B. Tech.

IN

PRODUCTION ENGINEERING

FLEXIBLE CURRICULUM

(For students admitted in 2015-16)

DEPARTMENT OF PRODUCTION ENGINEERING

NATIONAL INSTITUTE OF TECHNOLOGY

TIRUCHIRAPPALLI – 620 015

TAMIL NADU, INDIA

CURRICULUM

The total minimum credits for completing the B.Tech. programme in Production Engineering is 176+15.

MINIMUM CREDIT REQUIREMENT FOR THE VARIOUS COURSE CATEGORIES

The structure of B.Tech. programmes shall have General Institute Requirements (GIR), Programme Core (PC), Elective Courses (PE, OE and MI) and Essential Programme Laboratory Requirements (ELR) as follows:

Sl.No.	COURSE CATEGORY	Number of Courses	Number of Credits
1.	General Institute Requirement (GIR)	17	68
2.	Programme Core (PC)	20	65
3.	Essential Programme Laboratory Requirement (ELR)	06	13
4.	Elective courses a. Programme Electives (PE) b. Open Electives (OE) c. Minor (MI) A student should be allowed a minimum of 50% of the total electives of a programme from (b) and (c) if so desired by the student.	10 **05**	30 **15**
TOTAL			**176 + 15**

*

(I) GENERAL INSTITUTE REQUIREMENTS

Sl.No.	Name of the course	Number of Courses	Maximum Credits
1.	Mathematics	4	14
2.	**Physics***	**2**	**7**
3.	**Chemistry***	**2**	**7**
4.	Humanities	1	3
5.	Communication	2	6
6.	Energy and Environmental Engineering	1	2
7.	Professional Ethics	1	3
8.	***Engineering Graphics***	***1***	***3***
9.	***Engineering Practice***	***1***	***2***
10.	Basic Engineering	2	4
11.	Introduction to Computer Programming	1	3
12.	**Branch Specific Course** (Introduction to Branch of Study)**	**1**	**2**
13.	***Summer Internship***	***1***	***2***
14.	***Project work***	***1***	***6***
15.	***Comprehensive Viva***	***1***	***3***
16.	Industrial lecture	-	1
17.	NSS / NCC / NSC	-	0
	TOTAL	**17 (Excluding Italics)**	**68**

***including Lab**

**** Commence during Orientation Programme**

I. GENERAL INSTITUTE REQUIREMENTS

1. MATHEMATICS

Sl.No.	Course Code	Course Title	Credits
1.	MAIR11	Mathematics I	**4**
2.	MAIR12	Mathematics II	**4**
3.	MAIR35	Mathematics for Production Engineers	**3**
4.	MAIR47	Probability and Statistics	**3**
		Total	**14**

2. PHYSICS

Sl.No.	Course Code	Course Title	Credits
1.	PHIR11	Physics I (Theory & Lab)	**3**
2.	PHIR12	Physics II (Theory & Lab)	**4**
		Total	**7**

3. CHEMISTRY

Sl.No.	Course Code	Course Title	Credits
1.	CHIR11	Chemistry I (Theory & Lab)	**3**
2.	CHIR12	Chemistry II (Theory & Lab)	**4**
		Total	**7**

4. HUMANITIES

Sl.No.	Course Code	Course Title	Credits
1.	HSOE13	Entrepreneurship Development	**3**
		Total	**3**

5. COMMUNICATION

Sl.No.	Course Code	Course Title	Credits
1.	HSIR11	English for communication	**3**
2.	HSIR12	Professional communication	**3**
		Total	**6**

6. ENERGY AND ENVIRONMENTAL ENGINEERING

Sl.No.	Course Code	Course Title	Credits
1.	ENIR11	Energy & Environmental Engineering	**2**
		Total	**2**

7. PROFESSIONAL ETHICS

Sl.No.	Course Code	Course Title	Credits
1.	HSIR14	Professional Ethics and Values	**3**
		Total	**3**

8. ENGINEERING GRAPHICS

Sl.No.	Course Code	Course Title	Credits
1.	MEIR12	Engineering Graphics	**3**
		Total	**3**

9. ENGINEERING PRACTICE

Sl.No.	Course Code	Course Title	Credits
1.	PRIR11	Engineering Practice	**2**
		Total	**2**

10. BASIC ENGINEERING

Sl.No.	Course Code	Course Title	Credits
1.	CEIR11	Basics of Civil Engineering	**2**
2.	EEIR11	Basics of Electrical and Electronics Engineering	**2**
		Total	**4**

11. INTRODUCTION TO COMPUTER PROGRAMMING

Sl.No.	Course Code	Course Title	Credits
1.	CSIR11	Basics of Programming	**3**
		Total	**3**

12. BRANCH SPECIFIC COURSE

Sl.No.	Course Code	Course Title	Credits
1.	PRIR15	Introduction to Production Engineering	**2**
		Total	**2**

13. SUMMER INTERNSHIP

Sl.No.	Course Code	Course Title	Credits
1.	PRIR16	INTERNSHIP / INDUSTRIAL TRAINING / ACADEMIC ATTACHMENT (2 to 3 months duration during summer vacation)	**2**
		Total	**2**

The student should undergo industrial training/internship for a minimum period of two months during the summer vacation of 3rd year. Attachment with an academic institution within the country (IISc/IITs/NITs/IIITs and CFTIs) or university abroad is also permitted instead of industrial training.

 # To be evaluated at the beginning of VII semester by assessing the report and seminar presentations.

14. PROJECT WORK

Sl.No.	Course Code	Course Title	Credits
1.	PRIR17	Project Work	**6**
		Total	**6**

15. COMPREHENSIVE VIVA

Sl.No.	Course Code	Course Title	Credits
1.	PRIR18	Comprehensive Training	**3**
		Total	**3**

16. INDUSTRIAL LECTURE

Sl.No.	Course Code	Course Title	Credits
1.	PRIR19	Industrial Lectures	**1**
		Total	**1**

A course based on industrial lectures shall be offered for 1 credit. A minimum of five lectures of two hours duration by industry experts will be arranged by the Department. The evaluation methodology, will in general, be based on quizzes at the end of each lecture.

