UNIVERSITY OF DELHI

NETAJI SUBHAS INSTITUTE OF TECHNOLOGY

CHOICE BASED CREDIT SYSTEM

SCHEME OF COURSES
FOR
M.TECH.
(MANUFACTURING PROCESSES AND AUTOMATION ENGINEERING)

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:

1. Students will apply knowledge of Computer aided design, simulation, manufacturing to pursue successful career in the field of Mechanical Engineering.
2. Students will become innovators, entrepreneurs to design and develop products and services to address social, technical and business challenges.

3. 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. Manufacturing Processes and Automation 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:

Table1: 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. The CGPA shall be converted into percentage of marks, if required by multiplying CGPA with 10.

III. PROGRAMME STRUCTURE

1. The M.Tech. Manufacturing Processes and Automation Engineering programme spans 4 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 Ist semester, the codes are:

MPC01	CC
MPC02	CC
MPD**	Elective
MPD**	Elective
MPD**	Elective
EO***	Open Elective

For IInd semester, the codes are:

MPC03	CC
MPC04	CC
MPD**	Elective
MPD**	Elective
MPD**	Elective
EO***	Open Elective

For IIIrd semester, the codes are:

MPC05	Seminar
MPC06	Major Project
MPD**	Elective
MPD**	Elective
MPD**	Elective

For IVth semester, the codes are:

MPC07	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 (MAMP) 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 Manufacturing and Automation 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

1. An ability to apply knowledge of mathematics and engineering.
2. An ability to design, analyze and interpret data using Engineering Management tools & techniques.
3. 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.
4. An ability to function in multi-disciplinary teams.
5. An ability to identify, formulate, and solve engineering problems.
6. Responsiveness towards professionalism and ethics.
7. An ability to communicate effectively.
8. Domain knowledge necessary to understand the impact of engineering solution in a global and societal context.
9. Recognition of the need for, and an ability to engross in lifelong learning.
10. Knowledge of contemporary issues.
11. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
12. 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 (FULL-TIME)

M.TECH. MANUFACTURING PROCESSES AND AUTOMATION ENGINEERING
(Full Time) SEMESTER I

CODE	TYPE	COURSE OF STUDY	L	T	P	C	EVALUATION (MARKS)					
							Theory			Practical		Total
							CA	MS	ES	CA	ES	
MPC01	CC	Advanced Manufacturing Process	3	0	2	4	15	15	40	15	15	100
MPC02	CC	Robotics	3	0	2	4	15	15	40	15	15	100
MPD**	ED	Elective #	-	-	-	4	-	-	-	-	-	100
MPD**	ED	Elective #	-	-	-	4	-	-	-	-	-	100
MPD**	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. MANUFACTURING PROCESSES AND AUTOMATION ENGINEERING
(Full Time) SEMESTER II

CODE	TYPE	COURSE OF STUDY	L	T	P	C	EVALUATION (MARKS)					
							Theory			Practical		Total
							CA	MS	ES	CA	ES	
MPC03	CC	Manufacturing Automation and Control	3	0	2	4	15	15	40	15	15	100
MPC04	CC	C.I.M.	3	0	2	4	15	15	40	15	15	100
MPD**	ED	Elective #	-	-	-	4	-	-	-	-	-	100
MPD**	ED	Elective #	-	-	-	4	-	-	-	-	-	100
MPD**	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. MANUFACTURING PROCESSES AND AUTOMATION ENGINEERING
(Full Time) SEMESTER III

CODE	TYPE	COURSE OF STUDY	L	T	P	C	EVALUATION (MARKS)					
							Theory			Practical		Total
							CA	MS	ES	CA	ES	
MPC05	CC	Seminar	0	0	4	2	-	-	-	40	60	100
MPC06	CC	Major project	-	-	-	6	-	-	-	40	60	100
MPD**	ED	Elective #	-	-	-	4	-	-	-	-	-	100
MPD**	ED	Elective #	-	-	-	4	-	-	-	-	-	100
MPD**	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. MANUFACTURING PROCESSES AND AUTOMATION ENGINEERING
(Full Time) SEMESTER IV

CODE	TYPE	COURSE OF STUDY	L	T	P	C	EVALUATION (MARKS)					
							Theory			Practical		Total
							CA	MS	ES	CA	ES	
MPC07	CC	Dissertation	-	-	-	14	-	-	-	40	60	100
		TOTAL	-	-	-	14						

SEMESTER-WISE COURSE ALLOCATION (PART-TIME)

M.TECH. MANUFACTURING PROCESSES AND AUTOMATION 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	
MPC01	CC	Advanced Manufacturing Process	3	0	2	4	15	15	40	15	15	100
MPC02	CC	Robotics	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 Table 2-3
$: The actual weekly load will depend upon the elective(s) chosen by the student

M.TECH. MANUFACTURING PROCESSES AND AUTOMATION 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	
MPC03	CC	Manufacturing Automation and Control	3	0	2	4	15	15	40	15	15	100
MPC04	CC	C.I.M.	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 Table 2-3.
$: The actual weekly load will depend upon the elective(s) chosen by the student

M.TECH. MANUFACTURING PROCESSES AND AUTOMATION 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	
MPD**	ED	Elective #	-	-	-	4	-	-	-	-	-	100
MPD**	ED	Elective #	-	-	-	4	-	-	-	-	-	100
MPD**	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. MANUFACTURING PROCESSES AND AUTOMATION 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	
MPD**	ED	Elective #	-	-	-	4	-	-	-	-	-	100
MPD**	ED	Elective #	-	-	-	4	-	-	-	-	-	100
MPD**	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. MANUFACTURING PROCESSES AND AUTOMATION 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	
MPC06	CC	Major project	-	-	-	6	-	-	-	40	60	100
MPD**	ED	Elective #	-	-	-	4	-	-	-	-	-	100
MPD**	ED	Elective #	-	-	-	4	-	-	-	-	-	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. MANUFACTURING PROCESSES AND AUTOMATION ENGINEERING
(Part Time) SEMESTER VI

