C4 |
| Final Exam | | 60% | CO2 | C4 |
| | | | CO3 | C6 |
| Total Marks | | 100% | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**REFERENCE BOOKS**

**1. Teach Yourself C - Herbert Schildlt**
**2. Programming in Ansi C - E Balagurusamy**
**3. C: The Complete Reference - Herbert Schildt**

**4. C Programming Language – Dennis M. Ritche**

| | | | |
|---|---|---|---|
| **COURSE INFORMATION** | | | |
| Course Code<br><br>Course Title | : CSE 282<br><br>: Computer Programming Sessional | Lecture Contact urs<br><br>Credit Hours | : 3.00<br><br>: 1.50 |
| **PRE-REQUISITE** | | | |
| Course Code: Nil<br><br>Course Title: Nil | | | |
| **CURRICULUM STRUCTURE** | | | |
| Outcome Based Education (OBE) | | | |
| **RATIONALE** | | | |
| The Computer programming Technique Sessional course is designed to practically introduce the fundamental principles, mechanism of programming skills and develop basic programming skills to program design and development. The course begins with introductory concepts of structured programming language and then covers other important topics related to structured programming language. It also deals with basic data structures like stack and queue. | | | |
| **OBJECTIVE** | | | |
| 1. To learn basic idea of programming languages.<br>2. To learn how to program with C, C++.<br>3. To learn how to think about the problems, their solutions and translating it to programming language. | | | |
| **LEARNING OUTCOMES& GENERIC SKILLS** | | | |

| No. | Course Learning Outcome<br>(Upon completion of the course, the students will be able to) | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO 1 | Discuss algorithm and solve problems using computers. | C1-C3 | 1 | 3 | 5 | F, T, ASG |
| CO 2 | Practically analyze the fundamental principles, typical characteristics and mechanisms of a computer programming technique. | C4 | 3 | | 7 | F, T, ASG, Q |
| CO 3 | Apply practical knowledge to develop basic programming skills with respect to program design and development. | C3, C6 | 1,3 | 3 | 7 | ASG |

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile,T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam, MT- Mid Term Exam)

**COURSE CONTENT**

**Basic programming Structures:** Mathematical problems using printf, scanf, Data types and their memory allocation, Operators, Expressions, Basic Input/output, Data type conversion; **Control Structure:** Practice problems on "if else", "switch", Flow Charts, Loop, Nested Loop; **Arrays:** Practice problems on One-dimensional array, Multi-dimensional array, Character array/ string; **Function:** Practice problems on Function, Parameter Passing Convention; **Pointer:** Practice problems on Different types of pointers, Pass pointer as arguments, Call by value vs call by reference; **Dynamic Memory Allocation:** Dynamically allocate memory using Malloc, Calloc, Free, Realloc; **User defined data types:** Practice problems on Structures, Unions, Enumerations; File I/O; Header files, Preprocessor; Error Handling; **Introduction to C++:** classes and objects

## SKILL MAPPING

| No. | Course Learning Outcome | PROGRAM OUTCOMES (PO) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| CO1 | Discuss algorithm and solve problems using computers. | | | | | | | | | H | | | |
| CO2 | Practically analyze the fundamental principles, typical characteristics and mechanisms of a structured programming technique. | | | | | | H | | | | | | |
| CO3 | Apply practical knowledge to develop basic programming skills with respect to program design and development. | | | | | | H | | | | | | |

(H – High, M- Medium, L-low)

## JUSTIFICATION FOR CO-PO MAPPING

| Mapping | Level | Justifications |
|---|---|---|
| CO1 – PO9 | High | In order to function effectively as a member or leader of a team, one need to discuss algorithm with team members in order to solve problems using computers. |
| CO2 – PO6 | High | In order to apply reasoning and take responsibilities relevant to the professional engineering practice, one need to analyse the fundamental |

| | | |
|---|---|---|
| | | principles, typical characteristics and mechanisms of a structured programming language. |
| CO3 – PO6 | High | In order to apply reasoning and take responsibilities relevant to the professional engineering practice, Apply practical knowledge to develop basic programming skills with respect to program design and development |

| **TEACHING LEARNING STRATEGY** | |
|---|---|
| Teaching and Learning Activities | Engagement (hours) |
| Face-to-Face Learning | |
| Lecture | - |
| Practical / Tutorial / Studio | 42 |
| Student-Centred Learning | - |
| Self-Directed Learning | |
| Non-face-to-face learning | - |
| Revision | – |
| Assessment Preparations | – |
| Formal Assessment | |
| Continuous Assessment | 4 |
| Final Examination | 3 |
| Total | 49 |

| **TEACHING METHODOLOGY** |
|---|
| Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method |

**COURSE SCHEDULE**

| Week | Lab | Topics | Remarks |
|---|---|---|---|
| **1** | Lab 1 | Mathematical problems using printf, scanf | |
| **2** | Lab 1 | Introduction to data types, mathematical problems using data types, data type conversion | Evaluation |
| **3** | Lab 1 | Control Structure: “if else”, “else if”, “switch” | Evaluation |
| **4** | Lab 1 | Control Structure: Nested “if else” | Evaluation |
| **5** | Lab 1 | Control Structure: Problem on Loop- For, Do While, Nested Loop | Evaluation |
| **6** | Lab 1 | Problem on Nested Loop, Array, | Evaluation |
| **7** | Lab 7 | Problem on Multidimensional Array | Online -1 |
| **8** | Lab 1 | Problem on Nested Loop, String | Evaluation |
| **9** | Lab 1 | Problem on Function, Parameter Passing Convention | Evaluation |

| | | | |
|---|---|---|---|
| **10** | Lab 1 | Problem on Pointer, Dynamic Memory Allocation | Evaluation |
| **11** | Lab 1 | Problem on User Defined Data Types: Structure, Union | Evaluation |
| **12** | Lab 1 | File I/O; | Evaluation |
| **13** | Lab 1 | Error Handling | Evaluation |
| **14** | Lab 1 | Problems on C++: Objects and Classes | Online -2, Viva/ Quiz |

