Department of Industrial and Production Engineering

Curriculum of Undergraduate Program

Session: 2021-22

Syllabus of Graduate Program

Session: 2021-22



Shahjalal University of Science and Technology

Sylhet, Bangladesh

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**Contents**

Overview of the University and Department ……… 5

Faculty List (Current) ……… 6

wefv‡Mi mswÿß cwiwPwZ ……… 7

Ordinance for Semester System for Bachelor’s Degree ……… 8

weGbwmwm K¨v‡WU‡`i Rb¨ Hw”QK wel‡qi wm‡jevm ……… 18

Curriculum for B.Sc. in Industrial and Production

Engineering Program : PART A ………. 19

Curriculum for B.Sc. in Industrial and Production

Engineering Program : PART B ………. 21

Curriculum for B.Sc. in Industrial and Production

Engineering Program : PART C

1. Summary and Mapping PLO vs CLO of all courses ……… 28
2. Teaching strategy ……… 141
3. Assessment or Evaluation Procedure …… 143

Curriculum for B.Sc. in Industrial and Production

Engineering Program : PART D ………. 145

Non-Major Courses (Offered for other departments) ……… 147

Ordinance for the Graduate Program at SUST ……… 165

Examination Ordinance for the Graduate Program ……… 172

Graduate Program Summary ……… 175

Detailed Syllabus for Masters Program ……… 176

**OVERVIEW OF THE UNIVERSITY AND DEPARTMENT**

(At a glance)

Name of the University

**Shahjalal University of Science and Technology, Sylhet**

Establishment of the University

**25 August 1986**

Founder Vice Chancellor of the University

**Professor Dr. Sadruddin Ahmed Chawdhury**

Current Vice Chancellor of the University

**Professor Farid Uddin Ahmed**

First Academic Session of the University

**1990-1991**

Website of the University

**www.sust.edu**

E-mail of the University

[**registrar@sust.edu**](mailto:registrar@sust.edu)

Name of the Department

**Industrial and Production Engineering (IPE)**

First Academic Session of the Department

**1995-1996**

Website of the Department

**www.sust.edu/d/ipe**

E-mail of the Department

**ipe@sust.edu**

PABX Extension of the Department

**268**

Founder Head of the Department

**Professor Dr. Muhammed Zafar Iqbal**

Current Head of the Department

**Professor Dr. Mohammad Muhshin Aziz Khan**

Programs Offering

**B.Sc. (Honors), Masters (General), M.Sc. Engineering, and Ph.D**

**Faculties/Teachers**:

|  |  |
| --- | --- |
| **Professors:** | |
| Dr. Engr. Mohammad Iqbal | |
| Dr. Abul Mukid Mohammad Mukaddes | |
| Dr. Md. Ariful Islam | |
| Dr. Mohammad Muhshin Aziz Khan | |
| Dr. Muhammad Mahamood Hasan | |
| Dr. Md. Abu Hayat Mithu | |
| Dr. ABM Abdul Malek | |
| Dr. Ahmed Sayem | |
| Dr Choudhury Abul Anam Rashed | |
| Dr. Mst. Nasima Bagum | |
|  | |
| **Associate Professors:** | |
| Engr. Syed Misbah Uddin | |
| Mr. Chowdhury Md. Luthfur Rahman | |
| Mr. Muhammad Abdus Samad | |
| Mr. Md. Rezaul Hasan Shumon\* | |
|  | |
| **Assistant Professors:** | |
| Engr. Mohammed Abdul Karim | |
| Ms. Shanta Saha | |
| Ms. Syeda Kamrun Nahar | |
| Mr. Jahid Hasan | |
| Pronob Kumar Biswas | |
| Mahathir Mohammad Bappy | |
| Md. Mehedi Hasan Kibria | |
| Saiful Islam | |

\* On study leave

**wefv‡Mi mswÿß cwiwPwZ**

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**Short description of the department of IPE**

The Department of Industrial and Production Engineering (IPE) was established at Shahjalal University of Science and Technology (SUST) in 1994. It is to be mentioned that IPE Department of SUST offered the B.Sc. Engg. (IPE) program first in Bangladesh followed by IPE Dept. BUET. Along with undergraduate program IPE, SUST has been running post graduate program (MS (general), M.Sc. Engg. & Ph.D.) successfully. Currently the department is well equipped with highly qualified faculty members with exposure globally. The graduates of IPE are capable in making strategic and operational plans for manufacturing and service industries. The curricular of IPE program has been designed in such a way that the graduates build their knowledge, skill and competence to design, develop and implement any production/service system ensuring optimal utilization of different resources. In a nut shell, IPE deals with development, improvement, implementation and evaluation of integrated system of people, equipment, energy, materials and processes. Without true industrial development in various sectors, socio-economic development is not possible. IPE graduates should be the pioneers to the drive of wheels of economic development of our nation replacing dependency of foreign experts in industrial engineering and engineering management. Our graduates are doing professionally well in both home and abroad overcoming the challenges to work as policy maker, operation manager, quality expert, system engineer, engineering manager and so on.

**Ordinance for Semester System for Bachelor’s Degree**

(This ordinance will replace other ordinances/resolutions etc. on the issues described here; however, it will not affect ordinances/resolutions on issues not mentioned here.)

**1. Student Admission**

**1.1 Undergraduate Admission:**

The admission committee of the university will conduct the admission process for Bachelor’s degree as per the rules. The student will be admitted in the first semester of an academic year in the individual discipline of different schools. However the admission of foreign students will be subjected to the verification of academic records as per the university rule.

**1.2 Student Status and Student Level:**

Every student has to maintain his/her student status by getting admission paying necessary fees and register for required credits every semester. Unless a student graduate early by taking courses in advance, every student has to get admission in every semester successively. For book keeping purpose a student’s level will be expressed by his/her year and semester. A student will be transferred to next level if he/she completes or appears in 80% of his designated courses at his/her present level. Once a student reaches 4th year 2nd (5th year 2nd for Architecture) semester he/she will be kept at this level until he/she graduates.

**1.3 Re-Admission:**

A student has to take re-admission if his/her student status is not maintained or one or more semesters were cancelled because of disciplinary action against him/her. In case of semester cancellation the student has to get re-admission in the same semester. The level (Year and Semester) of re-admission will be determined by his completed/appeared credits. A student will be eligible for re-admission in the first year first semester of the subsequent session if s/he was present in at least 25% of the classes of his/her major courses, appeared at the semester final examination and his/her admission/semester fees was clear in the past semester/session. Re-admitted students will always be assigned the original Registration Number.

**1.4 Student’s Advisor:**

After admission every batch of student will be assigned to a student’s Advisor from the teacher of his/her discipline to guide him/her through the semester system. Advisors will always be accessible to the students and will be ready to mentor them in their academic activities, career planning and if necessary, personal issues. There will be a prescribed guideline for the Advisors to follow.

**2. Academic Calendar**

**2.1 Number of Semesters:**

There will be two semesters in an academic year. The first semester will start on 1st January and end on 30th June, the Second semester will start on 1st July and end on 31st December. The routine of the final examination dates along with other academic deadlines will be announced in the academic calendar at the beginning of each semester.

**2.2 Duration of Semesters:**

The duration of each semester will be as follows:

Classes and Preparatory weeks 15 weeks

Final Examination 04 weeks

Total 19 weeks

These 19 weeks may not be contiguous to accommodate various holidays and the Recess before the final examination may coincide with holidays. The final grading will be completed before the beginning of the next semester.

**3. Course Pattern**

The entire Bachelor’s degree program is covered through a set of theoretical, practical, project, viva and seminar courses. At the beginning of every academic session a short description of every available course will be published by the syllabus committee of each discipline.

**3.1 Course Development:**

**3.1.1 Major and Non-Major Courses:**

Syllabus committee of every discipline will develop all the courses that will be offered by that particular discipline and has to be approved by the respective school and the Academic Council. These include major courses for the respective discipline as well as non-major courses that will be offered to other disciplines. Non-major courses will be developed with close cooperation of the disciplines concerned keeping into consideration of the need of that discipline.

**3.1.2 Syllabus:**

(a) Major and Non-Major Courses: Syllabus committee will select and approve the courses from major courses of the discipline as well as non-major courses offered by other disciplines to complete the syllabus. The syllabus committee will also select a group of courses as core-courses and without these courses a student will not be allowed to graduate even if he completes the credit requirement. The committee may assign pre-requisite for any course if deemed necessary.

(b) Second Major Courses: The syllabus committee will select a set of courses of 28-36 credits from the major courses for a second major degree.

**3.1.3 Course Instruction:**

At the beginning of every semester the course instructor has to make a detailed plan of the course instruction in the prescribed form and supply it to the head of the discipline to make it available to the students. The course plan should have the information about the suggested text books, number of lectures per topic, number and type of assignments, number and approximate dates of mid-semester examinations and mandatory office hours reserved for the students of the course offered. If not otherwise mentioned the medium of instruction is always English.

**3.2 Course Identification System:**

Each course is designated by a three-letter symbol for discipline abbreviation followed by a three-digit number to characterize the course. To avoid confusion new or modified courses should never be identified by reusing a discontinued course number

**3.2.1 Discipline Identification:**

The three-letter symbol will identify a discipline offering the course as follows. If same course is offered to more than one discipline, if necessary, an extra letter shown in the list may be used after the three digits to specify the department receiving the non-major course.

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | **School of Applied Sciences and Technology:** |  |
| 1. | ARC | Architecture | A |
| 2. | CEP | Chemical Engineering and Polymer Science | B |
| 3. | CEE | Civil and Environmental Engineering | C |
| 4. | CSE | Computer Science and Engineering | D |
| 5. | EEE | Electrical and Electronic Engineering | E |
| 6. | FET | Food Engineering and Tea Technology | F |
| 7. | IPE | Industrial and Production Engineering | G |
| 8. | MEE | Mechanical Engineering | Q |
| 9. | PME | Petroleum and Mining Engineering | H |
|  |  |  |  |
|  |  | **School of Life Sciences:** |  |
| 10. | BMB | Biochemistry and Molecular Biology | I |
| 11. | GEB | Genetic Engineering and Biotechnology | J |
|  |  | **School of Physical Sciences:** |  |
| 12. | CHE | Chemistry | K |
| 13. | GEE | Geography and Environment | L |
| 14. | MAT | Mathematics | M |
| 15. | PHY | Physics | N |
| 16. | STA | Statistics | O |
|  |  |  |  |
|  |  | **School of Social Sciences:** |  |
| 17. | ANP | Anthropology | a |
| 18. | BNG | Bangla | b |
| 19. | ECO | Economics | c |
| 20. | ENG | English | d |
| 21. | PSS | Political Studies | e |
| 22. | PAD | Public Administration | f |
| 23. | SCW | Social Work | g |
| 24. | SOC | Sociology | h |
|  |  | **School of Agriculture and Mineral Sciences:** |  |
| 25. | FES | Forestry and Environmental Science | P |
|  |  | **School of Management and Business Administration:** |  |
| 26. | BUS | Business Administration | i |

**3.2.2 Course Number:**

The three-digit number will be used as follows:

(a) First Digit: The first digit of the three digit number will correspond to the year intended for the course recipient.

(b) Second Digit: A discipline should use the number 0 and 1 for the second digit to identify non-major courses. The digits 2-9 are reserved for major courses to identify the different areas within a discipline.

(c) Third Digit: The third digit will be used to identify a course within a particular discipline. This digit can be used sequentially to indicate follow up courses. If possible even numbers will be used to identify laboratory courses.

**3.2.3 Course Title and Credit:**

Every course will have a short representative course title, declaration if it is core course, a number indicating the total credits as well as reference to prerequisite courses if any.

**3.2.4 Theory and Lab Course:**

If a single course has both Theory and Laboratory/Sessional part, then the course must be split into separate Theory and Lab courses and both should have separate course number. A student may not register for a lab course without registering or completing the corresponding theory course.

**3.3 Assignment of Credits:**

**3.3.1 Theoretical:**

One lecture per week (or 13 lectures in total) of 1 hour duration per semester will be considered as one credit. (There will be 10 minutes recess between theory classes). A theory course will have only integer number of credits.

**3.3.2 Laboratory Classes:**

Minimum two contact hours of a laboratory class per week (or 26 contact hours in total) per semester will be considered as one credit. A laboratory course may have half integer credits with a minimum of 1 credit.

**3.3.3 Seminar, Thesis, Projects, Monographs, Fieldwork, Viva etc.:**

Will be assigned by the respective discipline.

**3.4 Classification of the Courses:**

The Bachelor’s degree courses will be classified into several groups and the syllabus committee will finalize the curricula selecting courses from the groups shown below.

**3.4.2 Major Courses:**

A student has to take at least 70% courses from his/her own discipline. Out of these courses a section will be identified as core courses and every student of a particular discipline will be required to take those courses.

**3.4.3 Non-Major Courses:**

Every student is required to take at least 20% (including mandatory) courses from related disciplines. If any Non-Major course is declared as Core course a student is required to take that course to graduate. The Non-Major courses will be designed, offered and graded by the offering disciplines.

**3.4.4 Other Courses:**

After completion of the required mandatory, major and non-major courses a student may take few other courses of his/her choice not directly related to his/her discipline to fulfill the total credit requirement.

**3.4.5 Credit-Only Courses:**

The credit of these Credit-Only courses will be added to the total credits if passed but will not affect the CGPA as there will be no grades for these courses.

**4. Course Registration**

**4.1 Registration:**

A student has to register for his/her courses and pay necessary dues within the first two weeks of every semester. Departmental student advisor will advise every student about his/her courses and monitor his/her performances. A student at any level is expected to register the courses at his level provided he/she does not have any incomplete courses from previous levels. A student will not be allowed to appear in the examination if his/her semester and examination fee is not cleared.

**4.2 Minimum and Maximum Credits:**

A student, if s/he is not a clearing graduate, has to register for at least 12 credits minimum and 30 credits maximum every semester.

**4.3 Incomplete Courses:**

If a student has incomplete courses, he/she has to register his/her available incomplete courses from preceding levels before s/he can register courses from current or successive levels. If an incomplete course is not offered in a given semester the student has to take the courses when it is offered next time. A student with incomplete courses will not be eligible for Distinction.

**4.4 Advance Courses:**

A student may register courses of higher levels in advance to get his degree in shorter time if he/she does not have any incomplete or failed courses from present and previous levels.

**4.5 Course Withdrawal:**

A student can withdraw a course by a written application to the Controller of Examinations through the Head of the discipline on or before the last day of instruction. The Controller of Examinations will send the revised registration list to the disciplines before the examination. There will be no record of the course in transcript if the course is withdrawn.

**4.6 Course Repetition:**

If a student has to repeat a failed or incomplete course and that course is not offered any more, the discipline may allow him/her to take an equivalent course from the current syllabus. For clearing graduates if any incomplete course is not offered in the running semester, the discipline may suggest a suitable course to complete the credit requirement.

**5. Graduation Criteria**

**5.1 Major Degree:**

**5.1.1 Total Credits:**

School of Physical Sciences, School of Social Sciences and School of Management and Business Administration have a requirement of 140 credits to graduate from its disciplines. School of Applied Sciences and Technology, School of Life Sciences and School of Agriculture and Mineral Science have requirement of 160 (200 for Architecture) credits for graduation.

**5.1.2 Total Years:**

A regular student is expected to graduate in 8 semesters (4 years) or in 10 semesters (5 years) for the discipline of Architecture. A student may graduate in shorter time period if s/he is willing to take extra courses in a systematic way. A student will be given 4 (2 years) extra semesters in addition to 8/10 semesters to complete his/her degree. The regular examination year will be identified by the session and the end-month (June or December) of the semester the student graduates.

**5.1.3 Early Graduation:**

A student may graduate early by completing courses in advance, in that case he does not need to pay tuition or get admission in subsequent semesters. However a student will not be able to start master's degree one session earlier unless he graduates two semesters early.

**5.1.4 Minimum Credit for a Clearing Graduate:**

For a clearing graduate (8th and subsequent semesters) condition for maximum and minimum credit requirements is relaxed.

**5.1.5 Break in study:**

In very special cases a student may take re-admission and complete his degree after a break of study of minimum one to a maximum of three years if he/she has completed at least 80% of required courses. He/she has to have recommendation from the discipline and the application has to be approved by the Academic Council. These students will not get any additional time benefit.

**5.2 Second Major Degree:**

**5.2.1 Total Credits:**

A student may apply for a second major degree if he/she completes an extra 28-36 credit requirement designated by the offering discipline.

**5.2.2 Total Semesters:**

A student has to complete the credit requirement of second major degree within 8 regular and 4 extra semesters.

**5.2.3 Requirement of Major Degree:**

A student will not be given a second major degree if he/she fails to complete his regular major degree. A student will not be allowed to enroll in Masters program before completion of his/her second major degree even if he/she complete his/her major degree requirement.

**5.2.4 Registration Criteria:**

An offering discipline will decide on the number of seats for second major, enrollment criteria and get it approved from the academic council. Students willing to get a second major have to apply to the offering discipline for enrollment and the discipline will enroll them as per the admission criteria. During registration enrolled students have to get their courses approved from the offering department completing a separate registration form.

**5.2.5 Class Routine:**

After enrollment a regular student may start taking the second major courses starting 3rd semester. The class routine may be arranged to accommodate the student need.

**5.2.6 Certificate and Mark sheet:**

A student completing the requirement will be given an additional certificate and grade sheet for his second major degree.

**6. Examination System**

A student will be evaluated continuously in the courses system, for theoretical classes s/he will be assessed by class participation, assignments, quizzes, mid-semester examinations and final examination. For laboratory work s/he will be assessed by observation of the student at work, viva-voce during laboratory works, from his/her written reports and grades of examinations designed by the respective course teacher and the examination committee.

**6.1 Distribution of Marks:**

The marks of a given course will be as follows:

|  |  |
| --- | --- |
| Class Attendance | 10% |
| Class Evaluation | 10% |
| Assignments and Mid-Semester Examinations | 20% |
| Final Examination | 60% |

**6.1.1 Class Participation:**

The marks for class participation will be as follows:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Attendance  (Percentage) | Marks | Attendance  (Percentage) | Marks | Attendance  (Percentage) | Marks |
| 95 and above | 10 | 80 to 84 | 7 | 65 to 69 | 4 |
| 90 to 94 | 9 | 75 to 79 | 6 | 60 to 64 | 3 |
| 85 to 89 | 8 | 70 to 74 | 5 | Less than 60 | 0 |

A student will not be allowed to appear at the examination of a course if his/her class attendance in that course is less than 50%.

**6.1.2 Assignments and Mid-Semester Examinations:**

There should be at least two mid-semester examinations for every course. The course teacher may decide the relative marks distribution between the assignments, tutorial and mid-semester examinations, however at least 50% contribution should come from the mid-semester examinations. The answer script should be returned to the students as it is valuable to their learning process.

**6.1.3 Final Examination:**

The final examination will be conducted as per the Semester Examination Ordinance.

(a) Duration of the Final Examination: There will be a 3-hour final examination for every course of 3 credits or more after the 13th week from the beginning of the semester. Courses less than 3 credits will have final examination of duration 2 hours. (b) Evaluation of Answer Script: The students of the School of Applied Science and Technology and the School of Agriculture and Mineral Sciences will have two answer scripts to answer separate questions during final examination. Two separate examiner will grade the two scripts separately and the marks will be added together to get the final mark. For the students of the other schools there will be a single answer script which will be evaluated by two examiners. The two marks will be averaged and if the marks by the two examiners differ by 20% or more the concerned answer scripts will be examined by a third examiner and the two closest marks among the three will be averaged to get the final mark.

**7. Grading System**

**7.1 Letter Grade and Grade Point:**

Letter Grade and corresponding Grade-Point for a course will be awarded from the roundup marks of individual courses as follows:

|  |  |  |
| --- | --- | --- |
| Numerical Grade | Letter Grade | Grade Point |
| 80% and above | A+ | 4.00 |
| 75% to less than 80% | A | 3.75 |
| 70% to less than 75% | A- | 3.50 |
| 65% to less than 70% | B+ | 3.25 |
| 60% to less than 65% | B | 3.00 |
| 55% to less than 60% | B- | 2.75 |
| 50% to less than 55% | C+ | 2.50 |
| 45% to less than 50% | C | 2.25 |
| 40% to less than 45% | C- | 2.00 |
| Less than 40% | F | 0.00 |

**7.2 Calculation of Grades**

**7.2.1 GPA:**

Grade Point Average (GPA) is the weighted average of the grade points obtained in all the courses completed by a student in a semester.

**7.2.2 CGPA:**

Cumulative Grade Point Average (CGPA) of only major and both major and second major degree will be calculated by the weighted average of every course of previous semesters along with the present semester. For clearing graduates if the roundup value of the third digit after decimal is nonzero the second digit will be incremented by one. A student will also receive a separate CGPA for his second major courses.

**7.2.3 F Grades:**

A student is given an ‘F’ grade if he fails or is absent in the final examination of a course. If a student obtains an ‘F’ grade his grade will not be counted for GPA and s/he has to repeat the course. An ‘F’ grade will be in his/her record and s/he will not be eligible for Distinction.

**8. Distinction**

**8.1 Distinction:**

Candidates for four-year Bachelor degree will be awarded the degree with Distinction if his/her overall CGPA is 3.75 or above. However a student will not be considered for Distinction if (a) s/he is not a regular student (has semester drop, incomplete courses in any semester or break of study) (b) has ‘F’ grade in one or more courses.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Ref.: This Ordinance was approved in the 126th Academic Council (26 June 2013). Clause 3.4.1 was cancelled in 127th Academic Council (27 August 2013). 128th Academic Council (21 November 2013) decided to make it effective from 01 January 2014.

kvnRvjvj weÁvb I cÖhyw³ wek¦we`¨vj‡qi we Gb wm wm K¨v‡WU‡`i Rb¨ Hw”QK welq wn‡m‡e wba©vwiZ

**MSC 004 MILITARY SCIENCE** (mvgwiK weÁvb)

*3 Hours/Week, 3 Credits*

cwVZ welq (ZË¡xq I e¨envwiK): we Gb wm wmÕi BwZnvm-HwZn¨, we Gb wm wmÕi mvsMVwbK KvVv‡gv, gnvb ¯^vaxbZv hy‡×i cVf~wg I KviY, ¯^vaxbZv hy‡×i †m±i mg~n, wWªj, KzPKvIqvR, g¨vc wiwWs, hy‡×i bvbv †KŠkj, hy‡× e¨eüZ A‡¯¿i cwiPq, evsjv‡`‡ki mk¯¿ evwnbxi cwiPq, †bZ…‡Z¡i ˆewkó¨, kixi PP©v, cÖv\_wgK wPwKrmv, mgvR †mev, `y‡h©vM e¨e¯’vcbv, fywgK¤ú e¨e¯’vcbv, N~wY©So e¨e¯’vcbv, AwMœ wbe©vc‡bi †KŠkj, mvs¯‹…wZK cÖwk¶Y BZ¨vw`|

mnvqK MÖš’ :

we Gb wm wm: mvgwiK weÁvb m`i `ßi KZ©„K wba©vwiZ I cÖKvwkZ|

**Curriculum for B.Sc. in Industrial and Production Engineering Program**

**Session: 2021-2022**

**PART: A**

***Vision Statement***

To be recognized as a global leader through innovative and creative education and research in the field of Industrial and Production Engineering.

***Missions***

**M1.** To produce graduates providing quality education and research ensuring state-of-art knowledge and skills on Industrial and Production Engineering;

**M2.** To equip the graduates with necessary technical know-how that expands their reasoning, communication and problem-solving abilities;

**M3.** To provide the graduates with strategy developing capability and managerial skills to face existing and upcoming industrial needs and challenges;

**M4.** To establish an effective industry-academia linkage that addresses the needs of stakeholders, society at large.

**Objectives of the B.Sc. in Industrial and Production Engineering (Program Educational Objectives, PEO)**

PEO1**.** To equip the students with basic knowledge and concept in engineering methods, tools, and techniques related to two main areas: Industrial Engineering and Production Engineering;

PEO2. To make the students able to demonstrate high level analytical and strategic thinking skills to solve conceptual and real-life problems in the field of industrial and production engineering;

PEO3. Helping the students to develop ability in expanding their capabilities through professional development and advanced learning;

PEO4. To enhance the skills on conceptual and experimental design in context of manufacturing and industrial practice through laboratory, and industrial projects & thesis;

PEO5. To develop graduates with effective communicative skill in both written and oral form so as to lead and function successfully in multidisciplinary and globally diverse teams;

PEO6. Help students develop curiosity and interest in continued life-long learning through graduate studies and/or professional activities;

PEO7. Acquaint students with moral and ethical values to handle the research findings, and to maintain the confidentiality of intellectual properties.

**PEO to Mission Statement Mapping**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Mission/**  **PEO** | PEO1 | PEO2 | PEO3 | PEO4 | PEO5 | PEO6 | PEO7 |
| **M1** | **×** |  |  | **×** |  |  | **×** |
| **M2** |  | **×** | **×** | **×** | **×** |  |  |
| **M3** |  | **×** | **×** | **×** |  | **×** |  |
| **M4** |  |  |  | **×** |  |  |  |

**Program Learning Outcomes (PLO)**

After successful completion of B.Sc. in Industrial and Production Engineering degree, graduates will be able to:

**PLO1.** apply the knowledge, skills, and modern engineering tools and techniques of Industrial and Production Engineering throughout the professional careers;

**PLO2.** design, develop, implement, interpret and improve integrated systems that include people, materials, information, equipment and machinery and other resources;

**PLO3.** analyze, synthesize, and control manufacturing operations as well processes using statistical tools, mathematical models, simulation and information technology;

**PLO4.** design a system component, or process to meet desired needs with realistic constraints linked to economic, environmental, social, political, ethical, health and safety factors, and its manufacturability and sustainability;

**PLO5.** identify, formulate and solve engineering problems individually or in a multidisciplinary team;

**PLO6.** communicate effectively with different stakeholders and society at large;

**PLO7.** recognize the need for, and engage in life-long learning;

**PLO8.** demonstrate the moral and professional ethical values to handle the research findings, and maintain the confidentiality of intellectual properties.

**Program Educational Objective, PEO to Program Learning Outcome, PLO Mapping**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **PEO**  **PLO** | **PEO1** | **PEO2** | **PEO3** | **PEO4** | **PEO5** | **PEO6** | **PEO7** |
| **PLO1** | **×** |  |  | **×** |  |  |  |
| **PLO2** |  | **×** | **×** | **×** |  |  |  |
| **PLO3** |  | **×** |  | **×** |  |  |  |
| **PLO4** | **×** | **×** |  |  | **×** |  |  |
| **PLO5** |  | **×** |  | **×** | **×** |  |  |
| **PLO6** |  |  |  |  | **×** |  |  |
| **PLO7** |  |  |  |  |  | **×** |  |
| **PLO8** |  |  |  |  |  |  | **×** |

**PART: B**

**Curriculum Structure:**

1. Duration of the program : Four Years (Eight Semesters)
2. Total Minimum credit requirement : 162.5 credits

**Year/Semester wise courses:**

1. **First Year: 1st Semester**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Course No. | Course Title | Hours/Week | | Credits |
| Theory | Lab |
| IPE 141 | Manufacturing Processes - I | 3 | 0 | 3.0 |
| PHY 107G | Mechanics, Structure, Waves & Oscillation | 3 | 0 | 3.0 |
| MAT103G | Differential Calculus and Solid Geometry | 3 | 0 | 3.0 |
| SSS 100 | History of the Emergence of Independent Bangladesh | 3 | 0 | 3.0 |
| ENG 101 | Effective Communication in English | 2 | 0 | 2.0 |
| ENG 102 | English Language Lab I | 0 | 2 | 1.0 |
| IPE 144 | Workshop Practice | 0 | 3 | 1.5 |
| IPE 122 | Engineering Graphics | 0 | 3 | 1.5 |
| IPE 152 | Professional Development Seminar | 0 | 2 | 1.0 |
| Total | | 14 | 10 | 19.0 |

1. **First Year: 2nd Semester**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Course No. | Course Title | Hours/Week | | Credits |
| Theory | Lab |
| IPE 121 | Engineering Mechanics | 3 | 0 | 3.0 |
| IPE 123 | Engineering Materials | 3 | 0 | 3.0 |
| MAT 104G | Integral Calculus and Differential Equations | 3 | 0 | 3.0 |
| CHE 101G | General Chemistry | 3 | 0 | 3.0 |
| CEP 101 | Process Technology | 2 | 0 | 2.0 |
| CHE 102G | Chemistry Practical | 0 | 3 | 1.5 |
| IPE 142 | Manufacturing Processes – I Sessional | 0 | 3 | 1.5 |
| IPE 146 | Machine Shop Practice | 0 | 3 | 1.5 |
| PHY 102G | Basic Physics Sessional | 0 | 3 | 1.5 |
| IPE 150 | Comprehensive Viva-I | - | - | 0.5 |
| Total | | 14 | 12 | 20.5 |

1. **Second Year: 1st Semester**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Course No. | Course Title | Hours/Week | | Credits |
| Theory | Lab |
| IPE 221 | Mechanics of Solids | 3 | 0 | 3.0 |
| IPE 223 | Thermodynamics and Heat Transfer | 4 | 0 | 4.0 |
| MAT 207G | Vectors, Matrices, and Laplace Transformation | 3 | 0 | 3.0 |
| EEE 103G | Introduction to Electric and Electronic Circuits Theory | 2 | 0 | 2.0 |
| ECO 105G | Principles of Economics | 3 | 0 | 3.0 |
| EEE 104G | Introduction to Electric and Electronic Circuits Lab | 0 | 3 | 1.5 |
| IPE 224 | Engineering Materials Sessional | 0 | 3 | 1.5 |
| IPE 242 | Computer Aided Drawing-I | 0 | 3 | 1.5 |
| IPE 244 | Machine Drawing | 0 | 3 | 1.5 |
| IPE 222 | Mechanics of Solid Sessional | 0 | 3 | 1.5 |
| Total | | 15 | 15 | 22.5 |

1. **Second Year: 2nd Semester**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Course No. | Course Title | Hours/Week | | Credits |
| Theory | Lab |
| IPE 225 | Mechanics of Machinery | 3 |  | 3.0 |
| IPE 227 | Fluid Mechanics and Machinery | 3 |  | 3.0 |
| IPE 231 | Engineering Economy | 3 |  | 3.0 |
| IPE 251 | Engineering Statistics | 3 |  | 3.0 |
| CSE 203G | Introduction to Computer Language | 2 |  | 2.0 |
| CSE 204G | Introduction to Computer Language Lab |  | 4 | 2.0 |
| IPE 228 | Fluid Mechanics and Machinery Sessional |  | 3 | 1.5 |
| IPE 246 | Computer Aided Drawing -II |  | 3 | 1.5 |
| IPE 250 | Comprehensive Viva-II |  |  | 0.5 |
| IPE 260 | Industrial Tour (Selected by IPE Dept) | ----- | ---- | 0.5 |
| Total | | 14 | 10 | 20 |

1. **Third Year: 1st Semester**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Course No. | Course Title | Hours/Week | | Credits |
| Theory | Lab |
| IPE 321 | Numerical Analysis | 3 |  | 3.0 |
| IPE 351 | Product Design and Development | 3 |  | 3.0 |
| IPE 331 | Ergonomics and Industrial Safety | 3 |  | 3.0 |
| IPE 333 | Quality Control and Management | 3 |  | 3.0 |
| IPE 353 | Facilities Planning and Material Handling | 3 |  | 3.0 |
| IPE 322 | Numerical Analysis Sessional |  | 3 | 1.5 |
| IPE 352 | Product Design and Development Sessional |  | 3 | 1.5 |
| IPE 332 | Ergonomics Sessional |  | 3 | 1.5 |
| Total | | 15 | 9 | 19.5 |

1. **Third Year: 2nd Semester**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Course No. | Course Title | Hours/Week | | Credits |
| Theory | Lab |
| IPE 335 | Industrial Management | 3 |  | 3.0 |
| IPE 337 | Operations Management | 3 |  | 3.0 |
| IPE 339 | Operations Research | 3 |  | 3.0 |
| IPE 341 | Manufacturing Process- II | 3 |  | 3.0 |
| IPE 323 | Measurement and Instrumentation | 3 |  | 3.0 |
| IPE 360 | Industrial Training- I (selected by IPE dept.) | 2 weeks | | 1.0 |
| IPE 342 | Manufacturing Process- II Sessional |  | 3 | 1.5 |
| IPE 336 | Operations Management and QCM Sessional |  | 3 | 1.5 |
| IPE 324 | Measurement and Instrumentation Sessional |  | 3 | 1.5 |
| IPE 354 | Business Communication Seminar |  | 2 | 1.0 |
| IPE 350 | Comprehensive Viva-III |  |  | 0.5 |
| Total | | 15 | 11 | 22 |

1. **Fourth Year: 1st Semester**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Course No. | Course Title | Hours/Week | | Credits |
| Theory | Lab |
| IPE 441 | Machine Tools and Machining | 3 |  | 3.0 |
| IPE 443 | Advanced Manufacturing System | 3 |  | 3.0 |
| IPE 431 | System Modeling and Simulation | 3 |  | 3.0 |
| IPE 433 | Supply Chain Management | 3 |  | 3.0 |
| Optional-I | Selected from Prescribed Optional Subjects | 3 |  | 3.0 |
| \*IPE 490 | Project and Thesis |  | 6 | 3.0 |
| IPE 442 | Machine Tools Sessional |  | 3.0 | 1.5 |
| IPE 444 | Advance Manufacturing System Sessional |  | 3.0 | 1.5 |
| IPE 432 | System Modeling and Simulation Sessional |  | 3.0 | 1.5 |
| Total | | 15 | 15 | 22.5 |

**Optional I**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Course No. | Course Title | Hours/Week | | Credits |
| Theory | Lab |
| IPE 436 | Marketing and Cost Management | 3 |  | 3.0 |
| IPE 437 | Organizational Behavior | 3 |  | 3.0 |
| IPE 438 | Industrial Psychology and Industrial Laws | 3 |  | 3.0 |

1. **Fourth Year: 2nd Semester**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Course No. | Course Title | Hours/Week | | Credits |
| Theory | Lab |
| IPE 435 | Project Management | 3 |  | 3.0 |
| IPE 439 | Production System Optimization | 3 |  | 3.0 |
| Optional-II | Selected from Prescribed Optional Subjects | 3 |  | 3.0 |
| Optional-III | Selected from Prescribed Optional Subjects | 3 |  | 3.0 |
| IPE 490 | Project and Thesis (Continuation) |  | 6 | 3.0 |
| IPE 460 | Industrial Training – II (Selected By IPE Dept.) | One Month | | 1.0 |
| \*IPE 450 | Comprehensive Viva |  |  | 0.5 |
| Total | | 12 | 6 | 16.5 |

**Optional II**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Course No. | Course Title | Hours/Week | | Credits |
| Theory | Lab |
| IPE 434 | Reliability Engineering and Maintenance Management | 3 |  | 3.0 |
| IPE 445 | Tool Engineering | 3 |  | 3.0 |
| IPE 449 | CAD and Virtual Reality | 3 |  | 3.0 |

**Optional III**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Course No. | Course Title | Hours/Week | | Credits |
| Theory | Lab |
| IPE 447 | Control Engineering | 3 |  | 3.0 |
| IPE 451 | Entrepreneurship Development and Technology Management | 3 |  | 3.0 |
| IPE 453 | Management Information System | 3 |  | 3.0 |

**NOTE:**

**\*** All courses offered by the department are compulsory to obtain the degree.

**Mapping of Courses with Program Learning Outcome (PLO)**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| PLO  **Course** | | Theory/  Sessional | Credit | **PLO 1** | **PLO 2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| IPE 141 | | Theory | 3.0 | × | × | × | × | × | × | × |  |
| PHY 107G | | Theory | 3.0 | × | × | × |  | × |  |  |  |
| MAT103G | | Theory | 3.0 | × | × | × | × | × |  | × |  |
| SSS 100 | | Theory | 3.0 | × |  |  |  |  | × |  | × |
| ENG 101 | | Theory | 2.0 |  | × |  |  | × | × |  |  |
| ENG 102 | | Lab | 1.0 |  | × |  |  |  | × |  |  |
| IPE 144 | | Lab | 1.5 | × | × |  |  | × | × |  |  |
| IPE 122 | | Lab | 1.5 | × | × |  | × | × | × |  |  |
| IPE 152 | | Lab | 1.0 | × |  |  |  | × | × |  |  |
|  | | | | | | | | | | | |
| IPE 121 | | Theory | 3.0 | × | × |  | × | × |  |  |  |
| IPE 123 | | Theory | 3.0 | × | × | × | × | × |  | × |  |
| MAT 104G | | Theory | 3.0 | × | × | × | × | × | × | × |  |
| CHE 101G | | Theory | 3.0 | × |  | × | × | × |  |  |  |
| CEP 101 | | Theory | 2.0 | × | × | × | × |  |  |  |  |
| CHE 102G | | Lab | 1.5 | × |  | × | × | × |  |  |  |
| IPE 142 | | Lab | 1.5 | × | × | × | × | × | × |  |  |
| IPE 146 | | Lab | 1.5 | × | × | × | × |  |  |  |  |
| PHY 102G | | Lab | 1.5 | × | × | × | × | × |  |  |  |
| IPE 150 | | Comprehe-nsive Viva-I | 0.5 | × |  |  |  |  | × | × |  |
|  | | | | | | | | | | | |
| IPE 221 | | Theory | 3.0 | × |  |  | × | × | × |  |  |
| IPE 223 | | Theory | 4.0 | × | × | × | × | × |  |  |  |
| MAT 207G | | Theory | 3.0 | × | × | × | × | × |  |  |  |
| EEE 103G | | Theory | 2.0 | × | × | × | × | × |  |  |  |
| ECO 105 | | Theory | 3.0 | × |  | × | × | × | × |  |  |
| EEE 104G | | Theory | 1.5 | × | × |  | × | × | × |  |  |
| IPE 224 | | Lab | 1.5 | × | × |  |  | × |  |  | × |
| IPE 242 | | Lab | 1.5 | × | × | × | × | × | × | × |  |
| IPE 244 | | Lab | 1.5 | × |  |  | × |  | × |  |  |
| IPE 222 | | Lab | 1.5 | × |  | × | × | × | × | × |  |
|  | | | | | | | | | | | |
| IPE 225 | | Theory | 3.0 | × |  | × | × | × |  |  |  |
| IPE 227 | | Theory | 3.0 | × | × |  | × | × | × |  |  |
| IPE 231 | | Theory | 3.0 | × | × | × | × | × | × | × | × |
| IPE 251 | | Theory | 3.0 | × | × | × | × | × |  |  |  |
| CSE 203G | | Theory | 2.0 | × |  | × | × | × |  |  |  |
| CSE 204G | | Lab | 2.0 | × |  |  | × | × |  |  |  |
| IPE 228 | | Lab | 1.5 | × | × |  |  | × |  |  |  |
| IPE 246 | | Lab | 1.5 | × | × |  | × |  |  |  |  |
| IPE 250 | | Comprehensive Viva-II | 0.5 | × |  |  |  |  | × | × |  |
| IPE 260 | | Industrial Tour | 0.5 | × |  |  |  |  | × |  | × |
|  | | | | | | | | | | | |
| IPE 321 | | Theory | 3.0 | × |  | × |  | × |  |  |  |
| IPE 331 | | Theory | 3.0 | × | × | × | × | × | × |  |  |
| IPE 333 | | Theory | 3.0 | × | × | × | × | × | × |  |  |
| IPE 351 | | Theory | 3.0 | × | × | × | × | × | × | × |  |
| IPE 353 | | Theory | 3.0 | × | × | × | × | × | × | × |  |
| IPE 322 | | Lab | 1.5 | × | × | × | × | × | × |  |  |
| IPE 332 | | Lab | 1.5 | × | × | × | × | × | × | × |  |
| IPE 352 | | Lab | 1.5 | × | × | × | × | × | × |  |  |
|  | | | | | | | | | | | |
| IPE 335 | | Theory | 3.0 | × | × | × | × | × | × | × |  |
| IPE 337 | | Theory | 3.0 | × | × | × | × | × | × | × |  |
| IPE 339 | | Theory | 3.0 | × | × | × | × | × | × | × |  |
| IPE 341 | | Theory | 3.0 | × | × | × | × | × | × | × |  |
| IPE 323 | | Theory | 3.0 | × | × | × |  |  |  |  |  |
| IPE 360 | | Industrial Training-I | 1.0 | × |  |  |  | × | × |  | × |
| IPE 342 | | Lab | 1.5 | × | × | × | × | × | × |  |  |
| IPE 336 | | Lab | 1.5 | × |  | × |  | × |  |  |  |
| IPE 324 | | Lab | 1.5 | × | × | × |  |  |  |  |  |
| IPE 354 | | Lab | 1.0 | × | × | × |  | × | × |  | × |
| IPE 350 | | Comprehensive Viva-III | 0.5 | × |  |  |  | × | × | × |  |
|  | | | | | | | | | | | |
| IPE 431 | | Theory | 3.0 | × | × | × | × | × | × | × | × |
| IPE 433 | | Theory | 3.0 | × | × | × | × | × | × | × | × |
| IPE 441 | | Theory | 3.0 | × | × | × | × | × |  |  |  |
| IPE 443 | | Theory | 3.0 | × | × | × | × | × | × | × |  |
| Optional-I | IPE 436 | Theory | 3.0 | × | × | × | × | × | × | × |  |
| IPE 437 | Theory | 3.0 | × | × |  | × | × | × | × | × |
| IPE 438 | Theory | 3.0 | × | × |  | × | × | × | × | × |
| IPE 490 | | Project/Thesis | 3.0 | × |  | × | × | × | × | × | × |
| IPE 432 | | Lab | 1.5 | × | × | × | × | × | × | × |  |
| IPE 442 | | Lab | 1.5 | × | × | × | × | × | × | × |  |
| IPE 444 | | Lab | 1.5 | × | × | × | × | × | × |  |  |
|  | | | | | | | | | | | |
| IPE 435 | | Theory | 3.0 | × | × | × |  | × | × |  |  |
| IPE 439 | | Theory | 3.0 | × | × | × | × | × | × | × |  |
| Optional-II | IPE 434 | Theory | 3.0 | × | × | × | × | × | × | × |  |
| IPE 445 | Theory | 3.0 | × | × | × | × | × | × | × |  |
| Optional-III | IPE 447 | Theory | 3.0 | × | × | × | × | × |  |  |  |
| IPE 451 | Theory | 3.0 | × | × | × | × | × | × |  |  |
| IPE 453 | Theory | 3.0 | × | × | × | × |  |  |  |  |
| IPE 490 | | Project/Thesis | 3.0 | × |  | × | × | × | × | × | × |
| IPE 450 | | Comprehensive Viva | 0.5 | × |  |  |  | × | × | × |  |
| IPE 460 | | Industrial Training-II | 1.0 | × |  |  |  | × | × |  | × |

**PART: C**

**Description of all courses**

1. ***Summary and Mapping PLO vs CLO of all courses:***

**First Year First Semester**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course No.: IPE141** | **Credit: 3.0** | **Year: First** | **Semester: First** |
| **Course Title: Manufacturing Processes – I** | | **Course Status: Theory** | |

**Rationale of the Course:**

Knowledge of manufacturing processes is required when working in any area of the manufacturing of products. There are many employment areas in manufacturing, as it is a vital component of all modern economies. By studying Manufacturing Processes – I, students will learn about the manufacturing process that goes into making a product. This course will help them understand the fundamental and practical aspects of a wide range of manufacturing processes such as machining, welding, and casting that enable production at scale.

**Course Objectives:**

The objectives of this course are:

* to make the students understand the concept of manufacturing and its associated cost terms
* to facilitate the necessary knowledge about the fundamental and practical aspects of a wide range of manufacturing processes used in practice to fabricate a product
* to help the students understand the difference among various manufacturing processes of the same category
* to develop skill in identifying, formulating, and solving the real-life manufacturing problems
* to provide knowledge about various manufacturing defects and their associated causes.

**Course Content:**

Introduction to manufacturing processes; Machining Processes: types, definition, concepts, and applications: Turning, Drilling, Shaping, Milling, Knurling; Thread cutting, Grinding, Reaming, Boring, Broaching, etc. Casting Processes: Definition, Classification, Molding: design of molds, riser, runner, gate sprue and core, cost analysis; Casting: casting processes for ferrous and nonferrous metals, sand, die, centrifugal, slush, plaster mould, loam mould, precision investment casting etc. Casting defects. Conventional Joining Processes: Definitions, Classification, Welding processes: soldering, brazing, Gas, Arc, TIG, MIG, Termite, Resistance, Friction, Electro slag; Welding Defects.