CODE	TYPE	COURSE OF STUDY	L	T	P	C	EVALUATION SCHEME Percentage (Weightage)					
							Theory			Practical		Total
							CA	MS	ES	CA	ES	
MPC05	CC	Seminar	-	-	4	2	-	-	-	40	60	100
MPC07	CC	Dissertation	-	-	-	14	-	-	-	40	60	100
MPD**	ED	Elective #	-	-	-	4	-	-	100	-	-	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 WTH 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**				
MPD01	Applied Operation Research		None				
MPD02	Micro Electro Mechanical System		None				
MPD03	IT in Manufacturing Enterprises		None				
MPD04	Optimization in Design		None				
MPD05	Advanced Mathematics & Numerical Analysis		None				
MPD06	Computational Methods		None				
MPD07	Finite Element method		None				
MPD08	Embedded systems		None				
MPD09	Mechatronics		None				
MPD10	Smart Materials, Machines and Processes		None				
MPD11	Design of Experiments		None				
MPD12	Composite Materials		None				
MPD13	Reliability Engineering		None				
MPD14	Modelling of metal forming processes		None				
MPD15	Value Engineering		None				
MPD16	Total Quality Management		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**				
MPD31	CNC Technology & Programming		None				
MPD32	Computer Programming & Interfacing		None				
MPD33	Manufacturing Technology		None				
MPD34	Rapid prototyping		None				
MPD35	Casting and welding process & Automation		None				
MPD36	Conventional & Unconventional Machining		None				
MPD37	Design of Machine tools and Cutting Tools		None				
MPD38	Automation in Manufacturing		None				
MPD39	Advanced Robotics		None				
MPD40	Artificial Intelligence		None				
MPD41	Flexible Manufacturing System		None				
MPD42	CAD and Geometric Modeling		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	Sociology		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				

COURSE CONTENTS OF CORE COURSES

Course No	Title of the Course	Course Structure	Pre-Requisite
MPC01	ADVANCED MANUFACTURING PROCESSES	L-T-P : 3-0-2	None

COURSE OUTCOMES (COs)

After taking this course students will be able to:

- Identify the need and to examine different functional elements of various advanced manufacturing processes and to identify the typical applications of these 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; ECDM, Plasma MIG 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. 2. P. C. Pandey and H. S. Shan, "Modern Machining Methods", Tata McGraw Hill Publishing Co. Ltd. 3. A. Ghosh and A. K. Mallik, "Manufacturing Analysis", East West Press Ltd. 4. G. F. Bennedict, "Non-Traditional Manufacturing Processes", Marcell Dekker Inc. 5. J. A. McGeugh, "Advanced Methods of Machining", Chapman and Hall Ltd.. 6. P. K. Mishra, "Nonconvetional Machining", Narosa Publishing House. 7. V. K. Jain, "Advanced Machining Processes", Allied Publisher. 8. ASM Handbook

Course No	Title of the Course	Course Structure	Pre-Requisite
MPC02	ROBOTICS	L-T-P : 3-0-2	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 robot system specification robot anatomy, coordinate trames mapping and transforms euler angle axis representation direct kinematics model, Denavit hartenberg notation. Inverse kinematics, Manipulator Differecntial motion & statics, Dynamic modeling lagrange Euler formulation, Newton Euler formulation inverse dynamics Trajectory planning control of manipulator PID control computed control feed torward 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. Sehilling, "Fundamental of Robotics: Analysis & Control", PHI Private Ltd.
3. Richard D, Klaffer "Robotic Engineering: An Integrated Approach" . PHI Private Ltd.
4. Tsuned Yoshikawa "Foundations of Robotics: Analysis & Control" PHI Private Ltd.
5. Dr. Surender Kumar and Dr. S.K. Mukherjee "Robotics Engineering" , Satya Prakashan
6. Satya Ranjan Deb "Robotics Technology and Flexible Automation" , Tata MC Graw Hill Publishing Company Ltd.
7. J.J. Craig Addison "Introduction to Robotics ME Chanics & Control 2nd Edition" Westeys

Course No	Title of the Course	Course Structure	Pre-Requisite
MPC03	MANUFACTURING AUTOMATION AND CONTROL	L-T-P : 3-0-2	None

COURSE OUTCOMES (COs)

- Knowledge of automation and its relevance to manufacturing.
- Knowledge of hard and soft automation.
- Knowledge of various elements of automation.
- Knowledge of hydraulic, pneumatic and Programmable Logic Controller (PLC).
- Knowledge of automated assembly systems.

COURSE CONTENT

Introduction to Automation and its relevance to manufacturing. Types of Automation Hard and soft automation. Merits Demerits and economics of Automation specific to manufacturing processes. Elements of automation. Sensing and Control Devices. Types of Controllers Hydraulic: Pneumatic: and Programmable logic Controller (PLC) Mechanical Feeding. Various Types of feeding devices: Vibratory Mechanical and Pneumatic Orientation Devices. Automation of Some Manufacturing Processes. Automated Assembly Systems. Design of Pick and Place systems Grippers and other actuators. Automated inspection.

SUGGESTED READINGS:

1. Antony Espossito, “Fluid power with Applications ", Prentice Hall.
2. Dudleyt, A.Pease and John J.Pippenger, " Basic Fluid Power ", Prentice Hall.
3. Andrew Parr, " Hydraulic and Pneumatics ", (HB), Jaico Publishing House.
4. Bolton. W. “Pneumatic and Hydraulic Systems ", Butterworth - Heineman.
5. Lawrence J.Kamm, “Understanding Electro-Mechanical Engineering, An Introduction to Mechatronics ", Prentice-Hall.
6. Ghosh, P.K. and Sridhar, P.R., 0000 to 8085, “Introduction to Microprocessors for Engineers and Scientists ", Second Edition, Prentice Hall.

Course No	Title of the Course	Course Structure	Pre-Requisite
MPC04	COMPUTER INTEGRATED MANUFACTURING SYSTEMS	L-T-P : 3-0-2	None

COURSE OUTCOMES (COs)

- Knowledge of new challenges in manufacturing.
- Knowledge of computer integrated manufacturing (CIM) systems.
- Knowledge of automation of manufacturing systems.
- Knowledge of flexible manufacturing systems as mini CIM systems.
- Knowledge of ERP group technology.
- Knowledge of simulation and artificial intelligence (AI) in CIM systems.