(II) PROGRAMME CORE (PC)

[Note: (1) Number of programme core: 20 (2) Credits: 65]

Sl.No.	Course Code	Course Title	Prerequisites	Credits
1.	PRPC10	Engineering Mechanics	---	4
2.	PRPC11	Casting & Welding Technology	PRIR15	3
3.	PRPC12	Machining Technology	PRIR15	3
4.	PRPC13	Metallurgy and Materials Engineering	CHIR12	3
5.	PRPC14	Mechanics of Solids and Fluids	PRPC10	3
6.	PRPC15	Thermal Engineering	---	3
7.	PRPC16	Kinematics and Dynamics of Machines	PRPC10	4
8.	PRPC17	Forming Technology	PRPC13	3
9.	PRPC18	Metrology (Theory and Lab)	PHIR12	3
10.	PRPC19	Electrical and Control Systems (Theory and Lab)	EEIR11	3
11.	PRPC20	Design of Machine Elements	PRPC14	4
12.	PRPC21	Tooling for Manufacturing	PRPC20	4
13.	PRPC22	Quality, Reliability and Safety Engineering	---	3
14.	PRPC23	Computer Integrated Manufacturing (Theory and Lab)	PRPC12	3
15.	PRPC24	Operations Research	MAIR47	4
16.	PRPC25	Work Design and Facilities Planning	PRPC22	3
17.	PRPC26	Computer Aided Design and Engineering (Theory and Lab)	CSIR11	3
18.	PRPC27	Mechatronics and Industrial Automation (Theory and Lab)	EEIR11	3
19.	PRPC28	Analysis of Production Systems and IE Lab	PRPC25	3
20.	PRPC29	Manufacturing System Simulation (Theory and Lab)	MAIR47	3
Total				**65**

(III) ELECTIVES

a. PROGRAMME ELECTIVE (PE)

[Note: Number of programme elective: at least 3 courses]

Students pursuing B.Tech. in Production Engineering should take at least three courses from the Programme Electives listed below.

Sl.No.	Course Code	Course Title	Prerequisites	Credits
1.	PRPE10	Unconventional Machining Processes	PRPC12	3
2.	PRPE11	Precision Engineering (Theory and Lab)	PRPC12	3
3.	PRPE12	Material Handling & Storage	PRPC25	3
4.	PRPE13	Manufacturing of Composite Materials	PRPC14	3
5.	PRPE14	Machine Tool Technology	PRPC12	3
6.	PRPE15	Industrial Robotics	PRPC25	3
7.	PRPE16	Plant Engineering	PRPC25	3
8.	PRPE17	Non Destructive Testing	---	3
9.	PRPE18	Micro Fabrication Processes	PRPC12	3
10.	PRPE19	Surface Engineering	PRPC14	3
11.	PRPE20	Processing of Friction composites	PRPC14	3
12.	PRPE21	Processing of Polymeric Composites	PRPC14	3
13.	PRPE22	Sustainable Manufacturing (Theory and Lab)	PRIR15	3
14.	PRPE23	Rapid prototyping, Tooling & Manufacturing	PRPC12	3
15.	PRPE24	Finite Element Methods	PRPC14	3
16.	PRPE25	Product Development Strategies	PRPC22	3
17.	PRPE26	Design for Manufacture and Assembly	PRPC22	3
18.	PRPE27	Vibration and Noise Engineering	PRPC16	3
19.	PRPE28	Concepts of Engineering Design	PRPC20	3
20.	PRPE29	Engineering Optimization	PRPC22	3
21.	PRPE30	Computational Fluid Dynamics	PRPC14	3
22.	PRPE31	Experimental Stress Analysis	PRPC14	3

23.	PRPE32	Design of Automated Manufacturing System	PRPC23	3
24.	PRPE33	Design and Analysis of Experiments	PRPC22	3
25.	PRPE34	Agile Manufacturing	PRPC22	3
26.	PRPE35	Integrated Materials Management	PRPE28	3
27.	PRPE36	Lean Manufacturing	PRPC22	3
28.	PRPE37	Total Quality Management	PRPC22	3
29.	PRPE38	Supply Chain Management	PRPC24	3
Total				**87**

b. OPEN ELECTIVE (OE)

Sl.No.	Course Code	Course Title	Prerequisites	Credits
1.	PROE10	Operations Management	MAIR11	3
2.	PROE11	Project Management	MAIR12	3
3.	PROE12	Value Engineering	---	3
4.	PROE13	Artificial Intelligence & Expert systems	CSIR11	3
5.	PROE14	Processing and manufacturing of semiconductors	---	3
6.	PROE15	Automobile component manufacturing processes	---	3
7.	PROE16	Laser Materials processing	PHIR12	3
Total				**21**

c. MINOR (MI)

Students who have registered for B.Tech Minor in Production Engineering

[Note: Number of Minor: 5 courses (Minimum)]

Sl.No.	Course Code	Course Title	Prerequisites	Credits
1.	PRMI10	Manufacturing Processes	---	3
2.	PRMI11	CAD, CAM and CAE	---	3
3.	PRMI12	Unconventional Manufacturing Processes	---	3
4.	PRMI13	Industrial Engineering and Management	---	3
5.	PRMI14	Quality Engineering	---	3
Total				**15**

Note : Student should be allowed a minimum of 50% of the total electives of a programme from Open electives and Minor, if so desired by the student.

(IV) ESSENTIAL PROGRAMME LABORATORY REQUIREMENT (ELR)

Sl.No.	Course Code	Course Title	Co requisites	Credits
1.	PRLR10	Manufacturing Processes Lab-I	PRPC12	2
2.	PRLR11	Mechanics of Solids & Fluids & Thermal Engineering Lab	PRPC14,15	2
3.	PRLR12	Manufacturing Processes Lab-II	PRPC12	2
4.	PRLR13	Weldability and Formability Testing Lab	PRPC11	2
5.	PRLR14	Machine Drawing Practice	MEIR12	3
6.	PRLR15	Production Drawing and Cost Estimation	PRLR14	2
Total				**13**

NOTE: Students can register for 2 laboratory courses during one session along with regular courses (PC / PE / OE / MI).

