Department of Industrial and Production Engineering

Curriculum of Undergraduate Program
Session: 2023-24

Shahjalal University of Science and Technology
Sylhet, Bangladesh

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Contents

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 Dr. A. M. Sarwaruddin Chowdhury

First Academic Session of the University
1990-1991

Website of the University
www.sust.edu

E-mail of the University
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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
2268

Founder Head of the Department
Professor Dr. Muhammed Zafar Iqbal

Current Head of the Department
Professor Dr. Muhammad Mahamood Hasan

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
Engr. Syed Misbah Uddin
Dr. Md. Rezaul Hasan Shumon*

Associate Professors:
Mr. Chowdhury Md. Luthfur Rahman
Mr. Muhammad Abdus Samad
Mrs. Shanta Saha
Mrs. Syeda Kamrun Nahar

Assistant Professors:
Engr. Mohammed Abdul Karim
Mr. Jahid Hasan
Mr. Pronob Kumar Biswas*
Mr. Mahathir Mohammad Bappy*
Mr. Md. Mehedi Hasan Kibria
Mr. Saiful Islam*

Lecturers:
Mr. Md. Jahedul Alam
Mr. Pritidipto Paul Chowdhury

* On study leave

বিভাগের সংক্ষিপ্ত পরিচিতি

শাহজালাল বিজ্ঞান ও প্রযুক্তি বিশ্ববিদ্যালয়ে (শাবিপ্রবি) ১৯৯৪ সালে ইন্ডাষ্ট্রিয়াল এবং প্রডাকশন ইঞ্জিনিয়ারিং (আইপিই) বিভাগটি প্রতিষ্ঠিত হয়। উল্লেখ্য যে, শাবিপ্রবির আইপিই বিভাগটি বাংলাদেশে সর্ব প্রথম বি এস সি ইঞ্জিনিয়ারিং (আইপিই) প্রোগ্রাম শুরু করে যা পরবর্তীতে বুয়েট এ চালু হয় । স্নাতক ডিগ্রী ছাড়াও শাবিপ্রবির আইপিই বিভাগ স্নাতকোত্তর পর্যায়ে মাস্টার্স বাই কোর্সওয়ার্ক, মাস্টার্স বাই মিক্সড মোড, মাস্টার্স বাই রিসার্চ এবং পিএইচ ডি প্রোগ্রামও সফলতার সাথে চালিয়ে যাচ্ছে। বর্তমানে বিভাগটি আন্তর্জাতিক মান সম্পন্ন বিশ্ববিদ্যালয় হতে ডিগ্রীধারী শিক্ষক মন্ডলী দ্বারা সুপ্রতিষ্ঠিত। ম্যানুফেকচারিং এবং সার্ভিস ইন্ডাস্ট্রির জন্য আইপিইর স্নাতকগণ কৌশলগত এবং দীর্ঘ ও স্বল্পমেয়াদী পরিকল্পনা প্রণয়ন ও বাস্তবায়নে সক্ষম। আইপিই প্রোগ্রামের কারিকুলামটি এমনভাবে প্রণয়ন করা হয়েছে যেন স্নাতকগণ তাদের জ্ঞান, দক্ষতা এবং উৎকর্ষতা অর্জনের মাধ্যমে যেকোন প্রোডাকশন এবং সার্ভিস সিষ্টেম ডিজাইন, উন্নয়ন, বাস্তবায়নের মাধ্যমে সম্পদের যথার্থ ব্যবহার করতে সক্ষম। বিভিন্ন শিল্প শাখা সমুহে বাস্তবিক শিল্প উন্নয়ন ছাড়া আর্থ সামাজিক উন্নয়ন সম্ভব নয়। ইন্ডাষ্ট্রিয়াল ইঞ্জিনিয়ারিং এবং ইঞ্জিনিয়ারিং ম্যানেজমেন্ট সম্পর্কিত বৈদেশিক বিশেষজ্ঞদের চাহিদা প্রতিস্থাপনে আইপিইর স্নাতকগণ সক্ষম এবং এ বিষয়ে তারা পেশাগত দক্ষতা অর্জনের মাধ্যমে যথাযথ ভূমিকা পালন করে যাচ্ছে। জাতীয় অর্থনৈতিক উন্নয়নের চালিকাশক্তি হিসাবে আগ্রগামী ভূমিকা পালনের মাধ্যমে অর্থনৈতিক উন্নয়ন সাধনে ক্রমবর্ধমান বিদেশী বিশেষজ্ঞদের সম্পৃক্ততা কমিয়ে দেশের উন্নয়নে ভূমিকা রাখতে আইপিইর স্নাতকগণ প্রস্তুত। আমাদের স্নাতকগণ অত্যন্ত দক্ষতার সাথে বিভিন্ন প্রতিকুলতাকে জয় করে দেশে এবং বিদেশে সফলতার কাজ করে যাচ্ছে। সেক্ষেত্রে তারা পলিসি প্রণয়নকারী, অপারেশন ম্যানেজার, ডিজাইনার, কোয়ালিটি এক্সপার্ট, সিস্টেম ইঞ্জিনিয়ারিং ম্যানেজার সহ অন্যান্য সংশ্লিষ্ট পদবীতে পেশাগত দায়িত্ব পালন করে যাচ্ছে। সংক্ষেপে, আইপিই যে কোন সিস্টেম যেখানে মানবসম্পদ, যন্ত্রপাতি, উৎপাদন প্রক্রিয়া তার উন্নতি সাধন এবং সমন্বিত কার্যক্রম জড়িত সেক্ষেত্রে অর্জিত জ্ঞানের সফল বিতরণ এবং প্রয়োগ করে থাকে। পাশপাশি তারা আন্তর্জাতিকভাবে ইন্ডাষ্ট্রিয়াল ইঞ্জিনিয়ারদের চাহিদার কিছু অংশ পূরণ করে যাচ্ছে। বাংলাদেশকে উন্নত এবং সমৃদ্ধশালী দেশ হিসাবে পরিণত করার জন্য শিল্পায়নের ভূমিকা অনস্বীকার্য। আর এই প্রত্যয়ে শাবিপ্রবির আইপিই বিভাগ শিল্পায়নের জন্য দক্ষ মানব সম্পদ তৈরীর মাধ্যমে অত্যন্ত অগ্রণী ভূমিকা পালন করে যাচ্ছে। পাশাপাশি আন্তর্জাতিক মানসম্পন্ন শিল্প প্রকৌশলী, গবেষক এবং নীতিনির্ধারক তৈরীর প্রয়াসে নিরলস প্রচেষ্টা চালিয়ে যাচ্ছে।

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 (Master's by Coursework, Master's by Mixed Mode, Master's by Research and Doctoral by Research) 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 the Bachelor's degree as per the rules. The student will enroll in the first semester of an academic year in individual disciplines of different schools. The admission of foreign students will be subjected to the verification of academic records as per the university rule.

1.2 Student Status, Student Level and Level of courses:
Every student has to maintain her/his student status by enrolling, paying tuition fees, and doing the registration for required credits every successive semester following the requirements (Section-4). For smooth operation of semester system and bookkeeping purpose: (1) a student's level will be expressed by her/his year and semester, and (2) courses of 1st year, 2nd Year, 3rd Year and 4th Year will be termed respectively as 100 level, 200 level, 300 level and 400 level courses.

1.3 Re-Admission:
(1) 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 her/his core and elective courses of the same semester.
(2) A student has to take re-admission if her/his student status is not maintained or one or more semesters have annulled because of disciplinary action taken against him/her. In the case of semester annulment, the student has to re-admit the same level of semester. The level (Year and Semester) of re-admitter will be determined by his/ her completed credits.
The re-admitted students will always be assigned the original Registration number.

1.4 Student's Advisor:
After admission, every batch of the students will be assigned to a student advisor nominated by the respective discipline to guide them during their study under the semester system. Advisors will always be accessible to the students and ready to mentor them in 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 of the year will start on 1st January and end on 30th June, the Second semester will begin on 1st July and end on 31st December. The roster of the final examination dates and other academic deadlines will be announced at the beginning of each semester.

2.2 Duration of Semesters:
The duration of each semester will be as follows:

Classes	14
weeks Recess before final Examination	2
weeks Final Examination	4
weeks Total	20
weeks	

These 20 (twenty) weeks may not be continuous in order to accommodate various holidays and the recess before the final examination. The final grading will be completed within one month of the beginning of the 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 Core, Elective and General Education Courses: The Curriculum Committee of the discipline duly formed by the respective Dean will develop all the courses of the curriculum for every session. These courses include the Core, General Education, and Elective courses needed for the program of the discipline. The General Education courses will be developed with the close cooperation of the respective discipline concerned, considering the necessity of the program. If for any of the disciplines, the needed General Education courses are not running/operating in the University then the Curriculum Committee of that discipline will develop all the necessary/relevant courses for the program. Finally, the curriculum has to be approved by the respective school and the Academic Council.

3.1.2 Curriculum: (a) Core, Elective and General Education Courses: The Curriculum Committee will select and approve the courses from Core/Elective courses of the discipline as well as General Education courses designed/offered by the other disciplines for completing the full curriculum. The Curriculum committee will also select a group of courses as the core courses. In that instance, without completing all of these core courses, a student will not be considered for graduation even if s/he completed the credits required for the degree. Also, the committee may assign a pre- requisite for any course if deemed necessary.

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

3.1.3 Course Instruction: At the beginning of every semester, the course instructor has to prepare a detailed course plan and submit it to the head of the discipline to make it available for the students. The course plan should have information about the suggested textbooks, topics per week and corresponding course learning outcomes (Cos) covered, teaching and learning strategies, assessment strategies, number and approximate dates of term-test examinations, quizzes, presentations, 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 specified/designated by a three-letter symbol for discipline/school abbreviation (if not otherwise mentioned) followed by a four-digit International Standard Classification of Education (ISCED) code and a four-digit number to characterize that course. To avoid confusion, any new or modified courses should never be specified/designated by reusing a discontinued course number.

3.2.1 Discipline Identification:

The three-letter symbol will identify a discipline/institute/school offering the course as follows. If the same course is offered to more than one discipline/institute, if necessary, an extra letter shown in the in the list may be used after the three digits to specify the department receiving the General Education 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
17.	OCG	Oceanography	S
		School of Social Sciences:	
18.	ANP	Anthropology	a
19.	BNG	Bangla	b
20.	ECO	Economics	c
21.	ENG	English	d
22.	PSS	Political Studies	e
23.	PAD	Public Administration	f
24.	SCW	Social Work	g
25.	SOC	Sociology	h
		School of Agriculture and Mineral Sciences:	
26.	FES	Forestry and Environmental Science	P
		School of Management and Business Administration:	
27.	BUS	Business Administration	i
		Institute of Information and Communication Technology	
28.	SWE	Software Engineering	W

3.2.2 Course Number:

(a) Following the BNQF (Bangladesh National Qualifications Framework) guidelines, an ISCED Code will be assigned to each course (offered by the discipline/institute/school) immediately after the three-letter code of the specified course.

(b) First Digit: The first digit of the four-digit number, after the ISCED Code, will correspond to the year (level) intended for the course recipient.

(c) Second Digit: The second digit of the four-digit number, after the ISCED Code, will correspond to the semester intended for the course recipient.

(d) Third Digit: A discipline should use the numbers 0 and 1 for the third digit to identify allied General Education courses. The digits 2-9 are reserved for Core and Elective courses to identify the different areas within a discipline/institute.

(e) Fourth Digit: The fourth digit of the four-digit numbers (after the ISCED Code) will identify a course within a particular discipline/institute/school. This digit may be sequential to indicate the follow-up courses. If possible, fourth digit may be even for identifying the laboratory/sessional courses of the discipline/institute/school.

3.2.3 Course Title and Credit: Every course will have a short representative course title and a number indicating the total credit as well as reference to prerequisite courses if any.

3.2.4 Theory and Lab/Sessional Course: If a single course has both Theory and Laboratory/sessional part, then the course must be split by Theory and Lab/Sessional courses, and both should have separate course numbers. A student will not be allowed to register for the Lab/Sessional course without registering or completing the corresponding Theory course. Completion of both the Theory and the corresponding Lab/Sessional courses is mandatory for graduation.

3.3 Assignment of Credits:

3.3.1 Theoretical: One lecture of 1 (One) hour duration per week or 14 (Fourteen) lectures in total per semester will be considered as one credit.

3.3.2 Laboratory/Sessional Classes: Within the (laboratory/sessional) classroom of the discipline/institute minimum two contact hours of a laboratory/sessional class per week (or 28 contact hours in total) per semester will be considered as one credit. The minimum – maximum credits of the lab/sessional courses will be specified by/

limited to 1-3 credits. The other laboratory/sessional courses (like the design studio, field practicum, etc.) will be designed, and the credits will be determined/specified based on the necessity by the discipline/institute.

3.3.3 Seminar, Projects, Fieldwork, Thesis, Viva etc.: Will be assigned by the respective discipline/institute.

3.4 Classification of the Courses:
The Bachelor's degree courses will be classified into several groups, and the curriculum committee will finalize the curriculum by selecting courses from the groups shown below.

3.4.1 Core and Elective Courses: Every student has to take the courses specified/marked as core courses of the program offered by the discipline/institute. The percentage of the core and elective courses shall be at most 75% of the total credits so designed by the respective discipline/institute.

3.4.2 General Education Courses: Every student is required to take General Education courses developed by the Curriculum Committee of the discipline/institute. The General Education courses shall be at least 25% of the total credits offered by the respective discipline/institute. If any General Education course is specified/declared as a mandatory course in the curriculum, a student is required to take that course to graduate.

3.4.3 Non-credit Courses: The credit of these courses will be added to the total credits if passed but will have no effect on the CGPA as there will be no grades for these courses.

3.4.4 Non-credit Course for BNCC: The credit of these courses will be added to the total credits if passed and its grade will be separately shown but will have no effect on the CGPA.

4. Admission in semesters and Course Registration

4.1 Requirements for Admission and Course Registration:

For admissions to higher semester (2^{nd} to 10^{th}) and course registration following requisites and steps have to be strictly maintained:
(1) Completion of 100 level courses is mandatory for student's admission in semester of 300 level courses.
(2) Completion of 200 level courses is required for admission in semester of 400 level courses.
(3) A student having incomplete 100 level courses shall be allowed for admission in her/his next available semester of 100-200 level courses until s/he completes all of 100 level courses.
(4) A student having incomplete 200 level courses shall be allowed for admission in her/his next available semester of 200-300 level courses until s/he completes all of 200 level courses.

(5) Once a student reaches to $8^{th}/10^{th}$ semester of 4/5 years' program s/he will be kept at this level, if necessary, till the specified last semester of the undergraduate program for completion of credit requirement of graduation.

Every admission/course registration of a student will be counted and adjusted from the total number of semesters of the program to determine her/his remaining period of study. Student advisors of all disciplines will advise every student about her/his courses for registration and monitor her/his performances. Accordingly, a student has to register for her/his courses and pay necessary dues within the first 4 (Four) weeks of every semester (2 more weeks for late registration). A student will not be allowed to appear in the examination if her/his semester and examination fee is not fully paid off. Foreign student must have valid Visa/residential permit to appear in the examination and that has to be checked by the student advisor and the head of the discipline/institute.

4.2 Minimum and Maximum Credit:
A student, if s/he is not a clearing graduate, will not be allowed to register for more than 30 credits per semester.

4.2.1 Course registration for clearing graduate: For course registration of a clearing graduate ($8^{th}/10^{th}$ and subsequent semesters), however, the condition(s) for maximum and minimum credits is/are relaxed.

4.3 Incomplete Courses:
If a student has an incomplete course(s), s/he has to register such an incomplete course(s) from preceding semesters before registering courses from current or successive semesters. If an incomplete course is not available or offered in the running semesters, the student shall take such course(s) when it is available or offered.

4.5 Course Withdrawal:
A student can withdraw a course by a written application to the Controller of Examinations through the Head/Director of the discipline/institute two weeks before the examination start. The Controller of Examinations will send the revised registration list(s) to the disciplines before the commencement of semester final examination. There will be no record 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 available/offered any more, the discipline may allow him/her to take an equivalent course from the current curriculum. For clearing graduates, if any incomplete course is not available/offered in the running semester, the discipline may suggest a suitable/equivalent course to complete the credit requirement so required for the degree.

5. Graduation Criteria

5.1 Major Degree

5.1.1 Total Credits: For graduation, a student must complete all of the offered courses prescribed by the curriculum committee for her/his session. In general, the minimum requirements for graduation from the disciplines of different Schools and Institute are as in the following table:

Schools/Institute	**Disciplines**	**Program duration (in year)**	**Minimum credits**
Physical Sciences	All disciplines	4	140
Social Sciences			
Management and Business Administration			
Applied Sciences and Technology	Architecture	5	200
	Other disciplines	4	160
Institute of Information and Communication Technology	Software Engineering	4	160
Life Sciences	All disciplines	4	160
Agriculture and Mineral Sciences			

Student must complete all the core and prerequisite (if assigned in curriculum) as well as all the registered courses for graduation.

5.1.2 Total Years:
A regular student is expected to complete her/his graduation in 8/10 semesters for 4/5 (four/five) years' program of the disciplines/institute. If necessary, s/he will be given 4 (four) extra semesters (in consecutive 2 (two) years) in addition to 8/10 (eight/ten) semesters of the program to complete the credit-requirement of the degree. In very special cases, that is, if a student completed her/his 80% or more of the credits and intended through application to complete the remaining credits then the discipline may send a detailed report to the respective Dean for further steps. Then, based on the report and Dean's opinion, Academic Council may allow 2 (two) extra semesters as the special semesters for completing the credit-requirement of the degree as irregular students. In the case of Institute, the director will send the report through the governing body to the academic council. The regular examination year will be specified/identified by the session and the end-month (June or December) of the semester in which the student graduates.

5.1.3 Break in study:
In very special cases, if a student does not register and remains absent continuously for 2-4 (two to four) semesters within her/his 12/14 semesters of 4/5 years' program, then s/he may apply for re- admission as an irregular student. Her/his application will be considered only once provided that s/he has already completed 80% or more of the credits for which s/he was supposed to register and sit in the examination before the beginning of her/his break of study. The concerned

discipline will analyze the application and send its well-judged recommendation to the Dean within the 1st month of the running semester. The Academic council, based on the recommendation of the discipline and the opinion of the Dean, may allow the applicant for admission as an irregular student. Such student has to complete the required credits within her/his remaining number of semesters.

In the certificate, grade sheet and transcript of all irregular students, the word "irregular" will be mentioned.

5.2 Second Major Degree

5.2.1 Total Credits: A student will be eligible for a second major degree if s/he completes an extra
28-36 credits requirement stipulated by the program offering discipline.

5.2.2 Total Semesters: A student must complete the credit-requirement of second major degree within her/his 8 (eight) regular and 4 (four) extra semesters.

5.2.3 Requirement of Second Major Degree: A student will not be given a second major degree if s/he fails to complete her/his regular major degree.

5.2.4 Registration Criteria: An offering discipline will decide on the number of seats for the 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 concerned discipline will enroll them as per the admission criteria.

5.2.5 Class routine: After enrollment, a regular student may start taking the second major courses starting from her/his 3rd semester. The class routine will be arranged to accommodate the student's need.

5.2.6 Certificate and Mark sheet: A Student completing the requirement will be given an additional standard certificate and mark sheet for her/his second major degree.

6. Examination System

A student will be evaluated continuously under the semester-course system. For theoretical classes, students have to be assessed by class participation, assignments, quizzes, term-test examinations, topic-based report writing/presentation, and semester-end final examination. For laboratory/sessional work, s/he will be assessed by observation at work, viva-voce during laboratory/sessional works, from her/his 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:

Attendance (Percentage)	≥ 95	90 – < 95	85 – < 90	80 – < 85	75 – < 80	70 – < 75	65 – < 70	60 – < 65	50 – < 60
Marks	10	9	8	7	6	5	4	3	0

	Class Attendance	10%
	Class performance (Quizzes, MCQ, fill in the gap, report writing/presentation / Assignments)	10%
	Term-Test Examinations	20%
	Final Examination (25% is the pass mark for the final examination)	60%

6.1.1 Class Participation:
The marks for class participation will be as follows:

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

6.1.2 Term-Test:
There should be at least two Term-Tests for every theory course. The course teacher may decide the marks distribution between term-tests. The answer script must be shown to the students as it is essential to their learning process.

6.1.3 Final Examination:
After the 16^{th} week since the beginning of the semester, 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 3-4 (three-four) credits, and the courses less than 3 (three) credits will have a final examination for 2 (two) hours duration.

(b) Evaluation of answer scripts of final examination:
The school of disciplines may follow any one of the following answer script evaluation system.
(1) Single Examiner system, SES: The students will have two answer scripts to answer a separate set of questions during the final examination. Two examiners will grade the two answer scripts separately, and their given marks will be added together (examinee wise) for determining the Final Mark.
(2) Double Examiner system, DES: The students will have a single answer script to answer questions during the final examination. The answer scripts will be evaluated by two examiners separately. For determining the Final Mark: (1) If the difference of two marks of the examiners is less than 20%, then these two marks will be averaged, and (2) If the difference of two marks of the examiners is 20% or more, the corresponding/concerned answer scripts will be examined by a third examiner and then the closer (by smaller difference) otherwise higher two marks of the three examiners will be averaged. Furthermore, if the total marks of two examiners differ by

15% or more in the case of 50% or more answer scripts of a course, then the whole set of answer scripts will be examined by the third examiner.
The examination committee will propose the name for appointing the third examiner(s) (not any member of the examination committee) to the respective Dean. The Dean will authenticate/approve the name and send it to the Controller of Examinations for book-keeping and to take the approval of the Vice-Chancellor.

The system of answer script evaluation of the school has to be approved by the Academic Council.

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 major and second major degrees will be calculated separately by the weighted average of all courses of the previous semesters along with that of the current/present semester. For the calculation of the final CGPA of clearing graduates, if the third digit after the decimal point is nonzero then its previous, that is, the second digit will be incremented by one. A student, if applicable, will also receive a separate CGPA for her/his Second Major courses.
7.2.3 F Grades: A student will be given an "F" grade if s/he fails or remains absent in the final examination of a registered course. If a student obtains an "F" grade, her/his grade will not be counted for GPA and s/he will have to repeat the course. An "F" grade will be in her/his record, and s/he will not be eligible for distinction, award, and scholarship of the university.
7.2.4 Course Improvement: A student will be allowed only once to improve maximum of 2 (two) theory courses for which s/he has obtained a B- grade or less in the previous level by registering in the semesters of the immediate next level.

Such course grade improvement opportunity shall be given only for 100- 300 level courses. If the course grade does not improve then the previous course grade will sustain in grade count. In the case of the course grade improvement, this will be cited/noted in the concerned transcripts beside the grade count as "Improvement."

8. Distinction

8.1 Distinction:

Candidates for 4/5 years' programs will be awarded the degree with Distinction if her/his overall CGPA is 3.75 or above. However, a candidate/student will not be considered for Distinction and any kind of Awards if s/he has any one of the following:
(a) s/he is not a regular student,
(b) s/he has semester drop or incomplete courses in any semester, (c) s/he has an "F" grade in any course,
(d) s/he has upgraded her/his GPA through improvement, (e) s/he is addicted to drugs,
(f) disciplinary action(s) is taken against her/him.

9. Certificate of Practical Skill

For extraordinary and remarkable contribution in establishing lab(s)/new lab set ups, instrument making, developing software/algorithm/apps/device/technology/technique, designing research tools, etc., student (involved) will be awarded a certificate of excellence in practical skill based on the decisions of the discipline by the respective Dean.

Ref.: This Ordinance was approved in the 171th Academic Council (16 March 2023).

শাহজালাল বিজ্ঞান ও প্রযুক্তি বিশ্ববিদ্যালয়ের বি এন সি সি ক্যাডেটদের জন্য ঐচ্ছিক বিষয় হিসেবে নির্ধারিত

MSC 004 MILITARY SCIENCE (সামরিক বিজ্ঞান)
3 Hours/Week, 3 Credits

পঠিত বিষয় (তত্ত্বীয় ও ব্যবহারিক): বি এন সি সি'র ইতিহাস-ঐতিহ্য, বি এন সি সি'র সাংগঠনিক কাঠামো, মহান স্বাধীনতা যুদ্ধের পঠভূমি ও কারণ, স্বাধীনতা যুদ্ধের সেক্টর সমূহ, ড্রিল, কুচকাওয়াজ, ম্যাপ রিডিং, যুদ্ধের নানা কৌশল, যুদ্ধে ব্যবহৃত অস্ত্রের পরিচয়, বাংলাদেশের সশস্ত্র বাহিনীর পরিচয়, নেতৃত্বের বৈশিষ্ট্য, শরীর চর্চা, প্রাথমিক চিকিৎসা, সমাজ সেবা, দুর্যোগ ব্যবস্থাপনা, ভুমিকম্প ব্যবস্থাপনা, ঘূর্ণিঝড় ব্যবস্থাপনা, অগ্নি নির্বাপনের কৌশল, সাংস্কৃতিক প্রশিক্ষণ ইত্যাদি।

সহায়ক গ্রন্থ :
বি এন সি সি: সামরিক বিজ্ঞান সদর দপ্তর কর্তৃক নির্ধারিত ও প্রকাশিত।

Curriculum for B.Sc. in Industrial and Production Engineering Program
Session: 2023-24
PART: A

1. Title of the Academic Program:
Bachelor of Science (Engineering)

2. Name of the University:
Shahjalal University of Science and Technology

3. Vision of the University:
To be a leading university of excellence in Science and Technology with a strong national commitment and significant international impact.

4. Mission of the University:

SUST M 1. To advance learning and knowledge through teaching and research in science and technology.

SUST M 2. To serve as a center for knowledge creation, technological innovation and transfer among academia, industry, and society.

SUST M 3. To assist in transferring Bangladesh a country with sustainable economic growth and equitable social development.

5. **Name of the Program Offering Entity (Department/Faculty/Institute):**
Department of Industrial and Production Engineering

6. Vision of the Program Offering Entity:
To be recognized as a global leader through innovative and creative education and research in the field of Industrial and Production Engineering.

7. Mission of the Program Offering Entity:

IPE M 1. To produce graduates providing quality education and research ensuring state-of-art knowledge and skills on Industrial and Production Engineering;

IPE M 2. To equip the graduates with the necessary technical know-how that expands their reasoning, communication and problem-solving abilities;

IPE M 3. To provide the graduates with strategy developing capability and managerial skills to face existing and upcoming industrial needs and challenges;

IPE M 4. To establish an effective industry-academia linkage that addresses the needs of stakeholders, society at large.

8. Objectives of the Program Offering Entity:
The objective of Industrial and Production Engineering Department is to provide state-of-the art knowledge to the students, so that the graduates will be capable of making strategic and operational decisions in various types of organizations.

9. Name of the Degree:
Bachelor of Science in Industrial and Production Engineering

10. Description of the Program:
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. 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 curriculum 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.

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.

