UNIVERSITY OF DELHI

NETAJI SUBHAS INSTITUTE OF TECHNOLOGY

CHOICE BASED CREDIT SYSTEM

SCHEME OF COURSES FOR M.TECH. (CAD/CAM)

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PREAMBLE

I. INTRODUCTION

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

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

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

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

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

II. CHOICE BASED CREDIT SYSTEM

The Indian Higher Education 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 then 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, term papers, 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 Computer 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 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 l etter 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

3. **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.

4. **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.

5. **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.

6. **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 undergone 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 points scored by the student in the i^{th} course.

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

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

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

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

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

III. PROGRAMME STRUCTURE

1. The M.Tech. CAD/CAM 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 I semester, the codes are:

CDC01	CC
CDC02	CC
CDD**	Elective
CDD**	Elective
CDD**	Elective
EO***	Open Elective

For II semester, the codes are:

CDC 03	CC
CDC04	CC
CDD**	Elective
CDD**	Elective
CDD**	Elective
EO***	Open Elective

For III semester, the codes are:

CDC05	Seminar
CDC06	Major Project
CDD**	Elective
CDD**	Elective
CDD **	Elective

For IV semester, the codes are:

CDC07	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 (CAD/CAM) 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 CAD/CAM.

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 OUTCOME

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

SEMESTER-WISE COURSE ALLOCATION

M.TECH. CAD/CAM (Full Time) SEMESTER I

CODE	Type	COURSE OF STUDY	L	T	P	C	EVALUATION (MARKS)					
							Theory			Practical		Total
							CA	MS	ES	CA	ES	
CDC01	CC	Geometric Modeling	3	0	2	4	15	15	40	15	15	100
CDC02	CC	Computer Integrated Manufacturing System	3	0	2	4	15	15	40	15	15	100
CDD**	ED	Elective #	-	-	-	4	-	-	-	-	-	100
CDD**	ED	Elective #	-	-	-	4	-	-	-	-	-	100
CDD**	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 table 2-3.
$ The actual weekly load will depend upon the elective (s) as chosen by the students.

M.TECH. CAD/CAM (Full Time) SEMESTER II

CODE	Type	COURSE OF STUDY	L	T	P	C	EVALUATION (MARKS)					
							Theory			Practical		Total
							CA	MS	ES	CA	ES	
CDC03	CC	CNC technology and Programming	3	0	2	4	15	15	40	15	15	100
CDC04	CC	Finite Element Analysis	3	0	2	4	15	15	40	15	15	100
CDD**	ED	Elective #	-	-	-	4	-	-	-	-	-	100
CDD**	ED	Elective #	-	-	-	4	-	-	-	-	-	100
CDD**	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 table 2-3.
$ The actual weekly load will depend upon the elective (s) as chosen by the students.

M.TECH. CAD/CAM (Full Time) SEMESTER III

CODE	Type	COURSE OF STUDY	L	T	P	C	EVALUATION (MARKS)					
							Theory			Practical		Total
							CA	MS	ES	CA	ES	
CDC05	CC	Seminar	0	0	4	2	100	-	-	-	-	100
CDC06	CC	Major Project	-	-	-	6	-	-	-	40	60	100
CDD**	ED	Elective #	-	-	-	4	-	-	-	-	-	100
CDD**	ED	Elective #	-	-	-	4	-	-	-	-	-	100
CDD**	ED	Elective #	-	-	-	4	-	-	100	-	-	100
		TOTAL	$			20						

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) as chosen by the students.

M.TECH. CAD/CAM (Full Time) SEMESTER IV

CODE	Type	COURSE OF STUDY	L	T	P	C	EVALUATION (MARKS)					
							Theory			Practical		Total
							CA	MS	ES	CA	ES	
CDC07	CC	Dissertation	0	0	-	14	-	-	-	40	60	100
		TOTAL	0	0	-	14						

SEMESTER-WISE COURSE ALLOCATION-PART-TIME
M.TECH. CAD/CAM (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	
CDC01	CC	Geometric Modeling	3	0	2	4	15	15	40	15	15	100
CDC02	CC	Computer Integrated Manufacturing System	3	0	2	4	15	15	40	15	15	100
EO***	EO	Open Elective #	-	-	-	4	-	-	-	-	-	100
		TOTAL	$			16						
# 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) as chosen by the students.												

M.TECH. CAD/CAM (Part Time) SEMESTER II

CODE	Type	COURSE OF STUDY	L	T	P	C	EVALUATION SCHEME Percentage (Wightage)					
							Theory			Practical		Total
							CA	MS	ES	CA	ES	
CDC03	CC	CNC technology and Programming	3	0	2	4	15	15	40	15	15	100
CDC04	CC	Finite Element Analysis	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) as chosen by the students.												

M.TECH. CAD/CAM (Part Time) SEMESTER III

CODE	Type	COURSE OF STUDY	L	T	P	C	EVALUATION SCHEME Percentage (Wightage)					
							Theory			Practical		Total
							CA	MS	ES	CA	ES	
CDD**	ED	Elective #	-	-	-	4	-	-	-	-	-	100
CDD**	ED	Elective #	-	-	-	4	-	-	-	-	-	100
CDD**	ED	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) as chosen by the students.

M.TECH. CAD/CAM (Part Time) SEMESTER IV

CODE	Type	COURSE OF STUDY	L	T	P	C	EVALUATION SCHEME Percentage (Wightage)					
							Theory			Practical		Total
							CA	MS	ES	CA	ES	
CDD**	ED	Elective #	-	-	-	4	-	-	-	-	-	100
CDD**	ED	Elective #	-	-	-	4	-	-	-	-	-	100
CDD**	ED	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) as chosen by the students.

M.TECH. CAD/CAM (Part Time) SEMESTER V

CODE	Type	COURSE OF STUDY	L	T	P	C	EVALUATION SCHEME Percentage (Wightage)					
							Theory			Practical		Total
							CA	MS	ES	CA	ES	
CDD**	ED	Elective #	-	-	-	4	-	-	-	-	-	100
CDD**	ED	Elective #	-	-	-	4	-	-	-	-	-	100
CDC06	CC	Major Project	-	-	-	6	-	-	-	40	60	100
		TOTAL	$			14						

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) as chosen by the students.