V. ADVANCED LEVEL COURSES FOR B.Tech. (HONOURS)

A student can obtain B.Tech. (Honours) degree provided the student has;

i. Registered at least for 12 theory courses and 2 ELRs in the second year.

ii. Consistently obtained a minimum GPA of 8.5 in the first four sessions

iii. Continue to maintain the same GPA of 8.5 in the subsequent sessions (including the Honours courses)

iv. Completed 3 additional theory courses specified for the Honors degree of the programme.

v. Completed all the courses registered, in the first attempt and in four years of study.

Sl.No.	Course Code	Course Title	Co requisites	Credits
1.	PRHO10	Tolerance Technology	---	3
2.	PRHO11	Robotics	---	3
3.	PRHO12	Intelligent Manufacturing Systems	---	3
4.	PRHO13	Total Quality Engineering	---	3
5.	PRHO14	Product Analysis and Cost Optimization	---	3
6.	PRHO15	Decision Support Systems	---	3
7.	PRHO16	Knowledge Management	---	3
8.	PRHO17	Product Life Cycle Management	---	3
9.	PRHO18	Technology Management	---	3
10.	PRHO19	Multi-Criteria Decision Making Techniques	---	3
Total				**30**

DESCRIPTION OF COURSE CODES FOR B.TECH. PROGRAMME

Sl. No.	Type of the course	Course Code and range
1.	General Institute requirements	xxIR10 to 99
2.	Programme core	xxPC10 to 99
3.	Programme Elective	xxPE10 to 99
4.	Essential Laboratory Requirement	xxLR10 to 99
5.	Open Electives	xxOE10 to 99
6.	Minors	xxMR10 to 99
7.	Honours	xxHO10 to 99

Where xx denotes the Department offering the course

DESCRIPTION OF DEPARTMENT CODES FOR B.TECH. PROGRAMME

Sl. No.	Department	Code
1.	Architecture	AR
2.	Chemical	CL
3.	Civil Engineering	CE
4.	Computer Applications	CA
5.	Computer Science and Engineering	CS
6.	Chemistry	CH
7.	Electronics and Communication Engineering	EC
8.	Electrical and Electronics Engineering	EE
9.	Energy and Environmental Engineering	EN
10.	Humanities	HM
11.	Instrumentation and control	IC
12.	Mathematics	MA
13.	Mechanical Engineering	ME
14.	Metallurgical and Materials Engineering	MT
15.	Production Engineering	PR
16.	Physics	PH
17.	Management Studies (DoMS)	MB
18.	Office of Dean, Student Welfare (NSS/NSC/NSO)	SW

Details of the flow of courses for a particular programme should be made available to the students at the beginning of the programme (I Year). The feasible year (I to IV year of study) and session of study for each core course should also be given.

Course flow: X → Y Z Where X, Y, Z are courses
The following table should be prepared before the commencement of the programme

Sl. No.	Course Code	Course Title	Year of Study	Session/s
1.	HSIR11	English for Communication	I	July
2.	MAIR11	Mathematics - I	I	July

Sl. No.	Course Code	Course Title	Year of Study	Session/s
3.	PHIR11	Physics – I (Theory & Lab)	I	July
4.	CHIR11	Chemistry – I (Theory & Lab)	I	July
5.	CSIR11	Basics of Programming (Theory & Lab)	I	July
6.	PRIR15	Introduction to Production Engineering	I	July
7.	CEIR11	Basics of Civil Engineering	I	July
8.	EEIR11	Basics of Electrical and Electronics Engineering	I	July
9.	MEIR12	Engineering Graphics	I	July
10.	HSIR12	Professional Communication	I	January
11.	MAIR12	Mathematics – II	I	January
12.	PHIR12	Physics – II (Theory & Lab)	I	January
13.	CHIR12	Chemistry – II (Theory & Lab)	I	January
14.	ENIR11	Energy and Environmental Engineering	I	January
15.	PRPC10	Engineering Mechanics	I	January
16.	PRIR11	Engineering Practice	I	January
17.	MAIR35	Mathematics for Production Engineers	II	July
18.	PRPC11	Casting & Welding Technology	II	July
19.	PRPC12	Machining Technology	II	July
20.	PRPC13	Metallurgy and Materials Engineering	II	July
21.	PRPC14	Mechanics of Solids & Fluids	II	July
22.	PRPC15	Thermal Engineering	II	July
23.	PRLR10	Manufacturing Processes Lab-I	II	July
24.	PRLR11	Mechanics of Solids & Fluids & Thermal Engineering Lab	II	July
25.	MAIR47	Probability & Statistics	II	January
26.	PRPC16	Kinematics and Dynamics of Machines	II	January

Sl. No.	Course Code	Course Title	Year of Study	Session/s
27.	PRPC17	Forming Technology	II	January
28.	PRPC18	Metrology (Theory & Lab)	II	January
29.	PRPC19	Electrical and Control Systems (Theory and Lab)	II	January
30.	PRLR12	Manufacturing Processes Lab-II	II	January
31.	PRLR13	Weldability and Formability Testing Lab	II	January
32.	PRPC20	Design of Machine Elements	III	July
33.	PRPC21	Tooling for Manufacturing	III	July
34.	PRPC22	Quality, Reliability and Safety Engineering	III	July
35.	PRPC23	Computer Integrated Manufacturing (Theory and Lab)	III	July
36.	HSIR14	Professional Ethics and Psychology	III	July
37.	PRPE10	Unconventional Machining Processes (Prog. Elective 1/2) / Minor 1 & 2	III	July
38.	PRPE15	Industrial Robotics (Prog. Elective 1/2) / Minor 1 & 2	III	July
39.	PRPE25	Product Development Strategies (Prog. Elective 1/2) / Minor 1 & 2	III	July
40.	PRLR14	Machine Drawing Practice	III	July
41.	PRHO10	Tolerance Technology (HO1)	III	July
42.	PRHO13	Total Quality Engineering (HO1)	III	July
43.	PRHO17	Product Life Cycle Management (HO1)	III	July
44.	PRPC24	Operations Research	III	January
45.	PRPC25	Work Design and Facilities Planning	III	January
46.	PRPC26	Computer Aided Design and Engineering (Theory and Lab)	III	January
47.	PRPC27	Mechatronics and Industrial Automation (Theory and Lab)	III	January
48.	PRPE11	Precision Engineering (Theory and Lab) (Prog. Elective 3/4) / Minor 3 & 4	III	January
49.	PRPE26	Design for Manufacture and Assembly (Prog. Elective 3/4) / Minor 3 & 4	III	January

