UNIVERSITY OF DELHI

NETAJI SUBHAS INSTITUTE OF TECHNOLOGY

CHOICE BASED CREDIT SYSTEM

SCHEME OF COURSES FOR

M.TECH. (PRODUCTION ENGINEERING)

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PREAMBLE

I. INTRODUCTION

Higher education is very important for the growth and development of any country. It is a living organ and requires continuous changes to ensure the quality of education. National Knowledge Commission and University Grants Commission have recommended many academic reforms to address the challenges of today's networked globalized world. People are coming together with the help of new technologies which is resulting towards new aspirations, expectations, collaborations and associations. The concept of "work in isolation" may not be relevant and significant anymore. The UGC guidelines on adoption of Choice Based Credit System may be an important step to revamp the processes, systems and methodologies of Higher Educational Institutions (HEIs). The teacher centric mode be changed to learner centric mode. Class room teaching and learning be made effective; relevant and interesting. Concepts and theories be explained with examples, experimentation and related applications.

A culture of discussions, arguments, interpretations, counter-interpretations, re-interpretations, and opposing interpretations must be established. Research should not only be confined to redefinition, extension and incremental change. Innovation & creativity should become an epicenter for all research initiatives. The most important capital is the human capital and thus the ultimate objective is to develop good human beings with utmost integrity & professionalism for this new world.

The Choice Based Credit System supports the grading system which is considered to be better than conventional marks system. It is followed in many reputed institutions in India and abroad. The uniform grading system facilitates student mobility across the institutions within and across the countries and also enable potential employers to assess the performance of the students. The Choice Based Credit System makes the curriculum interdisciplinary and bridge the gap between professional and liberal education.

Programme Educational Objectives (PEO) of the programme are as follows:

- Students will apply knowledge of Computer aided design, simulation, manufacturing to pursue successful career in the field of Mechanical Engineering.
- Students will become innovators, entrepreneurs to design and develop products and services to address social, technical and business challenges.
- Students will engross in lifelong learning such as higher studies, research and other continuous professional development activities

II. CHOICE BASED CREDIT SYSTEM

The Indian Higher Education Institutions have been moving from the conventional annual system to semester system. Currently many of the institutions have already introduced the choice based credit system. The semester system accelerates the teaching-learning process and enables vertical and horizontal mobility in learning. The credit based semester system

provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching. The choice based credit system provides a 'cafeteria' type approach in which the students can take courses of their choice, learn at their own pace, undergo additional courses and acquire more than the required credits, and adopt an interdisciplinary approach to learning. It is desirable that the HEIs move to CBCS and implement the grading system.

A. Types of Courses

Courses are the subjects that comprise the M.Tech. Programme.

1. A course may be designed to comprise lectures, tutorials, laboratory work, field work, outreach activities, project work, vocational training, viva, seminars, termpapers, assignments, presentations, self-study etc. or a combination of some of these components.

2. The learning objectives and learning outcomes of each course will be defined before the start of a semester.

3. Courses are of two kinds: Core and Elective.
   i. **Core Course (CC)**: This is a course which is to be compulsorily studied by a student as a core requirement to complete the requirement of M.Tech. Production Engineering
   ii. **Elective Course**: An elective course is a course which can be chosen from a pool of subjects. It is intended to support the discipline of study by providing an expanded scope, enabling exposure to another discipline/domain and nurturing a student's proficiency/skill. An elective may be of following types:

      a) **Discipline Centric Elective (ED)**: It is an elective course that adds proficiency to the students in the discipline.

      b) **Open Elective (EO):** It is an elective course taken from other engineering disciplines that broadens the perspective of an Engineering student.

4. Each course contributes certain credits to the programme. A course can be offered either as a full course (4 credits) or as a half course (2 credits). A full course is conducted with 3 hours of lectures and either 1 hour of tutorial or 2 hours of practical work per week. A half course is conducted with 2 hours of lectures.

5. A student of Postgraduate programme has to accumulate about 40% credits from the Core Courses and the remaining credits from the Elective Courses to become eligible for the award of degree/ diploma/ certificate programmes.

6. A course (full/half) may also be designed without lectures or tutorials. However, such courses may comprise Field work, Outreach activities, Project work, Vocational Training, Seminars, Self-study etc. or a combination of some of these.

7. A Project work/Dissertation is considered as a special course involving application of the knowledge gained during the course of study in exploring, analyzing and solving complex problems in real life applications. A candidate completes such a course on his own with an advisory support by a teacher/faculty member.

B. Examination and Assessment

The following system will be implemented in awarding grades and CGPA under the CBCS system.

1. **Letter Grades and Grade Points:** A 10-point grading system shall be used with the letter grades as given in Table 1 below:

Table 1: Grades and Grade Points

Letter Grade	Grade point
O (Outstanding)	10
A+ (Excellent)	9
A (Very Good)	8
B+ (Good)	7
B (Above average)	6
C (Average)	5
P (Pass)	4
F (Fail)	0
Ab (Absent)	0

2. **Fail grade:** A student obtaining Grade F shall be considered failed and will be required to reappear in the examination. If the student does not want to reappear in an elective subject (that is ED, EO *but not CC courses*) then he/she can re-register afresh for a new elective subject.
3. **Non-credit course:** For non-credit courses, 'Satisfactory' or "Unsatisfactory' shall be indicated instead of the letter grade and this will not be counted for the computation of SGPA/CGPA. However, a student must get satisfactory to get the degree.
4. **Fairness in Assessment:** The CBCS promotes continuous evaluation system where end semester examinations weightage should not be more than 60%. The Departments should design their own methods for continuous evaluation. They have the flexibility and freedom in designing the examination and evaluation methods that best fits the curriculum, syllabi & teaching, learning methods. In this regard, the checks and

balances be implemented which enable Departments would effectively and fairly carry out the process of assessment and examination.

5. **Computation of SGPA and CGPA:** The following procedure be used to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

   i. The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses under gone by a student, i.e.

$$SGPA\ (S_i) = \frac{\sum C_i \times G_i}{\sum C_i}$$

   Where C_i is the number of credits of the i^{th} course and G_i is the grade point scored by the student in the i^{th} course.

   ii. The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, i.e.

$$CGPA = \frac{\sum C_i \times SGPA\ (S_i)}{\sum C_i}$$

   Where S_i is the SGPA of the i_{th} semester and C_i is the total number of credits in that semester.

   iii. The SGPA and CGPA shall be rounded off to two decimal points and reported in the transcripts.

   iv. CGPA shall be converted into percentage of marks, if required, by multiplying CGPA with 10.

III. PROGRAMME STRUCTURE

1. The M.Tech. Production Engineering programme span of four semesters, normally completed in 2 years.
2. The courses offered in each semester are given in the **Semester-wise Course Allocation.**
3. The discipline centric subjects under CC and ED categories are listed for each discipline separately.
4. A course may have pre-requisite courses that are given in the **Semester-wise Course Allocation**. A student can opt for an elective only if he/she has fulfilled its pre-requisites.
5. A student has to register for all electives before the start of a semester.

IV. COURSE CODIFICATION

The codes for various Postgraduate Programme are as follows:

i. Department of Electronics and Communication Engineering:
   1. Signal Processing-ECSP
   2. Embedded System and VLSI-ECES

ii. Department of Computer Engineering:
   1. Information System-COIS

iii. Department of Instrumentation and Control Engineering:
   1. Process Control-ICPC
   2. Industrial Electronics-ICIE
   3. Mechatronics-ICMT

iv. Department of Biotechnology:
   1. Biochemical Engineering -BTBC
   2. Bioinformatics-BTBF

v. Manufacturing processes and Automation Engineering:
   1. CAD CAM-MACD
   2. Manufacturing process and Automation Engineering.-MAMP
   3. Production Engineering-MAPE
   4. Engineering Management-MAEM
   5. Nano Technology-MANT

The codes for Departmental core subjects and Domain-specific Electives are specific to each Discipline. The first two characters are derived from Departmental codes listed above.

For I semester, the codes are:

PEC01	CC
PEC02	CC
PED***	Elective
PED***	Elective
PED***	Elective
EO***	Open Elective

For II semester, the codes are:

PEC03	CC
PEC04	CC
PED**	Elective
PED**	Elective
PED**	Elective
EO***	Open Elective

For III semester, the codes are:

PEC05	Seminar
PEC06	Major Project
PED**	Elective
PED**	Elective
PED**	Elective

For IV semester, the codes are:

PEC07	Dissertation

V. EVALUATION SCHEME

The courses are evaluated on the basis of continuous assessments, mid-semester exams and end-semester exams. The weightage of each of these modes of evaluation for the different types of courses are as follows.

Type of Course	**Continuous Assessment (CA), Theory**	**Mid-Semester Exam (MS), Theory**	**End-semester Exam (ES), Theory**	**Continuous Assessment (CA), Lab**	**End-semester Exam (ES), Lab**
CC/ED/EO Theory with/ without Tutorial	25	25	50	Nil	Nil
CC/ED/EO Theory with Practical	15	15	40	15	15
Major Project and Dissertation	Nil	Nil	Nil	40	60

VI. EVALUATION AND REVIEW COMMITTEE

The Committee of Courses and Studies in each department shall appoint one or more Evaluation-cum-Review Committees (ERC), each committee dealing with one course or a group of courses. This ERC consists of all faculty members who are likely to teach such courses in the group. Normally Head of the department shall be ERC Chairman.

The ERC has the following functions-

(i) To recommend appointment of paper setters/examiners of various examinations at the start of each semester.

(ii) To prepare quizzes, assignments, test papers etc. for Continuous Assessment (CA), Mid-Semester examination (MS) and End Semester (ES) examination and to evaluate them. Normally, each concerned faculty member, who is also a member of ERC, will do this job for his/her class. However, in exceptional circumstances any part of the work may be entrusted to some other member of the ERC.

(iii) To consider the individual representation of students about evaluation and take remedial action if needed. After scrutinizing, ERC may alter the grades awarded upward/downward. The decision of the ERC shall be final.

(iv) To moderate assignments, quizzes etc. for courses given by each of the concerned faculty members for his/her class with a view to maintain uniformity of standards.

(v) To review and moderate the MS and ES results of each course with a view to maintain uniformity of standards.

(vi) To lay guidelines for teaching a course.

VII. ATTENDANCE, PROMOTION AND DETENTION RULES

1. A student should normally attend all the classes. However, a student will be allowed to appear in the examination if he/ she has put in a minimum of 75% attendance separately in each course for which he / she has registered. A relaxation up to a maximum of 25% may be given on the production of satisfactory evidence that (a) the student was busy in authorized activities, (b) the student was ill.
2. A student should submit the evidence to the fact 1(a) and / or 1(b) above within seven working days of resuming the studies. Certificates submitted later will not be considered.
3. No relaxation in attendance beyond 25% is permitted in any case.
4. A student may re-register for a course if he/ she want to avoid a decrement in the grades.
5. There shall be no supplementary examinations. A student who has failed in a course will have to re-register for the course in a subsequent year.
6. If the student does not want to reappear in an elective course (that is, ED, EO, but not CC courses) then he/she can re-register afresh for a new elective course.

VIII. DECLARATION OF RESULTS

1. The M. Tech (PE) programme consists of 82 credits. A student will be awarded the degree if he/she has earned all 82 credits.
2. CGPA will be calculated on the basis of the best 78 credits earned by the student.
3. The candidate seeking re-evaluation of a course shall apply for the same on a prescribed proforma along with the evaluation fee prescribed by the university from time to time only for the End Semester Examination within seven days from the date of declaration of result.
4. The Institution/University may cancel the registration of all the courses in a given semester if
   i. The student has not cleared the dues to the institution/hostel.
   ii. A punishment is awarded leading to cancellation of the student's registration.

IX. CURRICULUM MODIFICATION

The curriculum will be updated regularly within a period of 5 to 10 years since last revision, to keep pace with the advancements in the field of Production Engineering.

X. CENTRAL ADVISORY COMMITTEE

There shall be a Central Advisory Committee consisting of the following—

a) Dean, Faculty of Technology, Chairman
b) Dean PGS
c) Head of Institution
d) Heads of Departments running M.Tech Courses

PROGRAMME OUTCOMES

- An ability to apply knowledge of mathematics and engineering.
- An ability to design, analyze and interpret data using Engineering Management tools & techniques.
- An ability to design and develop a manufacturing system, process etc. to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability.
- An ability to function in multi-disciplinary teams.
- An ability to identify, formulate, and solve engineering problems.
- Responsiveness towards professionalism and ethics.
- An ability to communicate effectively.
- Domain knowledge necessary to understand the impact of engineering solution in a global and societal context.
- Recognition of the need for, and an ability to engross in lifelong learning.
- Knowledge of contemporary issues.
- An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
- An ability to demonstrate the knowledge of engineering and management principles and apply these to manage the projects and its financial aspects.

SEMESTER-WISE COURSE ALLOCATION

M.TECH. PRODUCTION ENGINEERING (Full Time) SEMESTER I

CODE	Type	COURSE OF STUDY	L	T	P	C	EVALUATION (MARKS)					
							Theory			Practical		Total
							CA	MS	ES	CA	ES	
PEC01	CC	Casting & Welding: Processes & Automation	3	0	2	4	15	15	40	15	15	100
PEC02	CC	Theory of Plasticity and Metal Forming	3	0	2	4	15	15	40	15	15	100
PED**	ED	Elective #	-	-	-	4	-	-	-	-	-	100
PED**	ED	Elective #	-	-	-	4	-	-	-	-	-	100
PED**	ED	Elective #	-	-	-	4	-	-	-	-	-	100
EO***	EO	Open Elective #	-	-	-	4	-	-	-	-	-	100
		TOTAL	$			24						

#: The LTP allocation, Evaluation Scheme and Pre-requisites for Elective(s) are given in Tables 2-3
$: The actual weekly load will depend upon the elective(s) chosen by the student

M.TECH. PRODUCTION ENGINEERING (Full Time) SEMESTER II

CODE	Type	COURSE OF STUDY	L	T	P	C	EVALUATION (MARKS)					
							Theory			Practical		Total
							CA	MS	ES	CA	ES	
PEC03	CC	Advanced Manufacturing Processes	3	0	2	4	15	15	40	15	15	100
PEC04	CC	Generative Manufacturing Processes	3	0	2	4	15	15	40	15	15	100
PED**	ED	Elective #	-	-	-	4	-	-	-	-	-	100
PED**	ED	Elective #	-	-	-	4	-	-	-	-	-	100
PED**	ED	Elective #	-	-	-	4	-	-	-	-	-	100
PEO**	EO	Open Elective #	-	-	-	4	-	-	-	-	-	100
		TOTAL	$			24						

#: The LTP allocation, Evaluation Scheme and Pre-requisites for Elective(s) are given in Tables 2-3
$: The actual weekly load will depend upon the elective(s) chosen by the student

M.TECH. PRODUCTION ENGINEERING (Full Time) SEMESTER III

CODE	Type	COURSE OF STUDY	L	T	P	C	EVALUATION (MARKS)					
							Theory			Practical		Total
							CA	MS	ES	CA	ES	
PEC05	CC	Seminar	0	0	4	2	-	-	-	40	60	100
PEC06	CC	Major Project	0	0	-	6				40	60	100
PED**	ED	Elective #	-	-	-	4	-	-	-	-	-	100
PED**	ED	Elective #	-	-	-	4	-	-	-	-	-	100
PED**	ED	Elective #	-	-	-	4	-	--	-	-	--	100
		TOTAL	$			20						