**Course Learning Outcomes, CLO**

After successful completion of the course, students will be able to:

1. explain the concept of manufacturing and the interactive factors in manufacturing
2. describe manufacturing systems and differentiate them
3. interpret types of cost involved in manufacturing
4. classify machining, welding, and casting processes and describe how these processes work
5. distinguish various machining processes, welding processes, and casting processes from one another
6. evaluate the usefulness of various machining, welding, and casting processes in manufacturing
7. design a manufacturing process/system appropriate for fabricating a designed product
8. apply the engineering knowledge to solve various real-life machining problems
9. explain the causes of defects linked with welding and casting.

**Mapping of CLOs with PLOs**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO 01** | × | × | × |  |  |  |  |  |
| **CLO 02** | × | × |  |  |  |  |  |  |
| **CLO 03** |  |  |  | × |  |  |  |  |
| **CLO 04** | × |  | × |  |  |  |  |  |
| **CLO 05** | × |  |  |  |  |  |  |  |
| **CLO 06** | × |  |  | × |  |  |  |  |
| **CLO 07** |  | × | × |  |  | × | × |  |
| **CLO 08** | × |  |  |  | × |  | × |  |
| **CLO 09** |  |  | × | × | × |  |  |  |

**Books Recommended:**

1. Mikell P. Groover, Fundamentals of Modern Manufacturing Materials, Processes, and Systems, John Wiley & Sons, Inc.
2. J.T. Black and Ronald A. Kohser, DeGarmo’s Materials and Processes in Manufacturing, John Wiley & Sons, Inc.
3. Serope Kalpakjian and Stevan R. Schmid, Manufacturing Engineering and Technology, Prentice Hall.
4. U.K. Singh and Manish Dwivedi, Manufacturing Processes, New Age International Publishers.
5. H.N. Gupta, R.C. Gupta, and Arun Mittal, Manufacturing Processes, New Age International Publishers.

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| **Course No: PHY 107G** | **Credits: 3.0** | **Year: First** | **Semester: First** |
| **Course Title: Mechanics, Structure of Matter, Waves and Oscillation** | | | **Course Type: Theory** |

**Rationale of the Course:**

Physics generates fundamental knowledge needed for the future technological advances. Study of physics develops the ability of problem solving, logical thinking and also the ability to think intellectually. There is no way an engineering graduate would solve complex engineering problems without understanding the physics behind it. This course includes the concept in mechanics, structure of matter, and waves and oscillation. The goal to gain knowledge and apply it to solve various real-life engineering problems.

**Course Objectives**

The objectives of this course are to:

* facilitate necessary knowledge about multi-dimensional motions
* make the students understand the basic theories of mechanics and apply them to a wide variety of interesting problems
* accumulate basic ideas of solid including structure types, packing fraction, crystallography and types of solid
* provide the knowledge of oscillation and wave motion.

**Course Content**

*Mechanics:* motion in two dimensions, projectile motion, Newton’s law of motion, momentum and energy conservations, collisions, circular motion, angular momentum and torque, moment of inertia, rotational dynamics of rigid bodies, central forces and gravitation. *Structure of Matter:* classification of solid, amorphous, crystalline, ceramics and polymers. atomic arrangements in solids. lattices, basis and crystal structure, unit cell, different types of crystal structure, packing in solids, packing fraction of *sc*, *bcc*, *fcc* and *hcp* lattices. X-ray diffraction, Bragg’s law, plasticity and elasticity. distinction among metal, insulator and semiconductor. *Oscillation:* simple harmonic motion, free, forced and damped harmonic oscillation, resonance. *Waves:* propagation and velocity of longitudinal waves in gaseous medium, superposition principle.

**Course Learning Outcomes**

After the successful completion of the course, students will be able to:

1. explain two-dimensional linear motion, rotational motion, projectile motion, Newton’s law of motion and identify those in real-life phenomena
2. apply fundamental laws of physics (for instance, motions, moment of inertia, etc.) to solve a wide variety of real-life problem
3. identify and explain the basic structure of solids
4. differentiate among metal, insulator and semiconductor
5. apply differential equations to model oscillating systems and interpret the system behavior
6. explain the propagation of waves in various mediums.

**Mapping of the CLOs with PLOs**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO 01** | × |  |  |  |  |  |  |  |
| **CLO 02** | × |  |  |  | × |  |  |  |
| **CLO 03** | × |  |  |  |  |  |  |  |
| **CLO 04** | × | × |  |  |  |  |  |  |
| **CLO 05** | × | × | × |  | × |  |  |  |
| **CLO 06** | × |  |  |  |  |  |  |  |

**Recommended Books**

1. Halliday, D. and Resnick, R.: *Physics (Part I)*
2. Sears, Zemansky and Young: *University Physics*
3. Beiser, A.: *Perspective of Modern Physics*
4. Puri, S. P.: *Fundamentals of Vibrations and Wave*
5. Jenkins and White: *Fundamentals of Optics*

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| **Course No.: MAT 103G** | **Credit: 3.0** | **Year: First** | **Semester: First** |
| **Course Title: Differential Calculus and Coordinate Geometry** | | | **Course Status: Theory** |

**Rationale of the Course:**

This course is about the basic mathematics that is fundamental and essential component in all streams of undergraduate studies in sciences and engineering. In this course, the students will study principles of differential calculus and coordinate geometry, and applies rules to calculate the derivative of various types of functions. Coordinate geometry is a very powerful language of mathematics that will be used for understanding derivatives and its applications. By the end of this course, students will have the ability to apply basic principles and techniques of differential calculus to the solution of various practical problems.

**Course Objectives:**

The objectives of this course are to:

* make the students interest on differential calculus and coordinate geometry as needed for solving problems in industry;
* develop students’ skills in understanding derivatives of real variable functions and their properties;
* use coordinate geometry for understanding the problems and solutions;
* provide concepts and techniques of solving the problems and its applications.

**Course Content:**

*Differential Calculus*: Differentiation of explicit and implicit functions and parametric equations, successive differentiation of various types of functions. Leibnitz’s theorem, Rolls theorem, Mean Value Theorem. Taylor’s theorem in finite and infinite forms. Maclaurin’s theorem in finite and infinite forms, Lagrange’s form of remainder, Cauchy’s form of remainder. Expansion of function by differentiation and integration. Partial differentiation. Euler’s theorem. Tangent and normal, subtangent and subnormal in Cartesian and polar coordinates. Determination of maximum and minimum values of functions, point of inflexion, its applications. Evaluation of indeterminant forms by L’ Hospital’s rule. Curvature, radius of curvature, center of curvature and chord of curvature. Asymptotes, Curve tracing and symmetry; *Two-dimensional coordinate geometry*: Change of coordinates; pair of straight lines, general equation of second degree. *Three-dimensional coordinate geometry*: System of coordinates, distance between two points, Sections formula, Projections, Direction cosines and direction ratios. Equations planes and straight lines.

**Course Learning Outcomes, CLO**

After successful completion of the course, students will be able to:

1. Explain the concept of limits, calculate limits using the limit laws, apply the precise definition of a limit, determine the continuity of a function, apply the Intermediate Value Theorem, explain how the idea of limit applies to tangents, velocities, and other rates of change
2. Compute derivatives of functions using the differentiation formulas and apply the derivative as a function. Construct the equation of a tangent line to a function
3. Compute the derivatives of trigonometric functions, apply the chain rule, differentiate implicitly, take higher derivatives, solve problems with related rates, use linear and quadratic approximations of functions, and apply differentials to approximation problems
4. Find local and global maximum and minimum values of functions on various intervals, use Leibnitz’s theorem, Rolle's Theorem and the Mean Value Theorem to relate average and instantaneous rates of change, use the first and second derivative tests, concavity, points of inflection, asymptotes, and limits at infinity to sketch the graph of a function, use Newton's method to ascertain the roots of equations
5. Trace the curves: Cartesian, Polar, and Parametric curves, and rectify the curves
6. Identify and apply the cartesian, spherical, polar and cylindrical coordinate systems to solve engineering problems.

**Mapping of CLOs with PLOs**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO 01** | × | × |  | × | × |  |  |  |
| **CLO 02** | × | × | × |  | × |  |  |  |
| **CLO 03** | × | × | × |  | × |  |  |  |
| **CLO 04** | × |  |  | × | × |  | × |  |
| **CLO 05** | × | × |  | × | × |  | × |  |
| **CLO 06** | × | × | × | × | × |  | × |  |

**Books Recommended:**

1. G.B. Thomas and R.L. Finney, Calculus and Analytic Geometry, Ninth Edition.
2. R.A. Adams and C. Essex, A Complete course Calculus, Eight Edition.

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| **Course No.: SSS 100** | **Credit: 3.0** | **Year: First** | **Semester: First** |
| **Course Title: History of the Emergence of Independent Bangladesh** | | | **Course Status: Theory** |

**Course Rationale:**

This course deals with the following interrelated themes and topics that are essential to understand the emergence of Bangladesh. These themes include land and people, politics, economy, governance, society, religion and culture, global connections as well as the basic topics on the freedom struggle and War of Liberation. Issues under each of the broad themes will be discussed from the perspective of historical evolution and contemporary significance

**Course Objectives**:

The objectives of this course are to:

* offer insight into the historical changes
* provide knowledge of the long struggle for freedom
* provide students with a clear vision on War of Independence led by the Father of the Nation Bangabandu Sheikh Mujibur Rahman that have shaped today’s Bangladesh.

**Course Content:**

*Description of the country and its people:* Impact of Geographical features, Ethnic composition of Bangladesh, Development of Bengali Language and its impact, Cultural syncretism and religious tolerance, Distinctive identity of Bangladesh in the context of undivided Bangladesh; *Proposal for undivided sovereign Bengal, the partition of the Subcontinent, 1947 and Foreshadowing Bangladesh:* Rise of communalism under the colonial rule, Lahore Resolution 1940, The proposal of Suhrawardi and Sarat Bose for undivided Bengal : consequences, The creation of Pakistan 1947, Foundation of Awami Muslim League and Foreshadowing Bangladesh; *Pakistan: Structure of the state and disparity:* Central and provincial structure, Influence of Military and Civil bureaucracy, Economic, social and cultural disparity; *Language Movement and quest for Bengali identity:* Misrule by Muslim League and Struggle for democratic politics, The Language Movement: context, phases and International Recognition of Bengali Language, United front of Haque – Vasani – Suhrawardi: election of 1954, consequences; *Military rule: the regimes of Ayub Khan and Yahia Khan (1958-1971):* Definition of military rules and its characteristics, Ayub Khan’s rise to power and characteristics of his rule (Political repression, Basic democracy, Islamisation), Fall of Ayub Khan and Yahia Khan’s rule; *Rise of nationalism and the Movement for self-determination:* Resistance against cultural aggression and resurgence of Bengali culture, Sheikh Mujibur Rahman and the 6 points movement, Reactions: Importance and significance, The Agortola Case 1968; *The mass- upsurge of 1969 and 11 point movement:* Background, Programme, Significance; *Election of 1970 and its Inpact:* Legal Framework Order (LFO), Programe of different political parties, Election result and centres refusal to comply; *Non-cooperation Movement and 7th March Speech, 1971:* The non-cooperation movement, Speech of 7th March: Background of the speech, major characteristics of the speech, impact of this speech, International recognition of 7th March Speech as part of world heritage; *Declaration of Independence of Bangladesh:* Operation Searchlight, Declaration of Independence of Bangladesh by Bangobondhu, Beginning of the Liberation War of Bangladesh; *The war of Liberation 1971:* Genocide, repression of women, refugees, Formation of Bangladesh government and proclamation of Independence, The spontaneous early resistance and subsequent organized resistance (Mukti Fouz, Mukti Bahini, guerillas and the frontal warfare), Publicity Campaign in the war of Liberation (Shadhin Bangla Betar Kendra, the Campaigns abroad and formation of public opinion), Contribution of students, women and the masses (Peoples war) and different political parties, The role of Great powers and the United Nations in the Liberation war, The contribution of India in the Liberation War, The Anti-liberation activities of the occupation army, the Peace Committee, Al-Badar, Al-Shams, Rajakars, pro-Pakistan political parties and Pakistani Collaborators, killing of the intellectuals, Trial of Bangabandhu and reaction of the World Community, Formation of joint command and the Victory, The overall contribution of Bangabandhu in the Independence struggle; *The Bangabandhu Regime 1972-1975:* Homecoming; Speech of 10 January, Making of the constitution, Reconstruction of the war-ravaged country, Foreign Policy of Bangabandhu; Bangabandhu’s First Speech in the United Nations The murder of Bangabandhu and his family and the ideological turn-around.

**Course Learning Outcomes:**

At the end of the course, students will:

1. have a broader understanding and further curiosity of the rich history, culture and heritage of the country
2. be able to appreciate the importance and relevance of history as a bridge between the past, present and the future.

**Mapping of CLOs with PLOs**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO 01** | × |  |  |  |  | × |  | × |
| **CLO 02** |  |  |  |  |  | × |  |  |

**Books Recommended**

1. Ahmed, Salahuddin and Bazlul Mobin Chowdhury (eds.), *Bangladesh: National Culture and Heritage: An Introductory Reader* (Dhaka: Independent University Bangladesh, 2004)
2. Harun-or-Roshid, *The Foreshadowing of Bangladesh: Bengal Muslim League and Muslim Politics, 1906-194*7 (Dhaka : The University Press Limited, 2012)
3. Jahan Rounaq, *Pakistan: Failure in National Integration,(Dhaka :* The University Press Limited, 1977)
4. Maniruzzaman Talukder, *Radical Politics and the Emergence of Bangladesh, (Dhaka :* Mowla,Brothers, 2003)
5. Muhith, A M A, *History of Bangladesh: A Subcontinental Civilization*, (Dhaka: UPL, 2016)
6. Samad Abdus, *History of Liberation War of Bangladesh*, (Dhaka : Aparajeyo Bangla Prakashani, 2019)
7. Milton Kumar Dev, Md. Abdus Samad, *History of Bangladesh* (Dhaka : Biswabidyalya Prokasoni, 2014)
8. Schendel, Willem van : *A History of Bangladesh* (Cambridge: Cambridge University Press, 2009)
9. †kL gywReyi ingvb : *Amgvß AvZ¥Rxebx, (*XvKv : w` BDwbfvwm©wU †cÖmwjwg‡UW, 2012)
10. bxnviiÄbivq : *evOvjxi BwZnvm, (*KjKvZv : †`Õ R cvewjwks, 1402 mvj)
11. mvjvn& DwÏb Avn‡g` I Ab¨vb¨ (m¤úvw`Z), *evsjv‡`‡ki gyw³ msMÖv‡gi BwZnvm* 1947-1971, (XvKv : AvMvgx cÖKvkbx, 2002)
12. Aveyj gvj Ave`yj gywnZ : *evsjv‡`k: RvwZiv‡óªi D™¢e, (XvKv :* mvwnZ¨ cÖKvk, 2000)
13. wmivRyj Bmjvg (m¤úvw`Z), *evsjv‡`‡ki BwZnvm 1704-1971,* 3 LÛ, (XvKv : GwkqvwUK †mvmvBwU Ae evsjv‡`k, 1992)
14. nviæb-Ai-iwk` : *e½xq gymwjg jxM cvwK¯Ívb Av‡›`vjb evOvwji ivóªfvebv I e½eÜz,* (XvKv : Ab¨ cÖKvkb, 2018)
15. হাসান হাফিজুর রহমান : *বাংলাদেশের স্বাধীনতাযুদ্ধ দলিলপত্র*, (m¤úvw`Z), (ঢাকা: MYপ্রজাতন্ত্রী বাংলাদেশ সরকার, ১৯৮৫)
16. ˆmq` Av‡bvqvi †nv‡mb : *evsjv‡`‡ki ¯^vaxbZvhy‡× civkw³i f~wgKv,* (XvKv :Wvbv cÖKvkbx, 1982)
17. gybZvmxi gvgyb I Ab¨vb¨, *¯^vaxb evsjv‡`‡ki Afy¨`‡qi BwZnvm*, (XvKv: myeY©, 2017)
18. Avey †gv †`‡jvqvi †nv‡mb, *¯^vaxb evsjv‡`‡ki Afy¨`‡qi BwZnvm*, (XvKv : wek¦we`¨vjq cÖKvkbx, 2014)
19. AvkdvK †nv‡mb, *¯^vaxb evsjv‡`‡ki Afy¨`‡qi BwZnvm*, (XvKv: cÖwZk~Y¨ cÖKvkb, 2019)
20. Avey †gv †`‡jvqvi †nv‡mb, *evsjv‡`‡ki BwZnvm, 1905-1971,*
21. AvkdvK †nv‡mb : *evsjv‡`‡ki gyw³hy× I RvwZmsN*, (XvKv: evsjv GKv‡Wwg, 2003)
22. Avey †gv. †`‡jvqvi †nv‡mb, W. †gvnv¤§` †mwjg (m¤úv`bv) : *evsjv‡`k I ewnwe©‡k¦, (*XvKv : evsjv‡`k BwZnvm mwgwZ, 2015)
23. AvkdvK †nv‡mb, *evsjv‡`‡ki gyw³hy× I Bw›`ªiv MvÜx* (XvKv : myeY© cÖKvkbx, 2017)

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| **Course No.: ENG 101** | **Credit: 2.0** | **Year: First** | | **Semester: First** |
| **Course Title: Effective Communication in English** | | | **Course Status: Theory** | |

**Course Rationale:**

This course will develop two basic skills i.e. reading and writing. A variety of reading strategies and texts will be used to effectively develop first year students’ academic reading skills thereby facilitating their future study. Also, the course focuses on developing the writing skills of students by familiarizing them with grammar rules, providing them with practice thereby enabling them to demonstrate the accurate use of grammar in their writing.

**Course Objectives:**

The objectives of this course are to:

* enable students to write with accuracy
* facilitate effective and comprehensible writing
* raise awareness of common errors that occur in writing
* develop student’s ability to understand write-ups on issues of general concern.
* improve the vocabulary of learners for effective communication.

**Course Content:**

*Reading*: Different Reading Strategies, Guessing Meaning from the Context, Critical Reading (Analyze), Critical Reading (Synthesize), Critical Reading (Evaluate), Annotation, Summary writing. *Material*: A selection of 08-10 editorials and reports from newspapers/ magazines/journals, etc.; Reading texts in New Headway Upper Intermediate Student’s Book (Current edition); Selected passages from recommended books; A selection of other material may be supplied as handouts as deemed necessary by the instructor. *Writing*: Forms and functions of different word categories (Noun, verb, adjective, etc.); Aspects and uses of tense; Subject-verb agreement; Use of infinitive, gerund, present participle, past participle, modals, causatives, conditionals, subjunctives, modals. Use of sentence connectors/ cohesion markers/ punctuation. Effective combination of sentences (simple, complex, compound); Developing a paragraph.

**Course Learning Outcomes:**

At the end of the course, students will be able to:

1. understand grammar rules
2. produce grammatically correct meaningful sentences
3. express oneself correctly by using appropriate words, phrases, sentences or ideas
4. think critically (reflect on a text, grasp abstract ideas and interpret them effectively arrive at well-reasoned conclusions and solutions).
5. extract information accurately.

**Mapping of CLOs with PLOs**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO 01** |  |  |  |  |  | × |  |  |
| **CLO 02** |  |  |  |  |  | × |  |  |
| **CLO 03** |  |  |  |  |  | × |  |  |
| **CLO 04** |  |  |  |  | × | × |  |  |
| **CLO 05** |  | × |  |  |  | × |  |  |

**Evaluation:**

* IELTS, TOEFL and other standardized testing formats for assessing the level of reading skill are to be followed. Test items may be as follows: fill in blanks, true/false, multiple choice/ matching word meanings/ information transfer/matching titles with relevant paragraphs in the text, etc.
* Reading skill will be tested on two reading texts. One reading text will be taken from one of the selections students have already read during the semester. The other reading text will be similar in terms of contents and difficulty but will not have been previously discussed.

**Books Recommended**

1. Tibbits, E. E. ed. Exercises in Reading Comprehension. Longman
2. Liz and John Soars. (Current edition). New Headway Upper Intermediate Student’s Book. Oxford: Oxford University Press
3. Cliff’s TOEFL
4. Resources recommended by course instructors

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| **Course No.: ENG 102** | **Credit: 1.0** | **Year: First** | **Semester: First** |
| **Course Title: English Language Lab - 1** | | **Course Status: Lab** | |

**Course Rationale:**

This course is designed to improve the speaking and listening skills of students in the English language. Emphasis is laid on proper pronunciation for accurate articulation and recognition of speech sounds as well as correct stress, intonation and language use in varied situations.

**Course objectives:**

The objectives of this course are to:

* enable students’ understanding of the variations in pronunciation
* teach proper pronunciation and accurate articulation
* facilitate appropriate stress and intonation in speech
* encourage use of English effectively in everyday situations
* ensure overall improvement of oral communication through listening and speaking.

**Course Content:**

*Speaking*: Articulators, English Phonetic Alphabet (British and American) and International Phonetic Alphabet (IPA), Stress rules of English, Intonation rules and functions of intonation, Communication Styles and Cultural Context, Fluency, mistakes, misunderstandings, audience, taboos, self-esteem, confidence; *Activities*: dialogue, debate, extempore speech, interview, role-play. *Listening:* Basics of listening, Various types of Pronunciation, IPA, RP, Transcription, Different accents and intonation patterns, Activities for Meaning-focused Listening, Information Transfer Strategies, Listening Practice through selection of audio clips.

**Course learning outcomes:**

At the end of the course, students will be able to:

1. read the symbols of the International Phonetic Alphabet used to represent the sounds of the English language
2. understand all that is being said in English in varied accents
3. determine what is being heard and gather information accurately
4. apply appropriate intonation and stress patterns in English words and sentences
5. produce continuous speech clearly and convincingly.

**Mapping of CLOs with PLOs**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
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| **CLO 02** |  |  |  |  |  | × |  |  |
| **CLO 03** |  | × |  |  |  | × |  |  |
| **CLO 04** |  |  |  |  |  | × |  |  |
| **CLO 05** |  |  |  |  |  | × |  |  |

**Evaluation**

* IELTS, TOEFL and other standardized testing formats for assessing the level of listening skill are to be followed. Test items may be as follows: fill in blanks, true/false, multiple choice/matching word meanings/ information transfer/matching, etc.
* Speaking skill will be tested through dialogue, debate, extempore speech, presentation, role-play etc.

**Books Recommended**

1. Anderson, A. & Lynch, T. Listening. Oxford: Oxford University Press.
2. Hancock, Mark. English Pronunciation in Use. New York: Cambridge University Press.
3. Anderson, Kenneth, et al. Study Speaking. Cambridge University Press.
4. Hancock, Mark. English Pronunciation in Use. Cambridge University Press.
5. Jones, Daniel. Cambridge English Pronunciation Dictionary. Cambridge University Press.
6. Richards J, et al. Person to Person. Oxford University Press.
7. Richards, Jack C, and David Bohlke. Speak Now: 1. Oxford University Press.
8. Roach, Peter. English Phonetics and Phonology. Cambridge University Press.

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| **Course No.: IPE 144** | **Credit: 1.5** | **Year: First** | **Semester: First** |
| **Course Title: Workshop Practice** | | **Course Status: Sessional** | |

**Rationale of the Course:**

To have a balanced overall development of IPE graduates, it is necessary to integrate theory with practice. Workshop practice includes basic knowledge about manufacturing those are essential for further study of the engineers. It provides practical knowledge about different hand tools and machine tools. Overall student can use the gathered knowledge to develop a product.

**Course Objectives:**

The objectives of this course are to:

* inform student about different types of hand tools and their uses
* accumulate basic knowledge about different types of machine tools including their components and functions
* provide the opportunity to use gathered knowledge practically
* encourage student performing teamwork.

**Course Content:**

Introduction to workshop tools; Study and operation of an Engine Lathe; Study and operation of Milling machine; Study and operation of Radial Drilling machine; Study and operation of Surface Grinding machine; Preparation of a hexagonal nut.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

1. identify different types hand tools and their purposes
2. specify and differentiate different types of machine tools used in manufacturing industries
3. identify different components of engine lathe, milling machine, radial drilling machine and surface grinding machine and know about their respective functions
4. perform different operations that can performed in the selected machine
5. develop a product in team based on the design specifications.

**Mapping of CLOs with PLOs**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO 1** | × |  |  |  |  |  |  |  |
| **CLO 2** | × | × |  |  |  |  |  |  |
| **CLO 3** | × | × |  |  |  |  |  |  |
| **CLO 4** | × |  |  |  |  |  |  |  |
| **CLO 5** | × | × |  |  | × | × |  |  |

**Books Recommended:**

1. Mikell P. Groover, Fundamentals of Modern Manufacturing Materials, Processes, and Systems, John Wiley & Sons, Inc.
2. J.T. Black and Ronald A. Kohser, DeGarmo’s Materials and Processes in Manufacturing, John Wiley & Sons, Inc.
3. Serope Kalpakjian and Stevan R. Schmid, Manufacturing Engineering and Technology, Prentice Hall.

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| **Course No.: IPE 122** | **Credit:1.5** | **Year: First** | **Semester: First** |
| **Course Title: Engineering Graphics** | | **Course Status: Sessional** | |

**Rationale of the Course:**

This course is a practical application of knowledge pertaining to all geometric features of a whole product, or assembly or sub-assemblies. Pictorial presentation by means of geometric shapes, lines, and dimensions is mandatory for engineering students. All engineering students need to have basic engineering graphics knowledge to express their thoughts and ideas.

**Course Objectives:**

The objectives of this course are to:

* provide the students with necessary skill to read, understand, and create mechanical engineering drawing
* familiarize the students to acquire and use engineering drawing skills on creating accurate, clear sketches of different mechanical objects following the information and instructions
* make students able to draw different types of angle projections, orthographic views, auxiliary, sectional views, isometric views, etc.
* enable students to acquire requisite knowledge required for advanced study of engineering drawing
* apply the drawing and drafting skills as problem-solving tools to resolve the primary design issues.

**Course Content:**

Introduction, Instruments and their uses, First angle and third angle projections, Orthographic drawing, Sectional views. Isometric views, Missing lines and views.

**Course Learning Outcomes, CLOs**

Upon successful completion of this course, student have reliably demonstrated the ability to:

1. understand the basic tools and techniques for making engineering drawings, and apply them to a wide range of engineering fields such as mechanical engineering, civil and architectural design, chemical process, etc.
2. create freehand sketches of visual expressions of technical ideas and can interpret common types of engineering drawings
3. understand the purpose of geometric shapes, signs and symbols, abbreviations and dimensional values found on engineering drawings
4. utilize graphic techniques to understand the relationships between real-world components and views of the components (orthographic, auxiliary, sectional, isometric views, etc.)
5. produce a formal engineering drawing according to standard drafting practice
6. participate in design reviews or technical meetings in a company concern to mechanical component and assembly suppliers

**Mapping of CLOs with PLOs**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| CLO 01 | **×** | **×** |  |  |  |  |  |  |
| CLO 02 | **×** | **×** |  | **×** | **×** |  |  |  |
| CLO 03 | **×** | **×** |  | **×** |  |  |  |  |
| CLO 04 | **×** | **×** |  | **×** | **×** | **×** |  |  |
| CLO 05 |  |  |  | **×** | **×** | **×** |  |  |
| CLO 06 |  |  |  |  | **×** | **×** |  |  |

**Books Recommended:**

1. K.V. Reddy, Textbook of Engineering Drawing, BS Publications, India.
2. K. Rathnam, A First Course in Engineering Drawing, Springer Nature Singapore Pte Ltd.
3. M.B. Shah and B. C. Rana, Engineering Drawing, Dorling Kindersley (India) Pvt Ltd.
4. Colin H. Simmons and Denis E. Maguire, Manual of Engineering Drawing to British and International standards, 2e, Elsevier Newnes, Oxford.
5. K. Morling, Geometric and Engineering Drawing, Elsevier Ltd. USA.

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| **Course No: IPE 152** | **Credit: 1.0** | **Year: First** | | **Semester: First** |
| **Course Title: Business Communication Seminar I** | | | **Course Status: Sessional** | |

**Rationale of the Course:**

Nowadays, engineering students’ communication skill development has gained considerable attention from the institutions providing accreditation and assuring quality for engineering education. Business communication seminar-I is designed to provide students with the necessary structure, resources, and support to successfully communicate both in written and speaking format. Hence, this course provides the students with opportunities to develop writing, communication, and teamwork skills for academic report writing and presentation.

**Course Objectives:**

The objectives of this course are to:

* acquaint students with the necessary knowledge about writing an academic/professional report
* provide practical guidance on writing a concise and effective report.
* develop the ability to accurately and clearly transmit messages to the intended audience in the most effective and acceptable manner
* enable the students to make a presentation easy-to-follow and interesting
* understand and apply basic principles of technical proficiency considering ethical issues.

**Course Content:**

This sessional course consists of the fundamental concept of academic communication. This will cover two parts. Presentation: relevance in the current world and country context, for instance, the history, scope and application of industrial and production engineering. Academic writing: application of concepts of academic writings, for instance, assignment, report for sessional courses, CV, and discussion in various aspects.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

**CLO 01:** utilize analytical and problem-solving skills appropriate to business communication.

**CLO 02:** discuss a given topic in a professional meeting as well as in a public seminar

**CLO 03:** apply academic writing principles to prepare a report professionally on a given topic

**CLO 04:** communicate effectively with the team members as well as with the target audience.

**CLO 05:** prepare a professional presentation using computer technology.

**Mapping of CLOs with PLOs**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO 01** | **×** |  |  |  | **×** |  |  |  |
| **CLO 02** |  |  |  |  |  | **×** |  |  |
| **CLO 03** | **×** |  |  |  |  |  |  |  |
| **CLO 04** |  |  |  |  | **×** | **×** |  |  |
| **CLO 05** |  |  |  |  |  |  |  |  |

**First Year Second Semester**

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| **Course No.: IPE 121** | **Credit: 3.0** | **Year: First** | **Semester: Second** |
| **Course Title: Engineering Mechanics** | | **Course Status: Theory** | |

**Rationale of the Course:**

This course introduces the basic principles of mechanics necessary for the engineering students. It focuses on the modeling and analyzing of static equilibrium concept based on real life engineering applications and necessary knowledge about solving the problems.

**Course Objectives:**

The objectives of this course are to:

* provide necessary knowledge about basic principles of mechanics
* help students to analyze and solve problems related to static equilibrium
* make the students understand the structural analysis
* provide the students with knowledge about centroid, first moment of inertia, second moment of inertia of an area and effect of friction
* help the students to develop ability to solve the engineering problems related to kinematics and kinetics.

**Course Content:**

Basic concepts of Mechanics: Statics: Statics of particles and rigid bodies. Centroids of lines areas and volumes; Forces in truss, frames, and cables; Friction; Moment of inertia of areas and masses; Relative motion. Dynamics: Kinetics of particles: Newton's second law of motion, Principles of work, energy, impulse, and momentum; System of particles: Kinematics of rigid bodies; Kinetics of plane motion of rigid bodies, forces, and acceleration; Principles of work and energy.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

**CLO 1**: implement the basic principles of mechanics to analyze and solve real life engineering problems

**CLO 2:** design and analyze different structures under loading conditions

**CLO 3:** analyze the effect of friction on a body

**CLO 4:** evaluate the importance of different laws of forces on the body and apply them in real context

**CLO 5:** solve problems related to kinematics and kinetics.

**Mapping of CLOs with PLOs**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO 1** | × |  |  | × | × |  |  |  |
| **CLO 2** | × | × |  | × | × |  |  |  |
| **CLO 3** |  |  |  | × | × |  |  |  |
| **CLO 4** | × |  |  | × | × |  |  |  |
| **CLO 5** | × | × |  | × |  |  |  |  |

**Books Recommended:**

1. Ferdinand P. Beer, E. Russell Johnston, Jr., David F. Mazurek and Phillip J. Cornwell, Vector Mechanics for Engineers, McGraw Hill.
2. R.S. Khurmi, A Textbook of Engineering Mechanics, S. Chand Publications.
3. Russell C. Hibbeler, Engineering Mechanics: Statics & Dynamics, Pearson

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| **Course No: IPE 123** | **Credit: 3.0** | **Year: First** | **Semester: Second** |
| **Course Title: Engineering Materials** | | **Course Status: Theory** | |

**Rationale of the Course:**

Knowledge of engineering materials is required when working in any area of designing and fabricating a product. The state-of-art engineering materials is a key aspect of most industries all over the world. In the race to make things stronger, cheaper, lighter, more functional and more sustainable, the modification of materials and their properties are vital. This course will help them understand the fundamental and practical aspects of a wide range of engineering materials such as metals and their alloys, ceramics, composites etc. The course will prepare students to make appropriate materials selection for design and other applications taking account of the interaction of structure, manufacture, properties and design.

**Course Objectives:**

The objectives of this course are to:

* facilitate necessary knowledge about the fundamental and practical aspects of a wide range of engineering materials used in practice to fabricate a product
* provide students with an understanding of how the mechanical and other properties of a material are a function of its atomic crystal structure and microstructures
* give students an understanding of why and how material properties can be tailored to suit a particular application by the use of thermal treatments
* help the students to interpret and use a variety of phase transformations using binary phase diagrams
* make qualitative comparisons among production processes, compositions, properties and application areas for the most commonly used ferrous and non-ferrous alloys including composites.

**Course Content:**

Fundamentals: Types of engineering materials, Mechanical and other important properties, Structures of materials; Material Testing: Mechanical and non-destructive tests of materials; Phase diagram: Binary and ternary phase diagrams (e.g. Iron-carbon equilibrium diagram); Heat Treatments: Annealing, normalizing and quenching processes, hardening (e.g. case hardening, carburizing, nitriding and induction hardening) processes; Carbon Steels: Plain carbon and alloy steels; Pig iron, Cast iron and Steels: Their production methods, types and uses, effects of impurities/alloying elements in steels; Light Metal Alloys: Common light metals and their alloys; Composites: Theory of composites, their types, structures, properties and uses (Particle-reinforced, fibre-reinforced, structural, and nanocomposites); Powder Metallurgy: Compaction and sintering.

**Course Learning Outcomes, CLO**

After successful completion of the course, students will be able to:

**CLO 01:** explain the classification schemes that are used to categorize engineering materials and identify characteristic properties of engineering materials made of metals, ceramics and polymers

**CLO 02:** describe why each of the fundamental mechanical properties of materials covered in the course are important in engineering design and calculate engineering stress, strain and the elastic modulus from data for basic engineering applications

**CLO 03:** apply the engineering knowledge in real-life problems by evaluating mechanical properties using different destructive and nondestructive testing methods

**CLO 04:** analyze binary phase diagrams to predict microstructures and explain how thermal treatments affect the microstructure and thus, properties of materials

**CLO 05:** explain the underlying mechanisms for both bulk hardening and surface hardening methods used for metals

**CLO 06:** distinguish various types of production processes, compositions, properties and application areas for the most common used ferrous alloys

**CLO 07:** describe basic properties and applications of light metal alloys

**CLO 08:** understand the principles of commonly used composite materials and assess the applicability and selection of a composite material for a variety of applications

**CLO 09:** interpret the principles of powder metallurgical techniques.

**Mapping of CLOs with PLOs**

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| **PLO CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO 01** | × |  |  |  |  |  |  |  |
| **CLO 02** | × |  | × |  | × |  |  |  |
| **CLO 03** | × | × |  |  | × |  |  |  |
| **CLO 04** |  |  |  |  | × |  |  |  |
| **CLO 05** | × |  |  |  |  |  |  |  |
| **CLO 06** | × |  |  | × |  |  |  |  |
| **CLO 07** | × |  |  |  |  |  |  |  |
| **CLO 08** | × |  |  | × |  |  |  |  |
| **CLO 09** | × |  |  | × |  |  |  |  |

**Books Recommended:**

1. William D. Callister and David G. Rethwisch, Materials Science and Engineering an Introduction, John Wiley.
2. Donald R. Askeland, Pradeep P. Fulay and Wendelin J. Wright, The Science and Engineering of Materials, Cengage Learning.
3. Sidney H. Avner, Introduction to Physical Metallurgy. McGraw Hill.
4. Michael F. Ashby, Materials Selection in Mechanical Design, Butterworth-Heinemann
5. William F. Hosford, Physical Metallurgy, CRC Press
6. G. E. Dieter. Mechanical Metallurgy, McGraw Hill.

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| **Course No.: MAT 104G** | **Credit: 3.0** | **Year: First** | **Semester: Second** |
| **Course Title: Integral Calculus and Differential Equations** | | | **Course Status: Theory** |

**Rationale of the Course:**

This course provides the essential mathematical techniques of engineering. These are the methods of multivariable integral calculus and differential equations. The course consists of topics in ordinary differential equations and applications, and multiple integral and techniques with applications to various engineering problems. It will provide the students with a solid foundation for further study in engineering.

**Course Objectives:**

The objectives of this course are to:

* engage students in sound mathematical thinking and reasoning
* facilitate the necessary knowledge about the fundamental aspects of integral calculus and differential equations
* develop students’ skills in understanding techniques to solve the problems of integral calculus and differential equations
* help the students understand how to analyze the structure of real-world problems and solution strategies.

**Course Content:**

*Integral calculus*: Definition of integration, integration by method of substitution, integration by parts, standard integrals, method of successive reduction. Definite integral, its properties and use in summing series. Walli’s formulae. Improper integral, Beta and Gamma function. Area under a plane curve in cartesian and polar coordinates, area of the region enclosed by two curves in cartesian and polar coordinates, Arc length of curves in cartesian and polar coordinates, volumes of solid of revolution; area of surface of revolution. *Differential Equations*: Ordinary differential equation and formation of differential equations, Solution of first order differential equations with various methods. Solutions of second order and higher order linear equations with constant coefficients in general. Solutions of homogeneous linear differential equations and its applications. Solution of differential equations of the higher order when the dependent and independent variables are absent. solutions of differential equations by the method based on factorization of the operators.

**Course Learning Outcomes, CLO**

After successful completion of the course, students will be able to:

1. acquire the skills to calculate the indefinite integral, definite integrals and improper integrals
2. apply the ideas of accumulation to calculate areas and volumes
3. analyze and combine ideas of accumulation in new contexts not specifically covered in the text
4. formulate differential equation in different area of science and engineering
5. give an account of basic concepts and definitions for ordinary differential equations
6. apply the fundamental concepts of ordinary differential equations for their resolution
7. solve the differential equations of science and engineering problems by choosing the most suitable method
8. formulate and solve differential equation problems in the field of engineering.

**Mapping of CLOs with PLOs**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO 01** | × |  | × |  |  |  |  |  |
| **CLO 02** | × | × | × | × |  |  |  |  |
| **CLO 03** | × |  | × | × | × |  |  |  |
| **CLO 04** | × |  |  | × | × |  |  |  |
| **CLO 05** | × |  | × |  | × | × | × |  |
| **CLO 06** | × |  | × |  | × | × | × |  |
| **CLO 07** | × |  | × |  | × | × | × |  |
| **CLO 08** | × | × | × | × | × |  | × |  |
| **CLO 09** |  | × | × | × | × |  | × |  |

**Books Recommended:**

1. G.B. Thomas and R.L. Finney, Calculus and Analytic Geometry, 9th Edition.
2. W.E. Boyce and R.C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edition.

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| **Course No: CEP 101** | **Credit: 2.0** | **Year: First** | **Semester: Second** |
| **Course Title: Chemical Process Technology** | | **Course Status: Theory** | |

**Rationale of the Course:**

A production engineer must possess a general view on different types of chemical productions, processes and equipment being under operation in their plants. The aim of the course is to provide knowledge about processes in natural chemical industries.

**Course Objectives:**

The objectives of this course are to:

* familiarize with different types of chemical industries
* make students understand the manufacturing technology of various inorganic and organic products
* acquaint students with the process flow diagram and various process parameters
* help students to develop ability in identifying and solving engineering problems of chemical industries.

**Course Content:**

*Pulp and Paper Industries:* Natural source of the cellulose, constituents associated with cellulose,  
mfg. of different types of pulp paper boards, black lacquer recovery, deinking of waste paper, pulp and paper industries in Bangladesh. *Soap and Detergent Industries*: Raw materials, manufacturing of different types of soap, recovery of the glycerin, classification of the detergents, industrial processing for the alkyl arylsulphonates (AAS), environmental pollution by detergents. Bio degradability of detergent. *Introduction of Chemical fertilizer:*Nitrogenous fertilizer, Raw materials of ammonia production of synthesis gas in ammonia plants, technology of urea manufacturing; Process used in Urea industries of Bangladesh.*Cement industries:*Raw materials, Composition, properties and uses different types of cements, Manufacture of cement by different methods, setting and hardening of cement, testing of cement.*Lubricants***:** Various types of lubricants, Production of lubricants, Properties of Various types of lubricants.

**Course Learning Outcomes, CLO**

After successful completion of the course, students will be able to:

1. discuss about the basic principle of paper making process and draw the flow diagram of industrial process
2. clarify the cleansing action of soap and detergent and their impact on environmental pollution
3. concept of nitrogenous fertilizer manufacturing processes and their prospect in Bangladesh
4. describe manufacturing method of clinker, setting and hardening mechanism of cement
5. understand the conepts of friction, wear, and practical importance of lubrication.

**Mapping of CLOs with PLOs**

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| **PLO CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO 01** | × | × | × | × |  |  |  |  |
| **CLO 02** | × |  |  | × |  |  |  |  |
| **CLO 03** | × |  | × | × |  |  |  |  |
| **CLO 04** | × | × | × |  |  |  |  |  |
| **CLO 05** | × |  |  |  |  |  |  |  |

**Books Recommended:**

1. G.N Pandey; A Text Book of Chemical Technology Vol. I and II
2. N. Austin; Chemical Process Industries.
3. Anderson and Winzet; Introduction to Chemical Engineering
4. Riegl; Industrial Chemistry
5. B. K. Sharma; Industrial Chemistry
6. S.S. Dara; A text book of Engineering Chemistry

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| **Course No: CHE 101G** | **Credit: 3.0** | **Year: First** | **Semester: Second** |
| **Course Title: General Chemistry** | | **Course Status: Theory** | |

**Course Objectives:**

The objectives of this course are to:

* familiarize the students with the basic concept of electronic structure
* acquire the knowledge about the properties of elements on the periodic table
* understand the concept of chemical formula and equation
* acquire the basics of acid-base concepts and apply them to identify different acids and bases
* understand gaseous state of matter and their properties
* introduce preliminary ideas of chemical equilibrium and kinetics
* acquaint students with the fundamentals of organic chemistry.

**Course Content:**

**Atoms, molecules and ions:** Atomic Theory, components of atoms. **Electronic Structure:** The quantum theory, atomic spectrum of hydrogen and the Bohr model, Quantum numbers, Energy levels and orbital, Electronic configuration, Chemical bonding and molecular structure. **The periodic Table:** Development of the periodic table, Electron arrangements and the periodic table, Summarized chemical properties of s-block, p-block, d-block and f-block elements. **Chemical formulas and equations:** Types of formulas, Percent composition from formula, Formulas from experiment, Formulas of ionic compounds, Names of compounds, Writing and balancing chemical equations, Mass relations in reactions, Limited reactant and theoretical yield. Concept of mole, Solution: different concentration units. **Acids and Bases:** Theories and Modern definition of acids and bases, Dissociation constant, strength, pH, Buffer solution etc. **Gases:** Measurement on gases, the ideal gas law, Volumes of gases involved in reactions, Gas mixtures, Partial pressure, Kinetic theory of gases, Real gases. **Introduction to Chemical Kinetics:** Rate laws, rate constant, equilibrium constant, order of reaction etc. **Organic Chemistry:** Introduction**,** Classification, Nomenclatures, preparations and Properties (Physical & Chemical) of (i) Aliphatic and aromatic hydrocarbons, (ii) Aldehydes and ketones, (iii) Carboxylic acids and (iv) Alcohols and phenols (v) Carbohydrates (mono- and disaccharides). **Chemistry of Fuels** (Hydrocarbon, Hydrogen), **Fertilizer, & Medicine.**

**Course Learning Outcomes:**

After the successful completion of the course, students will be able to

1. classify elements, correlate atomic models, orbit & orbitals, electron distribution & energy level, hydrogen spectral series etc.
2. apply different principles to determine the configuration for any atom or ion
3. explain the development of the periodic table of elements, analyze and compare periodic trends in physical and chemical properties of elements in periodic table
4. identify and explain the metallic and non-metallic characters of elements across the periodic table
5. calculate the percent composition of a compound and derive empirical formulas from experimental data
6. understand the concept and use of different concentration unit, limiting reactant and percent of yield
7. define and apply the modern concepts of acids and bases to identify and classify the acids and bases and their strength and explain acidic and basic properties of species
8. understand the ideal gas laws and its application on real system
9. calculate volume, pressure, and temperature of gases based on the ideal gas laws
10. understand the relationship between chemical kinetics and equilibrium
11. name and understand the proper structure of different organic compounds
12. predict physical and chemical properties of different organic compounds.