11. Graduate Attributes (based on need assessment):

GA 1. *Technical competence*: Students should have a sound understanding of the basic sciences, engineering fundamentals and specialization, and their underlying principles in the field of Industrial and Production Engineering;

GA 2. *Analytical competence:* Students should be able to formulate and analyze complex engineering problems reaching substantial conclusions using basic principles of mathematics, natural sciences and engineering sciences;

GA 3. *Problem-solving competence:* Students should be able to identify and solve engineering problems in real-life contexts with a systematic and logical manner;

GA 4. *Investigation competence:* Students should be able to conduct investigations of complex engineering problems using research-based knowledge and methods to provide valid conclusions, either by oneself as a professional or as an effective and proactive team member;

GA 5. *Engineering tools:* Students should be able to apply appropriate techniques, resources, and modern engineering and IT tools to complex engineering problems with their limitations;

GA 6. *Communication skills:* Students should be able to communicate effectively with different stakeholders, including engineers, management, and customers using a range of communication tools and techniques, such as valid reports, designed documentations, clear instructions, etc.;

GA 7. *Professionalism:* Students should be able to demonstrate professional conduct, including ethical behavior, a commitment to continuous learning and development, and respect for diversity and inclusivity;

GA 8. *Leadership:* Students should be able to demonstrate leadership skills, including the ability to work collaboratively and manage a team in multi-disciplinary settings;

GA 9. *Sustainability competence:* Students should be able to evaluate the sustainability and economic impacts of professional engineering work in a societal and environmental context;

GA 10. *Lifelong learning:* should be able to recognize the need for and have the ability to engage in independent and life-long learning in the broadest context of technical change.

12. Program Educational Objectives (PEOs)

PEO1. To equip 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 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. To help 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. To help students develop curiosity and interest in continued life-long learning through graduate studies and/or professional activities;

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

13. Program Learning Outcomes (POs)

PO	Program Learning Outcomes (POs)	Domains
PO 1	Apply knowledge of mathematics, natural science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	Fundamental Skills
PO 2	Identity, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.	Fundamental Skills
PO 3	Design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.	Fundamental Skills
PO 4	Conduct investigations of complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.	Thinking Skills
PO 5	Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering problems, with an understanding of the limitations.	Fundamental Skills
PO 6	Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solutions to complex engineering problems.	Social Skills
PO 7	Understand and evaluate the sustainability and impact of professional engineering work in the solution of complex engineering problems in societal and environmental	Thinking Skills
PO 8	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.	Personal Skills
PO 9	Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.	Social Skills
PO 10	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	Social Skills

PO 11	Demonstrate knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	Personal Skills
PO 12	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	Personal Skills

14. Mapping <u>mission of the university</u> with PEOs:

Mission/ PEO	SUST M1	SUST M2	SUST M3
PEO1	√		
PEO2	√		√
PEO3		√	√
PEO4	√	√	
PEO5			√
PEO6			√
PEO7	√	√	

15. Mapping POs with the PEOs

PEO / PO	**PEO1**	**PEO2**	**PEO3**	**PEO4**	**PEO5**	**PEO6**	**PEO7**
PO1	√						
PO2	√			√			
PO3		√		√			
PO4			√	√			√
PO5		√		√			
PO6			√				
PO7						√	
PO8				√			√
PO9					√		
PO10			√		√		
PO11			√				
PO12				√		√	√

16. Mapping courses with the POs

Course \ POs	Theory/ Sessional	Credit	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
			PO1	**PO2**	**PO3**	**PO5**	**PO6**	**PO9**	**PO10**	**PO4**	**PO7**	**PO8**	**PO11**	**PO12**
IPE 0715 1141	Theory	3.0	√	√		√							√	
PHY 0533 1107G	Theory	3.0	√											
MAT 0541 1103G	Theory	3.0	√	√										
SSS 0222 1100G	Theory	3.0					√							√
ENG 0231 1101G	Theory	2.0							√				√	
ENG 0231 1102G	Sessional	1.0						√	√					
IPE 0715 1144	Sessional	1.5	√	√				√						
IPE 0732 1122	Sessional	1.5	√			√			√					
IPE 0488 1152	Sessional	1.0						√	√					
IPE 0715 1221	Theory	3.0	√	√		√								
IPE 0715 1223	Theory	3.0	√	√		√								√
MAT 0541 1204G	Theory	3.0	√	√		√								
CEP 0711 1201G	Theory	2.0	√	√		√								
CHE 0531 1201G	Theory	3.0	√	√		√								
CHE 0531 1202G	Sessional	1.5		√	√			√	√					
IPE 0715 1242	Sessional	1.5	√	√				√						
IPE 0715 1246	Sessional	1.5		√				√						
PHY 0533 1202G	Sessional	1.5	√	√						√				
IPE 0031 1250	Comprehensive Viva-I	0.5						√	√					
IPE 0715 2121	Theory	3.0	√	√		√					√			√
IPE 0715 2123	Theory	4.0	√	√						√				
MAT 0541 2107G	Theory	3.0	√	√	√	√								√
EEE 0713 2103G	Theory	3.0	√	√	√	√								
ECO 0311 2105G	Theory	3.0	√	√		√								
EEE 0713 2104G	Sessional	1.5	√	√		√								
IPE 0715 2124	Sessional	1.5	√	√										
IPE 0788 2142	Sessional	1.5	√			√								√

IPE 0788 2144	Sessional	1.5		√		√								
IPE 0715 2225	Theory	3.0	√			√								
IPE 0715 2227	Theory	3.0	√	√										
IPE 0412 2231	Theory	3.0	√	√									√	
IPE 0542 2251	Theory	3.0	√	√						√				
CSE 0613 2206G	Sessional	3.0		√		√					√			
IPE 0715 2222	Sessional	1.5		√					√					
IPE 0715 2228	Sessional	1.5	√			√								√
IPE 0788 2246	Sessional	1.5			√	√			√					
IPE 0031 2250	Comprehensive Viva-II	0.5						√	√					
IPE 0031 2260	Industrial Tour	0.5		√					√			√		
IPE 0541 3121	Theory	3.0	√	√		√				√				
IPE 1022 3131	Theory	3.0	√	√	√				√					
IPE 0413 3133	Theory	3.0	√	√		√							√	
IPE 0788 3151	Theory	3.0	√	√	√		√	√	√		√			
IPE 0788 3153	Theory	3.0	√	√							√			
IPE 0541 3122	Sessional	1.5	√	√		√		√						
IPE 1022 3132	Sessional	1.5	√	√				√						
IPE 0788 3152	Sessional	1.5	√	√	√			√	√		√		√	
IPE 0413 3235	Theory	3.0	√	√	√		√			√			√	
IPE 0788 3237	Theory	3.0	√	√		√		√					√	
IPE 0541 3239	Theory	3.0	√	√	√	√	√							
IPE 0715 3241	Theory	3.0	√	√	√	√								
MEE 0714 3203G	Theory	3.0	√	√		√		√						√
MEE 0714 3204G	Sessional	1.0	√	√		√		√						
IPE 0788 3236	Sessional	1.5		√		√								
IPE 0715 3242	Sessional	1.5	√	√		√								
IPE 0031 3250	Comprehensive Viva-III	0.5						√	√					
IPE 0031 3254	Sessional	1.0			√			√	√			√	√	√
IPE 0031 3260	Industrial Training-I	1.0	√	√					√			√		
IPE 0788 4131	Theory	3.0	√	√		√	√						√	
IPE 0413 4133	Theory	3.0	√	√	√	√				√				
IPE 0715 4141	Theory	3.0	√	√						√				

Optional-I	IPE 0715 4143	Theory	3.0	√	√		√							√
	IPE 0715 4145	Theory	3.0	√	√									
Optional-II	IPE 0488 4136	Theory	3.0	√	√		√							√	
	IPE 0413 4137	Theory	3.0	√	√	√			√	√					
	IPE 0788 4138	Theory	3.0	√											√
IPE 0788 4190		Project/Thesis	3.0	√	√		√		√	√	√		√		√
IPE 0788 4132		Sessional	1.5	√	√		√	√			√			√	
IPE 0715 4142		Sessional	1.5	√	√		√								
IPE 0715 4144		Sessional	1.5	√	√	√	√				√				
IPE 0788 4235		Theory	3.0	√	√		√		√	√				√	√
IPE 0788 4239		Theory	3.0	√	√	√				√				√	
Optional-III	IPE 0788 4234	Theory	3.0	√	√	√	√		√						
	IPE 0715 4245	Theory	3.0	√		√	√								
	IPE 0788 4249	Theory	3.0	√	√		√		√						
Optional-IV	IPE 0788 4251	Theory	3.0	√	√		√			√		√			
	IPE 0688 4253	Theory	3.0	√			√				√		√	√	√
	IPE 0788 4255	Theory	3.0	√		√	√				√				
IPE 0788 4190		Project/Thesis	3.0	√	√		√		√	√	√		√		√
IPE 0031 4250		Comprehensive Viva	0.5						√	√					
IPE 0031 4260		Industrial Training-II	1.0	√	√				√	√			√		

PART: B

17. Structure of the Curriculum

a) Duration of the program: Years: *Four* Semesters: *Eight*

b) Admission Requirements:

As per the rules and regulations set by academic council, SUST. In order to be eligible for the admission test for the Department of Industrial and Production Engineering, a student must have completed the national curriculum with a cumulative grade point average (CGPA) of at least 3.50 (both in S.S.C. and H.S.C./equivalent, science background), and the total CGPA for S.S.C. and H.S.C./equivalent, science background should be 8.00. A candidate passing through G.C.E system must have at least B grade in 3 subjects and pass in 5 subjects at O level, and B grade in 2 subjects and pass in 3 subjects at A level to qualify. In addition, a student must satisfy an additional requirement; at least GPA 3.5 (H.S.C/Equivalent) or B grade (G.C.E A level) in Physics and Mathematics.

c) Graduating credits: *162 credits*

d) Total class weeks in a semester: 14 weeks

e) Minimum CGPA requirements for graduation: 2.00

f) Maximum academic years of completion: 6 years

g) Category of Courses:

Course Category	Course Type	Course Title	Credits
General Education (GED) Courses	Theory	1. General Physics 2. Differential Calculus and Solid Geometry 3. History of the Emergence of Independent Bangladesh 4. Effective Communication in English 5. Integral Calculus and Differential Equations 6. Process Technology 7. General Chemistry 8. Vectors, Matrices, and Laplace Transformation 9. Introduction to Circuit Analysis and Electrical Machines 10. Principles of Economics 11. Measurement and Instrumentation	31
	Sessional	12. English Language Lab 13. Chemistry Practical 14. Basic Physics Sessional 15. Introduction to Circuit Analysis and Electrical Machines Lab 16. Python Programming Lab	9.5
		17. Measurement and Instrumentation Sessional	
Core/ Compulsory Courses	Theory	18. Manufacturing Processes – I 19. Engineering Mechanics 20. Engineering Materials 21. Mechanics of Solids 22. Thermodynamics and Heat Transfer 23. Mechanics of Machinery 24. Fluid Mechanics and Machinery 25. Engineering Economy 26. Engineering Statistics 27. Numerical Analysis and Optimization 28. Ergonomics and Industrial Safety 29. Quality Control and Management 30. Product Design and Development 31. Facilities Planning and Material Handling 32. Industrial Management 33. Operations Management 34. Operations Research 35. Manufacturing Process- II 36. System Modeling and Simulation 37. Supply Chain Management 38. Machine Tools and Machining 39. Project Management 40. Production System Optimization	70
	Sessional	41. Workshop Practice 42. Engineering Graphics 43. Professional Development Seminar 44. Manufacturing Processes – I Sessional 45. Machine Shop Practice 46. Comprehensive Viva-I 47. Engineering Materials Sessional 48. Computer Aided Drawing-I 49. Machine Drawing 50. Mechanics of Solid Sessional 51. Fluid Mechanics and Machinery Sessional 52. Computer Aided Drawing -II 53. Comprehensive Viva-II 54. Numerical Analysis Sessional 55. Product Design and Development Sessional 56. Ergonomics Sessional 57. Manufacturing Process- II Sessional 58. Operations Management and QCM Sessional 59. Business Communication Seminar 60. Comprehensive Viva-III 61. System Modeling and Simulation	31

		Sessional 62. Machine Tools Sessional 63. Advanced Manufacturing System Sessional 64. Comprehensive Viva	
Optional/ Elective Courses	Theory	65. Advanced Manufacturing System 66. Micro and Nano Manufacturing Techniques 67. Marketing and Cost Management 68. Organizational Behavior 69. Industrial Psychology and Industrial Laws 70. Reliability Engineering and Maintenance Management 71. Tool Engineering 72. CAD and Virtual Reality 73. Robotics and Control System 74. Entrepreneurship Development and Technology Management 75. Data Analytics	30
Capstone course/Internship /Thesis/Projects/ Portfolio	Sessional	76. Industrial Tour 77. Industrial Training- I 78. Project and Thesis 79. Industrial Training – II	8.5
Total		**79 courses**	**162.00**

18. Description of all courses of the program

a. First Year: 1st Semester

Course No.	Course Title	Hours/Week		Credits
		Theory	Lab	
IPE 0715 1141	Manufacturing Processes - I	3	0	3.0
PHY 0533 1107G	General Physics	3	0	3.0
MAT 0541 1103G	Differential Calculus and Solid Geometry	3	0	3.0
SSS 0222 1100G	History of the Emergence of Independent Bangladesh	3	0	3.0
ENG 0231 1101G	Effective Communication in English	2	0	2.0
ENG 0231 1102G	English Language Lab	0	2	1.0
IPE 0715 1144	Workshop Practice	0	3	1.5
IPE 0732 1122	Engineering Graphics	0	3	1.5
IPE 0488 1152	Professional Development Seminar	0	2	1.0
Total		14	10	19.0

b. First Year: 2nd Semester

Course No.	Course Title	Hours/Week		Credits
		Theory	Lab	
IPE 0715 1221	Engineering Mechanics	3	0	3.0
IPE 0715 1223	Engineering Materials	3	0	3.0
MAT 0541 1204G	Integral Calculus and Differential Equations	3	0	3.0
CEP 0711 1201G	Chemical Process Technology	2	0	2.0
CHE 0531 1201G	General Chemistry	3	0	3.0
CHE 0531 1202G	Chemistry Practical	0	3	1.5
IPE 0715 1242	Manufacturing Processes – I Sessional	0	3	1.5
IPE 0715 1246	Machine Shop Practice	0	3	1.5
PHY 0533 1202G	Basic Physics Sessional	0	3	1.5
IPE 0031 1250	Comprehensive Viva-I	-	-	0.5
Total		14	12	20.5

c. Second Year: 1st Semester

Course No.	Course Title	Hours/Week		Credits
		Theory	Lab	
IPE 0715 2121	Mechanics of Solids	3	0	3.0
IPE 0715 2123	Thermodynamics and Heat Transfer	4	0	4.0
MAT 0541 2107G	Vectors, Matrices, and Laplace Transformation	3	0	3.0
EEE 0713 2103G	Introduction to Circuit Analysis and Electrical Machines	3	0	3.0
ECO 0311 2105G	Principles of Economics	3	0	3.0
EEE 0713 2104G	Introduction to Circuit Analysis and Electrical Machines Lab	0	3	1.5
IPE 0715 2124	Engineering Materials Sessional	0	3	1.5
IPE 0788 2142	Computer Aided Drawing-I	0	3	1.5
IPE 0788 2144	Machine Drawing	0	3	1.5
Total		15	15	22.0

d. Second Year: 2nd Semester

Course No.	Course Title	Hours/Week		Credits
		Theory	Lab	
IPE 0715 2225	Mechanics of Machinery	3		3.0
IPE 0715 2227	Fluid Mechanics and Machinery	3		3.0
IPE 0412 2231	Engineering Economy	3		3.0
IPE 0542 2251	Engineering Statistics	3		3.0
CSE 0613 2206G	Python Programming Lab		6	3.0
IPE 0715 2222	Mechanics of Solid Sessional	0	3	1.5

IPE 0715 2228	Fluid Mechanics and Machinery Sessional		3	1.5
IPE 0788 2246	Computer Aided Drawing -II		3	1.5
IPE 0031 2250	Comprehensive Viva-II			0.5
IPE 0031 2260	Industrial Tour (Selected by IPE Dept.)	-----	----	0.5
Total		14	10	20.5

e. Third Year: 1st Semester

Course No.	Course Title	Hours/Week		Credits
		Theory	Lab	
IPE 0541 3121	Numerical Analysis and Optimization	3		3.0
IPE 1022 3131	Ergonomics and Industrial Safety	3		3.0
IPE 0413 3133	Quality Control and Management	3		3.0
IPE 0788 3151	Product Design and Development	3		3.0
IPE 0788 3153	Facilities Planning and Material Handling	3		3.0
IPE 0541 3122	Numerical Analysis Sessional		3	1.5
IPE 1022 3132	Ergonomics Sessional		3	1.5
IPE 0788 3152	Product Design and Development Sessional		3	1.5
Total		15	9	19.5

f. Third Year: 2nd Semester

Course No.	Course Title	Hours/Week		Credits
		Theory	Lab	
IPE 0413 3235	Industrial Management	3		3.0
IPE 0788 3237	Operations Management	3		3.0
IPE 0541 3239	Operations Research	3		3.0
IPE 0715 3241	Manufacturing Processes - II	3		3.0
MEE 0714 3203G	Measurement and Instrumentation	3		3.0
IPE 0031 3260	Industrial Training- I (selected by IPE dept.)	2 weeks		1.0
IPE 0715 3242	Manufacturing Processes- II Sessional		3	1.5
IPE 0788 3236	Operations Management and QCM Sessional		3	1.5
MEE 0714 3204G	Measurement and Instrumentation Sessional		2	1.0
IPE 0031 3254	Business Communication Seminar		2	1.0
IPE 0031 3250	Comprehensive Viva-III			0.5
Total		15	11	21.5

g. Fourth Year: 1st Semester

Course No.	Course Title	Hours/Week		Credits
		Theory	Lab	
IPE 0788 4131	System Modeling and Simulation	3		3.0
IPE 0413 4133	Supply Chain Management	3		3.0
IPE 0715 4141	Machine Tools and Machining	3		3.0
Optional-I	Selected from Prescribed Optional Subjects	3		3.0
Optional-II	Selected from Prescribed Optional Subjects	3		3.0
IPE 0788 4190	Project and Thesis		6	3.0
IPE 0788 4132	System Modeling and Simulation Sessional		3.0	1.5
IPE 0715 4142	Machine Tools Sessional		3.0	1.5
IPE 0715 4144	Advanced Manufacturing System Sessional		3.0	1.5
Total		15	15	22.5

Optional I

Course No.	Course Title	Hours/Week		Credits
		Theory	Lab	
IPE 0715 4143	Advanced Manufacturing System	3		3.0
IPE 0715 4145	Micro and Nano Manufacturing Techniques	3		3.0

Optional II

Course No.	Course Title	Hours/Week		Credits
		Theory	Lab	
IPE 0488 4136	Marketing and Cost Management	3		3.0
IPE 0413 4137	Organizational Behavior	3		3.0
IPE 0788 4138	Industrial Psychology and Industrial Laws	3		3.0

h. Fourth Year: 2nd Semester

Course No.	Course Title	Hours/Week		Credits
		Theory	Lab	
IPE 0788 4235	Project Management	3		3.0
IPE 0788 4239	Production System Optimization	3		3.0
Optional-III	Selected from Prescribed Optional Subjects	3		3.0
Optional-IV	Selected from Prescribed Optional Subjects	3		3.0
IPE 0788 4190	Project and Thesis (continuation)		6	3.0
IPE 0031 4250	Comprehensive Viva			0.5

IPE 0031 4260	Industrial Training – II (Selected By IPE Dept.)	One Month		1.0
Total		12	6	16.5

Optional III

Course No.	Course Title	Hours/Week		Credits
		Theory	Lab	
IPE 0788 4234	Reliability Engineering and Maintenance Management	3		3.0
IPE 0715 4245	Tool Engineering	3		3.0
IPE 0788 4249	CAD and Virtual Reality	3		3.0

Optional IV

Course No.	Course Title	Hours/Week		Credits
		Theory	Lab	
IPE 0788 4251	Entrepreneurship Development and Technology Management	3		3.0
IPE 0688 4253	Data Analytics	3		3.0
IPE 0788 4255	Robotics and Control System	3		3.0

NOTE: All courses offered by the department are compulsory to obtain the degree.

PART: C

Description of all courses

a. Summary, Mapping PO vs CO and Teaching strategy of all courses

First Year First Semester

Course No.: IPE 0715 1141	**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, which 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
- facilitate the 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 skills in identifying, formulating, and solving the real-life manufacturing problems
- 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, COs
After successful completion of the course, students will be able to:

CO 1: explain the concept of manufacturing, manufacturing systems, and cost elements linked to manufacturing;

CO 2: describe various manufacturing processes, including the machining, welding, and casting processes and the defects associated with welding and casting;

CO 3: differentiate various machining processes, welding processes, and casting processes from one another;
CO 4: apply the engineering fundamental and specialized knowledge to solve various real-life machining problems;
CO 5: prepare a manufacturing plan, including the list of manufacturing processes and their operational sequence, required for fabricating a particular product.

Mapping of COs with POs

Course Learning Outcomes (CO)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1	2											
CO 2	2	1										
CO 3		2										
CO 4	3	2										
CO 5				2							2	

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using projectors, Tutorial, and Assignment	Assignment, Midterm Exam 1, and Semester-end Exam
CO 2	Lecture using projectors	Quiz and Semester-end Exam
CO 3	Lecture using projectors, Tutorial and Assignment	Assignment, Midterm Exam 2, and Semester-end Exam
CO 4	Lecture using projectors and video demonstration	Midterm Exam 2, and Semester-end Exam
CO 5	Lecture using projectors and Assignment	Assignment and Semester-end Exam

Books Recommended:

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

Course Code: PHY 0533 1107G	**Credits:** 3.0	**Year:** First	**Semester:** First
Course Title: General Physics		**Course Status:** 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. This course includes the concepts of structure of matter, waves and oscillations, optics and electromagnetism relevant to their field.

Course Objectives:
The objectives of this course are to:

- accumulate basic idea of solid including structure types, packing fraction and crystallography.
- to introduce and describe the free damped and forced oscillations, and propagations and velocity of longitudinal waves in gaseous mediums.
- to acquire basic knowledge about nature and propagation of light, geometrical optics and interference of light.
- to develop a basic understanding about Electromagnetism.

Course Content:
Structure of Matter: classifications of solids, amorphous, crystalline, atomic arrangement in solids, lattice, basis and crystal structure, unit cell, different types of crystal structure, packing fraction of sc, bcc, fcc and hcp lattices, X-ray diffraction and Bragg's law. **Waves and Oscillations:** simple harmonic oscillations, damped oscillations, force oscillations and resonance. Progressive wave, propagation and velocity of longitudinal wave in gaseous medium. **Optics:** nature and propagation of light, combinations of lenses, equivalent focal length, power of lens, Huygen's principle, superposition principle, interference of light, Young's experiments, Newton's rings. **Electromagnetism:** Coulomb law, electric field, Gauss's law and its applications, electric potential and potential energy. Magnetic field, field strength, Biot-Savart law and its applications, magnetic force on a charge and current, Ampere's law and its applications, Faraday and Lenz law.

Course Learning Outcomes, COs
After the successful completion of the course, students will be able to:

CO 1: describe basic structures of solids, its types including packing fraction and apply Bragg's law;
CO 2: explain different oscillatory motion, wave propagations and evaluate related physical quantities;
CO 3: analyze the laws of optics for evaluation of optical systems;
CO 4: evaluate electrostatic properties of simple charge distributions using Coulomb's and Gauss's law and magnetic field for moving charge, steady currents;
CO 5: apply Biot-Savart and Ampere's laws

Mapping of the COs with POs

Course Learning Outcomes (CO)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO 1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1	3											
CO 2	2	1										
CO 3	2											
CO 4	2											
CO 5	2		1									

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using projectors, Tutorial, and Assignment	Assignment, Midterm Exam 1, and Semester-end Exam
CO 2	Lecture using projectors, Tutorial, and Assignment	Assignment, Midterm Exam 1, and Semester-end Exam
CO 3	Lecture using projectors, Tutorial, and Assignment	Assignment, Midterm Exam 2, and Semester-end Exam
CO 4	Lecture using projectors, Tutorial, and Assignment	Assignment, Midterm Exam 2, and Semester-end Exam
CO 5	Lecture using projectors, Tutorial, and Assignment	Assignments and Semester-end Exam

Recommended Books

1. Gias Uddin Ahmed: *Physics for Engineers (Part-I and Part-II)*
2. Halliday, D. and Resnick R.: *Physics (Vol. I and II)*
3. Halliday, D, Resnick, R and Walker, J: *Fundamental of Physics*
4. Puri, S. P.: *Fundamental of vibrations and waves*
5. N. Subrahmanyam, Brijlal, M. N. Avadhanulu*: A textbook of Optics*
6. Jenkins and White: *Fundamental of Optics*
7. Kip, A.: *Fundamental of Electricity and Magnetism*
8. Sears , Zemnasky and Young: *University Physics*

Course No.: MAT 0541 1103G	Credit: 3.0	Year: First	Semester: First
Course Title: Differential Calculus and Solid Geometry		Course Status: Theory	

Rationale of the Course:

This course is about the basic mathematics that is a fundamental and essential component in all streams of undergraduate studies in the sciences and engineering field. After studying this course, students will have the ability to apply the basic principles and techniques of differential calculus and geometry to the solution of various practical problems.

Course Objectives:

The objectives of this course are to:

- make the students interested in 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 for solving the problems and their 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, COs

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

CO 1: explain the concepts of limit, continuity, and differential coefficients of various functions;

CO 2: compute the derivatives of trigonometric functions, take higher derivatives, and solve real-life problems with their related rates;

CO 3: apply Leibnitz's, Rolle's, Mean Value theorem and various forms of Taylor's theorems in finite and infinite forms;

CO 4: use the first and second derivative tests, concavity, points of inflection, asymptotes, and limits at infinity to sketch the graph of a function;

CO 5: apply the Cartesian, spherical, polar, and cylindrical coordinate systems to solve engineering problems.

Mapping of COs with POs

Course Learning	Fundamental Skills	Social Skills	Thinking Skills	Personal Skills

Outcomes (CO)	PO 1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1	2											
CO 2	2											
CO 3		3										
CO 4	1	2										
CO 5	1	2										

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board, projector, Assignment, Tutorials	Quiz, Short answer, Midterm Exam 1, and Semester-end Exam
CO 2	Lecture using board, projector, Assignment, Tutorials	Assignment and Semester-end Exam
CO 3	Lecture using board, projector, Assignment, Tutorials	Problem solving task cards, Assignment, Midterm Exam 1, and Semester-end Exam
CO 4	Lecture using board, projector, Assignment, Tutorials	Quiz, Midterm Exam 2, and Semester-end Exam
CO 5	Lecture using board, projector, Assignment, Tutorials	Quiz, Midterm Exam 2 and Semester-end Exam

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.