#:The LTP allocation, Evaluation Scheme and Pre-requisites for Elective(s) are given in Tables 2-3.
$: The actual weekly load will depend upon the elective(s) chosen by the student

M.TECH. PRODUCTION ENGINEERING (Full Time) SEMESTER IV

CODE	Type	COURSE OF STUDY	L	T	P	C	EVALUATION (MARKS)					
							Theory			Practical		Total
							CA	MS	ES	CA	ES	
PEC07	CC	Dissertation	-	-	-	14	-	-	-	40	60	100
		TOTAL	-	-	-	14						

SEMESTER-WISE COURSE ALLOCATION-PART-TIME

M.TECH. PRODUCTION ENGINEERING (Part Time) SEMESTER I

CODE	Type	COURSE OF STUDY	L	T	P	C	EVALUATION SCHEME Percentage (Weightage)					
							Theory			Practical		Total
							CA	MS	ES	CA	ES	
PEC01	CC	Casting & Welding: Processes & Automation	3	0	2	4	15	15	40	15	15	100
PEC02	CC	Theory of Plasticity and Metal Forming	3	0	2	4	15	15	40	15	15	100
EO***	EO	Open Elective #	-	-	-	4	-	-	-	-	-	100
		TOTAL	$			12						

#: The LTP allocation, Evaluation Scheme and Pre-requisites for Elective(s) are given in Tables 2-3.
$: The actual weekly load will depend upon the elective(s) chosen by the student

M.TECH. PRODUCTION ENGINEERING (Part Time) SEMESTER II

CODE	Type	COURSE OF STUDY	L	T	P	C	EVALUATION SCHEME Percentage (Weightage)					
							Theory			Practical		Total
							CA	MS	ES	CA	ES	
PEC03	CC	Advanced Manufacturing Processes	3	0	2	4	15	15	40	15	15	100
PEC04	CC	Generative Manufacturing Processes	3	0	2	4	15	15	40	15	15	100
EO***	EO	Open Elective #	-	-	-	4	-	-	-	-	-	-
		TOTAL	$			12						

#: The LTP allocation, Evaluation Scheme and Pre-requisites for Elective(s) are given in Tables 2-3
$: The actual weekly load will depend upon the elective(s) chosen by the student

M.TECH. PRODUCTION ENGINEERING (Part Time) SEMESTER III

CODE	Type	COURSE OF STUDY	L	T	P	C	EVALUATION SCHEME Percentage (Weightage)					
							Theory			Practical		Total
							CA	MS	ES	CA	ES	
PED**	ED	Elective #	-	-	-	4	-	-	-	-	-	100
PED**	ED	Elective #	-	-	-	4	-	-	-	-	-	100
PED**	ED	Elective #	-	-	-	4	-	-	-	-	-	100
		TOTAL	$			12	-	-	-	-	-	100

#: The LTP allocation, Evaluation Scheme and Pre-requisites for Elective(s) are given in Tables 2-3.
$: The actual weekly load will depend upon the elective(s) chosen by the student

M.TECH. PRODUCTION ENGINEERING (Part Time) SEMESTER IV

CODE	Type	COURSE OF STUDY	L	T	P	C	EVALUATION SCHEME Percentage (Weightage)					
							Theory			Practical		Total
							CA	MS	ES	CA	ES	
PED**	ED	Elective #	-	-	-	4	-	-	-	-	-	100
PED**	ED	Elective #	-	-	-	4	-	-	-	-	-	100
PED**	ED	Elective #	-	-	-	4	-	-	-	-	-	100
		TOTAL	$			12						

#: The LTP allocation, Evaluation Scheme and Pre-requisites for Elective(s) are given in Tables 2-3.
$: The actual weekly load will depend upon the elective(s) chosen by the student

M.TECH. PRODUCTION ENGINEERING (Part Time) SEMESTER V

CODE	Type	COURSE OF STUDY	L	T	P	C	EVALUATION SCHEME Percentage (Weightage)					
							Theory			Practical		Total
							CA	MS	ES	CA	ES	
PED**	ED	Elective #	-	-	-	4	-	-	-	-	-	100
PED**	ED	Elective #	-	-	-	4	-	-	-	-	-	100
PEC06	CC	Major Project	-	-	-	6	-	-	-	40	60	100
		TOTAL	$			14						

#: The LTP allocation, Evaluation Scheme and Pre-requisites for Elective(s) are given in Tables 2-3.
$: The actual weekly load will depend upon the elective(s) chosen by the student

M.TECH. PRODUCTION ENGINEERING (Part Time) SEMESTER VI

CODE			L	T	P	C	EVALUATION SCHEME Percentage (Weightage)					
							Theory			Practical		Total
							CA	MS	ES	CA	ES	
PED**	ED	Elective #	-	-	-	4	-	-		-	-	100
PEC05	CC	Seminar	-	-	4	2	-	-	-	40	60	100
PEC07	CC	Dissertation	-	-	-	14	-	-	-	40	60	100
		TOTAL	$			20						

#: The LTP allocation, Evaluation Scheme and Pre-requisites for Elective(s) are given in Tables 2-3.
$: The actual weekly load will depend upon the elective(s) chosen by the student

TABLE 2A: LIST OF DISCIPLINE CENTRIC ELECTIVES WITH TUTORIAL							
LTP Allocation			**Evaluation Scheme**				
L	**T**	**P**	**CA**	**MS**	**ES**	**CA**	**ES**
3	**1**	**0**	**25**	**25**	**50**	**-**	**-**
Code	**Name of Elective**		**Pre-Requisites**				
PED01	Operation Research & Production Management		NONE				
PED02	Artificial Intelligence		NONE				
PED03	Design of Experiments		NONE				
PED04	Design of Facilities		NONE				
PED05	Design of Management and Information System		NONE				
PED06	Financial Management		NONE				
PED07	Work Study and Ergonomics		NONE				
PED08	Reliability Engineering		NONE				
PED09	Computational Methods		NONE				
PED10	Optimization Techniques		NONE				
PED11	IT in Manufacturing Enterprises		NONE				
PED12	Value Engineering		NONE				
PED13	Supply Chain Management		NONE				
PED14	Maintenance Management		NONE				
PED15	Design for Manufacture		NONE				

TABLE 2B: LIST OF DISCIPLINE CENTRIC ELECTIVES WITH PRACTICAL							
LTP Allocation			**Evaluation Scheme**				
L	**T**	**P**	**CA**	**MS**	**ES**	**CA**	**ES**
3	**0**	**2**	**15**	**15**	**40**	**15**	**15**
Code	**Name of Elective**		**Pre-Requisites**				
PED31	Advanced Mathematics and Numerical Analysis		NONE				
PED32	Robotics		NONE				
PED33	Product Design and Manufacturing		NONE				
PED34	Computer Aided Manufacturing (CAM)		NONE				
PED35	Metrology		NONE				
PED36	Finite Element Methods		NONE				
PED37	Automation in Manufacturing		NONE				
PED38	Flexible Manufacturing Systems		NONE				
PED39	Design of Machine Tools and Cutting Tools		NONE				
PED40	Mechatronics		NONE				
PED41	CAD and Geometric Modeling		NONE				
PED42	Computer Programming and Interface		NONE				
PED43	Composite Materials		NONE				
PED44	Micro Electro Mechanical Systems		NONE				
PED45	CNC Operation and Programming		NONE				
PED46	Advanced Machining Processes		NONE				

TABLE 3 : LIST OF OPEN ELECTIVES EO-***							
LTP Allocation			**Evaluation Scheme**				
L	**T**	**P**	**CA**	**MS**	**ES**	**CA**	**ES**
3	**1**	**0**	**25**	**25**	**50**	**-**	**-**
Code	**Name of Elective**		**Pre-Requisites**				
EO001	Technical Communication		None				
EO002	Disaster Management		None				
EO003	Basics of Finance Management		None				
EO004	Basics of Human Resources Management		None				
EO005	Project Management		None				
EO006	Basics of Corporate Law		None				
EO007	Biological computing		None				
EO008	Basic of social science		None				
EO009	Entrepreneurship		None				
EO010	Social work		None				
EO011	IP and Patenting		None				
EO012	Supply Chain Management-Planning and logistics		None				
EO013	Organization Development		None				
EO014	Industrial Organization and Managerial Economics		None				
EO015	Global Strategy and Technology		None				
EO016	Engineering System Analysis and Design		None				
EO017	Biology for Engineers		None				
EO018	Energy, Environment and Society		None				
EO019	Public Policy and Governance		None				

DETAILED SYLLABUS FOR CORE COURSES

Course No	Title of the Course	Course Structure	Pre-Requisite
PEC01	Casting and Welding: Processes & Automation	L-T-P:3-0-2	None

COURSE OUTCOMES (COs)

- To inculcate the principle, thermal and metallurgical aspects during solidification of metal and alloys.
- To impart knowledge about principles/methods of casting with detail design of gating/riser system needed for casting, defects in cast objects and requirements for achieving sound casting.
- To impart knowledge about welding behavior of machine and process during welding, analysis of common and newer welding techniques and metallurgical and weldability aspects of different common engineering materials.

COURSE CONTENT

Introduction; Introduction to Manufacturing

CASTING

Expendable Mold Casting Processes; mold types, sand casting types, pattern designs/mold designs, gating systems, cores.

Casting fundamentals of Sand Casting; solidification of metals, cast structures, fluidity of molten metals, heat transfer, shrinkage, casting defects, foundry methods, cast alloys.

Investment Casting Processes; investment casting types, mold design, ceramic mold casting, shell mold casting.

Permanent Mold Casting Processes; mold design, die casting types, centrifugal casting, squeeze casting, vacuum molding, turbine blade casting methods.

Casting Heat Treatment

Quality Assurance;

Plaster mold casting

Process Automation Case Studies

WELDING

Introduction to welding; Classification, transformation of an art to science.

Solid State Welding Processes; science of solid state welding, ultrasonic, cold, friction, hot forge and diffusion welding processes.

Liquid State Welding Processes; Science of liquid state welding processes, gas welding, thermite welding, arc welding (Arc welding processes, power sources, physics of arc welding, applications, newer arc welding processes viz. Plasma – MIG Welding, Twisted Arc Welding etc.), resistance welding, induction welding, laser welding electron beam welding and their applications.

Solid/Liquid State Welding; Soldering, brazing, adhesive bonding.

Weldability tests. Quality Assurance, Sensors and controls in welding.

SUGGESTED READINGS:

1. Nomura, H. "Sensors and Control Systems in Arc Welding". Japan, Chapman & Hall
2. Welding Handbook, 8th edition, Vol. 1 - 5. AWS American Welding Society Publications
3. ASM Handbook Volume 06: "Welding, Brazing, and Soldering Hardbound"; Publisher: ASM; Publication.
4. A. Ghosh and A. K. Mallik, "Manufacturing Analysis", East West Press Ltd. New Delhi.

Course No	Title of the Course	Course Structure	Pre-Requisite
PEC02	Theory of Plasticity and Metal Forming	L-T-P:3-0-2	None

COURSE OUTCOMES (COs)

- Describe diverse metal working processes
- To select the relevant load to be applied drawing wires and tubes
- To select the relevant metal working process for the given application
- To impart knowledge about principles and criteria of yielding during forming of metals
- To impart knowledge of analysis of different bulk metal forming processes following different analysis approach
- To understand the process mechanics with role of different controlling process parameters

COURSE CONTENT

Mechanics of Solids: 3D-State of Stress; Mohr's Circle for 3D-stress; Stress and Strain Tensor; Hydrostatic and Deviatoric Components of Stress; Strain a Point; Mohr's Circle of Strain; Elastic Stress-Strain Relations; Strain Energy; Isotropy and Anisotropy.

Theory of Plasticity: Strain-hardening; Bauschinger Effect; Flow Rules; True Stress and Strain; Yield Criteria; Anisotropy in Yielding; Yield Locus; Yield Surface and Normality; Octahedral Shear Stress Strain; Invariants of Stress and Strain; Plastic Stress-Strain Relations

Mechanics of Metal Working Processes:

Slab Method of Analysis;

Uniform Deformation Energy Method;

Limit Analysis (Upper Bound and Lower Bound Techniques);

Slip-Line Field Theory (Two-Dimensional Plastic Flow)

Analysis of Rolling; Forging; Drawing; Extrusion; Deep Drawing; and Bending Processes using these methods.

Fundamentals of Metal Forming Operations: Classification of Forming Processes; Operating Principles Different Forming Processes; Temperature in Forming Processes (Hot, Cold and Warm Working); Friction and Lubrication in Metal Forming; Strain-Rate Effects; Workability; Residual Stresses; Commonly Occurring Forming Defects in Different Forming Processes

Sheet Metal Working Operation: Spring-Back Effect; Shearing and Blanking; Bending; Stretch Forming, and Miscellaneous Sheet-Metal Forming Operations; Forming Limit Criteria; Advanced Topics in Metal Working

SUGGESTED READINGS:

1. G. E. Dieter, "Mechanical Metallurgy", McGraw Hill Book Co. London.
2. G. W. Rowe, "Elements of Metal Working Theory", Edward Arnold London.
3. B. Avitzur,"Metal Forming: Processes and Analysis", McGraw Hill Book Co. New York.
4. J. Chakrabarty, "Theory of Plasticity", McGraw Hill International.
5. A. Ghosh and A. K. Mallik, "Manufacturing Analysis", East West Press Ltd. New Delhi.

Course No	Title of the Course	Course Structure	Pre-Requisite
PEC03	Advanced Manufacturing Processes	L-T-P:3-0-2	None

COURSE OUTCOMES (COs)

- Identify the need and to examine different functional elements of various advanced manufacturing processes and to identify the typical applications theses modern manufacturing processes.
- Examine and evaluate the unconventional manufacturing methods and their classification to use to the right manufacturing method for the right product
- Formulate real production problems creatively, especially in design considerations like material selection and process identification which is very important in the designing of new components.
- Demonstrate the ability to collect data of a given process/system, interpret, analyse data and make some conclusions for the different applications in the industry using variety of modern manufacturing methods such as unconventional machining (EDM, ECM, ECDM, IBM, EBM, PAM etc), micro/nano finishing operations (MRF, AFF, MAF, MRAFF, MFP etc), micro casting, micro forming, additive manufacturing etc.
- Design a process for day to day changing need of market in terms of applications and huge material choices due to advancement in materials technology.

COURSE CONTENT

Need and Classification of Advanced Manufacturing Processes
Advanced or Unconventional Machining Processes: Mechanics, Mechanism and Modeling of Material Removal; Parametric Analysis; Machine Tools; Shape and Material Applications; and Limitations of Mechanical type (AJM, USM, WJM, AWJM, AFM);
Chemical type (CHM, PCM),
Electro Chemical Type (ECM, ESD, etc.) , and Thermal type AMPs (EDM, LBM, EBM, PAM, IBM, etc.) Concept and Need of Hybrid Machining Processes: WEDM, Plasma MIG, ECDM, etc.
Advanced Welding Techniques: Twisted Arc Welding; Plasma-MIG Welding; Laser Beam Welding; Electron Beam Welding; Solid Phase Joining Processes
Manufacturing/Shaping and Fabrication Processes for Advanced Materials like Polymers, Ceramics, and Composites, etc.