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M.TECH. CAD/CAM (Part Time) SEMESTER VI

CODE	Type	COURSE OF STUDY	L	T	P	C	EVALUATION SCHEME Percentage (Wightage)					
							Theory			Practical		Total
							CA	MS	ES	CA	ES	
CDD**	ED	Elective #	-	-	-	4	-	-	100	-	-	100
CDC05	CC	Seminar	0	0	4	2	-	-	-	40	60	100
CDC07	CC	Dissertation	0	0	-	14	-	-	-	40	60	100
		TOTAL	$			20						

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) as chosen by the students

TABLE 2A: LIST OF DISCIPLINE CENTRIC ELECTIVES WITH TUTORIAL							
LTP Allocation			**Evaluation Scheme**				
L	**T**	**P**	**CA**	**MS**	**ES**	**CA**	**MS**
3	**1**	**0**	**25**	**25**	**50**	**-**	**-**

Code	**Name of Elective**	**Pre-Requisites**
CDD01	Industrial Statistics and Forecasting	None
CDD02	Manufacturing Information System	None
CDD03	Computer Aided Process Planning	None
CDD04	Manufacturing Automation and Control	None
CDD05	Advanced Machine Tool Design	None
CDD06	Design for Manufacture	None
CDD07	Optimization in Design	None
CDD08	Reliability Engineering	None
CDD09	Advanced Concurrent Engineering	None
CDD10	Manufacturing System and Simulation	None
CDD11	Computational Methods	None
CDD12	Optimization Techniques	None
CDD13	IT in Manufacturing Enterprise	None
CDD14	Applied Operations Research	None
CDD15	Design of Process Equipments	None
CDD16	Value Engineering	None
CDD17	Mechatronics in Manufacturing System	None
CDD18	Design of Experiments	None
CDD19	Modelling of Metal Forming Processes	None
CDD20	Mechanical Vibrations	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**
CDD31	Computer Methods in Mechanical Design	None
CDD32	Robotics	None
CDD33	Product Design and Development Strategies	None
CDD34	Computational Fluid Dynamics	None
CDD35	System Engineering	None
CDD36	Flexible Manufacturing System	None
CDD37	Artificial Intelligence	None
CDD38	Rapid Prototyping and Tooling	None

TABLE 3 : LIST OF OPEN ELECTIVES EO***							
LTP Allocation			**Evaluation Scheme**				
L	**T**	**P**	**CA**	**MS**	**ES**	**CA**	**ES**
3	**1**	**0**	**25**	**25**	**50**	**-**	**-**
Code	**Name of Elective**		**Pre-Requisites**				
EO001	Technical Communication		None				
EO002	Disaster Management		None				
EO003	Basics of Finance Management		None				
EO004	Basics of Human Resources Management		None				
EO005	Project Management		None				
EO006	Basics of Corporate Law		None				
EO007	Biological computing		None				
EO008	Basic of social science		None				
EO009	Entrepreneurship		None				
EO010	Social work		None				
EO011	IP and Patenting		None				
EO012	Supply Chain Management-Planning and logistics		None				
EO013	Organization Development		None				
EO014	Industrial Organisation 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
CDC01	Geometric Modeling	L-T-P : 3-0-2	None

COURSE OUT COMES (COs):

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

COURSE CONTENT:

1. Unit I General

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

Unit II Graphic Primitive

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

2. Unit III 2D & 3D Transformation

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

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

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

3. Unit IV Curves, Surfaces, Solids

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

Unit IV Graphics Standards for CAD.

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

4. Unit V Reverse Engineering

Introduction to reverse engineering.
SUGGESTED READINGS: 1. Ibrahim Zaid,"CAD/CAM- Theory and Practice", McGraw Hill, International Edition. 2. Chris Mc Mohan and Jimmi Browne, "CAD/CAM Principles, Practice and Manufacturing Management", Pearson Education Asia Ltd.. **3.** Donald Hearn and M. Pauline Baker ,"Computer Graphics", Prentice Hall. Inc.

Course No	Title of the Course	Course Structure	Pre-Requisite
CDC02	Computer Integrated Manufacturing Systems	L-T-P : 3-0-2	None

COURSE OUT COMES (COs):

- Develop an understanding of classical and state-of-the-art production systems, control systems, management technology, cost systems, and evaluation techniques.
- Develop an understanding of computer-integrated manufacturing (CIM) and its impact on productivity, product cost, and quality.
- Obtain an overview of computer technologies including computers, database and data collection, networks, machine control, etc, as they apply to factory management and factory floor operations.
- Describe the integration of manufacturing activities into a complete system
- Acquire sensitivity to human-factors related issues as they affect decision making in the factory environment.

COURSE CONTENT:

1. INTRODUCTION

Objectives of a manufacturing system-identifying business opportunities and problems classification production systems-linking manufacturing strategy and systems-analysis of manufacturing operations

2. GROUP TECHNOLOGY AND COMPUTER AIDED PROCESS PLANNING

Introduction-part families-parts classification and cooling - group technology machine cells-benefits of group technology. Process planning function CAPP - Computer generated time standards.

3. COMPUTER AIDED PLANNING AND CONTROL

Production planning and control-cost planning and control-inventory management-Material requirements planning (MRP)-shop floor control-Factory data collection system-Automatic identification system-barcode technology automated data collection system.

4. COMPUTER MONITORING

Types of production monitoring systems-structure model of manufacturing process-process control & strategies direct digital control-supervisory computer control-computer in QC - contact inspection methods non-contact inspection method - computer-aided testing - integration of CAQC with CAD/CAM.

5. INTEGRATED MANUFACTURING SYSTEM

Definition - application - features - types of manufacturing systems-machine tools-materials handling system computer control system - DNC systems manufacturing cell.

Flexible manufacturing systems (FMS) - the FMS concept-transfer systems - head changing FMS – variable mission manufacturing system - CAD/CAM system - human labour in the manufacturing system-computer integrated manufacturing system benefits.

Rapid prototyping - Artificial Intelligence and Expert system in CIM.

SUGGESTED READINGS:

1. David Bedworth, "Computer Integrated Design and Manufacturing", TMH .

2. Yorem Koren, "Computer Integrated Manufacturing Systems", McGraw Hill.
3. Ranky, Paul G., "Computer Integrated Manufacturing", Prentice Hall International.

Course No	Title of the Course	Course Structure	Pre-Requisite
CDC03	CNC Technology and Programming	L-T-P : 3-0-2	None

COURSE OUTCOMES (COs):

- Understand the basic procedures and concepts of programming, set up and operation of a CNC Machining Center.
- Identify and understand the basic programming codes.
- Create geometry and toolpaths from the specifications on a blueprint for simple parts using Mastercam programming software.
- Identify and define the functions of the CNC machine control.
- Set up the CNC machining center for manufacturing simple parts
- Manufacture simple parts on the CNC machining center.

COURSE CONTENT:

Introduction to NC/CNC/DNC and its role in FMS and CIMS, basic elements of CNC system, CNC hardware elements including drives, actuators and sensors, construction of modern CNC machine tool controllers, introduction to part programming, radius and length compensation schemes, too long and work-holding for CNC machine tools, advanced programming features and canned cycles, geometric modeling for NC machining and machining of free-from surfaces, NC program generation from CAD models, NC program verification and virtual NC, recent developments in CNC machine tools.