Sl. No.	Course Code	Course Title	Year of Study	Session/s
50.	PRPE33	Design and Analysis of Experiments (Prog. Elective 3/4) / Minor 3 & 4	III	January
51.	PRPE36	Lean Manufacturing (Prog. Elective 3/4) / Minor 3 & 4	III	January
52.	PRLR15	Production Drawing and Cost Estimation	III	January
53.	PRHO11	Robotics (HO2)	III	January
54.	PRHO12	Intelligent Manufacturing Systems(HO2)	III	January
55.	PRHO14	Product Analysis and Cost Optimization (HO2)	III	January
56.	PRIR16	Internship / Industrial Training / Academic Attachment	IV	July
57.	PRIR19	Industrial Lecture	IV	July
58.	PRPC28	Analysis of Production Systems and IE Lab	IV	July
59.	PRPC29	Manufacturing System Simulation (Theory and Lab)	IV	July
60.	PRPE22	Sustainable Manufacturing (Theory and Lab) (Prog. Elective 5/6/7) / Minor 5	IV	July
61.	PRPE38	Supply Chain Management (Prog. Elective 5/6/7) / Minor 5	IV	July
62.	PROE10	Operations Management (Prog. Elective 5/6/7) / Minor 5	IV	July
63.	PRIR18	Comprehensive Training	IV	July
64.	HSOE13	Entrepreneurship Development	IV	January
65.	PRPE13	Manufacturing of Composite Materials (Elective 8/9/10)	IV	January
66.	PRPE23	Rapid prototyping,Tooling & Manufacturing (Elective 8/9/10)	IV	January
67.	PRPE24	Finite Element Methods (Elective 8/9/10)	IV	January
68.	PRPE35	Integrated Materials Management (Elective 8/9/10)	IV	January
69.	PRHO15	Decision Support Systems (HO3)	IV	January
70.	PRHO16	Knowledge Management (HO3)	IV	January
71.	PRHO18	Technology Management (HO3)	IV	January
72.	PRHO19	Multi-Criteria Decision Making Techniques (HO3)	IV	January
73.	PRIR17	Project Work	IV	January

PROGRAMME CORE (PC)

PRPC12 MACHINING TECHNOLOGY

L	T	P	C
3	0	0	3

PREREQUISITE COURSE: Basic Engineering

COURSE OBJECTIVES:

- To perform different machining operations like turning, drilling, milling and finishing.
- To predict tool life and tool failure
- To select suitable cutting fluid for respective materials

Theory of metal cutting: Introduction – Machine tools – Cutting tools – Tool geometry - Orthogonal and oblique cutting – Mechanics of cutting – Types of chips – Cutting speeds and feeds – Tool failure, Tool life – Tool materials – Cutting fluids.

Turning operations: Introduction – Lathe – Types of lathes – Size of a lathe – Work holding devices – Lathe operations – Metal removal rate and machining time calculations.

Drilling and allied operations: Introduction – Drilling machines – Types – Drills – Drilling machine operations – Boring, Reaming and other operations – Boring machine – Types.

Introduction – Milling machine – Types – Milling cutters – Milling process – Milling machine operations.

Finishing processes: Introduction – Abrasive machining – Abrasives – Grinding wheel – Grinding machines – Types – Fine finishing operations.

TEXT BOOKS:

1. Nagendra Parashar, and Mittal, R.K, Elements of manufacturing processes, Prentice Hall of India Private Limited,1st Edition, 2003.

2. Hajra Choudhury SK, Bose HK and Hajra Choudhury AK, Elements of Workshop Technology, Vol.II, Media promoters and Publishers Pvt. Ltd. 12th Edition, 2007.

REFERENCES:

1. Khanna, O.P and Lal, M, A Text book of Production Technology, Vol.II, DhanpatRai Publications (P) ltd.,1st Edition, 2009.
2. H.M.T, Production Technology, Tata McGrawHill Publishing Co.Ltd, 1st Edition, 2008.
3. ASM Handbook, Machining.

COURSE OUTCOMES:

- Summarize the theory of metal cutting and compute cutting forces involved from Mohr's circle.
- Recognize various parts of lathe list the accessories and explain various operations performed.
- Explain the construction of drilling, boring, reaming and milling machines and explain operations performed

PRPC13 METALLURGY AND MATERIALS ENGINEERING

L	T	P	C
3	0	0	3

PREREQUISITE COURSES: Chemistry I and Chemistry II

COURSE OBJECTIVES:

- To test materials through various testing methods to evaluate their properties
- To conduct heat treatment processes for metals

Art and science of metallurgy-structure of metals and alloys-phase and structural constitutions- Equilibrium diagrams

Ferrous metals and alloys-Fe-Fe3C diagram-Effect of alloying elements in steel, Classification of ferrous alloys and their applications

Heat treatment of steel-CCT diagram-Surface hardening process-Non Ferrous Metals Alloys- composition-properties and applications of copper, nickel, lead, tin, zinc, aluminium, Mg and Ti alloys-Heat treatment of Non Ferrous alloy-Non Metallic Metals and alloys-ceramic material- polymers-composite material – Nano-structured materials

Testing of Materials-Non-Destructive Testing, Tensile testing, compression testing - Hardness Testing

Testing of Materials-Impact testing, Fatigue testing, Creep, other related testing methods characterization of TEM, XRD, SEM

Practice:

Microstructural study of carbon steels, Cast Iron Jominy end quench test – Heat Treatments on steels – Hardening – Annealing – Normalizing – Tempering

Demonstration on SEM/XRD

TEXT BOOK:

1. Raghavan V, Physical Metallurgy - Principles and Practice, Prentice - Hall of India,2nd Edition, 2007.
2. Avner S.H., Introduction to Physical Metallurgy, Tata McGraw Hill,2nd edition, 2008

REFERENCE BOOKS:

1. Dieter G. E., Mechanical Metallurgy, McGraw Hill Co- Koga, 1stEdition ,2002
2. Suryanarayana AVK, Testing of Metallic Materials,BS Publications,2nd Edition, 2007.