COURSE CONTENT

Evolving manufacturing environment new competitive challenges, Evolving Role Information Technology, CIM Systems; Flexibility, Integration and Automation Opportunities Automation of Information and manufacturing systems, Automation strategies, Towards Flexible Automation Islands of automation, Evolution Towards CIM SYSTEMS, computer based integration between various functions-manufacturing sales, design, materials etc Flexible Manufacturing Systems (FMS) as mini CIM, Computer Integrated Production Management, ERP Group technology, Concurrent Engineering, Simulation and AI in CIM Systems, CIM and beyond.

SUGGESTED READINGS:

1. Grover, M.P., "Automation, Production System and CIM", Prentice-Hall of India.
2. David Bedworth, "Computer Integrated Design and Manufacturing", TMH, New Delhi.
3. Yorem Koren, "Computer Integrated Manufacturing Systems", McGraw Hill.
4. Ranky, Paul G., "Computer Integrated Manufacturing", Prentice Hall International .
5. R.W. Yeomamas, A. Choudry and P.J.W. Ten Hagen, "Design rules for a CIM system", North Holland Amsterdam.

COURSE CONTENTS OF DISCIPLINE CENTRIC ELECTIVES

Course No	Title of the Course	Course Structure	Pre-Requisite
MPD01	APPLIED OPERATIONS RESEARCH	L-T-P: 3-1-0	None

COURSE OUTCOMES (COs)

- Knowledge of linear programming.
- Knowledge of linear programming limitations.
- Knowledge of PERT and CPM.
- Knowledge of dynamic programming.
- Knowledge of queuing characteristics and terminology.
- Knowledge of poisson and non-poisson models.

COURSE CONTENT

Introduction, Concepts, development, applications, Linear Programming, Definitions, assumption, formulation, graphical method, computational procedure, dual, sensitivity analysis, revised simples, LP limitations, Net Work Methods, Transportation, assignment, maximum flow, shortest route, spanning tree problems, PERT / CPM. Dynamic Programme , Concepts , formulation, recursive approach, computation procedure. Waiting Line Models, Queuing characteristics and terminology, poisson and non-poisson models.

SUGGESTED READINGS:

1. Hamdy M.Taha," Operations research an introduction, 4th edition", Mc Millan Co..
2. Don T.Phillips, A.Ravindran & James Solberg, "Operations Research: Principles and practice", John Wiley & Sons.
3. Guisseppi A.Forgionne, "Quantitative decision making", Wordsworth Publishing Co.
4. Richard Broson, Govidasamy & Naachimuthu, " Operations Research" , Schaum's Outline Series.

Course No	Title of the Course	Course Structure	Pre-Requisite
MPD02	MICRO ELECTRO MECHANICAL SYSTEMS (MEMS)	L-T-P: 3-1-0	None

COURSE OUTCOMES (COs)

At the end of the course, the student shall be able to

- 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, microsensors, microactuation, microaccelerometers, microfluidics.

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

Microsystem Fabrication Processes; Photolithography, ion implantation, diffusion, oxidation, chemical vapor deposition, physical vapor deposition, deposition by epitaxy, etching. 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
MPD03	IT IN MANUFACTURING ENTERPRISES	L-T-P: 3-1-0	None

COURSE OUTCOMES (COs)

- Understanding of production system.
- Understanding the role, challenges and opportunities of IT in manufacturing.
- Knowledge of MIS in manufacturing system.
- Knowledge of FMS, CIM & intelligent manufacturing system.
- Knowledge of E-Business and supply Chain Management.
- Knowledge of DOT NET, DATA MINING etc.

COURSE CONTENT

Production Systems, Manufacturing Enterprises as Systems, Appreciate the evolving manufacturing environment and multi0attributed 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
MPD04	OPTIMIZATION IN DESIGN	L-T-P : 3-1-0	None

COURSE OUTCOMES (COs)

- Knowledge of principle of optimization.
- Knowledge of various optimization techniques.
- Knowledge of single variable and multivariable optimization.
- Knowledge of design applications of various structural members.

COURSE CONTENT

Introduction ,Optimization Techniques ,Engineering Applications, General Characteristics of mechanical elements, adequate and optimum design, principles of optimization, formulation of objective function, design constraints -Classification of optimization problems.

Single variable and multivariable optimization, Techniques of unconstrained minimization - Golden Section - Random , pattern and gradient search methods -Interpolation methods; Optimization with equality and inequality constraints - Direct methods - Indirect methods using penalty functions Lagrange multipliers; Geometric programming and stochastic programming; Multi objective optimization, Genetic algorithms and Simulated Annealing techniques.

Structural applications - Design of simple truss members. Design application - design of simple axial, transverse loaded members for minimum cost, maximum weight, - Design of shafts and torsionally loaded members - Design of springs, Dynamic Applications - Optimum design of single, two degree freedom system, vibration absorbers. Application in Mechanism - Optimum design of simple linkage mechanism.

SUGGESTED READINGS:

1. Singeresu S. Rao, "Engineering Optimization - Theory and Practice" New Age Intl. Ltd., Publishers.
2. Johnson Ray, C., "Optimum design of mechanical elements" , Wiley , John & Sons.
3. Goldberg, D.E., "Genetic algorithms in search, optimization and machine", Barnen, Addison-Wesley, New
York.
4. Kalyanamoy Deb, "Optimization for Engineering design algorithms and Examples", Prentice Hall of India

Course No	Title of the Course	Course Structure	Pre-Requisite
MPD05	ADVANCED MATHEMATICS AND NUMERICAL ANALYSIS	L-T-P: 3-1-0	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, mathed asymptotic expansions
Integral Transforms of Fourier, Laplace hanked and melon fredbotm and volterra integral equations and the iterative solutions, feedhole alternative symmetric kernels and singular integral equations
Solution of a system of liner equations : Gaussian Elimination and gauss sedel methods
Solution of nonlinear equations: Bisection method secant method method of false position Newton raphson method chebysehev method rate of luetooth e system of nonlinear equations.
Interpolation by polynomials: Divided difference error of the interpolation polynomial least square approximation pieewise liner and cubic spline interpolation.
Numerical Integration: Composit 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 Numercial Analysis, an Algorithmic Approch" 3rd ed McGraw Hill.
2. C.E. Froberg "Introduction to Numercial Analysis" 2nd Ed Addision Wesley.
3. K.E. Atkinson "An introduction to Numerical Analysis" Wiley.
4. E.B Hildebrand, "Introduction to numerical analysis" Tata McGraw Hill.
5. L.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.