SUGGESTED READINGS:

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

Course No	Title of the Course	Course Structure	Pre-Requisite
CDC04	Finite Element Analysis	L-T-P : 3-0-2	None

COURSE OUT COMES (COs):

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

COURSE CONTENT:

Discretization and the Direct Stiffness Method
I. 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.
II. Formulation of Finite Elements
Mathematical interpretation of finite elements, variational formulation.
Development of continuum elements, shape functions, consistent loads.
Isoparametric elements for plane stress.
Numerical integration
Convergence requirements.
III. Computer Implementation of the Finite Element Method
Pre processing: 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”, Pergamon Press, Oxford.
2. K.J. Bathe, “Finite element procedures in Engineering Analysis", Prentice Hall.
3. C.S. Desai and J.P. Abel., "Introduction to finite element method", Affiliated East West Press.
4. Besant, “ Finite Element Method”, Prentice Hall.
5. P. N. Godbole, “Introduction to Finite Element Methods”, I. K. International.

COURSE CONTENTS OF DISCIPLINE CENTRIC ELECTIVES WITH TUTORIAL

Course No	Title of the Course	Course Structure	Pre-Requisite
CDD01	Industrial Statistics and Forecasting	L-T-P : 3-1-0	None

COURSE OUT COMES (COs):

- Knowledge of basic components of statistical techniques.
- Knowledge of various forecasting procedures.
- Knowledge of various softwares related to forecasting and statistics.
- Be able to use orthogonal matrices in different areas like QFD, Conjoint Analysis and design of experiments.
- Be able to use multifactor standard arrays in experiment design.
- Be able to create models for analysis using Monte Carlo technique.
- Be able to make predictions with numerical analysis of risks and their probability.

COURSE CONTENT:

Moments, Skewness and kurtosis, set theory, Elements of theory of probability, Binomial, Poisson and Normal distribution, standard error, concepts of statistical elimination and decision making, Application of students t-test chi-square test and f-test of significance for small and large samples, linear regression, correlation co-efficient and Rank correlation, introduction to analysis of variance. Clustering, Classifications.

Time series and its components, determination of trend, smoothing techniques, adaptive filtering, Evaluation of forecasting techniques implementation. Application of artificial intelligence tools, data mining tools for statistics and forecasting techniques with software for industrial problems.

SUGGESTED READINGS:

1. James H Stock & Mark W.Watson , "Introduction to Econometrics", Pearson Education Limited.
2. Boras Abrahm & Johnson Leodlter, "Statistical method for forecasting", (Willey series in probability & Statistics), Duxbury Press.
3. Stefan Steiner & Jock Mackay, "Statistical engineering ", Quality press.

Course No	Title of the Course	Course Structure	Pre-Requisite
CDD02	Manufacturing Information System	L-T-P : 3-1-0	

COURSE OUTCOMES (COs):

- Understand basic conceptions and development of manufacturing information system.
- Mater basic methods in automated manufacturing system design.
- Mater basic plan management and schedule control methods in manufacturing systems.
- Understand functions of manufacturing information systems.

COURSE CONTENT:

1. INTRODUCTION

The evolution of order policies, from MRP to MRP II, the role of Production organization, Operations control.

2. DATABASE

Terminologies - Entities and attributes - Data models, schema and subschema - Data Independence – ER Diagram - Trends in database.

3. DESIGNING DATABASE

Hierarchical model - Network approach - Relational Data model -concepts, principles, keys, relational operations - functional dependence -Normalization, types - Query languages.

4. MANUFACTURING CONSIDERATION

The product and its structure, Inventory and process flow - Shop floor control - Data structure and procedure - various model - the order scheduling module, input / output analysis module the stock status database – the complete IOM database.

5. INFORMATION SYSTEM FOR MANUFACTURING

Parts oriented production information system - concepts and structure -computerized production scheduling, online production control systems; Computer based production management system, computerized manufacturing information system - case study.

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
CDD03	Computer Aided Process Planning	L-T-P : 3-1-0	None

COURSE OUTCOMES (COs):

- Generate the structure of automated process planning system and uses the principle of generative and retrieval CAPP systems for automation
- Select the manufacturing sequence and explains the reduction of total set up cost for a particular sequence
- Predict the effect of machining parameters on production rate, cost and surface quality and determines the manufacturing tolerances
- Explain the generation of tool path and solve optimization models of machining processes
- Create awareness about the implementation techniques for CAPP.

COURSE CONTENT:

1. INTRODUCTION

The Place of Process Planning in the Manufacturing cycle - Process Planning and Production Planning – Process Planning and Concurrent Engineering, CAPP, Group Technology.

2. PART DESIGN REPRESENTATION

Design Drafting - Dimensioning - Conventional tolerance - Geometric tolerance - CAD - input / output devices - topology - Geometric transformation - Perspective transformation - Data structure – Geometric modeling for process planning - GT coding - The optiz system - The MICLASS system.

3. PROCESS ENGINEERING AND PROCESS PLANNING

Experienced, based planning - Decision table and decision trees - Process capability analysis - Process Planning - Variant process planning - Generative approach - Forward and Backward planning, Input format, Al.

4. COMPUTER AIDED PROCESS PLANNING SYSTEMS

Logical Design of a Process Planning - Implementation considerations -manufacturing system components, production Volume, No. of production families - CAM-I, CAPP, MIPLAN, APPAS, AUTOPLAN and PRO, CPPP.

5. AN INTEGRATED PROCESS PLANNING SYSTEMS

Totally integrated process planning systems - An Overview - Modulus structure - Data Structure, operation - Report Generation, Expert process planning.

SUGGESTED READINGS:

1. Gideon Halevi and Roland D. Weill, " Principles of Process Planning ", A logical approach, Chapman & Hall.
2. Tien-Chien Chang, Richard A.Wysk, "An Introduction to automated process planning systems ", Prentice Hall.
3. Chang, T.C., “An Expert Process Planning System ", Prentice Hall.
4. Nanua Singh, “Systems Approach to Computer Integrated Design and Manufacturing", John Wiley & Sons.

Course No.	Title of the Course	Course Structure	Pre-Requisite
CDD04	Manufacturing Automation and Control	L-T-P : 3-1-0	None

COURSEOUT COMES (COs):

Upon completion of the subject, students will be able to

- Understand basic conceptions and development of manufacturing automation and control.
- Mater basic methods in automated manufacturing and control.
- Mater basic plan management and schedule control methods in manufacturing systems ;
- Understand functions of manufacturing information systems and its control.

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", 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.

Course No.	Title of the Course	Course Structure	Pre-Requisite
CDD05	Advanced Machine Tool Design	L-T-P : 3-1-0	None

COURSEOUT COMES (COs):

Upon completion of the subject, students will be able to

- Students will be able to examine and identify the different functional elements of different manufacturing methods of die and tool; jigs and fixtures
- Students will be able to examine and evaluate the basic manufacturing methods and their classification to use to the right manufacturing method for the tool and die
- Students will be able to formulate and real production problems creatively, especially in design considerations like material selection and process identification which is very important in the designing of jigs and fixture
- Students will demonstrate the ability to collect data of a given process/system, interpret, analyse data and make some conclusions for fixture and jigs of drilling, milling, and for other type of machine tools
- Students will be able to design a process for the different applications in the day to day life.