**ASSESSMENT STRATEGY**

| Components | | Grading | CO | Blooms Taxonomy |
|---|---|---|---|---|
| Continuous Assessment (40%) | Lab Test | 20% | CO1 | C1-C3 |
| | | | CO2 | C4 |
| | Class Participation | 5% | CO1 | C1-C3 |
| | Assignment | 15% | CO3 | C3, C6 |
| Online Test – 1 | | 20% | CO1 | C1-C3 |
| | | | CO2 | C4 |
| Online Test – 2 | | 20% | CO1 | C1-C3 |
| | | | CO2 | C4 |

| | | | |
|---|---|---|---|
| Viva/ Quiz | 20% | CO2 | C4 |
| Total Marks | 100% | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

| REFERENCE BOOKS |
|---|
| **1. Teach Yourself C - Herbert Schidlt**<br>**2. Programming in Ansi C - E Balagurusamy**<br>**3. C: The Complete Reference - Herbert Schildt**<br>**4. C Programming Language – Dennis M. Ritche** |

## 7.2 Detailed Curriculum of ME Courses

| **COURSE INFORMATION** | | | |
|---|---|---|---|
| Course Code | : SHOP 172 | Lecture Contact Hours | : 2.00 |
| Course Title | : Machine Shop Practice | Credit Hours | : 1.00 |
| **PRE-REQUISITE** | | | |
| None | | | |
| **CURRICULUM STRUCTURE** | | | |
| Outcome Based Education (OBE) | | | |
| **SYNOPSIS/RATIONALE** | | | |
| To help the students to explore various welding techniques and put theory in practice. Our mission is to expose students to the constructions of different machines. This course is targeted to verify the working principle of types of welding, casting, molding and also to gain knowledge of different | | | |

manufacturing parts from lathe, drilling, milling and drilling machine etc. and relate them with their theoretical knowledge.

## OBJECTIVE

1. The student will be able to use different manufacturing (machining, welding, foundry, sheet metal working, etc.) processes required to manufacture a product from the raw materials.

2. He will be able to use different measuring, marking, cutting tools used in workshop.

3. He will be aware of the safety precautions while working in workshop.

## LEARNING OUTCOMES & GENERIC SKILLS

| No. | Course Outcome | Corresponding PO | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|---|
| CO1 | Be able to **identify** the basics of tools and equipment used in machining, welding, casting and molding | 1 | C3 | | | 1 | R, Q, LT |
| CO2 | Be able to **compare** between different types of welding and machining processes and **select** proper cutting tool for specific machining processes. | 2,3 | C1, C3 | | | 1 | R, Q, LT |
| CO3 | **Find** out about the importance of general safety precautions on different shop floors | 1 | C4 | | | 1 | R, Q, LT |
| CO4 | **Develop** practical skills by performing the experiments in different shops of workshop | 5 | C3 | | | 6 | R, Q, LT |

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, LT – Lab Test, PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

**COURSE CONTENT**

**Experiments:**

**1)** Design and making of pattern for casting

**2)** Mold making, casting and assembly of final project

**3)** Study of electric arc welding

**4)** Study of Resistance Welding/Spot Welding

**5)** Study of Welding joints and welding positions

**6)** Study of Gas Welding/cutting

**7)** Study of TIG and MIG Welding

**8)** Manufacturing of machine component by using Lathe machine

**9)** Manufacturing of machine component by using Shaper machine

**10)** Manufacturing of a machine component by using Milling Machine

**11)** Manufacturing of a machine component by using Drilling Machine

**CO-PO MAPPING**

| No. | Course Learning Outcome | PROGRAM OUTCOMES (PO) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| CO1 | Be able to **identify** the basics of tools and equipment used in machining, welding, casting and molding | 3 | | | | | | | | | | | |
| CO2 | Be able to **compare** between different types of welding and machining processes and **select** proper cutting tool for specific machining processes. | | 3 | 2 | | | | | | | | | |
| CO3 | **Find** out about the importance of general safety precautions on different shop floors | 3 | | | | | | | | | | | |
| CO4 | **Develop** practical skills by performing the experiments in different shops of workshop | | | | | 3 | | | | | | | |

| Justification for CO-PO mapping: | | |
|---|---|---|
| **Mapping** | **Corresponding Level of matching** | **Justifications** |
| CO1-PO1 | **3** | In order to identify the basics of tools and equipment, the knowledge of engineering fundamental would be required. |
| CO2-PO2 | **3** | In order to perform the experiments, the knowledge of engineering fundamentals would be required |
| CO2-PO3 | **2** | In order to perform the experiments, the knowledge of engineering fundamentals is also required. |

| | | |
|---|---|---|
| CO3-PO1 | **3** | For performing the experiments, safety precautions are very essential in this laboratory. |
| CO4-PO5 | **3** | Students will acquire knowledge on how to select and apply appropriate techniques, resources, and modern engineering tools. |
| | | |

| **TEACHING LEARNING STRATEGY** | |
|---|---|
| Teaching and Learning Activities | Engagement (hours) |
| Face-to-Face Learning | |
| Lecture | 14 |
| Practical | 28 |
| | Total 42 |
| Self-Directed Learning | |
| Preparation of Lab Reports | 10 |
| Preparation of Lab Test | 10 |
| Preparation of presentation | 5 |
| Preparation of Quiz | 10 |
| Engagement in Group Projects | 20 |
| Formal Assessment | |
| Continuous Assessment | 14 |
| Final Quiz | 1 |
| Total | 112 |
| | |
| **TEACHING METHODOLOGY** | |
| Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method | |