Course No.: SSS 0222 1100G	Credit: 3.0	Year: First	Semester: First
Course Title: History of the Emergence of Independent Bangladesh			Course Status: Theory

Rationale of the Course:

This course deals with the interrelated themes of land and people, politics, economy, governance, society, religion and culture, global connections as well as the basic topics of the freedom struggle and the War of Liberation. It will develop insights into the historical changes, the long struggle for freedom, and above all, the War of Independence led by the Father of the Nation, Bangabandhu Sheikh Mujibur Rahman, that has shaped today's Bangladesh.

Course Objectives:

The objectives of this course are to:

- provide students with an overview of the historical emergence of Bangladesh
- help students develop insights into the historical changes towards the building of an independent nation
- facilitate students' learning of the long struggle for the freedom of the country
- foster students' knowledge of the War of Independence led by the Father of the Nation Bangabandhu Sheikh Mujibur Rahman has 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, COs

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

- **CO 1:** explain the understanding of the historical emergence of Bangladesh;
- **CO 2:** communicate the knowledge concerning the context of historical change toward the building of an independent nation;
- **CO 3:** explain the reasons behind the war of independence in Bangladesh;
- **CO 4:** interpret the right understating of the role of the Father of the Nation Bangabandu Sheikh Mujibur Rahman during the emergence of Bangladesh.

Mapping of COs with POs

Course Learning Outcomes (CO)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO 1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1					2	1						
CO 2							1					
CO 3						1						
CO 4					2							2

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture and Visual Presentation	Class Participation and Final exam
CO 2	Lecture and Class Discussion	Class Participation and Midterm exam-1
CO 3	Lecture and Visual Presentation	Class Participation, Midterm exam-2 and Final exam
CO 4	Lecture and Class Discussion	Assignment and Final exam

Books Recommended

১. Ahmed, Salahuddin and Bazlul Mobin Chowdhury (eds.), *Bangladesh: National Culture and Heritage: An Introductory Reader* (Dhaka: Independent University Bangladesh, 2004)

২. Harun-or-Roshid, *The Foreshadowing of Bangladesh: Bengal Muslim League and Muslim Politics, 1906-1947* (Dhaka : The University Press Limited, 2012)

৩. Jahan Rounaq, *Pakistan: Failure in National Integration,(Dhaka :* The University Press Limited, 1977)

৪. Maniruzzaman Talukder, *Radical Politics and the Emergence of Bangladesh, (Dhaka :* Mowla,Brothers, 2003)

৫. Muhith, A M A, *History of Bangladesh: A Subcontinental Civilization*, (Dhaka: UPL, 2016)

৬. Samad Abdus, *History of Liberation War of Bangladesh*, (Dhaka : Aparajeyo Bangla Prakashani, 2019)

৭. Milton Kumar Dev, Md. Abdus Samad, *History of Bangladesh* (Dhaka : Biswabidyalya Prokasoni, 2014)

৮. Schendel, Willem van : *A History of Bangladesh* (Cambridge: Cambridge University Press, 2009)

৯. শেখ মুজিবুর রহমান : *অসমাপ্ত আত্মজীবনী, (*ঢাকা : দি ইউনিভার্সিটি প্রেসলিমিটেড, ২০১২)

১০. নীহাররঞ্জনরায় : *বাঙালীর ইতিহাস, (*কলকাতা : দে' জ পাবলিশিং, ১৪০২ সাল)

১১. সালাহ্ উদ্দিন আহমেদ ও অন্যান্য (সম্পাদিত), *বাংলাদেশের মুক্তি সংগ্রামের ইতিহাস* ১৯৪৭-১৯৭১, (ঢাকা : আগামী প্রকাশনী, ২০০২)

১২. আবুল মাল আবদুল মুহিত : *বাংলাদেশ: জাতিরাষ্ট্রের উদ্ভব, (ঢাকা :* সাহিত্য প্রকাশ, ২০০০)

১৩. সিরাজুল ইসলাম (সম্পাদিত), *বাংলাদেশের ইতিহাস ১৭০৪-১৯৭১,* ৩ খন্ড, (ঢাকা : এশিয়াটিক সোসাইটি অব বাংলাদেশ, ১৯৯২)

১৪. হারুন-অর-রশিদ : *বঙ্গীয় মুসলিম লীগ পাকিস্তান আন্দোলন বাঙালির রাষ্ট্রভাবনা ও বঙ্গবন্ধু,* (ঢাকা : অন্য প্রকাশন, ২০১৮)

১৫. হাসান হাফিজুর রহমান : *বাংলাদেশের স্বাধীনতাযুদ্ধ দলিলপত্র,* (সম্পাদিত), (ঢাকা: গণপ্রজাতন্ত্রী বাংলাদেশ সরকার, ১৯৮৫)

১৬. সৈয়দ আনোয়ার হোসেন : *বাংলাদেশের স্বাধীনতাযুদ্ধে পরাশক্তির ভূমিকা,* (ঢাকা : ডানা প্রকাশনী, ১৯৮২)

১৭. মুনতাসীর মামুন ও অন্যান্য, *স্বাধীন বাংলাদেশের অভ্যুদয়ের ইতিহাস,* (ঢাকা: সুবর্ণ, ২০১৭)

১৮. আবু মো দেলোয়ার হোসেন, *স্বাধীন বাংলাদেশের অভ্যুদয়ের ইতিহাস,* (ঢাকা : বিশ্ববিদ্যালয় প্রকাশনী, ২০১৪)

১৯. আশফাক হোসেন, *স্বাধীন বাংলাদেশের অভ্যুদয়ের ইতিহাস,* (ঢাকা: প্রতিশূণ্য প্রকাশন, ২০১৯)

২০. আবু মো দেলোয়ার হোসেন, *বাংলাদেশের ইতিহাস, ১৯০৫-১৯৭১,*

২১. আশফাক হোসেন : *বাংলাদেশের মুক্তিযুদ্ধ ও জাতিসংঘ,* (ঢাকা: বাংলা একাডেমি, ২০০৩)

২২. আবু মো. দেলোয়ার হোসেন, ড. মোহাম্মদ সেলিম (সম্পাদনা) : *বাংলাদেশ ও বহির্বিশ্বে, (*ঢাকা : বাংলাদেশ ইতিহাস সমিতি, ২০১৫)

২৩. আশফাক হোসেন, *বাংলাদেশের মুক্তিযুদ্ধ ও ইন্দ্রিরা গান্ধী* (ঢাকা : সুবর্ণ প্রকাশনী, ২০১৭)

Course No.: ENG 0231 1101G	Credit: 2.0	Year: First	Semester: First
Course Title: Effective Communication in English		Course Status: Theory	

Rationale of the Course:

This course is expected to 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 and 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, COs
After successful completion of the course, students will be able to:

CO 1: apply grammar rules
CO 2: express oneself correctly by using appropriate words, phrases, sentences or ideas
CO 3: critically reflect on a text (grasp abstract ideas and interpret them effectively, arrive at well-reasoned conclusions and solutions)
CO 4: Create using earned knowledge both independently and in collaboration with peer groups
CO 5: demonstrate a comprehension of subject knowledge and its subsequent use.

Mapping of the COs with POs

Course Learning Outcomes (CO)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO 1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1						1	2					
CO 2							2					
CO 3							3					
CO 4						1					2	
CO 5							1				1	

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/projectors, Tutorial, Assignment, and Self-learning	Assignment, Quiz, Midterm Exam 1, and Semester-end Exam
CO 2	Lecture using board/projectors, Tutorial, Assignment, and Self-learning	Assignment, Midterm Exam 1, Presentation, and Semester-end Exam
CO 3	Lecture using board/projectors, Tutorial, Assignment, and Self-learning	Assignment, Presentation and Semester-end Exam
CO 4	Tutorial and Assignment	Presentation
CO 5	Lecture using board/projectors, Tutorial, Assignment, Self-learning, field demonstration	Quiz, Midterm Exam 2, and Semester-end Exam

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.

Course No.: ENG 0231 1102	Credit: 1.0	Year: First	Semester: First
Course Title: English Language Lab		Course Status: Sessional	

Rationale of the Course:
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, COs
After successful completion of the course, students will be able to:
CO 1: identify the symbols of the International Phonetic Alphabet used to represent the sounds of the English language
CO 2: apply appropriate intonation and stress patterns in English words and sentence
CO 3: interpret information accurately
CO 4: produce continuous speech clearly and convincingly.

Mapping of the COs with POs

Course Learning Outcomes (CO)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO 1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1							1					
CO 2							3					
CO 3						1	2					
CO 4						2						

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/projectors, Tutorial, Assignment, and Self-learning	Assignment, Quiz, and Semester-end Exam
CO 2	Lecture using board/projectors, Tutorial, Assignment, and Self-learning	Assignment, Presentation, and Semester-end Exam
CO 3	Lecture using board/projectors, Tutorial, Assignment, and Self-learning	Assignment and Presentation
CO 4	Lecture using board/projectors, Tutorial, Assignment, Self-learning, and field demonstration	Semester-end Exam

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. Jones, Daniel. Cambridge English Pronunciation Dictionary. Cambridge University Press.
5. Richards J, et al. Person to Person. Oxford University Press.
6. Richards, Jack C, and David Bohlke. Speak Now: 1. Oxford University Press.
7. Roach, Peter. English Phonetics and Phonology. Cambridge University Press.

Course Code: IPE 0715 1144	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 that is essential for further study of the engineers. It provides practical knowledge about different hand tools and machine tools. Overall, students 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 students performing teamwork.

Course Content:
Introduction to hand tools; Study and operation of an Engine Lathe; Study and operation of a milling machine; Study and operation of a drilling machine; Study and operation of a surface grinding machine; Preparation of a hexagonal nut.

Course Learning Outcomes, COs
After the successful completion of the course, students will be able to:
CO 1: identify different types of hand tools and their purposes

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

Mapping of COs with POs

Course Learning Outcomes (CO)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO 1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1	3	2										
CO 2	3											
CO 3	3	2										
CO 4											1	
CO 5						2	1					

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board and Instruction materials, Practical demonstration, Hands on practice	Quiz, Report evaluation, Oral examination
CO 2	Lecture using board and Instruction materials, Practical demonstration, Hands on practice	Quiz, Report evaluation, Oral examination
CO 3	Lecture using board and Instruction materials, Practical demonstration, Hands on practice	Quiz, Report evaluation, Oral examination
CO 4	Instruction materials, Practical demonstration, Hands on practice	Quiz, Report evaluation
CO 5	Instruction materials, Practical demonstration, Hands on practice	Quiz, Report evaluation

Books Recommended:

1. Mikell P. Groover, Fundamentals of Modern Manufacturing Materials, Processes, and Systems, John Wiley & Sons, Inc.
2. Serope Kalpakjian and Stevan R. Schmid, Manufacturing Engineering and Technology, Prentice Hall.

3. J.T. Black and Ronald A. Kohser, DeGarmo's Materials and Processes in Manufacturing, John Wiley & Sons, Inc.

Course No.: IPE 0732 1122	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 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, COs
Upon successful completion of this course, student will be able to:
CO 1: explain basic concepts of engineering drawing as an important form of conveying technical information;
CO 2: apply principles of engineering visualization and projection theory to prepare mechanical engineering drawings (2D and 3D), using conventional and modern drawing tools;
CO 3: practice drawing orthographic projection, sectional views, and isometric views of different mechanical parts;
CO 4: create a review report on mechanical components drawing using the engineering drawing-specific knowledge and skill for the multidisciplinary design team comprised of engineering professionals.

Mapping of COs with POs

Course	Fundamental	Social Skills	Thinking	Personal Skills

Learning Outcomes (CO)	Skills							Skills				
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1	1											
CO 2	3											
CO 3				3								
CO 4							3					

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board and Instruction materials	Quiz and Semester-end oral examination
CO 2	Lecture using board and Tutorial	Quiz, Drawing assessment, and Semester-end oral examination
CO 3	Lecture using board and Tutorial	Quiz, Drawing assessment, and Semester-end oral examination
CO 4	Lecture using board and Assignment	Quiz and Semester-end oral examination

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.

Course No: IPE 0488 1152	Credit: 1.0	Year: First	Semester: First
Course Title: Professional Development Seminar		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. This course 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 including introduction, goal, significance, and purpose of communication. Communication dimensions, channels, and functions, communication barriers and filters in the workplace. This course will cover two main 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 writing, for instance, assignment, report for sessional courses, CV, and discussion in various aspects.

Course Learning Outcomes, COs

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

CO 01: utilize analytical and problem-solving skills appropriate to business communication

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

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

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

CO 05: prepare a professional presentation using computer technology.

Mapping of COs with POs

Course Learning Outcomes (CO)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1		1										
CO 2							2					
CO 3							2			1		1
CO 4						2	3					
CO 5							2					1

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/projectors	Continuous assessment, Quiz
CO 2	Lecture using board/projectors/project record	Continuous assessment
CO 3	Lecture using board/projectors/ Self-learning	Quiz/Assignment
CO 4	Lecture using board/projectors/ Self-learning	Presentation
CO 5	Lecture using board/projectors/ Self-learning	Presentation

Books Recommended:
Reference materials will be supplied by the course teacher.

First Year Second Semester

Course No.: IPE 0715 1221	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 (statics and dynamics) essential for engineering students. It focuses on the modeling and analyzing of static equilibrium as well as dynamic concepts based on real life engineering applications and necessary problem-solving knowledge.

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

CO 1: apply the basic principles of mechanics to analyze and solve real life engineering problems
CO 2: evaluate different structures under various loading conditions (static and dynamic)
CO 3: analyze the effects of friction on a body
CO 4: evaluate the different laws of a static/moving body (work, energy, momentum, etc.) in real life context
CO 5: apply the knowledge to analyze and solve problems related to kinematics and kinetics.

Mapping of COs with POs

Course Learning Outcomes (CO)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1	3	1										
CO 2		2		1								
CO 3	2	1										
CO 4	3	1										
CO 5	2	2		2								

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/projectors	Assignment, Midterm Exam 1, and Semester-end Exam
CO 2	Lecture using board/ projectors, tutorials and Assignment	Assignment, Midterm Exam 1, and Semester-end Exam
CO 3	Lecture using board, tutorials and Assignment	Assignment, Midterm Exam 2, and Semester-end Exam
CO 4	Lecture using board/ projectors and tutorials	Assignment and Semester-end Exam
CO 5	Lecture using board/ projectors and Assignment	Assignment, Midterm Exam 2, and Semester-end Exam

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

Course No: IPE 0715 1223	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 including advanced materials, Mechanical and other important properties, Structures of materials; Material testings: Mechanical and non-destructive tests of materials; Phase diagrams: Binary and ternary phase diagrams (e.g. Iron-carbon equilibrium diagram); Heat treatment processes: Annealing, normalizing, quenching, tempering; Surface hardening processes: Case hardening (carburizing, nitriding etc.), flame hardening and induction hardening; 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; Common light metals and their alloys; Superalloys; 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, COs

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

CO 1: describe engineering materials, different crystal structures, different mechanical properties, fundamentals of carbon steel, light metal alloy and super alloys, production processes and uses of pig iron, cast iron, steel and composite materials

CO 2: explain the appropriate mechanical and non-destructive testing procedures to determine specific mechanical properties to investigate a product

CO 3: evaluate the mechanical properties of metals and their alloys using the knowledge of stress-strain and phase diagrams

CO 4: distinguish various heat treatment processes e.g., annealing, normalizing, quenching, tempering, surface hardening etc. with one another

CO 5: apply the knowledge of engineering materials (ferrous and non-ferrous alloys and composites) in real-life problems

Mapping of COs with POs

Course Learning Outcomes (CO)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1	3											
CO 2	1	2										
CO 3	2	2		1								
CO 4	2	1										
CO 5	2			2								1

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/projectors, Assignment	Quiz, Midterm Exam 1, and Semester-end Exam, Assignment
CO 2	Lecture using board/projectors, Assignment	Quiz, Midterm Exam 2, and Semester-end Exam, Assignment
CO 3	Lecture using board/projectors, Assignment/ tutorial	Quiz, Midterm Exam 1, and Semester-end Exam, Assignment
CO 4	Lecture using board/projectors, Assignment/ tutorial	Quiz, Midterm Exam 2, and Semester-end Exam, Assignment
CO 5	Lecture using board/projectors,	Semester-end Exam,

	Project	Report

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.

Course No.: MAT 0541 1204G	**Credit: 3.0**	**Year: First**	**Semester: Second**
Course Title: Integral Calculus and Differential Equations			**Course Status: Theory**

Rationale of the Course:

The combination of integral calculus and differential equations is a basic requirement to solve various integrals and differential equations for science and engineering students. It will provide the students with a solid foundation for further study in engineering.

Course Objectives:

The objectives of this course are to:

- 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;
- apply integration techniques in evaluating area of the surface, length of the curves and volume of a solid in cartesian and polar coordinates system;
- 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, COs

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

- **CO 1:** evaluate the indefinite, definite, and improper integrals;
- **CO 2:** solve ordinary differential equations of first and second order using different methods;
- **CO 3:** apply the ideas of accumulation to calculate areas and volumes;
- **CO 4:** create differential equations in different areas of science and engineering;
- **CO 5:** apply the concepts of ordinary differential equations for solving engineering problems by choosing the most suitable method.

Mapping of COs with POs

Course Learning Outcomes (CO)	**Fundamental Skills**				**Social Skills**			**Thinking Skills**		**Personal Skills**		
	PO1	**PO2**	**PO3**	**PO5**	**PO6**	**PO9**	**PO10**	**PO4**	**PO7**	**PO8**	**PO11**	**PO12**
CO 1	2											
CO 2	3											
CO 3	1	3										
CO 4		2		2								
CO 5	3			1								

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	**Teaching-Learning Strategy**	**Assessment Strategy**
CO 1	Lecture using board/projectors	Quiz, Short answer, Midterm Exam 1, and Semester-end Exam
CO 2	Lecture using board/projectors	Assignment and Semester-end Exam
CO 3	Lecture using board/projectors, Group work	Problem solving task cards, Assignment, Midterm Exam 1, and Semester-end Exam
CO 4	Lecture using board/projectors, audio-visual tutorial	Quiz, Midterm Exam 2, and Semester-end Exam
CO 5	Lecture using board/projectors	Quiz, Midterm Exam 2 and Semester-end Exam

Books Recommended:

1. G.B. Thomas and R.L. Finney, Calculus and Analytic Geometry, Addition-Wesley.
2. W.E. Boyce and R.C. DiPrima, Elementary Differential Equations and Boundary Value Problems, John Wiley & Sons, Inc.

Course No: CEP 0711 1201G	Credit: 2.0	Year: First	Semester: Second
Course Title: Chemical Process Technology		Course Status: Theory	

Rationale of the Course:
Chemical process technology is an integral component of engineering education. A production engineer must possess a general view on different types of chemical productions, processes and equipment being under operations in plants. The aim of the course is to provide knowledge about processes in various chemical industries.

Course Objectives:
The objectives of this course are to:

- familiarize with different types of chemical industries
- help the students understand the manufacturing technology such as glass and ceramics, soap and detergents, fertilizers, and cement
- provide necessary knowledge to perceive the process flow diagram and various process parameters
- develop the skills to identify and solve engineering problems of chemical industries.

Course Content:
Glass industries: History of development of glass industries composition, raw materials, properties and uses of different types of glasses, manufacturer of glass, special glasses.
Ceramic industries: Types of ceramic products, Basic raw materials, White wares, manufacturer of porcelain, types of clay, clay preparation, firing, different stages of firing, Chemical conversion including basic ceramic industry, manufacture of refractories.
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, COs
After successful completion of the course, students will be able to:

CO 1: discuss the basic principles of selected chemical processes
CO 2: draw and analyze the flow diagrams of chemical processes
CO 3: analyze optimum operation of the manufacturing processes
CO 4: interpret the ways of quality control

CO 5: illustrate friction, wear, and practical importance of lubrication.

Mapping of COs with POs

Course Learning Outcomes (CO)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1	2											
CO 2	2											
CO 3		2		2								
CO 4		2										
CO 5		2										

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Class room lecture using board/projector and Assignment	Class evaluation, Assignment, Midterm Exam, and Semester-end Exam
CO 2	Class room lecture using board/projector, tutorial and Assignment	Class evaluation, Assignment, Midterm Exam, and Semester-end Exam
CO 3	Class room lecture using board/projector, homework	Class evaluation, Assignment, Midterm Exam, and Semester-end Exam
CO 4	Class room lecture using board/ projectors	Class evaluation, Assignment and Semester-end Exam
CO 5	Class room lecture using board/projector, homework,	Quiz test, Class evaluation, Assignment and Semester-end Exam

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

Course No: CHE 0531 1201G	Credit: 3.0	Year: First	Semester: Second
Course Title: General Chemistry		Course Status: Theory	

Rationale of the Course:
Students are expected to understand the structures, properties, and applications of atoms, molecules, and chemical compounds in the context of inorganic, organic and physical chemistry.

Course Objectives:
The objectives of this course are to:

- familiarize the students with the basic concept of electronic structure in atoms and molecules.
- acquire knowledge of the physical and chemical properties of elements in the periodic table
- analyze the properties of molecular compounds using various mathematical calculations and chemical formulas
- explain the basics of acid-base concepts and apply them to identify different acids and bases
- understand the various state and properties of materials
- introduce preliminary knowledge on reaction equilibrium and chemical kinetics
- acquaint students with the fundamental aspects and applications in various fields for organic compounds.

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

CO 1: outline the basic structural properties in atomic and molecular levels of atoms and molecules, respectively, using various recognized theories and laws

CO 2: describe the physical and chemical properties of metal and non-metal periodically

CO 3: analyze the properties of molecular compounds using various mathematical calculations through chemical formulas

CO 4: explain various properties of solid, liquid, and gaseous substances based on fundamental parameters in qualitative and quantitative contexts

CO 5: distinguish the chemical features and properties between inorganic and organic substances and describe their potential applications in various applied fields

Mapping of COs with POs

Course Learning Outcomes (CO)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1	3											
CO 2	3											
CO 3	2	2		1								
CO 4	3											
CO 5	1	1		2								

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using projectors/ and practical data demonstration	Assignment
CO 2	Lecture using projectors	Class test (Short questions and MCQ)
CO 3	Lecture using projectors and model demonstration	Final Exam (Short questions, MCQ, Quiz, Explanation)
CO 4	Lecture using projectors	Class test (Short questions and MCQ), presentation
CO 5	Lecture using projectors and Group discussion	Final Exam (Short questions, MCQ, Quiz, Explanation)

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*

Course No: CHE 0531 1202G	Credit: 1.5	Year: First	Semester: Second
Course Title: Chemistry Practical		Course Status: Practical	

Rationale of the Course:
This course is aimed at making students practically skilled in handling chemical compounds and it also focuses on understanding their properties.

Course Objectives:
The objectives of this course are to:

- familiarize students with qualitative identifications of cations and anions, and functional groups containing the inorganic and organic compounds, respectively
- demonstrate the recorded data in the report obtained from the laboratory
- accumulate practical skills 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, COs
After the successful completion of the course, students will be able to:

CO 1: use the aqueous solution of inorganic compounds accurately for the identification of cations and anions using necessary reagents
CO 2: identify the properties of various functional groups contained in the organic compounds
CO 3: acquire knowledge on the concentration of solution using titrimetric analysis
CO 4: analyze the recorded data in the report, and draw appropriate conclusions from the laboratory
CO 5: handle the chemicals and apparatus safely individually as well as in a group.

Mapping of COs with POs

Course Learning Outcomes (CO)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1		3										
CO 2	1	3										
CO 3	1	2										
CO 4							2					
CO 5			2			2						

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Apparatus demonstration and presenting MSDS	Lab Performance (group)
CO 2	Lectures, experiment demonstration	Lab Reports, Viva Voce
CO 3	Lectures and experiment demonstration	Lab Performance, Viva Voce
CO 4	Lectures and experiment demonstration	Lab Performance (individual), Written Examination
CO 5	Group work, demonstration	Lab Performance (group)

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.

Course No.: IPE 0715 1242	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 skills to perform various machining operations on the machine tools and get 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, COs
After the successful completion of the course, students will be able to:

CO 01: identify various components of an engine lathe, and surface grinding machine and describe their respective functions

CO 02: perform various machining operations on engine lathe, and surface grinding machine individually and record, calculate, and interpret the machining parameters

CO 03: distinguish among different types of welded joints as well as different types of welding techniques and interpret the characteristics of each

CO 04: practice team efforts to fabricate sand casting mould using the supplied patterns with desired specifications

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Mapping of COs with POs

Course Learning Outcomes (CO)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1		2										
CO 2	2	1										
CO 3	1	2										
CO 4						2						

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ projectors/experimental demonstration	Quiz, Report, Semester-end Exam and Viva
CO 2	Lecture using board/ projectors/experimental demonstration	Quiz, Report, Semester-end Exam and Viva
CO 3	Lecture using board/ projectors/experimental demonstration	Quiz, Report, Semester-end Exam and Viva
CO 4	Lecture using board/ projectors/experimental demonstration	Quiz, Report, Semester-end Exam and Viva

Books Recommended:

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

Course No: IPE 0715 1246	Credit: 1.5	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 skills 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, COs
After the successful completion of the course, students will be able to:

CO 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

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

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

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

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

Mapping of COs with POs

Course Learning Outcomes (CO)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1		2										
CO 2		2										
CO 3		2										
CO 4		2				2						
CO 5		2				2						1

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ projectors/experimental demonstration	Quiz, Report, Semester-end Exam and Viva
CO 2	Lecture using board/ projectors/experimental demonstration	Quiz, Report, Semester-end Exam and Viva
CO 3	Lecture using board/ projectors/experimental demonstration	Quiz, Report, Semester-end Exam and Viva
CO 4	Lecture using board/ projectors/experimental demonstration	Quiz, Report, Semester-end Exam and Viva
CO 5	Lecture using board/ projectors/experimental demonstration	Quiz, Report, Semester-end Exam and Viva

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

Course No: PHY 0533 1202G	Credit:1.5	Year: First	Semester: Second
Course Title: Basic Physics Sessional		Course Status: Sessional	

Rationale of the Course:

This laboratory course in physics provides students with practical experience in conducting experiments where they find applications and clarification of the concepts learned in their theory courses. 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 in physics
- understand the principles of physics through careful experimentation
- learn the proper use of specialized apparatus and the systematic collection, presentation, and interpretation of scientific data
- develop skills in designing, conducting, and reporting experiments
- learn how to identify errors of observation and perform error analysis.

Course Content

Mechanics: Determination of moment of inertia of a flywheel; Determination of "g" by and moment of inertia of a compound pendulum and the determination of its moment of inertia; Using a flat spiral spring: i) Verification of Hooke's law and determination of stiffness constant; ii) Determination of "*g*" and the effective mass of the spring; iii) Determination of modulus of rigidity of a spring material; *Properties of matter:* Determination of Young's modulus by the method of bending; Determination of rigidity modulus by static method; *Electricity:* Determination of galvanometer resistance by half deflection method.