SUGGESTED READINGS:

1. A. Bhattacharyya, “New Technology”, Institution of Engineers (India), Calcutta.
2. P. C. Pandey and H. S. Shan, “Modern Machining Methods”, Tata McGraw Hill Publishing.
3. A. Ghosh and A. K. Mallik, “Manufacturing Analysis”, East West Press Ltd. New Delhi.
4. G. F. Bennedict, “Non-Traditional Manufacturing Processes”, Marcell Dekker Inc.
5. J. A. McGeugh, “Advanced Methods of Machining”, Chapman and Hall Ltd. London.
6. P. K. Mishra, “Nonconvetional Machining”, Narosa Publishing House, New Delhi.
7. V. K. Jain, “Advanced Machining Processes”, Allied Publisher, Mumbai.

Course No	Title of the Course	Course Structure	Pre-Requisite
PEC04	Generative Manufacturing Processes	L-T-P:3-0-2	None

COURSE OUTCOMES (COs)

- Describe the current available rapid prototyping systems, their fundamental operating principles, and their characteristics.
- Describe complementary, secondary fabrication processes commonly used with the above rapid prototyping systems.
- Select the appropriate fabrication technology, or technologies, for a given prototyping task.

COURSE CONTENT

Overview of Rapid Prototyping - definitions, evolution
Processes, Principles, Materials, Resources
CAD for Rapid Prototyping
Case Studies - Building the Prototype
Description: The method of course delivery will be split into lectures and student presentations, with a series of projects in parallel. Everyone will get the opportunity to learn popular rapid prototyping technologies. This course will have a decision-based design / CAD basis, rather than a materials processing / physical prototyping basis. That is, the focus will be on the usage of RP technologies in product development, with an emphasis on their selection.
The course will be structured into three modules:
Selection of RP technologies. First-cut attributes and scales for selecting an appropriate technology. Survey of RP technologies with some hands-on training. Short reports and presentations on individual surveys.
In-depth development of analytical &/or experimental models for RP technology. The analytical or experimental model should lead to at least one selection attribute and scale. Geometric modeling issues and methods for RP, highlighting the CAD-RP interface. Reports and presentations on development of attributes and scales for one RP technology.
Application of RP selection method in 3-week design project (groups of 3-4). RP case studies in industry. Reports and presentations.

SUGGESTED READINGS:

1. Marshall Burns, “Automated Fabrication: Improving Productivity in Manufacturing”, Prentice Hall.
2. Jerome L. Johnson, “Principles of Computer Automated Fabrication”, Palatino Press, Inc.
3. Lamont Wood, “Rapid Automated Prototyping: An Introduction”, Industrial Press.
4. Paul F. Jacobs, “Rapid Prototyping and Manufacturing: Fundamentals of Stereo lithography”, Society of Manufacturing Engineers.
5. Larry Binstock, “Rapid Prototyping Systems: Fast Track to Product Realization”, Society of Manufacturing Engineers.
6. Detlef Kochan, “Solid Freeform Manufacturing”, Elsevier Science Publisher.
7. Paul F. Jacobs, “Stereolithography and Other RP&M Technologies: From Rapid Prototyping to Rapid Tooling”, Society of Manufacturing Engineers.

DETAILED SYLLABUS FOR DISCIPLINE CENTRIC ELECTIVES

Course No	Title of the Course	Course Structure	Pre-Requisite
PED01	Operation Research and Production Management	L-T-P:3-1-0	None

COURSE OUTCOMES (COs)

- To understand the role of operations management in the overall business strategy of the firm.
- To understand the interdependence of the operating system with other key functional areas of the firm.
- To identify and evaluate the key factors and the interdependence of these factors in the design of effective operating systems.
- To identify and evaluate a range of tools appropriate for analysis of operating systems of the firm.
- To identify and evaluate comparative approaches to operations management in a global context.
- To understand the application of operations management policies and techniques to the service sector as well as manufacturing firms.

COURSE CONTENT

Brief Review of Linear Programming: Simplex Method; Big M Method; Transportation Model; and Assignment Model
Advanced Topics in Linear Programming: Duality; Parametric; Goal; and Integer Programming
Sequencing Model
Dynamic Programming: Need; Approach; System Reliability and Applications of Dynamic Programming
Queuing Model
Game Theory
Simulation
Replacement Models
Technique of Project Management: PERT, CPM
Production Management: Concept, Definition, Types of Production Systems;
Demand Forecasting;
Facility Location; Plant Layout;
Production Scheduling;
Inventory Control;
Tools and Techniques of Modern Production Management

SUGGESTED READINGS:

1. J. L. Riggs, "Production Systems: Planning", Analysis and Control", John Willey and Sons Inc.
2. E. S. Buffa, "Modern Production and Operations Management" Willey Eastern Limited.
3. R. Panneerselvam, "Production and Operations Management", Prentice Hall of India, New Delhi.

Course No	Title of the Course	Course Structure	Pre-Requisite
PED02	Artificial Intelligence	L-T-P:3-1-0	None

COURSE OUTCOMES (COs)

- Understand the history, development and various applications of artificial intelligence;
- Familiarize with propositional and predicate logic and their roles in logic programming;
- Learn the knowledge representation and reasoning techniques in rule-based systems, case-based systems, and model-based systems;
- Appreciate how uncertainty is being tackled in the knowledge representation and reasoning process, in particular, techniques based on probability theory and possibility theory (fuzzy logic);
- Master the skills and techniques in machine learning, such as decision tree induction, artificial neural networks, and genetic algorithm;

COURSE CONTENT

Basic of artificial neural Networks, Activation & Synaptic Dynamics, Feed forward Neural Networks, Feed Back neural Networks, Neural Networks for linear & nonlinear Dynamic System, Modeling and control, Basics of Fuzzy logic export systems ,fuzzy sets & control theory, Fuzzy systems as inference engines, Fuzzy systems as function approximates, model based fuzzy control learning based fuzzy control classical fuzzy control problem inverted pendulum.

Fuzzy modeling & tracking control of nonlinear systems stability of fuzzy controllers examples of fuzzy control system Design, Neuro fuzzy systems.

SUGGESTED READINGS:

1. Timothy Ross “Fuzzy Logic with Engineering Applications”. MC Graw Hill.
2. B. Yegnanarayana , “Artifical Nearal Networks”. P.H.I Private Limited
3. Danw. Pathersm “Artificial Intelligence & Expert Systems”, Eastern Economy Edition

Course No	Title of the Course	Course Structure	Pre-Requisite
PED03	Design of Experiments	L-T-P:3-1-0	None

COURSE OUTCOMES (COs)

- Plan, design, and conduct experimental investigations efficiently and effectively.
- Understand strategy in planning and conducting experiments.
- Choose an appropriate experiment to evaluate a new product design or process improvement through experimentation strategy, data analysis, and interpretation of experimental results.

COURSE CONTENT

Objectives, principles, terminologies, guidelines, and applications of design of experiments. Completely randomized design. Randomized block design. Latin square design. Two level and three level full factorial designs. Fractional factorial designs. Robust design. Mixture experiments. Central composite and Box-Behnken designs. Response surface methodology. Multi-response optimization. Analysis of variance. Statistical test of hypothesis. Analysis of multiple linear regression. Use of statistical software packages.

SUGGESTED READINGS:

Montgomery, “Design and Analysis of Experiments”, Wiley Publication.

Course No	Title of the Course	Course Structure	Pre-Requisite
PED04	Design of Facilities	L-T-P:3-1-0	None

COURSE OUTCOMES (COs)

- Introducing the overall facilities planning process
- Exposing product, process and schedule design and their effects on the facility layout
- Developing the systematic facility layout procedure.
- Introducing mathematical models if the facility location problem and their analysis
- Exposing storage and warehouse design and their effects on facility planning
  Assess the value of facility planning on the strategy of a firm.
- Understand product, process and schedule design and their interaction with facility planning
- Develop a systematic facility layout using mathematical models.

COURSE CONTENT

System approach for the planning and design of facilities, plant location factors and theories, location of plant operation locational dynamics, Transportation models in plant location, Types of layout, Quantitative approaches to plant layout, computerized layout- planning, CRAFT, CORELAP, ALDEP. Analysis of material handling problems, selection of materials handling equipments automated warehousing and comeyorized systems. Assembly line balancing, plant maintenance, optimal maintenance policies, manpower planning and scheduling for maintenance, recent advancements.

SUGGESTED READINGS:

1. Tompkins, "Facilities Planning", Wiley Publications.
2. Buffa, "Modern Production/Operations Management", Wiley Publication.

Course No	Title of the Course	Course Structure	Pre-Requisite
PED05	Design of Management and Information System	L-T-P:3-1-0	None

COURSE OUTCOMES (COs)

- Knowledge and understanding of Information, strategy and customer-facing design theories which are relevant to the adoption and use of management information systems for competitive advantage
- Be able to reflect on the importance of customer centered information systems design on organizational effectiveness and global, competitive strategy
- Personal effectiveness to balance time/resources to deliver a range of formally and informally assessed outcomes, such as case analyses and presentations, class and tutorial discussions and overall attendance
- Be able to reflect on, analyse, and interpret information on contemporary IS management issues

COURSE CONTENT

Concepts is MIS, Role of information is decision making, characteristics of good MIS objectives of MIS, Reliability and availability of information on quality of decision making, Decision making without information (under uncertainty), Information kinds for various kinds of management, formal and informal information system, Distinction between physical system and information system, Information flow periodicity, forms and storage, Basic steps is determining the information cost. Frequency and form of information flow, computer purchases for various functional areas, selective information management, and information in MIS design. E.R.P, M.R.P., S.R.S., S.D.D., MIS for financial system, Inventory Management, Relative software platforms like DOT NET technology, data mining softwares.

SUGGESTED READINGS:

1. Laudon, Kenneth C., and Laudon, Jane P., "Management Information Systems-Managing Digital Firm", Prentice Hall.
2. S. Sadagopan "management information systems" PHI learning
3. Hans van der Heijden, "Designing Management Information Systems" , oxford university press.

Course No	Title of the Course	Course Structure	Pre-Requisite
PED06	Financial Management	L-T-P:3-1-0	None

COURSE OUTCOMES (COs)

- Financial management provides a foundation of the main topics in financial economics covering selected topics in corporate finance and asset pricing.
- In corporate finance we will be discussing capital budgeting, valuation, capital structure, and payout policy.
- In asset pricing we will be studying the risk and return tradeoff, the Capital Asset Pricing Model, market efficiency, and derivative securities.
- To give everybody a base level of finance knowledge that an MPA from a top business school should possess,
- To give everybody the ability and confidence to tackle common financial problems in practice,
- To provide adequate preparation for future finance classes, especially the advanced corporate and investment classes at the McCombs School of Business

COURSE CONTENT

Introduction, factors affecting the growth of financial engineering, price volatility, liquidity needs, cash flow, time value, sensitivity analysis of time value, risk and return, managing risks, credit policy, asset management. Fixed assets and depreciation, analysis, and interpretation of financial statements, cash management, sources of funds for working capital, cost accumulation systems, budgeting, standard budgeting and control. Use of software like mat lab, dot net, data mining softwares.

SUGGESTED READINGS:

1. Khan, M.Y. and P.K. Jain, "Financial Management: Text and Problems" Tata McGraw Hill.
2. Srivastava, Rajiv, and Anil Mishra, "Financial Management" Oxford University Press.
3. Chandra, P. "Financial Management-Theory and Practice" Tata McGraw Hill.
4. Horne, Van; James C., John Wachowicz, "Fundamentals of Financial Management" Pearson Education.

Course No	Title of the Course	Course Structure	Pre-Requisite
PED07	Works Study and Ergonomics	L-T-P:3-1-0	None

COURSE OUTCOMES (COs)

- Identify, explain and evaluate the impact of various personal attributes (anatomical, physiological, anthropometric and psychological) on proper safe working practice;
- Assess the effect of physical environment factors on comfort and performance;
- Apply principles of good ergonomic design of work areas and equipment to a range of occupational settings;
- Explain the influence of ergonomic principles on work organization and culture.

COURSE CONTENT

Introduction, Measurement of productivity, Method study, principles of motion economy, Macro motions analysis, work measurement, Time study, performance rating, standard allowances, work sampling, PMT MTM standard data system.

Ergonomics: Man machine system, types of displays, autodoxy presentation of information and speech communication Man-machine dynamics, Design of control, layout of workplace environmental effects and anthropometry.

SUGGESTED READINGS:

1. O.P Khanna, "Work Study: Motion &Time Study, Dhanpat Rai Publication.
2. Barnes , " Motion and Time Study Design and Measurement of Work" , Wiley Publication.
3. S. Dalela ,"Text Book of Work Study and Ergonomics", Standard Publishers.
4. Lakhwinder Pal singh, "Work study and Ergonomics" Combridge university press.

Course No	Title of the Course	Course Structure	Pre-Requisite
PED08	Reliability Engineering	L-T-P:3-1-0	None

COURSE OUTCOMES (COs)

- Understand the basic concepts of quality, reliability & safety.
- Compute measures of reliability of products and systems.
- Analyze failure data I Perform a Failure Modes, Effects and Criticality Analysis.
- Conduct a Fault Tree Analysis.
- Construct and analyze reliability block diagrams.
- Identify component importance.

Use redundancy to achieve reliability

COURSE CONTENT

Introduction, failure data analysis, MTTF, MTBF, Hazard models, series, parallel and mixed configuration, reliability improvement, reliability allocation, maintainability and availability, reliability based design, maintenance policies.

Reliability testing: Burn in testing, Binomial Testing, Acceptance testing, Accelerated life Testing, Degradation Models.

Reliability Improvement: Reliability specification and system measurements, System effectiveness, Economic analysis and life cycle cost, Reliability allocation (AGREE method, Redundancies).

Reliability Design Methods: Parts and material selection, De-rating, Stress-Strength analysis, Complexity and Technology, Redundancy.

Maintenances systems and economics of reliability.

SUGGESTED READINGS:

1. ADS Carter, “Mechanical Reliability Engineering”, Mc Milan.
2. Roy Bilington and R. N. Allen, “Reliability Evaluation of Engineering Systems, Pitman.
3. Balagurusamy.E., "Reliability Engineering", Tata McGraw Hill Publishing Company.

Course No	Title of the Course	Course Structure	Pre-Requisite
PED09	Computational Methods	L-T-P:3-1-0	None

COURSE OUTCOMES (COs)

At the end of the Course, Student will be able to

- Discuss several important methods with widespread application for solving large system of equations
- Appraise the importance of Eigen value problems in engineering sciences.
- Analyze experimental data by fitting a polynomial or estimating the derivative or finding the integrals or performing Fourier analysis.
- Prepare mathematical model for physical situations and numerically analyze the corresponding ordinary linear/nonlinear, initial/boundary value differential equations.
- Prepare mathematical model for physical situations and numerically analyze the corresponding partial linear/nonlinear, initial value/ initial boundary value differential equations.