| COURSE SCHEDULE | |
|---|---|
| Week-1 | Expt-01: Design and making of pattern for casting |
| Week-2 | Expt-02: Mold making, casting and assembly of final project |
| Week-3 | Expt-03: Study of electric arc welding |
| Week-4 | Expt-04: Study of Resistance Welding/Spot Welding |
| Week-5 | Expt-05: Study of Welding joints and welding positions |
| Week-6 | Expt-06: Study of Gas Welding/cutting |
| Week-7 | Expt-07: Study of TIG and MIG Welding |
| Week-8 | Expt-08: Manufacturing of machine component by using Lathe machine |
| Week-9 | Expt-09: Manufacturing of machine component by using Shaper machine |
| Week-10 | Expt-10: Manufacturing of a machine component by using Milling Machine |
| Week-11 | Expt-11: Manufacturing of a machine component by using Drilling Machine |
| Week-12 | Final Lab Report Submission |
| Week-13 | Viva |
| Week-14 | Quiz Test |
| | |

| Components | | Grading |
|---|---|---|
| Continuous Assessment | Lab participation and Report | 30% |
| | | |

| | | |
|---|---|---|
| (60%) | Labtest-1, Labtest-2 | 30% |
| | Lab Quiz | 40% |
| | Total Marks | 100% |

| REFERENCE BOOKS |
|---|
| 1. Machine Shop Practice – James Anderson, W. A. Chapman.<br>2. Callister W. D., Material Science & Engineering, John Wiley & Sons. |

| COURSE INFORMATION | | | |
|---|---|---|---|
| Course Code<br>Course Title | ME 160<br>Engineering Drawing | Contact Hours<br>Credit Hours | 3.00<br>1.50 |
| **PRE-REQUISITE** | | | |
| None | | | |
| **CURRICULUM STRUCTURE** | | | |
| Outcome Based Education (OBE) | | | |
| **SYNOPSIS/RATIONALE** | | | |
| The rationale for this course is to motivate students by fostering creativity and introducing conceptual design, sustainable design in engineering, industrial design, computer aided design and drafting early in the course. Early training and practice in the engineering design method, the introduction to engineering handbooks. Engineers need skills in graphical communication and spatial vision in the practice of their profession. | | | |
| **OBJECTIVE** | | | |
| 1. To enable students to acquire and use engineering drawing skills as a means of accurately and clearly communicating ideas, information and instructions.<br>2. To enable students to acquire requisite knowledge, techniques and attitude required for advanced study of engineering drawing. | | | |
| **LEARNING OUTCOMES & GENERIC SKILLS** | | | |

| No. | Course Outcome | Corresponding PO | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|---|
| CO1 | Demonstrate proficiency in using drawing instruments for sketches. | 5 | P3 | | | 5 | T, ASG, Q |
| CO2 | Analyze the 2D and 3D views for various sample objects individually and/or in a team. | 9 | P5 | | | 5 | T, ASG, Q |
| CO3 | Justify sketches obtained in the form of drawing reports, and projects. | 10 | C4 | | | 5 | T, ASG, Q |

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

**COURSE CONTENT**

Introduction, Instrument and their uses. (1)

Dimensioning and Title box. (1)

First and third angle projections. (1)

Orthographic drawings (2)

Sectional views and conventional practices. (2)

Auxiliary views. (1)

Isometric views (3)

Reading Mechanical Design of HVAC System. (1)

**CO-PO MAPPING**

| No. | Course Learning Outcome | PROGRAM OUTCOMES (PO) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| CO1 | Demonstrate proficiency in using drawing instruments for sketches. | | | | | √ | | | | | | | |
| CO2 | Analyze the 2D and 3D views for various sample objects individually and/or in a team. | | | | | | | | | √ | | | |
| CO3 | Justify sketches obtained in the form of drawing reports, and projects. | | | | | | | | | | √ | | |

| Justification for CO-PO mapping: | | |
|---|---|---|
| **Mapping** | **Corresponding Level of matching** | **Justificatios** |
| CO1PO3 | **3** | To operate AutoCad and make use of it, knowledge regarding modern engineering and IT tools will be required. |
| CO2PO9 | **3** | Student must analyze the 2D and 3D views for various sample objects individually and/or in a team. |
| CO3PO10 | **3** | To communicate with other engineering professionals and manufacturers of mechanical systems, the skill to read manufacturing and construction drawings is a must. |

| TEACHING LEARNING STRATEGY | |
|---|---|
| Teaching and Learning Activities | Engagement (hours) |
| Face-to-Face Learning<br>Lecture<br>Practical | <br>14<br>28<br>Total 42 |
| Self-Directed Learning<br>Preparation of Assignments<br>Preparation of Mid Quiz<br>Preparation of presentation<br>Preparation of Quiz<br>Engagement in Group Projects | <br>10<br>10<br>5<br>10<br>20 |
| Formal Assessment<br>Continuous Assessment<br>Final Quiz | <br>14<br>1 |
| Total | 112 |