Course No	Title of the Course	Course Structure	Pre-Requisite
MPD06	COMPUTATIONAL METHODS	L-T-P : 3-1-0	None

COURSE OUTCOMES (COs)

- Knowledge of various computational methods.
- Ability to solve algebraic and transcendental equations.
- Knowledge of numerical differential and integration.
- Ability to solve ordinary and partial differential equations.
- Ability to solve important production engineering problems.

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"

Course No	Title of the Course	Course Structure	Pre-Requisite
MPD07	FINITE ELEMENT METHODS	L-T-P: 3-1-0	None

COURSE OUTCOMES (COs)

- Ability to create models for trusses, frames, plate structures, machine parts etc.
- Ability to evaluate and interpret FEA analysis results for design and evaluation purposes.
- Understanding of the limitations of the FE method and understand the possible error sources in its use.

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., Pergamum Press.
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.

Course No	Title of the Course	Course Structure	Pre-Requisite
MPD08	EMBEDDED SYSTEM	L-T-P: 3-1-0	None

COURSE OUTCOMES (COs)

- Knowledge of C programming.
- Knowledge of real time operating system.
- Knowledge of microcontroller architecture.
- Knowledge of embedded controller components.
- Knowledge of memory subsystems.

COURSE CONTENT

Programming Concepts: Review of C programming data structures, arrays, stacks, queues, project management

Real Time Operating Systems: OS services and structures process and memory management Inter process communication Example RTOS:

Application specific instruction set processor and digital signal processor: RISC and CISC architectures with focus on designing the datapath and control path. Sample DSP architucture Motorola 56XX series, Analog Devices:

Microcontroller Architectures: 8 bit microcontroller, focusing on AVR RISC microcontrollers 32 bit focusing on ARM microcontroller.

Embedded controller components: Timers/counters, UMRT, Watchdog Timers ADC, DAC RTC Digital I/O Peripheral devices: LCD Character and graphics displays switches touch screen keyboard Communication protocols: 12C, SPI CAN bus RS232, RS485, Ethernet luetooth, IrDA IEEE802.11 etc.

Memory Subsystems: Common memory types memory hierarchy and cache storage subsystems.

Interfacing communication basics I/O addressing Interrupts DMA Bus architectures like ISA PCI compact PCL Communication Software protocols like TCP/IP

SUGGESTED READINGS:

1. R.J.A. Buhr, D.L.Bailey, “An Introduction to Real-Time Systems”, PHI.
2. C.M.Krishna, Kang G. Shin, Real Time Systems, McGraw Hill.
3. Raymond J.A.Buhr, Donald L. Bailey; “An Introduction to Real Time Systems”, PHI.

Course No	Title of the Course	Course Structure	Pre-Requisite
MPD09	MECHATRONICS	L-T-P: 3-1-0	None

COURSE OUTCOMES (COs)

- Understanding of mechatronics.
- Knowledge of Hydraulic and Pneumatic actuator systems.
- Knowledge of operational characteristics and performance of hydraulic based actuation systems.

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-1 converters ancillary.

SUGGESTED READINGS:

1. Andrew Parr, "Hydraulic and Pneumatics ", (HB), Jaico Publishing House.
2. Bolton. W. "Pneumatic and Hydraulic Systems ", Butterworth – Heineman.
3. Lawrence J.Kamm, "Understanding Electro-Mechanical Engineering, An Introduction to Mechatronics ", Prentice-Hall.

Course No	Title of the Course	Course Structure	Pre-Requisite
MPD10	SMART MATERIALS, MACHINES AND PROCESSES	L-T-P: 3-1-0	None

COURSE OUTCOMES (COs)

- Ability to describe different kinds of smart materials.
- Ability to describe the modelling and applications for sensing, actuation and control.
- Ability to describe the adaptive control application in structure.
- Diagnostics of faults using expert systems, artificial neural networks, fuzzy logic etc.

COURSE CONTENT

Characteristics of smart materials like piezoelectric, shape memory alloys electro- rheological materials Magnetostrictive materials etc. Modelling and applications for sensing, actuation and control. Adaptive control applications in structures for vibration suppression, detection and control of damage in composite structures, use for actuation, valves, suspensions, clutches brakes etc.

Health monitoring and fault diagnosis of machines and structures like computer controlled manufacturing machines, aerospace structures etc. Monitoring of parameters like temperature, cracks, wear, speed, thermal deflections, vibrations and process parameters. Diagnostics of faults using expert systems, artificial neural networks, fuzzy logic, wavelet transforms etc.

Practical Courses shall be undertaken based on the theoretical topics covered in the theory courses.

SUGGESTED READINGS:

1. Halpin, J.C., "Primer on Composite Materials, Analysis ", Techomic Publishing Co.
2. Agarwal, B.D., and Broutman L.J., " Analysis and Performance of Fiber Composites ", John Wiley and Sons, New York.

Course No	Title of the Course	Course Structure	Pre-Requisite
MPD11	DESIGN OF EXPERIMENTS	L-T-P: 3-1-0	None

COURSE OUTCOMES (COs)

Upon completion of the subject, students shall be able to

- 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:

1. Douglas C. Montgomery "Design and Analysis of Experiments", Wiley Publication.

Course No	Title of the Course	Course Structure	Pre-Requisite
MPD12	COMPOSITE MATERIALS	L-T-P: 3-1-0	None

COURSE OUTCOMES (COs)

- Knowledge of various composite materials.
- Ability to design composite structures, selection of composite materials.
- Conduct stress analyses of selected practical applications using laminated plate theories.
- Familiar with the properties and response of composite structures subjected to mechanical loading under static and cyclic conditions.