**Mapping of CLOs with PLOs**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO 01** | × |  |  |  |  |  |  |  |
| **CLO 02** | × |  |  |  |  |  |  |  |
| **CLO 03** | × |  | × |  | × |  |  |  |
| **CLO 04** | × |  |  |  |  |  |  |  |
| **CLO 05** |  |  | × |  | × |  |  |  |
| **CLO 06** | × |  |  |  |  |  |  |  |
| **CLO 07** | × |  |  | × |  |  |  |  |
| **CLO 08** |  |  | × |  | × |  |  |  |
| **CLO 09** | × |  |  |  |  |  |  |  |
| **CLO 10** | × |  |  |  |  |  |  |  |
| **CLO 11** | × |  |  |  |  |  |  |  |
| **CLO 12** |  |  |  |  |  |  |  |  |

**Books Recommended:**

1. S. Z. Haider, *Introduction to Modern Inorganic Chemistry.*
2. Haque and Mollah, *Physical Chemistry*
3. R. T. Morrison and R. N. Boyd, *Organic Chemistry* (6th edition)
4. Raymond Chang, *General Chemistry*

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| **Course No: CHE 102G** | **Credit: 1.5** | **Year: First** | **Semester: Second** |
| **Course Title: Chemistry Practical** | | **Course Status: Practical** | |

**Course Objectives:**

The objectives of this course are to:

* Familiarize students with the qualitative analysis of inorganic salts
* Acquaint students with the qualitative analysis of organic functional groups
* Accumulate practical skill on titration

**Course Content:**

*Qualitative analysis of inorganic salts:*Separation and identification of group I cations; Separation and identification of group II cations; Separation and identification of group IIIA and IIIB cations; Separation and identification of group IV cations; Separation and identification of group V cations; Identification of anions. *Qualitative analysis of organic salts:*Analysis of the functional groups of organic compounds. *Quantitative analysis:*Standardization of NaOH solution with standard oxalic acid solution.

**Course Learning Outcomes:**

After the successful completion of the course, students will be able to:

1. identify analytical group cations in the solution of inorganic salt
2. design an analytical scheme to separate and identify the known ions from a mixture of inorganic salts
3. apply designed analytical scheme to separate and identify the unknown ions from a mixture of inorganic salts
4. identify the functional group(s) presence in an organic compound and then perform a confirmatory test
5. determine the concentration of an unknown solution using a standard solution of known concentration.

**Mapping of CLOs with PLOs**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO 01** |  |  | × |  | × |  |  |  |
| **CLO 02** |  |  |  | × |  |  |  |  |
| **CLO 03** | × |  |  | × |  |  |  |  |
| **CLO 04** |  |  |  |  | × |  |  |  |
| **CLO 05** |  |  | × |  |  |  |  |  |

**Books Recommended:**

1. Vogel, *Qualitative Inorganic Analysis*
2. A.I. Vogel, *A Text Book of Practical Organic Chemistry*
3. A.I. Vogel, *Elementary Practical Organic Chemistry* (Part 1)
4. Vogel, *Text book of Quantitative Analysis.*

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| **Course No.: IPE142** | **Credit: 1.5** | **Year: First** | | **Semester: Second** |
| **Course Title: Manufacturing Processes - I Sessional** | | | **Course Status: Sessional** | |

**Rationale of the Course:**

This sessional provides hands-on experience on various manufacturing processes learned in Manufacturing Processes-I. Integration of practical experiences with prior knowledge of basic manufacturing process, develops the competency of the graduates on traditional manufacturing processes. This course also develops understanding of workplace safety practices along with right attitude, and collaborative teamwork.

**Course Objectives:**

The objectives of this course are to:

* acquaint students with the conventional machine tools used in workshop as well as its parts and related functions
* develop skill in performing various machining operations on the machine tools and getting idea about associated machining parameters
* help students develop the ability to compare and contrast among different types of welded joints as well as different types of welding techniques
* develop skills in design and fabrication of sand casting
* develop culture of obeying safety practices and use of personal protective equipment
* help students develop ability to work in a team.

**Course Content:**

Study and operation of Engine Lathe and turning related operations. Study and operation of Surface Grinding and grinding related operations. Study and operation of different types of welded joints: soldering, brazing, gas welding. Study and operation of different types of welding techniques, e.g., SMAW, TIG and MIG. Design and fabrication of sand casting molds using supplied pattern.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

**CLO 01**: specify various machine tools such as engine lathe, and surface grinding machine

**CLO 02**: identify various components of an engine lathe, and surface grinding machine and describe their respective functions

**CLO 03**: perform various machining operations on engine lathe, and surface grinding machine individually and record, calculate, and interpret the machining parameters

**CLO 04**: distinguish among different types of welded joints as well as different types of welding techniques and interpret the characteristics of each

**CLO 05**: perform welding operations using different types of welding techniques to produce different types of welded joints individually

**CLO 06**: apply their knowledge to design a sand casting mould according to desired specifications

**CLO 07**: practice team effort to fabricate sand casting mould using the supplied pattern.

**Mapping of CLOs with PLOs**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO 01** | × |  |  |  |  |  |  |  |
| **CLO 02** | × |  |  |  |  |  |  |  |
| **CLO 03** | × |  | × |  |  |  |  |  |
| **CLO 04** | × |  |  | × |  |  |  |  |
| **CLO 05** | × |  | × | × |  |  |  |  |
| **CLO 06** | × | × |  |  |  |  |  |  |
| **CLO 07** |  |  |  |  | × | × |  |  |

**Books Recommended:**

1. Mikell P. Groover, Fundamentals of Modern Manufacturing Materials, Processes, and Systems, John Wiley & Sons, Inc.
2. J.T. Black and Ronald A. Kohser, DeGarmo’s Materials and Processes in Manufacturing, John Wiley & Sons, Inc.
3. Serope Kalpakjian and Stevan R. Schmid, Manufacturing Engineering and Technology, Prentice Hall.
4. U.K. Singh and Manish Dwivedi, Manufacturing Processes, New Age International Publishers.
5. H.N. Gupta, R.C. Gupta, and Arun Mittal, Manufacturing Processes, New Age International Publishers.

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| **Course No: IPE146** | **Credit: 1.0** | **Year: First** | **Semester: Second** |
| **Course Title: Machine Shop Practice** | | **Course Status: Sessional** | |

**Rationale of the Course:**

In order to have a balanced overall development of IPE graduates, it is necessary to integrate theory with practice. Machine Shop Practice has been included in the curriculum to provide hands-on experience using different tools and basic manufacturing practices. By studying machine shop practice, students will learn to explain the function, use, and application of different equipment, machine tools, and the technique of manufacturing a product from its raw material. This course also aims to develop precision, safety at work, teamwork, and the students' right attitude.

**Course Objectives:**

The objectives of this course are to:

* acquaint students with the hand tools used in practice to fabricate a product
* facilitate necessary knowledge about the specification of machine tools used in workshops and manufacturing industries
* develop skill in identifying the machine tool components and their respective functions, and performing various machining operations on the machine tools used in practice
* help students develop the ability to identify and differentiate the work holding devices used in practice to manufacture a product
* encourage the students to provide team effort in product manufacturing.

**Course Content:**

Study of various machining operations (turning, drilling, chamfering, knurling, thread cutting and parting) using engine lathe. Study and operation of turret lathe. Study and operation of shaper machine and quick return motion mechanism (preparation of a V-block). Study and operation of radial drilling machine and fabrication of an oil hole. Study and operation of a milling machine and different milling cutters.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

**CLO 01:** specify various machine tools such as engine lathe, turret lathe, milling machine, radial drilling machine, and shaper machine used in workshops as well as manufacturing industries

**CLO 02:** identify various components of an engine lathe, turret lathe, milling machine, radial drilling machine, and shaper machine, and describe their respective functions

**CLO 03:** identify and differentiate the work holding devices used in an engine lathe, turret lathe, milling machine, radial drilling machine, and shaper machine

**CLO 04:** perform various machining operations on an engine lathe, turret lathe, milling machine, radial drilling machine, and shaper machine individually

**CLO 05:** apply their machining skills to fabricate parts of desired features from a given workpiece as per given drawing.

**Mapping of CLOs with PLOs**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO 01** | × | × |  | × |  |  |  |  |
| **CLO 02** | × |  |  |  |  |  |  |  |
| **CLO 03** | × |  |  | × |  |  |  |  |
| **CLO 04** | × |  | × |  |  |  |  |  |
| **CLO 05** | × | × |  |  |  |  |  |  |

**Books Recommended:**

1. Rajender Singh, Introduction to Basic Manufacturing and Workshop Technology

2. U.K. Singh and Manish Dwivedi, Manufacturing Processes

3. H.N. Gupta, R.C. Gupta, and Arun Mittal, Manufacturing Processes

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| **Course No: PHY 102G** | **Credit:1.5** | **Year: First** | **Semester: Second** |
| **Course Title: Basic Physics Sessional** | | **Course Type: Sessional** | |

**Rationale of the Course:**

Physics sessional aids a student in establishing the relevance of the theory. It brings clarity in the mind of the students regarding the basic concept of the subject. This course has been designed for the IPE graduates to make them understand the difference between theory and application. Also, it helps students in improvising their approach towards the subject.

**Course Objectives**

The objectives of this course are to:

* facilitate necessary knowledge for carrying out some fundamental experiments of physics
* understand and verify some basic laws of physics
* helping the students to find out the values of some physical parameters reflecting the properties of materials by performing experiments.

**Course Content**

*Mechanics:*Determination of moment of inertia of a flywheel, Determination of “g” by and moment of inertia of a compound pendulum. *Properties of matter:*Determination of Young’s Modulus by the method of bending, Determination of Rigidity Modulus by Static method, Using a flat spiral spring: a) Verification of Hooke’s Law and determination of stiffness constant; b) Determination of “g” and the effective mass of the spring; c) Determination of modulus of rigidity of the material of the spring. *Electricity:*Determination of galvanometer resistance by half deflection method.

**Course Learning Outcomes:**

After the completion of this course, students will be able to:

1. explain conservation of mechanical energy for a system undergoing both rotational and translational motions, and find the moment of inertia of uniformly shaped, rigid body
2. determine the value of acceleration due to gravity “g” by using a compound pendulum from the measured time period and compare the predicted result with the published data
3. interpret load versus strain graphs and perform calculations for elastic moduli
4. describe the elastic deformations of materials needed in our daily life
5. determine the resistance of a galvanometer, understand the functions of various electrical components used in the experiment and construct electrical circuit based on the circuit diagram
6. calculate the percentage and standard errors using the error analysis rules.

**Mapping of the CLOs with PLOs**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO 01** | × |  | × |  |  |  |  |  |
| **CLO 02** | × | × |  |  | × |  |  |  |
| **CLO 03** | × | × |  |  | × |  |  |  |
| **CLO 04** | × | × | × |  |  |  |  |  |
| **CLO 05** |  | × |  | × |  |  |  |  |
| **CLO 06** | × |  |  |  |  |  |  |  |

**Recommended Books**

1. Worsnop, B.L. and Flint, H.T.: *Advanced Practical Physics*

2. Chowdhury, S. A. and Basak, A. K.: *Byaboharik PadarthaBidya*

3. Ahmed, G. and Uddin, M. S.: *Practical Physics*

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| **Course No.: IPE 150** | **Credit: 0.5** | **Year: First** | **Semester: Second** |
| **Course Title: Comprehensive Viva-I** | | **Course Status: Sessional** | |

**Rationale of the Course:**

A comprehensive viva forms a part of the theory component of a summative examination. Its purpose is to evaluate the student’s learning and understanding of different courses in their undergraduate program. This course also aims to provide students with confidence while discussing the fundamental aspect of an engineering problem in academic and professional environments.

**Course Objectives:**

The objectives of this course are to:

* assess the comprehensive knowledge gained in every course covered till the second semester
* comprehend the questions asked and answer them with confidence.

**Course Content:**

The viva-voce will be conducted based on the courses covered in the first year.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

**CLO 01:** face interview both in the academic and the industrial sector and perform better in future

**CLO 02:** discuss the fundamental aspects of basic engineering problems/situations with confidence in future.

**Mapping of CLOs with PLOs**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO 01** | × |  |  |  |  |  |  |  |
| **CLO 02** |  |  |  |  |  | × | × |  |

**Books Recommended:**

Books recommended and material supplied for the courses covered till the second semester.

**Second Year First Semester**

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| **Course No.: IPE 221** | **Credit: 3.0** | **Year: Second** | **Semester: Second** |
| **Course Title: Mechanics of Solids** | | **Course Status: Theory** | |

**Rationale of the Course:**

The application of the principles of mechanics to bulk matter is conventionally divided into the mechanics of solids and the mechanics of fluids. Solid mechanics is a basic subject for structural analysis. It concerned with the stressing, deformation and failure of solid materials and structures. In this course student will get the basic idea of the behavior of a body due to the external loading.

**Course Learning Objectives:**

The objectives of the course are to:

* help the students conceptualize the fundamental concepts of stress, strain and deformation of solids
* make the students understand the mechanism of load transfer in beams, the induced stress resultants and deformations
* facilitate the necessary knowledge about the effect of torsion on shafts and springs
* foster analytical and critical thinking required for solving the real-life engineering problems related to product design.

**Course Content:**

**Stress Analysis:** Statically intermediate axially loaded member, thermal and centrifugal stresses, **s**tresses in thin-walled pressure vessels (cylinders and spheres). **Torsional Formula:** Angle of twist, Modulus of rupture. **Beams:** Shear force and bending moment diagrams, various types of stresses in beams, deflection of beams using integration and area moment methods, Reinforced Beam: Timber and concrete beams, Riveted and welded joints., **Combined Stresses:** principal stress, Mohr's Circle, Stresses in thick-walled pressure vessels. **Columns:** Euler's Formula, Intermediate Column Formulas.

**Course Learning Outcomes, CLOs:**

After the successful completion of the course, students will be able to:

1. establish an understanding of the fundamental concepts of mechanics of deformable solids including static equilibrium, geometry of deformation, and material constitutive behavior
2. apply the systematic methods for solving engineering problems in solid mechanics
3. explain the basic mechanical principles underlying modern approaches for design of various types of structural members subjected to axial load, torsion, bending, transverse shear, and combined loading
4. build the necessary theoretical background for further structural analysis and design courses
5. solve real-life engineering problems and design engineering systems.

**Mapping of CLOs with PLOs**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO 01** | **×** |  |  | **×** | **×** |  |  |  |
| **CLO 02** | **×** |  |  | **×** | **×** |  |  |  |
| **CLO 03** |  |  |  | **×** |  | **×** |  |  |
| **CLO 04** | **×** |  |  | **×** | **×** |  |  |  |
| **CLO 05** | **×** |  |  | **×** | **×** |  |  |  |

**Books Recommended:**

1. Andrew Pytel and Ferdinand L. Singer, Strength of Materials.
2. Ferdinand P. Bear, E. Russel Jhonston, Jr, Jhon T. DeWolf; Mechanics of Materials.

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| **Course No.: IPE 223** | **Credit: 4.0** | **Year: Second** | | **Semester: First** |
| **Course Title: Thermodynamics and Heat Transfer** | | | **Course Status: Theory** | |

**Rationale of the Course:**

The content of Thermodynamics and Heat Transfer course contains three areas such as thermodynamics, thermal engineering and heat transfer. Hence, the comprehensive and rigorous treatment of thermodynamics in an engineering perspective set the ground work for consecutive studies in the field of thermal engineering and heat transfer. The fundamentals of heat transfer mechanisms in solids and fluids and their applications in varied heat transfer equipment give students a feel for how thermodynamics is applied in engineering practice both in designing and analyzing system.

**Course Objectives:**

The objectives of this course are to:

* familiarize the students with thermodynamic systems, control volume and process
* understand and analyze different thermodynamic properties to solve engineering problem
* explain the laws of thermodynamic and its proposition in term of real-life engineering problem
* acquire preliminary ideas of increasing performance of system undergoing thermodynamic cycle
* identify various components of steam power plant, internal combustion engine and steam generating unit
* understand the fundamental concepts and principles of heat transfer in solids and fluids
* develop analytical skills for solving a wide variety of engineering problems linked to work and heat transfer domain
* choose necessary mathematical models in designing boiler and heat exchanger.

**Course Content:**

*Thermodynamics*: Systems, Control volume, Processes, etc., Properties of pure substances (P-V-T diagram), Work and heat, Laws of thermodynamics (Zeroth law, First law, and its application to control volume, Second law), Vapor power cycle; Study of IC engines: Performance, Mechanical and thermodynamic cycles, Indicator diagram, Lubrication system and cooling ystem; Steam Generating Units: Classifications, Working principle (Cochran, Babcock and Wilcox), Accessories and mountings. Basics of psychometric properties. *Heat transfer:* Mode of heat transfer; Conduction: General conduction equation, Thermal conductivity, Boundary conditions, Thermal resistance of composite medium, One dimensional steady state heat conduction, Critical thickness of insulation, Heat transfer from finned surfaces, Concept of unsteady state conduction; Convection: Principles of convection, Boundary layer theory for flow over flat plates and flow through pipes – Velocity boundary layer and thermal boundary layer concept, Dimensionless parameters, Empirical correlations for laminar and turbulent flow; Heat Exchanger: Classification, Fouling, LMTD.

**Course Learning Outcomes, CLOs**

After the successful completion of the course, students will be able to:

1. explain the basic concepts of thermodynamics and heat transfer
2. interpret the three-dimensional P–v–T surface in the context of two-dimensional representations
3. state and apply the first law and second law of thermodynamics to different thermodynamic systems, and evaluate the performance of various types of open systems
4. explain different thermolytic processes using ideal Carnot cycle, Rankine cycle, Vapor power cycle, Otto cycle and Diesel cycle
5. explain different sort of IC engines, and their lubrication and cooling systems
6. describe and differentiate the working principle, construction, and application of different steam generating unit
7. explain and analyze the mode and laws of heat transfer in solids and fluids
8. assess and analyze the performance of heat exchangers
9. solve real-life engineering problems related to thermodynamic, heat transfer and thermal engineering.

**Mapping of CLOs with PLOs**

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| **PLO/**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO 01** | **×** |  |  |  |  |  |  |  |
| **CLO 02** | **×** |  | **×** |  |  |  |  |  |
| **CLO 03** | **×** |  |  |  |  |  |  |  |
| **CLO 04** | **×** | **×** | **×** |  |  |  |  |  |
| **CLO 05** | **×** |  |  |  |  |  |  |  |
| **CLO 06** | **×** |  | **×** |  | **×** |  |  |  |
| **CLO 07** | **×** |  | **×** |  |  |  |  |  |
| **CLO 08** |  |  | **×** | **×** |  |  |  |  |
| **CLO 09** | **×** |  |  |  | **×** |  |  |  |

**Books Recommended:**

1. Moran, Michael J.; Shapiro, Howard N.; Boettner, Daisie D; Bailey, Margaret B, Fundamentals of Engineering Thermodynamics, WILEY.
2. Claus B.; Richard E. S., Fundamentals of Thermodynamics, WILEY.
3. R. S. khurmi and J.K. Gopta, A text book of Thermal Engineering, S. Chand and Company.
4. J. P. Holman, Heat Transfer, McGraw-Hill.
5. Ozisik, M. N., Heat Transfer: A Basic Approach, McGraw-Hill.
6. R. K. Rajput, Heat and Mass Transfer, S. Chand & Company Ltd.

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| **Course No: MAT 207G** | **Credit: 3.0** | **Year: Second** | | **Semester: Second** |
| **Course Title: Vector, Matrices and Laplace Transformation** | | | **Course Status: Theory** | |

**Rationale of the Course:**

This course provides the essential mathematical techniques of engineering. These are the methods of vector calculus, matrices, and laplace transformation. In this course, students will study basic principles and techniques of vectors, matrices and laplaces, and their applications in solving the engineering problems. It will provide the students with a solid foundation for further study in engineering.

**Course Objectives:**

The objectives of this course are to:

* present the fundamental concepts of multivariable calculus
* develop student understanding and skills in the topic necessary for its applications to science and engineering.

**Course Content:**

*Vector Calculus*: Definitions of vectors; different operations of vectors (Triple products and multiple products of vectors). Differentiations and integration of vectors together with elementary applications. Line, surface and volume integrals. Gradient of scalar functions. Divergence and curl of vector functions. Physical significance of gradient, divergence and curl. Stoke’s theorem. Green’s theorem and their applications. *Matrices*: Types of matrices, elementary transformations of matrices, rank of a matrix; Linear dependence and independence of vectors, matrix polynomials. Determination of characteristic roots and vectors. Fourier series and applications. *Laplace transforms:* Definition of Laplace transforms. Elementary transformations and properties. Convolution. Solution of differential equations by Laplace transforms. Evaluation of integrals by Laplace transforms.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

1. understand algebraic and geometric representations of vectors in three dimensions and their operations, including addition and multiplication
2. apply vector algebra and use the gradient of scalar field to solve elementary problems in physics
3. carry out line, surface and volume integration as well as differentiation of scalar and vector fields
4. interpret the divergence and the curl physically and apply these operators to carry out integrations by means of Green’s and Stoke's theorems
5. recognize and use equivalent forms to identify matrices and perform row operations on a matrix
6. understand the properties of Fourier series and their applications
7. apply Laplace transform in engineering analysis
8. use Laplace transform methods to solve ordinary and partial differential equations; and use partial fraction and convolution methods in inverse Laplace transforms.

**Mapping of CLOs with PLOs**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO 01** |  |  | **×** | **×** |  |  |  |  |
| **CLO 02** |  |  | **×** | **×** | **×** |  |  |  |
| **CLO 03** |  | **×** | **×** |  |  |  |  |  |
| **CLO 04** | **×** | **×** |  |  |  |  |  |  |
| **CLO 05** |  |  | **×** |  |  |  |  |  |
| **CLO 06** | **×** |  | **×** |  |  |  |  |  |
| **CLO 07** |  |  | **×** | **×** | **×** |  |  |  |
| **CLO 08** |  |  | **×** | **×** | **×** |  |  |  |

**Books Recommended:**

1. Spiegel, M.R; Advanced Calculus
2. Spiegel, M.R.; Vector Analysis and Introduction to Tensor Analysis
3. Lass, H; Vector and Tensor Analysis
4. Ayres, F; Matrices
5. A G Hamilton; Linear Algebra
6. Spiegel, M. R.; Laplace Transform
7. Khanna, M. L.; Laplace Transforms

**Prerequisites:**

Knowledge of Integral Calculus, Course: MAT104G, and basic mathematical concepts.

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| **Course No: EEE103G** | **Credit: 2.0** | **Year: Second** | | **Semester: First** |
| **Course Title: Introduction to Electrical and Electronic Circuits** | | | **Course Status: Theory** | |

**Rationale of the Course:**

This is an introductory course in Electrical and Electronic Engineering, introducing simple electrical DC circuits as well as the technical skills to facilitate necessary knowledge to analyze such simple and complex circuits. It is a course suitable for students pursuing further studies in electrical, electronic or telecommunications engineering as well as some other related engineering disciplines. It gives the through idea about different types of circuit analysis techniques. This course endeavors to build on this knowledge and further expand student’s skill in analyzing and designing analogue circuits involving diodes. It covers the basic principles of operation and device characteristics of diodes. It also includes study of basic logic gates which will help the students to understand and build logic devices.

**Course Objectives:**

The objectives of this course are to:

* facilitate the basic concepts of electrical charge, voltage, current and power
* assist students, develop basic knowledge about DC circuit behavior, basic theorems of circuit analysis, diode and its applications
* develop the skills to solve mathematical problems of simple and complex electrical circuits
* facilitate the basic concepts of Boolean algebra and logic gates.

**Course Contents:**

Voltage and Current, Power and Energy, Ohm’s law, Series-Parallel circuits, Voltage division and current division, KVL, KCL, Nodal analysis, Mesh analysis, Superposition theorem, Thevenin’s theorem, Source transformation, Capacitors and Inductors with series parallel connection. Diode, I-V characteristics of diode, half and full wave rectifier, series- parallel configuration of diode. Binary logic, Boolean algebra, De Morgan’s theorem, Basic Logic gates, Universal gates.

**Course Learning Outcomes:**

After the successful completion of the course, the student will be able to

1. explain the basic concepts of Electrical Circuits.
2. solve and analyze the electrical circuits using different analytical methods and theorems
3. describe the basics of diode and its applications
4. explain the basic concepts of logic gates.

**Mapping of CLOs with PLOs**

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| **PLO CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| CLO1 | **×** |  |  | **×** |  |  |  |  |
| CLO2 | **×** |  | **×** |  | **×** |  |  |  |
| CLO3 | **×** |  |  | **×** |  |  |  |  |
| CLO4 | **×** | **×** |  | **×** |  |  |  |  |

**Recommended Books**

1. Fundamental of Electric Circuits – Charles K. Alexander and Matthew N.O. Sadiku
2. Introductory Circuit Analysis by Robert L. Boylestad
3. Electronic Devices and Circuit Theory by Robert L. Boylestad and Louis Nashlesky
4. Microelectronic Circuits- Sedra/Smith
5. Digital logic and Computer Design – M. Morris Mano

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| **Course No: ECO 105G** | **Credit: 3.0** | **Year: Second** | **Semester: First** |
| **Course Title: Principles of Economics** | | **Course Status: Theory** | |

**Rationale of the Course:**

This course provides an introduction to the main ideas and concepts involved in modern economics and attempts to provide students with an understanding of how the economy works, what type of problems economists attempt to solve, and how they set about trying to solve them. The course is primarily concerned with the analysis of individual decision-making agents, the behavior of firms and industries in the economy (microeconomics), on the economy as a whole (macroeconomics) and the inherent problems facing underdeveloped and developing countries (economic development).

**Course Objectives:**

The objectives of this course are to:

* provide an introduction to microeconomic analysis
* outline the theory of markets with relevant applications to business, social and individual issues
* give an introductory analysis of the role of governments in seeking to ensure the efficient operation of markets
* facilitate necessary knowledge about macroeconomic analysis outlining how the national income is measured and determined
* make students understand a framework in which the interaction of money and goods and services markets can be developed, allowing students to understand the process by which the levels of economic activity, employment are determined
* help students conceptualize economic theories and analysis in the field of development economics.

**Course Content:**

*Introduction to Microeconomics:* Definition and scope; basic concepts and tools—PPF and circular flow model; fundamental economic problems and solution systems; Concepts of demand, supply and equilibrium; Concepts of elasticity, different types of elasticities, their applications; Concepts of total and marginal utility; Concepts of production, cost and profit, characteristics of different types of markets. *Introduction to Macroeconomics:* Key macroeconomic indicators and their performance measurement - GNP, GDP, inflation, unemployment; money, functions of money, function of commercial and central bank, monetary policy; fiscal policy and structure of govt. budget. *Development and related issues:* Growth and development; concept of poverty and poverty measures; HDI; key human-socio-economic development indicators of Bangladesh, Sustainable Development Goals (SDG).

**Course Learning Outcomes, CLO**

After successful completion of the course, students will be able to:

1. understand the analysis of individual decision-making agents, the behaviour of firms and industries in the economy
2. understand the concept of elasticity quantitatively and qualitatively in economic analysis and know differences between different types of markets
3. explain macroeconomic concepts and use simple economic models to interpret the behaviour of key macroeconomic variables
4. understand monetary and fiscal policy and Government budget
5. understand the main issues confronting underdeveloped and developing countries.

**Mapping of CLOs with PLOs:**

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| **PLO CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO 01** | × |  | × | × |  |  |  |  |
| **CLO 02** | × |  |  | × |  |  |  |  |
| **CLO 03** | × |  |  |  | × |  |  |  |
| **CLO 04** |  |  |  |  | × | × |  |  |
| **CLO 05** | × |  |  |  |  | × |  |  |

**Books Recommended:**

1. Arnold, R. A. (2014): Economics, South Western Publishing Company, Eleventh Edition
2. Bangladesh Economic Review relevant issues.
3. Mankiw, N. G. (2012): Principles of Economics, Thomson South Western Publishing, Sixth Edition
4. Samuelson, P. A. and Nordhaus,W. D. (2009): Economics, McGraw-Hill USA, Nineteenth Edition.
5. Todaro, M. P. and Smith,S. C. (2012): Economics of Development in the Third World, Longman, Eleventh Edition

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| **Course No.: EEE 104G** | **Credit: 1.5** | **Year: Second** | | **Semester: First** |
| **Course Title: Introduction to Electrical and Electronic Circuits Lab** | | | **Course Status: Sessional** | |

**Rationale of the Course:**

In this course students will perform experiments to verify practically the theories and concepts learned in EEE-103G. Theoretical knowledge is incomplete without hands on experiments using the basic components and measuring devices used in electrical circuits’ analysis. This course teaches the fundamentals of electrical circuits, application of circuit laws, theorems and measuring techniques for DC circuits. It contains experiments of investigating the performance characteristics of diodes and different types diode circuits. The course covers practical experiments of the topics of digital electronics including: Number Theory, Boolean Algebra, Logic Circuits, Logic Minimization Techniques.

**Course Objectives:**

The objectives of this course are to:

* provide the students with capability of implementing different real-life dc circuits
* acquaint the students with the techniques of solving of different types of circuits by network theorem
* make the students understand the voltage, current and load relationship in a network
* facilitate necessary knowledge about basic concepts of AC circuit
* getting idea about the basics of diode and its applications
* provide knowledge of basics of Boolean algebra and logic gates.

**Course Content:**

Use of measuring Equipment: Multi-meter, Frequency meter and Oscilloscope. Test of Ohm’s Law plot of I-V, P-V curve. Verification of KVL. Verification of KCL. Determination of Thevenin’s equivalent circuit. Verification of superposition theorem. Making AND/OR gates using diode/ transistors. Making half wave and full wave rectifier.

**Course Learning Outcomes:**

After the successful completion of the course, the student will be able to:

1. Explain the basic operation of different types of electrical instruments and measuring devices
2. Use network theorems and laws for different type of circuit analysis
3. Describe the characteristics of diode
4. Construct different rectifier circuits
5. Manipulate logic expressions using binary Boolean algebra
6. Demonstrate team-based communication skills, magnify their moral standards and apply these in practical life.

**Mapping of CLOs with PLOs**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| CLO1 | **×** |  |  |  |  |  |  |  |
| CLO2 | **×** | **×** |  |  |  |  |  |  |
| CLO3 | **×** |  |  | **×** |  |  |  |  |
| CLO4 | **×** |  |  |  |  |  |  |  |
| CLO5 | **×** | **×** |  | **×** |  |  |  |  |
| CLO6 |  |  |  |  | **×** | **×** |  |  |

**Recommended Books**

1. Fundamental of Electric Circuits – Charles K. Alexander and Matthew N.O. Sadiku
2. Introductory Circuit Analysis by Robert L. Boylestad
3. Electronic Devices and Circuit Theory by Robert L. Boylestad and Louis Nashlesky
4. Microelectronic Circuits- Sedra/Smith
5. Digital logic and Computer Design – M. Morris Mano

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| --- | --- | --- | --- | --- |
| **Course No: IPE224** | **Credit: 1.5** | **Year: Second** | | **Semester: First** |
| **Course Title: Engineering Materials Sessional** | | | **Course Status: Sessional** | |

**Rationale of the Course:**

To give students the background required to pursue further studies in materials processing, design and related engineering fields. Hand-on knowledge on processing engineering materials is important for any engineering graduate because the state-of-art engineering materials is a key aspect of most industries all over the world. This course will help them understand working procedures of developing and modifying engineering materials using a variety of processing techniques and thermal treatments.

**Course Objectives:**

The objectives of this course are to:

* provide opportunities to directly observe and study the interrelationships between engineering materials’ structure and properties
* teach the operation of different equipment for processing and testing engineering materials
* familiarize students with different thermal treatments on metal alloys using laboratory scale equipment
* help the students to develop ability in collecting and analyzing data, constructing and interpreting graphs, and discussing experimental findings through formal laboratory reports.

**Course Content:**

Study and operation of an electric air furnace. Preparation of a metallographic sample and its study using a metallurgical microscope. Preparation and study of samples after different heat treatment processes. Preparation and study of samples after the flame hardening process. Study of standard samples to observe the stages of a recrystallization process.

**Course Learning Outcomes, CLO**

After successful completion of the course, students will be able to

**CLO 01:** operate basic instruments used in materials science and engineering following proper safety guidelines and necessary precautions

**CLO 02:** describe the basic principles and operating procedures relating to heat treatment and optical microscopy

**CLO 03:** analyze binary phase diagrams and perform various material processing techniques, such as annealing, normalizing, quenching and tempering, etc.

**CLO 04:** explain the underlying mechanisms for the obtained microstructures in the heat-treated samples after performed experiments

**CLO 05:** evaluate the results of various material processing techniques, such as annealing, normalizing, quenching and tempering on material properties

**CLO 06:** interpret the data from the experiments and report experimental findings in formal laboratory reports using an appropriate technical writing style.

**Mapping of CLOs with PLOs:**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **PLO CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO 01** | × |  |  |  |  |  |  |  |
| **CLO 02** | × |  |  |  |  |  |  |  |
| **CLO 03** | × | × |  |  | × |  |  |  |
| **CLO 04** | × |  |  |  |  |  |  |  |
| **CLO 05** | × |  |  |  |  |  |  |  |
| **CLO 06** | × |  |  |  |  |  |  | × |

**Books Recommended:**

1. Materials Science and Engineering an Introduction by William D. Callister and David G. Rethwisch
2. Heat Treatment: Principles and Techniques by T. V. Rajan, C. P. Sharma, Ashok Sharma
3. Introduction to Physical Metallurgy by Sidney H. Avner
4. Physical Metallurgy by William F. Hosford

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| **Course No.: IPE 242** | **Credit: 1.5** | **Year: Second** | | **Semester: First** |
| **Course Title: Computer Aided Drawing and Drafting - I** | | | **Course Status: Sessional** | |

**Rationale of the Course:**

Computer Aided Drawing and Drafting (CADD) is a technique for design and technical documentation of a product’s design process, which replaces manual drafting with automated process. CADD-I is an introductory course entailing the running/operation of a typical CAD system. Primary Emphasis is placed on developing entry-level CAD user skills using the current version of the AutoCAD software. This course is fundamentally the two-dimensional (2D) computer-aided-drawing which teaches students to use modern CAD software to produce two-dimensional drawings / computer models of a designed product for manufacturing applications. At the completion of this course the student will be able to gain comprehensive knowledge and have technical skills on AutoCAD necessary to complete a basic set of AutoCAD drawings as well as to apply 2D computer aided drawing and drafting techniques for engineering designing a product in a practical/professional way.

**Course Objectives:**

The objectives of this course are to:

* introduce the students to computer aided drawing/drafting (CAD) system using the current version of the AutoCAD software (for e.g., AutoCAD 2020)
* teach the students the use of modern CAD software to produce two-dimensional drawings / computer models of a designed product for manufacturing applications
* provide the students with the basic understanding of AutoCAD commands and capabilities by providing hands on training environment where each student will complete drawings and exercises following the instructions.
* help the students learn the basic features and tools used to create and modify/edit two-dimensional drawings and proper dimensioning of a designed product.
* facilitate the students to create a drawing sheet and plot two-dimensional drawings.

**Course Contents:**

Introduction to Computer Aided Design and Drafting (CADD), Introducing the AutoCAD window, Opening a drawing, Using commands, Specifying coordinates, Setting up a drawing, Drawing in two dimensions (2D), Viewing the drawing, Editing the drawing: Basic and advance tools, Organizing drawing with layers, colors and line types, Drawing dimensions, Adding text to drawing, Storing and linking data with graphics, Getting and exchanging data from drawing.

**Course Learning Outcomes, CLOs:**

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

1. understand and use the basic commands and tools of AutoCAD software for creating an engineering drawing with the use of computers
2. demonstrate and apply the basic concepts of AutoCAD software to develop drawing techniques
3. create two-dimensional drawings/computer models of a designed product for manufacturing applications using AutoCAD software
4. conceptualize and draw 2D orthographic projections of an object by representing the object in the single-view format which shows two of the three object dimensions
5. manipulate drawings through modifying/ editing tools and plotting techniques and produce template drawings
6. explain and use blocks, layers, line-types, and colors for clarity and to show function in drawings
7. develop mid-level CAD user skills using the current version of the AutoCAD software
8. apply the critical thinking and problem-solving skills in teamwork and project study
9. implement the drawing/drafting concepts and technical skills gained in the real-life design problems and/or design reviews based on current professional practices.

**Mapping of CLOs with PLOs:**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO 01** | × | × |  | × |  |  | × |  |
| **CLO 02** | × | × |  |  |  |  | × |  |
| **CLO 03** | × | × | × | × |  |  |  |  |
| **CLO 04** | × |  |  |  |  |  | × |  |
| **CLO 05** |  |  |  |  |  |  | × |  |
| **CLO 06** | × |  |  |  |  |  | × |  |
| **CLO 07** | × | × |  |  |  | × | × |  |
| **CLO08** | × | × |  | × | × |  |  |  |
| **CLO 09** | × |  | × |  | × | × |  |  |

**Books Recommended:**

1. Up and Running with AutoCAD 2017: 2D and 3D Drawing and Modeling – By Gindis, Elliot, (1ST edition), Academic Press Publisher
2. Introduction to AutoCAD 2011: 2D and 3D Design – By Yarwood, Alf, (1ST edition), Taylor & Francis Publisher
3. Beginning AutoCAD 2011: Exercise Workbook – By Shrock, Cheryl R.**,** New York Industrial Press.
4. Tutorial Guide to AutoCAD 2020: 2D Drawing, 2D Modeling – By Lockhart, Shawna, SDC Publications.
5. AutoCAD 2016 Tutorial: First Level 2D Fundamentals – By Shih, Randy H.,SDC Publications.
6. AutoCAD 2004 Bible – By Finkelstein, Ellen,Wiley Publisher.

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| **Course No: IPE 244** | **Credit: 1.5** | **Year: Second** | **Semester: First** |
| **Course Title: Machine Drawing** | | **Course Status: Sessional** | |

**Rationale of the Course:**

The purpose of an engineering drawing is to concisely and accurately capture all geometric features of a product or component so that a manufacturer or engineer can produce the required item. This course focuses on detail drawing of different machine components with their bill of materials as well as assembly drawing.

**Course Objectives:**

The objectives of this course are to:

* help students identify the orthographic, auxiliary and sectional views of a given 3D objects precisely
* make students able to predict the isometric view of an object from the given orthographic views
* enable students to sketch different machine elements like Fasteners, Gears and Key Springs
* help students understand and create bill of materials
* provide necessary skills on assembly drawing consisting item of more than one component.

**Course Content:**

Review of orthographic projections; Isometric view; Fasteners, Gears and Key Springs; Detail Drawing with bill of materials and assembly drawing.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

**CLO 1:** draw orthographic, auxiliary and sectional views of an object;

**CLO 2:** predict the isometric view of an object from the given orthographic views correctly;

**CLO 3:** draft different machine elements like Fasteners, Gears and Key Springs;

**CLO 4:** create and understand bill of materials;

**CLO 5:** understand and organize assembly drawing.

**Mapping of CLOs with PLOs**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO 1** | × |  |  | × |  |  |  |  |
| **CLO 2** | × |  |  | × |  | × |  |  |
| **CLO 3** | × |  |  | × |  |  |  |  |
| **CLO 4** | × |  |  | × |  | × |  |  |
| **CLO 5** | × |  |  | × |  | × |  |  |

**Books Recommended:**

1. Textbook of Engineering Drawing - By Reddy, K. V., BS Publications.
2. Engineering Drawing – By M.B. Shah and B. C. Rana, Dorling Kindersley Pvt. Ltd.
3. A Textbook of Machine Drawing - By Dhawan, R.K., S. Chand Publications.

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| **Course No: IPE 222** | **Credit: 1.5** | **Year: Second** | **Semester: First** |
| **Course Title: Mechanics of Solids Sessional** | | **Course Status: Sessional** | |

**Rationale of the Course:**

Mechanics of solids or materials deals with the internal effects and deformations that are caused by the applied loads. Both considerations are of paramount importance in engineering design of any machine part or structure. This laboratory course provides engineering students important hands-on knowledge and experience in designing and evaluating mechanical properties using a number of materials testing methods.

**Course Objectives:**

The objectives of this course are to:

* provide students opportunities to become familiar with standard mechanical testing methods and fundamental properties of engineering materials
* do exercises by observing and applying the aspects of mechanics of solids learned in relevant theory courses
* operate, safely and correctly, typical mechanical properties testing equipment, such as tensile tester, hardness tester, impact tester, etc.
* help the students to develop ability in collecting and analyzing data, constructing and interpreting graphs, and discussing experimental findings through formal laboratory reports.

**Course Content:**

Study and operation on - Tensile and compressive test; Hardness test; Impact test; Fatigue test; Bending and torsion test; Column test.

**Course Learning Outcomes, CLO**

After successful completion of the course, students will be able to

**CLO 01:** operate, safely and correctly, typical material testing equipment, such as tensile/compression tester, hardness tester, impact tester, fatigue tester, etc.

**CLO 02:** measure deformations, forces, and strains under a variety of loading conditions, including tension, compression, bending using universal testing machine

**CLO 03:** gather and analyze experimental data, and discuss experimental findings as they relate to material processing, structure, and property

**CLO 04:** formulate, implement and verify mechanics of solids problems using experimental techniques

**CLO 05:** compare quantitatively among measured experimental results and calculated theoretical values

**CLO 06:** interpret the data from the experiments and report experimental findings in informal or formal laboratory reports using an appropriate technical writing style

**CLO 07:** work in groups or independently to perform an experimental work.

**Mapping of CLOs with PLOs**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **PLO CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO 01** | × |  |  |  |  |  |  |  |
| **CLO 02** | × |  |  |  |  |  |  |  |
| **CLO 03** | × |  | × | × |  |  |  |  |
| **CLO 04** | × |  |  | × | × |  |  |  |
| **CLO 05** | × |  |  |  |  |  |  |  |
| **CLO 06** | × |  |  |  |  | × | × |  |
| **CLO 07** |  |  |  |  | × |  |  |  |

**Books Recommended:**

1. Strength of Materials by Andrew Pytel, ‎Ferdinand Leon Singer.
2. Mechanics of Materials by Andrew Pytel, ‎Jaan Kiusalaas
3. Materials Science and Engineering an Introduction by William D. Callister and David G. Rethwisch
4. Introduction to Physical Metallurgy by Sidney H. Avner

**Second Year Second Semester**

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| --- | --- | --- | --- |
| **Course No.: IPE 225** | **Credit: 3.00** | **Year: Second** | **Semester: Second** |
| **Course Title: Mechanics of Machinery** | | **Course Status: Theory** | |

**Rationale of the Course:**

Mechanics of Machinery helps to understand the kinematic design process and apply theory to the design of a functional kinematic system. The goal of this course is to understand the mechanics and mechanisms involved in various machine elements to learn the application of various machine components.

**Course Objectives:**

The objectives of this course are to:

* facilitate necessary knowledge about the foundation for the study of machine design
* understand the concept of machines, mechanisms and related terminologies
* make the students become familiar and understanding of the most commonly used mechanisms
* develop skills for designing and analyzing linkages, gears, belt, cams, and other mechanisms
* build up critical thinking and problem-solving capacity of various mechanical engineering problems related to kinematics of machines
* acquire knowledge about brakes, clutches and governors in practice
* utilize analytical, mathematical and graphical aspects of kinematics of Machines for effective design.

**Course Content:**

Mechanisms: Displacement, Velocity and Acceleration, Turning moment, Inertia and kinematics energy of reciprocating and rotating parts; Power transmission by belts, ropes and chains, Clutches and brakes; Study of gears and gear trains; Study of governors; Multi-cylinder in-line engines; Balancing of masses; Study of cams and cam followers; Flywheels; Longitudinal and Transverse Vibration: Undamped free and forced vibrations with single degree of freedom, Damped free and forced vibrations with single degree of freedom, Introduction to vibration control.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

1. interpret the concepts of kinematic, kinematics links, relative motions of machine components and apply these concepts in designing various mechanisms used in practice
2. understand the concepts of relative and instantaneous velocity as well as radial and tangential acceleration, and apply them to solve problem associated with static and dynamic balancing
3. explain various mode of vibration generated in the machines and control them in practice
4. design various cam mechanisms and use them in various engineering application
5. explain, design and use power transmission mechanisms to solve engineering problems.