COURSE CONTENT

Errors in numerical calculations and series approximations, Solution of algebraic and transcendental equations, Interpolation of data, finite differences, Curve fitting, Numerical differentiation and integration, Matrices and linear system of equations, Numerical solution of ordinary differential and partial differential equations, Solution of integral equations, Numerical solution of important production engineering problems.

SUGGESTED READINGS:

1. Steven C. Chapra and Raymond P Canale "Numerical Methods for Engineers"
2. T.R. McCalla "Introduction to Numerical Methods and Fortran Programming"
3. S.P. Venkateshan and Prasanna Swaminathan "Computational Methods in Engineering" Elsevier Inc.
4. M. **Kleiber**; E. **Oñate**, "Archives of Computational Methods in Engineering" Springer.

Course No	Title of the Course	Course Structure	Pre-Requisite
PED10	Optimization Techniques	L-T-P:3-1-0	None

COURSE OUTCOMES (COs)

- Identify necessity and development of mathematical models for various industries.
- Describe basic optimization and simulation techniques applied to various industries.
- Predict the industrial systems under the conditions of certainty, uncertainty and risk.
- Propose a queuing model based upon given data.
- Derive the network models and understanding of reliability concept.
- Demonstrate cost effective strategies in various applications in industry.
- Explain the importance and phases of Operation Research.
- Form the Linear programming model and solve it by graphical method and simplex algorithms.
- Recognize the balanced and unbalanced transportation models and predict optimum solution by MODI method.
- Outline and solve the shortest route, minimal spanning tree and maximal flow network problems.
- Construct the CPM and PERT networks.

COURSE CONTENT

Introduction: historical development, engineering applications; statement of problem-objective function, constraints, classification, techniques. Single variable optimization, multivariable optimization with equality and inequality constraints.

Linear programming: Formulations of linear programs, graphical method, simplex method, simplex algorithm, sensitivity analysis. Duality, decomposition principle.

Mathematical statement of transportation problem, methods of finding Basic Feasible Solution, test of optimality, MODI'S method for optimal solution, variation in transportation problem. Network Analysis: Project planning and control with PERT-CPM.

Decision analysis: decision under certainty, risk probability and uncertainty; AHP- assigning weight and consistency test of AHP. Meta-heuristics: Definition of heuristic and meta-heuristic algorithms; introduction to Tabu search, Simulated Annealing and Genetic algorithms.

SUGGESTED READINGS:

1. Hillier FS and Liberman GJ; "Introduction to Operations Research concept and cases"; TMH
2. Taha H; "Operations research"; PHI
3. Sen RP; Operations Research-Algorithms and Applications; PHI Learning

Course No	Title of the Course	Course Structure	Pre-Requisite
PED11	IT in Manufacturing Enterprises	L-T-P:3-1-0	None

COURSE OUTCOMES (COs)

- To be able to application of ERP systems in Manufacturing sector
- To be able to understand information technology systems in manufacturing enterprise

COURSE CONTENT

Production Systems, Manufacturing Enterprises as Systems, Appreciate the evolving manufacturing environment and multi-attributed competition; IT role Challenges and Opportunities, Evolving Role of information Technology in Enterprises; P&I Implications, Technology Management Challenges, Technical Fundamentals; MIS in Manufacturing Enterprises, FMS (Flexible manufacturing Systems), CIM Systems, Intelligent Manufacturing Systems, Concurrent Engineering and Extended Enterprises, ERP (Enterprise Resource Planning), E-Business and supply Chain Management, Discrete Event Simulation and AI Applications in manufacturing enterprises, Implementation Issues, Future Treands Careers etc, use of software like DOT NET, DATA MINING etc..

SUGGESTED READINGS:

1. Luca G. Sartori, “Manufacturing Information Systems ", Addison-Wesley Publishing Company.
2. Date.C.J., “An Introduction to Database systems ", Narosa Publishing House.
3. Orlicky.G., “Material Requirements Planning ", McGraw-Hill Publishing Co.
4. Kerr.R, “Knowledge based Manufacturing Management ", Addison-wesley.

Course No	Title of the Course	Course Structure	Pre-Requisite
PED12	Value Engineering	L-T-P:3-1-0	None

COURSE OUTCOMES (COs)

- Understand the basics of Value Engineering (VE) to ensure that a standardized method is used for VE applications to projects
- Learn to perform "function analysis" for buildings and civil projects
- Understand the appropriate time to apply VE for building design projects
- Gain an understanding of the total decision-making methodology of value engineering
- Learn of the "SAVE International Value Methodology Standard" and the convention to be followed for application of VE to projects
- Acquire the necessary information on VE to recognize the benefits resulting from their adoption as a standard practice within an organization
- Be able to engage clients in a meaningful discussion on VE as well as demonstrate a commitment to optimize the value for facilities

COURSE CONTENT

Introduction to Value Engineering (V.E.) and Value Analysis, Life Cycle of a Product, Methodology of V.E., Quantitative definition of Value, Use Value and Prestige Value, Estimation of product quality performance

Types of Functions, Relationship between Use Functions and Esteem Functions in product design, Functional Cost and Functional Worth, Effect of value improvement on profitability, Aims of VE systematic Approach.

Introduction to V.E. Job plan / Functional Approach to Value Improvement, Various phases and techniques of the job plan, Factors governing project selection, Life Cycle Costing for managing the Total Value, Concepts in LCC, Present Value concept, Annuity concept, Net Present Value, Pay Back period, Internal rate of return on investment (IRR), Examples and illustrations.

Creative thinking and creative judgment, False material, labor and overhead saving, System Reliability, Reliability elements in series and parallel, Decision matrix, Estimation of weights and efficiencies, Sensitivity analysis, Utility functions, Fast diagramming, Critical path of functions.

SUGGESTED READINGS:

1. S.S. Iyer, "Value Engineering", New Age International, New Delhi.
2. Miles, Lawrence D., "Technology of Value Analysis And Engineering", McGraw Hill.
3. Mudge Arthur E., "Value Engineering: Systematic Approach", Mcgraw Hill, New York.

Course No	Title of the Course	Course Structure	Pre-Requisite
PED13	Supply Chain Management and Logistics	L-T-P:3-1-0	None

COURSE OUTCOMES (COs)

- Supply chain management consist of all parties (including manufacturer, marketer, suppliers, transporters, warehouses, retailers and even customers) directly or indirectly involved in fulfillment of a customer.
- The main objective is to acquaint the students with the concepts and tools of supply chain management and logistics as relevant for a business firm.

COURSE CONTENT

Unit I

Introduction: Concept of supply chain management (SCM) and trade logistics; Scope of logistics; Logistic activities – an Overview; Contribution of logistics at macro and micro levels; SCM and trade logistics; Business view of SCM; Concept, span and process of integrated SCM; Demand management – methods of forecasting; Supply chain metrics (KPIs), performance measurement and continuous improvement; Product development Process and SCM; Strategic role of purchasing in the supply chain and total customer satisfaction; Types of purchases; Purchasing cycle.

Unit II

Managing Relationship: Role of Relationship marketing in SCM; Managing relationships with suppliers and customers; Captive buyers and suppliers; Strategic partnerships; Supplier-retailer collaboration and alliances.

Unit III

Focus Areas of Logistics and Supply Chain management: Transportation-Importance of effective transportation system; Service choices and their characteristics; inter-modal services; Transport cost characteristics and rate fixation; In-company management vs. out-sourcing; World sea borne trade; International shipping- characteristics and structure; Liner and tramp operations; Liner freighting; Chartering-Types, principles and practices; Development in sea transportation-Unitization, containerisation, inter and multimodal transport; CFC and ICD. Air transport: Set up for air transport and freight rates; Carriage of Goods by sea -Role and types of cargo intermediaries. Warehousing and inventory management: Reasons for warehousing; Warehousing evaluation and requirements; Warehousing location strategies; Inventory management principles and approaches; Inventory categories -EOQ, LT, ICC

Unit IV

IT Enabling Logistics and Supply Chain: Technology in logistics – EDI, bar Coding, RFID etc., data warehousing, electronic payment transfers; Business management systems; TRADITIONAL ERP, SPECIAL ERP, MR, DRP, PDM, EIP, CPFR, WMS, TMS; Re-engineering the supply chain- Future directions.

Unit V

Trends and Challenges in logistics and supply chain management: Third party logistic outsourcing –challenges and future directions.
SUGGESTED READINGS: 1. Christopher, M., "Logistics and Supply Chain Management", Prentice Hall. 2. Handfield and Nicholas, Jr., "Introduction to Supply Chain Management", Prentice Hall. 3. Jhon J Coyle, C. JhonandLangley,Brian J Gibs, "Logistics approach to Supply Chain Management", Cengage Learning.

Course No	Title of the Course	Course Structure	Pre-Requisite
PED14	Maintenance Management	L-T-P:3-1-0	None

COURSE OUTCOMES (COs)

- Describe modern maintenance practices and their integration within the production organization.
- Explain the roles of management and planning in maintenance.
- Evaluate and apply modern maintenance practices to mine production operations.

COURSE CONTENT

Introduction to maintenance management, Reliability basics, Asset criticality Analysis, Reliability centered maintenance, Basic maintenance models for age and time based replacement, block and group replacement, inspection and shock based replacement, imperfect maintenance models, Maintainability models, Availability models, Life cycle cost models, Simulation based approach for maintenance planning, Queuing models for maintenance planning, Models for condition monitoring, Models for Maintenance scheduling, Maintenance performance measurement, Asset management practices, Case studies.

SUGGESTED READINGS:

Mohamed Ben-Daya, Uday Kumar, D. N. Prabhakar Murthy Introduction to Maintenance Engineering: Modelling, Optimization and Management, Wiley.

Course No	Title of the Course	Course Structure	Pre-Requisite
PED15	Design of Manufacture	L-T-P:3-1-0	None

COURSE OUTCOMES (COs)

- Perform the essential stages of a Design for Manufacture process.
- Recognize and list the benefits of the DFM/DFA method in creating product designs which support manufacturing processes and cost reduction.
- Outline a Robust Manufacturing Plan that optimizes and simplifies product design without sacrificing quality.
- Objectively determine which designs would be suitable as DFM/DFA candidates.
- Construct an actual DFM/DFA worksheet and calculate design efficiency using an instructor provided project.

COURSE CONTENT

1. INTRODUCTION

General design principles for manufacturability - strength and mechanical factors, mechanisms selection, evaluation method, Process capability - Feature tolerances - Geometric tolerances - Assembly limits – Datum features - Tolerance stacks.

2. FACTORS INFLUENCING FORM DESIGN

Working principle, Material, Manufacture, Design - Possible solutions - Materials choice - Influence of materials on from design - from design of welded members, forgings and castings.

3. COMPONENT DESIGN-MACHINING CONSIDERATION

Design features to facilitate machining - drills - milling cutters - keyways - Doweling procedures, counter sunk screws - Reduction of machined area - simplification by separation - simplification by amalgamation - Design for machinability - Design for economy - Design for clampability - Design for accessibility - Design for assembly.

4. COMPONENT DESIGN - CASTING CONSIDERATIONS

Redesign of castings based on parting line considerations - Minimizing core requirements, machined holes, redesign of cast members to obviate cores.

5. REDESIGN FOR MANUFACTURE AND CASE STUDIES

Identification of uneconomical design - Modifying the design - group technology - Computer Applications for DFMA

SUGGESTED READINGS:

1. Harry Peck, "Design for Manufacture", Pittman Publication.
2. Robert Matousek, "Engineering Design - A systematic approach", Blackie & sons Ltd.
3. James G. Bralla, "Hand Book of Product Design for Manufacturing", McGraw Hill Co.
4. Swift K.G., "Knowledge based design for manufacture, Kogan Page Ltd.

Course No	Title of the Course	Course Structure	Pre-Requisite
PED31	Advanced Mathematics and Numerical Analysis	L-T-P:3-0-2	None

COURSE OUTCOMES (COs)

- To be able to expand functions in a Fourier series and apply Harmonic analysis to numerical data.
- To be able to evaluate Laplace transforms and inverse Laplace transform and apply Laplace transforms to solve ordinary differential equations.
- To be able to evaluate line, surface and volume integrals
- To be able to describe errors involved in computations and to estimate these errors.
- To be able to solve equations, apply numerical methods to interpolate, extrapolate, and differentiate and integrate functions.
- To be able to solve differential equation using numerical methods and solve system of equations.

COURSE CONTENT

Perturbation Method: Asymptotic Expansion, Method of steepest descent, Regular and singular perturbations, Method of strained Co-ordinates, Multiple scales, Matched asymptotic expansions.

Integral Transforms of Fourier, Laplace, Hankel and Mellin. Fredholm and Volterra Integral equations and the iterative solutions. Fredholm alternative, Symmetric Kernels and Singular Integral Equations.

Solution of a system of linear equations: Gaussian Elimination and Gauss-Seidel Methods.

Solution of Nonlinear equations: Bisection Method, Secant Method, Method of False Position, Newton-Raphson Method, Chebyschev Method, Rate of Convergence, System of nonlinear equations.

Interpolation by polynomials: Divided difference, Error of the interpolating polynomial, least square approximation, Piecewise linear and cubic spline interpolation.

Numerical Integration: Composite Rules, Gaussian Quadrature formula, Error formula.

Numerical solutions of differential equations: Euler and Runge-Kutta methods, Multistep methods, and Predictor - corrector Methods, Order of convergence.

SUGGESTED READINGS:

1. S. D. Conte, Carl De Boor, "Elementary Numerical Analysis, An Algorithmic Approach", 3rd Ed. McGraw – Hill.
2. C. E. Froberg, "Introduction to Numerical Analysis", 2nd Ed., Addision – Wesley.
3. K. E. Atkinson, "An Introduction to Numerical Analysis", Wiley.
4. F. B. Hildebrand, "Introduction to Numerical Analysis", Tata McGraw-Hill.
5. I. N. Sneddon, "The use of Integral Transforms", Tata McGraw Hill.
6. S. G. Mikhlin, "Integral Equations", Pergamon Press.
7. A. C. Pipkin, "A Course on Integral Equations", Springer-Verlag,

Course No	Title of the Course	Course Structure	Pre-Requisite
PED32	Robotics	L-T-P	None

COURSE OUTCOMES (COs)

- Knowledge of basic components and configuration of Robot.
- Knowledge of Statics and Dynamics of Robotics.
- Knowledge of motion planning of robotics.
- Knowledge of Conventional Control algorithms of Robotics and non-linear dynamic system.
- Knowledge of artificial intelligent control algorithms of Robotics.
- Knowledge of concepts of actuators and sensors used in Robots.
- Knowledge of Hardware and software aspect of the Robot.
- Design and fabricate working robotic systems in a group-based term project

COURSE CONTENT

Introduction, Applications, classification, Basic components of a robot system, Specifications, Robot Anatomy, Coordinate frames, mapping, and transforms, Euler angle axis representation, Direct kinematics model, Denavit Hartenberg notation, Inverse kinematics, Manipulator Differential Motion & statics, Dynamic modeling ,Lagrange -Euler formulation, Newton-Euler formulation, Inverse dynamics, Trajectory planning, control of Manipulators, PID control, computed torque control feed forward control, AI control, Sensors in Robotics, Robotic Vision, Robot Software & Programming, Robotic system overall Design.