Course Learning Outcomes:

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

CO 1: analyze experimental data properly and draw logical conclusions therefrom, perform error analysis and present the findings in a formal report

CO 2: apply the principle of conservation of mechanical energy to analyze a system undergoing separate rotational and translational motions

CO 3: determine the value of the acceleration due to gravity using a special type of physical pendulum (compound pendulum) and its rotational inertia

CO 4: evaluate the elastic properties of solids by determining the Young's modulus and the modulus of rigidity

CO 5: calculate the resistance of a galvanometer using Ohm's and Kirchhoff's law and construct a simple electrical circuit.

Mapping of COs with POs

Course Learning Outcomes (CO)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1		2						1				
CO 2	2	2										
CO 3	1							2				
CO 4	1							2				
CO 5		2						2				

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ projectors	Quiz and viva
CO 2	Lecture using board/ projectors/ demonstration	Written and oral examination; evaluation of lab report
CO 3	Lecture using board/ projectors/ demonstration	Written and oral examination; evaluation of lab report
CO 4	Lecture using board/ projectors/ demonstration	Written and oral examination; evaluation of lab report
CO 5	Lecture using board/ projectors/ demonstration	Written and oral examination; evaluation of lab report
	Lecture using white board and OHP projector.	Written and oral examination; evaluation of lab report

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*
4. Topping, J: Errors of Observation and Their Treatment
5. Bevington, P and Robinson, D K: Data Reduction and Error Analysis for the Physical Sciences.

Course No.: IPE 0031 1250	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, COs

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

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

CO 02: explain the fundamental aspects of basic engineering problems/situations with confidence in future.

Mapping of COs with POs

Course Learning Outcomes (CO)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1							2					
CO 2						2						1

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Self-learning on first year courses	Viva-voce
CO 2	Self-learning on first year courses	Viva-voce

Books Recommended:

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

Second Year First Semester

Course Code: IPE 0715 2121	Credit: 03	Year: Second	Semester: First
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 is concerned with the stresses, deformation and failure of solid materials and structures. In this course, a student will get the basic idea of the behavior of a body due to the external loading.

Course 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 and columns, the induced stresses and resulting 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: Basic concepts of stress and strain, statically determinate and indeterminate axially loaded members, 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. **Combined Stresses:** principal stress, Mohr's Circle, Stresses in thick-walled pressure vessels. **Columns:** Euler's Formula, Intermediate Column Formulas. **Introduction to Riveted and welded joints.**

Course Learning Outcomes, COs
After successful completion of the course, students will be able to:

CO 1: apply the fundamental concepts of engineering mechanics for deformable and rigid bodies;
CO 2: 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 loadings;
CO 3: analyze beams, columns and pressure vessels under various loads;
CO 4: apply the systematic methods for solving engineering problems in mechanics for solids;
CO 5: solve real-life engineering problems and design engineering systems.

Mapping of COs with POs

Course	Fundamental	Social Skills	Thinking	Personal

Learning Outcomes (CO)	Skills							Skills		Skills		
	PO 1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1	3	2										
CO 2	3	2		2								
CO 3	3	2		2					1			
CO 4				2					2			
CO 5			1									3

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ projectors	Continuous assessment, Midterm Examination 1, Semester-end examination
CO 2	Lecture using board/ projectors/ Assignment/tutorial	Continuous assessment, Midterm Examination 1, Quiz, Semester-end examination
CO 3	Lecture using board/ projectors/ Assignment/tutorial	Midterm Examination 2, Assignment, Semester-end examination
CO 4	Lecture using board/ projectors/ Assignment/ tutorial	Assignment, Semester-end examination
CO 5	Lecture using board/ projectors/Self-learning using reference books	Assignment, Semester-end examination

Books Recommended:
1. Andrew Pytel and Ferdinand L. Singer, Strength of Materials.
2. Andrew Pytel and Jaan Kiusalaas, Mechanics of Materials.
3. William A. Nash and Merle C. Potter, Strength of Materials
4. Ferdinand Beer, Jr. Johnston, E. Russell, John DeWolf and David Mazurek, Mechanics of Materials.

Course No.: IPE 0715 2123	Credit: 4.0	Year: Second	Semester: First
Course Title: Thermodynamics and Heat Transfer		Course Status: Theory	

Rationale of the Course:

The course deals with thermodynamics, thermal engineering and heat transfer for different states of materials. 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 are required for engineering practices 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
- 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
- explain 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
- select necessary mathematical models in designing boiler and heat exchanger.

Course Content:
Thermodynamics: Systems, Control volume, Processes, 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, ***Flow over flat plate and tube, flow through tube***. Dimensionless parameters, Empirical correlations for laminar and turbulent flow; Heat Exchanger: Classification, Fouling, LMTD.

Course Learning Outcomes, COs
After the successful completion of the course, students will be able to:

CO 1: explain the basic laws and principles of thermodynamics and heat transfer;
CO 2: apply the laws of thermodynamics to analyze the performance of different systems;
CO 3: analyze various power cycles using thermodynamic processes;

CO 4: interpret heat transfer equipment such as heat exchangers, steam generating units, etc.
CO 5: solve real-life engineering problems related to thermodynamic, heat transfer and thermal engineering.

Mapping of COs with POs

Course Learning Outcomes (CO)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1	3	2										
CO 2	3	2										
CO 3	2	2										
CO 4	2	2										
CO 5								2				1

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ projectors	Continuous assessment, Midterm Examination 1, Semester-end examination
CO 2	Lecture using board/ projectors/tutorial	Continuous assessment, Quiz, Semester-end examination
CO 3	Lecture using board/ projectors/Assignment/tutorial	Midterm Examination 2, Assignment, Semester-end examination
CO 4	Lecture using board/ projectors/ Assignment/ tutorial	Assignment, Quiz, Semester-end examination
CO 5	Lecture using board/ projectors/tutorial	Assignment, Semester-end examination

Books Recommended:

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

7. R. K. Rajput, Heat and Mass Transfer, S. Chand & Company Ltd.

Course No: MAT 0541 2107G	Credit: 3.0	Year: Second	Semester: First
Course Title: Vectors, Matrices and Laplace Transformation		Course Status: Theory	

Rationale of the Course:
The fundamental mathematical engineering approaches are covered in this course. It will give the students a strong basis for continuing their engineering education. These are the vector calculus, matrices, and Laplace transformation techniques. Students will learn the fundamental concepts and methods of vectors, matrices, and Laplace and how to use them to solve engineering issues.

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; Gradient of scalar functions. Divergence and curl of vector functions. Physical significance of gradient, divergence and curl. Stoke's theorem. Line, surface, and volume integrals. 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, Elementary transformations and properties, Convolution. Solution of differential equations by Laplace transforms. Evaluation of integrals by Laplace transforms.

Course Learning Outcomes, COs
After the successful completion of the course, students will be able to:
CO 1: understand algebraic and geometric representations of vectors in two/three dimensions and their operations;
CO 2: interpret and determine the gradient, divergence, and curl of vectors and apply these operators to carry out integrations by means of Green's and Stoke's theorems;
CO 3: evaluate line, surface, and volume integrals;
CO 4: solve systems of linear equations using matrices, differential and integral equations using the Fourier and Laplace transform methods;

Mapping of COs with POs

Course Learning	Fundamental Skills	Social Skills	Thinking Skills	Personal Skills

Outcomes (CO)	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1	3	1										
CO 2	3	1										
CO 3	1	2										
CO 4	1		3									

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/projectors	Quiz, Midterm Exam 1, and Semester-end Exam
CO 2	Lecture using board/projectors, tutorial	Assignment and Semester-end Exam
CO 3	Lecture using board/projectors, tutorial, assignment	Quiz, Midterm Exam 2, and Semester-end Exam
CO 4	Lecture using board/projectors, tutorial, assignment, group work	Midterm Exam 2, and Semester-end Exam

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.

Course No: EEE 0713 2103G	Credit: 3.0	Year: Second	Semester: First
Course Title: Introduction to Circuit Analysis and Electrical Machines		Course Status: Theory	

Rationale of the Course:
This fundamental Electrical and Electronic Engineering course is an introduction to the Electrical and Electronic circuits and Electrical Machines. The contents of this course allow the students to garner the necessary knowledge to analyze different electrical and electronic circuits utilizing a number of of circuit analysis techniques. This course also covers the basic principles of operation, device characteristics and applications of

semiconductor diodes. Additionally, it also covers the fundamentals of Electrical Machines including Transformer, Three-phase alternator and Induction motors.

Course Objectives:
The objectives of this course are to:

- To facilitate the basic concepts of electrical charge, voltage, current, power, energy and phasor.
- To acquaint students with fundamental theorems of circuit analysis.
- To accumulate basic ideas about semiconductor diode and its applications.
- To familiarize the fundamentals of Electrical Machines including Transformer, Three-phase alternator and Induction motors.

Course Contents:
Electrical circuits: Voltage and Current, Power and Energy, Ohm's law, Series-Parallel circuits (including Resistors, Capacitors and Inductors), Voltage division and current division, KVL, KCL, Nodal analysis and Mesh analysis, Thévenin's theorem, Introduction to Phasor, Three-phase networks.
Electronic circuits: Semiconductor p-n junction, Diode, I-V characteristics of general-purpose diode, Avalanche breakdown, Zener breakdown and applications of diodes.
Electrical machines: *Transformer:* Working principles, EMF equation, Transformer losses and efficiency. *Three-phase alternator:* Working principles, Equivalent circuits, Vector diagrams under load conditions. *Three-phase Induction motor:* Working principles and classifications, Equivalent circuits, slip and torque-speed characteristics.

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

CO 1: explain basic electrical and electronic circuit analysis techniques;
CO 2: solve fundamental circuit problems;
CO 3: recognize the fundamentals of electrical machineries.

Mapping of COs with POs

Course Learning Outcomes (CO)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1	1	2										
CO 2	3		2	2								
CO 3	2	2										

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/projectors	Class Test, Final Exam
CO 2	Lecture using board/projectors, Demonstration	Quiz, Mid Term Exam-1 Test, Semester end Exam
CO 3	Lecture using board/projectors, Demonstration	Assignment, Quiz, Mid Term Exam-2 Test, Semester end Exam

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- Adel S. Sedra and Kenneth C. Smith
5. Electrical Machines by Charles I. Hubert
6. Principles of Electrical Machines by V. K. Mehta and Rohit Mehta
7. A Textbook of Electrical Technology (Volume II) by B. L. Theraja and A. K. Theraja

Course No: ECO 0311 2105G	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, COs
After successful completion of the course, students will be able to:

- **CO 1:** describe individual decision-making agents, the behaviour of firms and industries in the economy, and the differences between the markets;
- **CO 2:** apply the concept of elasticity quantitatively and qualitatively in economic analysis;
- **CO 3:** explain macroeconomic concepts and use simple economic models to interpret the behaviour of key macroeconomic variables;
- **CO 4:** demonstrate the knowledge of fiscal policy and government budget;
- **CO 5:** explain the main issues confronting underdeveloped and developing countries.

Mapping of COs with POs

Course Learning Outcomes (COs)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1	2											
CO 2		2	1									
CO 3		1		3							1	
CO 4	2											
CO 5		**2**										

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/projectors	Quiz, and Semester-end Exam
CO 2	Lecture using board/projectors/tutorial/Assignment	Quiz, Midterm Exam 1, and Semester-end Exam
CO 3	Lecture using board/projectors	Assignment and Semester-end Exam
CO 4	Lecture using board/projectors, Assignment	Midterm Exam 2, and Semester-end Exam
CO 5	Lecture using board/projectors, Assignment	Presentation and Semester-end Exam

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

Course No.: EEE 0713 2104G	Credit: 1.5	Year: Second	Semester: First
Course Title: Introduction to Circuit Analysis and Electrical Machines 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 0713 2103G. Theoretical knowledge is complete with hands-on experiments using the essential components and measuring devices. This course teaches the fundamentals of electrical circuits, the application of circuit laws, theorems and measuring techniques. It contains experiments investigating diode's performance characteristics, different types of diode circuits and their applications. Finally, the course covers practical experiments on the topics of Electrical Machines, including Transformer, Induction motor and Electrical machines.

Course Objectives:
The objectives of this course are to:

- provide basic knowledge about voltage, current and load relationships in an electrical network
- develop the student's skills and hands-on experience in analyzing various Electrical and Electronic circuits.
- familiarize with the semiconductor diodes and their applications.
- demonstrate the working principles of Electrical Machines and their characteristics.

Course Content:
Introduction to electrical circuit and machine lab components; Verifying Ohm's Law and plotting the I-V, P-V curve; Construction of resistive series-parallel circuits; Verification of Kirchhoff's voltage law; Verification of Kirchhoff's current law; Demonstration of Thevenin's circuit theorem; Investigation the I-V characteristic of general-purpose diode; Study of Half-Wave Rectification circuit; Mid-semester evaluation; Investigate the RC circuits and calculate time constants; Determination of voltage transformation ratio and turn ratio of a single-phase transformer; Control the

speed of a three-phase induction motor and obtain the torque-speed curve; No load and loading characteristics of an alternator.

Course Learning Outcomes, COs

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

CO 1: demonstrate electrical circuit analysis techniques;
CO 2: implement electronic circuits utilizing semiconductor diodes;
CO 3: evaluate the characteristics of electrical machines;

Mapping of COs with POs

Course Learning Outcomes (CO)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1	3	2										
CO 2	2	2		2								
CO 3		3		2								

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lab class, Experiments	Viva, Quiz, Continuous assessment, Final Exam
CO 2	Lab class, Experiments	Viva, Quiz, Continuous assessment, Final Exam
CO 3	Lab class, Experiments	Viva, Quiz, Continuous assessment, Final Exam

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- Adel S. Sedra and Kenneth C. Smith
5. Electrical Machines by Charles I. Hubert
6. Principles of Electrical Machines by V. K. Mehta and Rohit Mehta
7. A Textbook of Electrical Technology (Volume II) by B. L. Theraja and A. K. Theraja

Course No: IPE 0715 2124	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, COs

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

CO 1: operate basic instruments of materials science and engineering including (electric furnace, optical microscope, hydraulic press, polishing machine, milling machine, etc.) following proper safety guidelines and necessary precautions;
CO 2: perform metallographic sample making and various heat treatment processes, such as annealing, normalizing, quenching and tempering, etc.;
CO 3: analyze the underlying mechanisms and reasoning for the obtained microstructures in the heat-treated samples;
CO 4: interpret the data from the experiments and report experimental findings in formal laboratory reports using an appropriate technical writing style.

Mapping of COs with POs

Course Learning Outcomes (COs)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1		2										

CO 2		2		1								
CO 3	2	1		1								
CO 4	2	2				1						1

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using instruction materials and laboratory work	Quiz, Report assessment, and Semester-end oral examination
CO 2	Lecture using instruction materials, and laboratory work	Quiz, Report assessment, and Semester-end oral examination
CO 3	Lecture using reference book and laboratory work	Quiz, Report assessment, and Semester-end oral examination
CO 4	Lecture using instruction materials	Quiz, Report assessment, and Semester-end oral examination

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.

Course No.: IPE 0788 2142	Credit: 1.5	Year: Second	Semester: First
Course Title: Computer Aided Drawing - I			Course Status: Sessional

Rationale of the Course:

Computer Aided Drawing-I (CAD-I) is an introductory course entailing the running/operation of a typical CAD system. This course deals with 2D computer-aided-drawings a designed product for manufacturing applications.

Course Objectives:

The objectives of this course are to:

- introduce computer aided drawing/drafting (CAD) system using the current version of the AutoCAD software
- teach 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
- help to learn the basic features and tools used to create and modify 2D drawings and proper dimensioning of a designed product
- facilitate to create a drawing sheet and plot 2D 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, COs

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

CO 1: demonstrate the basic commands, tools and concepts of AutoCAD software for creating an engineering drawing with the use of computers;

CO 2: practice two-dimensional (2D) drawings /computer models of a designed product for manufacturing applications using AutoCAD software;

CO 3: manipulate drawings through modifying/editing tools and plotting techniques, and produce template drawings;

CO 4: develop mid-level CAD user skills using the current version of the AutoCAD software;

CO 5: apply the concepts and technical skills learned in the course to real-world design problems and current professional practices.

Mapping of COs with POs

Course Learning Outcomes (CO)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1	1			3								
CO 2	2	1										
CO 3	1			2								
CO 4				2		1						
CO 5				2		2						2

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning	Teaching-Learning Strategy	Assessment Strategy

Outcomes (COs)		
CO 1	Presentation with projectors and instruction materials	Drawing assignment, oral exam, semester-end exam
CO 2	Lecture using projectors, Tutorial and Assignment	Drawing assignment, oral exam, semester-end exam
CO 3	Lecture projectors, Tutorial and Assignment	Drawing assignment, oral exam, and semester-end exam.
CO 4	Lecture using projectors and tutorial	Drawing assignment, oral exam and group project
CO 5	Lecture using PC softwares and tutorial	Semester-end Oral examination and individual project

Books Recommended:

1. Up and Running with AutoCAD 2017: 2D and 3D Drawing and Modeling – By Gindis, Elliot, Academic Press Publisher
2. Introduction to AutoCAD 2011: 2D and 3D Design – By Yarwood, Alf, Taylor & Francis Publisher
3. Beginning AutoCAD 2011: Exercise Workbook – By Shrock, Cheryl R.**,** 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.

Course No: IPE 0788 2144	**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
- guide 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, COs

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

CO 1: draw orthographic, auxiliary and sectional views of an object;
CO 2: predict the isometric view of an object from the given orthographic views correctly;
CO 3: draft different machine elements like Fasteners, Gears and Springs;
CO 4: develop bill of materials;
CO 5: generate assembly drawings.

Mapping of COs with POs

Course Learning Outcomes (CO)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1		2										
CO 2		2		1								
CO 3		1		1								
CO 4				1			1					
CO 5				2								1

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board and Instruction materials	Quiz, Report assessment, and Semester-end Exam
CO 2	Lecture using board, , Assignment and Instruction materials	Quiz, Report assessment, and Semester-end Exam
CO 3	Lecture using board and Instruction materials	Quiz, Report assessment, and Semester-end Exam
CO 4	Lecture using board, , Assignment and Instruction materials	Quiz, Report assessment, and Semester-end Exam
CO 5	Lecture using board, , Assignment and Instruction materials	Quiz, Report assessment, and Semester-end Exam

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.

Second Year Second Semester

Course No.: IPE 0715 2225	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, COs

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

CO 1: apply the concepts of kinematic, kinematics links, relative motions of machine components in designing various mechanisms used in practice

CO 2: relate the concepts of relative and instantaneous velocity as well as radial and tangential acceleration associated with static and dynamic balancing

CO 3: explain various modes of vibration generated in the machines to control them in practice

CO 4: illustrate various cam mechanisms used in various engineering applications

CO 5: analyze power transmission mechanisms to solve engineering problems.

Mapping of COs with POs

Course Learning Outcomes (CO)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1	3			1								1
CO 2	3											
CO 3		1		2								
CO 4	2			1								
CO 5	2			1								

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ projectors	Assignment, Midterm Examination 1, Semester-end examination
CO 2	Lecture using board/ projectors/Assignment/tutorial	Assignment, Semester-end examination
CO 3	Lecture using board/ projectors	Assignment, Semester-end examination
CO 4	Lecture using board/ projectors/Assignment/tutorial	Midterm Examination 2, Assignment, Semester-end examination
CO 5	Lecture using board/ projectors/Assignment/tutorial	Assignment, Semester-end examination

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

Course No: IPE 0715 2227	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 involve fluid flow phenomena. The students will be able to evaluate and design hydraulic machines and to solve real-life complex problems related to fluid mechanics.

Course Objectives:
The objectives of this course are to:

- accumulate basic knowledge of fluid properties and flow behaviors
- 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
- inculcate the importance of fluid flow measurement and its applications in industries
- provide knowledge of the head losses in flow systems including fluid flow through pipes
- facilitate necessary knowledge about dimensional analysis, similitude and apply Rayleigh's and Buckingham-pi techniques to solve real-life fluid problems
- acquaint students with the working and design criteria of different types of hydraulic machines

Course Content:
Fluid Mechanics: *Fluid properties*; *Fluid statics:* Manometry, Force on submersed planes and curved surfaces, Buoyancy and floatation; *One-dimensional flow of fluid:* Equation of continuity, Euler's equation, Bernoulli formula, Energy equation, Impulse momentum equation, Pipe flow, Frictional losses in pipes and fittings (Moody diagram), Pipe Network; *Dimensional analysis and Similitude*; **Fluid Machinery:** Types of fluid machinery, Impulse and Reaction turbines, Centrifugal pumps, Radial and axial flow pumps, Compressors, Reciprocating pumps.

Course Learning Outcomes, COs
After the successful completion of the course, students will be able to:

CO 1: explain the fluid properties, buoyancy and stability of emerged bodies and evaluate fluid pressure using manometer and hydrostatic pressure on submerged surfaces;
CO 2: apply Euler's Equation of motion, Bernoulli's formula and impulse momentum equation for one dimensional fluid flow;
CO 3: analyze different frictional losses in pipes and fittings and apply dimensional analysis to predict fluid phenomena;
CO 4: apply the working principles and design of different types of hydraulic machines;
CO 5: solve real-life engineering problems in the context of fluid mechanics.

Mapping of COs with POs

Course Learning Outcomes (CO)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO 1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1	3	1										
CO 2	3	2										
CO 3	3	2		1								
CO 4	2	2		1								
CO 5			1	1								1

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ projectors	Continuous assessment, Midterm Examination 1, Semester-end examination
CO 2	Lecture using board/ projectors/Assignment	Continuous assessment, Midterm Examination 1, Quiz, Semester-end examination
CO 3	Lecture using board/ projectors/Assignment/tutorial	Midterm Examination 2, Assignment, Semester-end examination
CO 4	Lecture using board/ projectors/ Assignment/ tutorial	Assignment, Semester-end examination
CO 5	Lecture using board/ projectors/Self-learning using reference books	Assignment, Semester-end examination

Books Recommended:
1. Yunus A. Çengel and John M. Cimbala, Fluid mechanics: fundamentals and applications, McGraw-Hill, Inc.

2. Bruce R. Munson, Theodore H. Okiishi, Wade W. Huebsch and Alric P. Rothmayer, Fundamentals of fluid mechanics, John Wiley and Sons, Inc.
3. Frank M. White, Fluid Mechanics, McGraw Hill Publishing Company Ltd., New Delhi.
4. R. K. Bansal, A Text Book of Fluid Mechanics and Hydraulic Machines, Laxmi Publications Ltd., New Delhi.
5. S. K. Som and G. Biswas, Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw-Hill Publishers Pvt. Ltd.

Course No: IPE 0412 2231	Credit: 3.0	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 using parameters like NPV, IRR, and payback period. The effects of depreciation, inflation and tax rate are widely addressed in this course. Students must have prior knowledge of statistics, algebra, and basic accounting for a 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, nominal and effective interest rate, 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; Project risk and uncertainties: Probabilistic assessment, Sensitivity analysis.

Course Learning Outcomes (COs):
After the successful completion of the course, the students will be able to:
CO1: identify the compound interest rates and their factors for the economic evaluation of the investment projects;
CO2: compare the net present worth of different investments with necessary parameters including equivalent annual cost, rate of return, and payback period;
CO3: interpret the cost effectiveness of investment alternatives by considering inflation, depreciation, tax, etc.;
CO4: apply the knowledge of engineering economy for capital budgeting and capital rationing;
CO5: evaluate the uncertainties involved in the investment projects so that a rationalization can be established for the stake holders.

Mapping of COs with POs

Course Learning Outcomes (CO)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1	3	1										
CO 2	3	2										
CO 3	2	3										
CO 4	3	3			1	1			1			
CO 5	1	2									2	

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/projectors, class work	Midterm Exam 1, and Semester-end Exam
CO 2	Lecture using board/projectors, assignment, tutorial	Midterm Exam 1, Tutorial assessment, and Semester-end Exam
CO 3	Lecture using board/projectors, group work	Assignment, Midterm Exam 2, and Semester-end Exam
CO 4	Lecture using board/projectors, assignment, group work	Assignment, Midterm Exam 2, and Semester-end Exam
CO 5	Lecture using board/projectors, tutorial	Semester-end Exam

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.

Course No.: IPE 0542 2251	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 the optimization of industrial processes, quality control, design of reliable systems, and modeling for simulation studies. 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:
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:* Basic concepts, 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, COs
After the successful completion of the course, students will be able to:

CO 1: describe the concepts of population and sample, quantitative and qualitative variables, descriptive and inferential statistics, parameter and statistic, etc.;
CO 2: calculate mean, variance and probabilities for various discrete and continuous random variables;
CO 3: infer certain characteristics of a population based on information contained in a sample (predictions, decisions);
CO 4: make decision by conducting hypothesis testing with known and unknown parameters;
CO 5: analyze the correlated and regressed data.

Mapping of COs with POs

Course Learning Outcomes (CO)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1	2											
CO 2	3	2										
CO 3		2										
CO 4		3										
CO 5								2				

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board	Midterm Exam 1, Semester end Examination
CO 2	Lecture using board and Tutorial	Assignment, Semester end Examination
CO 3	Lecture using board and Tutorial	Midterm Exam 2, Semester end Examination
CO 4	Lecture using board and Tutorial	Assignment and Semester end Exam
CO 5	Lecture using board and Tutorial	Semester end Examination

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.

4. Scheffer, Mulekar and McClave, Probability and Statistics for Engineers, Duxbury Press.

Course No: CSE 0613 2206G	Credit: 3.0	Year: Second	Semester: Second
Course Title: Python Programming Lab		Course Status: Sessional	

Rationale

In this current world, most of the research works require computational data analysis of corresponding fields. This requirement has emphasized the necessity of 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

- 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 Contents:

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, COs

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

CO 1: implement knowledge of Python for writing computer programs;
CO 2: apply solutions to real-life problems using necessary components of Python;
CO 3: identify errors from a program and use exception handlers to handle errors and exception;
CO 4: design basic data structures to solve efficient data storage issues;
CO 5: implement object oriented programming and modular concepts, etc., in data analysis and manipulation.

Mapping of COs with POs

Course Learning Outcomes (CO)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1				2								
CO 2		2		2					1			1
CO 3		2										
CO 4		1		2								
CO 5				2					2			

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/projectors/Lab work using Python	Viva, Programming language tests and Semester-end Exam
CO 2	Lecture using board/projectors/Lab work using Python	Viva, Programming language tests and Semester-end Exam
CO 3	Lecture using board/projectors/Lab work using Python	Viva, Programming language tests and Semester-end Exam
CO 4	Lecture using board/projectors/Lab work using Python	Viva, Programming language tests and Semester-end Exam
CO 5	Lecture using board/projectors/Lab work using Python	Viva, Programming language tests and Semester-end Exam

Books Recommended:

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

Course No: IPE 0715 2222	Credit: 1.5	Year: Second	Semester: Second
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
- apply the aspects of mechanics of solids learned in relevant theory courses
- operate, safely and properly, 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, COs
After successful completion of the course, students will be able to
CO 01: analyze experimental data obtained from tensile and compressive testings of carbon steels;
CO 02: evaluate experimental data collected from a impact and fatigue tester to determine relevant mechanical properties of materials ;
CO 03: determine surface and bulk hardness of a solid body using a hardness tester;
CO 04: interpret the experimental results through group demonstration and technical report.