COURSE OUTCOMES:

- Interpret microstructure of engineering materials and explain Equilibrium diagrams.
- Classify ferrous alloys and their applications with respect to foundry and welding processes.
- Understand heat treatment processes for alloys, non alloys & summarize testing methods like TEM, XRD, SEM

PRPC14 MECHANICS OF SOLIDS AND FLUIDS

L	T	P	C
3	1	0	3

PREREQUISITE COURSES: Engineering mechanics

COURSE OBJECTIVES:

- To measure fluid flows and handle fluid machineries.
- To predict the behaviour of structures on loading and implement the concepts in suitable applications.

Stress - Strain - Elastic constants - Stress in Composite bars - Beams - Types - Shear force and bending moment diagrams for simply supported and overhanging

Columns Long column - Euler's Theory - Short column - Empirical formulae - Torsion of Circular shafts - Hollow Shafts - Power transmission

Vapour Pressure - Pressure at a point its variation - Measurement with Piezo meter, manometers and gauges

Continuity equation in one dimension - Bernoulli's equation - Venturi meters and Orificie meters - Flow through pipes - Laminar Turbulent flow Major losses

Pumps - General principles of displacement and Centrifugal pumps - Efficiency and Performance Curves of Pumps - Cavitation in Pumps - Turbines - Efficiency - Governing of turbines

Text Book:

1. Ramamirtham, S., `Strength of Materials ', Dhanpat Rai and Sons, New Delhi, 2003.

2. Kothandaraman, C.P. and Rudramoorthy, R., Basic Fluid Mechanics, New Age International, 1st Edition, 1999.

Reference:

1. Rajput , R.K., 'Strength of Materials ', S.Chand & Co Ltd., New Delhi, 1996.

2. Nagarathnam, S. 'Fluid Mechanics', Khanna Publishers,New Delhi, 1995.

3.Bansal, R.K., Textbook of Fluid Mechanics and Hydraulic Machines,Lakshmi Publications, 9th Edition 2008.

COURSE OUTCOMES:

- Understand properties of fluids.
- Determine flow through hydraulics machines and pipes
- Able to perform simple stress and strain calculations.

PRPC15 THERMAL ENGINEERING

L	T	P	C
3	0	0	3

PREREQUISITE COURSES: Physics

COURSE OBJECTIVES:

- To design I.C.Engines, Compressors and Turbines effectively
- To perform flow analysis in nozzles used in different locations

Laws of Thermodynamics-Basic concepts - first law of thermodynamics applied to closed and open systems - simple problems.

Second law of thermodynamics - concept of reversible process

Air standard cycles - Otto, diesel and dual cycles - I.C. engines, S.I. engines and CI engines

Reciprocating compressor - effect of clearance volume, single and multistage compressor - Volumetric efficiency - calculation of power requirement - gas turbines - open and closed cycle - intercooling, reheating and regenerative cycles Wankel engine-Sonic velocity, mach no. Wave propagation - mach cone, static and stagnation property relations, isotropic flow, use of gas tables, normal shock, flow through converging and diverging nozzle

Properties of steam: P – V, T - S and H - S diagrams- Rankine cycle, modifications to improve thermal efficiency - psychrometrics - various a/c processes - systems - refrigeration - Bell coleman and vapor compression cycles - vapor absorption cycle.

TEXT BOOKS:

1. Nag,P.K. “Engineering Thermodynamics”, 3rd Edition, Tata McGraw Hill, 2005.
2. Kothandaraman, C.P. and Domkundwar, S. "A Course in Thermodynamics and Heat Engines", Part- I, SI units, 3rd Edition, DhanpatRai and Sons, 1993.

REFERENCES:

1. Ganesan, V., "Internal Combustion Engine", Tata McGraw Hill, New Delhi, 2004.

COURSE OUTCOMES:

- Apply thermodynamic laws in engineering applications
- Calculation of power requirements of gas turbines and flow rates through nozzles
- Calculation of thermal efficiencies of steam turbines

PRPC16 KINEMATICS AND DYNAMICS OF MACHINES

L	T	P	C
2	2	0	4

PREREQUISITE COURSES: Engineering Mechanics

COURSE OBJECTIVES:

- To design various machines and to perform kinematic and dynamic analysis.

Kinematic pairs, diagram and inversion - Displacement, velocity and acceleration analysis of planar linkages– static and dynamic analysis of simple mechanisms

Cam profile synthesis - Gears dynamic force analysis

Flywheel – fluctuation of energy and speed, Governors

Inertia forces and their balancing for rotating and reciprocating machines. Hydrodynamic and boundary lubrication in journal and thrust bearings.

Longitudinal – Transverse – Torsional vibration – Two degrees of freedom and multi-degree of freedom systems.

TEXT BOOKS:

1.Shigley, J.E. and Uicker, J.J.,Theory of Machines and Mechanisms, OxfordUniversity Press, 3rd Edition, 2008.
2.Thomas Bevan, Theory of Machines, CBS Publishers. 3rd edition, 2008.
3. Rattan S.S., Theory of Machines, Tata McGraw Hill Pub Co, 2nd Edition, 2008.

REFERENCES:

1.Rao, J.S., and Dukkipati, R.V.,Mechanism and Machine Theory, Wiley Eastern Ltd., Second Edition 1992.
2. Ghosh A and Mallik A.K., Theory of Mechanisms and Machines, Affiliated EWP Pvt. Ltd, Third Edition,2003.