SUGGESTED READINGS:

1. K.S Fu R.C. Gonzalez, C.S. G. Lee "Robotics control sensing vision and Intelligence": Mc Graw Hill Book Company,
2. Robert, J. Schilling, "Fundamentals of Robotics: Analysis & control" PHI Private Ltd.
3. Richard D. Klaffer "Robotic Engineering: An Integrated Approach", P.H.I Private Limited
4. TSUNEO Yoshikawa, "Foundations of Robotics: Analysis & Control", P.H.I. Private Limited
5. Satya Ranjan Deb "Robotics Technology and Flexible Automation", Tata MC-Graw Hill
6. J. J. Craig Addison "Introduction to Robotics Mc Chanics & Control 2nd Edition", Wesley

Course No	Title of the Course	Course Structure	Pre-Requisite
PED03	Product Design and Manufacturing	L-T-P:3-0-2	None

COURSE OUTCOMES (COs)

- To introduce different design disciplines and various steps involved in a design process.
- To provide a detailed insight to students about engineering design and how it is different from other design disciplines.
- To introduce various types of mechanical elements like springs, bearings, shafts, brakes, clutches, gears etc. to the students and brief explanation about their manufacturing process.
- To introduce theories of failure, mechanical properties of material, stress-strain diagram for ductile and brittle materials.
- Introduction to dynamic stress, calculation of endurance limit.
- To develop an aptitude among the students that how different products and components that they see in their daily life can me manufactured and fabricated.
- To provide detailed introduction about different types of permanent and temporary fasteners and calculation of stresses using mathematical equations.
- To develop ability among students to use the knowledge of mathematics, mechanics of solids and other reengineering disciplines like Computer Aided Design and Finite Element Analysis in solving engineering problems and to have a better design aptitude.
- After the completion of the course students should develop a know-how that how different mechanical elements can be combined together to develop a simple machine.

COURSE CONTENT

Introduction, development processes and organizations, opportunity identification. Product planning. Identifying customer needs. Product specifications. Concept generation. Concept selection. Concept testing. Product architecture. Industrial design

Design for environment. Design for manufacturing. Prototyping. Robust design. Patents and intellectual property. Design of services. Product development economics. Managing projects.

SUGGESTED READINGS:

Karl T. Ulrich and Steven D. Eppinger “Product Design and Development”:, Sixth Edition, McGraw-Hill, New York.

Course No	Title of the Course	Course Structure	Pre-Requisite
PED34	Computer Aided Manufacturing (CAM)	L-T-P:3-0-2	None

COURSE OUTCOMES (COs)

- Identify different axes, machine zero, home position, controls and features of CNC machines.
- Select, mount and set cutting tools and tool holders on CNC.
- Prepare part programmes using ISO format for given simple components with and without use of MACRO, CANNED CYCLE and SUBROUTINE using ISO format.
- Interface software application for auto part programming.

COURSE CONTENT

Unit – I. Fundamentals of CAM.

1.1 CAM - concept and definition. 1.2 NC (Numerical Control), CNC (Computerized Numerical Control) and DNC (Direct Numerical Control) - concept, features and differences. 1.3 Advantages and limitations of CNC. 1.4 Selection criteria for CNC machines.

Unit- II Constructional features of CNC machines.

2.1 CNC machines: Types, classification, working and constructional features. 2.2 Spindle drives and axes drives on CNC machines. 2.3 Machine structure- Requirements and reasons. 2.4 Elements of CNC machines - Types, sketch, working and importance of: i. Slide ways. ii. Re-circulating ball screw. iii. Feedback devices (transducers, encoders). iv. Automatic tool changer (ATC). v. Automatic pallet changer (APC). 2.5 CNC axes and motion nomenclature. 2.6 CNC tooling: i. Tool presetting-concept and importance. ii. Qualified tools-definition need and advantages. iii. Tool holders- types and applications.

Unit – III CNC Turning & Machining Centers.

3.1 CNC turning centres: i. Types. ii. Features. iii. Axes nomenclature. iv. Specification. v. Work holding devices -types, working and applications. vi. Tool holding and changing devices - types, working and applications. 3.2 CNC machining centres: i. Types. ii. Features. iii. Axes nomenclature. iv. Specification. v. Work holding devices-types, working and applications. vi. Tool holding and changing device types, working and applications

Unit – IV CNC part programming.

4.1 Definition and importance of various positions like machine zero, home position, work piece zero and programme zero. 4.2 CNC part programming: programming format and structure of part programme. 4.3 ISO G and M codes for turning and milling-meaning and applications of important codes. 4.4 Simple part programming for turning using ISO format having straight turning, taper turning (linear interpolation) and convex/concave turning (circular interpolation). 4.5 Simple part programming for milling using ISO format. 4.6 Importance, types, applications and format for: i. Canned cycles. ii. Macro. iii. Do loops. iv. Subroutine. 4.7 CNC turning and milling part programming using canned cycles, Do loops and

Subroutine. 4.8 Need and importance of various compensations: i. Tool length compensation. ii. Pitch error compensation. iii. Tool radius compensation. iv. Tool offset. 4.9 Simple part programming using various compensations.

Unit – V Recent trends in CAM.
5.1 Interfacing standards for CAD/CAM - Types and applications 5.2 Adaptive control- definition, meaning, block diagram, sources of variability and applications. 5.3 Flexible Manufacturing System (FMS) - concept, evaluation, main elements and their functions, layout and its importance, applications. 5.4 Computer Integrated Manufacturing (CIM) - Concept, definition, areas covered, benefits. 5.5 Robotics- definition, terminology, classification and types, elements and applications. 5.6 Rapid prototyping - Concept and application

SUGGESTED READINGS:

1. Rao P N, Tiwari N K, Kundra T ,"Computer Aided Manufacturing" Tata McGraw Hill.
2. Groover Mikell P, Zimmered W Emory ,"CAD/CAM: computer aided design and manufacturing". Prentice Hall.
3. Quesada Robert , "Computer Numerical Control Turning and Machining centers".. Prentice Hall.

Course No	Title of the Course	Course Structure	Pre-Requisite
PED35	Metrology	L-T-P:3-0-2	None

COURSE OUTCOMES (COs)

- Student learns the importance of different types of measurements, measuring instruments and measuring techniques.
- Student will be able to relate the ideas conveyed, to the industrial applications.
- Student learns about vast variety of measuring instruments available along with their right usage point.
- Student learns about the design aspects of gauges, their tolerances and selection.
- Student can maturely utilize the knowledge gained in solving quality related issues.
- Student learns about the various quality control techniques prevalent in industry along with their applications
- Student understands the basic concepts of quality, its cost and value of quality, standardization.
- Student learns the importance of quality certifications and the awarding agencies involved.
- Student learns the role and importance of computer in controlling the quality related issues.

COURSE CONTENT

Introduction to Dimensional Metrology, standardization, interchangeability, selective assembly, Indian standard specifications, application of tolerances, Limit gauging-Taylor's principles of limit gauging, Design of Gauges, Inspection by measurement; interferometers. GD&T, Applications of Dimensional Inspection, Inspection of Surface Quality, Feature inspection- straightness, flatness, parallelism, squareness, circularity and roundness. Automated Dimensional Measurements: Introduction, Automatic Gauging, Automatic Measuring Machines for inspecting multiple workpiece dimensions, Automatic Gauging Machine Part-Matching Functions, Coordinate Measuring Machines-Types, Probes, Accessories, Measurement, Computer supported Coordinate Measurements.

SUGGESTED READINGS:

1. Bewoor, "Metrology and Measurement" Tata McGraw-Hill Education.
2. A.M.Badadhe, "Metrology And Quality Control" Technical Publications.

Course No	Title of the Course	Course Structure	Pre-Requisite
PED36	Finite Element Methods	L-T-P:3-0-2	None

COURSE OUTCOMES (COs)

- Students to understand the basics of finite element analysis and its applications in engineering with one, two and three dimensional elements**.**
- To provide the fundamental concepts of the theory of the finite element method
- To obtain an understanding of the fundamental theory of the FEA method;
- To develop the ability to generate the governing FE equations for systems governed by partial differential equations;
- To understand the use of the basic finite elements for structural applications using truss, beam, frame, and plane elements; and
- To understand the application and use of the FE method for heat transfer problems.

COURSE CONTENT

Discretization and the Direct Stiffness Method
Basic concepts of structural modeling
Review of the stiffness method of structural analysis.
Modeling stiffness, loads and displacement boundary conditions.
Advanced modeling: general constraints, substructuring.
Formulation of Finite Elements
Mathematical interpretation of finite elements, vibrational formulation.
Development of continuum elements, shape functions, consistent loads.
Isoperimetric elements for plane stress.
Numerical integration
Convergence requirements.
Computer Implementation of the Finite Element Method
Preprocessing: model definition.
Element level calculations.
Equation assembly.
Equation solver.
Post processing: strain and stress recovery.

SUGGESTED READINGS:

1. Rao. S.S. ` The Finite element method in Engineering', II Ed., Pergamon Press, Oxford.
2. K.J. Bathe, ` Finite element procedures in Engineering Analysis", Prentice hall, Engle Wood chiffs,
3. C.S. Desai and J.P. Abel. “Introduction to finite element method" Affiliated East West Press,
4. Besant, ` Finite Element Method', Prentice Hall, II Ed.

Course No	Title of the Course	Course Structure	Pre-Requisite
PED37	Automation in Manufacturing	L-T-P:3-0-2	None

COURSE OUTCOMES (COs)

- Become familiar with the different types automation and study both technological and economic issues involved in automatic manufacturing of products.
- Develop an understanding of programmable or flexible manufacturing and its suitability for various manufacturing environments.
- Learn about the modern techniques and devices used for the monitoring and control of manufacturing systems including programming of programmable logic controllers and their interfacing with various sensors and actuators.
- Understand the major components of mechatronic systems used in automation such as commonly used sensors and common techniques for sensor interfacing and protection circuits.
- Understand industrial control logic design using ladder diagram and programmable logic controller.

COURSE CONTENT

Introduction to Automation of different manufacturing processes. Types of systems - mechanical, electrical, electronics; Data conversion devices, transducers, signal processing devices, relays, contactors and timers. Sensors and their interfaces;

Hydraulics & Pneumatic Systems design and their application to manufacturing equipment; Sequence operation of hydraulic and pneumatic cylinders and motors; Electro Pneumatic & Electro Hydraulic Systems design, Relay Logic circuits, Feedback control systems, PID Controller; Drives and mechanisms of an automated system: stepper motors, servo drives. Ball screws, linear motion bearings, electronic caming and gearing, indexing mechanisms, tool magazines, and transfer systems. Programmable Logic Controllers, I/Os, system interfacing, ladder logic, functional blocks, structured text, and applications. Human Machine Interface & SCADA; Motion controller and their programming, PLC Open Motion Control blocks, multi axes coordinated motion, CNC control; RFID technology and its application; Machine vision and control applications. Modular Production Systems – Distribution, Conveying, Pick & Place etc.

Laboratory work will be hands-on design and operation of automatic systems.

SUGGESTED READINGS:

S. K. Taneja and S. P. Rana, "Automation in Manufacturing", Springer.

Course No	Title of the Course	Course Structure	Pre-Requisite
PED38	Flexible Manufacturing Systems	L-T-P:3-0-2	None

COURSE OUTCOMES (COs)

- Classify and distinguish FMS and other manufacturing systems including job-shop and mass production systems
- Explain processing stations and material handling systems used in FMS environments.
- Design and analyze FMS using simulation and analytical techniques.
- Understand tool management in FMS
- Analyze the production management problems in planning, loading, scheduling, routing and breakdown in a typical FMS.

COURSE CONTENT

Introduction to FMS: Definition of FMS – types and configuration concepts – types of flexibility and performance measures. Functions of FMS host computer – FMS host and area controller function distribution.

Development and implementation of FMS: Planning phases – integration – system configuration – FMS layouts – simulation – FMS project development steps. Project management – equipment development – host system development – planning - hardware and software development.

Distributed numerical control: DNC system – communication between DNC computer and machine control unit – hierarchical processing of data in DNC system – features of DNC system.

Automated material handling: Function - types – analysis of material handling equipment's. Design of conveyor and AGV systems.

Automated storage: Storage system performance – AS/RS – carousel storage system – WIP storage – interfacing handling storage with manufacturing.

Programmable logic controllers: Components of the PLC – PLC operating cycle – additional capabilities of a PLC – programming the PLC - Ladder logic diagrams, counters etc– Industrial process control using PLC.

FMS rationale: Economic and technological justification for FMS – GT, JIT – operation and evaluation – personnel and infra structural aspects – typical case studies – future prospects.

SUGGESTED READINGS:

1. Parrish D. J, "Flexible manufacturing", Butterworth – Heinemann Ltd.
2. Groover M. P, "Automation, production systems and computer integrated manufacturing", Prentice Hall India (P) Ltd.
3. Kusiak A., "Intelligent manufacturing systems", Prentice Hall, Englewood Cliffs, NJ.
4. Considine D. M. & Considine G. D, "Standard handbook of industrial automation", Chapman and Hall, London.
5. Ranky P. G, "The design and operation of FMS", IFS Pub, U. K.

Course No	Title of the Course	Course Structure	Pre-Requisite
PED39	Design of Machine Tools and Cutting Tools	L-T-P:3-0-2	None

COURSE OUTCOMES (COs)

- To be able to explain requirements of machine tools.
- To be able to understand analysis of machine tools structures like strength, rigidity.
- To be able to understand functional analysis of guides and sideways.

COURSE CONTENT

Basic Concept and General Requirements of Machine Tools
Analysis of Machine Tools from Different Point of View: Kinematic, Strength, Rigidity, Dynamic, Fatigue, Wear, Reliability, Economy
Drives: Design and Analysis of Belt, Gear, and Hydraulic Drives
Bearing Design and Selection
Functional Analysis of Guides and Slide ways
Static and Dynamic Analysis of Machine Tools
Control and Automation of Machine Tools
Cutting Tool Design: General Considerations; Methods and Procedures of Tool Cutting Design; Tool Making Practices; Cutting Tool Designation; Design of Single Point and Multi Point Cutting Tools.

SUGGESTED READINGS:

1. N. K. Mehta, "Machine Tool Design and Numerical Control", Tata McGraw Hill Publishing Co. Ltd. New Delhi.
2. G. C. Sen and A. Bhattacharyya, "Principles of Machine Tools: Vol.2 Design and Construction of Machine Tools", New Central Book Agency, Calcutta.
3. G. Boothryod, "Fundamentals of Metal Machining and Machine Tools" Marcel Dekker.
4. B. L. Juneja and G. S. Shekhon, "Fundamentals of Metal Cutting and Machine Tools", Wiley Eastern, New Delhi.