Mapping of COs with POs

Course Learning Outcomes (CO)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1		2										
CO 2		2										
CO 3		2										
CO 4						1	2					1

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board, Experiment in group and Instruction materials	Quiz, Report assessment, and Semester-end Exam
CO 2	Lecture using board, Experiment in group, Assignment, and Instruction materials	Quiz, Report assessment, and Semester-end Exam
CO 3	Lecture using board, Experiment in group and Instruction materials	Quiz, Report assessment, and Semester-end Exam
CO 4	Lecture using board, Assignment, Experiment in group and Instruction materials	Quiz, Report assessment, and Semester-end Exam

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

Course No: IPE 0715 2228	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; Flow through different types of weirs (Triangular and Rectangular); Calibration of venturimeter and orificemeter; Verification of Bernoulli's equation; Determination of hydrostatic pressures on submerged surfaces; Study of Reynolds's number apparatus/hydraulic machines.

Course Learning Outcomes, COs
After the successful completion of the course, students will be able to:
CO 1: explain the properties of fluids and the use of various instruments including hydraulic bench for fluid flow measurement;
CO 2: perform the calibration of a Venturimeter and Orificemeter and evaluate their coefficient of discharge;
CO 3: verify the Bernoulli's theorem and analyze energy grade lines;
CO 4: apply the knowledge of fluid statics for determining hydrostatic forces;

Mapping of COs with POs

Course Learning Outcomes (CO)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO 1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1				1								1
CO 2	2			2								
CO 3	1			3								
CO 4	2			2								

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board, Assignment and Instruction materials	Quiz, and Semester-end examination
CO 2	Lecture using board and Tutorial	Quiz, Report assessment and Semester-end examination
CO 3	Lecture using board and Tutorial	Quiz, Report assessment, and Semester-end examination
CO 4	Lecture using board and Tutorial Assignment	Quiz, Report assessment and Semester-end examination

Books Recommended:
1. Sarbjit Singh, Experiments in Fluid Mechanics.
2. R. K. Bansal, A Text Book of Fluid Mechanics and Hydraulic Machines, Laxmi Publications Ltd., New Delhi.
3. Mohd. Kaleem Khan, Fluid Mechanics and Machinery.

Course No.: IPE 0788 2246	Credit: 1.5	Year: Second	Semester: Second
Course Title: Computer Aided Drawing-II			Course Status: Sessional

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 basic understanding of AutoCAD commands to design 3D objects
- facilitate necessary knowledge to create and modify 3D solid objects
- demonstrate the knowledge of 3D rendering and animation of designed products.

Course Content:
3D Auto CAD: Introduction, Tools, creating extruded, revolved and composite solids Rendering, Printing and Plotting; Projects: AUTOCAD 3D/3D Studio Max/ Solidworks®.

Course Learning Outcomes, COs
After the successful completion of the course, students will be able to:
CO 1: navigate the unique features of the computer aided 3D modelling workspace to create 3D objects;
CO 2: interpret the tools for creating, editing, and analyzing 3D models;
CO 3: design basic 3D models and animations;
CO 4: demonstrate the rendering of 3D objects for optimal system processing and analysis.

Mapping of COs with POs

Course Learning Outcomes (CO)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO 1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1			2				1					

CO 2			3				2					
CO 3			2	2			2					
CO 4				2								

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Presentation with projectors	Assignment, oral exam, semester-end exam
CO 2	Lecture using white board and color marker, Tutorial and Assignment	Assignment, oral exam, semester-end exam, project
CO 3	Lecture using white board and color marker, Tutorial and Assignment	Assignment , oral exam, project and semester-end exam.
CO 4	Lecture using white board and color marker	Assignment , oral exam and semester-end exam.

Books/Software Recommended:

1. Pandey, Jaiprakash, Shoukry, Yasser, AutoCAD 2020 3D Modeling.
2. Goutam Pohit and Goutam Ghosh, Machine Drawing with AutoCAD
3. Ami Chopine, 3D Art Essentials.

Course No.: IPE 0031 2250	**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 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 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 in the second year.

Course Learning Outcomes, COs

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

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

CO 02: explain the fundamental aspects of basic engineering problems/situations with confidence in future.

Mapping of COs with POs

Course Learning Outcomes (CO)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1							2					
CO 2						2						1

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Self-learning on first year courses	Viva-voce
CO 2	Self-learning on first year courses	Viva-voce

Books Recommended:

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

Course No: IPE 0031 2260	**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 observations. 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 how an IPE graduate may work in a professional organization
- expose students to the various aspects of industrial practices and ethics
- make students understand functions of business organizations and companies.

Course Content:

The department will select the industry and organize the tour.

Course Learning Outcomes, COs

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

CO 01: identify the work responsibility, and ethics in the working environment;
CO 02: outline various aspects of manufacturing processes;
CO 03: prepare a technical report on the experience gained from the industrial tour.

Mapping of COs with POs

Course Learning Outcomes (CO)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1									1	3		
CO 2		2			1							
CO 3							2					1

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Tour to a selected manufacturing or service industry	Viva and Report
CO 2	Tour to a selected manufacturing or service industry	Viva and Report
CO 3	Tour to a selected manufacturing or service industry	Viva and Report

Third Year First Semester

Course No.: IPE 0541 3121	Credit: 3.0	Year: Third	Semester: First
Course Title: Numerical Analysis and Optimization			Course Status: Theory

Rationale of the Course:
This course deals with 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 to solve these complex problems optimally.

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 problem-solving techniques
- make students apply techniques to solve problems optimally
- help students become equipped with necessary skills on MATLAB and other convenient numerical software.

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; *Numerical Differentiation and Integration:* Newton –Cotes Integration Formulas, High-accuracy differentiation formulas, Runge-Kutta Methods, engineering applications;
Unconstraint Optimization: Line search method, Trust-Region method, engineering applications; Theory of Constraint Optimization: local and global solution, smoothness, first and second order optimality conditions. Engineering applications.

Course Learning Outcomes, COs
After the successful completion of the course, students will be able to:

CO 1: explain common numerical methods and how they are used to obtain approximate solutions to otherwise intractable mathematical problems;
CO 2: apply numerical methods to obtain approximate solutions to nonlinear equations;
CO 3: derive numerical solution techniques for various mathematical problems such as differentiation, integration, linear equations;
CO 4: optimize problem to obtain best solution;
CO 5: implement numerical methods in MATLAB and simulate complex system.

Mapping of COs with POs

Course Learning Outcomes (COs)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO 1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1	3	2										
CO 2	2											
CO 3		2						2			1	
CO 4				2								
CO 5				3								

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/projector, Tutorial, and Assignment	Assignment, Midterm Exam 1, and Semester-end Exam
CO 2	Lecture using board/projector	Quiz and Semester-end Exam
CO 3	Lecture using board/projector, Tutorial and Assignment	Assignment, Midterm Exam 2, and Semester-end Exam
CO 4	Lecture using board/projector	Midterm Exam 2, and Semester-end Exam
CO 5	Lecture using board/projector and assignment	Assignment and Semester-end Exam

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/projector, Tutorial, and Assignment	Assignment, Midterm Exam 1, and Semester-end Exam
CO 2	Lecture using board/projector	Quiz and Semester-end Exam
CO 3	Lecture using board/projector, Tutorial and Assignment	Assignment, Midterm Exam 2, and Semester-end Exam
CO 4	Lecture using board/projector	Midterm Exam 2, and Semester-end Exam
CO 5	Lecture using board/projector and assignment	Assignment and Semester-end Exam

Books Recommended:

1. Chapra, S. C., & Canale, R. P., Numerical methods for engineers. McGraw-Hill Higher Education.
2. Jorge Nocedal and Stephen J. Wright, Numerical Optimization, Springer.

Course No: IPE 1022 3131	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 applications 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:

- make students understand 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 uses 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, COs

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

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

CO 2: explain the factors that must be addressed for better work place design and interpret the problems arising discomforts due to improper lightings and noises;

CO 3: apply standard lifting equations to analyze manual lifting;
CO 4: explain the importance of visual display signs;
CO 5: describe the safety standards, the causes of hazards and accidents, and develop the necessary safety precautions for better risk management.

Mapping of COs with POs

Course Learning Outcomes (COs)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1	2											
CO 2		2										
CO 3	3											
CO 4		2										
CO 5			2				2			1		

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using projectors, and Assignment	Assignment, Mid-term Exam1, and Semester-end Exam
CO 2	Lecture using projectors	Quiz and Semester – end Exam
CO 3	Lecture using projectors, Tutorial and Assignment	Assignment and Semester-end Exam
CO 4	Lecture using projectors, Tutorial and Assignment	Mid-term Exam-2, and Semester-end Exam
CO 5	Lecture using projectors, Assignment and case study	Assignment, Report and Semester end Exam

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.

Course No: IPE 0413 3133	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, improve, implement, and management of quality control processes in any industrial setting. A basic knowledge of the fundamentals of engineering statistics 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 skills in solving quality related problems 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(SQC): 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, COs
After the successful completion of the course, students will be able to:
CO 1: explain quality concepts for the manufacturing and service industries, along with relevant quality costs;
CO 2: apply basic SQC tools to calculate the control limits for both variable and attribute control charts and evaluate the process status;
CO 3: design and perform single and double sampling plans based on producers' and customers' risks;
CO 4: describe and distinguish the basic concepts underlying total quality management, considering the regulations of a quality system certification process.
CO 5: apply the Design of experiment (DOE) to solve real-life production/service quality issues, considering various indices of process capability.

Mapping of COs with POs

Course Learning Outcomes (COs)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1	2	1										
CO 2	2	2					1					
CO 3	2			2								
CO 4	**1**	**2**										
CO 5				**2**							2	1

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/projector, and instruction materials	Assignment, and Semester-end exam
CO 2	Lecture using board/projector, Tutorial, Group work	Assignment, Mid-term exam-1, semester-end exam
CO 3	Lecture using board/projector, Tutorial, Group work	Assignment, and semester-end exam.
CO 4	Lecture using board/projector, and case study	Mid-term exam-2 and semester-end exam.
CO 5	Lecture using board/projector, and tutorials	Report, Semester-end exam

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
4. William J. Kolarik, Creating quality : concepts, systems, strategies, and tools
5. Total Quality Management, Dale H. Besterfield.

Course No: IPE 0788 3151	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 the 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 development economics, 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, COs

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

CO 1: formulate the product design and development problem, particularly in the manufacturing industry;
CO 2: record and maintain appropriate design documentations for planning a project.
CO 3: apply the methodologies for product design and development to create, evaluate and select design concepts;
CO 4: interpret design rules for material selection, design for manufacturability, design for assembly, and design for environment;
CO 5: recognize issues of product safety, risk, and reliability including economic analysis of product development.

Mapping of COs with POs

Course Learning Outcomes (COs)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1		3										
CO 2	2						2					
CO 3			2			2						
CO 4	2						2		2			
CO 5	2				2							

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/projectors/ research paper	Continuous assessment, Term Test
CO 2	Lecture using board/projectors/ project record	Continuous assessment
CO 3	Lecture, Self-learning (article) and Teamwork	Group presentation, Mid Exam-1, final exam
CO 4	Lecture using board/ projectors/individual problem solving	Assignment, Mid Exam-2 /Final exam
CO 5	Lecture using board/ projectors/case study	Presentation, Final exam

Books Recommended:

1. Product Design and Development, Karl T. Ulrich and Steven D. Eppinger
2. Total Quality Management, Dale H. Besterfield.

Course No: IPE 0788 3153	Credit: 3.0	Year: Third	Semester: First
Course Title: Facilities Planning and Material Handling		Course Status: Theory	

Rationale of the Course:

Facilities planning and material handling course basically focuses on strategic facilities planning and decision making through detailed plant location, layout and material handling system design. This course is designed to provide the students with knowledge for making decisions about the selection and placement of manufacturing and service facilities. The students also learn about the tools and techniques, procedures, and material-handling equipment with regard to real life problems in different operational areas.

Course Objectives:

The objectives of this course are to:

- facilitate necessary knowledge about theoretical aspects of production facility locations, layouts and material handling systems
- make the students understand the basic concepts related to the interactions between the production system parameters and their impact on the design of materials handling systems
- help students conceptualize standard methods for the design and modeling of plant layouts
- equip students with an understanding of the basic concepts related to the interactions between the production system parameters and their impact on materials-handling system design.

Course Content:

Operations Function: Manufacturing operations, Non-manufacturing or service operations; Plant Location: Factors, objectives, market and materials oriented locations, single facility location; Location Evaluation Methods: Point rating method, Load-distance method; Mathematical models of plant location (Brown-Gibson model, Transportation model); Plant Layout: Objectives, principles, functions, classic plant layouts, hybrid and fixed layouts, manufacturing cells and Group technology, analysis of plant layout problems-line balancing, process layout problems and plant layout software (CRAFT, ALDEP, CORELAP); Material Handling: Introduction, conveying equipment, general theories for conveyors; Different types of onveyors (Belt, Apron, Flight, Bucket, Pneumatic); Auxiliary equipment - Chute, Hopper, Feeder, Industrial trucks, Pallets etc., Lifting and hoisting equipment, Industrial cranes; AGV.

Course Learning Outcomes, COs

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

CO 1: outline the traditional and contemporary issues in manufacturing and their impact on facility design and integration with manufacturing and supporting operations;

CO 2: explain the concepts related to the qualitative and quantitative models of facility location decision and layout design;

CO 3: apply the analytical knowledge gained to design and solve the practical problems of plant location and layout;

CO 4: describe the principles, concepts, and techniques of effective material handling systems employed in different manufacturing facilities;

CO 5: interpret the environmental and economic aspects of facility planning and materials handling.

Mapping of COs with POs

Course Learning Outcomes (COs)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1	3	1										
CO 2	2	2										
CO 3	1	2										1
CO 4	3											
CO 5							1		2		1	

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy

CO 1	Lecture using board/projector, and instruction materials	Assignment, and Semester-end exam
CO 2	Lecture using board/projector, Tutorial, Group work	Assignment, Mid-term exam-1, semester-end exam
CO 3	Lecture using board/projector, Tutorial, Group work	Assignment, Mid-term exam-1 and semester-end exam.
CO 4	Lecture using board/projector, and instruction materials	Mid-term exam-2 and semester-end exam.
CO 5	Lecture using board/projector, and instruction materials	Semester-end exam.

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. Schroedar, Roger G., Operations Management: Decision Making in the Operations Function, McGraw Hill.
4. Krajewski, Lee J., Operations Management: Processes and Value Chains, Pearson Education, Inc.
5. A Spivakovsky, and V. Dyachkov**,** Conveyor and Related Equipment**s**, Peace Publishers.

Course No: IPE 0541 3122	**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 python language and MATLAB application to replicate various algorithm studied in the course 'Numerical Analysis and Optimization'. 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 python 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 python or MATLAB) of different algorithm studied on IPE 0541 3121.

Course Learning Outcomes, COs

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

CO 1: demonstrate the user interface of MATLAB application and uses of its various options and menus

CO 2: develop computer based numerical solution models using both python language and MATLAB;

CO 3: generate solutions from computer-based model and interpret the result in the context of the original problem;

CO 4: compare between solutions given by model and evaluate the usefulness on basis of error acceptance;

CO 5: apply their team effort to model and solutions generation of real-life problems.

Mapping of COs with POs

Course Learning Outcomes (COs)	**Fundamental Skills**				**Social Skills**			**Thinking Skills**		**Personal Skills**		
	PO1	**PO2**	**PO3**	**PO5**	**PO6**	**PO9**	**PO10**	**PO4**	**PO7**	**PO8**	**PO11**	**PO12**
CO 1		2										
CO 2	3			2								
CO 3		2		1								
CO 4	2	2										
CO 5						2					1	1

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	**Teaching-Learning Strategy**	**Assessment Strategy**
CO 1	Lecture using board and Tutorial	Quiz, Report assessment and Semester-end oral examination
CO 2	Lecture using board, Assignment and Instruction materials	Quiz, Report assessment and Semester-end oral examination
CO 3	Lecture using board, Assignment and Instruction materials	Quiz, Report assessment and Semester-end oral examination
CO 4	Lecture using board, Assignment and	Quiz, Report assessment and Semester-end oral examination

	Instruction materials	
CO 5	Lecture using board, Assignment	Report assessment and Semester-end oral examination

Books Recommended:
Chapra, S. C. and Canale, R. P., Numerical methods for engineers, McGraw Hill.

Course No.: IPE 1022 3132	**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:
Measurement of anthropometric data using anthropometer and analysis of secondary data; Design and drafting of a class room and executive chair, computer chair and table using the data measured in experiment-I (drafting in AutoCAD environment); 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; Assessment of luminance in different workplace -inside industries, classrooms, and laboratories; Measurement of pinch and grip strength and their applications in production/hand tool design and drafting (drafting in Auto CAD environment); The complete Minnesota Manual Dexterity test for rapid eye-hand-finger movement; Study of industrial safety signs, their types and purposes.

Course Learning Outcomes (COs):
After the successful completion of the course, students will be able to:

CO 1: apply the principles of anthropometry in ergonomic design of work areas and equipment;
CO 2: identify the components of various ergonomics equipment, their functions, as well as their operational procedures;
CO 3: evaluate pinch and grip strength values, and their applications in production/hand tool design
CO 4: identify rapid eye-hand-finger movement using ergo-equipment (Minnesota Manual Dexterity test)
CO 5: demonstrate industrial safety signs, and their applications in industries.

Mapping of COs with POs

Course Learning Outcomes (COs)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1	3				1							
CO 2	1	2										
CO 3	1	2										
CO 4		3						1				
CO 5						2					1	1

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/projectors, and Assignment	Quiz, Assignment, Report and Oral Exam
CO 2	Lecture using board/projectors and video demonstration	Quiz, Report and Oral Exam
CO 3	Lecture using board/projectors, Tutorial and Assignment	Assignment and Report
CO 4	Lecture using board/projectors, Tutorial and Assignment	Quiz, Assignment, Report and Oral Exam
CO 5	Lecture using board/projectors and Assignment	Quiz, Assignment, Report and Oral Exam

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.

Course No: IPE 0788 3152	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 design, development and fabrication of a firm's 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., industrial design, engineering, and production)
- 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 and scoring, concurrent engineering, quality function deployment; 3D Scanner and printer-based operations.

Course Learning Outcomes, COs
After the successful completion of the course, students will be able to:

CO 1: explain the product development process and apply the appropriate methods of concept development;
CO 2: effectively communicate ideas and concepts into written, visual and digital presentations;
CO 3: apply the methodologies for product design and development to create, evaluate and select design concepts;
CO 4: interpret design rules for material selection, design for manufacturability, design for assembly, and design for environment;
CO 5: demonstrate the theoretical knowledge into practical applications using 3D scanner and printer-based operations.

Mapping of COs with POs

Course Learning Outcomes (COs)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1	2	1										
CO 2		2					2					
CO 3			2			2						
CO 4	2						2		2			
CO 5		2									2	

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/projectors,	Quiz, Presentaion, and Oral
CO 2	Lecture using board/projectors, Tutorials, video demonstration	Quiz, Presentaion, Assignment, Viva voce
CO 3	Lecture using board/projectors, tutorials, group work	Quiz, Presentaion, Report, Viva voce
CO 4	Lecture using board/projectors, tutorials, group work	Quiz, Presentaion, Workbook, Assignment, Viva voce
CO 5	Lecture using board/projectors, on-hand applications, group work.	Product assessment, Presentaion, Viva voce

Books Recommended:
1. Karl T. Ulrich and Steven D. Eppinger, Product Design and Development, New York, McGraw-Hill.
2. Dale H. Besterfield, C. Besterfield-Michna, G.H. Besterfield, M. Besterfield-Sarce, Total Quality Management, Pearson Prentice Hall.

Third Year Second Semester

Course No: IPE 0413 3235	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 of organization. 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 both the 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:

- demonstrate understanding of basic principles of Industrial anagement, 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 emPOyees
- 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, COs

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

CLO 1: demonstrate understanding of basic principles of Industrial management, and the activities of an industrial enterprise.

CLO 2: explain how the industrial engineering activities are carried out and managed

CLO 3: compare and contrast how managers can effectively plan in today's dynamic environment, design the organization structure, and describe how environmental uncertainty affects the organization design

CLO 4: apply known procedures of management theories and issues to real-life decision-making process

CLO 5: interpret organizations' system based on the psychology of human being, and the usefulness of personal development programs.

Mapping of COs with POs

Course Learning Outcomes (COs)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1	3	2										
CO 2		2	1									
CO 3			2		2							
CO 4	2							2				1
CO 5						1					3	

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using projectors	Short answer, Midterm Exam 1, and Semester-end Exam
CO 2	Lecture using projectors, Discussion	Assignment and Semester-end Exam
CO 3	Lecture using board and projectors, Group work	Problem solving task cards, Assignment, Midterm Exam 1, and Semester-end Exam
CO 4	Lecture using projectors, Tutorial	Quiz, Midterm Exam 2, and Semester-end Exam
CO 5	Lecture using projectors, Group discussion	Midterm Exam 2 and Semester-end Exam

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.

Course No.: IPE 0788 3237	Credit: 3.0	Year: Third	Semester: Second
Course Title: Operations Management		Course Status: Theory	

Rationale of the Course:
Operations Management, in short OM, is a business function that plans, organizes, coordinates, and controls the resources needed to produce a company's goods and services for customers. Operations management is a management function that involves managing people, equipment, technology, information, and many other resources. Regardless of company size, OM is the central core function of all businesses. Therefore, by studying the Operations Management course, students will be able to understand how work gets done, setting up processes, uncovering the bottlenecks, tuning processes to save time and money, and managing resources 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.
- to understand the key concepts and issues of OM in both manufacturing and service organizations;
- to identify the operational issues in the value adding and non-value adding operations;
- to make students able to take responsibilities in four categories of work- direct, design, deliver, and develop a process;
- to 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 of Operations Management; 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 analysis and Engineering, Taguchi Methods, VSM, Forecasting: Subjective 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 Scheduling: Sequencing and scheduling concepts, Priority rules, Dispatching, Routing, Machine loading, Scheduling in different situations – single, double and triple machines & n jobs (Johnsons rule), Gantt chart.

Course Learning Outcomes, COs
After successful completion of the course, students will be able to:

CO 1: explain the basics of the input–output framework, production systems occurring in an operations unit, and the challenges they face and roles and responsibilities of operations managers in an organization;
CO 2: analyze different types of production processes for innumerable design decisions, and how they relate to the overall strategies of an organization;
CO 3: apply the fundamental and subjective knowledge to forecasting, work improvement, inventories, job scheduling, etc., and manage them in the production system;
CO 4: develop the skills needed to ensure the ongoing contribution of a firm's operations to its competitive position;
CO 5: apply the engineering knowledge to solve real-world unstructured problems related to various production planning and control areas.

Mapping of COs with POs

Course Learning Outcomes (COs)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO 1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1	2											
CO 2	1	2										
CO 3	3	1										
CO 4				2							2	
CO 5				2		3						

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using multimedia projectors, Tutorial, and Assignment	Assignment, Midterm Exam 1, and Semester-end Exam
CO 2	Lecture using multimedia projectors, Tutorial, and Assignment	Assignment, Midterm Exam 1, and Semester-end Exam
CO 3	Lecture using multimedia projectors, Tutorial, and Assignment	Assignment, Midterm Exam 2, and Semester-end Exam
CO 4	Lecture using multimedia projectors, Tutorial, and Assignment	Midterm Exam 2, and Semester-end Exam
CO 5	Lecture using multimedia projectors, Tutorial, and Assignment	Assignment and Semester-end Exam

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, 10e, 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.

Course No: IPE 0541 3239	**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 the given circumstances, OR plays the role of a powerful 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 how 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, Branch and Bound 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, COs

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

CO 1: demonstrate an understanding of concepts of how operations research linked to decision making;

CO 2: apply various techniques of operations research to solve complex engineering problems;

CO 3: design models for a real-world industrial problem applying mathematical programming;

CO 4: putting techniques together to develop optimum strategies to relevant situations;

CO 5: make judgements based on criteria and tools of operations research in manufacturing and service industries.

Mapping of COs with POs

Course Learning Outcomes (COs)	**Fundamental Skills**				**Social Skills**			**Thinking Skills**		**Personal Skills**		
	PO1	**PO2**	**PO3**	**PO5**	**PO6**	**PO9**	**PO10**	**PO4**	**PO7**	**PO8**	**PO11**	**PO12**
CO 1	2	1										
CO 2	2	2										
CO 3				2								1
CO 4			2	2								
CO 5					2						1	1

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	**Teaching-Learning Strategy**	**Assessment Strategy**
CO 1	Lecture using board and Instruction materials	Semester-end Exam
CO 2	Lecture using board and Tutorial	Assessment, Midterm Exam 1, and Semester-end Exam
CO 3	Lecture using board and Tutorial	Assessment, and Midterm Exam 1
CO 4	Lecture using board and Assignment	Midterm Exam 2, and Semester-end Exam
CO 5	Lecture using board and Assignment	Assessment, and Semester-end Exam

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.

Course No.: IPE 0715 3241	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;
- make the students understand the difference among various manufacturing processes in the same category;
- develop skill in identifying, formulating, and solving real-life manufacturing problems;
- provide knowledge about various conventional and nonconventional manufacturing processes, explain parameters used, and estimate the associated costs of manufacturing.

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 processes: 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, COs
After successful completion of the course, students will be able to:
CO 1: explain various bulk deformation processes and sheet metal forming processes, and their differences;
CO 2: describe how various nonconventional machining and joining processes, and plastic product manufacturing processes work, and differentiate them from one another;
CO 3: evaluate the usefulness of various nonconventional machining and joining processes in manufacturing;
CO 4: apply the engineering knowledge to solve real-life problems related to various metal forming, machining, and joining processes;
CO 5: design a manufacturing process/system and their operational sequence appropriate for fabricating a desired part/product.

Mapping of COs with POs

Course Learning Outcomes (COs)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO 1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1	2											
CO 2	2	2										
CO 3	1	2		2		1						
CO 4	3					1						1
CO 5			3	1								

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using whiteboard, multimedia projector, Tutorial, and Video demonstration.	Assignment, Midterm Exam 1, and Semester-end Exam
CO 2	Lecture using whiteboard, multimedia projector, and Video demonstration	Quiz and Semester-end Exam
CO 3	Lecture using whiteboard, multimedia projector, Tutorial, and Assignment	Assignment, Midterm Exam 2, and Semester-end Exam
CO 4	Lecture, multimedia projector, Tutorial, and Assignment work	Class assessment, Midterm Exam 2, and Semester-end Exam
CO 5	Lecture using whiteboard, multimedia projector, and Assignment	Classroom assessment, Assignment and Semester-end Exam

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

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.

Course No: MEE 0714 3203G	Credit: 3.0	Year: Third	Semester: Second
Course Title: Measurement and Instrumentation		Course Status: Theory	

Rationale of the Course:
This course introduces industrial instrumentation used for troubleshooting, process measurements and process control. Specifically, the course encompasses measurement terminology, working principles of various measuring devices, and modern instruments used for industrial process measurement and control. It also helps the students to deploy these understandings in practical aspect.