**Mapping of CLOs with PLOs:**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO1** | × |  |  |  | × |  |  |  |
| **CLO2** | × |  |  |  | × |  |  |  |
| **CLO3** | × |  | × |  | × |  |  |  |
| **CLO4** | × |  |  | × |  |  |  |  |
| **CLO5** | × |  |  | × | × |  |  |  |

**Books Recommended:**

1. Shigley J. E. and Uicker J. J., Theory of Machines and Mechanisms, McGraw Hill Intl.
2. Hartenberg and Denavit, Kinematic Synthesis of Linkages, McGraw Hill International
3. Rao J. S. & Dukkipati R. V., Mechanism and Machine Theory, New Age Intl. Publishers
4. Ratan S. S., Theory of Machines, Tata McGraw Hill Publishing Company Ltd.
5. Sharma C. S. and P. Kamlesh, Theory of Mechanisms and Machines, Printice Hall of India Pvt. Ltd.
6. K. J. Waldron, and G. L. Kinzel, Kinematics, Dynamics, and Design of Machinery, John Wiley & Sons, Inc.
7. D. H. Myszka, Machines & Mechanisms: Applied Kinematic Analysis, Pearson Education
8. Khurmi R. S. and Gupta J. K., Theory of Machines, S. Chand Publication, New Delhi

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| **Course No: IPE 227** | **Credit: 3** | **Year: Second** | | **Semester: Second** |
| **Course Title: Fluid Mechanics and Machinery** | | | **Course Status: Theory** | |

**Rationale of the Course:**

Fluid Mechanics and Machinery is a basic engineering subject deals with the basic concepts and principles in hydrostatics, hydro kinematics and hydrodynamics and their application in solving fluid flow problems in the field of Engineering. Many natural, industrial and biological processes revolve around fluid whether liquid or gas flow. The students will be able to understand the behavior of fluid, under various forces and at different atmospheric conditions and to select the proper fluid for various applications, be able to handle them properly to better design hydraulic equipment and to solve real life complex problem.

**Course Objectives:**

The objectives of this course are to:

* introduce and explain fundamentals of fluid mechanics
* accumulate basic knowledge of fluid, its properties and behavior under various conditions of internal and external flows
* make students understand the hydrostatic law, principle of buoyancy and stability of a floating body and application of mass, momentum and energy equation in fluid flow
* teach basic laws and equations used for analysis of static and dynamic fluids
* inculcate the importance of fluid flow measurement and its applications in industries
* provide knowledge of the losses in a flow system, flow through pipes, boundary layer flow and flow past immersed bodies
* facilitate necessary knowledge about dimensional analysis, similitude and apply Rayleigh’s indicial and Buckingham-pi techniques to solve real life problem
* acquaint students with the fundamental idea of different types of hydraulic machines, along with the governing equations
* develop skills on comprehending the significance of characteristic curves for various turbines and pumps.

**Course Content:**

Fluid Mechanics: Fluid properties, Fluid static’s, Manometry, Force on submersed planes and curved surfaces, Buoyancy and floatation, One-dimensional flow of fluid: Equation of continuity, Energy equation, Impulse Momentum equation. Pipe flow, Bernoulli equation, Frictional losses in pipes and fittings (Moody diagram), Pipe Network, Dimensional analysis and Similitude. Fluid Machinery: Types of fluid machinery, Impulse and Reaction turbine, Centrifugal pumps, Radial and Axial flow pumps, Reciprocating pumps, Compressors.

**Course Learning Outcomes, CLO:**

After the successful completion of the course, students will be able to:

**CLO1:** state the Newton’s law of viscosity and Explain the mechanics of fluids at rest and in motion by observing the fluid phenomena

**CLO2:** compute force of buoyancy on a partially or fully submerged body and Analyze the stability of a floating body

**CLO3:** solve and explain hydrostatic problems like, hydrostatic pressure and force distribution on plane and curved surface

**CLO4:** derive Euler’s Equation of motion and Deduce Bernoulli’s equation

**CLO5:** apply the knowledge of fluid flow measurement and its real-life applications

**CLO6:** examine energy losses in pipe transitions and sketch energy gradient lines

**CLO7:** apply dimensional analysis to predict formulas which connect particular variables in given circumstances

**CLO8**: explain the performance and design of hydraulic machines.

**Mapping of CLOs with PLOs:**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO1** | × | × |  |  | × |  |  |  |
| **CLO2** | × |  |  |  | × |  |  |  |
| **CLO3** | × | × |  |  | × |  |  |  |
| **CLO4** | × |  |  |  | × |  |  |  |
| **CLO5** | × |  |  |  |  |  |  |  |
| **CLO6** | × |  |  |  |  |  |  |  |
| **CLO7** | × |  |  |  | × |  |  |  |
| **CLO8** | × | × |  | × |  | × |  |  |

**Books Recommended:**

1. Hydraulics and Fluid Mechanics, P.N. Modi and S.M. Seth, Standard Book House, Delhi.
2. Fluid Mechanics by Frank .M. White, McGraw Hill Publishing Company Ltd, New Delhi.
3. Solving problems in fluid mechanics, Douglas, J.F. and Mathews R.D., United States: John Wiley and Sons Inc.
4. Introduction to Fluid Mechanics, R.W. Fox, P.J. Pritchard and A.T. McDonald, John Wiley, New York
5. Introduction to Fluid Machines, S.K. Som and G. Biswas, 2nd Edition, Tata McGraw-Hill Publishers Pvt. Ltd.

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| **Course No: IPE 231** | **Credit: 3.00** | **Year: Second** | **Semester: Second** |
| **Course Title: Engineering Economy** | | **Course Status: Theory** | |

**Rationale of the Course:**

This course is designed to equip students to acquire analytical tools for evaluating the economic viability of an independent project, as well as the comparative viability of mutually exclusive alternatives. Economic performance of investment projects is evaluated with the parameters like NPV, IRR, and payback period. The effect of depreciation, inflation and tax rate are widely addressed in this course. Students must have prior knowledge of statistics, algebra, and basic accounting for the better understanding of the subject.

**Course Objectives:**

The specific objectives of this course are to:

* familiarize the students with the compound interest rates for cash flow analysis
* make the students understand the economic principles for analyzing the independent and mutually exclusive investments
* understand the effect of inflation, depreciation, tax rate on the rate of return from project life
* make students able to analyze and calculate the after-tax cash flows under legal economic framework
* acquire clear understanding of capital budgeting and sensitivity analysis.

**Course Content:**

*Basic Concepts of Engineering Economy*: The role of engineers in business and corporation, time value of money, simple and compound interest, compound interest rate factors and their use, types of investments; *Economic Analysis Methods:* Present worth analysis, annual worth analysis, equivalent annual worth analysis, cost-benefit analysis, and Internal Rate of Return (IRR) analysis. *Incremental Analysis:* incremental net present worth analysis, incremental internal rate of return analysis. Nominal and effective interest rate for loan amortization, credit card and other loan payments calculation; *Depreciation:* role of depreciation, methods of depreciation. Straight line depreciation, Declining balance method of depreciation, accelerated cost recovery systems, and modified accelerated cost recovery systems (MACRS), etc.; After tax cash flow analysis; Inflation and its impact on economic decision; Capital budgeting and rationing; Financial Risk Analysis; Sensitivity Analysis.

**Course Learning Outcomes (CLOs):**

After the successful completion of the course, the students will be able to:

**CLO1**: identify the compound interest rate factors for the economic evaluation of the investment projects

**CLO2**: estimate the net present worth of different types of investments and compare them with parameters like net present worth, equivalent annual cost, internal rate of return, and payback period

**CLO3**: interpret the cost effectiveness of investment alternatives by considering inflation and depreciation and make a quantitative decision for the best investment project from the alternatives

**CLO4**: apply the knowledge of engineering economy for capital budgeting and capital rationing

**CLO5**: explain the factors which are most sensitive to figure of merits like NPV, IRR, and PBP

**CLO6**: evaluate the uncertainties involved in the investment projects so that a rationalization can be established for the stake holders.

**Mapping of CLOs with PLOs:**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| CLO1 | × |  | × |  | × |  | × |  |
| CLO2 | × | × |  |  | × |  |  |  |
| CLO3 | × | × | × |  |  |  |  |  |
| CLO4 | × |  |  | × | × | × |  | × |
| CLO5 |  |  | × |  |  |  | × | × |
| CLO6 |  | × | × |  | × | × |  | × |

**Books Recommended:**

1. Park, C. S., Contemporary Engineering Economics, Addison-Wesley.
2. Park, C. S., Contemporary Engineering Economics, Pearson Prentice Hall.
3. Steiner, H. S., Engineering Economic Principles, McGraw-Hill.
4. Blank, L. and Tarquin, A., Engineering Economy, McGraw Hill.

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| **Course No.: IPE 251** | **Credit: 3.0** | **Year: Second** | **Semester: Second** |
| **Course Title: Engineering Statistics** | | **Course Status: Theory** | |

**Rationale of the Course:**

Probability and statistical methods play an important role in many aspects of engineering including optimization of industrial processes, quality control, design of reliable systems, and modeling for simulation study. This course develops a strong background in basic concepts of probability and statistics including methods of descriptive data analysis, probability distributions and their random variables, statistical inference and demonstrates how these concepts provide the theoretical foundation for data analysis through statistical modelling, estimation and hypothesis testing with a major emphasis on applications in Industrial and Production Engineering.

**Course Objectives:**

The objectives of this course are to:

* facilitate knowledge about basic concepts of probability and statistics as well as different types of data along with their characteristics
* help the students understand the basic concepts underlying probability distribution and hypothesis testing
* develop skill in engineering problem solving and interpreting the solution in real life context using statistical concepts for both descriptive and inferential domain
* enhance analytical ability and decision-making skill.

**Course Content:**

Engineering Statistics: Set - Sets and their properties; Probability: Sample space and Event, Probability of events, Bayes’ Rule of probability, Theorem of Total and Compound probability, Conditional probability, Mathematical Expectation, Mean, Variance and Covariance, Properties of mean and variance. Probability Distribution: Discrete and Continuous; Discrete Probability distribution: Binomial, Geometric, Negative Binomial, Poisson, Hyper Geometric and Multinomial distribution; Continuous Distribution: Uniform distribution, Normal with applications, Gamma, Exponential and Weibull, Chi-square distribution; Joint, Conditional and Marginal Probability distributions. Functions of Random Variables: Variables transformation, Moments and Moment generating functions, Random sampling, Sampling distribution; Correlation Theory: Linear correlation, measures of correlation and its significance; Estimation Theory: Inference, methods of estimation estimating the mean tolerance limits, estimating the variance; Test of Hypothesis: Definition of statistical Hypothesis, Type I and Type II error, Goodness of fit test, Test for independence.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

**CLO 01**: distinguish and interpret different data types including its shape, center, spread, and outliers

**CLO 02**: describe the concepts of mutually exclusive events, conditional probability, total and compound probability, dependent and independent events, and Bayes theorem

**CLO 03**: explain the concepts of probability distribution as well as mathematical descriptions of random variables and be able to apply these concepts to solve engineering problems

**CLO 04**: calculate the various moments of random variables such as mean values, variances and standard deviations and identify their use

**CLO 05**: calculate linear correlation coefficient and interpret its significance in real life context

**CLO 06**: calculate and interpret point and interval estimates for population means, proportions and variance

**CLO 07**: describe the concept of a sampling distribution and its use in conducting statistical inference for population parameters

**CLO 08**: understand the basic concepts underlying hypothesis testing as well as perform and interpret the results of hypothesis testing for a sample means, proportions and variance

**CLO 09**: conduct a chi-square test of independence and chi-square goodness of fit test.

**Mapping of CLOs with PLOs**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO 01** |  |  | × |  | × |  |  |  |
| **CLO 02** |  |  | × |  | × |  |  |  |
| **CLO 03** | × | × | × |  | × |  |  |  |
| **CLO 04** | × |  | × |  | × |  |  |  |
| **CLO 05** | × | × | × |  | × |  |  |  |
| **CLO 06** | × | × | × | × | × |  |  |  |
| **CLO 07** |  |  | × |  | × |  |  |  |
| **CLO 08** | × |  | × | × | × |  |  |  |
| **CLO 09** |  |  | × | × | × |  |  |  |

**Books Recommended:**

1. Walpole, Myers, Myers and Ye, Probability & Statistics for Engineers & Scientists.
2. Douglas C. Montgomery and George C. Runger, Applied Statistics and Probability for Engineers.
3. Ron Larson and Betsy Farber, Elementary Statistics Picturing the World.

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| **Course No.: CSE 203G** | **Credit: 2.0** | **Year: Second** | | **Semester: Second** |
| **Course Title: Introduction to Programming with Python** | | | **Course Status: Theory** | |

**Rationale of the Course:**

In this current world, most of the research works require computational data analysis of corresponding fields. This requirement has emphasized the necessity of a knowledge of computer programming for all the researchers. For research-related purposes, computer programming using Python is one of the best choices. This course is designed with the purpose to make students acquainted with programming using python and make them comfortable to deal with computational data analysis.

**Course Objectives:**

The objectives of this course are to:

* help students conceptualize basic theories of computer programming
* make the students understand fundamental components of python programming
* develop skills for writing computer programs using all necessary branches of Python
* accumulate basic ideas about data structures and data manipulations.

**Course Content:**

**Computer Basics:** Concept on Computer Hardware, Software and its classification, Compiler vs Interpreter. **Using the Python Interpreter:** Invoking the Interpreter, Argument Passing, Interactive Mode, The Interpreter and Its Environment, Source Code Encoding; **An Informal Introduction to Python:** Using Python as a Calculator- Numbers, Strings, Lists. First Steps Towards Programming; **More Control Flow Tools:** if Statements, for Statements, The range() Function, break and continue Statements, and else Clauses on Loops, pass Statements, Defining Functions;  **More on Defining Functions:** Default Argument Values, Keyword Arguments,  Arbitrary Argument Lists, Unpacking Argument Lists, Lambda Expressions, Documentation Strings, Function Annotations, **Intermezzo:** Coding Style; **Data Structures:** More on Lists- Using Lists as Stacks, Using Lists as Queues, List Comprehensions, Nested List Comprehensions, The del statement, Tuples and Sequences, Sets, Dictionaries, Looping Techniques, More on Conditions, Comparing Sequences and Other Types; **Modules:** More on Modules- Executing modules as scripts, The Module Search Path, Compiled” Python files, Standard Modules, The dir() Function, Packages- Importing \* From a Package, Intra-package References, Packages in Multiple Directories, matplotlib, numpy, other common necessary packages; **Input and Output:** Fancier Output Formatting, Old string formatting, **Reading and Writing Files**: Methods of File Objects,  Saving structured data with json; **Errors and Exceptions:** Syntax Errors, Exceptions, Handling Exceptions, Raising Exceptions, User-defined Exceptions, Defining Clean-up Actions, Predefined Clean-up Actions. **Classes:** A Word About Names and Objects, Python Scopes and Namespaces, Scopes and Namespaces Example, A First Look at Classes,  Class Definition Syntax, Class Objects, Instance Objects, Method Objects, Class and Instance Variables, Random Remarks, Inheritance, Multiple Inheritance, Private Variables, Odds and Ends, Iterators, Generators, Generator Expressions.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

1. implement knowledge of Python for wiritng computer programs
2. design solutions of real-life problems using necessary componetns of Python
3. identify errors from a program and use exception handlers to handle errors and exception
4. implement Object Oriented Programming and Moduler concepts
5. design basic data structure to solve efficient data storage issues
6. apply knowledge of programming in data analysis and manupuation

**Mapping of CLOs with PLOs**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO 01** | × |  |  |  |  |  |  |  |
| **CLO 02** | × |  |  |  | × |  |  |  |
| **CLO 03** | × |  |  |  | × |  |  |  |
| **CLO 04** |  |  |  | × |  |  |  |  |
| **CLO 05** |  |  |  | × | × |  |  |  |
| **CLO 06** | × |  | × | × |  |  |  |  |

**Books Recommended:**

1. Learning Python, By Mark Lutz
2. Think Python, By Allen B. Downey
3. The Python Tutorial, Official documentation of Python

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| **Course No: CSE 204G** | **Credit: 2.0** | **Year: Second** | | **Semester: Second** |
| **Course Title: Introduction to Programming with Python Lab** | | | **Course Status: Sessional** | |

**Rationale of the Course:**

In this current world, most of the research works require computational data analysis of corresponding fields. This requirement has emphasized the necessity of a knowledge of computer programming for all the researchers. For research-related purposes, computer programming using Python is one of the best choices. This course is designed with the purpose to make students acquainted with programming using python and make them comfortable to deal with computational data analysis.

**Course Objectives:**

The objectives of this course are to:

* help students conceptualize basic theories of computer programming
* make the students understand fundamental components of python programming
* develop skills for writing computer programs using all necessary branches of Python
* accumulate basic ideas about data structures and data manipulations

**Course Content:**

**Laboratory works based on theory classes and basic problem solving from rosalind.info using Pycharm, Jupyter, and Anaconda IDEs.**

**Computer Basics:** Concept on Computer Hardware, Software and its classification, Compiler vs Interpreter. **Using the Python Interpreter:** Invoking the Interpreter, Argument Passing, Interactive Mode, The Interpreter, and Its Environment, Source Code Encoding; **An Informal Introduction to Python:** Using Python as a Calculator- Numbers, Strings, Lists. First Steps Towards Programming; **More Control Flow Tools:** if Statements, for Statements, The range() Function, break and continue Statements, and else Clauses on Loops, pass Statements, Defining Functions;  **More on Defining Functions:** Default Argument Values, Keyword Arguments,  Arbitrary Argument Lists, Unpacking Argument Lists, Lambda Expressions, Documentation Strings, Function Annotations, **Intermezzo:** Coding Style; **Data Structures:** More on Lists- Using Lists as Stacks, Using Lists as Queues, List Comprehensions, Nested List Comprehensions, The del statement, Tuples and Sequences, Sets, Dictionaries, Looping Techniques, More on Conditions, Comparing Sequences and Other Types; **Modules:** More on Modules- Executing modules as scripts, The Module Search Path, Compiled” Python files, Standard Modules, The dir() Function, Packages- Importing \* From a Package, Intra-package References, Packages in Multiple Directories, matplotlib, numpy, other common necessary packages; **Input and Output:** Fancier Output Formatting, Old string formatting, **Reading and Writing Files**: Methods of File Objects,  Saving structured data with JSON; **Errors and Exceptions:** Syntax Errors, Exceptions, Handling Exceptions, Raising Exceptions, User-defined Exceptions, Defining Clean-up Actions, Predefined Clean-up Actions. **Classes:** A Word About Names and Objects, Python Scopes and Namespaces, Scopes and Namespaces Example, A First Look at Classes,  Class Definition Syntax, Class Objects, Instance Objects, Method Objects, Class and Instance Variables, Random Remarks, Inheritance, Multiple Inheritance, Private Variables, Odds and Ends, Iterators, Generators, Generator Expressions.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

1. implement knowledge of Python for wiritng computer programs
2. design solutions of real-life problems using necessary componetns of Python
3. identify errors from a program and use exception handlers to handle errors and exception
4. implement Object Oriented Programming and Moduler concepts
5. design basic data structure to solve efficient data storage issues

**Mapping of CLOs with PLOs**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO 01** | × |  |  |  |  |  |  |  |
| **CLO 02** | × |  |  |  | × |  |  |  |
| **CLO 03** | × |  |  |  | × |  |  |  |
| **CLO 04** |  |  |  | × |  |  |  |  |
| **CLO 05** |  |  |  | × | × |  |  |  |

**Books Recommended:**

1. Learning Python, By Mark Lutz
2. Think Python, By Allen B. Downey
3. The Python Tutorial, Official documentation of Python

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| **Course No: IPE 228** | **Credit: 1.50** | **Year: Second** | | **Semester: Second** |
| **Course Title: Fluid Mechanics and Machinery Sessional** | | | **Course Status: Sessional** | |

**Rationale of the Course:**

To understand the knowledge of Fluid mechanics and machinery, it is essential for all to related the theory with practice. This Fluid Mechanics and Machinery Sessional helps to understand these theories by hands-on experiment more closely. Various apparatus is available in the laboratory like, Verification of Bernoulli's theorem apparatus, venturi and orifice meters, flow over notches apparatus etc.

**Course Objectives:**

The objectives of this course are to:

* enrich the concept of fluid mechanics and hydraulic machines
* acquaint students with the properties of fluids and the use of various instruments for fluid flow measurement
* make the students to determine the various parameters related to fluid flow in pipes and in open channels.

**Course Content:**

Study of hydraulic bench; Discharge through Weirs (Triangular and Rectangular); Calibration of venturi meter and orifice meter; Flow through a rectangular and triangular notch; Verification of Bernoulli’s equation; Study of Reynolds’s number apparatus.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

**CLO01:** understand the properties of fluids and the use of various instruments for fluid flow measurement

**CLO02:** perform in hydraulic Bench under various conditions of working and their characteristics

**CLO03:** verify the Bernoulli’s theorem

**CLO04:** determine the coefficient of discharge of venturi meter and orifice meter

**CLO05:** apply the basic concepts of fluid mechanics and machinery to carry out professional engineering activities in the field of fluids.

**Mapping of CLOs with PLOs**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO1** | × |  |  |  |  |  |  |  |
| **CLO2** |  | × |  |  |  |  |  |  |
| **CLO3** |  | × |  |  | × |  |  |  |
| **CLO4** |  |  |  |  | × |  |  |  |
| **CLO5** | × |  |  |  |  |  |  |  |

**Books Recommended:**

1. Sarbjit Singh, Experiments in Fluid Mechanics.

2. Mohd. Kaleem Khan, Fluid Mechanics and Machinery.

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| **Course No.: IPE 246** | **Credit: 1.50** | **Year: Second** | | **Semester: Second** |
| **Course Title: Computer Aided Drawing and Drafting -II** | | | **Course Status: Lab** | |

**Rationale of the Course:**

Designers and manufacturers in virtually every industry use computer-aided design system to create engineering design solutions. This course introduces the students with the concepts and methods of 3D modeling in AutoCAD®/ Solidworks®. The course gives in depth knowledge of 3D fundamentals and explores the main features of AutoCAD’s advanced 3D environment. The course structure focuses on 3D modeling, composition and rendering with AutoCAD/ Solidworks®. Prerequisites to take this course is proficient in 2D drawings using AutoCAD/ Solidworks®.

**Course Objectives:**

The objectives of this course are to:

* acquaint students with the basic tools of 3D design using AutoCAD/ Solidworks®.
* provide the students with the basic understanding of AutoCAD commands to design 3D objects
* facilitate necessary knowledge to create and modify 3D elements
* provide the knowledge of 3D rendering and animation.

**Course Content:**

3D Auto CAD: Introduction, Tools, Rendering, Printing and Plotting; Projects: AUTOCAD 3D/3D Studio Max/ Solidworks®.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

**CLO1:** develop skills to work with and navigate the unique features of the computer aided 3D modelling workspace to create 3D objects

**CLO2:** understand and interpret the tools to creating, editing, and analyzing 3D models.

**CLO3:** design basic 3D models and animations.

**CLO4:** identify and understand the characteristics of rendering 3D objects for optimal system processing and analysis.

**Mapping of CLOs with PLOs**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO1** | × |  |  |  |  |  |  |  |
| **CLO2** | × | × |  |  |  |  |  |  |
| **CLO3** | × | × |  | × |  |  |  |  |
| **CLO4** | × |  |  |  |  |  |  |  |

**Books Recommended:**

1. Pandey, Jaiprakash, Shoukry, Yasser, AutoCAD 2020 3D Modeling.

2. Munir Hamad, AutoCAD 2020 3D Modeling,.

3. Ami Chopine, 3D Art Essentials.

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| **Course No.: IPE 250** | **Credit: 0.5** | **Year: Second** | **Semester: Second** |
| **Course Title: Comprehensive Viva-II** | | **Course Status: Sessional** | |

**Rationale of the Course:**

A comprehensive viva forms a part of the theory component of a summative examination. Its purpose is to evaluate the student’s learning and understanding of different courses in their undergraduate program. This course also aims to provide students with confidence while discussing the fundamental aspects of an engineering problem/situation in academic and professional environments.

**Course Objectives:**

The objectives of this course are to:

* assess the comprehensive knowledge gained in every course covered in third and fourth semester
* comprehend the questions asked and answer them with confidence.

**Course Content:**

The viva-voce will be conducted based on the courses covered till the fourth semester.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

**CLO 01:** face interview both in the academic and the industrial sector, and perform better in future

**CLO 02:** discuss the fundamental aspects of basic engineering problems/situations with confidence in future.

**Mapping of CLOs with PLOs**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO 01** | × |  |  |  |  |  | × |  |
| **CLO 02** |  |  |  |  |  | × |  |  |

**Books Recommended:**

Books recommended and material supplied for the courses covered in third and fourth semester.

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| **Course No: IPE 260** | **Credit: 0.5** | **Year: Second** | **Semester: Second** |
| **Course Title: Industrial Tour** | | **Course Status: Sessional** | |

**Rationale of the Course:**

The purpose of the industrial tour is to expose students to a real work environment and, at the same time, to gain knowledge through hands-on observation. The students will also develop skills in production processes, work ethics, and others from the industrial tour.

**Course Objectives:**

The objectives of this course are to:

* experience what it is like to work in a professional organization
* expose students to the various aspects of industrial practices and ethics
* make the student understand functions and organization of business and companies.

**Course Content:**

The department will select the industry and organize the tour.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

**CLO 01:** understand the work, responsibility, and ethics in the working environment

**CLO 02:** outline various aspects of manufacturing processes

**CLO 03:** prepare a technical report on the experience gained from the industrial tour.

**Mapping of CLOs with PLOs**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO 01** | × |  |  |  |  |  |  | × |
| **CLO 02** | × |  |  |  |  |  |  |  |
| **CLO 03** |  |  |  |  |  | × |  |  |

**Third Year First Semester**

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| **Course No.: IPE 321** | **Credit: 3.0** | **Year: Third** | **Semester: First** |
| **Course Title: Numerical Analysis** | | **Course Status: Theory** | |

**Rationale of the Course:**

This course intended to study mathematical techniques used to model engineering systems. It involves the development of mathematical models and solving of complex engineering problems using different computational techniques. Analytical solutions of complex engineering problems may be very difficult and time consuming. Numerical methods can be implemented easily to solve these complex problems easily and efficiently.

**Course Objectives:**

The objectives of this course are to:

* familiarize students with different techniques to formulate complex real-life engineering mathematical models numerically.
* facilitate students with knowledge of different on hand numerical problem-solving techniques
* make the students understand several errors and approximation in numerical methods
* help students become familiar with MATLAB and other convenient numerical software
* enhance skills on several available numerical techniques and software for simulation of complex physical systems.

**Course Content:**

Introduction: Mathematical model, Accuracy and precisions, errors; Nonlinear Equation: Roots of polynomials and transcendental equations; Linear System: Linear algebraic equations; Gauss elimination with pitfalls and techniques for improvement, LU decomposition, Engineering application; Optimization: One dimensional unconstrained and constrained optimization, engineering applications; Interpolation and Curve Fitting: Interpolating polynomials, Method of least squares, Curve fitting, Linear and nonlinear regression, Engineering applications; Numerical Differentiation and Integration: Newton –Cotes Integration Formulas, High-accuracy differentiation formulas, Runge-Kutta Methods, engineering applications; Boundary value problems: Initial and boundary value problems, Finite Difference Method (FDM), Finite Element Method (FEM).

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

**CLO 1:** demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions to otherwise intractable mathematical problems

**CLO 2:** apply numerical methods to obtain approximate solutions to mathematical problems

**CLO 3:** derive numerical solution techniques for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations

**CLO 4:** analyze and evaluate the accuracy of common numerical methods

**CLO 5:** implement numerical methods in MATLAB as well as simulate complex system

**CLO 6:** write efficient, well-documented MATLAB code and present numerical results in an informative way.

**Mapping of CLOs with PLOs**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO 1** | × |  |  |  | × |  |  |  |
| **CLO 2** | × |  | × |  | × |  |  |  |
| **CLO 3** |  |  |  |  |  |  |  |  |
| **CLO 4** |  |  |  |  |  |  |  |  |
| **CLO 5** |  |  | × |  | × |  |  |  |
| **CLO 6** |  |  | × |  | × |  |  |  |

**Books Recommended:**

1. Chapra, S. C., & Canale, R. P., Numerical methods for engineers. McGraw-Hill Higher Education.
2. Griffiths, D. V., & Smith, I. M., Numerical methods for engineers. CRC press.
3. Gupta S. K., Numerical methods for engineers. New Age International.

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| **Course No: IPE 331** | **Credit:03** | **Year: Third** | | **Semester: First** |
| **Course Title: Ergonomics and Industrial Safety** | | | **Course Status: Theory** | |

**Rationale of the Course:**

This course addresses the scope of ergonomics and the application of ergonomic principles for better workplace design. It also familiarizes the students with safety measures and accident prevention methods for better safety management in workplaces.

**Course Objectives:**

The following objectives are to:

* familiarize the students with man-machine systems and their components.
* acquaint students with the principles of ergonomics for better workplace design
* make the students understand the factors that make a workplace user friendly
* provide in depth knowledge of safety codes and standards
* facilitate necessary understanding on fire safety, electrical safety, safety in material handling and storage
* accumulate basic knowledge about the personal protective equipment and their use in industries
* enhance the knowledge about risk assessment and risk management.

**Course Content:**

Ergonomics: Introduction, history of development, man-machine system and its components. Anthropometry in workstation design (design of work surfaces and seat), stress and strain, metabolism; Measure of Physiological Functions: workload and energy consumption, biomechanics, types of movements of body members, strength and endurance, speed of movements; NIOSH lifting equation, Lifting index, Maximum acceptable weights and forces, Distal upper extremities risk factors, Strain index, RULA, REBA, and Office ergonomics; Visual displays for static information, visual displays of dynamic information, auditory, displays and controls, effect of vibration, noise, temperature and illumination on performance. *Industrial Safety:* Safety Management, Understanding accident, injury and hazard, Various hazards encountered in workplace, Hazard control, Company policy and management responsibilities, Direct and indirect cost, Accident causes and their control, Knowledge of existing safety codes and standards; Accident Prevention and Control: Fire safety, Electrical Safety, Safety in material handling and storage, Safety in hand portable power tools; Industrial Hygiene and Workers Protection: Understanding industrial hygiene, Types of personal protective equipment (PPE), Design standards and selection criteria of PPE; Risk Management: Risk assessment in workplace, Principles of sensible risk management.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

**CLO 1:** identify the impact of various personal attributes (anatomical, physiological, anthropometric and psychological) for healthy work environment

**CLO 2:** outline the factors that must be addressed for better work place design

**CLO 3:** interpret the problems arising discomforts due to improper lighting and noise

**CLO 4:** analyze and calculate manual lifting using standard lifting equation

**CLO 5:** explain the importance of visual display signs

**CLO 6:** understand the safety standards and explain the causes of hazards and accidents

**CLO 7:** develop the necessary safety precautions for better risk management.

**Mapping of CLOs with PLOs**

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| **PLO CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO 1** | × |  | × |  | × |  |  |  |
| **CLO 2** |  | × |  | × |  |  |  |  |
| **CLO 3** | × |  | × |  | × |  |  |  |
| **CLO 4** |  | × | × | × |  |  |  |  |
| **CLO 5** |  |  |  |  |  | × |  |  |
| **CLO 6** | × |  |  | × |  |  |  |  |
| **CLO 7** |  |  |  |  | × | × |  |  |

**Books Recommended:**

1. A Guide to the Ergonomics of Manufacturing; Martin Helander; publisher-Taylor & Francis.
2. Human Factors in Engineering and Design; Sanders and Mc Cormick;Latest Edition, publisher- McGraw HILL, INC.
3. An Introduction to Human Factors Engineering; Wickens, Lee, Liu and Becker; PHI Learning Private Limited- New Delhi; Second edition.
4. Industrial Safety Management- Hazard Identification and Risk Control, L M Deshmukh, publisher-TATA McGraw HILL.
5. The Safety Handbook, First Edition, Mark McGuire Moran
6. Industrial Safety, Health and Environment Management Systems, First Edition, R. K. Jain, Sunil S. Rao.

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| **Course No: IPE 333** | **Credit: 3.0** | **Year: Third** | | **Semester: First** |
| **Course Title: Quality Control and Management** | | | **Course Status: Theory** | |

**Rationale of the Course:**

Proper quality control and management is deemed as a surviving factor for industries nowadays. This course provides students with the knowledge of basic quality management concepts as well as statistical quality control methods and tools. It also develops the technical skills necessary to apply those concepts to design, implement, improve, and management of quality control processes in any industrial setting. A basic knowledge of the fundamentals of statistics and probability is required.

**Course Objectives:**

The objectives of this course are to:

* facilitate knowledge about modern concepts of quality, total quality management, and statistical quality control
* provide knowledge of using Statistical Process Control (SPC) techniques as a means to diagnose, reduce and eliminate causes of variation
* develop skill in solving quality related problem and interpreting the solution in industry context
* enhance analytical ability and decision-making skill.

**Course Content:**

Concept of Quality: Modern concept of quality and its measurement, quality redefined, identification of quality characteristics: quality of design conformance and performance, Deming’s principles on quality and productivity, Quality costs and their interpretation; Statistical Quality Control: Control and measurement of quality, Elementary SPC tools: Control charts, Process capability analysis, Design of experiments, Acceptance sampling plans: OC curves, single and double sampling plan, rectifying inspection, AOQ; Quality Management: Fundamentals of Quality Management, Quality planning, Total Quality Management: origin, concept and implementation, QCC, TQC, Quality Standards – ISO 9000 and 14000, Process analysis/Spaghetti Chairt, 5S, 6-Sigma methodology, TPM, SMED, Poka-Yoke etc.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

**CLO 1**: explain quality concepts for both manufacturing and service industry perspective along with its characteristics and measurement dimensions

**CLO 2**: interpret the quality costs and explain its association with productivity and profitability

**CLO 3**: interpret the Deming’s quality philosophy and explain its significance in quality improvement

**CLO 4**: identify the sources of variation and apply basic statistical quality control tools;

**CLO 5**: calculate the control limits for both variable and attribute control chart and evaluate the process status

**CLO 6**: explain various indices of process capability and evaluate process capability using various indices

**CLO 7**: explain, design, and perform single and double sampling plan as well as evaluate sampling plans based on producers’ and customers’ risks

**CLO 8**: design an experiment to obtain maximum knowledge about a process through least amount of experimentation

**CLO 9**: describe, distinguish and use quality management tools and understand the basic concepts underlying total quality management

**CLO 10**: explain the regulation and the phases of a quality system certification process.

**Mapping of CLOs with PLOs**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO 1** | × |  |  |  |  |  |  |  |
| **CLO 2** | × | × | × |  |  |  |  |  |
| **CLO 3** | × |  |  |  |  | × |  |  |
| **CLO 4** | × | × | × |  |  |  |  |  |
| **CLO 5** | × |  | × |  |  |  |  |  |
| **CLO 6** | × |  | × |  |  |  |  |  |
| **CLO 7** | × |  |  | × | × | × |  |  |
| **CLO 8** | × |  |  | × | × | × |  |  |
| **CLO 9** | × | × |  |  |  |  |  |  |
| **CLO 10** | × |  |  |  |  | × |  |  |

**Books Recommended:**

1. Douglas C. Montgomery, Introduction to Statistical Quality Control.
2. Amitav Mitra, Fundamentals of Quality Control and Improvement
3. John S. Oakland, Statistical Process Control

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| **Course No: IPE 351** | **Credit: 3.0** | **Year: Third** | | **Semester: First** |
| **Course Title: Product Design and Development** | | | **Course Status: Theory** | |

**Rationale of the Course:**

Design and development of innovative products is the key for manufacturing companies to achieve the long-term success and survive in intensively competitive global market. An integrated approach of product design and development is also required to create better quality products with enhanced capabilities, at attractive prices with compressed time to market cycles due to the intensified competition, rapidly changing technologies, especially computer-based technology and shorter product life cycles.

**Course Objectives:**

The objectives of this course are to:

* familiarize the students with the design philosophy, methodology, and general design process techniques
* engage students in real life product design by participating in a group project
* let students know about the impact of product or production process on environment through life cycle assessment.

**Course Content:**

Basic concepts of product design and development: Characteristics, business needs, designing process, Product life cycle, Concept generation in product development, Customer needs and demands, Concept generation and selection, Product and estimation, QFD; Product Architecture: Attributes and Satisfactions, Design for Manufacturing (DFM), Design for assembly and disassembly, Concept of Concurrent Engineering and Rapid Prototyping, Rapid Prototyping techniques (including 3D printing), Sequential Engineering, Consideration of ISO 9000 and ISO 14000 guidelines in product development process, FMEA analysis, Concept on Design for Environment.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

**CLO 1:** identify and analyze the product design and development processes in manufacturing industry.

**CLO 2:** record and maintain appropriate design documentation for planning a project.

**CLO 3:** apply the methodologies for product design and development to create, evaluate and elect design concepts.

**CLO 4:** apply design rules for material selection, design for manufacturability, design for assembly, and design for environment.

**CLO 5:** recognize issues of product safety, risk, and reliability.

**Mapping of CLOs with PLOs**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO 1** |  | × |  | × |  |  |  |  |
| **CLO 2** |  |  | × |  |  | × |  |  |
| **CLO 3** | × | × |  | × | × |  |  |  |
| **CLO 4** | × |  |  | × |  |  |  |  |
| **CLO 5** |  |  |  | × |  |  | × |  |

**Books Recommended:**

1. Product Design and Development, Karl T. Ulrich and Steven D. Eppinger

2. Total Quality Management, Dale H. Besterfield.

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| **Course No: IPE 353** | **Credit: 3.0** | **Year: Third** | | **Semester: First** |
| **Course Title: Facilities Planning and Material Handling** | | | **Course Status: Theory** | |

**Rationale of the Course:**

Business organizations strive to gain competitive advantage through minimization of costs on handling materials and final products. Facilities planning and material handling course basically focuses on strategic facilities planning through detailed facility location and layout design. It considers product and process flow, space and activity relationships, personnel requirements, material handling, etc. In addition, purpose of this course is to gain understanding of material handling systems for real world application. During this course, students will learn about solving problems in different operational areas that need decisions. Knowledge and skills developed through this course can be useful for the planning and design of manufacturing enterprises and service organizations for instance health care facilities, airport, warehouse, distribution center, etc.

**Course Objectives:**

The objectives of this course are to:

* facilitate necessary knowledge about theoretical aspects of production facilities location and material handling
* make the students understand the basic concepts related to the interactions between the production system parameters and their impact on materials handling systems design
* help students conceptualize standard methods for the design and modeling of plant layouts
* accumulate basic ideas about materials handling systems design for various aspects of the manufacturing and service industry.

**Course Content:**

Operations Function: Manufacturing operations, Non-manufacturing or Service operations; Plant Location: Factors, Objectives, Market oriented Location and Materials oriented Location, Single Facility Location, Location evaluation Methods: Point Rating method, The Load-distance method; Mathematical models of Plant location (Brown-Gibson Model, Transportation Model); Plant Layout: Objectives of Facility layout design, Principles of plant layout, The layout function, Classic plant layouts, Hybrid and Fixed layouts, Manufacturing Cells and Group Technology, Analysis of plant layout problems-Line Balancing, Analysis of process layout problems, Plant Layout Software (CRAFT, ALDEP, CORELAP); Material handling: Introduction to Material Handling, Conveying equipment, General theories for conveyors, Different types of Conveyors (Belt, Apron, Flight, Bucket, Pneumatic). Auxiliary equipment for material handling- Chute, Hopper, Feeder, Industrial trucks, Pallets etc., Lifting and Hoisting equipment, Industrial cranes; AGV.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

**CLO 1:** outline the traditional and contemporary issues in manufacturing and their impact on facilities design including receiving, shipping, warehousing, and integration with manufacturing and supporting operations

**CLO 2:** assess the value of facility planning on the strategy of a firm

**CLO 3:** explain facility design problems through analyzing layout models theoretically and using necessary mathematical tolls. Moreover, the student will able to solve facility location problems by applying different methods

**CLO 4:** describe and determine the effect of product, process, and schedule design parameters on plant layout and materials handling systems design

**CLO 5:** get the idea about the material handling systems. Also design material handling systems for a variety of scenarios pertaining to manufacturing and service industry

**CLO 6:** outline the procedure for the “Winning Facilities Planning Process” through applying quantitative facilities planning models

**CLO 7:** analyze flow, space, and activity relationships with impact to material handling and layout alternatives

**CLO 8:** interpret the environmental and economic aspects of facilities planning.

**Mapping of CLOs with PLOs**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO 1** | × | × | × |  | × |  |  |  |
| **CLO 2** | × | × | × | × |  | × |  |  |
| **CLO 3** | × | × | × | × | × |  |  |  |
| **CLO 4** | × | × | × | × | × |  |  |  |
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| **CLO 6** | × | × | × |  | × |  | × |  |
| **CLO 7** | × | × | × | × | × |  |  |  |
| **CLO 8** |  | × |  | × |  | × |  |  |

**Books Recommended:**

1. Dilworth, J.B., Production and Operations Management: Manufacturing and Services, McGraw-Hill.
2. Elwood S. Buffa, Modern Production Management, John Wiley.
3. A Spivakovsky, and V. Dyachkov, Conveyor and related equipments- Peace Publishers.

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| **Course No: IPE 322** | **Credit: 1.5** | **Year: Third** | **Semester: First** |
| **Course Title: Numerical Analysis Sessional** | | **Course Status: Sessional** | |

**Rationale of the Course:**

This sessional provides hands-on experience on developing model using ‘C’ language and MATLAB application to replicate various algorithm studied in IPE 321. This will provide students the ability to transform paper based numerical solution model to computer-based programming model which can solve complex engineering problems efficiently with higher accuracy. This sessional also develops understanding of error analysis and result interpretations techniques.

**Course Objectives:**

The objectives of this course are to:

* familiarize students with the MATLAB application interface and its uses in numerical problem solution
* develop skill in building computer-based programming model in both ‘C’ and MATLAB of general numerical solutions models
* provide knowledge of debugging the common error occurred during model development using programming language
* enhance skill in solutions generation, presentation, and interpretation
* encourage the students to model real life problem as well as solution generation by team working.

**Course Content:**

Code development (using programming language “C” or MATLAB) of different algorithm studied on IPE 321.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

**CLO 1**: explain the user interface of MATLAB application and uses of its various options and menus

**CLO 2**: develop computer based numerical solution model using both ‘C’ language and MATLAB

**CLO 3**: debug errors from developed computer-based models to produce desired output

**CLO 4**: generate solutions from computer-based model and interpret the result in the context of the original problem

**CLO 5**: compare between solutions given by model and evaluate the usefulness on basis of error acceptance

**CLO 6**: apply their team effort to model and solutions generation of real-life problems.

**Mapping of CLOs with PLOs**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
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| **CLO 3** | × | × |  |  | × |  |  |  |
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| **CLO 6** | × |  |  | × | × | × |  |  |

**Books Recommended:**

Chapra, S. C. & Canale, R. P., Numerical methods for engineers.

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| **Course No.: IPE 332** | **Credit: 1.5** | **Year: Third** | **Semester: First** |
| **Course Title: Ergonomics Sessional** | | **Course Status: Sessional** | |

**Rationale of the Course:**

In order to have a sensible development of IPE graduates, it is necessary to integrate theory with practice. With the aim to develop the dignity, Ergonomics sessional course is designed to develop work related various components, (such as class room, executive chair, computer chair and table, etc.) using anthropometric data and safety at work. In addition, this sessional course has been designed to provide hands-on experience using different ergo tools, equipment and industrial safety tools.

**Course Objectives:**

The objectives of this course are to:

* acquaint students with measurement of anthropometric data using anthropometer and analysis of data
* facilitate students with necessary knowledge about the specification of ergo tools and industrial safety knowledge used in ergonomics sessional class and in various industries
* develop skill in identifying the components of various ergonomics equipment’s and their respective functions, and performing various ergonomics equipment operations
* help students in developing the ability to identify and differentiate the measuring devices used in various industries
* acquaint skill for rapid eye-hand-finger movement using ergo-equipment (Minnesota Manual Dexterity Test)
* acquaint students with different industrial safety signs with their applications in real life
* encourage students to attain team effort in product design, development and fabrication.