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, Al_2O_3, Si_3N_4 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 material” CRC Press.
4) R.J. Crawford, Butterworth “Plastic Engineering”, -Heinemann publications.
5) P.K. Mallick, Marcel Dekker,”Fiber-Reinforced Composites- Materials, Manufacturing and Design”.

Course No	Title of the Course	Course Structure	Pre-Requisite
MPD13	RELIABILITY ENGINEERING	L-T-P: 3-1-0	None

COURSE OUTCOMES (COs)

At the end of the course, the student shall be able to:

- 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. L. A. Doty “Reliability Engineering”, Industrial Press Inc.
4. Srinath.L.S., "Reliability Engineering", Affiliated East West Press Pvt. Ltd.
5. Collact, "Mechanical Fault Diagnosis & condition monitoring".
6. Balagurusamy.E., "Reliability Engineering", Tata Mcgraw Hill Publishing Company, New Delhi.

Course No	Title of the Course	Course Structure	Pre-Requisite
MPD14	MODELLING OF METAL FORMING PROCESSES	L-T-P : 3-1-0	None

COURSE OUTCOMES (COs):

- Ability to describe the concept of plastic deformation in metal forming processes.
- Abilty to understand various process modelling techniques in metal forming.
- Understanding of plasticity fundamentals, failure criterion in metal foming processes.
- Modelling various forming processes using different modelling procedures.

COURSE CONTENT:

Review of tensile test, Yield phenomenon, Baushinger effect, strain hardening, effect of carbon and temperature on steel properties. Stress-strain relation.

Yield criteria - Tresca and Von Mises, Flow rules, Incremental and deformation theories. Plane strain problems, slip-line theory and its application to indealized problems of indentation and forming processes. Introduction to modelling techniques used for metal forming processes.

Forming processes - rolling, forging, drawing, deep drawing, bending and extrusion, punching and blanking; operations, practices and machines; other processes like coining, thread rolling, tube piercing, spinning, stretch forming.

Mechanics of forming processes: Rolling - Modeling, rolling pressure, roll separating force. Strip forging - Mechanics, pressure distribution, total force, forging of a disc.

Drawing - Modelling, drawing force, power, maximum allowable reduction.

Deep drawing - Mechanics, stress distribution, effect of friction, blank holding force.

Bending - Mechanics, work load, spring back.

Extrusion - Stress analysis, work load, frictional power loss. Effect of different parameters on the processes, theory and practice, operations and machines. Explosive forming, electro hydraulic forming. defects, inspection and various nondestructive techniques.

SUGGESTED READINGS::

1. Dieter G.E., “Mechanical Metallurgy” (Revised Edition II) McGraw Hill Co.
2. Altan T., “Metal forming – Fundamentals and applications” – American Society of Metals, Metals park.
3. ASM Hand book, “Forming and Forging”, Ninth edition.

Course No	Title of the Course	Course Structure	Pre-Requisite
MPD15	VALUE ENGINEERING	L-T-P: 3-1-0	None

COURSE OUTCOMES (COs)

At the end of the course, the student shall be able to:

- 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.
- 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:

2. Miles, Lawrence D, "Technology of Value Analysis And Engineering", McGraw Hill, 1961.
3. Mudge Arthur E., "Value Engineering: Systematic Approach", M Hill, New York, 1971.

Course No	Title of the Course	Course Structure	Pre-Requisite
MPD16	TOTAL QUALITY MANAGEMENT	L-T-P: 3-1-0	None

COURSE OUTCOMES (COs)

- Understanding of approaches and philosophies of total quality management (TQM).
- Understanding of Statistical Design of Experiments.
- Ability to solve problem in TQM.
- Knowledge of measurement and audit for TQM.

COURSE CONTENT

Module I : Introduction to TQM; Customer Orientation, Continuous Improvement, Quality, Productivity and Flexibility, Approaches and philosophies of TQM, Quality Awards, Strategic Quality Management, TQM and corporate culture, Total Quality Control; Basic Analytical tools-Check Sheets; Histograms; Pareto charts, Cause and Effect diagrams; Flow charts.

Module II : Statistical Process Control; Advanced Analytical tools- Statistical Design of Experiments; Taguchi Approach; Cost of Quality; Reliability and failure analysis. FMECA, Quality Function Deployment, Benchmarking, Concurrent Engineering.

Module III : Quality Teams, Employee practices in TQM organisations: Leadership, delegation; empowerment and motivation; role of communication in Total Quality, Quality Circles; Total Employee Involvement; Problem Solving in TQM- Brain storming; Nominal Group Technique Team process; Kaizen and Innovation; Measurement and audit for TQM; Quality Information Systems, ISO 9000 series of Quality Standards; TQM Implementation; Reengineering and TQM.

SUGGESTED READINGS:

Gilton, “Quality Management”, McGraw Hill.

Gryna, “Juran’s Quality Planning & Analysis for Enterprise”, McGraw Hill.

Besterfield, “Total Quality Management”, Pearson Education.

Course No	Title of the Course	Course Structure	Pre-Requisite
MPD31	CNC TECHNOLOGY & 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

Introduction to NC/CNC/DNC and its role in FMS and CIMS, Basics elements of CNC system, CNC Hardware Elements Including drives actuators & sensors, Construction of modern CNC machine tool controllers, introduction to part programming, Radius and length Compensation Schemes, Tooling & Work-holding for CNC Machine tools, Advance Programming Features & Canned Cycles Geometric, Modeling for NC machining & machining of Free – form Surfaces, NC program generation from CAD models, NC Program verification and Virtual NC, Recent developments in CNC machine tools.