Course Objectives:
The objectives of this course are to:
- familiarize students with different engineering measuring instrument
- provide the knowledge of working principles for various measuring 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 control system like PLC.

Course Content:
Introduction to engineering measurements, testing and calibration, error analysis, tolerance, allowance and fit; Taylor's principle on limit gauge; Dimension measurement, Abbey's 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 test; 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, COs
After the successful completion of the course, students will be able to:
CO 1: explain the fundamental concepts of engineering measurement;
CO 2: distinguish between different measuring systems used in industrial processes;
CO 3: analyze different dimensions necessary for industrial settings;
CO 4: evaluate appropriate measuring instrument based on requirements;

CO 5: design electronic devices for industrial automation, process measurement and control.

Mapping of COs with POs

Course Learning Outcomes (COs)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1	3	1										
CO 2	1	2										
CO 3	1	2		2								
CO 4		1		2		1						
CO 5		1				2					1	2

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/projectors	Assessment, Midterm Examination 1, Semester-end examination
CO 2	Lecture using board/projectors, tutorial	Assessment, Midterm Examination, Semester-end examination
CO 3	Lecture using board/projectors, Assignment/ tutorial	Midterm Examination 2, Assignment, Semester-end examination
CO 4	Lecture using board/projectors, Assignment, tutorial, Self-learning	Assignment, Semester-end examination
CO 5	Lecture using board/projectors, Assignment, tutorial and case study	Assignment, Semester-end examination

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
3. Thomas G. Beckwith, N. Lewis Buck and Roy D. Maragoni, Mechanical measurement, Narosa Publishing House.

Course No.: MEE 0714 3204G	Credit: 1.0	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 hands-on 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 test.

Course Learning Outcomes, COs
After the successful completion of the course, students will be able to:
CO 1: explain different instrumentation and control systems;
CO 2: measure dimensional accuracy and calibration of different measuring instruments;
CO 3: perform shaft alignment test, thickness measuring test, ultrasonic test, sampling and normality test, etc.;
CO 4: develop electrical measuring instrument in a group used for industrial purposes.

Mapping of COs with POs

Course Learning Outcomes (COs)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1	1	2										
CO 2	2	2										
CO 3	1	2										
CO 4				2		2					1	

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course	Teaching-Learning Strategy	Assessment Strategy
Learning Outcomes (COs)		
CO 1	Lecture using board/projectors, experimental work	Report, Quiz and Semester-end examination
CO 2	Lecture using board/projectors, experimental work	Report, Quiz and Semester-end examination
CO 3	Lecture using board/projectors, experimental work	Report, Quiz and Semester-end examination
CO 4	Lecture using board/projectors, video demonstration, case study, experimental work	Device assessment, Report, presentation

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

Course No: IPE 0788 3236	Credit: 1.5	Year: Third	Semester: Second
Course Title: Operations Management and QCM Sessional		Course Status: Sessional	

Rationale of the Course:
This course deals with an in-depth knowledge of different tools and techniques used for solving complex problems in operations management and quality control. It also helps students learn to use statistical software as a problem-solving tool.

Course Objectives:
The objectives of this course are to:
- familiarize students with different statistical softwares like SPSS, Minitab, Microsoft Excel
- enable students creating different control charts and Pareto analysis using a statistical software
- make students able to conduct design of experiments (DOE) in a 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:
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; With necessary assumptions, deriving the EOQ

formula, and solving the problems of Inventory Management: EOQ, EPQ, EBQ, and Price discount model; Developing a Gantt Chart to solve the planning problems; Solving the sequencing and scheduling problems (basic priority rules, Johnson's rule: 2 machine n jobs, 3 machine n jobs); With necessary diagrams, solving the given problems using SPC tool and techniques; With necessary diagrams, constructing the model, and solving problems of control chart (chart for attributes and chart for variables); Drawing OC curves, and solving the problems of acceptance sampling (single and multiple sampling); Preparing a DoE table, and interpreting the result obtained from a set of given data.

Course Learning Outcomes, COs

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

CO 1: use different statistical software like SPSS, Minitab, Microsoft Excel;
CO 2: create different control charts and Pareto analysis using statistical software;
CO 3: conduct design of experiments (DOE) using a selected software(s)
CO 4: solve large forecasting and inventory management problems with the help of software;
CO 5: solve large problems of production scheduling using statistical software.

Mapping of COs with POs

Course Learning Outcomes (COs)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1	1	2		2								
CO 2		3		1								
CO 3		2		2								
CO 4		2		3								
CO 5		2		2							1	

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/projectors, tutorial	Viva
CO 2	Lecture using board/projectors, tutorial, Lab. work	Report, Quiz, and Semester-end Examination
CO 3	Lecture using board/projectors, tutorial, Lab. work	Report, Quiz, and Semester-end Examination
CO 4	Lecture using board/projectors, tutorial, Lab. work	Report, Quiz, and Semester-end Examination
CO 5	Lecture using board, Overhead projectors, tutorial, Lab. work	Report, Quiz, and Semester-end Examination

Books Recommended:

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

Course No.: IPE 0715 3242	Credit: 1.5	Year: Third	Semester: Second
Course Title: Manufacturing Processes – 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 the student conceptualize and analyze the effect of parametric influences during processing of materials;
- facilitate student 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, Micromachining, 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, COs

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

CO 1: identify different cutting tools with respect to their geometry and functionality;
CO 2: categorize the various conventional and unconventional manufacturing processes based on mechanisms employed and energy sources;
CO 3: perform various forming and machining operations using a bending machine, an injection molding machine, lathe, drill press, and milling machine, electrochemical machine and laser machine individually;

CO 4: calculate the different machining responses of respective machines, including the effect of process parameters and output characteristics;

CO 5: apply their team effort and understanding of theoretical knowledge on machining to the fabrication of a specified product as per given specifications.

Mapping of COs with POs

Course Learning Outcomes (COs)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO 1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1	1	2										
CO 2	2	1										
CO 3	3	1										
CO 4		3										
CO 5				3				1				

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using whiteboard and supplied cutting tools	Lab report, Assignment, Quiz and Semester-end oral examination
CO 2	Lecture using whiteboard and machine/machine tools in the IPE workshop	Lab report, Assignment, Quiz and Semester-end oral examination
CO 3	Lecture using whiteboard and on hand training on machine/machine tools in the IPE workshop	Lab report, Assignment, Quiz and Semester-end oral examination
CO 4	Lecture using whiteboard and hands on training on machine/machine tools	Lab report, Assignment, Quiz and Semester-end oral examination
CO 5	Lecture using whiteboard and using machine/machine tools	Project report, and Semester-end oral Exam

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.

Course No.: IPE 0031 3250	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 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 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 the third year.

Course Learning Outcomes, COs

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

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

CO 02: explain the fundamental aspects of basic engineering problems/situations with confidence in future.

Mapping of COs with POs

Course Learning Outcomes (COs)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1							2					
CO 2						2						1

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Self-learning on first year courses	Viva-voce

CO 2	Self-learning on first year courses	Viva-voce

Books Recommended:
Books recommended and material supplied for the courses covered in fifth and sixth semester.

Course No.: IPE 0031 3254	**Credit: 1.0**	**Year: Third**	**Semester: Second**
Course Title: Business Communication Seminar		**Course Status: Sessional**	

Rationale of the Course:
Business communication seminar 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, COs
After the successful completion of the course, students will be able to:

CO 1: demonstrate competencies in writing, listening, and verbal skills using the latest technology when appropriate
CO 2: work as part of a team as related to human relations, time management, and accomplishing planning goals
CO 3: apply problem solving capabilities through analytical skills, critical thinking, and creativity
CO 4: apply known procedures to leadership, self-motivation, and confidence in professional and social interaction
CO 5: demonstrate understanding of concepts of moral and professional business behavior.

Mapping of COs with POs

Course Learning Outcomes (COs)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1							1				1	
CO 2											2	
CO 3			3									
CO 4						3						
CO 5										2		2

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using projectors	Quiz and Semester-end oral examination
CO 2	Discussion sessions, Tutorial, and Group work	In-class assessment
CO 3	Lecture using projectors, and Assignment	Assignment
CO 4	Tutorial	Assignment, and Semester-end Exam
CO 5	Tutorial	In-class assessment

Books Recommended:
Reference materials will be supplied by the course teacher.

Course No: IPE 0031 3260	**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 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, COs
After the successful completion of the course, students will be able to:
CO 1: identify the work responsibility, and ethics in the working environment;
CO 2: explain general and specific procedures of engineering field related to industry;
CO 3: apply theorical knowledge and engineering methods to a solve industrial problem;
CO 4: communicate effectively within the working environment and prepare a technical report.

Mapping of COs with POs

Course Learning Outcomes (COs)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1										2		
CO 2		2			1							
CO 3	3				1							
CO 4						1	2					1

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Training in selected industries	Viva and Technical report
CO 2	Training in selected industries	Viva and Technical report
CO 3	Training in selected industries	Viva and Technical report
CO 4	Training in selected industries	Viva and Technical report

Fourth Year First Semester

Course No.: IPE 0788 4131	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 and variables
- understand details of simulation process with input and output analysis;
- 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 shortcomings; objectives of simulation in industrial and service organizations, areas of applications; 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, inventory system and business modeling; Random Numbers: Properties, techniques and testing of randomness; Random Variates: Inverse transform techniques; Input modeling: Identifying the distribution of data, parameter estimation, Goodness of Fit tests; Simulation of manufacturing and material handling systems; System Dynamics: Causal loop diagramming; Behavior of linear low order systems – Order of the system, positive and negative feedback systems.

Course Learning Outcomes, CO
After successful completion of the course, students will be able to:
CO 1: explain systems, models and simulation techniques;
CO 2: simulate queuing, inventory, material-handling systems and business modeling processes;
CO 3: apply the probability theories involved in the simulation process;
CO 4: validate and verify simulation models applicable to industries;
CO 5: develop the system dynamic tools for the real-life scenarios.

Mapping of COs with POs

Course Learning Outcomes (CO)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO 1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1	3	1										
CO 2	2	2										
CO 3		2		2					1			
CO 4					2							1
CO 5				3							2	1

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/projectors	Assignment, Midterm Exam 1, and Semester-end Exam
CO 2	Lecture using board/projectors, Tutorial and Assignment	Quiz and Semester-end Exam
CO 3	Lecture using board/projectors, Tutorial and Assignment	Assignment, Midterm Exam 2, and Semester-end Exam
CO 4	Lecture using board/projectors	Midterm Exam 2, and Semester-end Exam
CO 5	Lecture using board/projectors and Assignment	Assignment and Semester-end Exam

Books Recommended:

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

Course No: IPE 0413 4133	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 framework of supply chain management and its functional areas
- acquaint students with the concept of supply chain networks development
- make students able to analyze the existing supply chain and modify it for better service and profitability
- accumulate ideas about current trends of global supply chain management with emerging e-commerce
- provide the necessary knowledge for better coordination among the partners so that the bullwhip 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 performance drivers and obstacles: Inventory, Transportation, Facilities and Information; Distribution Networks: role of distribution, common types of distribution networks, metrics for evaluation; 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, IT in the supply chain for industry 4.0. Coordination in a Supply Chain: The Bullwhip Effect, effects on performance, the obstacles and the remedies, Partnerships and Trust within a supply chain; Sustainable supply chain thoughts.

Course Learning Outcomes (COs)

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

CO 1: describe the major areas of the supply chain and their performance drivers;
CO 2: apply the supply chain network fundamentals to develop the distribution network;
CO 3: evaluate different sourcing, pricing, and transportation modes for profit maximization and cost minimization;
CO 4: justify the proper inventory management system for the whole supply chain;

CO 5: relate the conflicting issues for better co-ordination, to facilitate building partnership and trust among the partners.

Mapping of COs with POs

Course Learning Outcomes (CO)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1	3	1										
CO 2	2	1		2								
CO 3		2		3								
CO 4		2		3				2				
CO 5		2	3									

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using projectors and Instruction materials	Quiz and Semester-end examination
CO 2	Lecture using projectors and Tutorial	Assignment, Mid-semester exam-1 and Semester-end oral examination
CO 3	Lecture using projectors and Tutorial	Assignment, Mid-semester exam-2 and Semester-end oral examination
CO 4	Lecture using projectors and Assignment	Assignment, and Semester-end oral examination
CO 5	Lecture using projectors, Assignment and case study	Case report, presentation and Semester-end oral examination

Books Recommended:

1. Supply Chain Management: Strategy, Planning, and Operations by Sunil Chopra and Peter Meindl. Prentice Hall.
2. Logistics and Supply Chain Management, by Martin Christopher, Prentice Hall.

Course No: IPE 0715 4141	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, machining parameters to reduce the machining time while maintaining quality.

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 tools; 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 stepless mechanical drives, electrical drives; Spindles and Bearings; Study of kinematic diagrams: Engine lathe, milling, drilling machines; 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; Tool geometry; Mechanics of chip curl; Chip breakers; Cutting forces, Economics of metal cutting; Tool life; Metal cutting dynamometers.

Course Learning Outcomes, CO (5)

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

CO 1: explain various parts of machine tools, their characteristics and the mechanisms of transmission elements;

CO 2: illustrate driving systems of machine tools, preparing layout of speed and feed gear boxes;

CO 3: interpret the kinematic diagrams of machine tools;

CO 4: describe the geometry of cutting tools, tool life, tool wear and tool failure during machining;

CO 5: explain the chip formation mechanism, cutting forces, chip breakers and the economics of metal cutting during machining.

Mapping of COs with POs

Course Learning Outcomes (CO)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1	3											
CO 2	3											
CO 3	1	2										
CO 4	2	2						2				1
CO 5	3	1							1			

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/projectors, video demonstration	Quiz, Mid-semester exam-1 and Semester-end examination
CO 2	Lecture using board/projectors, video demonstration	Assignment, Mid-semester exam-1 and Semester-end examination
CO 3	Lecture using board/projectors, video demonstration, tutorial	Assignment, Mid-semester exam-2 and Semester-end examination
CO 4	Lecture using board/projectors, video demonstration	Assignment, and Semester-end examination
CO 5	Lecture using board/projectors, video demonstration, tutorial, assignment	Semester-end examination

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.

Course No: IPE 0715 4143	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 systems; NC/CNC: Historical development, features, types and components 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): Characteristics, manufacturing systems reconfiguration, reconfiguration level; CIM: Concepts, architectures, benefits, challenges, and implementation, databases for CIM.

Robotics: Concepts and types of robots, overview of robot subsystems, resolution, repeatability and accuracy, degrees of freedom of robots, robot configurations and concepts 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, CO

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

CO 1: describe the basic concepts of computer-based technology used in product design (CAD) and manufacturing(CAM);

CO 2: apply programming codes for NC/CNC to fabricate a given manufactured product on an automated machine tools;

CO 3: distinguish FMS and other manufacturing systems including RMS;

CO 4: explain processing stations and material handling systems used in FMS environments;

CO 5: explain the basic principles of robot technology, classification, structures, drives, sensors and actuators for industrial robots.

Mapping of COs with POs

Course Learning Outcomes (CO)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1	3	1										
CO 2	2			3								
CO 3	1	3										
CO 4	2	2										
CO 5		1		2								2

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using projectors	Quiz, Mid-semester exam-1 and Semester-end examination
CO 2	Project /tutorial	Assignment, Mid-semester exam-1 and Semester-end examination
CO 3	Lecture using projectors	Assignment, Mid-semester exam-2 and Semester-end examination
CO 4	Lecture using projectors/ Assignment, video demonstrtion	Assignment, and Semester-end examination
CO 5	Lecture using projectors, video demonstrtion	Semester-end examination

Course Requirements:
Concept of python programming and conventional machining processes.

Books Recommended:

1. CAD/CAM: Computer-Aided Design and Manufacturing, by Groover M. and Zimmers E. 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
4. Computer Integrated Manufacturing, Alan Weather all, EWP
5. Robotics Technology and Flexible Automation, S. R. Deb, Tata McGrow Hill
6. Industrial Robotics, Mikell P. Groover, McGrow Hill

Course No.: IPE 0715 4145	Credit: 3.0	Year: Fourth	Semester: First
Course Title: Micro and Nano Manufacturing Techniques		Course Status: Theory	

Rationale of the Course:
As technology progresses, equipment is becoming increasingly miniaturized. At smaller scales, both materials and equipment exhibit different behaviors, necessitating the development of new technologies for producing miniature components. This course aims to familiarize students with the technologies used in micro- and nano-scale manufacturing.

Course Objectives:
The objectives of this course are to:
- make the students understand the concept of Micro- and Nano-manufacturing;
- facilitate the necessary knowledge about the fundamental and practical aspects of a wide range of manufacturing technologies used in practice to fabricate products at micro- and nano-scale;
- help the students understand the difference among various Micro- and Nano-manufacturing technologies of the same category;
- develop skills in identifying and selecting Micro- and Nano-manufacturing technologies appropriate for making a particular product in the industrial settings.

Course Content:
Introduction: Overview of micromanufacturing, approaches to nanotechnology, *Transition from nanotechnology to nanomanufacturing*: Top-down approach and bottom-up approach, challenges and opportunities related to micro- and nanomanufacturing, toxicology and ethical issues concerning nanotechnologies; **Micro and Nano-manufacturing Technologies:** *Deposition technologies*: Introduction and historic background, Thermal Physical Vapor Deposition (Thermal PVD), Plasma/Arc PVD, Solgel Technology, *Electrochemical and Chemical Reaction Deposition*: Electrochemical Deposition, Chemical Deposition: Electroless Plating; *Etching technologies*: Etching technologies basics, Wet-Chemical Etching, Dry Etching, LIGA: Introduction, LIGA infrastructure, LIGA Fabrication, Direct LIGA, LIGA and Direct LIGA production samples; ***Micro-Machining*****:** *Material removal at micro-scale*: size effect, chip thickness, Micro-Structure and Grain Size Effects; Tool Stiffness and Deflections under Dynamic Loading; Sustainability of Micro-Manufacturing Technologies.

Course Learning Outcomes, COs
After successful completion of the course, students will be able to:
CO 1: explain the fundamental concepts of Micro- and Nano-manufacturing, ethical and sustainability issues concerning Micro- and Nano-technologies;
CO 2: describe various technologies used to manufacture products at Micro- and Nano-scales;

CO 3: apply the engineering fundamentals and specialized knowledge specific to the Micro- and Nano-manufacturing technologies to manufacture various products at Micro- and Nano-scales;

CO 4: differentiate various Micro- and Nano-manufacturing technologies of same categories, including the technologies related to deposition, etching, lithography, and LIGA.

Mapping of COs with POs

Course Learning Outcomes (COs)				Social Domain	Thinking Domain		Personal Domain	
	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO 1	2							
CO 2	3							
CO 3		3						
CO 4		2			1			

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using multi-media projectors	Quiz and Semester-end Exam
CO 2	Lecture using multi-media projectors and Assignment	Assignment, Midterm Exam 1 and Semester-end Exam
CO 3	Lecture using multi-media projectors and Group presentation	Report Assessment, Midterm Exam 2, and Semester-end Exam
CO 4	Lecture using multi-media projectors	Midterm Exam 2, and Semester-end Exam

Books Recommended:

1. Ahmed, W. & Jackson, M. J. (2009). Emerging nanotechnologies for manufacturing. Elsevier, Linacre House, Jordan Hill, Oxford OX2 8DP, UK.
2. Gatzen, H. H., Saile, V., & Leuthold, J. (2015). Micro and nano fabrication. Springer, Berlin, Heidelberg.
3. Qin, Y. (2010). Micromanufacturing engineering and technology. Elsevier, The Boulevard, Langford Lane, Kidlington, Oxford OX5 1GB, UK
4. Lyshevski, S. E. (2018). Nano-and micro-electromechanical systems: fundamentals of nano-and microengineering. CRC press, Washington, D.C., USA.

5. Bhushan, B. (Ed.). (2017). Springer handbook of nanotechnology. Springer-Verlag GmbH Germany
6. Van de Voorde, M., Werner, M., & Fecht, H. J. (Eds.). (2015). The nano-micro interface: bridging the micro and nano worlds. John Wiley & Sons.

Course No: IPE 0488 4136	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 satisfy individual and organizational objectives. First part of this course deals with the concepts of marketing, followed by the fundamentals of each of the most important marketing tasks. Second part of this course contains the cost management 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 analyze how different situations in the competitive environment that affect choices in target marketing
- provide real-life examples or scenarios to enable them properly to evaluate the situation
- acquaint students with the tools and techniques available to measure various costs involved in decision-making and performance evaluation
- provide knowledge about the importance of process costing and cost allocation.

Course Content:

Marketing Management: Introduction to marketing, Marketing concepts, Marketing environment, Consumer-buying behavior, 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, CO

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

CO 1: explain the basic concepts necessary to deal with marketing decision making;

CO 2: analyze elements and tactics together to form a coherent marketing strategies intended to domestic, as well as international markets;

CO 3: interpret different market research techniques and their applications to run a business in the domestic and global arena;

CO 4: demonstrate analytical skills pertaining to cost management;

CO 5: apply relevant procedures to new situation and various real-life problems linked to cost and management accounting.

Mapping of COs with POs

Course Learning Outcomes (CO)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1	2	1										
CO 2	1	2		3								
CO 3		3		2								
CO 4	3										1	
CO 5	3	2									2	

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using projectors	Midterm Exam 1, and Semester-end Exam
CO 2	Lecture using projector, and Tutorial	Assignment and Semester-end Exam
CO 3	Lecture using board/projectors, Group work Problem solving tasks	Assignment, Midterm Exam 1, and Semester-end Exam
CO 4	Lecture using projectors	Quiz, Midterm Exam 2, and Semester-end Exam
CO 5	Lecture using projectors, Tutorials	Semester-end Exam

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.

Course No: IPE 0413 4137	Credit: 3.0	Year: Fourth	Semester: First
Course Title: Organizational Behavior		Course Status: Theory	

Rationale of the Course:

The main objective of the course is to help the students acquire and develop skills to make rational decisions by understanding the human interactions in an organization, finding what is driving it, and influencing it for better results in attaining business goals. It details the impact of individual, group, and organizational factors on human behavior. It highlights the significance of the challenges and opportunities of Organizational Behavior (OB), perception, attribution, learning, organizational change, organizational culture, motivation, leadership, and conflict management.

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, COs

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

CO 1: define basic organizational behavior principles, and analyze how these influence behavior in the workplace;

CO 2: analyze individual human behavior in the workplace as influenced by personality, values, perceptions, and motivations;

CO 3: outline the elements of group behavior including group dynamics, communication, leadership, power and politics, and conflict and negotiation;

CO 4: apply management styles as they relate to influencing and managing behavior in organizations;

CO 5: demonstrate critical thinking and analysis skills through the use of management case studies, personal application papers, and small group exercises.

Mapping of COs with POs

Course Learning Outcomes (CO)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1	2											
CO 2	2	2			1							
CO 3	2					2				1		
CO 4						2					1	
CO 5		2	2			2	2					1

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using projectors	Semester-end Exam
CO 2	Lecture using projectors, and Tutorial	Quiz, Midterm Exam 1, and Semester-end Exam
CO 3	Lecture using projectors, and Tutorial	Midterm Exam 2 and Semester-end Exam
CO 4	Lecture using projectors	Assignment, Midterm Exam 1, and Semester-end Exam
CO 5	Lecture using projectors, Tutorial, and Assignment	Assignment and Semester-end Exam

Books Recommended:

1. McShane, SL and Travaglione, T, Organizational Behavior on the Pacific Rim, McGraw-Hill, Roseville

2. Langton, Robbbins and Judge, Fundamentals of Organizational Behaviour, 4th Canadian Edition, Pearson.Bounce Back, Nelson Press.

Course No: IPE 0788 4138	Credit: 3.0	Year: Fourth	Semester: First
Course Title: Industrial Psychology and Industrial Laws			Course Status: Theory

Rationale of the Course:

This course is designed to enable students to expand their understanding of how to apply psychological principles to the workplace context and employee lives. It also covers topics ranging from selecting employees to improving work-life satisfaction and reducing work-stress. 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:

- provide a comprehensive knowledge of how psychological methods and theories are applied in industrial and organizational settings
- equip students with an in-depth look at the application of psychology in job analysis, performance appraisal, work motivation, work attitudes, etc.
- develop a strong appreciation of the importance of group dynamics, organizational climate, culture, and socialization
- acquaint them with the structure, environment and functions of trade unions, employer associations
- provide knowledge of Bangladesh and the International Labor Law Act
- make students understand the environmental conservation law and ammendments.

Course Content:

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 and ammendments, International Labor Law; 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. *Industrial Psychology*: Definitions, characteristics and components; Work motivation; Job attitudes; Group and Team formation: Theories of group formation, stages of group development, mitigating group conflicts, group dynamics; Organizational climate, culture, and socialization; *Managing Change*: Organizational Change and Learning; Fairness and diversity in the workplace.

Course Learning Outcomes, COs

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

CO 1: explain and evaluate the theories, research, and practices within the field of Industrial psychology;

CO 2: describe the socio-cultural issues facing organizations today and how these issues affect workers, organizations, culture, and society;
CO 3: apply knowledge of the structure of the legal system to various types of legal pronouncements and identify various types of legal issues;
CO 4: classify the various types of legal remedies available under labor laws;
CO 5: trace the development of government regulations of the employment relationship, environmental conservation law, and worker safety regulations.

Mapping of COs with POs

Course Learning Outcomes (CO)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1	3											
CO 2	3											
CO 3	2	1										
CO 4	3									1		
CO 5	2											2

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/projectors	Mid term Exam 1, Semester-end examination
CO 2	Lecture using board/projectors, Assignment	Assignment, Mid term Exam 1, Semester-end examination
CO 3	Lecture using board/projectors	Assignment, Semester-end examination
CO 4	Lecture using board/projectors, Assignment	Mid term Exam 2, Assignment, Semester-end examination
CO 5	Lecture using board/projectors, Assignment	Assignment, Semester-end examination

Books Recommended:

1. Ronald E. Riggio, Introduction to Industrial/Organizational Psychology, Routledge
2. Frank J. Landy, Jeffrey M. Conte, Work in the 21st Century: An Introduction to Industrial and Organizational Psychology, Wiley and Sons
3. Paul E. Spector, Industrial and Organizational Psychology, Wiley and Sons
4. Michael G. Aamodt, Industrial Organizational Psychology: An Applied Approach, Cengage Learning
5. Michael Salamon, Industrial Relations: Theory and Practice, Prentice Hall.
6. H. K. Sharay, Labour and Industrial Law, Universal Law publishing Co.
7. Amendment of the Bangladesh Labor Law

Course No: IPE 0788 4190	Credit: 3.0 + 3.0	Year: Fourth	Semester: First and Second
Course Title: Project and Thesis		Course Status: Project/Thesis	

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 students 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 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, COs
After the successful completion of the course, students will be able to:
CO 1: explain obligations summarizing scientific literatures for theoretical and practical professional specialization areas;
CO 2: interpret, calculate and discuss scientific data related to research questions at hand;
CO 3: demonstrate writing skills through a clear and concise research proposal with scientifically defendable aims, methods and conclusions;

CO 4: demonstrate communication skills through various interactions and oral presentations;

CO 5: evaluate the importance of ethical issues, considering scientific misconduct and plagiarism, in an adequate manner related to the research work.