COURSE CONTENT:

1. INTRODUCTION

Introduction to Metal Cutting Machine tools, Kinematics, Basic Principles of Machine tool design, estimation of drive power.

2. DESIGN OF MACHINE TOOLS, SPINDLES, FRAMES, SLIDEWAYS

Design of Machine tool spindle and bearings, Design of power Screws - Static deformation of various machine tool structures - thin walled box structures with open and compliant cross sections - correction coefficients - design of beds, columns, tables and supports.

Dynamics of cutting forces - tool chatter - design of slideways.

Concepts of aesthetics and ergonomics applied to machine tools, latest trends in Machine Tool Design, Introduction to CAD techniques

3. DESIGN OF DRIVES AND CONTROL MECHANISMS

Design considerations of electrical, mechanical and Hydraulic drives in machine tool, stepped and stepless arrangements and systems.

Design of control mechanisms - selection of standard components - Dynamic measurement of forces and vibrations in machine tools - Stability against chatter - use of vibration dampers.

4. TESTING AND STANDARDISATION

Acceptance tests and standardization of machine tools - machine tools reconditioning.

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, Moscow.
4. Sen.G. and Bhattacharya, A., "Principles of Machine Tools", Vol.2, NCB Calcutta.

Course No.	Title of the Course	Course Structure	Pre-Requisite
CDD06	Design for Manufacture	L-T-P : 3-1-0	None

COURSE OUTCOMES (COs):

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

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

COURSE CONTENT:

1. INTRODUCTION

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

2. FACTORS INFLUENCING FORM DESIGN

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

3. COMPONENT DESIGN-MACHINING CONSIDERATION

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

4. COMPONENT DESIGN - CASTING CONSIDERATIONS

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

5. REDESIGN FOR MANUFACTURE AND CASE STUDIES

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

SUGGESTED READINGS:

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

Course No	Title of the Course	Course Structure	Pre-Requisite
CDD07	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. .
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 .
4. Kalyanamoy Deb, "Optimization for Engineering design algorithms and Examples", Prentice Hall of India.

Course No	Title of the Course	Course Structure	Pre-Requisite
CDD08	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. Balagurusamy.E., "Reliability Engineering", Tata Mcgraw Hill Publishing Company.

Course No.	Title of the Course	Course Structure	Pre-Requisite
CDD09	Advanced Concurrent Engineering	L-T-P : 3-1-0	None

COURSE OUTCOMES (COs):

Students will be able:

- To familiarize with the basics of concurrent engineering.
- To use tools and methodologies available in CE.
- To understand various approaches of CE.
- To apply various aspects of CE for a real system.

COURSE CONTENT:

1. INTRODUCTION

Extensive definition of CE - CE design methodologies - Organizing for CE - CE tool box collaborative product development.

2. USE OF INFORMATION TECHNOLOGY

IT support - Solid modeling - Product data management - Collaborative product commerce - Artificial Intelligence - Expert systems - Software hardware co-design.

3. DESIGN STAGE

Life-cycle design of products - opportunity for manufacturing enterprises - modality of Concurrent Engineering Design - Automated analysis idealization control - Concurrent engineering in optimal structural design - Real time constraints.

4. MANUFACTURING CONCEPTS AND ANALYSIS

Manufacturing competitiveness - Checking the design process - conceptual design mechanism – Qualitative physical approach - An intelligent design for manufacturing system - JIT system - low inventory - modular - Modeling and reasoning for computer based assembly planning - Design of Automated manufacturing.

5. PROJECT MANAGEMENT

Life Cycle semi realization - design for economics - evaluation of design for manufacturing cost – concurrent mechanical design - decomposition in concurrent design - negotiation in concurrent engineering design studies - product realization taxonomy - plan for Project Management on new product development – bottleneck technology development.

SUGGESTED READINGS:

1. Anderson MM and Hein, L. Berlin, "Integrated Product Development", Springer Verlog .
2. Cleetus, J, "Design for Concurrent Engineering Concurrent Engg. Research Centre", Morgantown, WV.
3. Andrew Kusaik, "Concurrent Engineering: Automation Tools and Technology", Wiley, John and Sons Inc.
4. Prasad, "Concurrent Engineering Fundamentals: Integrated Product Development", Prentice Hall.

Course No.	Title of the Course	Course Structure	Pre-Requisite
CDD10	Manufacturing System and Simulation	L-T-P : 3-1-0	None

COURSE OUTCOMES (COs):

Upon completion of the subject, students will be able to

- Develop conceptual models of manufacturing systems problems.
- Develop a discrete event simulation model. 3. Distinguish between the concepts of model verification, validation and credibility and make recommendations.
- Assess the goodness of fit of a theoretical probability distribution to a dataset of observations
- Analyse the outputs of discrete event simulation models to determine appropriate simulation model run lengths.

COURSE CONTENT:

1. COMPUTER MODELING AND SIMULATION SYSTEMS

Monte Carlo simulation, Nature of computer modeling and simulation. Limitation of simulation, areas of application. Components of a system - discrete and continuous systems. Models of a system - a variety of modeling approaches.

2. RANDOM NUMBER GENERATION

Techniques for generating random numbers - midsquare method - the mid product method - constant multiplier technique - additive congruential method - linear congruential method - tests for random numbers – the Kolmogorov - Smirnov test - the Chi-Square test.

3. RANDOM VARIABLE GENERATION

Inverse transform technique - exponential distribution - uniform distribution - Weibull distribution. Empirical continuous distribution - generating approximate normal variates - Erlang distribution.

4. DISTRIBUTION AND EVALUATION OF EXPERIMENTS

Discrete uniform distribution - Poisson distribution - geometric distribution - acceptance rejection technique for Poisson distribution gamma distribution. Simulation Experiments - Variance reduction techniques - antithetic variables - verification and validation of simulation models. Variance reduction techniques - antithetic variables - verification and validation of simulation models.

5. DISCRETE EVENT SIMULATION

Concepts in discrete-event simulation, manual simulation using event scheduling, single channel queue, two server queue, simulation of inventory problem. Programming for discrete event systems in GPSS - Case studies.

SUGGESTED READINGS:

1. Jerry Banks and John S. Carson, II, "Discrete Event System Simulation", Prentice Hall Inc.
2. Gordon G, "Systems Simulation", Prentice Hall of India Ltd.

Course No	Title of the Course	Course Structure	Pre-Requisite
CDD11	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:

Steven C Chapra & Raymond P Canalo, "Numerical Methods for Engineering", Mcgraw Hill .

1. Thomas Richard Mccalla, "Introduction to Numerical Methods and Fortran Programming", John Wiley & Sons Inc .
2. J.B Doshi, "Analytical Methods in Engineering ", Alpha Science International Ltd .

Course No.	Title of the Course	Course Structure	Pre-Requisite
CDD12	Optimization Techniques	L-T-P : 3-1-0	None

COURSE OUTCOMES (COs):

- Formulate real problems in terms of input-output parameters relationships and identify the solution methods.
- Analyze problems in engineering, management, or business environment, focusing on important details.
- Describe basic optimization and simulation techniques applied to various industries.