SUGGESTED READINGS:

1.NIIT, “Fundamental of Computer Numerical Control” , PHI Publication
2.Richard R. Kibbe|John E. Neely RRK|Roland O. Meyer|Warren T. White, Machine Tool Practices , PHI Publication

Course No	Title of the Course	Course Structure	Pre-Requisite
MPD32	COMPUTER PROGRAMMING AND INTERFACING	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.
- Knowledge of role of constants, variables, identifiers, operators, type conversion and other building blocks of language.
- Use of conditional expressions and looping statements to solve problems associated with conditions and repetitions.

COURSE CONTENT

Introduction to c and C++ Pointers structure and files in C, C++ as an object oriented language creation objects using member functions constructors and destructors classes and structures and friends overloading operators file operations in C++ Inheritance polymorphism.

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
MPD33	MANUFACTURING TECHNOLOGY	L-T-P : 3-0-2	None

COURSE OUTCOMES (COs)

- Knowledge of various manufacturing processes.
- Sound knowledge of metal casting process and able to design the gating system.
- Knowledge of metal cutting & tool specification system.
- Knowledge of tool life & economics of machining.
- Knowledge of different joining processes, weld design consideration and weld quality.
- Knowledge of various unconventional machining processes.
- Identify the need and to examine different functional elements of various advanced manufacturing processes and to identify the typical applications of these modern manufacturing processes.

COURSE CONTENT

Introduction to Manufacturing processes, Metal casting process, design of gating system and riser, Inspection; Foundry automation, Plastic deformation; load estimation; High velocity forming; defects. Metal cutting; Tool specification system. Merchant's theory; tool life & economics of machining. Mechanics of grinding. Common shaping process for plastics; defects and product design. Joining processes, solidification of welds, TIG, MIG, resistance welding; design consideration and weld qualify. Unconventional machining processes ECM, EDM, USM, EBM and LBM, Various RP processes. Rapid tooling techniques; applications of RP/RT. Metrology; limits, fits and tolerance, Automated inspection and CMM; demonstration of various measuring equipments; Selection of manufacturing processes for a given product including real life example.

SUGGESTED READINGS:

1. Hajra Choudhory C.J., " Elements of workshop Technology ", Vol.I and Vol.II, Asia Publishing House.
2 Rand R.K., Gupta S.C., " Production Technology ", Khanna Publishers.
3 "H.M.T.Production Technology-Hand book ", Tata McGraw Hill.
4 Gupta R.B., " Production Technology ", Sathya Prakasan.
5 Benjamin, Neibell W., Albn B. Droper, Richard A. Wyste, " Modern Manufacturing Process Engineering ", McGraw Hill.

Course No	Title of the Course	Course Structure	Pre-Requisite
MPD34	RAPID PROTOTYPING (RP)	L-T-P: 3-0-2	None

COURSE OUTCOMES (COs)

- Able to describe popular rapid prototyping technology.
- Apply the basic principles of rapid prototyping (RP) to product development.
- Knowledge of CAD for rapid prototyping.

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 project 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 Technology in product development, with an emphasis on their selection.

The course will be structured into three modules;

1. 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.
2. 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", Palationo press, Ine .
3. Lamont wood, "RAPID automated Prototyping; An Introduction", Industrial Press.
4. Paul F. Jacobs "Rapid Prototyping and Manufacturing: Fundamentals of Streolithography", Society of manufacturing Engineers.

Course No	Title of the Course	Course Structure	Pre-Requisite
MPD35	CASTING AND WELDING: PROCESSES & AUTOMATION	L-T-P : 3-0-2	None

COURSE OUTCOMES (COs)

- Knowledge of fundamentals of sand casting: solidification of metals, cast structures, fluidity of molten metals, heat transfer, casting defects etc.
- Knowledge of investment casting.
- Knowledge of various permanent mold casting processes.
- Knowledge of basic principle of the welding and its classifications.
- Knowledge of science of liquid state welding processes.
- Knowledge of science of solid state welding processes.
- Knowledge of science of solid/liquid state welding processes.

COURSE CONTENT

Introduction: Introduction to Manufacturing

CASTING

Expendable Mold Casting Processes: Mold types, send 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.

Permanent Mold Casting Processes: Mold design, die casting types, centrifugal casting, squeeze casting, vacuum molding, turbine blade casting methods. Casting Heat Treatment. Plaster mold casting. Process Automation Case Studies

Welding

Introduction to welding; Classification, Transformation of an art to science. Forge and diffusion welding processes. Liquid State Welding Processes: Science of liquid state welding processes gas welding thermit welding, are welding (are welding processes, power sources, physics of are welding applications, newer are welding process viz. Plasma – MIG Welding, Twisted are welding etc.) resistance welding, inducation 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. Welding handbook 8th edition vol. 1-5 AWS American welding society Publications
2. ASM Handbook volume 06: Welding Brazing and soldering hardbound; Publisher ASM Publication Date:1993: ISBN0-87170-3;1299 Pages
3. ASM Handbook Volume 15: Casting Hardbound: Publisher: ASM: Publication Date:1988 ISBN 0-87170-021-2:937 page; 1300.
4. Jain, P.L. "Principles of Foundry Technology".

Course No	Title of the Course	Course Structure	Pre-Requisite
MPD36	CONVENTIONAL AND UNCONVENTIONAL MACHINING	L-T-P : 3-0-2	None

COURSE OUTCOMES (COs)

- To be able to describe basic functional principles of machine tools.
- To be able to show configuration of basic machine tools and state their uses.
- To be able to identify the characteristics of conventional machining.
- To be able to identify the characteristics of non-conventional machining processes.
- To be able to identify the need for non-traditional machining processes.

COURSE CONTENT

(A) Conventional Machining

Fundamentals of Metal Cutting Mechanics of machining Processes orthogonal & oblique cutting cutting tool materials and geometry of cutting tools, Thermal aspects of machining processes, cutting fluids tool wear tool life and machinability, abrasive machining processes Grinding.

(B) Non Conventional Machining

Introduction Classification of Non- conventional machining processes, AJM, USM, WJM, Hybrid Machining Processes Machining of Advanced & difficult to machine materials applications in the present scenario

Economics of non-conventional machining.