**Course Content:**

Experiment- I: Measurement of Anthropometric data using anthropometer and analysis of secondary data; Experiment-II: Design and drafting of a class room and executive chair, computer chair and table using the data measured in experiment-I (only drafting in AutoCAD environment); Experiment-III: Measurement of the ambience noise in various work environment (different sections of industry, road side hospitals or clinics, classroom etc.) using sound level meter and its consequences; Experiment-IV: Assessment of different luminance in different workplace -inside industries, classrooms, and laboratories; Experiment-V: Measurement of pinch and grip strengths data and their applications in production/hand tool design and drafting (only drafting in Auto CAD environment); Experiment-VI: The complete Minnesota Manual Dexterity Test for rapid eye-hand-finger movement. Experiment-VII: Study of Industrial Safety Signs, their types and purposes.

**Course Learning Outcomes (CLO):**

After the successful completion of the course, students will be able to:

**CLO 1:** apply the principles of anthropometry in ergonomic design of work areas and equipment to a range of occupational settings

**CLO 2:** identify the components of various ergonomics equipment, their functions, as well as their operations procedure

**CLO 3:** identify and differentiate the measuring devices used in ergonomics

**CLO 4:** calculate pinch and grip strength values, and their applications in production/hand tool design

**CLO 5:** identify rapid eye-hand-finger movement using ergo-equipment (Minnesota Manual Dexterity Test)

**CLO 6:** understand different industrial safety signs and will be able to apply those industrial safety signs in appropriate places in industries

**CLO 7:** apply students’ team effort to develop the sequence of operations required for manufacturing a product from given data, and 2D & 3D engineering drawings.

**Mapping of CLOs with PLOs**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO 1** | × | × |  | × | × |  | × |  |
| **CLO 2** | × | × |  | × |  |  |  |  |
| **CLO 3** | × | × |  |  | × |  |  |  |
| **CLO 4** | × | × | × | × |  |  |  |  |
| **CLO 5** | × | × |  | × | × |  |  |  |
| **CLO 6** | × | × |  | × |  | × |  |  |
| **CLO 7** | × | × | × |  | × | × |  |  |

**Books Recommended:**

1. A Guide to the Ergonomics of Manufacturing; Martin Helander; publisher-Taylor & Francis.
2. Human Factors in Engineering and Design; Sanders and Mc Cormick;Latest Edition, publisher- McGraw HILL, INC.
3. An Introduction to Human Factors Engineering; Wickens, Lee, Liu and Becker; PHI Learning Private Limited- New Delhi; Second edition.
4. Industrial Safety Management- Hazard Identification and Risk Control, L M Deshmukh, publisher-TATA McGraw HILL.
5. The Safety Handbook, First Edition, Mark McGuire Moran
6. Industrial Safety, Health and Environment Management Systems, First Edition, R. K. Jain, Sunil S. Rao.

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| **Course No: IPE 352** | **Credit: 1.5** | **Year: Third** | | **Semester: First** |
| **Course Title: Product Design and Development Sessional** | | | **Course Status: Sessional** | |

**Rationale of the Course:**

The focus of Product Design and Development is integration of the marketing, design, and manufacturing functions of the firm in creating a new product. The sessional provides students with an appreciation for the realities of industrial practice and for the complex and essential roles played by the various members of product development teams.

**Course Objectives:**

The objectives of this course are to:

* familiarize the students with a set of tools and methods for product design and development
* helping the students to develop ability to create a new product confidently
* enhance team working skill through engaging students in real life product design in a group
* develop awareness of the role of multiple functions in creating a new product (e.g. marketing, finance, industrial design, engineering, production)
* nurture the ability to coordinate multiple, interdisciplinary tasks in order to achieve a common objective
* reinforce specific knowledge from other courses through practice and reflection in an action-oriented setting.

**Course Content:**

Design and Development of a real-life product or model or prototype following the steps of concept development, designing process, concept screening & scoring, concurrent engineering, quality function deployment. 3D Scanner and printer-based operations.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

**CLO 1:** explain the product development process and apply the appropriate methods of concept development

**CLO 2**: effectively communicate ideas and concepts into written, visual and digital presentations

**CLO 3**: creatively explore diverse strategies to conceptualize and generate original and relevant solutions to design problems

**CLO 4:** clearly convey comprehensive, detailed and meaningful information about their body of work

**CLO 5:** apply technical skill, knowledge and craftsmanship to prove feasibility of their concepts

**CLO 6:** work in a team through innovative design and development of models and prototypes of real-life problems

**CLO 7:** convert the theoretical learning into practical applications through practicing 3D scanner and printer-based operations.

**Mapping of CLOs with PLOs**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
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| **CLO 4** |  |  |  | × |  |  |  |  |
| **CLO 5** | × |  |  | × | × |  |  |  |
| **CLO 6** |  |  |  |  | × |  |  |  |
| **CLO 7** | × |  | × |  |  |  |  |  |

**Books Recommended:**

* 1. Karl T. Ulrich and Steven D. Eppinger, Product Design and Development, New York, NY: McGraw-Hill.
  2. Dale H. Besterfield, Carol Besterfield-Michna, Glen H. Besterfield, Mary Besterfield-Sarce, Total Quality Management, Pearson Prentice Hall.

**Teaching strategy for IPE 352 (**Product Design and Development Sessional)**:**

Teacher-centered approach:

1. *Direct Lecture:* Course Teacher will deliver lecture and course materials/guidelines on the design of a particular product.
2. *Formation of lab group:* In needed, Course Teacher will form a number of lab groups among students in order to manage the assigned work effectively.

Student-centered approach:

1. *Brain-storming:* Course teacher will conduct several brain-storming sessions with students to outline the product design and development.
2. *Design finalization and fabrication*: Group of students along with the course teachers will finalize the design of the product, and fabricate its prototype.
3. *Report preparation and submission:* student group will be asked to prepare an report on the assigned task and submit to course teachers.

**This course will be assessed as follows:**

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| i | Class Attendance | : | 10% |
| ii | Workbook evaluation | : | 10% |
| iii | Report Evaluation | : | 20% |
| iv | Product Evaluation \* | : | 40% |
| v | Final Presentation \* | : | 20% |

\* A student will not be allowed to appear at product evaluation and final presentation of this course if his/her class attendance is less than 50%.

**Third Year Second Semester**

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| **Course No: IPE 323** | **Credit: 3.0** | **Year: Third** | | **Semester: Second** |
| **Course Title: Measurement and Instrumentation** | | | **Course Status: Theory** | |

**Rationale of the Course:**

This course will introduce industrial instrumentation as used for troubleshooting, process measurements and process control. Specifically, the course will discuss measurement terminology, working principles of different measuring device, differentiate between analog and digital measuring instruments, describe the instrumentation used for electronic testing and develop the principles of operation of transducers used for industrial process measurement and control.

**Course Objectives:**

The objectives of this course are to:

* familiarize the students with different engineering measuring instrument
* provide the knowledge of working principles of different measuring techniques and devices
* facilitate necessary knowledge about sensors and transducers
* help them conceptualize different signal conditioning techniques
* acquaint students with the knowledge and concept of modern instrumentation and PLC.

**Course Content:**

Introduction to fundamental engineering measurements, Testing and calibration, Error analysis, Tolerance, Allowance and Fit, Tailors principle on limit gauge. Dimension Measurement, Abbeys principles of measuring threads and gears. Ultrasonic measurement, Measurement of light wave interference. Sensors and Transducers. Liquid level measurement. Force, Pressure, Torque measurement. Temperature measuring systems. Signal conditioning processes. Purpose, amplifying elements, filters, Wheatston bridge, analog to digital conversion, Multiplexers, digital signal processing. Analog and digital methods for data presentation. Sampling and normality testing. Study and use of instrumentation and control systems: Analog and digital instrumentation, characteristics, use, concept of modern instrumentation, Programmable Logic Controller (PLC).

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

**CLO 1:** make accuracy statements for various types of measurements

**CLO 2:** differentiate between digital and analog measuring instruments and describe the advantages of each

**CLO 3:** interpret how different instruments are used for process control

**CLO 4:** describe and understand the operation of different instruments used for various measurement in numerous industries

**CLO 5:** use PLC, microcontroller and electronic devices for industrial automation, process measurement and control.

**Mapping of CLOs with PLOs**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
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| **CLO 2** | × |  |  |  |  |  |  |  |
| **CLO 3** | × |  | × |  |  |  |  |  |
| **CLO 4** | × |  |  |  |  |  |  |  |
| **CLO 5** | × | × | × |  |  |  |  |  |

**Books Recommended:**

1. Jain, R.K (2009). *Engineering Metrology*. Khanna Publishers
2. Bolton, W (2015). *Mechatronics: Electronic control systems in mechanical and electrical engineering.* Pearson

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| --- | --- | --- | --- | --- |
| **Course No.: IPE 324** | **Credit: 1.5** | **Year: Third** | | **Semester: Second** |
| **Course Title: Measurement and Instrumentation Sessional** | | | **Course Status: Sessional** | |

**Rationale of the Course:**

This course focuses on developing practical knowledge of industrial instruments used in troubleshooting, process measurements and control. Specifically, the course will provide on-hand training on operating different measuring devices, digital electronic components, sensors, transducers, PLCs used for industrial process measurement and control.

**Course Objectives:**

The objectives of this course are to:

* familiarize the students with different instrumentation and control systems
* make students able to test and calibrate different measuring instruments
* enable students to perform Shaft Alignment Test, Thickness Test
* help them conceptualize Abbeys principles of measuring threads and gears
* develop skills on ultrasonic measurement, sampling and normality testing.

**Course Content:**

Study and use of instrumentation and control systems, Shaft alignment test, Dry film thickness test, Testing and calibration, Error analysis (Roundness of the Ball and Squareness of the Plate), Dimension measurement, Abbeys principles of measuring threads and gears, Ultrasonic measurement, Sampling and Normality testing.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

**CLO 1: e**xplain different instrumentation and control systems

**CLO 2:** measure accuracy, calibration of different measuring instruments

**CLO 3:** perform Shaft Alignment Test, Thickness measuring test

**CLO 4:** apply Abbeys principles of measuring threads and gears

**CLO 5:** perform ultrasonic measurement, sampling and normality test.

**Mapping of CLOs with PLOs**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
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| **CLO 2** | × | × | × |  |  |  |  |  |
| **CLO 3** | × | × | × |  |  |  |  |  |
| **CLO 4** | × | × | × |  |  |  |  |  |
| **CLO 5** | × | × | × |  |  |  |  |  |

**Books Recommended:**

1. Jain, R.K (2009). Engineering Metrology. Khanna Publishers.
2. Bolton, W (2015). Mechatronics: Electronic control systems in mechanical and electrical engineering. Pearson

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| **Course No: IPE 335** | **Credit: 3.0** | **Year: Third** | **Semester: Second** |
| **Course Title: Industrial Management** | | **Course Status: Theory** | |

**Rationale of the Course:**

Industrial Management course imparts the knowledge and skill required in managing different functions in factories. This course is designed to assist the students to acquire an understanding of business and management processes, and their relevance in complementing technical skills for a variety of large, medium, and small work settings, as well as for profit and non-profit organizations. It helps explore the knowledge in industrial management to improve the working environment and human resource working efficiency. Industrial psychology that refers to the practice of applying psychological theories and principles to the workplace environment, is also included in this course to meet the day-to-day challenges.

**Course Objectives:**

The objectives of this course are to:

* understand the basic principles of Industrial Management, and the major functions of managers
* explain how the Industrial Engineering activities are carried out and managed
* make the students think critically and strategically about management theories and issues which will enable them to develop their analytical skills in the decision-making process
* familiarize the students with management concepts, motivation theories, leadership, managing work groups and teamwork, control of groups, risk management, and to know the psychology of employees
* understand how the science of human behavior is used to select, develop, and manage employee groups
* develop an understanding of personal development process and how organizations can create a supportive work environment.

**Course Content:**

Evolution of management thoughts; Management Theories; Management Functions and Principles: Planning: types of plans and steps in planning, objectives and MBO, decision making; Organizing: Four building blocks, Organizational design functional organization, formal-informal organizations, organizational levels and span of management, organizational structures; Power and authority, Line and staff authority, Delegation, Job design, Managing creativity and innovation; Staffing: overview of the staffing function, situational factors affecting staffing; recruitment & selection, wages and incentives, job evaluation and enrichment, performance appraisal and compensation; Leading: Motivation, theories in motivation (McGregor’s theory, Need theory, Expectation theory etc.), leadership, managing work groups and Teamwork; Controlling: control principles, process and problems, Designing Control System. Risk Management: Potential causes of risk and failure, preventing risk and failure, risk mitigation and recovery. Industrial Psychology: Definitions, characteristics and components of industrial psychology; Hawthorne effects, criticism of Hawthorne experiments; Causes of stress, managing stress; Group dynamics: Theories of group formation, stages of group development, mitigating group conflicts; Personal development, personal development factors.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

1. understand and explain the activities of an industrial enterprise from different perspectives based on the concepts from the subject or Industrial Management
2. provide an integrated introduction to the business environment, the nature of business organizations, the role of the manager and techniques relevant to management
3. understand how managers can effectively plan in today’s dynamic environment, design the organization structure, and describe how environmental uncertainty affects the organization design
4. identify the strategies of the organization, and do the action plan accordingly
5. understand and importance of job design, staffing function, recruitment and selection, wages and incentives plan, job evaluation and enrichment, performance appraisal and compensation, etc.
6. acquainted with the theories of motivation, and characteristics of a leader, managing workgroups, mitigating group conflicts, and design a control system for an organization
7. access, evaluate, and manage risks on the basic level, and mitigate them on business process
8. apply different controlling principles and processes to design a control system
9. analysis, evaluate a system based on the psychology of human being, and understand the usefulness of personal development programs.

**Mapping of CLOs with PLOs**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO1** | **×** | **×** |  |  |  |  |  |  |
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| **CLO3** | **×** | **×** |  | **×** | **×** |  |  |  |
| **CLO4** |  | **×** | **×** | **×** | **×** |  |  |  |
| **CLO5** | **×** | **×** |  |  | **×** |  | **×** |  |
| **CLO6** |  | **×** |  | **×** | **×** |  |  |  |
| **CLO7** |  |  | **×** | **×** |  |  | **×** |  |
| **CLO8** |  |  | **×** |  | **×** | **×** |  |  |
| **CLO9** |  |  | **×** | **×** | **×** |  | **×** |  |

**Books Recommended:**

1. Philip E. Hicks, Industrial Engineering and Management- A New Perspective, McGraw Hill International Editions.
2. Andrew J. Dubrin, Essentials of Management, South-Western Cengage Learning.
3. Heinz Weihrich and Harold Koontz, Management -A Global Perspective, McHILL International Edition, Tenth Edition.
4. Ricky W. Griffin, Fundamentals of Management, 8e, Cengage Learning, USA
5. O.P. Khanna and A. Sarup, Industrial Engineering and Management, Dhanpat Rai Publication Ltd., India.
6. Charles W. L. Hill and Steven L. McShane, Principles of Management, McGraw Hill Irwin.
7. Dr. B. Kumar, Industrial Engineering, Khanna Publisher, India.

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| **Course No: IPE 336** | **Credit: 1.5** | **Year: Third** | | **Semester: Second** |
| **Course Title: Operations Management and QCM Sessional** | | | **Course Status: Sessional** | |

**Rationale of the Course:**

To solve complex problems of operations management and quality control, in-depth knowledge of different tools and techniques is required. This course will provide the students with opportunity of learning and applying different tools and techniques to solve complex problems related to operations management and quality control. Also, it will help student learn how to use statistical softwares as problem solving tools.

**Course Objectives:**

The objectives of this course are to:

* familiarize students with different statistical software like SPSS, Minitab, Microsoft Excel
* enable students creating different control charts and Pareto analysis using statistical software
* make students able to conduct design of experiments (DOE) using different software
* enable students, solve large forecasting and inventory management problems with the help of software
* help students solve large problems of production scheduling using statistical software.

**Course Content:**

**1.** From the set of historical data, preparing a suitable forecast for the next production period based on 3-month, 4-month, 5-month moving average, exponential smoothing, and regression and correlation method; **2.** With necessary assumptions, deriving the EOQ formula, and solving the problems of Inventory Management: EOQ, EPQ, EBQ, and Price discount model; **3.** Developing a Gantt Chart to solve the planning problems; **4.** Solving the sequencing and scheduling problems (basic priority rules, Johnson’s rule: 2 machine n jobs, 3 machine n jobs); **5.** With necessary diagrams, solving the given problems using SPC tool and techniques; **6.** With necessary diagrams, constructing the model, and solving problems of control chart (chart for attributes and chart for variables); **7.** Drawing OC curves, and solving the problems of acceptance sampling (single and multiple sampling); **8.** Preparing a DoE table, and interpreting the result obtained from a set of given data.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

**CLO 1:** use and implement different statistical software like SPSS, Minitab, Microsoft Excel

**CLO 2:** create different control charts and Pareto analysis using statistical software

**CLO 3:** conduct design of experiments (DOE) using different software

**CLO 4:** solve large forecasting and inventory management problems with the help of software

**CLO 5:** solve large problems of production scheduling using statistical software.

**Mapping of CLOs with PLOs**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO 1** | × |  | × |  |  |  |  |  |
| **CLO 2** | × |  | × |  |  |  |  |  |
| **CLO 3** | × |  | × |  |  |  |  |  |
| **CLO 4** | × |  | × |  | × |  |  |  |
| **CLO 5** | × |  | × |  | × |  |  |  |

**Books Recommended:**

1. Stevenson, W.J, Operations Management, McGraw-Hill Education
2. Hasin, A. A., Quality Control and Management, Bangladesh Business Solution, Dhaka.

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| **Course No: IPE 337** | **Credit: 3.0** | **Year: Third** | **Semester: Second** |
| **Course Title: Operations Management** | | **Course Status: Theory** | |

**Rationale of the Course:**

Business creates value by supplying products or services to satisfy customer demand that involves numerous activities and processes across the organization. Operations management involves managing people, equipment, technology, information, and many other resources to produce a company’s goods and services for customers. Irrespective of the company size, it is the core function of every company. Therefore, by studying the Operations Management course, students will be able to understand how work gets done, setting up processes, identifying the bottlenecks, fine-tuning processes to save time and money for a smooth production run.

**Course Objectives:**

The objectives of this course are to:

* familiarize the basic concepts, issues, tools and techniques of Operations Management
* understand the key concepts and issues of OM in both manufacturing and service organizations
* identify the operational issues in the value adding and non-value adding operations
* make students able to take responsibilities in four categories of work- direct, design, deliver, and develop a process
* acquire preliminary ideas of chemical equilibrium and kinetics
* apply the analytical skills and problem-solving tools to resolve the operational issues.

**Course Content:**

Introduction to Operations Management: Concepts, Tools and techniques, Systems and models, Scopes and benefits; Productivity: Concept, Factors affecting productivity, Productivity measurement, Different types of production processes and their characteristics, Importance of operations strategy; System Design: *Work-force* *management:* work standards and methods of work measurement, Time study, Method and Motion study, Value Engineering, LeValue Stream Mapping; Forecasting: Systems and methods, Subjective forecasting methods, Causal forecasting methods, Time series forecasting methods, Routine-short term forecasting, Comparison among different methods; Inventory Management: Concepts of inventory, Dependent and independent demand, ABC analysis, EOQ model, Inventory control models (P and Q), Concept of lumpy demand; Production Sequencing and Scheduling: Dispatching, Routing, Sequencing (FIFO, LIFO, EDD, CR, SPT), Scheduling concepts, machine loading, scheduling in different situations - Johnsons rule (1 m/c & n jobs, 2 m/c & n jobs); Gantt chart; Recycling and Remanufacturing.

**Course Learning Outcomes, CLOs**

After the successful completion of the course, students will be able to:

1. understand the basics of the input–output framework, and apply them to a wide range of operations in an organization
2. understand the various types of production processes occurring within operations
3. define the roles and responsibilities of operations managers and the challenges they face in the new business environment
4. examine and analyze different types of production processes for innumerable design decisions, and how they relate to the overall strategies of an organization
5. understand the roles and applications of forecasting, work improvement, inventories, work scheduling and system tools, and managing them in the production system
6. develop the skills and concepts needed to ensure the ongoing contribution of a firm's operations to its competitive position
7. understand the content of work-study or motion-study, and how these work in the operational environment
8. demonstrate ability to identify strengths and weaknesses of alternative solutions and obtain relevant managerial insights
9. apply the engineering knowledge to solve real-world unstructured problems related to various production planning and control areas.

**Mapping of CLOs with PLOs**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO 1** | **×** | **×** | **×** | **×** |  |  |  |  |
| **CLO 2** | **×** | **×** |  |  |  |  |  |  |
| **CLO 3** | **×** | **×** |  |  |  |  |  |  |
| **CLO 4** |  |  | **×** | **×** | **×** |  | **×** |  |
| **CLO 5** |  | **×** |  | **×** |  |  |  |  |
| **CLO 6** | **×** |  |  | **×** | **×** |  |  |  |
| **CLO 7** |  | **×** |  |  | **×** |  |  |  |
| **CLO 8** |  |  | **×** |  |  | **×** |  |  |
| **CLO 9** | **×** |  |  |  | **×** | **×** | **×** |  |

**Books Recommended:**

1. William J. Stevenson, Operations Management, 13e, McGraw Hill Edition
2. Lee J. Krajewski, Larry P. Ritzman, and Manoj K. Malhotra, Operations Management Processes and Supply Chains, Pearson Education Limited, England
3. Roberta S. Russell, and Bernard W. Taylor III, Operations Management Creating Value Along the Supply Chain, John Wiley & Sons, Inc, USA
4. Nigel Slack, Stuart Chambers, Robert Johnston, Operations Management, Pearson Education Limited
5. K. C. Jain and L.N. Agarwal, Production Planning & Control and Industrial Management, Khanna Publishers, India
6. R N Roy, A Modern Approach to Operations Management, New Age Int. Ltd., India.

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| **Course No: IPE 339** | **Credit: 3.00** | **Year: Thrid** | **Semester: Second** |
| **Course Title: Operations Research** | | **Course Status: Theory** | |

**Rationale of the Course:**

Operations Research (OR) is a quantitative approach that solves problems, using a number of mathematical techniques. It helps in solving problems in different engineering areas that need decisions with constraints. To achieve the best performance under given circumstances, operations research plays as a power tool. It involves building models or replications in order to try out and test solutions before applying them. The goal of this course is to teach students to formulate, analyze, and solve mathematical models that represent real-world problems.

**Course Objectives:**

The objectives of this course are to:

* impart knowledge in concepts and tools of operations research
* introduce student to quantitative methods, techniques and tools for effective decision-making
* make the students understand mathematical models of problems involving the operations of systems
* develop skills to support decision making in manufacturing and service sector.

**Course Content:**

Introduction and scope of operations research, Introduction to linear programming:Graphical method, simplex algorithm, special cases of simple algorithm, duality theory and sensitivity analysis. Transportation models and its variances; Assignment models, Dynamic programming, Integer linear programming, B & B algorithm, Additive algorithm, Decision making under certainty, Risk analysis, Game theory, Queuing Model, Markov Chain. Application of operations research in industrial and production engineering.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

**CLO 1:** formulate a real-world problem as a mathematical programming model

**CLO 2:** understand the theoretical workings of the simplex method for linear programming and iterations of it by hand and computer

**CLO 3:** understand the relationship between a linear program and its dual, including strong duality

**CLO 4:** solve specialized linear programming problems like the transportation and assignment problems

**CLO 5:** understand the applications of, basic methods for, and challenges in integer programming

**CLO 6:** understand how to model and solve problems using dynamic programming

**CLO 7:** model and analyze a dynamic system as a queuing model and compute important performance measures

**CLO 8:** design new simple models to improve decision-making and develop critical thinking and take optimum strategies

**CLO 9:** apply the operations research tools in manufacturing and service industries.

**Mapping of CLOs with PLOs**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO 1** | **×** | **×** |  |  | **×** | **×** |  |  |
| **CLO 2** | **×** |  | **×** | **×** | **×** |  | **×** |  |
| **CLO 3** | **×** |  |  |  |  |  |  |  |
| **CLO 4** | **×** |  |  | **×** |  |  |  |  |
| **CLO 5** | **×** |  |  |  |  |  |  |  |
| **CLO 6** | **×** |  | **×** | **×** |  |  |  |  |
| **CLO 7** | **×** |  | **×** |  |  |  |  |  |
| **CLO 8** | **×** | **×** | **×** |  |  |  | **×** |  |
| **CLO 9** |  |  | **×** | **×** | **×** | **×** | **×** |  |

**Books Recommended:**

1. Hiller, F. S. and Lieberman, G.J., Introduction to Operations Research, McGraw-Hill.
2. Winston, W.L., Introduction to Mathematical Programming, Duxbury Press.
3. Hamdy, A. Taha, Operations Research: An Introduction, Pearson Education Ltd.

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| **Course No: IPE 341** | **Credit: 3.0** | **Year: Third** | | **Semester: Second** |
| **Course Title: Manufacturing Processes – II** | | | **Course Status: Theory** | |

**Rationale of the Course:**

Knowledge of manufacturing processes is required when working in any area of the manufacturing of products. There are many employment areas in manufacturing, as it is a vital component of all modern economies. By studying Manufacturing Processes – II, students will learn about the manufacturing process that goes into making a product. This course will help them understand the fundamental and practical aspects of a wide range of manufacturing processes such as metal forming, nonconventional machining and joining, and plastic product manufacturing that enable production at scale.

**Course Objectives:**

The objectives of this course are to:

* facilitate necessary knowledge about the fundamental and practical aspects of a wide range of manufacturing processes used in practice to fabricate a product
* help the students understand the difference among various manufacturing processes of the same category
* develop skill in identifying, formulating, and solving the real-life manufacturing problems
* help students develop the ability to explain and estimate the cost of manufacturing plastic products in particular.

**Course Content:**

Bulk deformation processes: Forging: open, close; Extrusion: Hot and cold extrusion process, Rolling, Drawing. Sheet metal working: Shearing and forming, Bending, Coining, Bulging, and Explosive forming. Threads and gear manufacturing process. Non-traditional machining process: Electro-discharge, electrochemical, LASER beam, electron beam, and abrasive jet machining. Nonconventional joining processes: LASER, Electron Beam, and Submerged Arc welding; Plastic products manufacturing processes: Injection molding, compression molding, blow molding, vacuum forming, and hand lay-up.

**Course Learning Outcomes, CLO**

After successful completion of the course, students will be able to:

**CLO 1:** explain the basic concept of metal forming processes and differentiate them

**CLO 2:** describe the working principle of various metal forming processes such as bulk deformation processes and sheet metal forming processes

**CLO 3:** differentiate various bulk deformation processes and sheet metal forming processes from one another

**CLO 4:** apply the engineering knowledge to solve real-life problems related to various metal forming processes, and gear and thread manufacturing processes

**CLO 5:** describe how various nonconventional machining and joining processes and plastic product manufacturing processes work, and differentiate them from one another

**CLO 6:** evaluate the usefulness of various nonconventional machining and joining processes in manufacturing

**CLO 7:** design a manufacturing process/system appropriate for fabricating a designed product

**CLO 8:** explain the basic concept of laser and the mechanism involved in laser beam machining

**CLO 9:** explain and estimate various cost terms involved in plastic product manufacturing.

**Mapping of CLOs with PLOs**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO 1** | × |  | × |  |  |  |  |  |
| **CLO 2** | × |  | × |  |  |  |  |  |
| **CLO 3** | × |  |  |  |  |  |  |  |
| **CLO 4** | × |  |  |  | × |  |  |  |
| **CLO 5** | × |  | × |  |  |  |  |  |
| **CLO 6** | × |  |  | × |  |  |  |  |
| **CLO 7** |  | × | × |  |  | × | × |  |
| **CLO 8** | × |  |  |  |  |  |  |  |
| **CLO 9** |  |  |  | × |  |  |  |  |

**Books Recommended:**

* 1. Mikell P. Groover, Fundamentals of Modern Manufacturing Materials, Processes, and Systems, Wiley & Sons
  2. J.T. Black and Ronald A. Kohser, DeGarmo’s Materials and Processes in Manufacturing, Wiley and Sons
  3. Serope Kalpakjian and Stevan R. Schmid, Manufacturing Engineering and Technology, Prentice Hall
  4. U.K. Singh and Manish Dwivedi, Manufacturing Processes, New Age Int. Publishers.
  5. H.N. Gupta, R.C. Gupta, and Arun Mittal, Manufacturing Processes, New Age Int. Publishers.
  6. Vukota Boljanovic, Sheet Metal Forming Processes and Die Design, Industrial Press Inc.

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| **Course No: IPE 342** | **Credit: 1.5** | **Year: Third** | | **Semester: Second** |
| **Course Title: Manufacturing Process II sessional** | | | **Course Status: Sessional** | |

**Rationale of the Course:**

To have a balanced overall development of IPE graduates, it is necessary to integrate theory with practice. In this sessional, students will be able to practically gain knowledge about both some conventional and unconventional machining processes.

**Course Objectives:**

The objectives of this course are to:

* facilitate students in understanding the use of the theoretical knowledge of manufacturing process in practice when a specific product has to be manufactured
* facilitate necessary knowledge about the specification of machine tools and working process relevant to metal forming process and different unconventional machining
* develop skills and make confident in operating the respective machine tools
* help students conceptualize and analyze the effect of parametric influences during processing of materials
* facilitate students in teamwork with an objective to use their gathered knowledge in developing a specified product.

**Course Content:**

Metal forming operation, sheet metal working, Laser machining, ECM and EDM, Effect of machining parameter on chip formation- chip thickness, shape, color and chip reduction ratio, study and operation of an injection molding machine; Fabrication of a power screw.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

**CLO 1:** identify different cutting tools with respect to their geometry and functionality

**CLO 2:** specify and differentiate different types of machine tools on the basis of suitability to make a certain product

**CLO 3:** categorize the various unconventional manufacturing process based on energy sources and mechanism employed

**CLO 4:** perform various machining operations on a bending machine, injection molding machine, lathe machine, drill machine milling machine, electrochemical machine and laser machine individually

**CLO 5:** understand the effect of parametric influences during processing of materials

**CLO 6:** calculate different machining responses of respective machines such as: spring back during bending; chip morphology, surface roughness and temperature for machining in engine lathe; MRR for machining in milling and laser, etc.

**CLO 7:** apply their team effort and understanding of theoretical knowledge on machining in manufacturing a specified product as per given specifications.

**Mapping of CLOs with PLOs**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO 1** | × |  |  |  |  |  |  |  |
| **CLO 2** | × | × |  | × |  |  |  |  |
| **CLO 3** | × |  |  |  |  |  |  |  |
| **CLO 4** | × |  |  |  |  |  |  |  |
| **CLO 5** | × |  | × |  |  |  |  |  |
| **CLO 6** | × | × | × |  |  |  |  |  |
| **CLO 7** |  |  |  | × | × | × |  |  |

**Books Recommended:**

1. Rajender Singh, Introduction to Basic Manufacturing and Workshop Technology, New Age Int. Publications.
2. [J.T. Black](https://www.textbooks.com/Author/J.T._Black.php?CSID=AZUKSAOUMTWJMTUQK2DTUDSCB) and [Ronald A. Kohser](https://www.textbooks.com/Author/Ronald_Kohser.php?CSID=AZUKSAOUMTWJMTUQK2DTUDSCB), DeGarmo's Materials and Processes in Manufacturing, Wiley & Sons.
3. H.N. Gupta, R.C. Gupta, and Arun Mittal, Manufacturing Processes, New Age Int. Publications.

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| **Course No.: IPE350** | **Credit: 0.5** | **Year: Third** | **Semester: Second** |
| **Course Title: Comprehensive Viva-III** | | **Course Status: Sessional** | |

**Rationale of the Course:**

A comprehensive viva forms a part of the theory component of a summative examination. Its purpose is to evaluate the student’s learning and understanding of different courses in their undergraduate program. This course also aims to provide students with confidence while discussing the fundamental aspects of an engineering problem/situation in academic and professional environments.

**Course Objectives:**

The objectives of this course are to:

* assess the comprehensive knowledge gained in every course covered in fifth and sixth semester
* comprehend the questions asked and answer them with confidence.

**Course Content:**

The viva-voce will be conducted based on the courses covered in fifth and sixth semester.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

**CLO 1:** face interview both in the academic and the industrial sector and perform better in future

**CLO 2:** formulate and solve the basic engineering problems/situations with confidence in future.

**Mapping of CLOs with PLOs**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO 1** | × |  |  |  |  |  | × |  |
| **CLO 2** |  |  |  |  | × | × |  |  |

**Books Recommended:**

Books recommended and material supplied for the courses covered till the sixth semester.

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| **Course No.: IPE 354** | **Credit: 1.0** | **Year: Third** | | **Semester: Second** |
| **Course Title: Business Communication Seminar II** | | | **Course Status: Sessional** | |

**Rationale of the Course:**

Business communication seminar-II helps students communicate with people across the globe. Seminar designed to provide students with the basic skills required in preparing essential business communication skills required to make an effective business presentation based on the given task.

**Course Objectives:**

The objectives of this course are to:

* improve oral communication and presentation skills of students
* enhance essential written business communication skills of students
* help students write and present academic thesis accurately and clearly
* facilitate necessary knowledge about careful articulation, stress on important words and effective modulation of the voice
* exchange ideas, opinions, thoughts, beliefs and information between human beings.

**Course Content:**

The students will be divided into different groups under the supervision of assigned teacher/s. Each group will be assigned different topics (such as topics on Industrial Engineering, Operations Management, Ergonomics, etc.). Students will have to prepare a report on the assigned topic and present it before the class. Academic thesis writing: application of concepts of undergraduate-level thesis writing. Provide guidelines to students about the ethical issues of academic research.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

1. demonstrate competencies in writing, listening, and verbal skills using the latest technology when appropriate
2. develop proficiency in research methodology, interpretative analysis, e-commendations, and information literacy
3. work as part of a team as related to human relations, time management, and accomplishing planning goals
4. apply problem solving capabilities through analytical skills, critical thinking, and creativity
5. practice leadership, self-motivation, and confidence in professional and social interaction
6. demonstrate the moral and professional business behavoir.

**Mapping of CLOs with PLOs**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO 1** | × |  |  |  |  | × |  |  |
| **CLO 2** | × |  | × |  |  |  |  | × |
| **CLO 3** | × | × |  |  | × |  |  |  |
| **CLO 4** | × |  | × |  | × |  |  |  |
| **CLO 5** | × |  |  |  |  | × |  |  |
| **CLO 6** |  |  |  |  |  |  |  | × |

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| **Course No: IPE360** | **Credit: 1.0** | **Year: Third** | **Semester: Second** |
| **Course Title: Industrial Training-I** | | **Course Status: Sessional** | |

**Rationale of the Course:**

The purpose of industrial training is to expose students to a real work environment and, at the same time, to gain knowledge through hands-on observation and job execution. From the industrial training, the students will also develop skills in work ethics, communication, management and others. Moreover, this practical training program allows students to relate theoretical knowledge with its application in the manufacturing industry.

**Course Objectives:**

The objectives of this course are to:

* provide the first-hand working experience as an engineering professional
* provide students an opportunity to know what it is like to work in a professional organization
* enhance their technical, interpersonal and communication skills
* observe interactions of engineers with other professional groups
* witness the functioning and organization of business and companies.

**Course Content:**

Industrial training will be selected by IPE department. It includes training, presentation, report writing and viva.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

**CLO 1:** understand the work, responsibility and the ethics in working environment

**CLO 2:** explain the general and specific procedure of engineering field related to industry

**CLO 3:** communicate effectively within the working environment

**CLO 4:** apply their theorical knowledge and engineering methods to a solve industrial problem

**CLO 5:** instill with good moral values such as commitment and trustworthy during their training

**CLO 6:** prepare technical report on industrial training.

**Mapping of CLOs with PLOs**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO 1** | × |  |  |  |  |  |  | × |
| **CLO 2** | × |  |  |  |  |  |  |  |
| **CLO 3** |  |  |  |  |  | × |  |  |
| **CLO 4** | × |  |  |  | × |  |  |  |
| **CLO 5** | × |  |  |  |  |  |  | × |
| **CLO 6** | × |  |  |  |  | × |  |  |

**Fourth Year First Semester**

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| **Course No: IPE 431** | **Credit: 3.0** | **Year: Fourth** | **Semester: First** |
| **Course Title: System Modeling and Simulation** | | **Course Status: Theory** | |

**Rationale of the Course:**

A system is a part of real world consisting of elements that are interconnected with each other following some rules to achieve a goal. A model is the representation of a system. Simulation is a computational technique to study a system using the model. IPE graduates need to study and solve many deterministic and probabilistic problems existed in manufacturing and service systems. To understand those problems, graduates need to measure the performance of a particular system considering many random effects. Knowledge of computational technique like simulation can be a guideline in solving those problems. The goal of this course is to teach students to understand the system, develop model and simulate the system through modeling.

**Course Objectives:**

The objectives of this course are to:

* understand the basic concepts of systems, models and simulation
* recognize the random effect in the process and follow different techniques to generate random numbers
* understand details of simulation process
* introduce student to simulation language and software
* understand mathematical models of system involving random effect
* develop necessary skills to apply the simulation techniques in various industrial sectors.

**Course Content:**

Simulation concepts, Its advantages and shortcoming, objectives of simulation in industrial and service organizations, areas of application; Systems and Models: components of a system, types of models ; System Simulation: Monte Carlo simulation, types of system simulation, steps in a simulation study; Extensive simulation examples – queueing system and inventory system; Random numbers: properties, techniques and testing of randomness; Random variates: Inverse transform techniques; Input modeling: identifying the distribution with data, parameter estimation, Goodness of Fit tests; Simulation of Manufacturing and Material Handling Systems: Models, Goals and performance measures, Issues, Case Studies. System dynamics modeling: System dynamics paradigm, Elements of SD modeling: physical flows, level & rate variables, information flow, flow diagrams, delays, smoothing of information; Causal Loop Diagramming; Behavior of linear low order systems: order of the system, positive and negative feedback systems.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

**CLO 1:** understand and identify the system, models and simulation techniques

**CLO 2:** develop conceptual model of a system

**CLO 3:** identify elements of simulation process and develop computer model of the systems

**CLO 4:** simulate the queuing system, inventory system and material handling system

**CLO 5:** follow the probability theories involved in the simulation process

**CLO 6:** verify and validate the system model and make it credible

**CLO 7:** apply simulation technique in manufacturing and service area

**CLO 8:** understand the system dynamics.

**Mapping of CLOs with PLOs**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO 1** | × |  |  |  |  |  |  |  |
| **CLO 2** | × | × |  | × |  |  |  |  |
| **CLO 3** |  | × | × | × |  |  |  |  |
| **CLO 4** |  | × | × | × |  |  |  |  |
| **CLO 5** |  |  |  |  |  |  |  |  |
| **CLO 6** | × |  | × |  | × | × | × | × |
| **CLO 7** |  |  |  | × |  |  | × |  |
| **CLO 8** | × | × |  |  |  |  |  |  |

**Books Recommended:**

1. B. Khoshnevis, Discrete Systems Simulation
2. Averill M. Law and W. David Kelton, Simulation modeling and analysis

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| **Course No: IPE 433** | **Credit: 3.00** | **Year: Fourth** | **Semester: First** |
| **Course Title: Supply Chain Management** | | **Course Status: Theory** | |

**Rationale of the Course:**

This course offers the understanding of the key issues involved in the management of global supply chains. It places supply chain management in a strategic context to align the corporate business strategies with supply chain strategies for better customer service, and impart higher surplus to the stake holders. In this course the students will study the basic concepts and elements of supply chain management within the broader framework of overall competitive business strategy.

**Course Objectives:**

The objectives of this course are to:

* familiarize the students with the frame work of supply chain management and its functional areas
* accumulate the ideas about current trends of global supply chain management with emerging e-commerce
* acquaint students the concept of supply chain networks development
* make students able to analyze the existing supply chain and modify it for better service and profitability
* provide the necessary the knowledge for better coordination among the partners so that bull whip effect can be minimized
* develop the student’s ability for collaborative planning so as to ensure partnership and trust within the supply chain.

**Course Content:**

Introduction to Supply Chain: What it is, the decision phases, importance, advantages, examples; Supply Chain drivers and obstacles: Inventory, Transportation, Facilities and Information; Inventory Management in Supply Chains: Planning and managing inventories in a supply chain, measuring the level of safety inventory, lead time and its management for competitive advantage, time based process mapping;, Quick Response Logistics: The philosophy, logistics implication, Vendor Managed Inventory (VMI) ; Lean and Agile Supply Chain: Lean thinking and quick response logistics, the concept of market winner and market qualifier, How to combine lean and agile mindsets; Managing the Global Pipeline: The tradeoffs among the logistics costs, concepts of centralization, focused factories and postponement. Transportation in a Supply Chain: role, factors, design options and trade-offs. Procurement: sourcing and its role and importance, make/buy decision and outsourcing, the process of purchasing, supplier selection, evaluation, and management; Pricing and Revenue Management in Supply Chain: role of pricing and revenue management, pricing to multiple segments, Information Technology in a Supply Chain: role, importance, use of information technologies, future of IT in the supply chain. Coordination in a Supply Chain: The Bullwhip Effect, effects on performance, the obstacles and the remedies, Partnerships and Trust within a supply chain.

**Course Learning Outcomes (CLOs)**

After the successful completion of the course, students will be able to:

**CLO 1:** identify the key elements of a supply chain network with associated performance drivers and stake holders involved

**CLO 2:** outline a supply chain distribution network specific to the supply chain strategy

**CLO 3:** apply the knowledge of supply chain management for better decision making for sourcing and pricing

**CLO 4:** justify the proper inventory management system for the whole supply chain

**CLO 5:** integrate ethical, economic, environmental, and cultural/societal contexts at the global level

**CLO 6:** manage the conflicting issues for better co-ordination, thus facilitate in building partnership and trust among the partners.

**Mapping of CLOs with PLOs**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
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| **CLO 5** |  |  |  | × |  | × | × |  |
| **CLO 6** |  |  | × |  | × |  | × |  |

**Books Recommended:**

1. Supply Chain Management: Strategy, Planning, and Operations (5th Edition) by Sunil Chopra and Peter Meindl. Prentice Hall.
2. Logistics and Supply Chain Management, 4th Edition, by Martin Christopher, Prentice Hall.

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| **Course No: IPE 441** | **Credit: 3.00** | **Year: Fourth** | | **Semester: First** |
| **Course Title: Machine Tools and Machining** | | | **Course Status: Theory** | |

**Rationale of the Course:**

A machine tool is a machine for handling or machining metal or other hard materials with precisions and higher productivity. By studying Machine Tools and Machining, students will gain the knowledge of machine tools and its mechanisms for transmission of motions through different parts. They will also develop the skills to design the drive system of machine tools and interpret the kinematic diagrams. This course will help them understand the selection criteria of proper cutting tools for machining to reduce the machining time.

**Course Objectives:**

The objectives of this course are to:

* facilitate necessary knowledge about the characteristics of machine tools and machine tool structures
* provide the knowledge of mechanism for transmission of motion in machine tools
* help students develop the ability to understand and design the drive system of machine tools
* make students understand the kinematic diagrams of different machine tools
* accumulate basic ideas about machine tool control systems
* acquaint students with the terminology and geometry of cutting tools
* help students conceptualize basic theories of metal cutting in machining.

**Course Content:**

Characteristics of machine tool and machine tool structure; Economics of machine tool selection; Mechanism for transmission of motions in machine tools; Drive system of machine tools: design of mechanical drive, speed gear boxes, feed gear boxes, stepped and other mechanical stepless drive, electrical drives; Spindles and Bearings, Study of kinematic diagrams: engine lathe and milling machines, etc., CNC machines; Machine tool control system: mechanical, electrical, hydraulic, adaptive and numerical control systems; Slide ways and guide ways of machine tools, Locating and clamping principles. Theory of metal cutting: chip formation and tool geometry, mechanics of chip curl, chip breakers, cutting forces, economics of metal cutting, tool life, metal cutting dynamometers.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

1. identify various parts of machine tools and their characteristics, and understand the mechanism for transmission of motion in machine tools
2. design the driving system of a machine tools by preparing layout of machine tool gear box and select number of teeth on each gear
3. understand and interpret the kinematic diagrams of machine tools
4. describe different machine tools’ control system and machine language
5. interpret the terminology and geometry of cutting tool and measure tool life, tool wear and tool failure during machining
6. explain the chip formation mechanism, and measure the cutting forces during chip formation process
7. explain the economics of metal cutting during machining.