COURSE CONTENT:

Unit 1: Introduction: historical development, engineering applications; statement of problem-objective function, constraints, classification, techniques. Single variable optimization, multivariable optimization with equality and inequality constraints.

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

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

Unit IV: Non-linear programming: one dimensional minimization methods, unrestricted search, golden search method, interpolation methods, unconstrained optimization techniques-direct search method, univariate method

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

SUGGESTED READINGS:

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

Course No	Title of the Course	Course Structure	Pre-Requisite
CDD13	IT in Manufacturing Enterprise	L-T-P : 3-1-0	None

COURSE OUT COMES (COs):

- Understanding of production system.
- Understanding the role, challenges and opportunities of IT in manufacturing.
- Understanding of MIS in manufacturing system.
- Understanding of FMS,CIM & intelligent manufacturing system.
- Understanding 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
CDD14	Applied Operations Research	L-T-P : 3-1-0	None

COURSE OUT COMES (COs):

Upon completion of the subject, students will be able to

- Recognize the importance and value of Operations Research and mathematical modeling in solving practical problems in industry.
- Formulate a managerial decision problem into a mathematical model.
- Understand Operations Research models and apply them to real-life problems.
- Able to design new simple models, like: CPM, PERT to improve decision making and develop critical thinking and objective analysis of decision problems.

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 programming, 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", 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
CDD15	Design of Process Equipment	L-T-P : 3-1-0	None

COURSE OUT COMES (COs):

- Knowledge of basic components of process industries.
- Knowledge of design parameters and type of lading in process equipments.
- Knowledge of failures modes in process equipments.
- Knowledge of design procedures for pressure vessels, pumps, compressors, heat exchangers etc.
- Ability to prepare CAD models for various process equipments.

COURSE CONTENT;

Introduction: Introduction to process equipments; Basics of process design; Design parameters: loading; Stress concentration and stresses/thermal stresses; Factory of safety; Material selection; Failure criteria.

Design of low and high Pressure vessels and Large Storage Tanks: Determination of equivalent stress under combined loadings including seismic and wind loads; Design of storage vessels.

Design of Heat Exchanging; Mixing/Separating Equipments: Design of agitators and mixers; Filters and driers; Centrifuges; Heat exchangers.

Design of Pump and Compressor: Selection and specification procedures for impeller pumps and compressors;

Process Controls: Fundamentals of process measurements and their control; Planning; Manufacturing; Erection and inspection of process equipments. Optimization technique and introduction to design codes, Non-destructive testing.

SUGGESTED READINGS:

1. M. V. Joshi, " Process Equipment Design", Mc-Millan.
2. Browell and Young," Process Equipment Design", John Wiley.
3. Max and Timasulaus Kalus , "Plant Design and Economics", McGraw Hill.
4. Kellen Heward, " Handbook of Instrumentation and Control", McGraw Hill.
5. D.N.W. Kentish , "Industrial Pipe Work", McGraw Hill.
6. S. S. Rao , "Engineering Optimization: Theory and Practice" , New Age Publishing Co.

Course No	Title of the Course	Course Structure	Pre-Requisite
CDD16	Value Engineering	L-T-P : 3-1-0	None

COURSE OUT COMES (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:

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

Course No.	Title of the Course	Course Structure	Pre-Requisite
CDD17	Mechatronics in Manufacturing System	L-T-P : 3-0-2	None

COURSE OUTCOMES (COs):

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

- Understand the elements of mechatronics system.
- Apply the principles of mechatronics and automation for the development of productive and efficient manufacturing systems.
- Understand the hydraulic and pneumatic systems employed in manufacturing industry.
- Understand the CNC technology and robotics as applications of mechatronics in manufacturing automation.

COURSE CONTENT:

1. INTRODUCTION

Introduction to Mechatronics - Systems - Mechatronics in Products - Measurement Systems - Control Systems - Traditional design and Mechatronics Design.

2. SENSORS AND TRANSDUCERS

Introduction - Performance Terminology - Displacement, Position and Proximity - Velocity and Motion – Fluid pressure - Temperature sensors - Light sensors - Selection of sensors - Signal processing - Servo systems.

3. MICROPROCESSORS IN MECHATRONICS

Introduction - Architecture - Pin configuration - Instruction set - Programming of Microprocessors using 8085 instructions - Interfacing input and output devices - Interfacing D/A converters and A/D converters –Applications - Temperature control - Stepper motor control - Traffic light controller.

4. PROGRAMMABLE LOGIC CONTROLLERS

Introduction - Basic structure - Input / Output processing - Programming -Mnemonics Timers, Internal relays and counters - Data handling - Analog input / output - Selection of PLC.

5. DESIGN AND MECHATRONICS

Designing - Possible design solutions - Case studies of Mechatronics systems.

SUGGESTED READINGS:

1. Michael B.Histand and David G. Alciatore, "Introduction to Mechatronics and Measurement Systems", McGraw-Hill International Editions.
2. Bradley, D.A., Dawson, D, Buru, N.C. and Loader, AJ., " Mechatronics ", Chapman and Hall.
3. Ramesh.S, Gaonkar, "Microprocessor Architecture, Programming and Applications ", Wiley Eastern.
4. Lawrence J.Kamm, "Understanding Electro-Mechanical Engineering, An Introduction to Mechatronics", Prentice-Hall.

Course No	Title of the Course	Course Structure	Pre-Requisite
CDD18	Design of Experiments	L-T-P : 3-0-2	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. Montgomery Douglas C Montgomery, "Design and Analysis of Experiments (English)", John Wiley & Sons.
2. M.N Das , N.C Giri, "Design and Analysis of Experiments (English) ", New Age Int..
3. Klaus Hinkelmann, Oscar Kempthorne, "Design and Analysis of Experiments, Volume 1, Introduction to Experimental Design", Wiley Series.

Course No	Title of the Course	Course Structure	Pre-Requisite
CDD19	Modelling of Metal Forming Processes	L-T-P : 3-0-2	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 ”, McGraw Hill Co.
2. Altan T., “Metal forming – Fundamentals and applications”, American Society of Metals, Metals park .
3. ASM Hand book, “Forming and Forging”.

Course No.	Title of the Course	Course Structure	Pre-Requisite
CDD20	Mechanical Vibrations	L-T-P : 3-0-2	None

COURSE OUTCOMES (COs):

Upon completion of the subject, students will be able to

- Formulate mathematical models of problems in vibrations using Newton's second law or energy principles,
- Determine a complete solution to mechanical vibration problems using mathematical or numerical techniques, and
- Determine physical and design interpretations from the results.

COURSE CONTENT:

1. FUNDAMENTALS OF VIBRATION

Review of Single degree system - Response to arbitrary periodic excitations - Duhamel's Integral – Impulse Response function - Virtual work - Lagrange's equation - Single degree freedom forced vibration with elastically coupled viscous dampers - System Identification from frequency response - Transient Vibration – Laplace transformation formulation.