SUGGESTED READINGS:

1. Milton C, Shaw “Metal Cutting Principles”;
2. Paul Kenneth Wright, Edward M. Trent “Metal Cutting”;
3. J.R. Davis “TOOL materials”
4. Boothroyd “Metal Cutting”
5. Panday & Shah “Newer machining methods”
6. P.K. Mishra “Non- Conventional Machining”
7. Benedict “Non-Traditional Manufacturing Processes”

Course No	Title of the Course	Course Structure	Pre-Requisite
MPD37	DESIGN OF MACHINE TOOLS & CUTTING TOOLS	L-T-P : 3-0-2	None

COURSE OUTCOMES (COs)

- Understanding of basic concept and requirements of machine tools.
- Understanding of dynamics of machine tools.
- Knowledge of tool wear.
- Knowledge of belt, gear and hydraulic drives.
- Knowledge of bearing design and selection.

COURSE CONTENT

Basic Concept and General Requirements of Machine Tools
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

SUGGESTED READINGS:

1. Mehta,N.K.,"Machine Tool design",Tata McGraw Hill.
2. Koenisberger,F., "Design Principles of Metal cutting Machine Tools",Pergamon Press.
3. Acherkan,N.,"Machine Tool Design",Vol.3&4, MIR Publishers.
4. Sen.G. and Bhattacharya, A. "Principles of Machine Tools",Vol.2,NCB.

Course No	Title of the Course	Course Structure	Pre-Requisite
MPD38	AUTOMATION IN MANUFACTURING	L-T-P : 3-0-2	None

COURSE OUTCOMES (COs)

- Knowledge of automation of various manufacturing processes.
- Knowledge of different types of mechanical, electrical and electronic systems.
- Knowledge of various hydraulic & Pneumatic Systems and their application to manufacturing equipment.
- Knowledge of different feedback control systems.
- Knowledge of drive and mechanism of an automated system.
- Knowledge of RFID technology and its applications.

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, PLCOpen 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.

SUGGESTED READINGS:

1. Mikell P. Groover "Automation, Production Systems and Computer Integrated Manufacturing" "CAD / CAM" by Mikell P. Groover and Emory W. Zimmer

2 Pressman and Williams, "Numerical Control and Computer Aided Manufacture"

3 Tiess Chieu Chang and Richard. "An Introduction to Automated Process Planning System"

Course No	Title of the Course	Course Structure	Pre-Requisite
MPD39	ADVANCE ROBOTICS	L-T-P: 3-0-2	None

COURSE OUTCOMES (COs)

- Knowledge of kinematics and dynamics of mobile robot.
- Knowledge of Non Convention Control Techniques of Robot Manipulates.
- Knowledge of fuzzy control techniques.
- Knowledge of application of sensors in robotics.
- Knowledge of robotics system design aspects.

COURSE CONTENT

Kinematics of Mobile Robot
Dynamics of Mobile Robot
Dynamics of Parallel Manipulates
Planning of Trajectories
Non Convention Control Techniques of Robot Manipulates
Fuzzy Control Techniques, Tuning
Application of Sensors in Robotics
Intelligent Robots
Industrial Cases & Examples
Robotics Systems Design Aspects
Maintenance and Safety, Sensor Integrated Gripers

SUGGESTED READINGS:

1. J.Schilling " Fundamentals of Robotics: Analysis & Control Robert" PHI Pri
2. Richard D. Klaffer " Robotic Engineering: An Integrated Approach", P.H.I Limited
3. B. Yegnanarayana, Timothy Ross, "Fuzzy Logic with Engineering Applications" Mc Graw Hill
4. "Artificial Neural Networks" P.H.I Private Limited
5. "Fuzzy Neural Control Principles Algorithms and Applications" Prentice Ha
6. Danw. Pathersm "Artificial Intelligence and Expert Systems", Eastern Edition
7. Kluwer "Fuzzy Systems, Modelling and Control" Acadmic Publishers.

Course No	Title of the Course	Course Structure	Pre-Requisite
MPD40	ARTIFICIAL INTELLIGENCE	L-T-P : 3-0-2	None

COURSE OUTCOMES (COs)

At the end of the course, the student shall be able to:

- 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 Neur Networks, Feed Back neural Networks, Neural Networks for linear & non linear Dynam System, Modeling and control, Basics of Fuzzy logic export systems ,fuzzy sets & control theor Fuzzy systems as inference engines, Fuzzy systems as function approximates, model based fuz control learning based fuzzy control classical fuzzy control problem inverted pendulum.
Fuzzy modeling & tracking control of non linear systems stability of fuzzy controller's 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 Neural Networks" P.H.I Private Limited
3. "Fuzzy Neural Control: Principles Algorithms & applications" Prentice Hall
4. Danw. Pathersm "Artificial Intelligence & Expert Systems", Eastern Economy Edition
5. Kluwer "Fuzzy Systems, Modelling & Control", Acadmic Publishers.

Course No	Title of the Course	Course Structure	Pre-Requisite
MPD41	FLEXIBLE MANUFACTURING SYSTEMS	L-T-P: 3-0-2	None

COURSE OUTCOMES (COs)

At the end of the course, the student shall be able to:

- 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 equipments. 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. Shivanand H. K., Benal M. M and Koti V, "Flexible manufacturing system", New Age International (P) Limited. Publishers.
4. Kusiak A., "Intelligent manufacturing systems", Prentice Hall, Englewood Cliffs, NJ.
5. Considine D. M. & Considine G. D, "Standard hand book of industrial automation", Chapman and Hall, London.
6. Viswanadhan N. and Narahari Y, "Performance modelling of automated manufacturing systems", Prentice Hall India (P) Ltd.
7. Ranky P. G, "The design and operation of FMS", IFS Pub.