Course No	Title of the Course	Course Structure	Pre-Requisite
PED40	Mechatronics	L-T-P:3-0-2	None

COURSE OUTCOMES (COs)

- Understand the mechanisms of commonly used actuators and how to select a proper set of sensors and actuators for a practical mechatronic system.
- Identification of key elements of mechatronics system and its representation in terms of block diagram
- Understanding the concept of signal processing and use of interfacing systems such as ADC, DAC, digital I/O
- Development of PLC ladder programming and implementation of real life system
- Explain the concepts of mechatronic systems, adoptive control, man-machine interface and mechatronic design.
- Summaries the concepts of mechanical and electronic actuation systems.
- Explain the working of stepper and servo motors.
- Write the programme for programmable logic controllers and discuss case studies of mechatronic systems.
- The students will be able to feel the importance of this subject as mechanical engineering students. They will be able to understand the need of the subject for industries. To some extent they will be able to design the basic circuit of a mechatronic system.

COURSE CONTENT

Introduction to Mechatronics. Hydraulic and Pneumatic actuator systems, operational characteristics and performance of hydraulic based actuation systems including linear devices, rotary devices, flow control valves, pressure control valves, I-P and P-I converters ancillary devices (accumulator, amplifiers etc.)

Electrical actuation systems: Operational characteristic and application of electrical actuation components for application like, AC/DC motors, stepper motors, relays, push buttons, switches, etc.

Programmable Logic Controllers and applications: PLC structures, PLC languages, programming of PLC, Interfacing PLC with actuators, open loop and closed loop control using PLC. Some case Studies like auto focus camera, printer, programming washing machine, optical mar reader (OMR) etc.

SUGGESTED READINGS:

1. Lawrence J.Kamm, " Understanding Electro-Mechanical Engineering, An Introduction to Mechatronics ", Prentice-Hall
2. Michael B.Histand and David G. Alciatore, "Introduction to Mechatronics and Measurement Systems", McGraw-Hill International Editions

Course No	Title of the Course	Course Structure	Pre-Requisite
PED41	CAD and Geometric Modeling	L-T-P:3-0-2	None

COURSE OUTCOMES (COs)

- Create, annotate, edit and plot drawings using basic AutoCAD commands and features.
- Apply basic Auto CAD skills to intermediate AutoCAD course and other design and drafting courses.
- Create part drawing and their assembled views for different machine parts in 2-D.
- Create part drawing and their assembled views for different machine parts in 3-D.

COURSE CONTENT

1. Unit I General

Introduction to CAD, Fundamentals of Computer Hardware- interactive graphic display- Graphic systems. Display devices- Hard copy devices- interactive graphic input & output devices display processors.

Unit II Graphic Primitive

Scan conversion, output primitive-point plotting techniques co-ordinate systems, increment methods. Line-drawing algorithms. Circle generating algorithms. Programming using C/Auto Lisp to generate various primitives. Color representation.

2. Unit III 2D & 3D Transformation

Translation, scaling rotation- matrix representations and Homogeneous co-ordinates.

Composite transformations (concatenation) Concatenation properties. General transformation equations. Windowing and clipping line-clipping midpoint sub division, clipping other graphic entities, polygon clipping viewing and windowing transformation

Writing interactive programs using C/AutoLisp for transformations. Perspective projection, techniques for visual realism- hidden line- surface removal. Algorithms for shading and Rendering. Concepts of Animation and Virtual reality.

3. Unit IV Curves, Surfaces, Solids

Representation of curves- Bezier curves- cubic spline curve B- Spline curves Rational curves- Surfaces modeling techniques-surface patch. Coons patch bi-cubic patch- Bezier and B- spline surfaces- Volume modelling Techniques- Boundary models- CSG, Feature Based Modeling- Parametric Modeling- Variational Modeling. Creation of parts using software packages2D Representation- Development of surfaces using C/AutoLisp.

Unit IV Graphics Standards for CAD.

Need of Graphics and computer standards, Open Architecture in CAD- Open GL, data exchange standards-STL - IGES-STEP-CALS-DXF- Communication standards. Application of Object broker Architecture in CAD/CAM data transfer.

4. Unit V Reverse Engineering

Introduction to reverse engineering

SUGGESTED READINGS:

1. IBRAHIM ZEID " CAD/CAM- Theory and Practice" McGraw Hill, International Edition.
2. Chris Mc Mohan and Jimmi Browne, " CAD/CAM Principles, practice and manufacturing management", Pearson Education Asia Ltd.
3. Donald Hearn and M. Pauline Baker "Computer Graphics", Prentice Hall. Inc.

Course No	Title of the Course	Course Structure	Pre-Requisite
PED42	Computer Programming and Interface	L-T-P:3-0-2	None

COURSE OUTCOMES (COs)

- Understand the basic concept of C programming, and its different modules that includes conditional looping expressions, Arrays, Strings, Functions, Pointers, Structures and file programming
- Acquire knowledge about the basic concept of writing a program.
- Role of constants, variables, identifiers, operators, type conversion and other buiding blocks of language.
- Use of conditional expressions and looping statements to solve problems associated with conditions and repetitions

COURSE CONTENT

Computer Programming

Introduction to C and C++. Pointers, Structure and Files in C. C++ as an Object Oriented Language, Creating Objects, Using member functions, Constructors and Destructors, Classes, and structures and friends, Overloading Operators, File operations in C++, Inheritance, Polymorphism.

Interfacing

Microprocessor and Microcontroller Architecture
Digital and Analog converters
Digital I/O
Serial I/O and Data communication
Timers and counters
Data Acquisition systems
Microprocessor based control systems
8. Interface busses ISA, PCI

SUGGESTED READINGS:

1. V. RAJARAMAN , Computer Oriented Numerical Methods, PHI Publication.
2. V. RAJARAMAN, Computer Programming In C, PHI Publication

Course No	Title of the Course	Course Structure	Pre-Requisite
PED43	Composite Materials	L-T-P:3-0-2	None

COURSE OUTCOMES (COs)

- Have knowledge of the types and properties of composites used in engineering.
- Have knowledge in processing and fabrication of structural composites.
- Analyze the effects of various load or displacement boundary conditions by applying laminate analysis to composite structures.
- Understand the differences in matrix materials and the implications for composites as substitute materials in design to meet several competing requirements
- Describe the need, characteristics and applications of composite materials.
- Summarize the importance of surface treatments of fibers and adding fillers and additives to the composite materials.
- Manipulate the interaction between fiber and matrix in a unidirectional lamina under tensile and compressive loading.
- Explain the experimental techniques used for evaluating the fatigue and impact properties.
- Discuss the mechanical behavior of composites due to variation in temperature and moisture.
- Choose the most appropriate manufacturing process for fabricating composite components.
- Identify and design composite materials and structures in various engineering applications

COURSE CONTENT

Introduction: Classification of various composite materials.
Reinforcements: Fibers: fabrication, properties and applications of glass fibers, boron fibers, carbon fibers, organic fibers, Kevelar fibers, ceramic fibers, metallic fibers (metallic glasses).
Particulates: Properties and application of SiC, Al2O3, Si3N4 and TiC particulates. Matrix Materials: Properties of common polymer, metallic and ceramic matrix materials.

Metal Matrix Composites: Solid state, liquid state and in-situ fabrication techniques of MMCs, Discontinuous reinforcement of MMCs, Properties and applications of MMCs.

Ceramic Matrix Composites: Fabrication, properties and interfaces in CMCs. Toughness of CMCs, applications of CMCs. Carbon Fiber Composites: Fabrication, properties and interfaces.

Mechanics of Composite Materials: Density, mechanical properties, predication of elastic constants, transverse stresses, and thermal properties. Mechanics of load transfer from matrix to fibers, relationship between engineering constants, analysis of laminated composites.
Strength, Fracture and Design of Composites: Tensile and compressive strength of composites, Fracture modes in composites, Strength of orthotropic lamina, maximum stress theory, maximum strain criterion, maximum work criterion.

SUGGESTED READINGS:

1) S.W. Tsai and H.T. Hahn "Introduction to Composite Materials", Technomic Publishing Co.
2) Robert M. Jones, "Mechanics of Composite Materials", McGraw-Hill.
3) A.K. Kaw, "Mechanics of composite materials", CRC Press.
4) R.J. Crawford "Plastic Engineering, Butterworth-Heinemann publications.
5) P.K. Mallick, Marcel Dekker "Fiber-Reinforced Composites- Materials, Manufacturing and Design" , Inc. New York

Course No	Title of the Course	Course Structure	Pre-Requisite
PED44	Micro Electro Mechanical Systems	L-T-P:3-0-2	None

COURSE OUTCOMES (COs)

- Knowledge of MEMS & microsystems.
- Knowledge of working principle of microsystems.
- Knowledge of engineering science for microsystem design and fabrication.
- Knowledge of various microsystem fabrication processes.
- Knowledge of microsystem design and packaging,

COURSE CONTENT

Overview of MEMS & Microsystems; MEMS and Microsystems, typical products, evolution of microsystem, microsystem and microelectronics, miniaturization, applications.

Working principles of Microsystems; Introduction, micro sensors, micro actuation, micro accelerometers, microfluidics.

Engineering Science for Microsystem Design and Fabrication; Atomic structure, ionization, molecular theory, doping of semiconductors, diffusion, and plasma physics, electro chemistry, quantum physics.

Engineering Mechanics for Microsystems Design

Materials for MEMS

Microsystem Fabrication Processes; Photolithography, ion implantation, diffusion, oxidation, chemical vapor deposition, physical vapor deposition, deposition by epitaxy, etching.

Overview of Micro-manufacturing.

Microsystem Design.

Microsystem Packaging

SUGGESTED READINGS:

1. Gad-El-Hak "MEMS Handbook", CRC Press.
2. G.T.A. Kovacs,"Micromachined Transducers Sourcebook," McGraw Hill.
3. Marc Madou,"Fundamental of Microfabrication," CRC Press.
4. Richard C. Jaeger,"Introduction to Microelectronic Fabrication," Addison-Wesley.
5. M. Elwenspoek and R. Wiegerink,"Mechanical Microsensors," Springer Verlag.
6. M. Elwenspoek and H. Jansen, "Silicon Micromachining," Cambridge Press.

Course No	Title of the Course	Course Structure	Pre-Requisite
PED45	CNC Operation and Programming	L-T-P:3-0-2	None

COURSE OUTCOMES (COs)

- Understanding of the significance of NC/CNC/DNC and its application in FMS and CIMS.
- Knowledge of basic elements of CNC system.
- Knowledge of NC program generation from CAD models.
- Knowledge of Advance programming.
- Knowledge of recent development in CNC machine tools.

COURSE CONTENT

Module-1

Introduction to Computer Numerical Control (CNC) • Numerical control • Functions of a machine tool • Concept of numerical control • Historical Development • Definition • Advantages of CNC machine tools • Evolution of CNC • Advantages of CNC • Limitations of CNC • Features of CNC • The Machine Control Unit (MCU) for CNC • Classification of CNC Machine Tools • CNC MACHINING CENTERS ¬ Classification ¬ Features Of CNC Machining Centers

Module-2

Blue print reading • Reading the machining sketches • Different Geometrical Tolerance symbols. • Reading Dimensional Tolerances. • Understanding the Views. • Concept of First angle & Third angle projection

Module-3

Auto CAD basic (ACAD-01) • Sketching Points line, Circles & Arcs. • Simple exercises based on above. • Isometric Views. • Splines & poly lines • Identifying the points in given drawing

Module-4

Conventional milling Awareness • Introduction to milling machine & its parts. • Different operations of milling. Plain milling Step milling Slot malling Pocket milling Co-ordinate drilling Job setting in vice by dialing Job setting on bed with clamps • Knowledge of different cutting tool materials used • Selecting speed feeds & depth of cut • Indexing(simple & compounding)

Module-4

CNC Milling- Basic • Fundamentals of CNC milling • Familiarization of control panel • Fundamentals of CNC programming • Part programming techniques • Machining practice on CNC Milling • Practice session at Industry

Module-5

Module-6 CNC Turning. • Work piece setting methods • Tool setting methods • Practice on CNC Turning. • Exercises on machine & Practice.

SUGGESTED READINGS:

Groover, M.P., "Automation, Production System and CIM", Prentice-Hall of India.

Course No	Title of the Course	Course Structure	Pre-Requisite
PED46	Advanced Machining Processes	L-T-P:3-0-2	None

COURSE OUTCOMES (COs)

- Identify the need and to examine different functional elements of various advanced manufacturing processes and to identify the typical applications theses modern manufacturing processes.
- Examine and evaluate the unconventional manufacturing methods and their classification to use to the right manufacturing method for the right product
- Formulate real production problems creatively, especially in design considerations like material selection and process identification which is very important in the designing of new components.
- Demonstrate the ability to collect data of a given process/system, interpret, analyse data and make some conclusions for the different applications in the industry using variety of modern manufacturing methods such as unconventional machining (EDM, ECM, ECDM, IBM, EBM, PAM etc), micro/nano finishing operations (MRF, AFF, MAF, MRAFF, MFP etc), micro casting, micro forming, additive manufacturing etc.
- Design a process for day to day changing need of market in terms of applications and huge material choices due to advancement in materials technology.

COURSE CONTENT

Introduction to advanced machining processes – need for such processes and application areas. Mechanical Energy utilized advanced machining processes like ultrasonic machining, abrasive flow machining, magnetic abrasive finishing,magneto-rheological finishing, abrasive water jet machining – mechanics of cutting, process parametric analysis, process capabilities, applications.

Thermoelectric based advanced machining processes like electro discharge machining, wire EDM, Plasma Arc Machining, Laser Beam Machining, Focussed Ion Beam Machining – working principles, material removal mechanisms, process capabilities and applications.

Electrochemical and Chemical Advanced Machining – ECG, Electrostream Drilling, Chemical Machining – process characteristics, numerical modelling of the processes, applications and limitations.

SUGGESTED READINGS:

1. P. C. Pandey and H. S. Shan, “Modern Machining Methods”, Tata McGraw Hill Publishing.
2. A. Ghosh and A. K. Mallik, “Manufacturing Analysis”, East West Press Ltd. New Delhi.
3. G. F. Bennedict, “Non-Traditional Manufacturing Processes”, Marcell Dekker Inc.
4. J. A. McGeugh, “Advanced Methods of Machining”, Chapman and Hall Ltd. London.
5. P. K. Mishra, “Nonconvetional Machining”, Narosa Publishing House, New Delhi.
6. V. K. Jain, “Advanced Machining Processes”, Allied Publisher, Mumbai.

SYLLABUS OF OPEN ELECTIVES

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO001	Technical Communication	L-T-P : 3-1-0	**None**

COURSE OUTCOMES (COs)

- The course will improve writing and documentation skills of students with emphasis on the importance of effective communication with focus on choice of words, formation of proper sentence structures and writing styles.
- This will enhance the students capability to prepare technical documents and correspondence.
- The course will equip the student with good communications skills for placements, preparing SOPs and CVs.
- The course will sensitize the students towards research ethics, copyright and plagiarism.

COURSE CONTENT

Definition of communication, meaning, importance & process of communication, objectives, types, C's of communication, barriers to communication
human & non -human communication, distinctive features of human languages
Business correspondence-definition, meaning and importance of business communication, business letters- purchase, enquiry, quotation, order, followup, acceptance-refusal
Emphasis on (i) paragraph writing, its kinds, coherence & cohesion
(ii)writing a paragraph/thesis: selection of topic and its development
(iii) writing reports, manuals, notices, memos, agendas, minutes
(iv)Interviews, speeches, presentations,
Research ethics, methodologies, copyright, plagiarism

SUGGESTED READINGS:

1. Martin Hewing, "Advanced English Grammar" Cambridge.
2. Meenakshi Raman & Sangeeta Sharma, "Technical Communication" Oxford University Press.