Mapping of COs with POs

Course Learning Outcomes (CO)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1	2	2										
CO 2		1		2				3				
CO 3							3					
CO 4						2	3					
CO 5										3		2

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Self-study and consultation with supervisor/scientific community and Literature review	Continous assessment
CO 2	Data analysis using scientific tools and techniques	Continous assessment
CO 3	Self-writing, literature review and consultation with supervisor	Continous assessment
CO 4	Seminar or poster presenation	Continous assessment and oral presentation
CO 5	Drafting, plagiarism check and final report	Continous assessment and dissertation

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, and Roger Bougie, Research Methods For Business: A Skill Building Approach, Wiley.

Course No: IPE 0788 4132	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 effects
- help students develop skills to apply knowledge of Microsoft spreadsheet, Arena, MATLAB and computer 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, COs

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

CO 1: solve linear programming problems using Microsoft spreadsheet;

CO 2: generate random numbers using different techniques and computer languages;

CO 3: explain the simulation of inventory, dentist's scheduling and business planning

CO 4: simulate the real system using the Arena simulation software;

CO 5: measure the performance of a real queuing system through manual data collection and simulation.

Mapping of COs with POs

Course Learning	Fundamental Skills	Social Skills	Thinking Skills	Personal Skills

Outcomes (CO)	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1		2		1								
CO 2	2							3				
CO 3				2								
CO 4				3							1	
CO 5					2						2	

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board	Assignment, oral exam and quiz
CO 2	Lecture using board, Tutorial and Assignment	Assignment, oral exam and programming
CO 3	Lecture using board, Tutorial and Assignment	Assignment and quiz
CO 4	Lecture using board	Presentation and oral examination
CO 5	Lecture using board and Assignment	Presentation and oral examination

Books/Software Recommended:

1. B. Khoshnevis, Discrete Systems Simulation
2. A M M Mukaddes, Short Cases of Modeling and Simulation
3. Averill M. Law and W. David Kelton, Simulation modeling and analysis
4. Microsoft spreadsheet, Mat lab, C language and Arena software

Course No.: IPE 0715 4142	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. This course provides hands-on skills on various types of machine tools available in our workshop facilities. It deals with the practical applications 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, COs

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

CO 1: explain the basics of a machine tool structure, machining parameters, various mechanisms, kinematics of traditional machine tools;

CO 2: examine and analyze the tool wear and parameters that affect tool-life;

CO 3: evaluate the chip formation with respect to chip size, shape, color and chip thickness ratio;

CO 4: demonstrate gear and gear trains, and relevant kinematic diagrams of tradional machine tools.

Mapping of COs with POs

Course Learning Outcomes (CO)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1	2	1										

CO 2		2						1				1
CO 3		2						1				
CO 4		2		2							1	

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board and practice in the Machine Shop	Quiz and Semester-end examination
CO 2	Lecture using board and practice in the Machine Shop	Quiz and Semester-end examination
CO 3	Lecture using board and practice in the Machine Shop	Quiz and Semester-end examination
CO 4	Lecture using board and practice in the Machine Shop	Quiz and Semester-end examination

Books Recommended:

1. N. Chernov (Translated by F. Palkin), Machiene Tools, Mir Publishers.
2. Helmi A. Youssef and Hassan El-Hofy, Machining Technology: Machine Tools and Operations, CRC Press.
3. N.K. Mehta, Machine tool design and numerial control, Tata McGraw Hill.

Course No.: IPE 0715 4144	**Credit: 1.5**	**Year: Fourth**	**Semester: First**
Course Title: Advanced Manufacturing System 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 hands-on experience of advanced manufacturing machineries 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 skills 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, CNC Lathe, Laser beam machining, 3D scanner and printer.

Course Learning Outcomes, COs

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

CO 1: describe the functions of various components and accessories of the CNC machines, laser beam machine and 3D scanner and printer;

CO 2: apply part programming for machining a particular product in CNC milling and CNC Lathe;

CO 3: analyze the processes by evaluating process parameters during machining of various materials like ply wood, acrylic etc;

CO 4: evaluate the optimal working conditions for the best quality of machined surfaces using modern machine tools;

Mapping of COs with POs

Course Learning Outcomes (CO)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1	3											
CO 2			2	2								
CO 3		2						2				
CO 4		1						2			1	1

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board and Instruction materials	Quiz, lab report and oral examination
CO 2	Lecture using board and Instruction materials	Assignment, lab report and Semester-end examination
CO 3	Lecture using board and Instruction materials	Quiz, Assignment, lab report and Semester-end examination
CO 4	Lecture using board and	Quiz, lab report and oral

	Tutorial	examination

Books Recommended:
Manuals and hand books available for the operational machines.

Pre-requisite:
Concept of computer programming and conventional machining process

Fourth Year Second Semester

Course No: IPE 0788 4235	**Credit: 3.0**	**Year: Fourth**	**Semester: Second**
Course Title: Project Management		**Course Status: Theory**	

Rationale of the Course:
Projects are important aspects of today's 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 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, COs
After the successful completion of the course, students will be able to:

- **CO 1:** analyze the business situation in the context of scope, cost, timing, resource constraints and justify the importance of PM in relevant industries;
- **CO 2:** apply knowledge of key tools and techniques of PM to accomplish time and resource bound activities in real life industrial environment;
- **CO 3:** apply the role of a project manager in leading, motivating and controlling a program;
- **CO 4:** apply appropriate technology for communication, collaboration, information management and decision support system;
- **CO 5:** develop contracts, resolve conflicts, motivate people and carry out teamwork successfully including uncertainties of activities.

Mapping of COs with POs

Course Learning Outcomes (CO)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1	3	2										
CO 2				1	1						2	
CO 3						2				1	1	
CO 4		2		2			2					
CO 5				2							1	2

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using projectors, Tutorial, and Assignment	Assignment, Midterm Exam 1 and Semester-end Exam
CO 2	Lecture using projectors, Tutorial, and Assignment	Assignment, Midterm Exam 1, and Semester-end Exam
CO 3	Lecture using projectors, Tutorial, and Assignment	Assignment, Midterm Exam 2, and Semester-end Exam
CO 4	Lecture using projectors, Tutorial, and Assignment	Assignment, Midterm Exam 2, and Semester-end Exam
CO 5	Lecture using projectors, Tutorial, and Assignment	Assignment, and Semester-end Exam

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.

Course No: IPE 0788 4239	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's 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, COs

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

CO 01: describe the concepts of operation and production functions in an organization;
CO 02: apply critical thinking to design, operate, and improve the systems that deliver products and services through standard techniques of operations management;
CO 03: explain the principles and their application to planning, design, and operations in manufacturing and service organizations;
CO 04: analyze the inter-relationships inherent in complex socio-economic productive systems;
CO 05: judge business operations, recognizing the importance of effective production and operational strategies to an organization based on its inefficiency and ineffectiveness.

Mapping of COs with POs

Course Learning Outcomes (CO)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1	3	1										
CO 2		2	1									
CO 3	3	1		1								
CO 4		1	2									
CO 5						1	2				2	

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using projectors	Semester-end Exam
CO 2	Lecture using projectors, Tutorial, and Assignment	In-class assessment, Midterm Exam 1, and Semester-end Exam
CO 3	Lecture using projectors, and Assignment	Midterm Exam 1, and Semester-end Exam
CO 4	Lecture using projectors	Midterm Exam 2, and Semester-end Exam
CO 5	Lecture using projectors and Assignment	Assessment, and Semester-end Exam

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 0788 3237) and basic mathematical concepts.

Course No: IPE 0788 4234	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. The course helps students understand the related mathematical concepts, basic techniques, methods and tools for engineering systems. It focuses on development and application of reliability evaluation techniques of engineering systems with emphasis on practical applications of reliability analysis in large-scale systems.

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
- provide students with the mathematical concepts, comprehensive knowledge and technical skills related to systems reliability and systems maintenance functions
- make students familiar with the concept of reliability and the techniques of estimating reliability and related characteristics of components/systems
- facilitate necessary knowledge with regard to maintenance concepts, objectives, types, requirements, functions and 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:* Normal, exponential, Rayleigh, Weibull, and Rectangular distributions; *Reliability Prediction:* Series, Parallel 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, *Reliability Design:* Reliability allocation, Reliability Improvement- Element, Unit and Standby redundancy; Maintainability and Availability; *Maintenance Management:* Concepts, objectives, types of maintenance and their applications; Probability theories applied to maintenance management; A production/ maintenance plan; Total productive maintenance.

Course Learning Outcomes, CO:
After the successful completion of the course, students will be able to:

CO 1: describe the fundamental concepts, tools and techniques, methods used for reliability engineering and maintenance management;
CO 2: evaluate various reliability functions and approaches associated with engineering system components from quality perspective;
CO 3: analyze practical failure data to formulate an appropriate failure model of an engineering system component;
CO 4: apply the engineering knowledge to design, model and analyze practical problems with regard to reliability assessment, requirements and allocation of a product or a system;
CO 5: explain maintenance functions and their requirements, to realize various types, policies, and their applications.

Mapping of COs with POs

Course Learning Outcomes (CO)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1	3											
CO 2	1	2										
CO 3		1		2								
CO 4			2			2					1	
CO 5	2											1

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/projectors and instruction materials	Assignment, Mid-Term exam-1, Semester-end exam
CO 2	Lecture using board/projectors, Tutorial and Assignment	Assignment, Mid-term exam-1, semester-end exam
CO 3	Lecture using board/projectors, Tutorial and Assignment	Assignment, Mid-term exam-2, and semester-end exam.
CO 4	Lecture using board/projectors and assignment	Mid-term exam-2 and semester-end exam.

CO 5	Lecture using board/projectors	Semester-end examination.

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

Course No.: IPE 0715 4245	**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, COs

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

CLO 1: explain the concept of tool design, various issues related to tool-plane referencing systems, and the necessity of using cutting fluids;

CLO 2: discuss the concepts, types, and suitability of commonly used clamping devices, dies, and jigs/fixtures in parts manufacturing;

CLO 3: apply the knowledge related to cutting tools to design and/or choose an appropriate single-point cutting tool and sharpen multipoint cutting tools, including milling cutters;

CLO 4: differentiate various clamping devices, dies, and jigs/fixtures from one another;

CLO 5: design appropriate clamping devices, dies, and jigs/fixtures using tool engineering-based knowledge to meet the specified needs of a parts manufacturing process.

Mapping of COs with POs

Course Learning Outcomes (CO)	**Fundamental Skills**				**Social Skills**			**Thinking Skills**		**Personal Skills**		
	PO1	**PO2**	**PO3**	**PO5**	**PO6**	**PO9**	**PO10**	**PO4**	**PO7**	**PO8**	**PO11**	**PO12**
CO 1		1										
CO 2	2	1										
CO 3	3			2								
CO 4		2										
CO 5			3									

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	**Teaching-Learning Strategy**	**Assessment Strategy**
CO 1	Lecture using projectors	Semester-end Exam
CO 2	Lecture using projectors, and Tutorial	Quiz, Midterm Exam 1, and Semester-end Exam
CO 3	Lecture using projectors, and Tutorial	Midterm Exam 2 and Semester-end Exam

CO 4	Lecture using projectors	Assignment, Midterm Exam 1, and Semester-end Exam
CO 5	Lecture using projectors, Tutorial, and Assignment	Assignment and Semester-end Exam

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

Course No.: IPE 0788 4249	**Credit: 3.0**	**Year: Fourth**	**Semester: Second**
Course Title: CAD and Virtual Reality		**Course Status: Theory**	

Rationale of the Course:

Computer Aided Design (CAD) is a technique for design and technical documentation of a product's design process that replaces manual drafting with an automated process. It involves the use of computer software to aid in the creation, modification, analysis, or optimization of a technical drawing. This course also includes virtual reality, which teaches students different types of virtual reality systems and virtual reality software, e.g., Supers cape, VRT, 3D Studio Max, JACK, World Tool Kit/Sense 8. It provides knowledge of the basic applications of different virtual reality software and their commands, such as coordinating systems, drawing and modifying/editing tools, multi-view drawing and proper dimensioning techniques, organizing drawings with layers, colors, and line types, and use of sectioning and projections for visualization, etc.

Course Objectives:

The objectives of this course are to:

- gain comprehensive knowledge and have technical skills on advanced CAD and virtual reality software and their applications to produce 3D drawings or computer models
- provide the students with in-depth knowledge on CAD hardware and software, part models, and the transfer of data from 3D CAD to VR software

- provide the students with a basic understanding of different types of VR systems and related softwares
- provide hands-on training in the 3D manufacturing environment
- demonstrate the tools and techniques used to create a complete 3D model in a manufacturing environment.

Course Content:

CAD: Introduction to Computer Aided Design; Drawing 3D objects; geometric modeling, curves, surface, finite element analysis, design of optimization; CAD design process, CAD hardware, CAD geometry, Computer graphics and, part model, creating blocks, dimensions, sorting and linking data with graphics, creating and exchanging data from drawing, printing and transfer of data from CAD.
Virtual Reality: Introduction to virtual reality past, present and future; *Virtual Environment*: Definition, application in different areas; Components of virtual reality system-hardware and software; Different virtual reality systems; *Virtual Reality Software*: Superscape, VRT, 3D Studio Max, JACK, World Tool Kit/Sense 8; *Virtual Reality Case Studies*: Military, air-force, navy, medicine, industry, engineering education, and entertainment.

Course Learning Outcomes, CO

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

CO 1: describe the basic concepts, tools, commands of AutoCAD and virtual reality software for creating an engineering object;
CO 2: analyze an 3D object, replicate models into a 3D product, convert into a real life product using 3D printer;
CO 3: apply different types of VR software to solve critical engineering design problems;
CO 4: implement their accumulated knowledge on VR of the areas of defense, education, medicine, and entertainment.

Mapping of COs with POs

Course Learning Outcomes (CO)	**Fundamental Skills**				**Social Skills**			**Thinking Skills**		**Personal Skills**		
	PO1	**PO2**	**PO3**	**PO5**	**PO6**	**PO9**	**PO10**	**PO4**	**PO7**	**PO8**	**PO11**	**PO12**
CO 1	3	1										
CO 2		2	1	3								
CO 3				2	1	1						
CO 4				2		2	1					1

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	**Teaching-Learning Strategy**	**Assessment Strategy**

CO 1	Lecture using board/ projector, video demonstration	Assignment, mid-term exam 1, Semester-end exam
CO 2	Lecture using board/ projector, tutorial, assignment	Assignment, mid-term exam 2, Semester-end exam
CO 3	Lecture using board/ projector, tutorial, assignment	Assignment, mid-term exam 2, Semester-end exam
CO 4	Lecture using board/ projector, tutorial, group project.	Report, Semester-end exam

Books Recommended:

1. Up and running with AutoCAD 2017: 2D and 3D Drawing and Modeling –by *Gindis* and *Elliot*, Academic Press Publisher.
2. AutoCAD 2016 Tutorial: First Level 2D Fundamentals – by Shih, Randy H., SDC Publications, 2015.
3. AutoCAD 2004 Bible –by Finkelstein, Ellen, Wiley Publisher.
4. Understanding Virtual Reality: Interface, Application, and Design by William R. Sherman, Alan B. Craig; Elsevier.
5. Virtual Reality Systems -by John Vince, John Wiley & Sons.
6. Virtual Reality Technology- by G. C. Burdea and Philippe Coiffet, John Wiley & Sons.

Course No: IPE 0788 4251	**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 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 accumulate 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. Case studies of MOT.

Course Learning Outcomes, CO

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

- **CO 1:** outline the key characteristics of an entrepreneur, and scopes of entrepreneurship development;
- **CO 2:** evaluate business strategies and its sustainability in context of entrepreneurship development and management of technology;
- **CO 3:** apply a range of tools to develop, analyze, select and implement technological innovations and strategies for development of entrepreneurship;
- **CO 4:** determine the risks involved in technology transfer from national and global perspective;
- **CO 5:** illustrate professional competencies in leadership, management, strategy and technology development.

Mapping of COs with POs

Course Learning Outcomes (CO)	**Fundamental Skills**				**Social Skills**			**Thinking Skills**		**Personal Skills**		
	PO1	**PO2**	**PO3**	**PO5**	**PO6**	**PO9**	**PO10**	**PO4**	**PO7**	**PO8**	**PO11**	**PO12**

CO 1		2										
CO 2	2								2			
CO 3				3			2					
CO 4		2			1							
CO 5							3					

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using projectors	Midterm Examination 1, Semester-end examination
CO 2	Lecture using projectors, Assignment	Assignment, Semester-end examination
CO 3	Lecture using projectors, Assignment, Self-learning using case study	Midterm Examination 2, Semester-end examination
CO 4	Lecture using projectors, Self-learning using case study	Assignment, Semester-end examination
CO 5	Lecture using projectors, Assignment	Presentation

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

Course No.: IPE 0688 4253	**Credit: 3.0**	**Year: Fourth**	**Semester: Second**
Course Title: Data Analytics		**Course Status: Theory**	

Rationale of the Course:

This course aims to introduce data science concepts, tools and techniques, enabling students to optimize industrial systems. By leveraging data, students address industry challenges, improve decision-making, and enhance overall efficiency in industrial settings. The course emphasizes business communication and relevance to the application of machine learning and optimization techniques to industrial engineering problems.

Course Objectives:

The objectives of this course are to:

- introduce the fundamentals of data science and its relevance to industrial engineering
- familiarize with data collection methods, data analysis tools and techniques, machine learning algorithms and their relevance to industrial engineering
- enable students to apply data analysis techniques using Excel, Power BI, and Python for industrial applications
- develop skills in data visualization and presentation to effectively communicate with stakeholders
- enable students to apply data-driven decision-making strategies in an industrial context.

Course Content:

Introduction to Data Science: Overview of data science, its importance, applications in industrial sectors, role of data science in optimization of industrial processes and decision-making; *Data Collection and Preprocessing:* Data sources and data collection methods, data cleaning and preprocessing techniques, data integration and transformation for analysis: *Data Analysis with Excel:* Utilizing Excel functions and tools for data analysis, descriptive statistics and data summary, Exploratory data analysis; *Data Visualization and Presentation with Excel*: Creating charts and graphs to visualize industrial data, building interactive dashboards, communicating through data visualization; *Power BI for Data Analysis:* Overview of Power BI and its capabilities, connecting, cleaning, and transforming data with Power Query, creating data models and measures for analysis; *Data Visualization and Dashboard Creation with Power BI*: Designing interactive and dynamic visuals in Power BI, building interactive dashboards for engineers, publishing and sharing Power BI reports; *Data Analysis with Python:* Working with data using Python libraries (*NumPy, Pandas*), data manipulation and preprocessing, statistical analysis and hypothesis testing, machine learning algorithms for industrial engineering applications, model evaluation and selection (*scikit-learn*); *Data Visualization with Python*: Creating interactive data visualizations using Python libraries (*Matplotlib, Seaborn*), geospatial data visualization and mapping; *Data-Driven Decision Making*: Formulating data-driven strategies for process optimization, case studies and projects on data science in industrial sectors, ethical considerations in data-driven decision-making.

Course Learning Outcomes, CO

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

CO 1: describe various data collection techniques in an industrial setting, employ data cleaning and preprocessing methods, and integrate and transform data for analysis;

CO 2: perform descriptive statistics using Excel for exploratory data analysis, and employ data visualization tools to communicate insights effectively;

CO 3: use Power Query in Power BI, and create dynamic visualizations and interactive dashboards to connect, clean, and transform data;

CO 4: utilize Python libraries (NumPy, Pandas) proficiently for data manipulation and preprocessing, conduct statistical analysis and hypothesis testing, and explore machine learning algorithms relevant to industrial engineering;

CO 5: develop strategies for optimizing industrial processes through data-driven approaches, applying their knowledge to real-world case studies, and demonstrating ethical considerations in decision-making.

Mapping of COs with POs

Course Learning Outcomes (CO)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1	3											
CO 2				3			1					1
CO 3				3			1					1
CO 4				3			1	2				2
CO 5									1	2	2	

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using projectors, Tutorial, and Assignment	Assignment, Midterm Exam 1, and Semester-end Exam
CO 2	Lecture using projectors, Tutorial, and Assignment	Assignment, and Semester-end Exam
CO 3	Lecture using projectors, Tutorial, and Assignment	Assignment, Midterm Exam 2, and Semester-end Exam
CO 4	Lecture using projectors, Tutorial, and Assignment	Assignment, Midterm Exam 2, and Semester-end Exam
CO 5	Lecture using projectors, Tutorial, and Assignment	Assignment, and Semester-end Exam

Books Recommended:

1. Wes McKinney, Python for Data Analysis, O'Reilly Media
2. Joel Grus, Data Science from Scratch, O'Reilly Media
3. Curbal, Power BI Step-by-Step
4. Nathan Yau, Data Points: Visualization That Means Something, Wiley.
5. Avraham Shtub, Gad Rabinowitz, Daniel D. Frey, Introduction to Industrial Engineering, CRC Press
6. John Morgan, Martin Brenig-Jones, Lean Six Sigma for Dummies, Wiley

Course No: IPE 0788 4255	Credit: 3.0	Year: Fourth	Semester: Second
Course Title: Robotics and Control System			Course Status: Theory

Rationale of the Course:

This course provides a comprehensive foundation in the essential principles and applications of robotics and control systems. Covering topics such as robot fundamentals, classification, kinematics, drive systems, and programming, the course explores both theoretical and practical aspects of robotics. Additionally, it introduces advanced control system concepts, including mathematical modeling, system stability, and controller design using techniques like PID control. Through this course, students will gain the technical knowledge and skills needed to design, analyze, and implement robotic and control systems in various industrial and technological applications.

Course Objectives:

The objectives of this course are to:

- introduce students to the fundamentals of robotics, including robot classification, parts, functions, and laws, and to familiarize them with key components, technical specifications, and applications of robotic systems.
- develop an understanding of robot kinematics, including the concepts of links, joints, and kinematic chains, and to apply forward and inverse kinematics for analyzing robot movement.
- provide knowledge of various robot drive systems, gripper types, and sensor technologies, enabling students to select and design appropriate components for specific robotic applications.
- equip students with skills in robot programming using different programming methods and languages, facilitating the control and operation of robots in various environments.
- introduce students to the principles of control systems, including system configuration, mathematical modeling, stability analysis, and frequency response, and to design controllers using techniques like root-locus and PID control.

Course Contents:

Robotics: Fundamentals of Robot, Robot Classification, Robot Parts and Functions, Laws of Robotics, Robotics Co-ordinate System, Basic Components of Robot Systems, Technical specification in Robotics, Applications of Robots. **Robot Kinematics**: Links and Joints, Kinematic Chain, Mechanisms and Machines, Forward and Inverse Kinematics. **Robot Drive Systems**: AC and DC Servo Motors, Working of a stepper motor, Mechanical drives system, Pneumatic actuators system. **Grippers**: Magnetic,

Mechanical, Hydraulic and Vacuum grippers, Selection and design considerations in robot gripper. **Sensors:** Internal and external sensors, Characteristics of Sensors, position, velocity and acceleration sensors, Slip sensing, proximity sensors, force sensors, laser range finder, **Machine Vision**: Vision systems of Robot, Various techniques in Image Processing and Analysis. **Robot Programming:** Types and Methods of Robot Programming, Hardware Programming Languages for Robotics, Robot Programming Languages.

Control System: Introduction to Control Systems, System configurations, analysis and design objectives. **Mathematical modelling:** Mathematical Model of Physical System, Transfer Functions, State-space modelling of dynamical systems. **Graphical Representation:** Block diagrams, block diagram reductions. Signal flow graph, Mason's gain formula. **System Stability:** Definition of stability, Routh-Hurwitz test. **Time response analysis**: Poles, zeros and system response: first order system, second order system, **Steady state errors**, **Frequency response analysis**: Bode plot, Polar plot, Nyquist plot. **Design of controllers:** The root-locus technique, steps in obtaining a root-locus. Design of controllers using root-locus. P, PI, PD and PID Controllers.

Course Learning Outcomes:

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

CO 1: explain the basic concept of control system as well as classification, components, and kinematics of robots, including the laws of robotics, technical specifications, and the functionality of various robotic systems in different applications;

CO 2: apply knowledge of robot sensors, machine vision systems, drive systems, and gripper types to solve problems related to sensing, image processing, and robot interaction with the environment, while considering design criteria and operational requirements for efficient robotic system performance;

CO 3: develop robot programming using different methods and languages, enabling the creation, modification, and control of robotic systems for specific applications;

CO 4: model physical systems mathematically, including transfer functions and state-space representations, to analyze the behavior of control systems; and

CO 5: design control system using mathematical modeling, system stability tests, and control techniques such as PID controllers to achieve desired system stability and performance in dynamic systems.

Mapping of COs with POs

Course Learning Outcomes (CO)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1	1											
CO 2	3											
CO 3	2		1									
CO 4				2								
CO 5			3					1				

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/LCD projectors	Midterm Examination 1, Semester-end examination
CO 2	Lecture using board/LCD projectors/Assignment/tutorial	Assignment assessment, Midterm Examination 1, Semester-end examination
CO 3	Lecture using board/LCD projectors/ Project on robot program development	Project evaluation, Semester-end examination
CO 4	Lecture using board/LCD projectors/Assignment/tutorial	Midterm Examination 2, Assignment evaluation, Semester-end examination
CO 5	Lecture using board/LCD projectors/Assignment	Midterm Examination 2, Assignment evaluation, Semester-end examination

Recommended Books

1. Industrial Robotics, Mikell P. Groover, McGrow Hill
2. Robotics: Control, Sensing, Vision and Intelligence - Ralph Gonzalez, C.S.G. Lee and K. S. Fu, McGraw Hill India.
3. Introduction to Robotics: Mechanics and Control - John J. Craig, Pearson Prentice Hall
4. Robotics: Designing the Mechanisms for Automated Machinery - Ben-Zion Sandier, Academic Press.
5. Modern Robotics: Building Versatile Machines, Harry Henderson, Chelsea House Publications.
6. Robot Vision - Berthold K. P. Horn, The MIT Press
7. Human-Robot Interactions: Principles, Technologies and Challenges - Diana Coleman, Nova Science Pub Inc.
8. Modern Control Engineering, Katsuhiko Ogata, Pearson
9. Control Systems Engineering, Norman S. Nise, John Wiley & Sons
10. Control Systems Engineering, L.J. Nagrath and M. Gopal
11. Automatic Control System, Hasan Saeed

Course No.: IPE 0031 4250	Credit: 0.5	Year: Fourth	Semester: Second
Course Title: Comprehensive Viva		Course Status: Viva	

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

CO 1: face interview both in the academic and the industrial sector and perform better in future;
CO 2: formulate and solve the basic engineering problems/situations with confidence in professional life;
CO 3: apply scholarly information to defend their standpoint on the issue under discussion.