Course No	Title of the Course	Course Structure	Pre-Requisite
MPD42	COMPUTER AIDED DESIGN (CAD) AND GEOMETRIC MODELING	L-T-P: 3-0-2	None

COURSE OUTCOMES (COs)

- Exposure to CAD tools for use in mechanical engineering design conceptualization, geometric modelling, communication, analysis and optimization, further use in CAD, CAM, CAE related courses and research work.
- Knowledge related to principles, methods and techniques of 3D modelling in parametric CAD software.
- Knowledge of graphic standards for CAD.
- Knowledge of professional software for design analysis, evaluation and optimization.

COURSE CONTENT

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 generation algorithms programming using C/Auto lisp to generate various primitives color representation.

Unit III 2D & 3D Transformation

Translation scale 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 transformations writing interactive programs using C/Auto lisp for transformations. Perspective projection techniques for visual realism hidden line surface removal. Algorithms for shading and rendering concepts of Animation and virtual reality.

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 n-some

surfaces – volume modeling techniques boundary models – CSG, Feature based modeling parametric modeling variation modeling creation of parts using software packages2D Representation Development of surfaces using C/Auto lisp.

Unit IV Graphic 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 subject broker architecture in CAD /CAM data transfer.

SUGGESTED READINGS:

1. William .M. Neumann and Robert .F. Sproul " Principle of Computer Graphics ", McGraw Hill.
2. Donald Hearn and .M. Pauline Baker “Computer Graphics " Prentice Hall, Inc.
3. Mikell .P. Grooves and Emory .W. Zimmers Jr. “CAD/CAM Computer -- Aided Design and Manufacturing, Prentice Hall, Inc.
4. Ibrahim Zeid "CAD/CAM -Theory and Practice” McGraw Hill, International Edition.

COURSE CONTENTS OF OPEN ELECTIVES

Course No	Title of the Course	Course Structure	Pre-Requisite
EO001	Technical Communication (TC)	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"
2. Meenakashi Raman & Sangeeta Sharma "Technical Communication"

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. Sahni, Pardeep. (Eds.) 2002, "Disaster Mitigation Experiences And Reflection" Prentice Hall Of India.
2. Goel S. L. 2007 Disaster Administration and Management Text and Case Studies Deep & Deep Publication.

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

COURSE OUTCOMES (COs)

The course's objective is to provide a theoretical framework for considering corporate finance problems and issues and to apply these concepts in practice. In this course, you will enhance your knowledge and understanding of financial management. You will learn 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. It will also 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 Human Resource 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. (2002) "Human Resource and Personnel Management", Tata McGraw-Hill.
2. Chhabra T.N. (2002) "Human Resource Management", Dhanpat Rai and Co. Delhi.
3. Saiyadain S. Mirza (2003) "Human Resource Management", Tata Mc-GrawHill, India.
4.Chadha, N.K. "Human Resource Management-issues, case studies, experimential exercises", Sri Sai Printographers, 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 benefits 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" , 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.

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

COURSE OUTCOMES (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. Hicks, Andrew & Goo S.H." Cases and Material on Company Law", Oxford University Press
2. Gowar, LCB, "Principles of Modern Company Law", Stevens & Sons, London.
3. Majumdar, A.K., and G.K. Kapoor, "Company Law and Practice", Taxmann
4. Hanningan, Brenda," Company Law", Oxford University Press, U.K.
5. Ramaiya wadhwa, "A Guide to Companies Act", LexisNexis Butters worth.
6. Kannal, S., & V.S. Sowrirajan, "Company Law Procedure", Taxman's Allied Services.

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" ,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	SOCIOLOGY	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.

Mead - Self and identity.

SUGGESTED READINGS:

1. Beteille, Andre, 2002, Sociology "Essays in Approach and Method", Oxford University Press.
2. Giddens, Anthony, 2010, "Sociology", Polity Press.
3. Weber, M. 1949. "The Methodology of the Social Sciences". New York: Free Press.
4. Durkheim, E. 1982. "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.

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: 1. Kumar, Arya, Entrepreneurship "Creating and Leading an Entrepreneurial Organization", Pearson. 2. Hishrich., Peters, "Entrepreneurship Starting, Developing and Managing" New Enterprise, Irwin 3. Barringer, Brace R., and R. Duane Ireland, "Entrepreneurship", Pearson Prentice Hall. 4. Hisrich, Robert D., Michael Peters and Dean Shephered," Entrepreneurship", Tata McGraw Hill. 5. Charantimath, Poornima, "Entrepreneurship Development and Small Business Enterprises", Pearson Education.

Course No	Title of the Course	Course Structure	Pre-Requisite
EO010	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	INTELLECTUAL PROPERTY 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. 1964. “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.

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

COURSE OUTCOMES (COs)

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

COURSE CONTENT

Topics included are

1. Organizational Systems and Human Behavior - Developing a basic knowledge of how organizations and groups function as systems; introducing and discussing various theoretical approaches and issues.
2. 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.
3. 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.
4. Intervention and Change in Organizations - Consolidating and further developing consulting skills and strategies
5. Action Research Project - Carrying out a change activity in an organization, while also researching the effects and lor the process. This provides participants with an opporfunity 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 A "Modern Microeconomics" ELBS.
2. Prof. D.N. Kakkar "Managerial Economics for Engineering"
3. D.N. Dwivedi "Managerial Economics"
4. Maheshwari. "Managerial Economics"
5. Ruddardutt and K.P.M.Sundharam "Indian economy"

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”
2. Pankaj Ghemawat “Redefining Global Strategy”
3. Cornelis A. de Kluyver “Fundamentals of Global Strategy”

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, 2010 Edition
2. Michael Small, "Dynamics of Biological system" CRC Press, 2011 Edition
3. Johnny T. Ottesen, MS Olufsen, JK Larsen, "Applied Mathematical Models and Human Physiology" Society for Industrial and Applied Mathematics,
4. Michael Roberts, Michael Jonathan Reiss, Grace Monger "Advanced Biology "
5. Hermann Remmer "Ecology"
6. Colin Ratledge, Bjorn Kristiansen (Ed.) "Basic Biotechnology"

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, N.D.

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, 2000, Indian reprint.

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, 1998.
2. Beryl Radin (2013), 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 (2015) " Pathways of Power: The dynamics of National Policymaking" Washington, DC: Georgetown University press.

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