**TEACHING METHODOLOGY**

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method,

| COURSE SCHEDULE | |
|---|---|
| Week-1 | Introduction; Instruments and their uses; First and third angle projections; |
| Week-2 | Orthographic drawings; |
| Week-3 | Orthographic drawings; |
| Week-4 | sectional views and conventional practices; |
| Week-5 | sectional views and conventional practices; |

| | |
|---|---|
| Week-6 | Auxiliary views |
| Week-7 | Isometric views |
| Week-8 | Isometric views |
| Week-9 | Reading Civil Drawing for Mechanical Design of HVAC System. |
| Week-10 | Importance to design and drafting, setting up a drawing: starting SolidWorks, menu, planning for a drawing |
| Week-11 | Basic commands, making a simple 2-D drawing. |
| Week-12 | Layers, object snap, poly lines and other features. |
| Week-13 | File handling and display control, editing and dimensioning. |
| Week-14 | Viva and Quiz Test |

## ASSESSMENT STRATEGY

| Assessment Method | | Grading |
|---|---|---|
| Continuous Assessment (60%) | Class Performance | 20% |
| | Attendance | 10% |
| | Assignment | 10% |
| Final Lab Quiz | | 50% |
| Viva | | 10% |
| Total Marks | | 100% |

## REFERENCE BOOKS

1.Metric Drafting –Paul Wallah, Publisher –GlenceoPublishing Co, Inc; 1979.

2. Drafting Technology and Practice –William P. Spence, Publisher –Chas A. Bennett Co, Inc, 1973.

3.Technical Drawing –Frederick E Giesecke, Alva Mitchell, Henry C. Spencer

4.Mechanical Engineering Drawing-AC Mandal& M.Q. Islam

## 7.3 Detailed Curricula of EECE Courses

| COURSE INFORMATION | | | |
|---|---|---|---|
| Course Code<br>Course Title | : EECE 171<br>: Basic Electrical and Electronic Circuit | Lecture Contact Hours<br>Credit Hours | : 3.00<br>: 3.00 |
| **PRE-REQUISITE** | | | |
| None | | | |
| **CURRICULUM STRUCTURE** | | | |
| Outcome Based Education (OBE) | | | |
| **SYNOPSIS/RATIONALE** | | | |
| The foundational course on electrical circuits is a basis of making freshmen engineering students well familiarize about the arena of DC and AC circuits. The course is aimed towards the methods of electric circuit analysis and evaluating their responses which can be very well achieved by the understanding of circuit laws, techniques and theorems for both AC and DC excitations. Investigation of first and second order DC circuits is vital in understanding circuit elements like capacitors and inductors used in daily life. A hands-on flavour of the course is the assessment of poly phase circuits which addresses the issue of faults and usable power in the transmission lines. Finally, this course is also aimed to teach the students the concepts, principles and working of basic electronic circuits (Diodes, BJTs) | | | |
| **OBJECTIVE** | | | |

1. **Create** a foundation of basic electrical engineering and circuits.
2. **Familiarize** students with basic Circuit laws (Ohm, Kirchhoff), techniques (Mesh, Nodal), concepts (Superposition, Source Transformation) and theorems (Thevenin, Norton).
3. **Develop** the understanding of AC steady state response of single-phase circuits and power in AC circuits.
4. **Introduce** students to poly-phase circuits as a practical arena of AC Circuits.
5. **Achieve** ability to familiarize the students with the working principle of semiconductor devices (Diodes, BJTs) as electronic circuit elements.

**COURSE OUTCOMES & GENERIC SKILLS**

| No. | Course Outcomes | Corresponding PO | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|---|
| CO1 | Capable to **interpret** circuit laws, **justify** particular circuit concept(s) and theorem(s), and **apply** their corresponding technique to find circuit quantities and simplifying complex circuits. | PO1 | C5 | 1,2,3 | - | 1-4 | T, MT, F |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CO2 | Manage to outline sinusoids, and able to understand the current voltage relation of 3 phase circuits for explaining circuit parameters, analyzing real life power consumptions of transmission lines using AC power knowledge. | PO2 | C4 | 1,2, 5 | - | 1-4 | F, ASG, MT |
| CO3 | Be skilful to explain the operating principle of some fundamental electronic devices (Diodes, BJTs). | PO1 | C2 | 1,2,3 | - | 1-4 | F, ASG, Pr |

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

**COURSE CONTENT**

Direct current circuits: laws and theorems, DC network analysis, alternating current: AC quantities and sinusoidal waveforms, phasors, AC circuit analysis: series and parallel branches-RL, RC, and RLC balanced three-phase circuits. Semiconductor diode: operation, characteristics and applications, introduction to bipolar junction transistors (BJTs), characteristic, common-emitter (CE), common-base (CB), common-collector (CC), and amplifier configurations.

**CO-PO MAPPING**

| No. | Course Outcome | PROGRAM OUTCOMES (PO) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| CO1 | Capable to **interpret** circuit laws, **justify** particular circuit concept(s) and theorem(s), and **apply** their corresponding technique to find circuit quantities and simplifying complex circuits. | 3 | | | | | | | | | | | |
| CO2 | Manage to **outline** sinusoids, and able to **understand** the current voltage relation of 3 phase circuits for **explaining** circuit parameters, **analyzing** real life power consumptions of transmission lines using AC power knowledge. | | 3 | | | | | | | | | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO3 | Be skilful to **explain** the operating principle of some fundamental electronic devices (Diodes, BJTs). | 3 | | | | | | | | | | | | |

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

| **TEACHING LEARNING STRATEGY** | |
|---|---|
| Teaching and Learning Activities | Engagement (hours) |
| Face-to-Face Learning | 42 |
| Self-Directed Learning | 84 |
| Formal Assessment | 05 |
| Total | 131 |