**Mapping of CLOs with PLOs**

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| **CLO 6** | × | × | × |  |  |  |  |  |
| **CLO 7** | × |  | × |  |  |  |  |  |

**Books Recommended:**

1. N. K. Mehta, Machine Tools Design and Numerical Control, Tata McGraw-Hill Education.
2. S. K. Basu and D. K. Pal, Design of Machine Tools, CBS Pub & Dist Pvt. Ltd.
3. G. C. Sen and A. Bhattacharya, Principles of Machine Tools, New Central Book Agency
4. A. Bhattacharya, Metal Cutting Theory and Practice, New Central Book Agency
5. A. B. Chattopadhyay, Machining and Machine Tools, John Wiley & Sons.

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| **Course No: IPE 443** | **Credit: 3.0** | **Year: Fourth** | | **Semester: First** |
| **Course Title: Advanced Manufacturing System** | | | **Course Status: Theory** | |

**Rationale of the Course:**

From the days of industrial revolution to date, manufacturing process has gone a drastic change due to the adoption of advanced manufacturing methods like automation and ICT in the production units. To keep up the pace of technology adoption and manufacturing efficiency, the need for advanced manufacturing as a course has emerged out. This course is designed to deliver the knowledge and skills of modern and advanced manufacturing techniques to the students.

**Course Objectives:**

The objectives of this course are to:

* help conceptualize the need and the state-of-the-art technological developments in the area of modern manufacturing
* familiarize students with computer assisted design and manufacturing system
* provide preliminary knowledge about numerical control machines and part programming
* facilitate necessary knowledge about the basic and practical aspects of different types of advanced manufacturing system
* give ideas about motion mechanism, functions, and application of robots
* understand the fundamental of robot parts, power and control system.

**Course Content:**

Evolution and challenges of manufacturing systems, Historical Perspective, Goals and Technologies, Manufacturing paradigms; *CAD:* Fundamental concepts, CAD features and tools, hardware and software; *CAM:* Fundamental concepts, CAM tools, CAD/CAM system. NC/CNC:Historical development; Features, components and types of NC machines, NC machine control, Part programming*;* FMS*:* Scope, features and components of FMS, Material handling, Layout and Flexibility in FMS, Benefits and Limitations; Reconfigurable Manufacturing System (RMS): Key Characteristics, Manufacturing systems reconfiguration, Reconfiguration level; CIM: Introduction, architectures, benefit, challenges and implementation of CIM, Databases for CIM.

Robotics: Introduction and classification of robots, Overview of robot subsystems, resolution, repeatability and accuracy, Degrees of freedom of robots, Robot configurations and concept of work space, Mechanisms and transmission, End effectors and Different types of grippers, *Actuators:* Pneumatic, hydraulic and electrical actuators, *Sensors and controllers:* Internal and external sensors, position, velocity and acceleration sensors, proximity sensors, force sensors, laser range finder, Applications of robots, specifications of different industrial robots.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

1. understand the breadth and depth of advanced manufacturing technology in production arena
2. explain the basic concept of computer-based technology used in product design and manufacturing
3. understand the operation and function of numerical control machines
4. demonstrate the basic principles of programming code and apply for CNC to fabricate a given manufactured product on an automated mill, lathe machine
5. distinguish FMS and other manufacturing systems including RMS
6. explain processing stations and material handling system used in FMS environments
7. explain the basic principles of robot technology, classification, structures and drives for robots.

**Mapping of CLOs with PLOs**

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**Course Requirements:**

Concept of C programming and conventional machining processes.

**Books Recommended:**

1. CAD/CAM: Computer-Aided Design and Manufacturing, by [Groover M.](https://www.amazon.com/s/ref=dp_byline_sr_ebooks_1?ie=UTF8&field-author=Groover+M.&text=Groover+M.&sort=relevancerank&search-alias=digital-text) and [Zimmers E.](https://www.amazon.com/s/ref=dp_byline_sr_ebooks_2?ie=UTF8&field-author=Zimmers+E.&text=Zimmers+E.&sort=relevancerank&search-alias=digital-text) Pearson Publication
2. Computer Control of Manufacturing Systems by Yoram Koren, (Int. edition) McGraw Hill
3. Automated Manufacturing Systems Actuators, Controls, Sensors, And Robotics by S. Brian Morriss, McGraw Hill

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| **Course No: IPE 436** | **Credit: 3.00** | **Year: Fourth** | | **Semester: First** |
| **Course Title: Marketing and Cost Management** | | | **Course Status: Theory** | |

**Rationale of the Course:**

Marketing management consists of planning and executing the conception, pricing, promotion and distribution of ideas, goods and services in order to create, exchange and satisfy individual and organizational objectives. The course explains the nature and purpose of marketing, followed by the fundamentals of each of the most important marketing tasks. This course also contains the cost management part that includes various costing methods and techniques, financial statement analysis of an organization. It addresses a number of basic tools and techniques that can be used to examine the cost structure of a business.

**Course Objectives:**

The objectives of this course are to:

* make students understand the basic concepts of marketing management and cost management
* facilitate necessary knowledge about marketing different types of products and services
* help students understand how different situations in the competitive environment that affect choices in target marketing
* provide real-life examples or scenarios to enable them properly understand the situation
* acquaint students with the tools and techniques available to measure various costs involved in decision-making and performance evaluation
* provide knowledge about importance of process costing and cost allocation.

**Course Content:**

Marketing Management:Introduction to marketing, Marketing concepts, Marketing environment, Consumer-buyingbehavior, Marketing mix, Product management concept, Product life cycles and its implication, Market research techniques. Advertising; Domestic and International markets; Global marketing. Cost Management:Scope and application of cost and management accounting, costing methods and techniques,marginal costing and standard costing, income measurements in manufacturing companies, Variable costing vs. absorption costing, Cost allocation and categories: material costing and labor costing, overheads and their allocations; Financial statements analysis:concept, test for profitability, liquidity, solvency, overall measures, Cost-volume-profit analysis,Budgeting, Variance Analysis.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

**CLO 1:** understand the basic knowledge in the functional area of marketing and cost management and their applications

**CLO 2:** address marketing problems and opportunities using a variety of strategies and tactics

**CLO 3:** formulate and prepare a marketing plan including marketing objectives, marketing mix strategies and tactics, product life cycles analysis, and business in the domestic & international markets

**CLO 4:** analyze and interpret different market research techniques and their applications, and apply the advertising strategies to run a business in domestic and global market

**CLO 5:** understand the associations among various cost drivers, analysis of various costs margins, and appreciate the importance of process costing and cost allocation

**CLO 6:** demonstrate analytical skills in identification and resolution of problems pertaining to marketing and cost management

**CLO 7:** explain the product costing methods including activity-based costing and customer profitability analysis

**CLO 8:** evaluate and manage organizational performance through planning, budgeting, and decision-making process.

**Mapping of CLOs with PLOs**

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| **CLO 2** | **×** | **×** |  | **×** | **×** |  |  |  |
| **CLO 3** | **×** | **×** | **×** |  | **×** |  |  |  |
| **CLO 4** |  | **×** | **×** | **×** |  |  |  |  |
| **CLO 5** | **×** | **×** |  | **×** |  |  |  |  |
| **CLO 6** |  | **×** | **×** | **×** | **×** |  |  |  |
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| **CLO 8** |  |  | **×** |  | **×** | **×** | **×** |  |

**Books Recommended:**

1. Philip Kotler and Kevin Lane Keller, Marketing Management, 14ed, Prentice Hall.
2. Naresh K. Malhotra and David F. Birks, Marketing Research: An Applied Approach, 3e, Trans-Atlantic Publications, Inc.
3. O. C. Ferrell and Michael D. Hartline, Marketing Strategy, 5e, South-Western Cengage Learning.
4. Colin Drury, Management and Cost Accounting, 10e, Cengage Learning EMEA.
5. P. Periasami, A Textbook of Financial, Cost and Management Accounting, Himalaya Publishing House.
6. Alnoor Bhimani, Charles T. Horngren, Srikant M. Datar and Madhav Rajan, Management and Cost Accounting, 7e, Pearson Education.
7. Don R. Hansen, Maryanne M. Mowen and Liming Guan, Cost Management: Accounting and Control, 6e, South-Western College Pub.

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| **Course No: IPE 437** | **Credit: 3.0** | **Year: Fourth** | **Semester: First** |
| **Course Title: Organizational Behaviors** | | **Course Status: Theory** | |

**Rationale of the Course:**

The study of organizational behavior enables managers to understand, predict and influence the behavior of individuals and groups in organizations. This course introduces theories and models related to organizational behavior. It also encourages to apply and reflect upon the theories and models, so the students can understand how theory support managers in being effective. The course will provide the opportunity for learning in practical situations, and reflection on that learning.

**Course Objectives:**

The objectives of this course are to:

* familiarize the students with organizational behaviors so they can contribute to decisions within diverse economic, environmental, social and political contexts
* make students able to work collaboratively in team
* facilitate students to communicate ideas, intentions and outcomes to a variety of audiences
* pursue continuous personal development of knowledge and skills related to a management career
* facilitate students developing an integrated view of human behavior in the workplace.

**Course Content:**

Managing demographic and cultural diversity within organization: role of work ethics and national culture; Organizational Culture: levels of organizational culture, characteristics, and creation of sustainable culture; Understanding people at work: personality and work behavior, norms and value system, perception theory of work behaviors, work attitudes and behavior (individual and group), work attitude and ethics; Motivation: Motivating employees through performance appraisal and job design; Stresses and Emotions: Stress cycle, types of stress, stresses and job satisfaction, and emotion at work; Communication: Types of communication, barriers in communication; Managing groups and teams: Group dynamics, inter-group conflict and negotiation, difference between group and team, designing effective team; Power and Politics: Sources of power, types, organizational politics; Leading people within organization: Trade approach, Behavioral and contemporary approach. Organizational Theory: Transactions cost, Resource based view (RBV), Resource dependency theory (RDT), Stakeholder theory, Social Capital, Institutional theory.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

1. explain and apply theories and models relating to the behavior of individuals and groups in organizations
2. reflect on skills, knowledge and learning experiences, and those of fellow team members
3. give sensitive feedback to others and reflect upon feedback received to improve your own effectiveness and the effectiveness of the group and organization
4. understand the complexity of human behavior and demonstrate the flexibility required to work effectively with others
5. assess strengths and weaknesses in organizational behavior and identify development opportunities
6. analyze learning and communication styles and use this knowledge to further development of skills

**Mapping of CLOs with PLOs**

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| **CLO5** |  |  |  | **×** |  |  |  |  |
| **CLO6** |  |  |  |  |  |  | **×** |  |

**Books Recommended:**

McShane, SL and Travaglione, T, Organizational Behavior on the Pacific Rim, McGraw-Hill, Roseville

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| **Course No: IPE 438** | **Credit: 3.0** | **Year: Fourth** | **Semester: First** |
| **Course Title: Industrial Law** | | **Course Status: Theory** | |

**Rationale of the Course:**

Industrial Law relates to the laws governing industrial enterprises. This course deals with a wide range of  legal  topics, from employment  laws  to environmental concerns, contracts, industrial relations, and worker safety regulations.

**Course Learning Objectives:**

The objectives of the course are to:

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| * introduce students to theoretical and historical dimension of employee–employer relations and factors surrounding it |
| * acquaint them with the structure, environment and functions of trade unions, employer associations; |
| * provide the knowledge of Bangladesh Labor law act |
| * make the students understand the environmental conservation law |
| * **familiarize them with the current Industrial Relations practices** |
| * **getting idea about warker safety regulations.** |

**Course Content:**

The course covers the following topics; Industrial Law: Introduction, Employee’s insurance act, Workmen’s compensation act, Trade union act, Payment of wages act, industrial dispute act, Minimum wages act, Bangladesh labor agreement, Bangladesh labor law 2013, Environmental conservation law, 1997; Factory Act: Introduction, Inspector, and Certifying Surgeons; Health and Hygiene; Safety; Employments of Young persons; Leave and Holidays with wages etc.

**Course Learning Outcomes, CLOs**

After the successful completion of the course, students will be able to:

1. apply knowledge of the structure of the legal system to understand the validity of various types of legal pronouncements
2. identify various types of legal issues when encountering them in the workplace
3. categorize forms of legal remedies available under employment laws
4. accumulate changes in labor and employment law
5. understand the administrative process and the role it plays in resolving disputes that frequently arise in employment settings,
6. trace the development of government regulation of the employment relationship, environmental concervation law, and worker safety regulations
7. evaluate the strengths and weaknesses of legal arguments regarding the issue at hand.

**Mapping of CLOs with PLOs**

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| **CLO 2** |  |  |  |  | × |  |  | × |
| **CLO 3** | × |  |  |  | × |  |  |  |
| **CLO 4** |  |  |  |  |  |  | × |  |
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| **CLO 6** |  |  |  | × |  |  | × |  |
| **CLO 7** |  |  |  |  |  |  | × |  |

**Books Recommended:**

1. [Michael Salamon](https://www.google.com.bd/search?tbo=p&tbm=bks&q=inauthor:%22Michael+Salamon%22&source=gbs_metadata_r&cad=3), Industrial Relations: Theory and Practice, Financial Times Prentice Hall.
2. Dr. H. K. Sharay, Labour and Industrial Law, Fifth Edition, Universal Law publishing Co., India.
3. Amendment of the Bangladesh Labor Law
4. Environmental conservation law

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| **Course No: IPE 490** | **Credit: 3.0 + 3.0** | **Year: Fourth** | **Semester: First and Second** |
| **Course Title: Project and Thesis** | | **Course Status: Sessional** | |

**Rationale of the Course:**

The purpose of this course is to train students to conduct research and produce a thesis or project. This includes all aspects of the research process: development of research materials and/or experimental procedures, how to conduct studies/experiments, data analysis and interpretation, and empirical writing. Upon preliminary discussion with the selected supervisor, the student is expected to choose a topic for either a project or thesis early in the seventh semester. Students will work with their thesis supervisor throughout the process of completing the thesis/project. Each project or thesis is unique to the student(s), and thus there is flexibility in scheduling, approach, and conducting style that is up to the discretion of the thesis supervisor.

**Course Objectives:**

The objectives of this course are to:

* provide the student with knowledge of how to seek scientific facts and how to plan, carry out and present scientific work as well as theoretical and practical specialization within the areas of Industrial and Production Engineering
* give idea on what a project description should contain and how to formulate it
* acquaint students with tools, analytical frameworks and principles of analyzing scientific data
* facilitate necessary knowledge about how to present scientific work
* make the students understand the need for continuous learning for self-improvement.

**Course Content:**

In this course, students are required to undertake a thesis or projects. The objective is to provide an opportunity to develop initiative, self-reliance, creative ability and engineering judgment. The results must be submitted in a comprehensive report with appropriate drawing, bibliography etc. along with the products if any. Use of locally available materials in manufacturing and feasibility study of local industrial units will be emphasized.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

**CLO 1:** develop an understanding of and an obligation for theoretical and practical professional specialization within industrial or production engineering area; including understanding of the research questions

**CLO 2:** search and summarize scientific literature

**CLO 3:** interpret, calculate and discuss scientific data related to the research question at hand

**CLO 4**: demonstrate writing skills by writing a clear and concise research proposal with scientifically defendable aims, methods and conclusions

**CLO 5**: understand how to present scientific data and conclusions in written and oral form

**CLO 6**: describe the underlying concepts and principles of scientific misconduct and plagiarism

**CLO 7**: evaluate the importance of ethical issues in an adequate manner related to the scientific work.

**Mapping of CLOs with PLOs**

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| **CLO 2** |  |  | × |  | × |  | × |  |
| **CLO 3** | × |  | × | × |  |  |  |  |
| **CLO 4** |  |  | × |  | × | × |  |  |
| **CLO 5** |  |  | × |  | × | × |  |  |
| **CLO 6** |  |  |  |  | × |  |  | × |
| **CLO 7** |  |  |  |  |  |  | × | × |

**Books Recommended:**

1. Turabian K.L, W.C. Booth, G.G. Colomb, and J.M. Williams, A manual for writers of research papers, theses, and dissertations, Chicago, IL: University of Chicago Press.
2. [Uma Sekaran](https://www.wiley.com/en-kg/search?pq=%7Crelevance%7Cauthor%3AUma+Sekaran), and [Roger Bougie](https://www.wiley.com/en-kg/search?pq=%7Crelevance%7Cauthor%3ARoger+Bougie), Research Methods For Business: A Skill Building Approach, Wiley.

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| **Course No: IPE432** | **Credit: 1.5** | **Year: Fourth** | **Semester: First** |
| **Course Title: System Modeling and Simulation Sessional** | | **Course Status: Sessional** | |

**Rationale of the Course:**

A *system* is a part of real world consisting of elements that are interconnected with each other following some rules to achieve a goal. A *model* is the representation of a system. *Simulation* is a computational technique to study a system using the model. IPE graduates need to study and solve many deterministic and probabilistic problems existed in system of manufacturing and service area. To understand those problems, graduates need to measure the performance of that particular system considering many random effects. Knowledge of computational technique like simulation can be a guideline in solving those problems. The goal of this course is to teach students to understand the system, develop model and measure the performance using the computer code like spreadsheet, mat lab, arena and C language.

**Course Objectives:**

The objectives of this course are to:

* provide knowledge of different random number generation techniques
* introduce students to simulation language and software
* make students understand the mathematical models of system involving random effect
* help students develop skills to apply knowledge of Microsoft spreadsheet, Arena, MATLAB and “C++” language to system simulation.

**Course Content:**

Random number generation; practice of mid-square method and linear congenital method; maintenance scheduling problems; Monte Carlo simulation to find the value of PI; Coin flipping game using Microsoft spreadsheet; inventory model and linear programming model using Microsoft spreadsheet; Simulation of a business planning; Simulation of single and multiple sever queuing system.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

1. generate random numbers using different techniques and computer languages
2. understand the simulation of maintenance schedule problems
3. construct the coin flipping game using spreadsheet
4. simulate the inventory management model using spreadsheet
5. simulate the linear programming model using the spreadsheet
6. measure the performance of a real queuing system through manual data collection and simulation
7. understand how to model the queuing system and simulate using simulation software
8. design simple models for health care applications.

**Mapping of CLOs with PLOs**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
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| **CLO 8** |  | **×** |  | **×** | **×** |  |  |  |

**Books/Software Recommended:**

1. B. Khoshnevis, Discrete Systems Simulation
2. Averill M. Law and W. David Kelton, Simulation modeling and analysis
3. Microsoft spreadsheet, Mat lab, C language and Arena software

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| **Course No.: IPE 442** | **Credit: 1.5** | **Year: Fourth** | **Semester: First** |
| **Course Title: Machine Tools Sessional** | | **Course Status: Sessional** | |

**Rationale of the Course:**

Machine tools are power operated machines that are used to make various parts and components, usually out of metal and other hard materials. Traditional machine tools include some common machines for processing by turning, milling, shaping, grinding, finishing, etc. Machine tools sessional course is included in this curriculum to provide on-hand skills on various types of machine tools available in our workshop facilities. This course is a practical application of knowledge pertaining to the safe set-up and operation of standard metal cutting machine tools, the correct and safe selection of machining parameters, selection of cutting tools, the study on basic components such as slideways and guideways, and kinematic diagrams. The course also aims to develop the dignity of labor, care, teamwork, and collaboration of students.

**Course Objectives:**

The objectives of this course are to:

* acquaint students with the basic sliding and guiding mechanisms used in the common traditional machine tools
* understand the basic and modern structures used in the machine tools and their applications
* examine and interpret the kinematic diagrams (schematic and structural formula of motion, links and joints of a mechanism) of some traditional machine tools
* help students develop the ability to set-up a machining system and operate under a set of correct machining parameters, choice of right cutting tools
* develop skills in identifying the correct machining environments for the chip formation, and determination of force required during machining
* help students apply the on-hand skills in the design, fabrication, and calculation of making a machine component and to report on a safe working practice
* encourage students to work individually, or within a team in the fabrication process.

**Course Content:**

Study of various types of slideways and guideways used in machine tools; Study of various types of structures used in machine tools; Study of kinematic diagrams of commonly used machine tools, e.g., lathe, milling, shaper, etc.; Inspection and testing of cutting tool wear, tool life under various cutting conditions; Study on the chip formation (size, shape, color, etc.), and determination of chip thickness ratio under various cutting conditions; Design and fabrication of various types of driving and guiding mechanisms used in the machine tools.

**Course Learning Outcomes, CLOs**

After the successful completion of the course, students will be able to:

1. understand the basics of a machine tool, *e.g*., sliding and guiding mechanisms, the structure of machine tools, schematic and structural formula of motion, links and joints mechanism of some traditionally used machine tools
2. sketch, specify the use of various mechanisms, kinematic linkage, force distribution, and identification of unsafe working conditions
3. understand the various machining parameters, and know how the parameters affect the machining operations
4. perform various machining operations, troubleshoot and maintenance work on traditional machine tools individually
5. examine and analyze the cutting tool wear, tool life for different machining parameters
6. understand the basis of chip formation with respect to chip size, shape and chip color, and be able to find out the chip thickness ratio for machining analysis
7. demonstrate the ability to identify diagnostics of machine tools related problems and find out the solutions to smooth operation of a metal industry
8. apply the engineering knowledge to solve real-world unstructured problems related to various manufacturing of metal fabrication.

**Mapping of CLOs with PLOs**

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| **CLO 8** |  |  | **×** | **×** |  | **×** | **×** |  |

**Books Recommended:**

1. Heinrich Gerling, All About Machine Tools, New Age International Publishers.
2. James Anderson and Earl E. Tatro, Shop Theory, 6ed, Tata McGraw Hill Education, India.
3. Helmi A. Youssef and Hassan El-Hofy, Machining Technology: Machine Tools and Operations, CRC Press.
4. B. L. Juneja, G. S. Sekhon, and Nitin Seth, Fundamentals of Metal Cutting and Machine Tools, New Age International Publishers.
5. Dan B. Marghitu, Kinematic Chains and Machine Components Design, Elsevier Academic Press.
6. N. Chernov (Translated by  F. Palkin), Machiene Tools, 2e, Mir Publishers.

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| **Course No.: IPE 444** | **Credit: 1.5** | **Year: Fourth** | | **Semester: First** |
| **Course Title: Advanced Manufacturing Systems Sessional** | | | **Course Status: Sessional** | |

**Rationale of the Course:**

From the days of industrial revolution to date, manufacturing processes has undergone a drastic change due to the development of advanced manufacturing systems. Introduction of information and communication technology (ICT) and automated production units (NC, CNC, DNC, etc.) has paved way the route to integrated manufacturing systems. To keep up the pace of technology adoption and manufacturing efficiency, the need for advanced manufacturing as a course has emerged out. This course is designed to deliver the knowledge and skills of modern and advanced manufacturing techniques to the students.

**Course Objectives:**

The objectives of this course are to:

* acquaint students with various modern manufacturing processes
* facilitate necessary knowledge about the specification of modern machine tools used in workshops and modern manufacturing industries
* develop skill in identifying the modern machine tool components and their respective functions
* provide the students with the experience on various types of modern manufacturing operations
* make familiar and capable students in using software of respective modern machine tools used for designing, modeling and manufacturing a specific product.

**Course Content:**

Part Programming (G code and M code), Study and operation of advanced manufacturing processes- CNC milling, Printed Circuit Board milling, Laser beam machining, 3D scanner and printer.

**Course Learning Outcomes, CLOs**

After the successful completion of the course, students will be able to:

1. understand the working principle of laser beam, CNC milling and additive manufacturing processes
2. identify various components and accessories of a laser beam machine, CNC milling, PCB milling, 3D printer and describe their respective functions
3. design various profiles with dedicated software to be imparted on the work specimens.
4. apply part programming for machining a particular product in CNC milling
5. analyze the processes and evaluate the role of each process parameter during machining of various materials like ply wood, acrylic etc.
6. select the appropriate process output of the available various advanced manufacturing processes for the given job assignment
7. evaluate the optimal working conditions for maximum material removal and best quality of machined surface while machining with the modern machine tools.

**Mapping of CLOs with PLOs**

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**Books Recommended:**

Manuals and hand books available for the operational machines.

**Pre-requisite:**

Concept of C programming and conventional machining process

**Fourth Year Second Semester**

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| **Course No: IPE 435** | **Credit: 3.0** | **Year: Fourth** | **Semester: Second** |
| **Course Title: Project Management** | | **Course Status: Theory** | |

**Rationale of the Course:**

Projects are important aspects of dynamic and innovative business world. Likewise, comprehensive knowledge and skills on Project Management (PM) becomes increasingly important for engineers and managers working in modern industrial settings. This course provides systematic and thorough introduction on major facets of PM. It underlines the key tools and techniques to manage a project from its selection phase to termination phase. Strategic and operational aspects are reinforced by fabricated examples and case studies.

**Course Objectives:**

The objectives of this course are to:

* familiarize the students with the importance of PM in modern industries and business units in modern era
* make students understand the difference among operations, projects and programs
* facilitate students towards comprehensive learning about key tools and techniques of PM applicable to different stages of project life cycle
* make students understand the roles of a project manager and project management team in planning, leading, motivating, scheduling and controlling a project addressing uncertainties
* acquaint students with appropriate technology for communication, collaboration, information management and decision support system
* familiarize students with contract management, negotiations and other aspects of a project or program for its successful accomplishment

**Course Content:**

Definition, scopes and objectives; Roles of project manager, & team member, Factors for successful projects; Project management process: *Project Initiation-* project manager, project organization structure, project planning and project negotiation; Appraisal- Technical, Financial and Socio-economic appraisal. *Project implementation-* work-breakdown structure, project scheduling (Gantt chart, PERT, CPM), controlling, project management information system, project monitoring, evaluation and control, project life cycle costing, and contracts; *Project Termination-* terminating the project, project audits; Case studies.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

1. understand the importance of PM in modern industries and business units in the context of scope, cost, timing, resource constraints and quality of a project or program
2. apply knowledge of key tools and techniques of PM to accomplish any time and resource bound activity in real life industrial environment
3. play important role as a project manager in leading, motivating and controlling a program whatever its types and purpose
4. conduct teamwork successfully for managing a project or program incorporating uncertainty of activities
5. utilize appropriate technology for communication, collaboration, information management and decision support system in industry
6. set up contracts, resolve conflicts, motivate people and carry out teamwork successfully
7. present complex matters in a well-structured and understandable way
8. analyze complex management situations and come up with appropriate solutions

**Mapping of CLOs with PLOs**

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**Books Recommended:**

1. Harold R. Kerzner Project Management: A Systems Approach to Planning, Scheduling, and Controlling, John Willey and Sons.
2. Terry Schmidt, Strategic Project Management Made Simple, John Willey and Sons.
3. David I. Cleland, Project Management: Strategic Design and Implementation, McGraw-Hill, Inc.
4. Larson, E.W. and Gray, C.F., Project Management: the managerial process, McGraw-Hill.

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| **Course No: IPE 439** | **Credit: 3.0** | **Year: Fourth** | | **Semester: Second** |
| **Course Title: Production System Optimization** | | | **Course Status: Theory** | |

**Rationale of the Course:**

Manufacturing firms strive to develop strategic objectives in a way which result in competitive advantage in the market place. This course introduces concepts and tools used to design, analyze and improve operations of a business from the Operation Management (OM) concept. The purpose of this course is to gain an understanding of the managerial processes for effective operations in both goods-producing and service-rendering organizations. During this course, students will learn about solving problems in different engineering areas that need decisions.

**Course Objectives:**

The objectives of this course are to:

* facilitate necessary knowledge about the core concepts, principles and problems of operations management
* acquaint students with tools, analytical frameworks and principles of managing business operations
* develop skills to improve problem solving capabilities that support operational decision making
* help students to develop idea about the role of operations management as a strategic element of an organization.

**Course Content:**

Aggregate Planning, Capacity Requirement Planning for product and services; MRP and ERP: MRP inputs-outputs, Processing, MRP-II, ERP and its significance; *Productivity Management:* Productivity Analysis - Total and Partial Productivity, Productivity Appraisal, Productivity Analysis in an Enterprise (Kurosawa Approach, Gold’s Approach, Lawler’s Approach, QPA); Productivity Improvement Programs in Organizations. *JIT and Lean Operations:* JIT, JIT-II, Lean Approach- lean tools and techniques, Push-pull production concepts, KANBAN, Kaizen, Toyota Production System, Seven elements of JIT system for planning and control; *Optimized Production Technology (OPT):* Concepts of Bottleneck, 10 rules of OPT, Scheduling in OPT, Theory of Constraints.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

**CLO 01:** understand and appreciate the operation and production function in any organization.

**CLO 02:** apply the analytical and critical thinking to design, operate, and improve the systems that deliver products and services through standard techniques of operations management

**CLO 03:** interpret the relationship of the various planning practices of capacity planning, aggregate planning, and project planning

**CLO 04**: explain the principles and their application to planning, design, and operations of manufacturing as well as service organizations

**CLO 05**: understand how Enterprise Resource Planning (ERP), MRP and MRP II systems are used in managing operations

**CLO 06**: interpret the importance of productivity and competitiveness to organizations, and analyze and synthesize the inter-relationships inherent in complex socio-economic productive systems effectively.

**CLO 07**: identify inefficiency and ineffectiveness in business operations and propose adequate minor changes or major redesigns to improve the processes

**CLO 08**: explain the importance of an effective production and operations strategy to an organization.

**Mapping of CLOs with PLOs**

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| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
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| **CLO 03** |  | × | × |  | × |  |  |  |
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| **CLO 06** | × | × | × | × | × |  | × |  |
| **CLO 07** |  | × | × | × | × | × |  |  |
| **CLO 08** | × | × |  |  |  | × | × |  |

**Books Recommended:**

1. Heizer and Render, Principles of Operations Management, Pearson Prentice Hall.
2. Dilworth, J.B., Production and Operations Management: Manufacturing and Services, McGraw-Hill.
3. Chase, R.B., and Aquilano, N.J., Production and Operations Management: Manufacturing and Services, IRWIN.

**Prerequisites:**

Knowledge of Operations Management (Course no: IPE 337) and basic mathematical concepts.

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| **Course No: IPE 434** | **Credit: 3.0** | **Year: Fourth** | | **Semester: Second** |
| **Course Title: Reliability Engineering and Maintenance Management** | | | **Course Status: Theory** | |

**Rationale of the Course:**

Reliability engineering and maintenance management is an important and integral feature of the planning, design, testing, operation, and control of all engineering systems. Reliability Engineering and Maintenance Management course will help the students understand the related mathematical concepts, basic techniques, methods and tools for engineering systems. The course focuses on development and application of reliability evaluation techniques of engineering systems with emphasis on practical applications of reliability analysis in large-scale systems. By studying this course, students will be able to evaluate system reliability, and gain comprehensive knowledge of maintenance concepts and various maintenance policies.

**Course Objectives:**

The objectives of this course are to:

* help students understand the fundamental concepts and basic techniques, methods and tools for reliability engineering and maintenance management of many engineering systems namely electrical, electronic, mechanical, manufacturing and power systems
* provide students with the mathematical concepts, the comprehensive knowledge and the technical skills related to systems reliability and systems maintenance functions
* make the students familiar with the concept of reliability and to help them learn the techniques of estimating reliability and related characteristics of components / systems and the procedures of improving the system reliability
* facilitate necessary knowledge with regard to maintenance concepts, maintenance types, maintenance objectives, maintenance requirements and various maintenance policies
* familiarize students with necessary practical skills and engineering knowledge used for analyzing, planning and controlling maintenance management systems.

**Course Contents:**

Reliability Theory: Mathematical definition. Factors influencing system reliability, Hazard rate, Failure Theory: Patterns of Failure, Bathtub Curve, mean time to failure (MTTF) for various distributions, mean time between failure (MTBF), Mean time to repair (MTTR). Probability Distribution Functions for Failure density function, Reliability and Hazard rate: The Normal distribution, The Exponential distribution, The Rayleigh distribution, The Weibull distribution, and The Rectangular distribution. Reliability Prediction: Series Configuration, Parallel configuration and mixed configurations, Application to a specific hazard model, an r-out-of-n structure, Methods solving the complex systems: Reduction to series element method, Path-tracing method and Composite method. Systems not reducible to mixed configuration: Methods of decomposition or Conditional probability approach, Cut-set method, Tie-set method. Logic diagram, Event Tree diagram, Fault Tree Analysis (FTA), Reliability Design: Reliability allocation, Reliability Improvement- Element redundancy, Unit redundancy and Standby redundancy. Maintainability and Availability. Maintenance Management: Concepts, Maintenance objectives, Types of maintenance and their applications to different situation. Probability theories applied to maintenance management; A production/maintenance plan, Total Productive Maintenance (TPM).

**Course Learning Outcomes, CLO:**

After the successful completion of the course, students will be able to:

1. understand the fundamental concepts and basic techniques, methods and tools for reliability engineering and maintenance management of many engineering systems.
2. identify and evaluate the various reliability functions associated with an engineering system component’s quality perspective.
3. analyze practical failure data and formulate an appropriate failure model of the engineering system component of interest.
4. interpret failure patterns and characteristics of engineering components.
5. describe numerous reliability evaluation techniques of engineering systems; from the smallest and most simple to the largest and most complex.
6. apply the engineering knowledge to design and analyze practical problems with regard to reliability assessment of a product or a component or a system.
7. design and modeling an engineering system based on reliability requirements and allocation and find optimal solutions to improve the system reliability.
8. estimate systems maintainability and availability as well as related characteristics and design systems for better maintainability.
9. explain the maintenance function and its objectives and requirements, and understand the various types of maintenance and maintenance policies, and their applications to varied situations.

**Mapping of CLOs with PLOs:**

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| **CLO 02** | × | × |  |  |  |  |  |  |
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| **CLO 08** |  | × |  |  | × |  |  |  |
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**Books Recommended:**

1. Reliability Engineering – By L. S. Srinath, EWP Publisher.
2. Reliability Evaluation of Engineering Systems – By Roy Billinton, Springer Publisher.
3. Reliability and Maintenance Engineering – By R. C. Mishra; New-Age International Publisher.
4. Maintenance Planning and Control – By Anthony Kelly; EWP Pvt. Ltd. Publisher

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| **Course No.: IPE 445** | **Credit: 3.0** | **Year: Fourth** | **Semester: Second** |
| **Course Title: Tool Engineering** | | **Course Status: Theory** | |

**Rationale of the Course:**

Tool Engineering is a branch of Industrial Engineering whose function is to plan the process of manufacture, develop various tools and machines, and integrate facilities required for producing particular products with minimal expenditure of time, labor and material. This coursework is intended to incorporate the art of designing jigs and fixtures, clamping devices, press tools, design and fabrication of various dies and molds, mastering the geometry of the advanced cutting tools, reference systems, tool wear and tool life, and demonstration of cutting environments for machining purposes.

**Course Objectives:**

The objectives of this course are to:

* develop an understanding of various types of tools used in the production processes
* acquaint students with the operational issues in the field of metal cutting processes, tool making and supplies of sophisticated tools such as dies, molds, jigs, clamps, single and multi-cutters, etc.
* acquire ideas of tool reference systems, conversion of different referencing systems, causes and mechanisms of tool wear, analysis of tool life, etc.
* help the students summing up tool engineering knowledge as designing and manufacturing a mold or die with accuracy and precision at a reduced cost
* develop the skills needed for competence and competitiveness in today’s manufacturing industry and to apply for the gained credit in the advanced machining and tool design program
* enhance the skills in applying problem-solving tools to resolve manufacturing and design issues.

**Course Content:**

Introduction: General consideration in tool design, degrees of freedom; Clamping: Design of clamps, clamping methods, clamping forces developed by different types of clamps. Jigs/Fixtures: Types, design and production of jigs/fixtures; Dies: Types, die parts, die design: blanking, shearing, bending, drawing, piercing, and hydro-forming; Design of cutting tools: Single point cutting tool: tool reference systems: ASA, ORS, MRS, and NRS, conversion of different tool referencing systems, tool wear: causes and mechanism, multi-point cutting tool: Geometry of plane milling cutter, sharpening of milling cutter, geometry of face mills, grinding tool angles; Cutting Fluids: Functions, types, effects of cutting fluids.

**Course Learning Outcomes, CLOs**

After the successful completion of the course, students will be able to:

1. define the roles and responsibilities of tool engineers and the challenges they face in the design and fabrication of new tools
2. plan, develop and integrate the facilities required for metal cutting operations within an organization
3. understand and explain various types of tool-plane reference systems, conversion of referencing systems, causes and mechanisms of tool wear, analysis of tool life, etc.;
4. efficiently design reliable tools that can be capable of fabricating machining surfaces at the lowest possible cost and at the highest quality levels, and significantly shorten the lead time of operations
5. understand the roles of and use effectively various clamping tools, jigs and fixtures, dies and molds, pressing tools, that are frequently used in the metal fabrication processes
6. design the single point and multi-point cutting tools and explain the functions of cutting fluids
7. demonstrate the forces and power requirements, the capabilities of die parts, its strengths, use of materials, adjacent costs and alternative solutions available, etc.
8. apply the tool engineering knowledge to solve real-world manufacturing-related problems, research design for projects, analyze and review and research findings related to the various cutting tool and metal fabrication areas.

**Mapping of CLOs with PLOs**

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| **CLO 08** |  |  |  |  | × |  | × |  |

**Books Recommended:**

1. Hassan Abdel-Gawad El-Hofy, Fundamentals of Machining Processes Conventional and Nonconventional Processes, 2e, CRC Press,New York
2. Edward G. Hoffman, Jig and Fixture Design, 5e, Delmar Cengage Learning, New York
3. Dr. John G. Nee (ed.), Fundamentals of Tool Design, 6e, Society of Manufacturing Engineers, 2010, Michigan
4. V. Boljanovic and J.R. Paquin, Die Design Fundamentals, Industrial Press, New York
5. V. Boljanovic, Sheet Metal Forming processes and Die Design, 2e, Industrial Press, New York
6. Fritz Klocke (translated by Aaron Kuchle), Manufacturing Processes 1: Cutting, Springer-Verlag Berlin, Heidelberg
7. Heinz Tschätsch (translated by Dr.-Ing. Anette Reichelt), Applied Machining Technology, Springer, Heidelberg

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| --- | --- | --- | --- |
| **Course No.: IPE 447** | **Credit: 3.00** | **Year: Fourth** | **Semester: Second** |
| **Course Title: Control Engineering** | | **Course Status: Theory** | |

**Rationale of the Course:**

Automation is deeply embedded in our society and a good understanding of controls is essential for all engineers. This course will focus on the analysis of linear dynamic systems and their control. The course will enable students to design effective feedback control using a broad range of control design tools including mathematical modelling of system components, block diagram manipulation, linearization, Laplace transform, root locus, frequency domain and state space techniques. The analysis aspect of the course is relevant to almost every other course in engineering.

**Course Objectives:**

The objectives of this course are to:

* facilitate knowledge necessary to formulate systems models of mechanical, electrical, and electromechanical systems
* help students develop the ability to analyze system models to understand behavior
* make students understand how to design and implement feedback control loops.

**Course Content:**

Introduction to control system and their presentation by different equations and Laplace transforms; block diagram and transfer functions; analogue computer solution of system equations; system response; control action and system types; Frequency response; System analysis; System compensation; Analogue of control systems; Hydraulic and pneumatic control system; Elements of electromechanical controls; Introduction to digital computer control.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

1. build and evaluate a system model of mechanical, electrical and electrochemical system
2. convert a feedback control system into a mathematical description that can be manipulated
3. analyze a feedback control system to predict its behavior
4. predict the stability of a feedback control system
5. design components of a feedback control system
6. apply structured knowledge for altering the system performance to obtain the desired system behavior.

**Mapping of CLOs with PLOs**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO1** | × | × | × |  |  |  |  |  |
| **CLO2** |  |  | × |  | × |  |  |  |
| **CLO3** |  |  | × |  |  |  |  |  |
| **CLO4** |  |  | × | × |  |  |  |  |
| **CLO5** |  | × |  | × |  |  |  |  |
| **CLO6** | × |  |  |  | × |  |  |  |

**Books Recommended:**

R. C. Dorf and R. H. Bishop, Modern Control Systems, Pearson Prentice Hall

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| **Course No: IPE 451** | **Credit: 3.00** | **Year: Fourth** | | **Semester: Second** |
| **Course Title: Entrepreneurship Development and Technology Management** | | | **Course Status: Theory** | |

**Rationale of the Course:**

Entrepreneurship development is an interdisciplinary course designed to teach students how to think and act as an entrepreneurial. Students work towards improving the ability to make themselves as future business owners through a focus on entrepreneurial concepts learned in innovation and creativity, business funding, and marketing. Technology management deals with the integrated planning, design, optimization, operation, and control of technological products, processes and services, and the management of the use of technology for human advantage. Therefore, this course is built on cross-curricular academic skills, by integrating a broad series of lessons and activities that offer a variety of modalities for ultimate student engagement and content retention. The Technology Management program educates students to be ethical stewards of technological innovation in their organization.

**Course Objectives:**

The objectives of this course are to:

* provide the necessary knowledge and skills required for organizing and carrying out entrepreneurial activities
* make the students understand the key concepts, models, and methods that enable the manager to effectively manage the development and utilization of technologies
* develop the ability to analyze and understand numerous business situations in which entrepreneurs act and master the knowledge necessary to plan entrepreneurial activities
* help students sum up various aspects of entrepreneurship, handle and take over the risks, and the managerial potentials towards the technological innovations and advancements
* equip the students with a proper attitude, belief, behavior, opportunity, and to embrace the new technologies and innovations for the advancement of society
* develop an awareness of the range, scope, and complexity of the phenomena, issues, and problems related to economics and management of technology and technological innovations
* facilitate the necessary knowledge about how the industries or firms are transformed by or keep pace with the modern technologies.

**Course Content:**

*Concept of Entrepreneurship:* theories, development factors, Process of developing entrepreneurship; Different entrepreneurship models, the profile of an Entrepreneur, High-tech entrepreneurship; Business plan; Developing joint venture; Entrepreneurial failure, Entrepreneurial case studies. *MOT:* scope, nature, application; Technological innovations and technology strategy, strategic attitudes and competitiveness, Planning technology: forecasting, assessment, implementing technology in product and services, technology substitution. Integration of technology and business plan; *Technology transfer:* risk involved in technology transfer, National and global perspective, Concept of Industry 4.0 and its relevance with MOT. *National innovation system:* scopes for entrepreneurship development and technology management. Case studies.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

1. outline the key characteristics of an entrepreneur, and explain who becomes an entrepreneur
2. identify the scopes of entrepreneurship development and technology management
3. evaluate business strategies for successful implementation of ideas towards the distinct entrepreneurial traits
4. apply methods and analytical tools to prepare a business plan, and analyze strength-weakness-opportunities exists in technology-based entrepreneurship
5. evaluate and interpret business plan and its sustainability in context of technology, management, and law
6. illustrate professional competencies in leadership, management, strategy and technology development
7. apply a range of tools to create, assessment, select, implement technology
8. explain the technological innovations and technology strategy for entrepreneurship
9. assess the risk involved in technology transfer from national and global perspective.

**Mapping of CLOs with PLOs**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO 01** |  |  |  |  |  | **×** |  |  |
| **CLO 02** | **×** |  |  |  |  | **×** |  |  |
| **CLO 03** | **×** |  | **×** |  |  |  |  |  |
| **CLO 04** | **×** |  | **×** | **×** |  |  |  |  |
| **CLO 05** | **×** | **×** |  | **×** |  |  |  |  |
| **CLO 06** |  |  |  |  | **×** | **×** |  |  |
| **CLO 07** | **×** | **×** |  | **×** |  |  |  |  |
| **CLO 08** | **×** |  |  |  |  | **×** |  |  |
| **CLO 09** | **×** |  | **×** |  |  |  |  |  |

**Books Recommended:**

1. Scarborough Norman and J. R. Cornwall, Essentials of Entrepreneurship and Small Business Management, Pearson Education
2. Dr A. R. Khan, Entrepreneurship Small Business and Lives of Successful Entrepreneurs, Bangladesh Rubi Publications
3. Peter F. Drucker, Innovation and Entrepreneurship: Practice and Principles, Perfect Bound, Harper Collins Publishers
4. Tarek M. Khalil, Management of Technology: The Key to Competitiveness and Wealth Creation, Tata Mcgraw-Hill Education Pvt Ltd., Delhi
5. Dilek Cetindamar, Rob Phaal and David Probert, Technology Management: Activities and Tools, Palgrave Macmillan
6. Robert Hisrich, Michael Peters and Dean Shepherd, Entrepreneurship, McGraw-Hill Education

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| **Course No.: IPE 453** | **Credit: 3.0** | **Year: Fourth** | | **Semester: Second** |
| **Course Title: Management Information System** | | | **Course Status: Theory** | |

**Rationale of the Course:**

This course aims to develop an appreciation of the nature of management of information systems and their applications in organizations. Issues associated with the development of these systems and their applications in business are introduced, along with some of the underlying mathematical modeling techniques that provide management information systems with a problem-solving capability. A particular emphasis is given on the individual and organizational work-practices required to support the implementation of information systems facilitated solutions in an enterprise context. Parallel to this specific business communication skills and decision support skills are developed.