2. TWO DEGREE OF FREEDOM SYSTEMS

Free vibration of spring - coupled system - mass coupled system - Bending vibration of two degree of freedom system - forced vibration - Vibration Absorber - Vibration isolation.

3. MULTI-DEGREE OF FREEDOM SYSTEM

Normal mode of vibration - Flexibility Matrix and Siffness matrix - Eigen values and eigen vectors – orthogonal properties - Modal matrix-Modal Analysis - Forced Vibration by matrix inversion - Modal damping in forced vibration - Numerical methods for fundamental frequencies

4. VIBRATION OF CONTINUOUS SYSTEMS

Systems governed by wave equations - Vibration of strings - vibration of rods - Euler Equation for Beams - Effect of Rotary inertia and shear deformation - Vibration of plates.

5. EXPERIMENTAL METHODS IN VIBRATION ANALYSIS

Vibration instruments - Vibration exciters Measuring Devices - Analysis - Vibration Tests - Free and Forced Vibration tests. Examples of Vibration tests - Industrial case studies.

SUGGESTED READINGS:

1. W.T Thomson, "Theory of Vibration with Applications", CBS Publishers and Distributors.
2 J.S Rao & K. Gupta, "Introductory Course on Theory and Practice of Mechanical Vibrations", New Age International Ltd.
3. Den Hartog, J.P. "Mechanical Vibrations", Dover Publication.
4. Rao, S.S, "Mechanical Vibrations", Addison Wesley Longman.
5. Iyenger, R. N., “Elements of Mechanical Vibrations”, I. K. International.

COURSE CONTENTS OF DISCIPLINE CENTRIC ELECTIVES WITH PRACTICAL

Course No	Title of the Course	Course Structure	Pre-Requisite
CDD31	Computer Methods in Mechanical Design	L-T-P : 3-0-2	None

COURSE OUTCOMES (COs):

- To introduce different computer based techniques in design disciplines and various steps involved in a design process.
- To provide a detailed insight to students about computer based engineering design and how it is different from other conventional design disciplines.
- To introduce various types of mechanical elements like springs, bearings, shafts, brakes, clutches, gears etc. to the students and brief explanation about their manufacturing process.
- To develop an aptitude among the students that how different products and components that they see in their daily life can me manufactured and fabricated.

COURSE CONTENT:

Introduction and overview. Need and scope of computer aided machine design. Role of geometric modeling, FE and optimization, principles of interactive computer graphics and overview of hardware available for use in CAD, geometric modeling, modeling of curves, cubic, splines, beziers and b-splines.

Modeling of surfaces; modeling of solids-b-reb, CSG, octree, feature based modeling; introduction to the finite elements method, principles of potential energy; ID elements, derivation of stiffness and mass matrices for a bar, a beam and a shaft, comparison with analytical results, solution of static problems and case studies in stress analysis of mechanical components, FEA using 2D and 3D elements; plain strain stress problems, FE using plates/shell elements; importance of finite elements mesh, automatic meshing techniques, interfacing with CAD software. Case studies using FEM for design of simple elements geometries such as tapered bar, a plate with a hole and a spanner.

Introduction to dynamic analysis; limitations of FEM, introduction to non-linear problems and FEA for plastic materials.

Practicals: Practice of transformation. Use of CAD package for developing typical objects using Boolean and sweep operations on primitive, use of CAD models for other applications. Development of FEM models for static/dynamic analysis of a bar, beam and a shaft. Practice in using and FEM software on other real life problems like spanners, connecting rods etc.

SUGGESTED READINGS:

1. William .M. Neumann and Robert .F. Sproul, “Principle of Computer Graphics ", McGraw Hill Book Co. Singapore.

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.

Course No	Title of the Course	Course Structure	Pre-Requisite
CDD32	Robotics	L-T-P : 3-0-2	None

COURSE OUT COMES (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. J. Sehilling ,”Fundamental of Robotics: Analysis & Control Robert” , PHI Private Ltd.
3. Richard D, Klaffer ,”Robotic Engineering: An Integrated Approach”, PHI Private Ltd.
4. T. Yoshikawa ,”Foundations of Robotics: Analysis & Control”, PHI Private Ltd.
5. Dr. Surender Kumar 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 ,”Introduction to Robotics Mechanics & Control”, Addison Wesley.

Course No.	Title of the Course	Course Structure	Pre-Requisite
CDD33	Product Design and Development Strategies	L-T-P : 3-0-2	None

COURSE OUTCOMES (COs):

Upon completion of the subject, students will be able to

- To introduce different design disciplines and various steps involved in a design process of a product.
- To provide a detailed insight to students about development strategies in product design.
- To develop an aptitude among the students that how different products and components that they see in their daily life can me manufactured and fabricated.
- To develop ability among students to use the knowledge of mathematics, mechanics of solids and other reengineering disciplines like Computer Aided Design and Finite Element Analysis in solving engineering problems and to have a better design aptitude.
- After the completion of the course students should develop a know-how that how different mechanical elements can be combined together to develop a simple machine.

COURSE CONTENT:

1. INTRODUCTION

Nature and scope of product engineering - creative thinking and organizing for product innovation criteria for product success in life cycle of a product.

2. MODELING AND SIMULATION

Modeling and simulation - the role of models in product design mathematical modeling similitude relations - weighted property index.

3. MATERIAL SELECTION

Material selection - problems of material selection-performance characteristics of materials - the materials selection process-economics of materials-cost versus performance relations-weighted property index.

4. DESIGN CONSIDERATIONS

Functional and production design-form design-influence of basic design, mechanical loading and material on form design - form design of gray castings, malleable iron castings, aluminum castings, pressure die castings, plastic mouldings, welded fabrications, forging and manufacture by machining methods. Influence of space, size, weight, etc., on form design, aesthetic and ergonomic considerations.

5. TOLERANCE AND ANALYSIS

Dimensioning and tolerance a product-functional production and inspection datum-tolerance analysis.

SUGGESTED READINGS:

1. Jones J.C., "Design Methods", Interscience.
2. Buhl, H.R., "Creative Engineering Design", Iowa State University Press.
3. Dieter, G.E., "Engineering Design", McGraw Hill .
4. Robert Matouseek, "Engineering Design", Blackie & Sons Ltd.
5. Niebel, B.W. & Draper, A.B., "Product Design and Process Engineering", McGraw Hill.
6. Harry Peck, "Designing for Manufacturing", Sir Issac Pitman and Sons Ltd.

Course No.	Title of the Course	Course Structure	Pre-Requisite
CDD34	Computational Fluid Dynamics	L-T-P : 3-0-2	None

COURSE OUTCOMES (COs):

Upon completion of the subject, students will be able to

- To develop an understanding for the major theories, approaches and methodologies used in CFD.
- To build up the skills in the actual implementation of CFD methods (e.g. boundary conditions, turbulence modelling etc.) in using commercial CFD codes.
- To gain experience in the application of CFD analysis to real engineering designs.
- An ability to apply knowledge of math and science to engineering by describing a continuous fluid-flow phenomena in a discrete numerical sense.
- An ability to use the techniques to a "real-world" fluid-flow problem.