**TEACHING METHODOLOGY**

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

**COURSE SCHEDULE**

| | |
|---|---|
| **Week 1** | |
| Class 1 | Introduction to basic electrical circuit |
| Class 2 | Basic laws and theorems of circuit. |
| Class 3 | Ohm’s law, Resistor, Conductor, Insulator, Semi-conductor, Branch, Node, Loop, Mesh |
| **Week 2** | |
| Class 4 | Series-parallel connection |
| Class 5 | KCL, KVL, Analysis of equivalent resistance of electrical circuit |
| Class 6 | Analysis of voltage, current and power |
| **Week 3** | |
| Class 7 | Analysis of current in different branches |
| Class 8 | Analysis of voltage in different parts of circuit |
| Class 9 | Practice mathematical problems related to current divider and voltage divider rule. |
| **Week 4** | |
| Class 10 | Introduction: Concept of phasor and complex impedance / admittance (Lec-01) |
| Class 11 | Introduction: Concept of phasor and complex impedance / admittance (Lec-02) |
| Class 12 | Theory of Active power, reactive power, apparent power (volt ampere) |
| **Week 5** | |
| Class 13 | Mathematical Problems of Active power, reactive power, apparent power (volt ampere) |
| Class 14 | Power factor and energy associated with these circuits |
| Class 15 | Concept of complex power, Phasor diagram |

| | |
|---|---|
| **Week 6** | |
| Class 16 | Impedance triangle and power triangle associated with complex circuits. |
| Class 17 | Resonance in series and parallel circuits |
| Class 18 | Q factor, half-power frequencies and bandwidth of resonant circuits. |
| **Week 7** | CT 3 |
| Class 19 | Transient response of RL,RC and RLC series and parallel circuits free response – step and sinusoidal responses |
| Class 20 | Frequency: Damped Frequency |
| Class 21 | Damping Factor and Logarithmic Decrement |
| **Week 8** | |
| Class 22 | Response of circuits for non-sinusoidal periodic inputs |
| Class 23 | Passive Filters |
| Class 24 | Magnetically Couples Circuits |
| **Week 9** | |
| Class 25 | Analysis of three phase circuits: Three phase supply |
| Class 26 | Balanced and Unbalanced circuits, Power calculation (Lec-01) |
| Class 27 | Balanced and Unbalanced circuits, Power calculation (Lec-02) |
| **Week 10** | CT 4 |
| Class 28 | Basics of semiconductor. |
| Class 29 | p-n junction, forward bias and reverse bias concept. |
| Class 30 | Basic structure of open-circuited p-n junction. |
| **Week 11** | |
| Class 31 | The current components of p-n diode. |
| Class 32 | Volt ampere characteristics of p-n junction. |
| Class 33 | Diode resistance. |
| **Week 12** | |
| Class 34 | p-n junction diode switching times. |
| Class 35 | Breakdown voltage and characteristics of diode. |
| Class 36 | Introduction to junction transistor. |
| **Week 13** | |
| Class 37 | Basics of BJT |
| Class 38 | Transistor characteristics components. |
| Class 39 | Detailed study of the currents in the transistor. |
| **Week 14** | |
| Class 40 | Common emitter, common-base and common-collector configuration of BJT |
| Class 41 | Amplifier configuration of BJT. |
| Class 42 | Cut-off and saturation region in different configuration in BJT. |

**ASSESSMENT STRATEGY**

<table>
<tr><th colspan="2">Components</th><th>Grading</th><th>CO</th><th>Bloom’s Taxonomy</th></tr>
<tr><td rowspan="7">Continuous Assessment (40%)</td><td rowspan="2">Test 1-3</td><td rowspan="2">20%</td><td>CO1</td><td>C5</td></tr>
<tr><td>CO2</td><td>C4</td></tr>
<tr><td>Class Participation</td><td>5%</td><td>CO3</td><td>C2</td></tr>
<tr><td>Class Attendance</td><td>5%</td><td></td><td></td></tr>
<tr><td rowspan="3">Mid term</td><td rowspan="3">15%</td><td>CO1</td><td>C5</td></tr>
<tr><td>CO2</td><td>C4</td></tr>
<tr><td>CO3</td><td>C2</td></tr>
<tr><td colspan="2" rowspan="3">Final Exam</td><td rowspan="3">60%</td><td>CO1</td><td>C5</td></tr>
<tr><td>CO2</td><td>C4</td></tr>
<tr><td>CO3</td><td>C2</td></tr>
<tr><td colspan="2">Total Marks</td><td>100%</td><td colspan="2"></td></tr>
<tr><td colspan="5">(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)</td></tr>
</table>

**TEXT AND REFERENCE BOOKS**

1. Fundamentals of Electric Circuit by C. K. Alexander & M. N. Sadiku
2. Introductory Circuit Analysis by R. L. Boylsted
3. Alternating Current Circuits by G. S. Corcoran & R. F. Kerchner
4. Electric Circuits by J. A. Edminister
5. Basic Engineering Circuit Analysis by J. D. Irwin & R. M. Nelms
6. Electric Circuits by James William Nilsson
7. Microelectronic circuit by Sedra Smith

| COURSE INFORMATION | | | |
|---|---|---|---|
| Course Code<br>Course Title | : EECE 172<br>: Basic Electrical and Electronic Circuits Sessional | Lecture Contact Hours<br>Credit Hours | : 1.50<br>: 0.75 |

| PRE-REQUISITE |
|---|
| None |

| CURRICULUM STRUCTURE |
|---|
| Outcome Based Education (OBE) |

| SYNOPSIS/RATIONALE |
|---|
| This course of electrical engineering discipline aims to familiarize the students with implementation of basic electrical circuits in hardware domain. Designed for fresher students, experiments of this laboratory course will enable them to assemble beginner-level circuits to experimentally verify some fundamental circuit laws and theorems (KVL, KCL, Thevenin, Norton). This course also familiarizes the students with hardware implementation of AC circuits and measurement of ac quantities by oscilloscope. This sessional course is designed to teach the students about the concepts, principles and working of basic electronic devices and circuits by hand-held experiments. |

| OBJECTIVE |
|---|
| 1. To enable the students to apply the fundamental circuit laws (KVL, KCL, Ohm's law) in hardware domain.<br>2. To develop students' skills to simplify complex electrical circuits into simpler circuits by Thevenin and Norton's theorem and verify them in hardware.<br>3. To teach the students the basic operation of oscilloscope to measure AC quantities (magnitude and phase).<br>4. To impart the students the skills of analogue filter design by RLC circuit.<br>5. To familiarize the students with input and output characteristics of different BJTs, FETs and also the operation of each device in terms of junction bias voltage and charge carrier movement. |