COURSE OUTCOMES:

- Understand the basic concepts of machines and machinery
- Understand law of gearing
- Understand the laws of dry friction
- Understand all mechanisms of machines.
- Design various mechanisms of machines
- Evaluate various mechanisms of machines

PRPC17 FORMING TECHNOLOGY

L	T	P	C
3	0	0	3

PREREQUISITE COURSES: Chemistry I, Chemistry II and Metallurgy and Materials Engineering

COURSE OBJECTIVES:

- To apply basic of metal forming processes to shape products to their desired forms without any defects.

Yield criteria for ductile metals - Flow theories – strain hardening – recrystallization

Fundamentals of metal forming- Effect of temperatures, speed and metallurgical microstructure on forming processes - Mechanics of Metal Forming

Forging Processes Forging Equipment, Forging defects - Types of Rolling mill - process variables – defects

Types of extrusion - Process variables - Wire drawing - Drawing and Deep drawing – Sheet metal working

High energy rate forming processes.

TEXT BOOKS:

1. Narayanasamy.R., Metal forming technology,Ahuja Pub,2nd Edition,2000.
2. William FHosford and Robert M Caddell, Metal Forming Mechanics and Metallurgy, Cambridge University Press,Third Edition, 2008

REFERENCES:

1. GeorgeE. Dieter, Mechanical Metallurgy, McGraw Hill book Co.- Koga, 1st edition, 2002
2. ASM Handbook on Forming and Forging, Vol.14, ASM International.,9th Edition, 1998

COURSE OUTCOMES:

- Understand the properties of ductile metals
- Understand the effects of temperature, speed on metal forming process
- Understand the principle, procedure and applications of Bulk Metal Forming and Sheet Metal Forming

PRPC18 METROLOGY (Theory & Lab)

L	T	P	C
2	0	2	3

PREREQUISTE COURSE: Physics-I

COURSE OBJECTIVES:

- To apply various measurement techniques to inspect and test products
- To apply statistical tools for quality assurance purpose
- To test and evaluate various components using various measuring instruments

Introduction to Measurement – objectives – classification of methods of measurements - Precision and Accuracy - Standards and their evolution -Types of errors in measurements – Limit gauging

Comparators – types – applications – Linear, angular and form measurements – Surface roughness methods of surface finish – Direct instrument measurements.

Screw Thread Measurement- Standard thread profiles, Effective diameter, Terminology of gear tooth – Gear measurement – Parkinson gear tester- Alignment testing of machine tools – Coordinate measuring machines – Machine vision – Nano measurements.

Measurement of field quantities like temperature, pressure, velocity by intrusive and non-intrusive techniques under various conditions met with in practice like steady and transient conditions. Measurement of derived quantities like heat flux, volume/mass flow rate, temperature in flowing fluids. Measurement of thermo-physical properties, radiation properties of surfaces, vibration and noise. Measurement of length, measurement of angle. Limits and fits.

LAB EXERCISES

Study and use of Electronic comparator - Profile projector - sine bar - precision measuring instruments - coordinate measuring machine Measurement of Gear tooth thickness - Adjacent base pitch error - surface roughness.

TEXTBOOK:

1. Jain R. K., “Engineering Metrology”, Khanna Publications, 2010 2. Douglas C. Montgomery,"Introduction to Statistical Quality Control”, Wiley Publications, 2004.

REFERENCES:

1. Gupta. I.C., “Engineering Metrology”, DhanpatRai and Sons, 1997.
2. Beckwith G. Thomas , Roy D. Marangoni, John H. Lienhard V, “Mechanical Measurements 6th Edition” Pearson publications, 2006.

COURSE OUTCOMES:

- Describe the fundamental concepts in measurement methods, techniques.
- Apply various instruments for measurements
- Apply quality control tools to achieve defects free quality products
- Take precise measurements using various instruments.
- Develop data for engineering analysis.

PRPC19 ELECTRICAL AND CONTROL SYSTEMS (Theory and Lab)

L	T	P	C
2	0	2	3

PREREQUISITE COURSES: Physics

COURSE OBJECTIVES:

- To apply concepts of electrical drives and control systems to various industrial applications.
- To test various electrical and electronic devices like generators, motors, semiconductor diodes, rectifiers and logic gates.

DC machines - Characteristics - Starting and speed control of DC motors. Transformers: (Single phase only)- equivalent circuit and regulation - losses and efficiency - auto transformer.

Alternators - EMF equation - regulation by synchronous impedance method - Synchronous motors starting and applications.

Three - phase induction motor - Cage and slip ring motors -torque slip characteristics –starting and speed control of induction motors - single phase induction motors and universal motors.

Electric drive for general factory, textile mill - pump, blowers, hoists, traction etc. - group and individual drives - Construction and working of dynamometer type watt meters and induction type energy meters.

Control System – open loop and closed loop systems- transfer function - time response of second order system - frequency response method - polar plot. Concept of stability - application of routh criterion for simple systems.

LAB

EXERCISE-1: No - load speed characteristics of D.C. shunt motor

EXERCISE-2: Load test on D.C.Shunt generator

EXERCISE-3: Equivalent circuit of single - phase transformer

EXERCISE-4: Swinburne's test

EXERCISE-5: Starting of 3-phase induction motors

EXERCISE-6: Semiconductor junction diode V-I characteristics

EXERCISE-7: Semiconductor zener diode V-I characteristics

EXERCISE-8: Inverting and Non-inverting Operational Amplifiers

EXERCISE-9: Uni Junction Transistor (UJT) and Silicon Controlled Rectifier(SCR) characteristics

EXERCISE-10: Logic gates

TEXT BOOK:

1. Boylestead, Electronics Devices and Integrated Circuits, PHI Publishers, 2008.

REFERENCES:

1.Palani, S. Control Systems ,ShanmugaPriya Publishers, 1995.
2.Theraja, B.L., Electrical Technology, Vol. 1 and 2, S.Chand and Co. Ltd, 23rd and 24th Edition,2009.