COURSE CONTENT:

1. GOVERNING DIFFERENTIAL EQUATION AND FINITE DIFFERENCE METHOD

Classification, Initial and Boundary conditions, Initial and Boundary value problems. Finite difference method, Central, Forward, Backward difference, Uniform and non-uniform Grids, Numerical Errors, Grid Independence Test.

2. CONDUCTION HEAT TRANSFER

Steady one-dimensional conduction, Two and Three dimensional steady state problems, Transient one dimensional problem, Two-dimensional Transient Problems.

3. INCOMPRESSIBLE FLUID FLOW

Governing Equations, Stream Function - Vorticity method, Determination of pressure for viscous flow, SIMPLE Procedure of Patankar and Spalding, Computation of Boundary layer flow, Finite deference approach.

4. CONVECTION HEAT TRANSFER AND FEM

Steady One-Dimensional and Two-Dimensional Convection - Diffusion, Unsteady one-dimensional convection - Diffusion, Unsteady two-dimensional convection - Diffusion - Introduction to finite element method - Solution of steady heat conduction by FEM - Incompressible flow - Simulation by FEM.

5. TURBULENCE MODELS

Algebraic Models - One equation model, K-I Models, Standard and High and Low Reynolds number models, Prediction of fluid flow and heat transfer using standard codes.

SUGGESTED READINGS:

1. Muralidhar, K.,and Sundararajan,T., "Computational Fluid Flow and Heat Transfer", Narosa Publishing House.
2. Ghoshdasdidar, P.S.,"Computer Simulation of flow and heat transfer", Tata McGraw-Hill Publishing Company Ltd.
3. Subas, V.Patankar , "Numerical heat transfer fluid flow", Hemisphere Publishing Corporation.
4. Taylor, C and Hughes J.B., “Finite Element Programming of the Navier Stock Equation”, Pineridge Press Ltd., U.K.

Course No.	Title of the Course	Course Structure	Pre-Requisite
CDD35	System Engineering	L-T-P : 3-0-2	None

COURSE OUTCOMES (COs):

Upon completion of the subject, students will be able to

- Emphasizes the links of systems engineering to fundamentals of decision theory, statistics, and optimization.
- Able to introduces the most current, commercially successful techniques for systems engineering.
- Focuses on defining customer needs and required functionality early in the development cycle, documenting requirements.
- Proceeding with design synthesis and system validation while considering the complete problem including operations, performance, test, manufacturing, cost, and schedule.

COURSE CONTENT:

Elements of systems engineering, methods and standards, software engineering, recent trends and directions, architecture of large scale engineering. Systems, Integrated nature of systems engineering, Application and case studies.

SUGGESTED READINGS:

Benjamin S. Blanchard, ”System Engineering Management”, Willey.

Course No	Title of the Course	Course Structure	Pre-Requisite
CDD36	Flexible Manufacturing System	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 handbook of industrial automation”, Chapman and Hall.
6. Viswanadhan N. and Narahari Y, “Performance modelling of automated manufacturing systems”, Prentice Hall India (P) Ltd.

Course No	Title of the Course	Course Structure	Pre-Requisite
CDD37	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 Neural Networks, Feed Back neural Networks, Neural Networks for linear & non linear Dynamic System, Modeling and control, Basics of Fuzzy logic export systems ,fuzzy sets & control theory, Fuzzy systems as inference engines, Fuzzy systems as function approximates, model based fuzzy control learning based fuzzy control classical fuzzy control problem inverted pendulum.

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

SUGGESTED READINGS:

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

Course No	Title of the Course	Course Structure	Pre-Requisite
CDD38	Rapid Prototyping and Tooling	L-T-P : 3-0-2	None

COURSE OUTCOMES (COs):

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

COURSE CONTENT:

Overview of rapid prototyping- Definitions, evolution. Processes, Principles, Materials, Resources. CAD for Rapid Prototyping. Case Studies Building the prototype

Selection of RP technologies. First cut attributes and scales for selecting an appropriate technology, Survey of RP technologies with some hands on training. Short reports and presentations on individual surveys.

In- depth development of analytical & / or experimental models for RP technology. The analytical or experimental model should lead to at least one selection attribute and scale Geometric modeling issues and methods for RP, highlighting the CAD-RP interface. Reports and presentations on development of attributes and scales for one RP technology.

Application of RP selection method in 3- week design project (groups of 3-4). RP case studies in industry. Reports and presentations.

SUGGESTED READINGS:

1. Marshall Burns, "Automated Fabrication: Improving Productivity in Manufacturing", Prentice Hall.
2. Jerome L.Johnson, "Principles of Computer Automated Fabrication", Palationo press Inc .
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 CONTENTS OF OPEN ELECTIVES

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

COURSE OUTCOMES (COs):

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

COURSE CONTENT:

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

SUGGESTED READINGS:

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

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.

COURSE CONTENT:

Unit -I: Introduction

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

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

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

Unit -II: Disaster Prone Areas In India

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

Unit -III: Disaster Preparedness And Management

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

Unit -IV: Risk Assessment

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

Unit -V: Disaster Mitigation

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

SUGGESTED READINGS:

1. R. Nishith, Singh AK , "Disaster Management in India: Perspectives, issues and strategies", New Royal book Company.

2. Sahni, Pardeep et.al. , "Disaster Mitigation Experiences And Reflections", Prentice Hall of India.

3. Goel S. L., "Disaster Administration and Management Text And Case Studies", Deep & Deep Publication Pvt. Ltd.

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

COURSE OUTCOMES (COs):

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

COURSE CONTENT:

Unit I

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

Unit II

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

Unit III

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

Unit IV

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

Unit V

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

SUGGESTED READINGS:

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

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

COURSE OUTCOMES (COs):

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

COURSE CONTENT:

Unit - I

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

Unit - II

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

Unit III

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

Unit - IV

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

Unit - V

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

SUGGESTED READINGS:

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

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

COURSE OUTCOMES (COs):

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

COURSE CONTENT:

Unit-I

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

Unit-II

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

Unit-III

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

Unit-IV

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

Unit-V

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

SUGGESTED READINGS:

References /Suggested Readings,

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

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

COURSE OUTCOME (COs):

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

COURSE CONTENT:

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

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

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

SUGGESTED READINGS:

1. Hicks, Andrew & Goo S.H., "Cases and Material on Company Law", Oxford University Press.
2. Gowar, LCB, "Principles of Modern Company Law", Stevens & Sons.
3. Majumdar, A.K., and G.K. Kapoor, "Company Law and Practice", Taxmann.
4. Hanningan,Brenda, "Company Law", Oxford University Press, U.K.
5. Sharma, J.P., "An Easy Approach to Corporate Laws", Ane Books Pvt. Ltd.
6. Kannal, S., & V.S. Sowrirajan, "Company Law Procedure", Taxman's Allied Services (P) Ltd.