**COURSE OUTCOMES & GENERIC SKILLS**

| No. | Course Outcomes | Corresponding PO | Bloom's Taxonomy | KP | CP | CA | Assessment Methods |
|---|---|---|---|---|---|---|---|
| CO1 | **Assemble** electrical circuits that can **verify** fundamental electrical laws such as KVL, KCL, Ohm's Law, Thevenin's and Norton's theorem. | PO5 | P5, A3 | 6 | 1,2,5 | | R, Q, T |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CO2 | Achieve ability to **produce** desired ac waves and **measure** amplitude and phase of ac waves in oscilloscope. | PO4 | P4 | 8 | 1,2,3 | | R, Q, T |
| CO3 | Be adept to **design** project using analogue RLC filter that can produce desired frequency response. | PO9 | P6 | | | | R, PR |

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

## COURSE CONTENT

In this course students will get a hands on experience about electrical and electronic circuits. They will observe the uses of electrical circuits practically and can use this knowledge gained in EECE 171 course for future project works.

## CO-PO MAPPING

| No. | Course Outcome | PROGRAM OUTCOMES (PO) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| CO1 | **Assemble** electrical circuits that can **verify** fundamental electrical laws such as KVL, KCL, Ohm's Law, Thevenin's and Norton's theorem. | | | | | 3 | | | | | | | |
| CO2 | Achieve ability to **produce** desired ac waves and **measure** amplitude and phase of ac waves in oscilloscope. | | | | 3 | | | | | | | | |
| CO3 | Be adept to **design** project using analogue RLC filter that can produce desired frequency response. | | | | | | | | | 3 | | | |

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching

## TEACHING LEARNING STRATEGY

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Face-to-Face Learning | |
| Lecture | 14 |
| Practical / Tutorial / Studio | 28 |
| Student-Centred Learning | 42 |

| | |
|---|---|
| Self-Directed Learning | |
| Preparation of Lab Reports | 10 |
| Preparation of Lab Test | 10 |
| Preparation of presentation | 5 |
| Preparation of Quiz | 10 |
| Engagement in Group Projects | 20 |
| Formal Assessment | |
| Continuous Assessment | 14 |
| Final Examination | 1 |
| Total | 112 |

**TEACHING METHODOLOGY**

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method.

**COURSE SCHEDULE**

| Week | Topic |
|---|---|
| 1 | Construction and operation of simple electrical circuits |
| 3 | Verification of KVL, Verification of KCL |
| 5 | Verification of Superposition Theorem, Verification of Thevenin's theorem |
| 7 | Verification of Norton's theorem, Familiarization with alternating current (ac) waves |
| 9 | Lab Test-01 |
| 11 | Study of R-L-C series circuit, Different types of filters and its characteristics with different input frequency |
| 13 | Practice Lab, Lab Test-02 |
| 14 | Quiz test, Viva |

**ASSESSMENT STRATEGY**

| Components | | Grading | CO | Bloom's Taxonomy |
|---|---|---|---|---|
| | | 20% | CO1 | P5, A3 |
| | | | CO2 | P4 |
| Continuous Assessment (75%) | Lab participation and Report | | CO3 | P6 |
| | Labtest-1 ,Labtest-2 | 30% | CO1 | P5, A3 |
| | | | CO2 | P4 |
| | | | CO3 | P6 |

| | | | |
|---|---|---|---|
| Lab Quiz | 25% | CO1 | P5, A3 |
| | | CO2 | P4 |
| Total Marks | 100% | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**TEXT AND REFERENCE BOOKS**

1. Introductory Circuit Analysis - R.L. Boylestad; Prentice Hall of India Private Ltd.
2. Introductory Circuits for Electrical & Computer Engineering - James. W. Nilson; Prentice Hall of India Private Ltd.
3. Basic Electrical Engineering – Fitzgerald; McGraw-Hill International.
4. Electricity and Magnetism - Mary Atwater; McGraw-Hill.
5. Introduction to Electrical Engineering – Robert P. Ward; Prentice Hall of India Private Ltd.
6. Introduction to Electric Circuits – Richard C. Dorf& James A. Svoboda; John Wiley & Sons Inc.

**COURSE INFORMATION**

| | | | |
|---|---|---|---|
| Course Code | : EECE 271 | Lecture Contact Hours | : 3.00 |
| Course Title | : Electrical Machines and Electronics | Credit Hours | : 3.00 |

**PRE-REQUISITE**

**CURRICULUM STRUCTURE**

Outcome Based Education (OBE)

**SYNOPSIS/RATIONALE**

To develop a strong foundation in the basic operating principle, constructions, characteristic features, applications etc. of AC and DC electrical machinery like DC generator, DC motor, synchronous generator, synchronous motor and three induction motors. The emphasis has been given on both physical insight and analytical techniques. The subject material covered here will provide the basis for understanding many real-world electric machinery applications as well as the foundation for advanced courses in electric machinery design and control. It is targeted to provide a basic foundation for technology areas like electronics devices (operational amplifiers and silicon-controlled rectifiers) as well as instrumentation, control systems and various electronic circuit design.