COURSE OUTCOMES:

- Understand the concepts of transformer and DC machines
- Understand open and closed system
- Understand the mechanics of fluids, transportation of mass, momentum and energy
- Conduct exercises to learn DC motor
- Conduct experiments for understanding VI characteristics of diodes
- Conduct experiments to learn about Logic Gates

PRPC20 DESIGN OF MACHIN ELEMENTS

L	T	P	C
2	2	0	4

PREREQUISITES: Engineering Mechanics, Strength of materials

COURSE OBJECTIVES:

- To understand material properties, design process and various theories of failures
- To design various basic machine components
- To design new components based on design principles

Introduction to the design process, factor influencing machine design, mechanical properties of materials, direct stress, bending stress, torsional stress and variable stress in machine parts, theories of failure, stress concentration factor, factor of safety.

Design of shafts based on bending moment, twisting moment, combined of bending and twisting moments, axial loads in addition to combined torsional and bending loads, rigidity and stiffness. Design of spring.

Belt and chain drives: selection of flat belt, V belt and chain drives. Design of couplings, keys and bearings.

Welded joints: types of joints, welding symbol and weld symbol and their representation, strength of welded joints subjected to various types of load. Riveted joints: types of joints, design of riveted joints for structure.

Design of spur and helical gears. Design of gear box: layout diagram, speed diagram, fixing number of teeth and module of gears.

TEXT BOOKS:

1. Bhandari, V.B., “Design of Machine Elements”,Tata McGraw-Hill, 2007.
2. Prabhu, T.J. "Design of Transmission Elements", Mani Offset, Chennai, 2005.

REFERENCES:

1. Shigley, J.E. and Mischke, C.R. "Mechanical Engineering Design" Tata McGraw Hill, 2006.
2. Sharma, C.S. and Purohit, K. “Design of Machine Elements”, Eurasia Publishing House (P) Ltd, New Delhi, 2005.

COURSE OUTCOMES:

- Understand the various theories of failures
- Design various machine components
- Design new components based on the design principles

PRPC21 TOOLING FOR MANUFACTURING

L	T	P	C
2	2	0	4

PREREQUISITES: Design of Machine Elements, Strength of materials, Engineering Mechanics

COURSE OBJECTIVES:

- To study the various design considerations for tooling**.**

Design of cutting tools: Tool materials, design of single point cutting tool, form tool, drill, reamer, broach & plain milling cutter.

Theory of metal cutting – design of tool holders for single point tools – Boring bars – selection of tools for machining applications – economics of machining

Design of fixtures: standard work holding devices – principles of location and clamping – clamping methods and elements – quick-acting clamps – design & sketching of milling fixtures for simple components – Turning, Grinding, Welding fixtures. inspection fixtures and design of gauges

Design of Drill jigs: Drill bushings – types of jigs: Plate, Leaf, Turn over & Box Jigs – design & sketching of drill jigs for machining simple components

Press tools: power presses – die cutting operations – centre of pressure – scrap strip lay out for blanking – press tonnage calculations – Progressive & Compound dies – die design for simple components. Drawing dies – blank development – estimation of drawing force – blank holders & blank holding pressure – design & sketching of drawing dies for simple components – Bending dies & Combination tools.

TEXT BOOKS:

1. A Bhattacharyya, Metal Cutting Theory and Practice, Central Book Agency Kolkata.

REFERENCES:

1. ASTME, Fundamentals of Tool Design, Prentice Hall.
2. F W Wilson, Hand Book of Fixture Design, McGraw Hill publications.

COURSE OUTCOMES

- Design single point cutting tool, form tool, drill etc
- Understand how to conduct machining economically
- Design jigs, fixtures and press tools

PRPC22 QUALITY, RELIABILITY AND SAFETY ENGINEERING

L	T	P	C
3	0	0	3

PREREQUISITES: Basic Engineering

COURSE OBJECTIVES

- To identify and analyze failures of components and subcomponents of mechanical and electronic items.
- To distinguish different concepts in maintenance and explore in order to increase service life of the products/machines
- To list various safety measures concerned with environment described for a safety engineer

Introduction to quality assurance and quality control – Statistical concepts in quality – Central limit theorem – Quality control tools

Control charts for variables and attributes– process capability studies – Sampling inspection-Quality System standard

Failure Rate, Mean Time Between Failures (MTBF)-Mean Time To Failure (MTTF), Bathtub distribution, Down time, Repair time, Availability, Series-Parallel Structures, Redundancy, Reliability Allocation, Mechanical Reliability, Failure Mode Analysis.

Safety - Importance -Fundamental Concepts and Terms- Workers' Compensation - Product Liability - Hazards and their Control -Walking and Working Surfaces, Electrical Safety -Tools and Machines - Materials Handling.

Fire Protection and Prevention -Explosions and Explosives - Radiation - Biohazards - Personal Protective Equipment - Managing Safety and Health.

TEXT BOOKS:

1. David J Smith, Butterworth-Heinemann,Reliability Maintainability and Risk; Practical methods for engineers, New Delhi, 2001
2. B.S. Dhillon, Maintainability, Maintenance and Reliability for Engineers,CRC Press, 2006
3. Roger L. Brauer, Safety and Health for Engineers, John Wiley Sons, 2006

REFERENCE:

1. Hoang Pha, Handbook of Reliability engineering, Springer Publication, 2003.
2. B.S. Dhillon, Engineering maintenance; a modern approach,CRCPress, 2002
3. Butterworth-Heinemann,R. Keith Mobley, Maintenance Fundamentals, II edition, 2004

COURSE OUTCOMES:

- Identify and analyze the failures of the components and subcomponents of mechanical and electronic items.
- Distinguish different concepts in maintenance and explore in order to increase the service life of the products/machines
- List various safety measures concerning with environments described for a safety engineer

PRPC23 COMPUTER INTEGRATED MANUFACTURING (Theory & Lab)

L	T	P	C
2	0	2	3

COURSE OBJECTIVES:

- To gain knowledge in Engineering product specification and CAD/CAM Integration.
- To impart knowledge in CAD software package for modeling, assembly, FEA of mechanical components and CNC programming for Milling/Turning.

CIM - evaluation, hardware and software of CIM - concurrent engineering – advance modeling techniques.

Numerical Control - Concepts and features– Classification – Input media - Design considerations– Functions of MCU - CNC concepts - Point-to-point and Contouring systems - Interpolators – Feedback devices – DNC - Adaptive Control – ACO and ACC systems.