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO002	Disaster Management	L-T-P : 3-1-0	**None**

COURSE OUTCOMES (COs)

- Demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

COURSE CONTENT

Unit -I: Introduction

Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

Repercussions Of Disasters And Hazards: Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem.

Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

Unit -II: Disaster Prone Areas In India

Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics

Unit -III: Disaster Preparedness And Management

Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

Unit -IV: Risk Assessment

Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.

Unit -V: Disaster Mitigation

Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

SUGGESTED READINGS:

1. R. Nishith, Singh AK "Disaster Management in India:Perspectives, issues and strategies" New Royal book Company, Lucknow.
2. Sahni, PardeepEt.Al. (Eds.), "Disaster Mitigation Experiences And Reflections". Prentice Hall Of India, New Delhi.
3. Goel S. L. "Disaster AdminastrationAnd Management" Text And Case Studies Deep &Deep Publication Pvt. Ltd., New Delhi

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO003	Basics of Finance Management	L-T-P : 3-1-0	**None**

COURSE OUTCOMES (COs)

- To provide a theoretical framework for considering corporate finance problems and issues and to apply these concepts in practice.
- Enhance knowledge and understanding of financial management.
- How managers should organize their financial transactions effectively and with integrity and how to give everybody the ability and confidence to tackle common financial problems in practice.
- Provide adequate preparation for future finance classes.

COURSE CONTENT

Unit I

Nature, scope and objectives of financial management, Time value of money, Risk and return (including Capital Asset Pricing Model).

Unit II

Long term investment decisions: The Capital Budgeting Process, Cash Flow Estimation, Payback Period Method, Accounting Rate of Return, Net Present Value (NPV), Net Terminal Value, Internal Rate of Return (IRR), Profitability Index.

Unit III

Financing Decisions: Sources of long-term financing, Estimation of components of cost of capital, Methods for calculating Cost of Equity, Cost of Retained Earnings, Cost of Debt and Cost of Preference Capital, Weighted Average Cost of Capital (WACC). Capital Structure-Theories of Capital Structure (Net Income, Net Operating Income, MM Hypothesis, Traditional Approach). Operating and Financial leverage. Determinants of capital structure

Unit IV

Dividend Decisions: Theories for Relevance and irrelevance of dividend decision for corporate valuation-Walter's Model, Gordon's Model, MM Approach, Cash and stock dividends. Dividend policies in practice.

Unit V

Working Capital Decisions: Concepts of Working Capital, Operating & Cash Cycles, sources of short term finance, working capital estimation, cash management, receivables management, inventory management.

SUGGESTED READINGS:

1. Khan, M.Y. and P.K. Jain, "Financial Management": Text and Problems, Tata McGraw Hill.
2. Srivastava, Rajiv, and Anil Mishra, "Financial Management", Oxford University Press, UK.
3. Chandra, P. "Financial Management-Theory and Practice", Tata McGraw Hill.
4. Horne, Van; James C., John Wachowicz, Fundamentals of Financial Management, Pearson Education.

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO004	Basics of Finance Management	L-T-P : 3-1-0	**None**

COURSE OUTCOMES (COs)

This course is designed to provide students with an understanding of human resource management (HRM) functions within organizations, including an appreciation of the roles of both HRM specialists and line managers in designing and implementing effective HRM policies and practices.

COURSE CONTENT

Unit - I

Evolution and growth of human resource management (with special reference to scientific management and Human relations approaches).Role of HR in strategic management.Nature.objectives, scope, and functions of HR management.

Unit - II

Challenges of HR (the changing profile of the workforce - knowledge workers, employment opportunities in BPOs, IT and service industries, Flexi options), Workforce diversity (causes, paradox, resolution of diversity by management).

Unit III

HRD; Human resource management as a profession.Concepts of line-staff in the structure of human resource department and the role of human resource manager.

Unit - IV

Manpower planning -objectives, elements, advantages, process. Job design - (simplification, rotation, enlargement, enrichment and approaches}.Job analysis.Job evaluation.

Unit - V

Recruitment (factors affecting, sources, policy, evaluation). Selection(procedure, tests, interviews). Placement and Induction.

SUGGESTED READINGS:

1. Aswathappa K. "Human Resource and Personnel Management", Tata McGraw-Hill, New Delhi.
2. Chhabra T.N. "Human Resource Management", DhanpatRai and Co. Delhi.
3. Saiyadain S. Mirza "Human Resource Management", Tata Mc-GrawHill, India.
4.Chadha, N.K. Human Resource Management-issues, case studies, experiential exercises, Sri SaiPrintographers, New Delhi.

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO005	Project Management	L-T-P : 3-1-0	**None**

COURSE OUTCOMES (COs)

In this comprehensive course, student will learn the fundamentals of project management: how to initiate, plan, and execute a project that meets objectives and satisfies stakeholders. This course provides a step-by-step guide to planning and executing a project and to develop a manageable project schedule.

COURSE CONTENT

Unit-I

Objectives of Project Planning, monitoring and control of investment projects. Relevance of social cost benefit analysis, identification of investment opportunities. Pre-feasibility studies.

Unit-II

Project Preparation: Technical feasibility, estimation of costs, demand analysis and commercial viability, risk analysis, collaboration arrangements; financial planning; Estimation of fund requirements, sources of funds.Loan syndication for the projects.Tax considerations in project preparation and the legal aspects.

Unit-III

Project appraisal: Business criterion of growth, liquidity and profitability, social cost benefit analysis in public and private sectors, investment criterion and choice of techniques. Estimation of shadow prices and social discount rate.

Unit-IV

Project review/control-Evaluation of project. PERT/CPM .resource handling/leveling.

Unit-V

Cost and Time Management issues in Project planning and management, success criteria and success factors, risk management.

SUGGESTED READINGS:

1. Ravi Ravindran: "Operations Research and Management Science Handbook", CRC Press.
2. Harold Kerzner: "Applied Project Management: Best Practices on Implementation", John Wiley & Sons, Inc.
3. Goodpasture, J. C. "Quantitative Methods in Project Management", J Ross Publishing, Boca Raton, Florida, USA.
4. Meredith, J. R. and Mantel Jr., S. J. "Project Management: A Managerial Approach", John Wiley, New York.
5. Clifford Gray, "Project Management", Richard D. Irwin.

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO006	Basics of Corporate Law	L-T-P : 3-1-0	**None**

COURSE OUTCOME(COs)

The objective of this Course is to provide in-depth knowledge of the Corporate laws and process related to integrate these aspects of management studies in decision making within an organization; analyze and interpret management information; make decisions based on the information available; communicate information effectively; understand and apply the theoretical aspects of accounting methods used for collecting, recording and reporting financial information; explain and appraise the taxation laws which govern corporations and individuals

COURSE CONTENT

.**Unit I: Introduction :** Administration of Company Law, characteristics of a company; common seal; lifting of corporate veil; types of companies including private and public company, government company, foreign company, one person company, small company, associate company, dormant company, producer company; association not for profit; illegal association; formation of company, promoters and their legal position, pre incorporation contract and provisional contracts; on-line registration of a company.

Unit II: Documents: Memorandum of association and its alteration, articles of association and its alteration, doctrine of constructive notice and indoor management, prospectus, shelf prospectus and red herring prospectus, misstatement in a prospectus; GDR; book building; issue, allotment and forfeiture of shares, calls on shares; public offer and private placement; issue of sweat capital; employee stock options; issue of bonus shares; transmission of shares, buyback and provisions regarding buyback; share certificate; D-Mat system; membership of a company.

Unit III: Management and Meetings: Classification of directors, additional, alternate and adhoc director; women directors, independent director, small shareholders' director; director identity number (DIN); appointment, who can appoint a director, disqualifications, removal of directors; legal position, powers and duties; key managerial personnel, managing director, manager; meetings of shareholders and board; types of meeting, convening and conduct of meetings, requisites of a valid meeting; postal ballot, meeting through video conferencing, e-voting; committees of board of directors – audit committee, nomination and remuneration committee, stakeholders relationship committee, corporate social responsibility committee; prohibition of insider trading.

SUGGESTED READINGS:

1. Franklin Gevurtz, "Global Issues in Corporate Law" Thomson West.
2. P. Narayanan, "Law of Copyright and Industrial Designs" Eastern Law House.

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO007	Biological computing	L-T-P : 3-1-0	**None**

COURSE OUTCOMES (COs)

- To understand computing in context of biological systems
- To understand computing languages needed to solve biological problems
- To acquire computational skills for analysis of biological processes through grid computing
- To gain knowledge of different biological databases and their usage
- To gain innovative insight into DNA computing

COURSE CONTENT

Introduction, Orientation and UNIX,
Python: Introduction to Variables and Control flow, Python II - Parsing In and Output,
Python III - Scripting and Functions, Python IV- Number Crunching and Plotting,
Grid computing, Biogrid, R basics and Visualization, Unix for fast text processing, SQL Database
Biological databases, R for speed, R for fun, Local BLAST, Unit Testing and Code Correctness
DNA computing,

SUGGESTED READINGS:

1. H. Bolouri, R. Paton "Computations in cells & tissues", 1st Edition; Published by Springer
2. Haubold, Bernhard, Wiehe, Thomas "Introduction to Computational Biology: An Evolutionary Approach". Springer

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO008	Basic of social science	L-T-P : 3-1-0	**None**

COURSE OUTCOMES (COs)

Sociology is a major category of academic disciplines, concerned with society and the relationships among individuals within a society. It in turn has many branches, each of which is considered a "social science".

COURSE CONTENT

Unit 1.

The Development of Sociology in the 19th Century

Unit 2. **Sociology as Science:**

a. Science, scientific method and critique.
b. Major theoretical strands of research methodology.
c. Positivism and its critique.
d. Fact value and objectivity.
e. Non- positivist methodologies.

Unit 3. **Religion and Society:**

a. Sociological theories of religion.
b. Types of religious practices: animism, monism, pluralism, sects, cults.
c. Religion in modern society: religion and science, secularization, religious revivalism, fundamentalism.

Unit 4. **Politics and Society:**

a. Sociological theories of power.
b. Power elite, bureaucracy, pressure groups, and political parties.
c. Nation, state, citizenship, democracy, civil society, ideology.
d. Protest, agitation, social movements, collective action, revolution.

Unit 5. **Sociological Thinkers:**

a. Kar l Marx- Historical materialism, mode of production, alienation, class struggle.
b. Emile Durkheim- Division of labour, social fact, suicide, religion and society.
c. Max Weber- Social action, ideal types, authority, bureaucracy, protestant ethic and the spirit of capitalism.
d. Talcolt Parsons- Social system, pattern variables.

e. Robert K. Merton- Latent and manifest functions, conformity and deviance, reference groups.
f. Mead - Self and identity.

SUGGESTED READINGS:

1. Beteille, Andre, "Sociology: Essays in Approach and Method", Oxford University Press.
2. Giddens, Anthony, "Sociology", Polity Press.
3. Weber, M. " *The Methodology of the Social Sciences"*. New York: Free Press.
4. Durkheim, E. "*The Rules of Sociological Method"*. London: Macmillan.

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO009	Entrepreneurship	L-T-P : 3-1-0	**None**

COURSE OUTCOMES (COs)

This Course Aims at Instituting Entrepreneurial skills in the students by giving an overview of who the entrepreneurs are and what competences are needed to become an entrepreneur.
contents:

COURSE CONTENT

Unit I-Introduction:

Concept and Definitions, Entrepreneur v/s Intrapreneur; Role of entrepreneurship in economic development; Entrepreneurship process; Factors impacting emergence of entrepreneurship; Managerial versus entrepreneurial Decision Making; Entrepreneur v/s Investors; Entrepreneurial attributes and characteristics; Entrepreneurs versus inventors; Entrepreneurial Culture; Women Entrepreneurs; Social Entrepreneurship; Classification and Types of Entrepreneurs; EDP Programmes; Entrepreneurial Training; Traits/Qualities of an Entrepreneurs.

Unit II- Creating Entrepreneurial Venture:

Generating Business idea- Sources of Innovation, methods of generating ideas, Creativity and Entrepreneurship; Challenges in managing innovation; Business planning process; Drawing business plan; Business plan failures; Entrepreneurial leadership- components of entrepreneurial leadership; Entrepreneurial Challenges; Legal issues – forming business entity, considerations and Criteria, requirements for formation of a Private/Public Limited Company, Intellectual Property Protection- Patents Trademarks and Copyrights – importance for startups, Legal Acts Governing Business in India.

Unit III-Functional plans:

Marketing plan– for the new venture, environmental analysis, steps in preparing marketing plan, marketing mix, contingency planning; Organizational plan – designing organization structure and Systems; Financial plan – pro forma income statements, pro forma cash budget, funds Flow and Cash flow statements; Pro forma balance sheet; Break Even Analysis; Ratio Analysis.

Unit IV- Entrepreneurial Finance:

Debt or equity financing, Sources of Finance- Commercial banks, private placements, venture capital, financial institutions supporting entrepreneurs; Lease Financing; Funding opportunities for Startups in India.

Unit V- Enterprise Management:

Managing growth and sustenance- growth norms; Factors for growth; Time management, Negotiations, Joint ventures, Mergers & acquisitions.

SUGGESTED READINGS:

Kumar, Arya, "Entrepreneurship: Creating and Leading an Entrepreneurial Organization" Pearson, India.

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO0010	Social work	L-T-P : 3-1-0	**None**

COURSE OUTCOMES(COs)

In this course students will learn about various methods of social work, about community organization, social welfare administration, Problems pertaining to Marriage, Family and caste

COURSE CONTENT

Unit 1.Social work

Philosophy and Methods. Social work: Meaning, Objectives, Scope, Assumptions & Values; History of Social work in U.K. U.S.A.and India, philosophy of Social Work. Democratic (Equality, Justice Liberty & Fraternity) and Humanitarian (Human Rights) Matrix.Social works as a profession.

Unit 2. Methods of Social work

Meaning, Scope Principles, Processes (Psychosocial study, Assessments, treatment-goal formulation and techniques), Evaluation, Follow-up and Rehabilitation. Social Groups work: Meaning,Objective, Principles, Skills, Processes (Study, Diagnosis, treatment and evaluation), Programme, Planningand Development, Role of Social group worker, Leadership Development.

Unit 3 Community organization Meaning, Objective, Principles, Approaches, Roles of Community Organization Worker.

Unit 4 Social Welfare Administration

Meaning Scope, Auspices-Private and Public, Principles, Basic Administrative Processes and Practice decision making communication, planning.organisation, budgeting and finacial control, reporting. Social work Research: Meaning objectives, types, scope, scientific method, Selection and formulation of the problem Research Design Sampling, Sources and Methods of Data Collection, Processing of Data, analysing and interpretation, Report writing. Social Action: Meaning,Scope, approaches (Sarvodays, Antyodaya etc.) and Strategies.