Mapping of COs with POs

Course Learning Outcomes (CO)	Fundamental Skills				Social Skills			Thinking Skills		Personal Skills		
	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1							2					
CO 2						2	1					1
CO 3					1		2				1	

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Self-learning on all courses covered in the undergraduate program	Viva-voce
CO 2	Self-learning on all courses covered in the undergraduate program	Viva-voce
CO 3	Self-learning on all courses covered in the undergraduate program	Viva-voce

Books Recommended:
Books recommended and material supplied for the courses covered till the eighth semester.

Course No: IPE 0031 4260	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 students 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 is like to work in a professional organization
- enhance their technical, interpersonal and communication skills, both oral and written
- help students to 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, CO
After the successful completion of the course, students will be able to:

CO 01: apply the work responsibility, and ethics in the working environment;
CO 02: explain the general and specific procedures of engineering fields related to industry;
CO 03: communicate effectively within the working environment and prepare a technical report;
CO 04: apply their theorical knowledge and engineering methods to solve an industrial problem;
CO 05: demonstrate good moral values such as commitment and trustworthiness.

Mapping of COs with POs

Course Learning	Fundamental Skills	Social Skills	Thinking Skills	Personal Skills

Outcomes (CO)	PO1	PO2	PO3	PO5	PO6	PO9	PO10	PO4	PO7	PO8	PO11	PO12
CO 1					1					2		
CO 2		2			1							
CO 3					1	1	2					
CO 4	3	1										1
CO 5						2				2	1	

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Training in selected industries	Viva and Technical report
CO 2	Training in selected industries	Viva and Technical report
CO 3	Training in selected industries	Viva and Technical report
CO 4	Training in selected industries	Viva and Technical report
CO 5	Training in selected industries	Viva and Technical report

b. 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 IPE 0788 3152 (Product Design and Development Sessional):

This course will be assessed as follows:

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%.

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	:	30%

ii	Thesis report evaluation by External-members	:	40%
iii	Defense before thesis evaluation board	:	30%

PART: D

Grading/Evaluation

a. 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

b. 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 major and second major degrees will be calculated separately by the weighted average of all courses of the previous semesters along with that of the current/present semester. For the calculation of the final CGPA of clearing graduates, if the third digit after the decimal point is nonzero then its previous, that is, the second digit will be incremented by one. A student, if applicable, will also receive a separate CGPA for her/his Second Major courses.

F Grades:
A student will be given an "F" grade if s/he fails or remains absent in the final examination of a registered course. If a student obtains an "F" grade, her/his grade will not be counted for GPA and s/he will have to repeat the course. An "F" grade will be in her/his record, and s/he will not be eligible for distinction, award, and scholarship of the university.

c. Course Withdrawal

A student can withdraw a course by a written application to the Controller of Examinations through the Head/Director of the discipline/institute two weeks before the examination start. The Controller of Examinations will send the revised registration list(s) to the disciplines before the commencement of semester final examination. There will be no record in transcript if the course is withdrawn.

d. Incomplete (I) courses

If a student has an incomplete course(s), s/he has to register such an incomplete course(s) from preceding semesters before registering courses from current or successive semesters. If an incomplete course is not available or offered in the running semesters, the student shall take such course(s) when it is available or offered.

e. Course Repetition:

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

List of Non-Major Courses offered for other departments

Course No.	Credit	Dept	Year-Semester	Course Title
IPE 0732 1102B	1.5	CEP	1-1	Mechanical Engineering Drawing Sessional
IPE 0715 1203H	3.0	PME	1-2	Engineering Mechanics
IPE 0715 1204C	1.0	CEE	1-2	Workshop Practice
IPE 0732 1206D	1.5	CSE	1-2	Engineering Graphics
IPE 0715 1208D	1.0	CSE	1-2	Workshop Practice
IPE 0715 2102F	1.0	FET	2-1	Workshop Practice
IPE 0715 2103B	3.0	CEP	2-1	Engineering Mechanics
IPE 0715 2105H	3.0	PME	2-1	Mechanics of Solids
IPE 0732 2106H	1.0	PME	2-1	Engineering Drawing
IPE 0715 2108B	1.0	CEP	2-1	Workshop Practice Sessional
IPE 0715 2205B	3.0	CEP	2-2	Mechanics of Solids
IPE 0413 3105E	2.0	EEE	3-1	Industrial Management
IPE 0413 3109F	3.0	FET	3-1	Supply Chain Management
IPE 0413 3219K	3.0	CHE	3-2	Industrial Management
IPE 0413 4205Q	3.0	MEE	4-2	Industrial Management

Detailed Curriculum: Courses offered for other departments

First Year First Semester

Course No.: IPE 0732 1102B	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, COs
Upon successful completion of this course, student will be able to:

CO 1: explain basic concepts of engineering drawing as an important form of conveying technical information;

CO 2: apply principles of engineering visualization and projection theory to prepare mechanical engineering drawings (2D and 3D), using conventional and modern drawing tools;

CO 3: practice drawing orthographic projection, sectional views, and isometric views of different mechanical parts;

CO 4: create a review report on mechanical components drawing using the engineering drawing-specific knowledge and skill for the multidisciplinary design team comprised of engineering professionals;

CO 5: Apply the engineering drawing principles to draw 2-D sketches using AutoCAD drawing and editing tools.

Mapping of COs with POs
According to the POs of CEP department.

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board and Instruction materials	Quiz and Semester-end oral examination
CO 2	Lecture using board and Tutorial	Quiz, Drawing assessment, and Semester-end oral examination
CO 3	Lecture using board and Tutorial	Quiz, Drawing assessment, and Semester-end oral examination
CO 4	Lecture using board and Assignment	Quiz and Semester-end oral examination
CO 5	Lecture using projectors/Autocad software using a PC	Drawing using Autocad

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

Course No.: IPE 0715 1203H	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 engineering students. It focuses on the modeling and analyzing of static equilibrium as well as dynamic concepts based on real life engineering applications and necessary problem-solving knowledge.

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

CO 1: apply the basic principles of mechanics to analyze and solve real life engineering problems
CO 2: evaluate different structures under various loading conditions (static and dynamic)
CO 3: analyze the effects of friction on a body
CO 4: evaluate the different laws of a static/moving body (work, energy, momentum, etc.) in real life context
CO 5: apply the knowledge to analyze and solve problems related to kinematics and kinetics.

Mapping of COs with POs
According to the POs of PME department.

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board and Assignment	Assignment, Midterm Exam 1, and Semester-end Exam
CO 2	Lecture using board/ projectors and Assignment	Assignment, Midterm Exam 1, and Semester-end Exam
CO 3	Lecture using board and Assignment	Assignment, Midterm Exam 2, and Semester-end Exam
CO 4	Lecture using board/ projectors	Assignment and Semester-end Exam
CO 5	Lecture using board/ projectors and Assignment	Assignment, Midterm Exam 2, and Semester-end Exam

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.

Course Code: IPE 0715 1204C	Credit: 1.0	Year: First	Semester: First
Course Title: Workshop Practice (For CEE)		Course Status: Sessional	

Rationale of the Course:
To have a balanced overall development of CEE graduates, it is necessary to integrate theory with practice. Workshop practice includes basic knowledge about manufacturing that is essential for further study of the engineers. It provides practical knowledge about different hand tools and machine tools. Overall, students 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
- familiarize the students with different welding techniques and their applicability
- provide the opportunity to use gathered knowledge practically
- encourage students performing teamwork.

Course Content:
Introduction to hand tools; Study and operation of an Engine Lathe; Study and operation of a milling machine; Study and operation of a drilling machine; Study and operation of a surface grinding machine; Study and operation of different types of welding techniques; Preparation of a hexagonal nut.

Course Learning Outcomes, COs
After the successful completion of the course, students will be able to:

CO 1: specify different types of hand tools and machine tools with their purposes
CO 2: perform operations on different types of machine tools used in manufacturing industries
CO 3: identify different components and functions of engine lathe, milling machine, bench drilling machine and surface grinding machine
CO 4: perform different types of welding techniques and identify their differences
CO 5: develop a product in a team based on the design specifications.

Mapping of COs with POs
According to the POs of CEE department.

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board and Instruction materials, Practical demonstration, Hands on practice	Quiz, Report evaluation, Oral examination
CO 2	Lecture using board and Instruction materials, Practical demonstration, Hands on practice	Quiz, Report evaluation, Oral examination
CO 3	Lecture using board and Instruction materials, Practical demonstration, Hands on practice	Quiz, Report evaluation, Oral examination
CO 4	Instruction materials, Practical demonstration, Hands on practice	Quiz, Report evaluation
CO 5	Instruction materials, Practical demonstration, Hands on practice	Quiz, Report evaluation

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

Course No.: IPE 0732 1206D	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 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 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, COs
Upon successful completion of this course, student will be able to:

CO 1: explain basic concepts of engineering drawing as an important form of conveying technical information;

CO 2: apply principles of engineering visualization and projection theory to prepare mechanical engineering drawings (2D and 3D), using conventional and modern drawing tools;

CO 3: practice drawing orthographic projection, sectional views, and isometric views of different mechanical parts;

CO 4: create a review report on mechanical components drawing using the engineering drawing-specific knowledge and skill for the multidisciplinary design team comprised of engineering professionals.

Mapping of COs with POs
According to the POs of CSE department.

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board and Instruction materials	Quiz and Semester-end oral examination
CO 2	Lecture using board and Tutorial	Quiz, Drawing assessment, and Semester-end oral examination
CO 3	Lecture using board and Tutorial	Quiz, Drawing assessment, and Semester-end oral examination
CO 4	Lecture using board and Assignment	Quiz and Semester-end oral examination

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.

Course Code: IPE 0715 1208D	Credit: 1.0	Year: First	Semester: Second
Course Title: Workshop Practice (For CSE)		Course Status: Sessional	

Rationale of the Course:
To have a balanced overall development of CSE graduates, it is necessary to integrate theory with practice. Workshop practice includes basic knowledge about manufacturing that is essential for further study of the engineers. It provides practical knowledge about different hand tools and machine tools. Overall, students 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 students performing teamwork.

Course Content:
Introduction to hand tools; Study and operation of an Engine Lathe; Study and operation of a milling machine; Study and operation of a drilling machine; Study and operation of a surface grinding machine; Preparation of a hexagonal nut.

Course Learning Outcomes, COs
After the successful completion of the course, students will be able to:
CO 1: identify different types of hand tools and their purposes
CO 2: specify and differentiate different types of machine tools used in manufacturing industries
CO 3: identify different components of engine lathe, milling machine, bench drilling machine and surface grinding machine and know about their respective functions
CO 4: perform different operations on the selected machine
CO 5: develop a product in team based on the design specifications.

Mapping of COs with POs
According to the POs of CSE department.

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board and Instruction materials, Practical demonstration, Hands on practice	Quiz, Report evaluation, Oral examination
CO 2	Lecture using board and Instruction materials, Practical demonstration, Hands on practice	Quiz, Report evaluation, Oral examination
CO 3	Lecture using board and Instruction materials, Practical demonstration, Hands on practice	Quiz, Report evaluation, Oral examination
CO 4	Instruction materials, Practical demonstration, Hands on practice	Quiz, Report evaluation
CO 5	Instruction materials, Practical demonstration, Hands on practice	Quiz, Report evaluation

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 First Semester

Course Code: IPE 0715 2102F	Credit: 1.0	Year: Second	Semester: First
Course Title: Workshop Practice (For FET)		Course Status: Sessional	

Rationale of the Course:
To have a balanced overall development of FET graduates, it is necessary to integrate theory with practice. Workshop practice includes basic knowledge about manufacturing that is essential for further study of the engineers. It provides practical knowledge about different hand tools and machine tools. Overall, students 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 students performing teamwork.

Course Content:

Introduction to hand tools; Study and operation of an Engine Lathe; Study and operation of a milling machine; Study and operation of a drilling machine; Study and operation of a surface grinding machine; Preparation of a hexagonal nut.

Course Learning Outcomes, COs

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

CO 1: identify different types of hand tools and their purposes

CO 2: specify and differentiate different types of machine tools used in manufacturing industries

CO 3: identify different components of engine lathe, milling machine, bench drilling machine and surface grinding machine and know about their respective functions

CO 4: perform different operations on the selected machine

CO 5: develop a product in team based on the design specifications.

Mapping of COs with POs

According to the POs of FET department.

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board and Instruction materials, Practical demonstration, Hands on practice	Quiz, Report evaluation, Oral examination
CO 2	Lecture using board and Instruction materials, Practical demonstration, Hands on practice	Quiz, Report evaluation, Oral examination
CO 3	Lecture using board and Instruction materials, Practical demonstration, Hands on practice	Quiz, Report evaluation, Oral examination
CO 4	Instruction materials, Practical demonstration, Hands on practice	Quiz, Report evaluation
CO 5	Instruction materials, Practical demonstration, Hands on practice	Quiz, Report evaluation

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

Course No.: IPE 0715 2103B	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 engineering students. It focuses on the modeling and analyzing of static equilibrium as well as dynamic concepts based on real life engineering applications and necessary problem-solving knowledge.

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, COs

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

CO 1: apply the basic principles of mechanics to analyze and solve real life engineering problems

CO 2: evaluate different structures under various loading conditions (static and dynamic)

CO 3: analyze the effects of friction on a body

CO 4: evaluate the different laws of a static/moving body (work, energy, momentum, etc.) in real life context

CO 5: apply the knowledge to analyze and solve problems related to kinematics and kinetics.

Mapping of COs with POs

According to the POs of CEP department.

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board and Assignment	Assignment, Midterm Exam 1, and Semester-end Exam

CO 2	Lecture using board/ projectors and Assignment	Assignment, Midterm Exam 1, and Semester-end Exam
CO 3	Lecture using board and Assignment	Assignment, Midterm Exam 2, and Semester-end Exam
CO 4	Lecture using board/ projectors	Assignment and Semester-end Exam
CO 5	Lecture using board/ projectors and Assignment	Assignment, Midterm Exam 2, and Semester-end Exam

Books Recommended:

3. Vector Mechanics for Engineers, Ferdinand P. Beer, E. Russell Johnston, Jr., David F. Mazurek and Phillip J. Cornwell, Tenth edition, McGraw Hill.
4. A Textbook of Engineering Mechanics, R.S. Khurmi, S. Chand publications.

Course Code: IPE 0715 2105H	**Credit: 03**	**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 is concerned with the stresses, deformation and failure of solid materials and structures. In this course, a student will get the basic idea of the behavior of a body due to the external loading.

Course 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 and columns, the induced stresses and resulting 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: Basic concepts of stress and strain, statically determinate and indeterminate axially loaded members, 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. **Combined Stresses:** Principal stress, Mohr's Circle, Stresses in thick-walled pressure vessels. **Columns:** Euler's Formula, Intermediate Column Formulas. **Introduction to Riveted and welded joints.**

Course Learning Outcomes, CO

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

CO 1: apply the fundamental concepts of engineering mechanics for deformable and rigid bodies;
CO 2: 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 loadings;
CO 3: analyze beams, columns and pressure vessels under various loads;
CO 4: apply the systematic methods for solving engineering problems in mechanics for solids;
CO 5: solve real-life engineering problems and design engineering systems.

Mapping of COs with POs

According to the POs of PME department.

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/projectors	Continuous assessment, Midterm Examination 1, Semester-end examination
CO 2	Lecture using board/ projectors /Assignment/tutorial	Continuous assessment, Midterm Examination 1, Quiz, Semester-end examination
CO 3	Lecture using board/projectors /Assignment/tutorial	Midterm Examination 2, Assignment, Semester-end examination
CO 4	Lecture using board/projectors/ Assignment/ tutorial	Assignment, Semester-end examination
CO 5	Lecture using board/projectors /Self-learning	Assignment, Semester-end examination

Books Recommended:

1. Andrew Pytel and Ferdinand L. Singer, Strength of Materials.
2. Andrew Pytel and Jaan Kiusalaas, Mechanics of Materials.
3. William A. Nash and Merle C. Potter, Strength of Materials
4. Ferdinand Beer, Jr. Johnston, E. Russell, John DeWolf and David Mazurek, Mechanics of Materials.

Course No.: IPE 0732 2106H	**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 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 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, COs
Upon successful completion of this course, student will be able to:

CO 1: explain basic concepts of engineering drawing as an important form of conveying technical information;

CO 2: apply principles of engineering visualization and projection theory to prepare mechanical engineering drawings (2D and 3D), using conventional and modern drawing tools;

CO 3: practice drawing orthographic projection, sectional views, and isometric views of different mechanical parts;

CO 4: create a review report on mechanical components drawing using the engineering drawing-specific knowledge and skill for the multidisciplinary design team comprised of engineering professionals.

Mapping of COs with POs
According to the POs of PME department.

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board and Instruction materials	Quiz and Semester-end oral examination
CO 2	Lecture using board and Tutorial	Quiz, Drawing assessment, and Semester-end oral examination
CO 3	Lecture using board and Tutorial	Quiz, Drawing assessment, and Semester-end oral examination
CO 4	Lecture using board and Assignment	Quiz and Semester-end oral examination

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.

Course Code: IPE 0715 2108B	Credit: 1.0	Year: Second	Semester: First
Course Title: Workshop Practice Sessional (For CEP)		Course Status: Sessional	

Rationale of the Course:
To have a balanced overall development of CEP graduates, it is necessary to integrate theory with practice. Workshop practice includes basic knowledge about manufacturing that is essential for further study of the engineers. It provides practical knowledge about different hand tools and machine tools. Overall, students 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 students performing teamwork.

Course Content:
Introduction to hand tools; Study and operation of an Engine Lathe; Study and operation of a milling machine; Study and operation of a drilling machine; Study and operation of a surface grinding machine; Preparation of a hexagonal nut.

Course Learning Outcomes, COs
After the successful completion of the course, students will be able to:

CO 1: identify different types of hand tools and their purposes

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

Mapping of COs with POs
According to the POs of CEP department.

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board and Instruction materials, Practical demonstration, Hands on practice	Quiz, Report evaluation, Oral examination
CO 2	Lecture using board and Instruction materials, Practical demonstration, Hands on practice	Quiz, Report evaluation, Oral examination
CO 3	Lecture using board and Instruction materials, Practical demonstration, Hands on practice	Quiz, Report evaluation, Oral examination
CO 4	Instruction materials, Practical demonstration, Hands on practice	Quiz, Report evaluation
CO 5	Instruction materials, Practical demonstration, Hands on practice	Quiz, Report evaluation

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

Course Code: IPE 0715 2205B	Credit: 03	Year: Second	Semester: Second
Course Title: Mechanics of Solids (For CEP)		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 is concerned with the stresses, deformation and failure of solid materials and structures. In this course, a student will get the basic idea of the behavior of a body due to the external loading.

Course 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 and columns, the induced stresses and resulting 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 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, shear and bending moment in beam, flexural stresses in beam, deflection of beam, combined loadings, stresses and deflection in column.

Course Learning Outcomes, COs
After successful completion of the course, students will be able to:
CO 1: apply the fundamental concepts of engineering mechanics for deformable and rigid bodies;
CO 2: 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 loadings;
CO 3: analyze beams and columns under various loads;
CO 4: apply the systematic methods for solving engineering problems in mechanics for solids;
CO 5: solve real-life engineering problems and design engineering systems.

Mapping of COs with POs
According to the POs of CEP department.

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/LCD	Continuous assessment,

	projectors	Midterm Examination 1, Semester-end examination
CO 2	Lecture using board/LCD projectors/Assignment/tutorial	Continuous assessment, Midterm Examination 1, Quiz, Semester-end examination
CO 3	Lecture using board/LCD projectors/Assignment/tutorial	Midterm Examination 2, Assignment, Semester-end examination
CO 4	Lecture using board/LCD projectors/ Assignment/ tutorial	Assignment, Semester-end examination
CO 5	Lecture using board/LCD projectors/Self-learning using reference books	Assignment, Semester-end examination

Books Recommended:

1. Andrew Pytel and Ferdinand L. Singer, Strength of Materials.
2. Andrew Pytel and Jaan Kiusalaas, Mechanics of Materials.
3. William A. Nash and Merle C. Potter, Strength of Materials
4. Ferdinand Beer, Jr. Johnston, E. Russell, John DeWolf and David Mazurek, Mechanics of Materials.

Third Year First Semester

Course Code: IPE 0413 3105E	**Credit: 2**	**Year: Second**	**Semester: Second**
Course Title: Industrial Management (for EEE)		**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 the basic principles of management, the major functions of managers, e.g., planning, organizing, staffing, leading, and controlling, and the 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 sound employment function as well as implementing a good wage and incentive scheme.
- let the students understand different marketing issues and the fundamental concepts of marketing management.

Course Content:

Organization and management: evolution, management functions, organization structure, development of organization theories, 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 concepts, marketing organization, industrial and consumer selling, advertising. Basics of inventory management.

Course Learning Outcomes (COs)

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

- **CO 1:** explain the theories, principles of management, contemporary theories of motivation, and apply these theories to tackle the managerial challenges;
- **CO 2:** apply leadership skills and implement its ideas in organizations/industries;
- **CO 3:** evaluate the different tasks of personnel management such as recruitment, selection, wages, and incentives
- **CO 4:** identify what marketing strategies organizations might practice to attract and retain customer
- **CO 5:** describe the concepts and techniques of inventory management system.

Mapping of COs with POs

According to the POs of EEE department.

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	**Teaching-Learning Strategy**	**Assessment Strategy**
CO 1	Lecture using board/Projectors	Assignment, Midterm Examination 1, Semester-end examination
CO 2	Lecture using board/Projectors, Assignment/tutorial	Assignment, Midterm Examination 1, Semester-end examination
CO 3	Lecture using board/Projectors	Assignment, Semester-end examination
CO 4	Lecture using board/Projectors, Assignment/tutorial	Midterm Examination 2, Assignment, Semester-end examination
CO 5	Lecture using board/Projectors, Assignment/tutorial	Midterm Examination 2, Assignment, Semester-end examination

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.
4. William J Stevenson, Operations Management, McGraw Hill International Edition.

Course No.: IPE 0413 3109F	Credit: 3.0	Year: Third	Semester: First
Course Title: Supply Chain Management (for FET)		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 framework of supply chain management and its functional areas
- acquaint students with the concept of supply chain networks development
- make students able to analyze the existing supply chain and modify it for better service and profitability
- accumulate ideas about current trends of global supply chain management with emerging e-commerce
- provide the necessary knowledge for better coordination among the partners so that the bullwhip 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:
SC-Understanding the Supply Chain: What it is, the decision phases, importance, advantages, examples; Supply chain performance 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.

Course Learning Outcomes (COs)

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

CO 1: describe the major areas of the supply chain and their performance drivers
CO 2: design both efficient and effective supply chain network
CO 3: relate the conflicting issues for better co-ordination, to facilitate building partnership and trust among the partners
CO 4: evaluate different sourcing, pricing, and transportation modes for profit maximization and cost minimization
CO 5: justify the proper inventory management system for the whole supply chain

Mapping of COs with POs
According to the POs of FET department.

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using projectors and Instruction materials	Quiz and Semester-end examination
CO 2	Lecture using projectors and Tutorial	Assignment, Mid-semester exam-1 and Semester-end oral examination
CO 3	Lecture using projectors, Assignment and case study	Case report, presentation and Semester-end oral examination
CO 4	Lecture using projectors and Tutorial	Assignment, Mid-semester exam-2 and Semester-end oral examination
CO 5	Lecture using projectors and Assignment	Assignment, and Semester-end oral examination

Books Recommended:
1. Supply Chain Management: Strategy, Planning, and Operations by Sunil Chopra and Peter Meindl. Prentice Hall.
2. Logistics and Supply Chain Management, by Martin Christopher, Prentice Hall.

Third Year Second Semester

Course Code: IPE 0413 3219K	Credit: 3	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 the basic principles of management, the major functions of managers, e.g., planning, organizing, staffing, leading, and controlling, and the 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 sound employment function as well as implementing a good wage and incentive scheme.
- let the students understand different marketing issues and the fundamental concepts of marketing management.

Course Content:
Organization and management: evolution, management functions, organization structure, development of organization theories, study of various types of organization and management information systems, concepts, and scope of application. Personnel management: importance, scope, need hierarchy, motivation theories, 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 (COs)
After successful completion of the course, students will be able to:

CO 1: explain the theories, principles of management, contemporary theories of motivation, and apply these theories to tackle the managerial challenges;
CO 2: apply leadership skills and implement its ideas in organizations/industries;
CO 3: evaluate the different tasks of personnel management such as recruitment, selection, wages, and incentives
CO 4: identify what marketing strategies organizations might practice to attract and retain customer
CO 5: describe the concepts and techniques of strategic management of technology.

Mapping of COs with POs
According to the POs of CHE Department.

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes	Teaching-Learning Strategy	Assessment Strategy
(COs)		
CO 1	Lecture using board/Projectors	Assignment, Midterm Examination 1, Semester-end examination
CO 2	Lecture using board/Projectors/ Assignment/tutorial	Assignment, Midterm Examination 1, Semester-end examination
CO 3	Lecture using board/Projectors	Assignment, Semester-end examination
CO 4	Lecture using board/Projectors/ Assignment/tutorial	Midterm Examination 2, Assignment, Semester-end examination
CO 5	Lecture using board/Projectors/ Assignment/tutorial	Midterm Examination 2, Assignment, Semester-end examination

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.
4. Andrew J. Dubrin, Essentials of Management, South-Western College Pub.

Fourth Year Second Semester

Course Code: IPE 0413 4205Q	Credit: 3	Year: Fourth	Semester: Second
Course Title: Industrial Management (for MEE)			**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 the basic principles of management, the major functions of managers, e.g., planning, organizing, staffing, leading, and controlling, and the 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 sound employment function as well as implementing a good wage and incentive scheme.
- let the students understand different marketing issues and the fundamental concepts of marketing management.

Course Content:
Organization and management: evolution, management functions, organization structure, development of organization theories, study of various types of organization and management information systems, concepts, and scope of application. Personnel management: importance, scope, need hierarchy, motivation theories, 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 (COs)
After successful completion of the course, students will be able to:

CO 1: explain the theories, principles of management, contemporary theories of motivation, and apply these theories to tackle the managerial challenges;
CO 2: apply leadership skills and implement its ideas in organizations/industries;
CO 3: evaluate the different tasks of personnel management such as recruitment, selection, wages, and incentives
CO 4: identify what marketing strategies organizations might practice to attract and retain customer
CO 5: describe the concepts and techniques of strategic management of technology.

Mapping of COs with LOs
According to the POs of MEE department.

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

Course Learning Outcomes (COs)	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/projectors	Assignment, Midterm Examination 1, Semester-end examination
CO 2	Lecture using board/projectors /Assignment/tutorial	Assignment, Midterm Examination 1, Semester-end examination
CO 3	Lecture using board projectors	Assignment, Semester-end examination
CO 4	Lecture using board/projectors	Midterm Examination 2, Assignment, Semester-end
	/Assignment/tutorial	examination
CO 5	Lecture using board/projectors /Assignment/tutorial	Midterm Examination 2, Assignment, Semester-end examination

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.
4. Andrew J. Dubrin, Essentials of Management, South-Western College Pub.