**Course Objectives:**

The objectives of this course are to:

* acquaint students with the role of information technology and decision support systems in business and record the current issues with those of the firm to solve business problems
* introduce the fundamental principles of computer-based information systems analysis and design and develop an understanding of the principles and techniques used
* make students understand the various knowledge representation methods and different expert system structures as strategic weapons to counter the threats to business and make business more competitive
* develop skill to use information to assess the impact of the Internet and Internet technology on electronic commerce and electronic business and understand the specific threats and vulnerabilities of computer systems
* facilitate necessary knowledge about the theoretical models used in database management systems to answer business questions.

**Course Content:**

*Management information system in a digital firm:* MIS concept, role of the MIS, impact of the MIS, Management as a control system, MIS a support to management, development process of the MIS. *System analysis and design:* System, need for system analysis, system analysis of the existing system, system analysis of a new requirements, *Information system applications:* MIS applications, DSS, Group DSS, DSS applications in E- enterprise, Knowledge management system and Knowledge-based expert system. Enterprise Model System and E-Business, E- Commerce, E-communication. *Technology of information system*: Data process- Transaction and application process, Information system process, Unified communication and network, Security challenges in E-enterprises, Security threats and vulnerability. *Data base management system (DBMS):* Objectives of data base approach, Characters of database management systems, Data processing system, Components of DBMS packages, Data base administration, Data models, Data warehouse. Case studies.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

1. relate the basic concepts and technologies used in the field of management information systems
2. compare the processes of developing and implementing information systems
3. outline the role of the ethical, social, and security issues of information systems
4. translate the role of information systems in organizations, the strategic management processes, with the implications for the management
5. apply the understanding of how various information systems like DBMS work together to accomplish the information objectives of an organization.

**Mapping of CLOs with PLOs**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO1** | **×** |  | **×** |  |  |  |  |  |
| **CLO2** | **×** | **×** |  |  |  |  |  |  |
| **CLO3** |  | **×** |  | **×** |  |  |  |  |
| **CLO4** | **×** |  | **×** |  |  |  |  |  |
| **CLO5** | **×** | **×** |  |  |  |  |  |  |

**Books Recommended:**

1. Baltzan, P., Business Driven Information System, New York, McGraw Hill
2. Jawadekar, W.S., Management Information Systems, Tata McGraw Hill
3. Kenneth C. Laudon and Jane P. Laudon, Management Information Systems, Pearson Education
4. Goyal, D.P., Management Information System, MACMILLAN India Limited
5. Murthy C.S.V., Management Information System, Himalaya Publications
6. Alex Leon and Mathew Leon: Data Base Management Systems, Vikas Publishing House
7. Philip J, Pratt, Joseph J. Adamski, Database Management Systems, Cengage Learning
8. Richard T. Watson, Data Management, WILEY INDIA Limited
9. Rob and Cornell, Data Base Management Systems, Cengage Learning.

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| **Course No.: IPE 450** | **Credit: 0.5** | **Year: Fourth** | **Semester: Second** |
| **Course Title: Comprehensive Viva** | | **Course Status: Sessional** | |

**Rationale of the Course:**

A comprehensive viva forms a part of the theory component of a summative examination. Its purpose is to evaluate the student’s learning and understanding of different courses in their undergraduate program. This course also aims to provide students with confidence while discussing the fundamental aspects of an engineering problem/situation in academic and professional environments.

**Course Objectives:**

The objectives of this course are to:

* assess the comprehensive knowledge gained in every course covered till the eighth semester
* comprehend the questions asked and answer them with confidence.

**Course Content:**

The viva-voce will be conducted based on the courses covered till the eighth semester.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

1. face interview both in the academic and the industrial sector and perform better in future
2. formulate and solve the basic engineering problems/situations with confidence in future
3. apply scholarly information to defend their standpoint on the issue under discussion.

**Mapping of CLOs with PLOs**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO 01** | × |  |  |  |  |  | × |  |
| **CLO 02** |  |  |  |  | × | × |  |  |
| **CLO 03** | × |  |  |  |  | × |  |  |

**Books Recommended:**

Books recommended and material supplied for the courses covered till the eighth semester.

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| **Course No.: IPE 460** | **Credit: 1.0** | **Year: Fourth** | **Semester: Second** |
| **Course Title: Industrial Training-II** | | **Course Status: Sessional** | |

**Rationale of the Course:**

The purpose of industrial training is to expose students to a real work environment and, at the same time, to gain knowledge through hands-on observation and job execution. From the industrial training, the students will also develop skills in work ethics, communication, management and others. Moreover, this practical training program allows students to relate theoretical knowledge with its application in the manufacturing industry.

**Course Objectives:**

The objectives of this course are to:

* provide the first-hand working experience as an engineering professional
* give students a scope to work with other engineering professionals
* provide students an opportunity to experience what it’s like to work in a professional organization
* enhance their technical, interpersonal and communication skills, both oral and written
* observe interactions of engineers with other professional groups
* let students witness the functioning and organization of business and companies.

**Course Content:**

Industrial training will be selected by IPE department. It includes training, presentation, report writing and viva.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

**CLO 01:** understand the work, responsibility and the ethics in working environment

**CLO 02:** explain the general and specific procedure of engineering field related to industry

**CLO 03:** communicate effectively within the working environment

**CLO 04:** apply their theorical knowledge and engineering methods to a solve industrial problem

**CLO 05:** instill with good moral values such as commitment and trustworthy during their training

**CLO 06:** prepare technical report on industrial training.

**Mapping of CLOs with PLOs**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **PLO**  **CLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **CLO 01** | × |  |  |  |  |  |  | × |
| **CLO 02** | × |  |  |  |  |  |  |  |
| **CLO 03** |  |  |  |  |  | × |  |  |
| **CLO 04** | × |  |  |  | × |  |  |  |
| **CLO 05** | × |  |  |  |  |  |  | × |
| **CLO 06** | × |  |  |  |  | × |  |  |

1. ***Teaching Strategies:***

Unless specified in individual course description, the following teaching strategies will be applied for all theory and sessional courses.

**Teaching strategy for theory courses:**

Teacher-centered approach:

1. *Direct Lecture:* Course teacher will deliver lectures on theoretical aspects of the course using white-board, multi-media projector and other audio-visual medium.
2. *Problem solving or case studies*: solving real life engineering problems applying the theoretical knowledge delivered.
3. *Tutorial*: Teacher will guide and assist the students to solve the course related problems outside the lecture hours.

Student-centered approach:

1. *Individual or Group Assignment/Project*: Course teacher will select and assign course related topic or project to either individual student or group of students.
2. *Presentation on assignment by the student group or individual student:* Students will analyze and solve the assigned project or topic (given in point iii); thereafter have to present and discuss before the whole class. Rest of the students will be encouraged to participate.

**Teaching strategy for sessional courses** (Other than engineering drawing/graphics and CAD sessional)

Teacher-centered approach:

1. *Direct Lecture:* Course Teacher will deliver lecture on theoretical aspect of a particular experiment using white board or multimedia projector.
2. *Formation of lab group:* In needed, Course Teacher will form a number of lab groups among students in order to manage the experimental work effectively.
3. *Demonstration on lab experiment:* Instructor will demonstrate the experimental procedure of the experiment to be performed.

Student-centered approach:

1. *Performance of experiment or group work*: Individual or group of students will perform the experiment demonstrated, collect and analyze the data.
2. *Report preparation and submission:* each student will be asked to prepare an experimental report on each task, and submit to course teacher.

**Teaching strategy for engineering drawing/graphics and CAD sessional:**

Teacher-centered approach:

1. *Direct Lecture:* Course Teacher will deliver lecture on theoretical aspect of a particular task using white board or multimedia projector.
2. *Formation of lab group (for CAD lab):* If needed, Course Teacher will form a number of lab groups among students in order to manage the task assigned effectively.
3. *Demonstration on task:* Instructor will demonstrate the drawing procedure of selected object/component to be drawn.

Student-centered approach:

1. *Performance of assigned task and submission*: Individual student will draw the object/component demonstrated, and submit to course teacher.

**Teaching strategy for professional development seminar:**

Teacher-centered approach:

1. *Formation of group:* Course Teacher will form a number of groups among students in order to conduct the seminar effectively.
2. *Direct Lecture:* Course teacher will assign topic/s to the group and deliver lecture on outline of the assigned topic.

Student-centered approach:

1. *Performance of assigned task and submission*: Student group will discuss the topic among themselves and prepare report on it, and present before the audience. It is mandatory for the students to participate in discussion and question-answering sessions.

**Teaching strategy for Thesis:**

1. *Study assignment:* Supervisor/s will help students to search and select relevant books, research articles and published documents.
2. *In course guidance:* Supervisor/s will assist thesis students in summarizing the articles, selected theories to organize their methodology and analysis.
3. *Brain-storming:* Supervisor will conduct several brain-storming sessions with thesis students to outline their research.
4. ***Assessment or Evaluation Procedure:***

**Evaluation procedure for theory course:**

Theory courses will be assessed as follows:

|  |  |  |  |
| --- | --- | --- | --- |
| i | Class Attendance | : | 10% |
| ii | Class Evaluation | : | 10% |
| iii | Assignments and Mid-Semester Examinations | : | 20% |
| iv | Final Examination | : | 60% |

**Evaluation procedure for sessional course (other than engineering drawing/graphics and CAD sessional, training, viva and Thesis):**

Sessional courses will be assessed as follows:

|  |  |  |  |
| --- | --- | --- | --- |
| i | Class Attendance | : | 10% |
| ii | Report Evaluation | : | 30% |
| iii | Oral Examinations \* | : | 20% |
| iv | Final Examination/ Quiz \* | : | 40% |

\* A student will not be allowed to appear at oral exam and final quiz of a sessional course if his/her class attendance in that sessional course is less than 50%.

**Evaluation procedure for engineering drawing/graphics and CAD sessional:**

Engineering drawing/graphics and CAD courses will be assessed as follows:

|  |  |  |  |
| --- | --- | --- | --- |
| i | Class Attendance | : | 10% |
| ii | Report Evaluation | : | 50% |
| iii | Final Examination: Quiz and Oral \* | : | 40% |

\* A student will not be allowed to appear at oral exam and final quiz of a sessional course if his/her class attendance in that sessional course is less than 50%.

**Evaluation procedure for Industrial tour and Training:**

Industrial tour and training courses will be assessed as follows:

|  |  |  |  |
| --- | --- | --- | --- |
| i | Participation | : | Mandatory |
| ii | Report assessment by Coordinator/s | : | 30% |
| iii | Continuous assessment by Coordinator/s | : | 30% |
| iv | Presentation |  | 10% |
| v | Oral Examinations | : | 30% |

**Evaluation procedure for Comprehensive viva:**

Comprehensive viva will be assessed as follows:

|  |  |  |  |
| --- | --- | --- | --- |
| i | Participation | : | Mandatory |
| ii | Oral examinations | : | 100% |

**Evaluation procedure for professional development seminar:**

Thesis and project will be assessed as follows:

|  |  |  |  |
| --- | --- | --- | --- |
| i | Participation | : | Mandatory |
| ii | Class Attendance | : | 10% |
| iii | Report evaluation | : | 40% |
| iv | Continuous assessment: presentation, question answering and discussion. | : | 50% |

**Evaluation procedure for Thesis:**

Thesis and project will be assessed as follows:

|  |  |  |  |
| --- | --- | --- | --- |
| i | Continuous evaluation by Supervisor | : | 40% |
| ii | Thesis report evaluation by External-members | : | 30% |
| iii | Defense before thesis evaluation board | : | 30% |

**PART: D**

**Grading/Evaluation**

1. **Grading scale and grades**

Letter Grade and corresponding Grade-Point for a course will be awarded from the roundup marks of individual courses as follows:

|  |  |  |
| --- | --- | --- |
| ***Numerical Grade*** | ***Letter Grade*** | ***Grade Point*** |
| 80% and above | A+ | 4.00 |
| 75% to less than 80% | A | 3.75 |
| 70% to less than 75% | A- | 3.50 |
| 65% to less than 70% | B+ | 3.25 |
| 60% to less than 65% | B | 3.00 |
| 55% to less than 60% | B- | 2.75 |
| 50% to less than 55% | C+ | 2.50 |
| 45% to less than 50% | C | 2.25 |
| 40% to less than 45% | C- | 2.00 |
| Less than 40% | F | 0.00 |

1. **Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA)**

**GPA:**

Grade Point Average (GPA) is the weighted average of the grade points obtained in all the courses completed by a student in a semester.

**CGPA:**

Cumulative Grade Point Average (CGPA) of only major and both major and second major degree will be calculated by the weighted average of every course of previous semesters along with the present semester. For clearing graduates if the roundup value of the third digit after decimal is nonzero the second digit will be incremented by one. A student will also receive a separate CGPA for his second major courses.

**F Grades:**

A student is given an ‘F’ grade if he fails or is absent in the final examination of a course. If a student obtains an ‘F’ grade his grade will not be counted for GPA and s/he has to repeat the course. An ‘F’ grade will be in his/her record and s/he will not be eligible for Distinction.

1. **Course Withdrawal**

A student can withdraw a course by a written application to the Controller of Examinations through the Head of the discipline on or before the last day of instruction. The Controller of Examinations will send the revised registration list to the disciplines before the examination. There will be no record of the course in transcript if the course is withdrawn.

1. **Incomplete (I) courses**

If a student has incomplete courses, he/she has to register his/her available incomplete courses from preceding levels before s/he can register courses from current or successive levels. If an incomplete course is not offered in a given semester the student has to take the courses when it is offered next time. A student with incomplete courses will not be eligible for Distinction.

1. **Course Repetition:**

If a student has to repeat a failed or incomplete course and that course is not offered any more, the discipline may allow him/her to take an equivalent course from the current syllabus. For clearing graduates if any incomplete course is not offered in the running semester, the discipline may suggest a suitable course to complete the credit requirement.

**List of Non-Major Courses offrered for other departments**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Course No.** | **Credit** | **Dept** | **Year-Semester** | **Course Title** |
| IPE 102B | 1.5 | CEP | 1-1 | Mechanical Engineering Drawing Sessional |
| IPE 103H | 3.0 | PME | 1-2 | Engineering Mechanics |
| IPE 104C | 1.0 | CEE | 1-2 | Workshop Practice |
| IPE 106D | 1.5 | CSE | 1-2 | Engineering Graphics |
| IPE 108D | 1.0 | CSE | 1-2 | Workshop Practice |
| IPE 202F | 1.0 | FET | 2-1 | Workshop Practice |
| IPE 205H | 3.0 | PME | 2-1 | Mechanics of Solids |
| IPE 206H | 1.0 | PME | 2-1 | Engineering Drawing |
| IPE 203B | 3.0 | CEP | 2-1 | Engineering Mechanics |
| IPE 208B | 1.0 | CEP | 2-1 | Workshop Practice Sessional |
| IPE 205B | 3.0 | CEP | 2-2 | Mechanics of Solids |
| IPE 205E | 2.0 | EEE | 2-2 | Industrial Management |
| IPE 309F | 3.0 | FET | 3-1 | Supply Chain Management |
| IPE319K | 3.0 | CHE | 3-2 | Industrial Management |
| IPE 405Q | 3.0 | MEE | 4-2 | Industrial Management |

**Detailed Curriculum: Courses offrered for other departments**

**First Year First Semester**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Course No.: IPE 102B** | **Credit: 1.5** | **Year: First** | | **Semester: First** |
| **Course Title: Mechanical Engineering Drawing (for CEP)** | | | **Course Status: Sessional** | |

**Rationale of the Course:**

Engineering drawing is a two-dimensional representation of three-dimensional objects and is the basic form of communication in technology and industry. It expresses ideas and conveys specific information by means of geometric shapes, lines, and dimensions. It is considered as a universal language that provides necessary information about the shape, size, surface quality, material, manufacturing process, etc., of the object. This course is a practical application of knowledge pertaining to the clearly and accurately capture all geometric features of a product or component so that a manufacturer or engineer can produce the required item. This course also aims to develop the dignity of labor, responsibilities, and collaboration of students.

**Course Objectives:**

The objectives of this course are to:

* introduce students to reading, understanding, and creating mechanical engineering drawing
* familiarize the students to acquire and use engineering drawing skills on creating accurate, clear sketches of different mechanical objects following the information and instructions
* make students able to draw different types of angle projections, orthographic views, auxiliary, sectional views, isometric views, etc.
* enable students to acquire requisite knowledge required for advanced study of engineering drawing
* apply the drawing and drafting skills as problem-solving tools to resolve the primary design issues
* understand 2D and 3D mechanical drawing as a preliminary information for the AutoCAD software.

**Course Content:**

Introduction, Instruments and their uses, First angle and third angle projections, Orthographic drawing, Sectional views. Isometric views, Missing lines and views. Introduction to Auto CAD:2D Drawing.

**Course Learning Outcomes, CLOs**

Upon successful completion of this course, student have reliably demonstrated the ability to:

1. understand the basic tools and techniques for making engineering drawings, and apply them to a wide range of engineering fields such as mechanical engineering, civil and architectural design, chemical process, etc.
2. create freehand sketches of visual expressions of technical ideas and can interpret common types of engineering drawings
3. understand the purpose of geometric shapes, signs and symbols, abbreviations and dimensional values found on engineering drawings
4. utilize graphic techniques to understand the relationships between real-world components and views of the components (orthographic, auxiliary, sectional, isometric views, etc.)
5. produce a formal engineering drawing according to standard drafting practice using standard drawing tools or computer software
6. develop the skills and concepts needed to participate in design reviews or technical meetings within the company or with mechanical component and assembly suppliers
7. execute basic CAD (*i.e*., AutoCAD or similar softwares) for creating and editing drawings.

**Mapping of CLOs with PLOs**

According to the PLO of CEP department.

**Books Recommended:**

1. K.V. Reddy, Textbook of Engineering Drawing, 2e, BS Publications
2. K. Rathnam, A First Course in Engineering Drawing, Springer Nature Singapore Pte Ltd.
3. M.B. Shah and B. C. Rana, Engineering Drawing, Dorling Kindersley (India) Pvt Ltd
4. Colin H. Simmons and Denis E. Maguire, Manual of Engineering Drawing to British and International standards, Elsevier Newnes, Oxford.
5. K. Morling, Geometric and Engineering Drawing, Elsevier Ltd.

**First Year Second Semester**

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| **Course No.: IPE 103H** | **Credit: 3.0** | **Year: First** | | **Semester: Second** |
| **Course Title: Engineering Mechanics (for PME)** | | | **Course Status: Theory** | |

**Rationale of the Course:**

This course introduces the basic principles of mechanics (statics and dynamics) essential for the engineering students. Its focus on the modeling and analyzing of static equilibrium as well as dynamic concept based on real life engineering applications and necessary knowledge about solving the problems.

**Course Objectives:**

The objectives of this course are to:

* provide necessary knowledge about basic principles of mechanics
* help students to analyze and solve matrix and vector notation and operations and recognize equivalence between systems of equations and matrix notation
* make the students understand the structural analysis
* provide the students with knowledge about centroid, first moment of inertia, second moment of inertia of an area and effect of friction
* develop ability to solve the problems related to kinematics and kinetics.

**Course Content:**

*Statics:* Statics of particles and rigid bodies. Centroids of lines areas and volumes; Forces in truss, frames, and cables; Friction; Moment of inertia of areas and masses; Relative motion. *Dynamics:* Kinetics of particles: Newton's second law of motion, Principles of work, energy, impulse, and momentum; System of particles: Kinematics of rigid bodies; Kinetics of plane motion of rigid bodies, forces, and acceleration; Principles of work and energy.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

**CLO 1**: implement the basic principles of mechanics to analyze and solve real life engineering problems

**CLO 2**: design and examine different structures (static and dynamic condition) under various loading conditions.

**CLO 3**:evaluate the effect of friction on a body

**CLO 4**:evaluate the importance of different laws of forces on the body and apply them in real context

**CLO 5**: apply the knowledge to analyze and solve problems related to kinematics and kinetics.

**Mapping of CLOs with PLOs**

According to the PLOs of PME department.

**Books Recommended:**

1. Vector Mechanics for Engineers, Ferdinand P. Beer, E. Russell Johnston, Jr., David F. Mazurek and Phillip J. Cornwell, Tenth edition, McGraw Hill.
2. A Textbook of Engineering Mechanics, R.S. Khurmi, S. Chand publications.

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| **Course No.: IPE 104 C** | **Credit: 1.0** | **Year: First** | **Semester: Second** |
| **Course Title: Workshop Practice (for CEE)** | | **Course Status: Sessional** | |

**Rationale of the Course:**

In order to have a balanced overall development of Engineering graduates, it is necessary to integrate theory with practice. Workshop practice has been included in the curriculum to provide hands-on experience using different tools and basic manufacturing practices. By studying Workshop Practice sessional, students will learn to explain the function, use, and application of different working tools, equipment, machine tools, and the technique of manufacturing a product from its raw material. This course also aims to develop the dignity of labor, precision, safety at work, teamwork, and the students' right attitude.

**Course Objectives:**

The objectives of this course are to:

* acquaint students with the hand tools used in practice to fabricate a product
* facilitate necessary knowledge about the specification of machine tools used in workshops and manufacturing industries
* develop skill in identifying the machine tool components and their respective functions, and performing various machining operations on the machine tools used in practice
* help students develop the ability to identify and differentiate the work holding devices used in practice to manufacture a product
* encourage the students to provide team effort in product manufacturing.

**Course Content:**

Introduction to Hand Tools; Study and operation of an Engine Lathe; Study and operation of the Milling Machine; Study and operation of the Bench Drilling Machine; Study and operation of Shaper Machine; and Preparation of a hexagonal nut.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

**CLO 01:** sketch, specify and use various work holding tools, marking and measuring tools, cutting tools, finishing tools, and other tools such as hammer, spanner, screwdriver, and wrench, etc.;

**CLO 02:** specify various machine tools such as engine lathe, milling machine, bench drilling machine, and shaper machine used in workshops as well as manufacturing industries;

**CLO 03:** identify various components of an engine lathe, milling machine, bench drilling machine, and shaper machine and describe their respective functions;

**CLO 04:** identify and differentiate the work holding devices used in an engine lathe, milling machine, bench drilling machine, and shaper machine;

**CLO 05:** perform various machining operations on an engine lathe, milling machine, bench drilling machine, and shaper machine individually;

**CLO 06:** apply their machining skills to fabricate parts of desired features from a given workpiece as per given drawing;

**CLO 07:** apply their team effort to make the sequence of operations required for manufacturing a hexagonal nut and prepare it from a given cylindrical workpiece as per given drawing.

**Mapping of CLOs with PLOs**

According to the PLOs of CEE department.

**Books Recommended:**

1. Rajender Singh, Introduction to Basic Manufacturing and Workshop Technology

2. U.K. Singh and Manish Dwivedi, Manufacturing Processes

3. H.N. Gupta, R.C. Gupta, and Arun Mittal, Manufacturing Processes

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| **Course No.: IPE 106 D** | **Credit:1.5** | **Year: First** | | **Semester: Second** |
| **Course Title: Engineering Graphics (for CSE)** | | | **Course Status: Sessional** | |

**Rationale of the Course:**

This course is a practical application of knowledge pertaining to all geometric features of a whole product, or assembly or sub-assemblies. Pictorial presentation by means of geometric shapes, lines, and dimensions is a must for engineering students. All engineering students need the basic engineering graphics knowledge to express their thoughts and ideas precisely and accurately.

**Course Objectives:**

The objectives of this course are to:

* provide the students with necessary skill to read, understand, and create mechanical engineering drawing;
* familiarize the students to acquire and use engineering drawing skills on creating accurate, clear sketches of different mechanical objects following the information and instructions;
* make students able to draw different types of angle projections, orthographic views, auxiliary, sectional views, isometric views, etc.;
* enable students to acquire requisite knowledge required for advanced study of engineering drawing;
* apply the drawing and drafting skills as problem-solving tools to resolve the primary design issues.

**Course Content:**

Introduction, Instruments and their uses, First angle and third angle projections, Orthographic drawing, Sectional views. Isometric views, Missing lines and views.

**Course Learning Outcomes, CLOs**

Upon successful completion of this course, student have reliably demonstrated the ability to:

1. understand the basic tools and techniques for making engineering drawings, and apply them to a wide range of engineering fields such as mechanical engineering, civil and architectural design, chemical process, etc.
2. create freehand sketches of visual expressions of technical ideas and can interpret common types of engineering drawings
3. understand the purpose of geometric shapes, signs and symbols, abbreviations and dimensional values found on engineering drawings
4. utilize graphic techniques to understand the relationships between real-world components and views of the components (orthographic, auxiliary, sectional, isometric views, etc.)
5. produce a formal engineering drawing according to standard drafting practice
6. participate in design reviews or technical meetings in a company concern to mechanical component and assembly suppliers.

**Mapping of CLOs with PLOs**

According to the PLOs of CSE department.

**Books Recommended:**

1. K.V. Reddy, Textbook of Engineering Drawing, BS Publications, India.
2. K. Rathnam, A First Course in Engineering Drawing, Springer Nature Singapore Pte Ltd.
3. M.B. Shah and B. C. Rana, Engineering Drawing, Dorling Kindersley (India) Pvt Ltd.
4. Colin H. Simmons and Denis E. Maguire, Manual of Engineering Drawing to British and International standards, 2e, Elsevier Newnes, Oxford.
5. K. Morling, Geometric and Engineering Drawing, Elsevier Ltd. USA.

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| **Course No.: IPE108 D** | **Credit: 1.0** | **Year: First** | **Semester: Second** |
| **Course Title: Workshop Practice (for CSE)** | | **Course Status: Sessional** | |

**Rationale of the Course:**

In order to have a balanced overall development of Engineering graduates, it is necessary to integrate theory with practice. Workshop practice has been included in the curriculum to provide hands-on experience using different tools and basic manufacturing practices. By studying Workshop Practice sessional, students will learn to explain the function, use, and application of different working tools, equipment, machine tools, and the technique of manufacturing a product from its raw material. This course also aims to develop the dignity of labor, precision, safety at work, teamwork, and the students' right attitude.

**Course Objectives:**

The objectives of this course are to:

* acquaint students with the hand tools used in practice to fabricate a product
* facilitate necessary knowledge about the specification of machine tools used in workshops and manufacturing industries
* develop skill in identifying the machine tool components and their respective functions, and performing various machining operations on the machine tools used in practice
* help students develop the ability to identify and differentiate the work holding devices used in practice to manufacture a product
* encourage the students to provide team effort in product manufacturing.

**Course Content:**

Introduction to Hand Tools; Study and operation of an Engine Lathe; Study and operation of the Milling Machine; Study and operation of the Bench Drilling Machine; Study and operation of Shaper Machine; and Preparation of a hexagonal nut.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

**CLO 01:** sketch, specify and use various work holding tools, marking and measuring tools, cutting tools, finishing tools, and other tools such as hammer, spanner, screwdriver, and wrench, etc.;

**CLO 02:** specify various machine tools such as engine lathe, milling machine, bench drilling machine, and shaper machine used in workshops as well as manufacturing industries;

**CLO 03:** identify various components of an engine lathe, milling machine, bench drilling machine, and shaper machine and describe their respective functions;

**CLO 04:** identify and differentiate the work holding devices used in an engine lathe, milling machine, bench drilling machine, and shaper machine;

**CLO 05:** perform various machining operations on an engine lathe, milling machine, bench drilling machine, and shaper machine individually;

**CLO 06:** apply their machining skills to fabricate parts of desired features from a given workpiece as per given drawing;

**CLO 07:** apply their team effort to make the sequence of operations required for manufacturing a hexagonal nut and prepare it from a given cylindrical workpiece as per given drawing.

**Mapping of CLOs with PLOs**

According to the PLOs of CSE department.

**Books Recommended:**

1. Rajender Singh, Introduction to Basic Manufacturing and Workshop Technology

2. U.K. Singh and Manish Dwivedi, Manufacturing Processes

3. H.N. Gupta, R.C. Gupta, and Arun Mittal, Manufacturing Processes

**Second Year First Semester**

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| **Course No: IPE202F** | **Credit: 1.0** | **Year: Second** | **Semester: First** |
| **Course Title: Workshop Practice (for FET)** | | **Course Status: Sessional** | |

**Rationale of the Course:**

In order to have a balanced overall development of Engineering graduates, it is necessary to integrate theory with practice. Workshop practice has been included in the curriculum to provide hands-on experience using different tools and basic manufacturing practices. By studying Workshop Practice sessional, students will learn to explain the function, use, and application of different working tools, equipment, machine tools, and the technique of manufacturing a product from its raw material. This course also aims to develop the dignity of labor, precision, safety at work, teamwork, and the students' right attitude.

**Course Objectives:**

The objectives of this course are to:

* acquaint students with the hand tools used in practice to fabricate a product
* facilitate necessary knowledge about the specification of machine tools used in workshops and manufacturing industries
* develop skill in identifying the machine tool components and their respective functions, and performing various machining operations on the machine tools used in practice
* help students develop the ability to identify and differentiate the work holding devices used in practice to manufacture a product
* encourage the students to provide team effort in product manufacturing.

**Course Content:**

Introduction to Hand Tools; Study and operation of an Engine Lathe; Study and operation of the Milling Machine; Study and operation of the Bench Drilling Machine; Study and operation of Shaper Machine; and Preparation of a hexagonal nut.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

**CLO 01:** sketch, specify and use various work holding tools, marking and measuring tools, cutting tools, finishing tools, and other tools such as hammer, spanner, screwdriver, and wrench, etc.;

**CLO 02:** specify various machine tools such as engine lathe, milling machine, bench drilling machine, and shaper machine used in workshops as well as manufacturing industries;

**CLO 03:** identify various components of an engine lathe, milling machine, bench drilling machine, and shaper machine and describe their respective functions;

**CLO 04:** identify and differentiate the work holding devices used in an engine lathe, milling machine, bench drilling machine, and shaper machine;

**CLO 05:** perform various machining operations on an engine lathe, milling machine, bench drilling machine, and shaper machine individually;

**CLO 06:** apply their machining skills to fabricate parts of desired features from a given workpiece as per given drawing;

**CLO 07:** apply their team effort to make the sequence of operations required for manufacturing a hexagonal nut and prepare it from a given cylindrical workpiece as per given drawing.

**Mapping of CLOs with PLOs**

According to the PLOs of FET department.

**Books Recommended:**

1. Rajender Singh, Introduction to Basic Manufacturing and Workshop Technology

2. U.K. Singh and Manish Dwivedi, Manufacturing Processes

3. H.N. Gupta, R.C. Gupta, and Arun Mittal, Manufacturing Processes

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| **Course No.: IPE 205H** | **Credit: 3.0** | **Year: Second** | | **Semester: First** |
| **Course Title: Mechanics of Solids (for PME)** | | | **Course Status: Theory** | |

**Rationale of the Course:**

The application of the principles of mechanics to bulk matter is conventionally divided into the mechanics of solids and the mechanics of fluids. Solid mechanics is a basic subject for structural analysis. It concerned with the stressing, deformation and failure of solid materials and structures. In this course student will get the basic idea of the behavior of a body due to the external loading.

**Course Learning Objectives:**

The objectives of the course are to:

* help the students conceptualize the fundamental concepts of stress, strain and deformation of solids
* make the students understand the mechanism of load transfer in beams, the induced stress resultants and deformation
* facilitate the necessary knowledge about the effect of torsion on shafts and springs
* foster analytical and critical thinking required for solving the real-life engineering problems related to product design.

**Course Content:**

*Stress Analysis:* Statically intermediate axially loaded member, axially loaded member, thermal and centrifugal stresses,Stresses in thin and thick-walled cylinders and spheres. *Beams:* shear force and bending moment diagrams. Various types of stresses in beam, Deflection of beams: integration and area moment methods, Introduction to reinforced concrete beams and slabs, Riveted and welded joints. *Torsional Formula:* Angle of twist, Modulus of rapture, Combined Stresses; principal stress, Mohr's Circle. *Columns***:** Euler's Formula, Intermediate Column Formulas.

**Course Learning Outcomes, CLOs**

After the successful completion of the course, students will be able to:

**CLO1** establish an understanding of the fundamental concepts of mechanics of deformable solids including static equilibrium, geometry of deformation, and material constitutive behavior

**CLO2** apply the systematic methods for solving engineering problems in solid mechanics.

**CLO3** explain the basic mechanical principles underlying modern approaches for design of various types of structural members subjected to axial load, torsion, bending, transverse shear, and combined loading

**CLO4** build the necessary theoretical background for further structural analysis and design courses

**CLO5** apply the knowledge of Mechanics of Solids to solve real-life engineering problems and design engineering systems.

**Mapping of CLOs with PLOs**

According to the PLOs of PME department.

**Books Recommended:**

1. Andrew Pytel and Ferdinand L. Singer, Strength of materials.
2. Beer, F.P., Johnston, E.R., DeWolf, J.T., Mechanics of Materials, McGraw Hill.
3. Hibbeler, R.C., Mechanics of Materials, Prentice Hall.

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| **Course No.: IPE 206H** | **Credit:1.0** | **Year: Second** | | **Semester: First** |
| **Course Title: Engineering Drawing (for PME)** | | | **Course Status: Sessional** | |

**Rationale of the Course:**

This course is a practical application of knowledge pertaining to all geometric features of a whole product, or assembly or sub-assemblies. Pictorial presentation by means of geometric shapes, lines, and dimensions is a must for engineering students. All engineering students need the basic engineering graphics knowledge to express their thoughts and ideas precisely and accurately.

**Course Objectives:**

The objectives of this course are to:

* provide the students with necessary skill to read, understand, and create mechanical engineering drawing;
* familiarize the students to acquire and use engineering drawing skills on creating accurate, clear sketches of different mechanical objects following the information and instructions;
* make students able to draw different types of angle projections, orthographic views, auxiliary, sectional views, isometric views, etc.;
* enable students to acquire requisite knowledge required for advanced study of engineering drawing;
* apply the drawing and drafting skills as problem-solving tools to resolve the primary design issues.

**Course Content:**

Introduction, Instruments and their uses, First angle and third angle projections, Orthographic drawing, Sectional views. Isometric views, Missing lines and views.

**Course Learning Outcomes, CLOs**

Upon successful completion of this course, student have reliably demonstrated the ability to:

1. understand the basic tools and techniques for making engineering drawings, and apply them to a wide range of engineering fields such as mechanical engineering, civil and architectural design, chemical process, etc.
2. create freehand sketches of visual expressions of technical ideas and can interpret common types of engineering drawings
3. understand the purpose of geometric shapes, signs and symbols, abbreviations and dimensional values found on engineering drawings
4. utilize graphic techniques to understand the relationships between real-world components and views of the components (orthographic, auxiliary, sectional, isometric views, etc.)
5. produce a formal engineering drawing according to standard drafting practice
6. participate in design reviews or technical meetings in a company concern to mechanical component and assembly suppliers.

**Mapping of CLOs with PLOs**

According to the PLOs of PME department.

**Books Recommended:**

1. K.V. Reddy, Textbook of Engineering Drawing, BS Publications, India.
2. K. Rathnam, A First Course in Engineering Drawing, Springer Nature Singapore Pte Ltd.
3. M.B. Shah and B. C. Rana, Engineering Drawing, Dorling Kindersley (India) Pvt Ltd.

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| **Course No.: IPE 203B** | **Credit: 3.0** | **Year: Second** | | **Semester: First** |
| **Course Title: Engineering Mechanics (for CEP)** | | | **Course Status: Theory** | |

**Rationale of the Course:**

This course introduces the basic principles of mechanics (statics and dynamics) essential for the engineering students. Its focus on the modeling and analyzing of static equilibrium as well as dynamic concept based on real life engineering applications and necessary knowledge about solving the problems.

**Course Objectives:**

The objectives of this course are to:

* provide necessary knowledge about basic principles of mechanics
* help students to analyze and solve matrix and vector notation and operations and recognize equivalence between systems of equations and matrix notation
* make the students understand the structural analysis
* provide the students with knowledge about centroid, first moment of inertia, second moment of inertia of an area and effect of friction
* develop ability to solve the problems related to kinematics and kinetics.

**Course Content:**

*Statics:* Statics of particles and rigid bodies. Centroids of lines areas and volumes; Forces in truss, frames, and cables; Friction; Moment of inertia of areas and masses; Relative motion. *Dynamics:* Kinetics of particles: Newton's second law of motion, Principles of work, energy, impulse, and momentum; System of particles: Kinematics of rigid bodies; Kinetics of plane motion of rigid bodies, forces, and acceleration; Principles of work and energy.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

**CLO 1**: implement the basic principles of mechanics to analyze and solve real life engineering problems

**CLO 2**: design and examine different structures (static and dynamic condition) under various loading conditions.

**CLO 3**:evaluate the effect of friction on a body

**CLO 4**:evaluate the importance of different laws of forces on the body and apply them in real context

**CLO 5**: apply the knowledge to analyze and solve problems related to kinematics and kinetics.

**Mapping of CLOs with PLOs**

According to the PLOs of CEP department.

**Books Recommended:**

1. Vector Mechanics for Engineers, Ferdinand P. Beer, E. Russell Johnston, Jr., David F. Mazurek and Phillip J. Cornwell, Tenth edition, McGraw Hill.
2. A Textbook of Engineering Mechanics, R.S. Khurmi, S. Chand publications.

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| **Course No.: IPE208** | **Credit: 1.0** | **Year: Second** | | **Semester: First** |
| **Course Title: Workshop Practice Sessional (for CEP)** | | | **Course Status: Sessional** | |

**Rationale of the Course:**

In order to have a balanced overall development of engineering graduates, it is necessary to integrate theory with practice. Workshop practice has been included in the curriculum to provide hands-on experience using different tools and basic manufacturing practices. By studying workshop practice, students will learn to explain the function, use, and application of different working tools, equipment, machine tools, and the technique of manufacturing a product from its raw material. This course also aims to develop the dignity of labor, precision, safety at work, teamwork, and the students' right attitude.

**Course Objectives:**

The objectives of this course are to:

* acquaint students with the general hand tools used in workshop and its proper uses;
* facilitate necessary knowledge about the specification of machine tools used in workshops and manufacturing industries;
* develop skill in identifying the machine tool components and their respective functions, and performing various machining operations on the machine tools used in practice;
* help students develop the ability to identify and differentiate the work holding devices used in practice to manufacture a product;
* encourage the students to provide team effort in product manufacturing from design to production.

**Course Content:**

Introduction to workshop tools. Study and operation of an Engine Lathe. Study and operation of Milling Machine. Study and operation of Radial Drilling Machine. Study and operation of Surface Grinding machine. Preparation of a hexagonal nut.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

**CLO 01**: sketch, specify and use various work holding tools, marking and measuring tools, cutting tools, finishing tools, and other tools such as hammer, spanner, screwdriver, and wrench, etc.

**CLO 02**: specify various machine tools such as engine lathe, milling machine, radial drilling machine, and surface grinding machine used in workshops as well as manufacturing industries

**CLO 03**: identify various components of an engine lathe, milling machine, radial drilling machine, and surface grinding machine and describe their respective functions

**CLO 04**: identify and differentiate the work holding devices used in an engine lathe, milling machine, radial drilling machine, and surface grinding machine

**CLO 05**: perform various machining operations on an engine lathe, milling machine, radial drilling machine, and surface grinding machine individually with safety precautions

**CLO 06**: apply their machining skills to fabricate parts of desired features from a given workpiece as per given drawing

**CLO 07**: apply their team effort to make the sequence of operations required for manufacturing a hexagonal nut and prepare it from a given cylindrical workpiece as per given drawing.

**Mapping of CLOs with PLOs**

According to the PLOs of CEP department.

**Books Recommended:**

1. James Anderson, Shop Theory.
2. Rajender Singh, Introduction to Basic Manufacturing and Workshop Technology
3. U.K. Singh and Manish Dwivedi, Manufacturing Processes
4. H.N. Gupta, R.C. Gupta, and Arun Mittal, Manufacturing Processes

**Second Year Second Semester**

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| **Course No.: IPE 205B** | **Credit: 3.0** | **Year: Second** | **Semester: Second** |
| **Course Title: Mechanics of Solids** | | **Course Status: Theory** | |

**Rationale of the Course:**

The application of the principles of mechanics to bulk matter is conventionally divided into the mechanics of solids and the mechanics of fluids. Solid mechanics is a basic subject for structural analysis. It concerned with the stressing, deformation and failure of solid materials and structures. In this course student will get the basic idea of the behavior of a body due to the external loading.

**Course Learning Objectives:**

The objectives of the course are to:

* help the students conceptualize the fundamental concepts of stress, strain and deformation of solids
* make the students understand the mechanism of load transfer in beams, the induced stress resultants and deformation
* facilitate the necessary knowledge about the effect of torsion on shafts and springs
* foster analytical and critical thinking required for solving the real-life engineering problems related to product design.

**Course Content:**

Stress and strain concepts, axial load, statically indeterminate axially loaded members, thermal stress, deflection of shaft due to torsional load, helical springs, statically indeterminate torque-loaded members, share and bending moment, flexural stress, deflection of beams, combined loadings, stresses and deflection in Column.

**Course Learning Outcomes, CLOs**

After the successful completion of the course, students will be able to:

**CLO1** establish an understanding of the fundamental concepts of mechanics of deformable solids including static equilibrium, geometry of deformation, and material constitutive behavior.

**CLO2** apply the systematic methods for solving engineering problems in solid mechanics.

**CLO3** explain the basic mechanical principles underlying modern approaches for design of various types of structural members subjected to axial load, torsion, bending, transverse shear, and combined loading.

**CLO4** build the necessary theoretical background for further structural analysis and design courses.

**CLO5** apply the knowledge of Mechanics of Solids to solve real-life engineering problems and design engineering systems.

**Mapping of CLOs with PLOs**

According to the PLOs of CEP department.

**Books Recommended:**

1. Andrew Pytel and Ferdinand L. Singer, Strength of materials.
2. Beer, F.P., Johnston, E.R., DeWolf, J.T., Mechanics of Materials, McGraw Hill.
3. Hibbeler, R.C., Mechanics of Materials, Prentice Hall.

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| **Course No.: IPE 205E** | **Credit: 3.0** | **Year: Second** | | **Semester: Second** |
| **Course Title: Industrial Management (for EEE)** | | | **Course Status: Theory** | |

**Rationale of the Course:**

The purpose of this course is to provide an understanding of the theories and principles of industrial management and encourage the course participants to make an appreciation of these principles in relation to their own experiences and selected managerial case studies.

**Course Objectives:**

The objectives of this course are to:

* provide knowledge about basic principles of management, and five major functions managers usually perform in an organization,
* make students think critically and strategically about management theories and issues in decision-making,
* familiarize students with the employment function as well as wage and incentive scheme
* let the students understand about different marketing issues and fundamental of inventory management.

**Course Content:**

*Organization and management:* evolution, management functions, organization structure, development of organization theory, study of various types of organizations. *Personnel management:* importance, scope, need hierarchy, motivation, defense mechanism, productivity and satisfaction, leadership, group dynamics, job evaluation and merit rating personnel development-hiring, wage systems. *Marketing management:* marketing concept, marketing organization, industrial and consumer selling, advertising. *Basics of inventory management*.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

1. describe the theories and principles of management and able to design an organogram
2. describe contemporary theories of motivation and discuss the challenges managers face in motivating distinctive group of people
3. explain leadership and implement its ideas in organizations
4. apply different task of personnel management such as recruitment, selection, wages and incentives in real life
5. identify what marketing strategies organizations might practice to attract and retain customer
6. explain the concepts of inventory management processes used in an organization.

**Mapping of CLOs with PLOs**

According to the PLOs of EEE department.