Unit 5 Work in India Problem pertaining to Marriage, Family and caste

Dowry- child Marriage, Divorce, Families with working couples, Disorganised Families, Families with Emigrant Heads of the Households, Gender Inequality, Authoritarian Family structure, Major Changes in Caste systems and problem of casteism. Problems Pertaining of Weaker Sections. Problems of Children, Women Aged. Handicapped and Backward Classes

(SCs, STs, and other Backward Classes). **Problems of Deviance:** Truancy Vagrancy and Juvenile Delinquency, Crime, White Colla Crime, Organized Crime,Collective Violence, Terrorism, Prostitution and Sex Related Crimes. Social Vices: Alcohilism. Drug Addiction, Beggary, Corruption and communalism. **Problems of Social Structure :** Poverty, Unemployment, Bonded Labour, Child Labour. **Fields of Soclal work India :** Child Development, Development of Youth, Women's Empowerment, Welfare of aged, Welfare of Physically. Mentally and Social Handicapped, Welfare of backward Classes (Scs, STs and Other Backward Classes) Rural Development Urban Community Development, Medical And Psychiatric Social work, Industrial Social work, Social Security offender Reforms.

SUGGESTED READINGS:

1. Malcolm Payne Modern, "Social Work Theory" Palgrave MacMillan.
2. Sanjay Bhattacharya, "Social Work: An Integrated Approach" Deep & Deep Publications.

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO011	IP and Patenting	L-T-P : 3-1-0	**None**

COURSE OUTCOMES(COs)

The objective of this Course is to provide in-depth knowledge of the laws and process related to Trademarks, Copyrights and other forms of IPs with focus on Patents, the Indian and International Patent filing procedure, drafting patent application and conducting prior art searches. Students will be exposed to the technical, management and legal aspects of IP and Patents.

COURSE CONTENT

UNIT I: Introduction: Historical and philosophical background of patents and other intellectual property, Patent System: the Constitution, Congress, Patent Office (PTO), and courts; Analyzing and understanding judicial opinions

UNITII: Comparative overview of patents, copyrights, trade secrets, and trademarks: Legal fundamentals of patent protection for useful inventions**,** Design and plant patents, Legal fundamentals of copyright protection, Similarity and access, Expression vs. ideas and information, merger, Fair use of copyrighted works (e.g., for classroom use), Contributory copyright infringement, Critical differences between patent and copyright protection, Copyright infringement distinguished from plagiarism, Legal fundamentals of trade-secret protection, Legal fundamentals of trademark protection

UNIT III: Requirements and limitations of patentability: New and useful: (A) The legal requirement of novelty (B) First to invent vs. first inventor to file, The legal requirement of non-obviousness.

UNIT IV: The process of applying for a patent ("patent prosecution"): Anatomy of a patent application, Adequate disclosure, The art of drafting patent claims, Patent searching: (A) Purposes and techniques, Actions for patent infringement, Interpretation of claims, Doctrine of equivalents, Product testing as a possibly infringing use, Doctrine of exhaustion

SUGGESTED READINGS:

Rines, Robert H. “Create or Perish: The Case for Inventions and Patents”, Acropolis

.Course No.	Title of the Course	Course Structure	Pre-Requisite
EO012	Supply Chain Management and Logistics	L-T-P : 3-1-0	**None**

COURSE OUTCOMES (COs)

Supply chain management consist of all parties (including manufacturer, marketer, suppliers, transporters, warehouses, retailers and even customers) directly or indirectly involved in fulfillment of a customer. The main objective is to acquaint the students with the concepts and tools of supply chain management and logistics as relevant for a business firm.

COURSE CONTENT

Unit I

Introduction: Concept of supply chain management (SCM) and trade logistics; Scope of logistics; Logistic activities – an Overview; Contribution of logistics at macro and micro levels; SCM and trade logistics; Business view of SCM; Concept, span and process of integrated SCM; Demand management – methods of forecasting; Supply chain metrics (KPIs), performance measurement and continuous improvement; Product development Process and SCM; Strategic role of purchasing in the supply chain and total customer satisfaction; Types of purchases; Purchasing cycle.

Unit II

Managing Relationship: Role of Relationship marketing in SCM; Managing relationships with suppliers and customers; Captive buyers and suppliers; Strategic partnerships; Supplier-retailer collaboration and alliances.

Unit III

Focus Areas of Logistics and Supply Chain management: Transportation-Importance of effective transportation system; Service choices and their characteristics; inter-modal services; Transport cost characteristics and rate fixation; In-company management vs. out-sourcing; World sea borne trade; International shipping- characteristics and structure; Liner and tramp operations; Liner freighting; Chartering-Types, principles and practices; Development in sea transportation-Unitization, containerisation, inter and multimodal transport; CFC and ICD. Air transport: Set up for air transport and freight rates; Carriage of Goods by sea -Role and types of cargo intermediaries. Warehousing and inventory management: Reasons for warehousing; Warehousing evaluation and requirements; Warehousing location strategies; Inventory management principles and approaches; Inventory categories -EOQ, LT, ICC

Unit IV

IT Enabling Logistics and Supply Chain: Technology in logistics – EDI, bar Coding, RFID etc., data warehousing, electronic payment transfers; Business management systems; TRADITIONAL ERP, SPECIAL ERP, MR, DRP, PDM, EIP, CPFR, WMS, TMS; Re-

engineering the supply chain- Future directions.

Unit V

Trends and Challenges in logistics and supply chain management: Third party logistic outsourcing –challenges and future directions.

SUGGESTED READINGS:

1. Christopher, M., "Logistics and Supply Chain Management", Prentice Hall.
2. Handfield and Nicholas, Jr., "Introduction to Supply Chain Management", Prentice Hall.
3. Jhon J Coyle, C. JhonandLangley,Brian J Gibs, "Logistics approach to Supply Chain Management", Cengage Learning.

Course No	Title of the Course	Course Structure	Pre-Requisite
EO013	ORGANISATION DEVELOPMENT	L-T-P: 3-1-0	None

COURSE OUTCOMES (COs)

Organisation Development is a growing field of Human Resource Management. It has its foundations in a number of behavioural and social sciences.

COURSE CONTENT

Topics included are

Organtzattonal Systems and Human Behaviour - Developing a basic knowledge of how organizattons and groups function as systems; introducing and discussing various theoretical approaches and issues.

Interpersonal and Consulting Skills - Increasing effectiveness as a change agent by providing a variety of opportunities in order to increase self-awareness, practice alternative ways of approaching personal and interpersonal problem-solving and develop basic consulting and interviewing skills.

Introduction to organization development - introducing some basic theories, models and methods in the field of organization development, especially those relating to the role of consultant and strategies for change.

Intervention and Change in Organizations - Consolidating and further developing consulting skills and strategies

Action Research Project - Carrying out a change activity in an organization, while also researching the effects and or the process. This provides participants with an opportunity to consolidate and demonstrate skills and knowledge gained in other units of the course.

SUGGESTED READINGS:

1. W. Burke and Debra Noumair, "Organization Development" Pearson.
2. Chris Argyris and David Schon, "Organizational Learning II Theory, Method, and Practice" Pearson.

Course No	Title of the Course	Course Structure	Pre-Requisite
EO014	Industrial organization and managerial economics	L-T-P: 3-1-0	None

COURSE OUTCOMES (COs)

This course help students in understanding the basics of management and Industrial organization.

COURSE CONTENT

Unit I: Principles of management, General idea, various functions, scope of engineering. Organisation structure, Types, merits and demerits.

Unit II: Plant location and layout, Factors effecting location, types of layout. Production planning and control, Sequence of planning and control of production. Scheduling , routing, despatching., Methods Study, Methods analysis, time study methods of rating.

Unit III: General idea of personnel management, Industrial psychology, job evaluation and monitoring. Business decision making and forward planning. Demand and demand forcasting of production analysis- prices and pricing decision-profit and capital, management. Analysis of inter-industry relation, macro-economics and business.

SUGGESTED READINGS:

1. Koutsoyiannis, “Modern Microeconomics” International Edition.
2. Pearson and Lewis, “Managerial Economics” Prentice Hall.
3. G.S. Gupta, “Managerial Economics” T M H, New Delhi.

Course No	Title of the Course	Course Structure	Pre-Requisite
EO015	Global Strategies and Technology	L-T-P: 3-1-0	None

COURSE OUTCOMES (COs)

This subject focuses on the specifics of strategy and organization of the multinational company, and provides a framework for formulating successful and adaptive strategies in an increasingly complex world economy.

COURSE CONTENT

Globalization of industries, the continuing role of country factors in competition, organization of multinational enterprises, and building global networks, Analysis of competitive situations from the general management point of view, including fit between key environmental forces and the firm's resources, and changes in these over time. Formulating and implementing strategy based on that analysis. Developing and leveraging a firm's core competencies to gain long-term sustainable advantage.

SUGGESTED READINGS:

1. Mike W. Peng, "Global strategy" Cengage Learning.
2. Pankaj Ghemawat, "Redefining Global Strategy" Harvard Business Press.

Course No	Title of the Course	Course Structure	Pre-Requisite
EO016	Engineering System analysis and Design	L-T-P: 3-1-0	None

COURSE OUTCOMES (COs)

The students will learn about system definitions and role of system analyst. They will learn about system modeling and design. They will be exposed to System Implementation and Maintenance issues.

COURSE CONTENT

Unit 1

System definition and concepts: Characteristics and types of system, Manual and automated systems

Real-life Business sub-systems: Production, Marketing, Personal, Material, finance Systems models types of models: Systems environment and boundaries, Real time and distributed systems, Basic principles of successful systems

Unit 2

Systems analyst: Role and need of systems analyst, Qualifications and responsibilities, Systems Analyst, agent of change.

Various phases of systems development life cycle: Analysis, Design, Development, Implementation, Maintenance

Unit3

Systems Design and modeling: Process modeling, Logical and physical design, Design representation, Systems flowcharts and structured charts, Data flow diagrams, Common diagramming conventions and guidelines using DFD and ERD diagrams. Data Modeling and systems analysis, designing the internals: Program and Process design, Designing Distributed Systems

Unit 4

User Interfaces – Relational Analysis – Database design – program design– structure chart – HIPO – SSADM – Alternate Life cycles – Prototypes.

Unit 5

System Implementation and Maintenance: Planning considerations, Conversion methods, producers and controls, System acceptance Criteria, System evaluation and performance, Testing and validation, Systems qualify Control and assurance, Maintenance activities and issues.

SUGGESTED READINGS:

1) Haryszkiewycz, "Introduction to Systems Analysis and Design", II Ed. PHI.
2) James A Senn : "Analysis and Design of Information Systems", McGraw Hill.

Course No	Title of the Course	Course Structure	Pre-Requisite
EO017	BIOLOGY FOR ENGINEERS	L-T-P: 3-1-0	None

COURSE OUTCOMES (COs)

- General understanding of organization in biological systems
- Conceptual knowledge of functioning in biological systems
- Clarity about relevance of Biology to engineering graduates
- Understanding human body or any other suitable organism as a study-model for engineering students.
- Understanding electrical, chemical and magnetic forces, and communication networks in bio system.

COURSE CONTENT

The Biological system – An Introduction; Biomolecules & self-assemblies; Molecular recognition; Bioenergetics; Communication network in biosystem; Mechanics in biology; Storage, preservation and propagation of biological information; Biomaterials in engineering applications; Organisms as factories for biomaterials; Engineering organisms for novel applications

SUGGESTED READINGS:

1. T. Johnson "Biology for Engineers", CRC Press.
2. Michael Small ,"Dynamics of Biological system", CRC Press.
3. Johnny T. Ottesen, MS Olufsen, JK Larsen "Applied Mathematical Models and Human Physiology", Published by Society for Industrial and Applied Mathematics,
4. Michael Roberts, Michael Jonathan Reiss, "Advanced Biology", Grace Monger
6. Colin Ratledge , "Basic Biotechnology", Bjorn Kristiansen (Ed.).

Course No	Title of the Course	Course Structure	Pre-Requisite
EO018	Energy, Environment and Society	L-T-P: 3-1-0	None

COURSE OUTCOMES (COs)

- To be able to assess the energy resources available worldwide
- To understand the negative impact of conventional energy resource utilization on ecosystem
- To learn about various types of pollutions and their control strategies
- To understand renewable energy resources and their socio-economic impact.

COURSE CONTENT

Introduction to Environment, Energy and its impact on society

Universe, Environment and Ecosystem: Origin of earth, atmosphere, Origin of Life, Ecosystem, Biotic and abiotic components, Ecological pyramids, Food chain, Food web, Habitat and Niche, Major ecosystems, Atmosphere, Biodiversity

Pollution: Air Pollution, Water Pollution, Soil Pollution, Noise Pollution

Energy: Different sources of Energy, Renewable sources of energy, Nonrenewable energy, Bioenergy, Bioethanol and Biodiesel

Biofertilizers, Biopesticides and Biopolymers

Environmental Ethics and Morals

SUGGESTED READINGS:

1. Kishore V V N, Editor, "Renewable Energy Engineering and Technology, Principles and Practice", The Energy and Resources Institute (TERI).
2. G. N. Tiwari and M. K. Ghosal, "Fundamentals of Renewable Energy Sources", Narosa Publishing House.
3. Mital K. M, "Biogas Systems: Principles and Applications", New Age International publishers (P) Ltd.
4. Nijaguna, B.T., Biogas Technology, New Age International publishers (P) Ltd.
5. D. Yogi Goswami, Frank Kreith, Jan. F .Kreider, "Principles of Solar Engineering", 2nd Edition, Taylor & Francis.
6. Rezaiyan. J and N. P. Cheremisinoff, Gasification Technologies, A Primer for Engineers and Scientists, Taylor and Francis.

Course No	Title of the Course	Course Structure	Pre-Requisite
EO019	Public Policy and Governance	L-T-P: 3-1-0	None

COURSE OUTCOMES (COs)

Students will be introduced to Public Policy and Administrative governance. They will also learn about Administrative Governance.

COURSE CONTENT

Unit 1 Introduction to Public Policy and Administrative Governance: Introduction to public policy, econometrics for policy research, policy analysis, economics for public decision making.

Unit 2 Public Bureaucracy in Theory and Practice: Benefit cost analysis, public budgeting, revenue and expenditures, managing and leading public service organisations.

Unit 3 Administrative Governance: The Challenge of Policy Implementation, public and non-profit programme evaluation.

Unit 4 Non-state Actors in Policy-making and Administrative Governance: governance in twenty-first century, Social Diversity and the Question of "Difference" in Policy-making and administrative Governance

SUGGESTED READINGS:

1. John Shields and B. Mitchell Evans. *Shrinkingthe State: Globalization and Public administration "Reform."* Halifax: Fernwood.
2. Beryl Radin, Beyond Machiavelli: Policy Analysis Reaches Midlife, 2nd edition. Washington, DC: Georgetown University Press.
3. Frank R. Baumgartner, Jeffrey M. Berry, Marie Hojnacki, and David C. Kimball , Lobbying and Policy Change: Who Wins, Who Loses, and Why. Chicago, IL: University of Chicago Press.
4. Timothy Conlan, Paul Posner, and David Beam, Pathways of Power: The dynamics of National Policymaking. Washington, DC: Georgetown University press.

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