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:

Reading material:

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

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

COURSE OUTCOMES (COs):

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

COURSE CONTENT:

Unit 1.

The Development of Sociology in the 19th Century

Unit 2. **Sociology as Science:**

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

Unit 3. **Religion and Society:**

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

Unit 4. **Politics and Society:**

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

Unit 5. **Sociological Thinkers:**

a. Kar l Marx- Historical materialism, mode of production, alienation, class struggle.
b. Emile Durkheim- Division of labour, social fact, suicide, religion and society.
c. Max Weber- Social action, ideal types, authority, bureaucracy, protestant ethic and the spirit of capitalism.
d. Talcolt Parsons- Social system, pattern variables.
e. Robert K. Merton- Latent and manifest functions, conformity and deviance, reference groups.
f. Mead - Self and identity.

SUGGESTED READINGS:

Suggested Readings:

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

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

COURSE OUTCOMES (COs):

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

COURSE CONTENT:

Unit I-Introduction:

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

Unit II- Creating Entrepreneurial Venture:

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

Unit III-Functional plans:

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

Unit IV- Entrepreneurial Finance:

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

Unit V- Enterprise Management:

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

SUGGESTED READINGS:

1. Kumar, Arya, "Entrepreneurship: Creating and Leading an Entrepreneurial Organization", Pearson, India.
2. Hishrich., Peters, "Entrepreneurship: Starting, Developing and Managing a New Enterprise", Irwin.
3. Taneja, "Entrepreneurship", Galgotia Publishers.
4. Barringer, Brace R., and R. Duane Ireland, "Entrepreneurship", Pearson Prentice Hall.

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

COURSE OUTCOMES(COs):

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

COURSE CONTENT:

Unit 1.Social work

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

Unit 2. Methods of Social work

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

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

Unit 4 Social Welfare Administration

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

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

Dowry- child Marriage, Divorce, Families with working couples, Disorganised Families, Families with Emigrant Heads of the Households, Gender Inequality, Authoritarian Family structure, Major Changes in Caste systems and problem of casteism. Problems Pertaining of Weaker Sections. Problems of Children, Women Aged. Handicapped and Backward Classes (SCs, STs, and other Backward Classes). **Problems of Deviance:** Truancy Vagrancy and Juvenile Delinquency, Crime, White Colla Crime, Organized Crime,Collective Violence, Terrorism, Prostitution and Sex Related Crimes. Social Vices: Alcohilism. Drug Addiction, Beggary, Corruption and communalism. **Problems of Social Structure :** Poverty, Unemployment, Bonded Labour, Child Labour. **Fields of Soclal work India :** Child Development, Development of Youth, Women's Empowerment, Welfare of aged, Welfare of Physically. Mentally and Social Handicapped, Welfare of backward Classes (Scs, STs and Other Backward Classes) Rural Development Urban Community Development, Medical And Psychiatric Social work, Industrial Social work, Social Security offender Reforms.

SUGGESTED READINGS:

1. Sanjay Bhattacharya ,"Social Work: An Integrated Approach", Rawat Publications.
2. NiteshDhawan , "Social work perspective Philosophy and Methods", Bharat Book Centre

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

COURSE OUTCOMES(COs):

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

COURSE CONTENT:

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

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

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

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

SUGGESTED READINGS:

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

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

COURSE OUTCOMES(COs):

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

COURSE CONTENT:

Unit I

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

Unit II

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

Unit III

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

Unit IV

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

Unit V

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

SUGGESTED READINGS:

1. Christopher, M., "Logistics and Supply Chain Management", Prentice Hall.

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

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

COURSE OUT COMES (COs):

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

COURSE CONTENT:

Topics included are

- Organtzattonal Systems and Human Behaviour - Developing a basic knowledge of how organizattons and groups function as systems; introducing and discussing various theoretical approaches and issues.
- Interpersonal and Consulting Skills - Increasing effectiveness as a change agent by providing a variety of opportunities in order to increase self-awareness, practice alternative ways of approaching personal and interpersonal problem-solving and develop basic consulting and interviewing skills.
- Introduction to organization development - introducing some basic theories, models and methods in the field of organization development, especially those relating to the role of consultant and strategies for change.
- Intervention and Change in Organizations - Consolidating and further developing consulting skills and strategies

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

SUGGESTED READINGS:

1. Dr Mee-Yan Cheung-Judge & Linda Holbeche, “Organization Development: A Practitioner's Guide for OD and HR”, Kogan Page.
2. Stephen R. Balzac, “The McGraw-Hill 36-Hour Course: Organizational Development ”, McGraw-Hill Education.
3. Edgar H. Schein , Joan V. Gallos, “Organization Development: A Jossey-Bass Reader (The Jossey-Bass Business and Management Reader Series)”, John Wiley & Sons.

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

COURSE OUT COMES (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. D.N. Kakkar ,"Managerial Economics for Engineering" , McGraw Hill **Publishing** Co.
3. D.N. Dwivedi , "Managerial Economics", Vikas Publishing, .
4. Maheshwari ,"Managerial Economics", PHI Learning Pvt. Ltd.
5. Ruddardutt and K.P.M.Sundharam ,"Indian economy", S. Chand Limited.

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

COURSE OUT COMES (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", South-Western College Pub.
2. Pankaj ghemawat ,"Redefining Global Strategy", Harvard Business Review Press.
3. Cornelis A. de Kluyver.,"Fundamentals of Global Strategy", Business Expert Press .

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

COURSE OUTCOMES (COs):

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

COURSE CONTENT:

Unit 1

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

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

Unit 2

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

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

Unit3

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

Unit 4

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

Unit 5

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

SUGGESTED READINGS:

1)Haryszkiewycz, “Introduction to Systems Analysis and Design”, 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 OUT COMES (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 bio system; Mechanics in biology; Storage, preservation and propagation of biological information; Biomaterials in engineering applications; Organisms as factories for biomaterials; Engineering organisms for novel applications.

SUGGESTED READINGS:

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

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):

1. To be able to assess the energy resources available worldwide
2. To understand the negative impact of conventional energy resource utilization on ecosystem
3. To learn about various types of pollutions and their control strategies
4. 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, Non renewable 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.
2. G. N. Tiwari and M. K. Ghosal ,"Fundamentals of Renewable Energy Sources", Narosa Publishing House.
3. Mital K. M, "Biogas Systems: Principles and Applications", New Age International publishers (P) Ltd.
4. Nijaguna, B.T.,"Biogas Technology", New Age International publishers (P) Ltd.
5. D. Yogi Goswami, Frank Kreith, Jan. F .Kreider, "Principles of Solar Engineering", Taylor & Francis.
6. Rezaiyan. J and N. P. Cheremisinoff, "Gasification Technologies, A Primer for Engineers and Scientists", Taylor and Francis.

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

COURSE OUTCOMES (COs):

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

COURSE CONTENT:

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

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

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

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

SUGGESTED READINGS:

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

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