**OBJECTIVE**

1. To develop a strong foundation on DC and AC electrical machines (DC motor, DC generator, synchronous machines, induction machines etc) with a special focus on operating principle, identification of parts and accessories, constructional features, types etc
2. To familiarize with advanced electronic circuits (operational amplifier and silicon-controlled rectifiers), their working principles, design criteria and applications.
3. To impart basic knowledge on the basic knowledge of different types of transducers with a view to know the fundamentals of instrument and control systems.
4. To develop a broad idea on application of electronics and electrical machines in practical industrial and domestic field.

| COURSE OUTCOMES & GENERIC SKILLS | | | | | | | |
|---|---|---|---|---|---|---|---|
| No. | Course Outcomes | Corresponding PO | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
| CO1 | **Explain** the fundamental operation, basic construction and classification of different DC and AC machines. | PO1 | C2 | 1, 2, 3 | | 1-4 | T, F |
| CO2 | **Interpret** and **analyze** the performance characteristics of different electrical machines e.g. transformers, DC and AC machines. | PO2 | C4 | 1, 2, 5 | | 1-4 | T, F |
| CO3 | **Analyze** electronic circuits consists of op-amps and SCRs and **know** the fundamentals of transducers and its application in instrument and control systems. | PO1 | C4 | 1, 2, 3 | | 1-4 | MT, F |

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

**COURSE CONTENT**

**Single phase transformer**
**DC Generator:** Principles and applications
**DC motor:** principle and applications,
**Three phase induction motor:** principle and applications.
**Alternator:** Principles and operation, introduction to synchronous motors.
**Introduction to operational amplifiers (OP-AMPs)** and applications,
**Silicon controlled rectifiers (SCR):** operation and characteristics, power control using SCR
**Transducers:** strain, temperature, pressure, speed and torque measurements.

**CO-PO MAPPING**

| No. | Course Outcome | PROGRAM OUTCOMES (PO) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| CO1 | **Explain** the fundamental operation, basic construction and classification of different DC and AC machines. | 3 | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO2 | **Interpret** and **analyze** the performance characteristics of different electrical machines e.g. transformers, DC and AC machines. | | 3 | | | | | | | | | | |
| CO3 | **Analyze** electronic circuits consists of op-amps and SCRs and **know** the fundamentals of transducers and its application in instrument and control systems. | 3 | | | | | | | | | | | |

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

| **TEACHING LEARNING STRATEGY** | |
|---|---|
| Teaching and Learning Activities | Engagement (hours) |
| Face-to-Face Learning<br>Lecture<br>Practical / Tutorial / Studio<br>Student-Centred Learning | <br>42<br>-<br>- |
| Self-Directed Learning<br>Non-face-to-face learning<br>Revision of the previous lecture at home<br>Preparation for final examination | <br>42<br>21<br>21 |
| Formal Assessment<br>Continuous Assessment<br>Final Examination | <br>2<br>3 |
| Total | 131 |

| TEACHING METHODOLOGY |
|---|
| Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method |

**COURSE SCHEDULE**

| | | |
|---|---|---|
| Week 1 | Single Phase Transformer: Principles, types | Class Test 1, Final |
| Week 2 | Single Phase Transformer: Performances and characteristics. | |
| Week 3 | DC generators: Principles, types | |
| Week 4 | DC generators: Performances and characteristics. | Class Test 2, Final |
| Week 5 | DC Motors: Principles, types | |
| Week 6 | DC Motors: Performances and characteristics | |
| Week 7 | Three phase induction motor: Principles and applications | |
| Week 8 | Alternator: Principles and applications | Mid Term Final |
| Week 9 | Introduction to operational amplifiers (OP-AMPs) | |
| Week 10 | Applications of operational amplifiers (OP-AMPs) | |
| Week 11 | Silicon controlled rectifiers (SCR): operation and characteristics | Class Test 3, ASG/ Pr Final |
| Week 12 | Silicon controlled rectifiers (SCR): power control using SCR | |
| Week 13 | Transducers: strain, temperature, pressure | |
| Week 14 | Transducers: speed and torque measurements. | |

**ASSESSMENT STRATEGY**

| Components | | Grading | CO | Blooms Taxonomy |
|---|---|---|---|---|
| Continuous Assessment (40%) | Class Test/ Assignment 1-3 | 20% | CO1 | C2 |
| | | | CO2 | C4 |
| | | | CO3 | C4 |
| | Class Participation | 5% | - | - |
| | Class Attendance | 5% | - | - |
| | Mid term | 15% | CO3 | C4 |
| Final Exam | | 60% | CO1 | C2 |
| | | | CO2 | C4 |
| | | | CO3 | C4 |
| Total Marks | | 100% | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**TEXT AND REFERENCE BOOKS**

**Text Books:**

1. Electrical Machinery Fundamentals – Stephen J. Chapman
2. A textbook of Electrical Technology – B.L. Theraja and A.K. Theraja
3. Op Amps & Linear Integrated Circuits - James M. Fiore; Delmar Thomson Learing.