**Books Recommended:**

1. Management-A Global Perspective, Heinz Weihrich and Harold Koontz, McGRAW HILL International Edition.
2. Industrial Engineering and Management -A New Perspective, Philip E. Hicks, McGRAW -HILL International Editions.
3. Industrial Engineering and Management, O.P. Khanna and A. Sarup, Dhanpat Rai Publication Ltd

**Third Year First Semester**

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| **Course No.: IPE 309F** | **Credit: 3.0** | **Year: Thrid** | | **Semester: First** |
| **Course Title: Supply Chain Management (for FET)** | | | **Course Status: Theory** | |

**Rationale of the Course:**

Supply Chain Management (SCM) is an important part of every organization which focuses on maximizing customer value and achieving a sustainable competitive advantage. This course focuses on both qualitative and quantitative methods for efficient design, effective management to increase total supply chain surplus.

**Course Objectives:**

The objectives of this course are to:

* familiarize students with supply chain management, along with its drivers and metrics
* facilitate students with knowledge of designing supply chain network
* enhance skills on planning and coordinating demand and supply in a supply chain
* help students learn about planning and managing inventories in supply chain
* make students able to plan and design transport networks effectively and efficiently
* make them aware of current challenges and future direction of supply chain management.

**Course Content:**

*SC-Understanding the Supply Chain:* What it is, the decision phases, importance, advantages, examples; Supply ChainDrivers and Obstacles: Inventory, Transportation, Facilities and Information; *Transportation in a Supply Chain:* role, factors, design options and trade-offs. *Information Technology in a Supply Chain:* role, importance, use, IT as the information enabler, example in practice; *Coordination in a Supply Chain:* The Bullwhip Effect, effects on performance, the obstacles and the remedies, Partnerships and Trust within a supply chain. *Strategic Lead Time Management:* time-based competition, time-based process mapping, logistics pipeline management. Lean thinking, *JIT and Quick Response Logistics*: The philosophy, logistics implication, Vendor Managed Inventory;*Agility and Agile Supply Chain:* the conceptof market winner and market qualifier, how to combine lean and agile mindsets (pareto curve, decoupling point), *Managing the Global Pipeline:*The tradeoffs among the logistics costs, concepts of Centralization, Focused Factories andPostponement. *Procurement:* role and importance, make/buy decision and outsourcing, the process of purchasing, no. of suppliers and supplier base reduction, buyer-supplier portfolio, JIT purchasing and its risks & advantages.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

1. identify the goal of a supply chain, and evaluate the impact of supply chain decisions on the success of a firm
2. categorize the performance measures that are relevant to a supply chain
3. design both efficient and effective supply chain network
4. compare the major applications of supply chain information technology
5. encounter different challenges which arise in supply chain and mitigate them.

**Mapping of CLOs with PLOs**

According to the PLOs of PME department.

**Books Recommended:**

1. Chopra, S., Meindl, P., & Kalra, D. V., Supply chain management: strategy, planning, and operation. Boston, MA: Pearson.
2. Lei, L., De Candia, L., Oppenheim, R., & Zhao, Y. Managing Supply Chain Operations. World Scientific Publishing Company.

**Third Year Second Semester**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Course No.: IPE 319K** | **Credit: 3.0** | **Year: Third** | | **Semester: Second** |
| **Course Title: Industrial Management (for CHE)** | | | **Course Status: Theory** | |

**Rationale of the Course:**

This course aims to provide an understanding of the theories and principles of industrial management and encourage the course participants to appreciate these principles in relation to their own experiences and selected managerial case studies.

**Course Objectives:**

The objectives of this course are to:

* provide knowledge about basic principles of management, and the five major functions of managers e.g. planning, organizing, staffing, leading and controlling and challenges managers face in each stage
* make students think critically and strategically about management theories and issues which will enable them to develop their decision-making and analytical skills
* familiarize students with the employment function as well as wage and incentive scheme
* let the students understand about different marketing issues and fundamental of technology management.

**Course Content:**

*Organization and management:* evolution, management functions, organization structure, development of organization theory, study of various types of organization and management information systems, concepts, and scope of application. *Personnel management:* importance, scope, need hierarchy, motivation, defense mechanism, productivity and satisfaction, leadership, group dynamics, job evaluation, merit rating, personnel development-hiring, training, and wage systems. *Marketing management:* marketing concept, marketing organization, industrial and consumer selling, channel decisions, advertising decisions, new product strategy. *Basics of Technology management;* Case studies.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

1. understand the theories and principles of management, and design an organogram
2. describe contemporary theories of motivation, and apply these theories to tackle the challenges that managers encounter in motivating a distinctive group of people
3. know about leadership and implement its ideas in organizations/industries
4. understand and evaluate the different tasks of personnel management such as recruitment, selection, wages, and incentives
5. identify what marketing strategies organizations might practice to attract and retain customer
6. understand the concepts and techniques of strategic management of technology.

**Mapping of CLOs with PLOs**

According to the PLOs of CHE department.

**Books Recommended:**

1. Management-A Global Perspective, Heinz Weihrich and Harold Koontz, McGRAW HILL International Edition.
2. Industrial Engineering and Management -A New Perspective, Philip E. Hicks, McGRAW -HILL International Editions.
3. Industrial Engineering and Management, O.P. Khanna and A. Sarup, Dhanpat Rai Publication Ltd.

**Fourth Year Second Semester**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Course No.: IPE 405Q** | **Credit: 3.0** | **Year: Fourth** | | **Semester: Second** |
| **Course Title: Industrial Management (for MEE)** | | | **Course Status: Theory** | |

**Rationale of the Course:**

The purpose of this course is to provide an understanding of the theories and principles of industrial management and encourage the course participants to make an appreciation of these principles in relation to their own experiences and selected managerial case studies.

**Course Objectives:**

The objectives of this course are to:

* provide knowledge about basic principles of management, and the five major functions of managers e.g. planning, organizing, staffing, leading and controlling and challenges managers face in each stage
* make students think critically and strategically about management theories and issues which will enable them to develop their decision-making and analytical skills
* familiarize students with the employment function as well as wage and incentive scheme
* let the students understand about different marketing issues and fundamental of technology management.

**Course Content:**

*Organization and management:* evolution, management functions, organization structure, development of organization theory, study of various types of organization and management information systems, concepts and scope of application. *Personnel management:* importance, scope, need hierarchy, motivation, defense mechanism, productivity and satisfaction, leadership, group dynamics, job evaluation and merit rating personnel development-hiring, training, wage systems. *Marketing management:* marketing concept, marketing organization, industrial and consumer selling, channel decisions, advertising decisions, new product strategy. *Basics of Technology management;* Case studies.

**Course Learning Outcomes, CLO**

After the successful completion of the course, students will be able to:

1. understand the theories and principles of management and able to design an organogram
2. describe contemporary theories of motivation and discuss the challenges managers face in motivating distinctive group of people
3. know about leadership and implement its ideas in organizations/industries
4. know about different task of personnel management such as recruitment, selection, wages and incentives
5. identify what marketing strategies organizations might practice to attract and retain customer
6. understand the concepts and techniques of strategic management of technology.

**Mapping of CLOs with PLOs**

According to the PLOs of MEE department.

**Books Recommended:**

1. Management-A Global Perspective, Heinz Weihrich and Harold Koontz, McGRAW HILL International Edition.
2. Industrial Engineering and Management -A New Perspective, Philip E. Hicks, McGRAW -HILL International Editions.
3. Industrial Engineering and Management, O.P. Khanna and A. Sarup, Dhanpat Rai Publication Ltd.

**Ordinance for the Graduate Program at SUST**

Formation of Graduate Study Committee (GSC) will be the prerequisite to start a Graduate program in any Discipline. The GSC will be headed by the Head of the Discipline/ Institute consisting of all professors/Associate Professors of the discipline concerned with a minimum number of 3 professors/Associate Professors. When Professors and Associate Professors are not available in the discipline, the required number of Professors, Associate Professors will be included from the relevant Discipline/Institute by the proposal of the Board of Advanced Studies (BAS) & the Academic council.

**1. Introduction**

**1.1** The graduate program consists of Masters (General), Masters (Thesis), M.Sc. (Engineering), Masters of Philosophy (M.Phil.) and Ph.D. degrees.

**1.2** A graduate program may also be offered by a discipline in some specified field in collaboration with other disciplines.

**1.3** Any student with (i) 4 year Bachelors degree (ii) 3-year Bachelor and 1-year Masters Degree or (iii) 5-year Bachelor of Architecture degree from a recognized university is eligible to get admitted into the graduate program at SUST.

**1.4** Notification for the admission process will be published every year.

**1.5** After admission every student will be assigned to a student advisor/supervisor from among the teachers of his/her discipline to guide him/her throughout the academic program.

**2. Qualification**

**2.1 Masters and M.Phil.**

**2.1.1** Any student with a Bachelors degree from SUST is eligible for admission to the Masters (General) Program.

**2.1.2** Any student with a CGPA of 3.25 or more from SUST is eligible for admission to the Masters (Thesis), M.Phil. (Engineering) or M.Phil. Program.

**2.1.3** Four-year Graduates from other recognized universities and institutions with a CGPA of 3.25 or more can apply for admission to the Masters (Thesis), M.Phil. (Engineering) or M.Phil. Program. A candidate who passed under course system and seeks admission to M.Phil program has to have First class in Masters or 50% marks in Masters and at least 2nd division in all public examination.

**2.1.4** Any student registered for Masters (General) or Masters (Thesis) may transfer to the M.Phil. program, offered by the relevant discipline, if he/she can maintain a CGPA of 3.25 or more during the first two semesters.

**2.1.5** The GSC of a discipline will decide if a student from a related discipline will be allowed to apply to the graduate program of that discipline. In these cases if necessary the GSC may ask the candidate to take extra undergraduate/graduate courses to ensure the basic foundation.

**2.2 Ph.D.**

**2.2.1** Candidates with Masters (Thesis), M.Phil. or M.Sc. (Engineering) Degrees are eligible for application for Ph.D. and will be selected after a written and/or viva voce examination and the proper evaluation of academic records by the GSC. A candidate who passed under course system and seeks admission to Ph.D. program has to have First class in Masters or 50% marks in Masters and at least 2nd division in all public examination.

**2.2.2** A Masters (Thesis) an M.Phil. or an M.Sc. (Engineering) student may be transferred to the Ph.D. program after the completion of first two semesters with a CGPA 3.25 and the recommendation of his/her supervisor certifying satisfactory progress of research work and with the approval of the GSC and BAS.

**2.2.3** The following candidates are eligible for direct admission to Ph.D. if they have a CGPA of 3.25 or more at Bachelors and Masters Level and 3.00 or equivalent in all public examinations. (i) University teachers with two years teaching experience and one publication in standard academic journals. (ii) Teachers of colleges with three years of teaching experience and one publication in a standard academic journal (iii) Researchers of recognized research organizations with three years of research experience and at least three publications in standard academic journals. (iv) Candidates with an M.Phil degree.

**3. Admission**

**3.1 Masters and M.Phil.**

**3.1.1** If a SUST graduate has the required qualifications he/she can be admitted to the Masters program (General, Thesis or Engineering) as per the recommendation of the GSC.

**3.1.2** The candidates for Masters (Thesis and Engineering) and M.Phil. will be selected for admission after a written and/or viva voce examination conducted by the GSC. Full time teachers of SUST are not required to sit for the admission test. GSC will then recommend the candidates for admission to the academic council through the BAS. During the process of admission each candidate shall be assigned by the appropriate GSC and approved by BAS a supervisor from among the teachers of the relevant discipline/institute not below the rank of an associate professor or an assistant professor with a Ph.D. / M.Phil. / M.S.

**3.2 Ph.D.**

**3.2.1** A candidate for admission to the Ph.D. degree program will apply in the prescribed form to the head of the discipline or the director of institute along with the recommendation from possible supervisor(s). The supervisor must be of the rank of professor or associate professor.

**3.2.2** After approval from the GSC, the application will be forwarded to the BAS for the approvals of the supervisor and co-supervisors (if any). Each candidate shall have not more than two co-supervisors; one co-supervisor may be from outside SUST. After careful scrutiny of the research proposal BAS will send it to the Academic Council for final Approval.

**3.2.3** If necessary a change of supervisor must also be approved by the BAS and the Academic Council.

**4. Registration**

**4.1** Every selected candidate will be registered with the University and enrolled as a full time or if allowed, part time student with payment of prescribed fees and dues before the commencement of each semester.

**4.2** A student has to register for at least 50% or maximum 150% credits of the courses at every semester in the prescribed syllabus. But for attaining degree in the last semester above mentioned restrictions will not be followed.

**4.3** A candidate may be admitted or change his status into part time student with prior approval of the university and a written consent from the serving organization. A part time student may be assigned a minimum of 6 credit hours per semester.

**4.4** A full time student must register for a minimum of 1(2.0 Credits) hours per semester. A full time student shall not be allowed to be employed as a part time employee in other organizations. However he/she may be employed as teaching/research assistant at the University. A Ph.D. candidate shall have to be a full time student for at least one year during his/her Ph.D. work.

**4.5** The registration for the Ph.D. degree will remain valid for a period of four years, and can be renewed for a further period of two years.

**5. Academic Regulations**

**5.1 Duration**

**5.1.1** The minimum duration for the Masters, M.Sc. (Engineering), M.Phil. and Ph.D. degrees will be as followed:

|  |  |  |
| --- | --- | --- |
| **Degree** | **Duration of Completion** | **Required Credits** |
| Masters (General) | 2 Semesters | Minimum 24 |
| Masters (Thesis) | 3 Semesters | 36 |
| M.Phil. / M.Sc. (Engg.) | 4 Semesters | 48 |
| Ph.D. | 6 semesters | 72 |

**5.1.2** Minimum duration of M.Phil will be 4 Semesters for students who completed 3 years Bachelors and 1 year Masters degree. Minimum duration of M.Phil will be 2 semesters for students who completed 4 years Bachelors and 1 year Masters degree.

**5.2 Credit Requirement**

**5.2.1** For the graduate program a full time student has to register for at least 1(2.0 Credits) each semester. For course work 1 credit means one hour of contact hour per week and for research or project work 1 credit hour means at least three hours per week. A student will be allowed to take theoretical course and research work simultaneously. Once the course requirement is completed, for the research work a graduate student has to register for “independent study” as credit/no-credit basis to fulfill the 1(2.0 Credits) per semester requirement.

**5.3 Course Requirement**

**5.3.1** Syllabus committee for the graduate program will be comprised of the GSC members and two external members from other universities nominated by the Dean.

**5.3.2** Every year the syllabus committee will design the graduate level courses for the respective disciplines and recommend the courses for approval of the Academic Council through the School and BAS. GSC can review the curriculum from time to time and recommend any change to the syllabus committee as may be considered necessary.

**Masters and M.Phil.**

**5.3.3** Every Masters (general, thesis and engineering) and M.Phil. student has to complete at least 16 hours of theory course work during the first two semesters. GSC will propose the required courses to the students with consultation of respective supervisors. The course work for M.Phil Program may be reduced and relaxed according to the recommendation of GSC. In that case the duration may be reduced up to 1 year.

**Ph.D.**

**5.3.4** The GSC may suggest courses, if felt necessary, for the Ph.D. students.

**5.4 Research Work Requirement**

**5.4.1** Research work for thesis shall be carried out under the supervision of the supervisor. Co-supervisors from within or outside the discipline / Institute may be appointed, if necessary. The topic of research proposal shall be approved by the BAS after the completion of the required course credits within six months/one year for M.Phil. / Ph.D. on the recommendation of the Head of the Discipline/Institute. A Ph.D. student must submit a progress report of his work to the supervisor(s) at the end of the every semester who will present it to BAS.

**5.4.2** The Ph.D. student will give at least one public seminar talk conducted by GSC at the Discipline / Institute every year on a topic of his own field of research.

**5.4.3** The research work must be carried out in this University or at a place approved by the supervisor in consultation with the GSC.

**6. Conduct of Examinations**

**6.1 Course Examination**

**6.1.1** The examination committee will conduct the course examinations as per the examination ordinance of graduate program.

**6.2 Thesis Submission**

**6.2.1** The title of the thesis has to be approved by the BAS on the recommendation of the Head of the Discipline / Institute. For Masters/M.Phil. it has to be done at least three months and for Ph.D. it has to be done at least six months before submitting.

**6.2.2** Every student shall submit to the supervisor required number of type written copies of his thesis in the approved forMATon or before a date to be fixed by the Head of the Discipline/ Institute in the consultation with the supervisor concerned.

**6.2.3** The student shall declare that the research work was done by him/her and has not submitted elsewhere for other purpose (except for publication).

**6.2.4** The thesis should demonstrate an evidence of satisfactory knowledge in the field of research undertaken by the student.

**6.3 Masters Thesis Examination**

**6.3.1** There is no thesis requirement for Masters (General). The project (if any) and the thesis for Masters (Thesis) and will be evaluated as per the examination ordinance of graduate program.

**6.4 M.Phil. / M.Sc. (Engineering) Thesis Examination**

**Thesis Evaluation**

**6.4.1** The academic council will, on the basis of the suggestion of the GSC and recommendation of the BAS, appoint for every thesis an examination committee consisting of two examiners of whom at least one shall be from outside this University.

**6.4.2** The examiners of thesis will either accept it or reject it for the degree and then individually and separately submit one copy of their reports in sealed covers to the controller of examination and another copy to the GSC Chairman. The majority decision will be considered as the final result.

**6.4.3** If a thesis is adjudged inadequate for the award of the degree, the candidate will be allowed to resubmit his thesis within six months. If the candidate fails to resubmit or the thesis is adjudged inadequate again the examiners may recommend Masters (general) degree and the controller of examination will place such recommendation before the BAS for the approval of academic council.

**Oral Examination and Open Presentation**

**6.4.4** The GSC in consultation with the supervisor shall suggest, to the Vice Chancellor through BAS, a committee of three members for oral examination consisting of: (i) Convener: Thesis supervisor (ii) A Professor in relevant field from outside the University (iii) One of the thesis examiners.

**6.4.5** If any examiner is unable to accept the appointment or has to relinquish his appointment before/ during the examination, the Vice-Chancellor shall appoint another examiner in his place as per the recommendation of GSC.

**6.4.6** After the oral examination the convener will send a consolidated report to the controller of examinations stating clearly whether the award of the degree is recommended, who will in turn place it to BAS for the approval of the Academic Council.

**6.4.7** In case a candidate performs unsatisfactorily in oral examination even though the thesis is adjudged adequate the examiners may recommend to the Academic Council that the candidate may be permitted to appear at another oral examination within six months from the first oral examination. No candidate shall be allowed to appear at the oral examination of the same thesis for more than two times.

**Recommendation for Degree**

**6.4.8** After completion for the viva-voce examination, the convener of the viva examination committee will send a consolidated report, stating clearly whether the award of the degree is recommended, to the Controller who will in turn place it to BAS for the approval of the academic council.

**6.5 Ph.D. Thesis Examination**

**Thesis Evaluation**

**6.5.1** The academic council will, on the basis of the suggestion of the GSC and recommendation of the BAS, appoint for every thesis an examination committee consisting of three examiners of whom one shall be the supervisor and the other two from outside this University and at least one from a university from abroad

**6.5.2** One of the three examiners will be appointed by the academic council as the convener of the examination committee.

**6.5.3** The examiner of thesis will individually and separately submit one copy of their reports in sealed covers to the controller of examination and another copy to the convener. Every examiner will have to explicitly state whether the award of the Ph.D. degree is recommended or not. The recommendations of all the three examiners must be explicit, unambiguous and unanimous for the award of the degree.

**6.5.4** If a thesis is adjudged inadequate for the award of the Ph.D. degree, the candidate will be allowed to resubmit his thesis after six months with proper modification. If the candidate fails to resubmit or the thesis is adjudged inadequate again the examiners may recommend the award of M.Phil. or M. S. degree and the controller of examination will place such recommendation before the BAS for the approval of academic council.

**Oral Examination and Open Presentation**

**6.5.5** On receipt of the unanimous opinions of the examiners, the convener shall fix a date and a venue and suggest, to the Vice Chancellor through BAS, a committee of three members for oral examination consisting of the convener, supervisor/co-supervisor and a thesis examiner. At least one of them has to be from outside the university.

**6.5.6** If any examiner is unable to accept the appointment or has to relinquish his appointment before/during the examination, the Vice-Chancellor shall appoint another examiner in his place as per the recommendation of GSC.

**6.5.7** In case a candidate is unable to satisfy the viva voice Board even though the thesis is adjudged adequate the Board may recommend to the Academic Council that the candidate may be permitted to appear at another oral examination after a lapse of six months from the first oral examination. No candidate shall be allowed to appear at the oral examination of the same thesis for more than two times.

**Recommendation for Degree**

**6.5.8** After completion of the viva voce examination, the convener will send a consolidated report to the controller of examinations stating clearly whether the award of the degree is recommended, who will in turn place it to BAS for the approval of the Academic Council.

**7. Award of the Degree**

**7.1 Masters**

**7.1.1** Students will be awarded his/her degree as per the recommendation of GSC chairman after the completion of his required credits.

**7.2 M.Phil. and Ph.D.**

**7.2.1** The vice chancellor shall place the reports of the Oral Examination committee for consideration of the academic council which shall recommend to the Syndicate for the award of the degree.

**7.2.2** A hard copy of the thesis accepted by the academic council incorporating any correction and changes suggested by the examination committee shall be preserved in the central library of the university and the corresponding electronic version shall be preserved in the archive.

**8. Academic Fee**

To be decided by the Academic Council and the Syndicate.

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**Ref.:** *The clause 4.2 of this Ordinance was approved in the 119th Academic Council.*

**Examination Ordinance for the Graduate Program**

University authorities will administer and publish the results of Masters, M.Phil. and Ph.D. degree examinations under the graduate program. The graduate program will follow the same academic calendar of the undergraduate program for course delivery, the final examination and publication of results. The graduate courses are comprised of theory and lab courses and where applicable, the thesis for the research works. The evaluation of thesis is conducted as per the Ordinance for the Graduate Program at SUST. The theory and lab courses are conducted by the examination committee.

**1. Examination Committee**

**1.1** The GSC of the Discipline/Institute will form the examination committee as per the rules of the University.

**1.2** The examination committee will propose the examination schedule, prepare question papers, help the discipline conducting the examination, prepare results and will resolve the issues that may arise concerning the examination procedure.

**2. Examination Dates and Routines**

**2.1** The examination routines will be designed by the respective disciplines and Head of the disciplines will notify them and send copies to the other relevant disciplines and to the office of the Controller of the Examinations.

**3. Theory Courses**

**3.1 Distribution of Marks**

A student will be continuously evaluated during the semester through tests, assignments, mid-semester examinations, viva etc. conducted by the course teachers, and it will contain 40% of total marks. The rest 60% marks will come from the final written examination at the end of that semester.

**3.2 Class Performance**

After the end of the classes, the course teachers will make three copies of mark-sheets showing the marks from class participation and assignment and mid semester examination. He/she will display one copy in the notice board, send one sealed copy to the chairman of the examination committee and another sealed copy to the controller of examination.

**3.3 Question Setting and Moderation**

**3.3.1** The examination Committee will appoint two question setters for each course at least four weeks before the date of commencement of the examination and inform the Controller of examination. The controller of examination will send the necessary papers to the question setters and the examiners. If a question setter or examiner declines the responsibility, he/she will return all the papers and the examination committee will suggest an alternative question setter or examiner.

**3.3.2** The chairman of the examination committee will receive all the manuscript of question papers; if no manuscript is received within the specified time the committee will suggest an alternative question setter.

**3.3.3** After receiving all the question papers the examination committee will moderate the question papers. Moderation will not be invalid if any member be absent during moderation. For the disciplines of the school of Applied Sciences and Technology the questions will be divided in two groups in the question paper so that two examiners can evaluate the answer script simultaneously. The examination committee will be responsible for the preparation of the necessary editing and printing of the question papers.

**3.4 Final Examination**

**3.4.1** The controller of examination will be responsible to print the blank answer scripts, mark sheets and other relevant forms and will make necessary arrangements, so that these are available during the conduct of examination in the examination hall in due time .

**3.5 Evaluation of Answer Script**

**3.5.1** The answer scripts from the disciplines of Applied Science and technology will be evaluated by two examiners simultaneously, of whom one should preferably the course teacher. The answer scripts from the disciplines of other school of studies will be evaluated by two examiners separately, of whom one should preferably the course teacher. The examiners will examine the scripts thoroughly, mark the scripts properly and grade legibly within the specified time. The examiners will send a sealed copy of mark-sheet to the controller of examination and one sealed copy to the chairman of the examination committee.

**3.5.2** The examination committee will assign members from the committee to scrutinize the answer scripts and if any discrepancy is found the committee will make the necessary arrangements to fix the problem and inform the controller of examination.

**3.5.3** If the difference between marks given by two examiners be 20% or more than 20% GSC will recommend a third examiner for approval by the V.C and marks given by 3rd examiner & the marks of the first or 2nd examiner which ever is nearest to this will be considered for the average marks .

**4. Lab Courses**

**4.1** Every lab course will be assigned to at least two course instructors and they will grade the students through continuous evaluation.

**4.2** For the projects, Masters (Thesis), Industrial assignments, monographs etc. the supervisor will give an overall assessment which will count as 30% of the total marks. Evaluation of the report by two external examiners, who is not involved in supervision/co-supervision will count as another 30% of the marks. The remaining 40% will come from the presentation and viva voce conducted by the examination committee. During viva-voce examination the supervisor or co-supervisor, if present, will not participate in marking.

**5. Publication of Result**

**5.1** Three original tabulation sheets will be prepared by the tabulators and checked by all the members and signed by the tabulators and members of the examination committee. The tabulation sheets will contain the grade point average obtained in the specific semester. The tabulation sheets will be sent to the Controller of Examinations for his signature and approval by the Vice-Chancellor.

**5.2** The Controller of Examination shall keep up to date record of all the grades obtained by the student in individual Academic Record Card. Grades shall be announced by the Controller of Examination at the end of each semester.

**Grade and grade points:**

**5.3** The letter grade and grade point will be awarded as follows:

|  |  |  |
| --- | --- | --- |
| **Numerical Grade** | **Letter Grade** | **Grade Points** |
| 80% Or above | A+ | 4.00 |
| 75% to less than 80% | A | 3.75 |
| 70% to less than 80% | A- | 3.50 |
| 65% to less than 70% | B+ | 3.25 |
| 60% to less than 65% | B | 3.00 |
| 55% to less than 60% | B- | 2.75 |
| 50% to less than 55% | C+ | 2.50 |
| 45% to less than 50% | C | 2.25 |
| 40% to less than 45% | C- | 2.00 |
| Less than 40% | F | 0.00 |

**6. Security and Ethics**

**6.1** Everyone involved in the process of examination has to guard the security of the question papers, examination grades and the final results. An examinee can never try to influence the examiners and any such attempt has to be brought to the controller of examination.

**6.2** A student may never be asked a question so that he is hurt because of his religious or ethnic background.

**6.3** If some one involved in the examination process has the following relatives as examinee he/she should immediately inform in to the authority: (a) Husband/wife, (b) Son/Daughter, (c) Brother/Sister, (d) Brother-in-Law/ Sister-in-Law (e) Son-in-Law/ Daughter-in-Law, (f) Nephew/ Niece, (g) Uncle/ Aunt, (h) First Cousins.

**Department of Industrial and Production Engineering**

**Graduate Program**

**Session 2021-2022**

The syllabus for the Graduate Program in Industrial and Production Engineering covers the requisite courses for the following degrees:

1. Masters (General)
2. M.Sc. Engineering in Industrial Engineering
3. Doctor of Philosophy (Ph.D.)

Masters (General) and M.Sc. Engineering Programs:

The duratioan of Masters General and M.Sc. Engineering program are one and two years respectively.

The department will fix the courses of two semesters for Masters (General) students considering the minimum requirement of 24 credits for the degree. It will fix the courses and/or thesis works that will be spreaded over four semester For M.Sc. Engineering program considering the minimum requirement of 48 credits for the Degree.

The detail syllabus of the program is given below:

**Semester I**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Course No. | Course Title | Hours/Week | | Credits |
| Theory | Lab |
| Compulsory Courses | | | | |
| IPE 5301 | Production and Operations Management | 3 | 0 | 3.0 |
| IPE 5303 | Industrial Safety and Risk Management | 3 | 0 | 3.0 |
| Optional Courses | | | | |
| IPE5501 | Applied Engineering Statistics | 3 | 0 | 3.0 |
| IPE 5503 | Technology Management | 3 | 0 | 3.0 |
| IPE 5505 | Management Accounting | 3 | 0 | 3.0 |
| IPE 5507 | Industrial Waste Management | 3 | 0 | 3.0 |
| IPE 5509 | Manufacturing Process Planning | 3 | 0 | 3.0 |
| Total | | 12 | 0 | 12.0 |

**Semester II**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Course No. | Course Title | Hours/Week | | Credits |
| Theory | Lab |
| Compulsory Courses | | | | |
| IPE 5307 | Quantitative Techniques | 3 | 0 | 3.0 |
| IPE 5309 | Statistical Quality Control | 3 | 0 | 3.0 |
| IPE 5900 | Industrial Project for Masters (General)\* | 0 | 6 | 3.0 |
| IPE 6900 | M.Sc. Engg. Thesis\* | 0 | 12 | 6.0 |
| Optional Courses | | | | |
| IPE 5305 | Supply Chain Management | 3 | 0 | 3.0 |
| IPE 5313 | Data Analytics | 3 | 0 | 3.0 |
| IPE 5315 | Behavioral Systems Engineering | 3 | 0 | 3.0 |
| IPE 5317 | Industrial Project Management | 3 | 0 | 3.0 |
| Total | |  | | 12.00 (General and MSc Engg.) |

**Semester III**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Course No. | Course Title | Hours/Week | | Credits |
| Theory | Lab |
| IPE 6900 | M.Sc. Engg. Thesis\* | 0 | 12 | 6.0 |
| Compulsory Course | | | | |
| IPE 6511 | Research Methodology | 3 | 0 | 3.0 |
| Optional Courses | | | | |
| IPE 6301 | Applied Forecasting Methods | 3 | 0 | 3.0 |
| IPE 6311 | Modern Marketing Management | 3 | 0 | 3.0 |
| IPE 6305 | Quality Planning and Management | 3 | 0 | 3.0 |
| IPE 6303 | Human Factors Engineering | 3 | 0 | 3.0 |
| IPE 6501 | Energy Management | 3 | 0 | 3.0 |
| IPE 6900 | M.Sc. Engg. Thesis | 0 | 12 | 6.0 |
| Total | | 12 | - | 12.0 |

**Semester IV**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Course No. | Course Title | Hours/Week | | Credits |
| Theory | Lab |
| IPE 6900 | M.Sc. Engg. Thesis | 0 | 24 | 12.0 |
| Total |  | 0 | 24 | 12.00 |
| Grand Total |  |  |  | 24.00 (General)  48.00  (MSc. Engg) |

**Detailed Syllabus for Masters Program**

**FIRST SEMESTER**

IPE 5301 (3.0 credits)

Production and Operation Management

**Introduction:** Concepts, factors, types and problems of production systems, productivity improvement. **Location selection and plant layout:** Site location selection, factors affecting location, evaluation of location factors, facility layout analysis. **Design of manufacturing system:** Organization of machines and resources, Push- Pull concepts and constant Work-in- Process (CONWIP), effect of variability on capacity, performance measures. **Factory dynamics:** Little’s law, laws of factory dynamics, application of factory dynamics. **Just in time production:** Just in time philosophy, total quality circles. **Theory of constraints:** Optimal production technology and theory of constrains, bottleneck management. **Demand forecasting:** Moving average, exponential smoothing technique, time series decomposition. Inventory and materials management: Inventory models, materials requirements planning. **Operations Scheduling:** Heuristic models, flow shop scheduling, job shop scheduling, line balancing and scheduling in FMS, sequencing and loading. **Advanced topics:** Enterprise resource planning system, customer relationship management, service industry, Corporate social responsibilities.

This course includes technical presentation, assignments and group study.

IPE 5303 (*3.00 Credits)*

Industrial Safety and Risk Management

An introduction to safety and accident, evolution of modern safety concepts, safety management, types of injuries and accidents occurred in industries, accident investigation, theories of accident causes, effects of strain and demand, principles of prevention: safety information; preventive measure of accidents, developing safety information, work related accident cost, health programs, safety programs, causes of stress, symptoms of stress, burnout, worker’s safety, protective management techniques for safety management, safety devices, safety standards and regulations for engineering works, understanding safety signs, cost of safety. **Risk Management**: Identification of hazards, Assessment of risks, Risk controlling and minimization, Techniques, models and frameworks for risk management.

This course includes technical presentation, assignments and group study.

IPE 5501 (3.00 Credits)

Applied Engineering Statistics

**Fundamentals:** Basic statistics and probability, Descriptive statistics; probability distributions: Discrete and continuous distributions; Sampling theory; **Applications of Inferential statistics:** estimation and hypothesis testing; linear regression and correlation, multiple linear regression, polynomial regression; analysis of variance (Anova); non-parametric tests; design of experiments; projects on a course topic.

This course includes technical presentation, assignments and group study.

IPE 5503 (3.00 Credits)

Technology Management

**Concept:** Technology, Engineering, Hardware and software technologies; Role of technology, Influence of technology in the modern economy, Technological innovations, Technology strategy, Strategic attitudes and competitiveness, Technology assessment; Multiplier model, Growth of Technology, Technology substitution, **Transfer of technology:** Methodologies, Absorption, Risk, Economy, Ancillary industry and linkage; **Planning technology:** Forecasting, Assessment, Implementing technology in product and services. Concept of Fourth Industrial Revolution (4 IR), Technology and its relevance with 4IR; Case studies on selected topics.

This course includes technical presentation, assignments and group study.

IPE 5505 (3.00 Credits)

Management ACCOUNTING

Cost terms; Costing; Cost behavior; **Cost planning and control:** cost-volume-profit relationship, profit planning, standard cost and performance measures; Flexible budget and overhead analysis; Using cost data in decision making: pricing of products and services, relevant costs for decision making; Capital budgeting; Financial statement analysis; Simulation and computer modeling techniques in management accounting.

This course includes technical presentation, assignments and group study.

IPE 5507 (3.00 Credits)

INDUSTRIAL WASTE Management

**Introduction to industrial wastes:** sources of industrial wastes; Types of industrial waste: solids, gases, liquids and semi-liquids; **Hazardous industrial wastes:** Waste mixed with heavy metals (like-lead, mercury, asbestos and nuclear wastes), used up fuels in nuclear reactors, toxic materials, CFCs, PCBs. **Industrial waste management strategies:** treatment and disposal techniques; management of solid wastes and recycling; effluent treatment plants (ETPs); Waste water management; Government and inter-government regulatory frameworks; Initiatives for industrial waste management: compliances and certification. Industrial waste auditing and reporting.

This course includes technical presentation, assignments and group study.

IPE 5509 (3.00 Credits)

manufacturing process planning

Introduction to manufacturing, Introduction to process planning, Drawing interpretation, Material evaluation and process selection, Production equipment and tooling selection, Process parameters, Work holding devices, Selection of quality assurance method, Economics of process planning, From design to manufacture, Case studies on selected topics.

This course includes technical presentation, assignments and group study.

**SECOND SEMESTER**

IPE 5307 (3.00 Credits)

QUANTITATIVE TECHNIQUES

**Deterministic optimization modeling:** Basic modeling concepts and standard models (LP, IP, NP, combinatorial), examples and applications. **Software packages:** Optimization package, Modeling package, Spreadsheet optimization. **Linear programming:** The graphical method, simplex and revised simplex method, duality and sensitivity analysis, convex analysis and polyhedral set. I**nteger programming and combination optimization:** Branch and bound approach, heuristic approach, dynamic programming, **Network flow:** Transportation and assignment models, Queuing theory, Markov chain.

This course includes technical presentation, assignments and group study.

IPE 5309 (3.00 Credits)

STATISTICAL QUALITY CONTROL

Introduction to statistical quality control (SQC), **SQC Categories:** *Descriptive Statistics*: Measure of accuracy, Measure of precision, shape of data distribution, Quality control tools: Pareto analysis, Cause-effect diagram, Stratification, Check Sheets, Histogram, and Scatter diagram; *Statistical Process Control:* Process control, Salient features of process control, Sources of variations, Theory behind process control, Process Control Chart: Introduction, Basic components, Use, Basic procedure, Interpretation of control chart, Errors in making inference from control chart and its effect, Control Charts: General model, Effect of control limits on errors in inference making, Suggested number of data points, Sample size and its effect on control limit, Control Charts for Variables: Introduction, Control charts for mean and range, Control charts for mean and standard deviation, Control Charts for Attribute: Control charts for fraction nonconforming, Control charts for nonconformities, Some Special Charts: Moving range chart, Exponentially weighted moving average chart, Cumulative sum charts for process mean and variability, Process Capability Analysis: Process variability, Natural tolerance, Specification, Process capability, Specification-Process capability relationships, Process capability Indices and their interpretations; Factorial Experiments for Process Design: Basics, Guidelines for designing an experiment, The 2K factorial design; *Acceptance Sampling:* Introduction, Advantage and disadvantage of sampling, Producer and customer risks, Operating characteristics (OC) curve: Construction, Effect of sample size and acceptance number on OC curve, Lot-by-lot attribute sampling plan: Single sampling plans, Double sampling plans, Multiple sampling plans, Sequential sampling plan, Characterizing Sampling Plans: Average outgoing quality, Average total inspection, Average sample number; Industrial projects and case studies: statistical process control and acceptance sampling plan.

This course includes technical presentation, assignments and group study.

IPE 5305 (3.0 credits)

SUPPLY CHAIN MANAGEMENT

**Understanding the Supply Chain:** What it is, the decision phases, importance, advantages, examples; **Supply Chain Drivers and Obstacles:** Inventory, Transportation, Facilities and Information; Transportation in a Supply Chain: role, factors, design options and trade-offs. **Information Technology in a Supply Chain:** role, importance, use, IT as the information enabler, example in practice; Coordination in a Supply Chain: The Bullwhip Effect, effects on performance, the obstacles and the remedies, Partnerships and Trust within a supply chain. **Strategic Lead Time Management:** time based competition, time based process mapping, logistics pipeline management. Lean thinking, **JIT and Quick Response Logistics:** The philosophy, logistics implication, Vendor Managed Inventory; Agility and Agile Supply Chain: the concept of market winner and market qualifier, How to combine lean and agile mindsets (pareto curve, decoupling point), **Managing the Global Pipeline:** The tradeoffs among the logistics costs, concepts of Centralization, Focused Factories and Postponement. **Procurement:** role and importance, make/buy decision and outsourcing, the process of purchasing, no. of suppliers and supplier base reduction, buyer-supplier portfolio, JIT purchasing and its risks & advantages.

This course includes technical presentation, assignments and group study.

IPE 5313 (3.00 Credits)

Data Analytics

**Fundamentals of data analytics:** History and Evolution of Data Analytics, Data Mining and Analytics, Data Privacy - Ethical and Organisational Issues; **Data Analytics Tools and Techniques:** Techniques: Descriptive, prescriptive, predictive, Popular tools: Python, R, Rapidminer etc.; Business Analytics and Intelligence, Machine Learning, Customer Relationship Analytics, Cloud Computing, Blockchain, and Cognitive Computing; **Application of data analytics in industry:** Data Analytics and the Retail Industry, Data Analytics in the Manufacturing Industry, Data Analytics in the Marketing Industry (focusing on product design and development), Data Analytics in the Transportation Industry.

IPE 5315 (3.00 Credits)

behavioral system engineering

Nature and Scope of organizational behavior- Personality, Learning and Perceptions; Values, Attitudes and Believes; motivation, Group dynamics, inter-group and intra-group communications, group decisions making process; power politics and conflict; process of resolving conflicts, theories of leadership; elements of organizational culture; organizational changes and development, technique for dealing with resistance to change.

This course includes technical presentation, assignments and group study.

IPE 5317 (3.00 Credits)

Industrial project management

Project identification and selection; Project financing; Project strategies; Project planning, appraisal and implementation, project termination; *Project organization:* matrix organization; Project manager; Budgeting; Project scheduling and resource allocation; GANTT chart; Network techniques: PERT/CPM; Information system and project control; Contract negotiation and conflict resolution; Project life cycle costing , Technical and financial evaluation of projects; Application of computer packages, case studies.

This course includes technical presentation, assignments and group study.

IPE 5900 (3.00 Credits)

INDUSTRIAL PROJECT FOR M.Sc. (GENERAL)

In this course, students are required to undertake an industrial project. The objective is to provide an opportunity to develop initiative, self-reliance, creative ability and engineering judgment. The results must be submitted in a comprehensive report with appropriate drawing, bibliography etc. along with the products if any. Use of locally available materials in manufacturing and feasibility study of local industrial units will be emphasized.

**THIRD SEMESTER**

IPE 6301 (3.00 Credits)

applied forecasting methods

Principle of model building, Advanced regression analysis, Forecasting error analysis, Smoothing and moving average models, Box-Jenkins methodologies, Application of statistical package, Four case studies.

This course includes technical presentation, assignments and group study.

IPE 6311 (3.00 Credits)

Modern Marketing Management

**Introduction to marketing management:** Concepts of marketing and marketing systems. Marketing Environment: Micro and macro environment, Analyzing marketing opportunities; Consumer markets, buying behavior and buying processes, Evaluation techniques; Market segmentation, Target marketing and product positioning; Market measurement and forecasting; **Organizing for marketing:** Marketing organization and planning; **Planning the marketing:** Programme-Product-Policy decisions, New product decisions, Price decisions, Channel decisions, **Promotion:** Advertising, Sales promotion, Sales decisions; **Controlling marketing effort:** Marketing control, Cost and profit analysis, profitable share of market; Global marketing; International marketing; Case studies on selected topics.

This course includes technical presentation, assignments and group study

IPE 6303 (3.00 Credits)

Human Factors engineering

Review of Human Factors, Human- Machine Systems & it’s Components; Visual Display for Static Information, Visual Display for Dynamic Information, Principles of Workstation Design; Workstation Design (Design of Work Surface, Seating, Standing) & Design of VDT(Visual Display Unit); Design for aging; Work Physiology (Workload and Energy); Office Ergonomics; Manual Material Handling: Equipment’s and their applications, Principles, Lifting Principles, NIOSH Lifting Equation, Maximum acceptable Weights; Auditory; Noise; Illumination; Temperature; Applications of Different Ergonomics Software; Human Factors Applications.

This course includes technical presentation, assignments and group study.

IPE 6305 (3.00 Credits)

quality planning and management

**Concept of Quality:** Modern concept of quality and its measurement, quality redefined, identification of quality characteristics: quality of design conformance and performance, Deming’s principles on quality and productivity, Quality costs and their interpretation. **Quality planning:** Quality function planning and deployment strategies (Process based strategy and Quality Function Deployment strategy) - establishment of quality goals, Identification and determination of the customer needs, Development of product and process features, Establishment of process controls. **Quality Management:** Fundamentals of Quality Management, Total Quality Management: origin, concept and implementation, QCC, TQC, Quality Standards – ISO 9000 and 14000, 5S, TPM, SMED, Poka-Yoke etc.

This course includes technical presentation, assignments and group study.

IPE 6501 (3.00 Credits)

energy management

A study of energy auditing, rate structures, economic evaluation techniques, lighting efficiency improvement, HVAC optimization, combustion and use of industrial waste, steam generation and distribution system performance, Distributed Digital Control systems, process energy management, and maintenance considerations.

This course includes technical presentation, assignments and group study.

IPE 6511 (3.00 Credits)

RESEARCH MWTHODOLOGY

Philosophy of research; **Research Process:** Problem identification, crafting research questions, Literature review: type of structured literature review process; Selection of research design; Data collection, data processing, data analysis. Taxonomy of Research Methodologies

**Advanced qualitative methods:** Qualitative research design, data collection methods (case study research), sample analysis using available software like NVivo. **Advanced quantitative methods:** Quantitative survey instrument design (Survey research), data collection, selection of data analysis method, Demonstration of sample analysis using software like R/STATA/SPSS/AMOS/MPLUS. Reporting results through publications: Communicating research outputs.

**FOURTH SEMESTER**

IPE 6900 (24.00 Credits)

M.Sc. Engg. Thesis

In this course, students are required to undertake a major project. The objective is to provide an opportunity to develop initiative, self-reliance, creative ability and engineering judgment. The results must be submitted in a comprehensive report with appropriate drawing, bibliography etc. along with the products if any. Use of locally available materials in manufacturing and feasibility study of local industrial units will be emphasized.

This is a continuation of the thesis started in the 2nd semester.

**Note:** For PhD/ MSc. Engg.(Thesis) maximum two courses( 6 credits) can be taken from other discipline according to the proposal of thesis supervisor with the approval of GSC, IPE department.