4. Operation Amplifiers and Linear Integrated Circuits- Robert F. Coughlin; Prentice Hall of India Private Ltd
5. Power Electronics: Device, Principles and Application –Muhammad H Rashid

| **COURSE INFORMATION** | | | |
|---|---|---|---|
| Course Code<br>Course Title | : EECE 272<br>: Electrical Machines and Electronics Sessional | Lecture Contact Hours<br>Credit Hours | : 1.50<br>: 0.75 |

**PRE-REQUISITE**

None

**CURRICULUM STRUCTURE**

Outcome Based Education (OBE)

**SYNOPSIS/RATIONALE**

To help the students to explore various DC and AC machines and put theory in practice. Our mission is to expose students to the constructions of electrical machines and analyze their performance. This course is targeted to verify the properties of generator, motor etc. and relate them with their theoretical knowledge. This course is also designed to examine some electronic devices and observe their characteristics.

**OBJECTIVE**

**1.** Be able to familiarize the students with the basic electrical machines like transformer, dc generator, dc motor, synchronous machines, induction machines etc.
**2.** Be able to calculate various parameters of machines like voltage regulation, efficiency etc., observe their behaviour under various load conditions and compare them.
**3.** To develop skills of handling basic machinery equipment by engaging students in experiences with experimental processes and by growing the capability to give connection.
**4.** Be able to impart practical knowledge on electrical machine crafting and develop collaborative learning skill.
**5.** To develop communication as well as project management skills among the students through presentation and group projects.

**COURSE OUTCOMES & GENERIC SKILLS**

| No. | Course Outcome | Corresponding PO | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|---|
| CO1 | **Identify** the characteristics of electrical machines like transformer, DC generator and motor, induction motor, alternator etc. **Compute** the voltage regulation and | PO1 | C1, C5 | 1, 2, 3 | | 1-4 | R, Q, LT |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | efficiency, **trace** various curves and **justify** characteristics of these electrical machines under various loading condition. | | | | | | |
| CO2 | **Compare** the starting and operating characteristics of various induction machines (squirrel cage induction motor, wound rotor induction motor etc.) by measuring the active power, reactive power, apparent power etc. and plotting torque-speed curve. | PO4 | C4 | 1, 2, 5 | | 8 | R, Q, LT |
| CO3 | **Identify** the characteristics of op-amps and **justify** the mathematical operations through hardware implementation. | PO5 | C1, C5 | 1, 2, 5 | | 6 | PR, Pr |
| (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam) | | | | | | | |

| COURSE CONTENT |
|---|
| In this course, students will perform experiments to practically verify the theories and concepts learned in EECE 271 using different hardware equipment and simulation software. |

**CO-PO MAPPING**

| No. | Course Learning Outcome | PROGRAM OUTCOMES (PO) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| CO1 | **Identify** the characteristics of electrical machines like transformer, DC generator and motor, induction motor, alternator etc. **Compute** the voltage regulation and efficiency, **trace** various curves and **justify** characteristics of these electrical machines under various loading condition. | 3 | | | | | | | | | | | |
| CO2 | **Compare** the starting and operating characteristics of various induction machines (squirrel cage induction motor, wound rotor induction motor etc.) by measuring the active power, reactive power, apparent power etc. and plotting torque-speed curve. | | | | 3 | | | | | | | | |
| CO3 | **Identify** the characteristics of op-amps and **justify** the mathematical operations through hardware implementation. | | | | | 3 | | | | | | | |

**TEACHING LEARNING STRATEGY**

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Face-to-Face Learning | |
| Lecture | 14 |
| Practical | 28 |
| | Total 42 |
| Self-Directed Learning | |
| Preparation of Lab Reports | 10 |
| Preparation of Lab Test | 10 |
| Preparation of presentation | 5 |
| Preparation of Quiz | 10 |
| Engagement in Group Projects | 20 |
| Formal Assessment | |
| Continuous Assessment | 14 |
| Final Quiz | 1 |
| Total | 112 |

**TEACHING METHODOLOGY**

| |
|---|
| Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method |
| **COURSE SCHEDULE** |

| | |
|---|---|
| Week-1 | Introduction to the lab equipments and safety measures |
| Week-3 | Expt-01: Regulation of the Transformer in Various Loads.<br>Expt-02: Study the properties of DC Separately Excited Shunt Generator |
| Week-5 | Expt-03: Study the properties of DC Self-Excited Shunt Generator<br>Expt-04: Study the properties of DC Shunt Motor |
| Week-7 | Expt-05: Study the properties of Three-Phase Alternator in various loads<br>Expt-06: Study the Three-Phase Alternator synchronizing process in power utility system. |
| Week-9 | Expt-07: Study the properties of Squirrel-Cage Induction Motor |
| Week-11 | Expt-08: Mathematical operation using operational amplifier (Adder and Subtractor)<br>Expt-09: Mathematical operation using operational amplifier (Integrator a Differentiator). |
| Week-13 | Practice Lab |
| Week-14 | Lab Test + Viva, Quiz test |

**ASSESSMENT STRATEGY**

| **Components** | | **Grading** | CO | Blooms Taxonomy |
|---|---|---|---|---|
| Continuous Assessment (40%) | Lab participation and Report | 20% | CO 1 | C1, C5 |
| | | | CO 1 | C1, C5 |
| | | | CO 2 | C4 |
| | Labtest-1, Labtest-2 | 30% | CO 1 | C1, C5 |
| | | | CO 1 | C1, C5 |
| | | | CO 2 | C4 |
| | Project and Presentation | 25% | CO3 | C1, C5 |
| Lab Quiz | | 25% | CO 1 | C1, C5 |
| | | | CO 1 | C1, C5 |
| | | | CO 2 | C4 |
| Total Marks | | 100% | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**TEXT AND REFERENCE BOOKS**


1. Electrical Machinery Fundamentals – Stephen J. Chapman
2. A textbook of Electrical Technology – B.L. Theraja and A.K. Theraja
3. Op Amps & Linear Integrated Circuits - James M. Fiore; Delmar Thomson Learing.