Part programming - manual part programming – preparatory, miscellaneous functions – computed aided part programming - post processors - APT programming.

Cellular manufacturing - Group Technology – Flexible Manufacturing Systems- Configurations- Workstations - Control systems - Applications and benefits

Materials handling and Storage Systems - types of material handling systems – storage systems- – Automated storage and retrieval systems – Robotics technology - control systems – Programming-Applications– Automated inspection and testing – Coordinate measuring machines.

LAB EXERCISES

1. Plain turning and facing operations on EMCO turning machine.
2. Step turning operation on LEADWELL machine.
3. External threading operation on LEADWELL and STC 15 machines.
4. Profile milling operation on VMC machine.
5. Rectangular pocketing and drilling operations on EMCO milling machine.
6. Mirroring operation on MTAB milling machine.
7. Inspection on CMM

TEXT BOOK:

1. Paul Ranky, “Computer Integrated Manufacturing”, Prentice Hall, 2005.

REFERENCES:

1. YoramKoren, "Computer Control of Manufacturing Systems", McGraw Hill Book co. New Delhi, 1986.
2. Mikell P Groover,, “Automation, Production Systems and Computer Integrated Manufacturing”, Prentice Hall, 2007.
3. Donatas T I junclis, Keith E Mekie, “Manufacturing High Technology Hand Book”, Marcel Decker.

COURSE OUTCOMES:

- Assembly of mechanical components using CAD software Solid Works/CATIA/Pro-E.
- Finite Element Analysis (FEA) using Pre-processing (solid modeling, meshing, analysis setup)
- and post processing (graphical display and report) with software PATRAN/ NASTRAN/ MARC/
- ABAQUS/ LS-DYNA/ ANSYS/PAM-CRASH (Exercises include Simple Beam, Plane Stress, Strain, axi-symmetric, 3D Solids).
- CNC code generation for CNC Milling.
- CNC code generation for CNC Turning.
- Demonstration of CNC Router Machine/ CNC Lathe/ CNC Milling (Students have to Submit detailed reports on each demonstrations).

PRPC24 OPERATIONS RESEARCH

L	T	P	C
2	2	0	4

PREREQUISITES: Applied statistics

COURSE OBJECTIVES:

- To understand Linear programming, assignment and queuing problems
- To make decisions under uncertainty
- To prepare project network and perform project scheduling

Concept of linear programming model-Development of LP models - Graphical method. Simplex method - Big M method - Two-phase method - Special cases in Linear Programming. Introduction to duality theory.

Introduction-Mathematical model for Transportation problem –balanced and unbalanced transportation problem. Methods to solve transportation problem-finding basic feasible solution- testing solution for optimality - Assignment problem-unbalanced assignment problem- maximisation problem-problem with assignment restrictions.Travelling sales man problem.

Introduction-characteristics of queuing problem-terminologies of queuing problem-applications of queuing model -single server model. Simulation-need for simulation-advantages and disadvantages. Random number generation-methods. Applications of simulation-maintenance, queuing and inventory.Line balancing.

Decision under uncertainty-Laplace criterion, Maximin criterion, minimax criterion, Savage minimaxregrert criterion, Hurwicz criterion. Decision making under risk-

expected value criterion- decision tree, Investment decisions –present worth method, annual equivalent method, rate of return method, Replacement Analysis-types of replacement problem. Replacement of item that fail with respect to time.Replacement of item that fail suddenly-individual replacement and group replacement.

Project network construction – Critical Path Method (CPM) - determination of critical path - Project Evaluation and Review Technique (PERT)-probability of completing a project in a scheduled date - Crashing of project network-cost considerations in project scheduling , Production scheduling- single machine scheduling, flow shop scheduling, Johnson's algorithm

TEXT BOOK:

1.Gupta, P.K. and Hira, D.S, Operations Research, 3rd Edition, S.Chand and Company Ltd., New Delhi, 2008.

REFERENCES:

1. Taha H.A, Operations research,Prentice – Hall of India, New Delhi, 8th Edition, 2006.

2. Panneerselvam, R, Operations Research,Prentice – Hall of India, 2nd Edition, New Delhi, 2006.

COURSE OUTCOMES:

- Summarize different techniques for production planning like queuing uncertainty and mathematical modeling are involved
- Apply optimization in utilization of resources
- Apply resource management techniques to industrial operations

PRPC25 WORK DESIGN AND FACILITIES PLANNING

L	T	P	C
3	0	0	3

PREREQUISITE: Reliability, maintenance and safety Engineering

COURSE OBJECTIVE:

- To understand method study and work management techniques

Methods study - motion and time study, and productivity - micromotion and macromotion study - Ergonomics.

Work measurement - techniques of work measurement - time study - production study. Facility layout - steps in facility location study - layout types and analysis.

Layout design process - systematic layout planning - analysis - designing the layout - Assignment model

Computerized layout planning - CRAFT, ALDEP and CORELAP

TEXTBOOKS:

1. Barnes, Motion and time study, John Wiley, New York, 1990.

REFERENCE:

1. ILO, Introduction to work study, ILO,Geneva,1974.

COURSE OUTCOMES:

- Perform ergonomic analysis
- Perform computerized layout planning
- Perform work measurements

PRPC26 COMPUTER AIDED DESIGN AND ENGINEERING (Theory&Lab)

L	T	P	C
2	0	2	3

PREREQUISITES: Physics, Applied Electronics

COURSE OBJECTIVES

- To understand various hardware and software that serve as components of CAD system
- To understand plotting, transformations techniques, geometric modeling
- To understand graphic standards, finite element modeling and DBMS

Fundamentals of computer - configurations - workstations - data communications - input/output devices, display technology, CAD software. Interactive graphics - point plotting techniques. Transformations techniques, viewing operations: window, viewport and clipping, visual realism

: Hidden line/surface removal, shading and colour models. Computer drafting through high level languages.

Geometric modeling: Wireframe modeling, S u r f a c e modeling: Representation of curves and surfaces, design of curves: cubic splines, bezier curves and B-spline, design of surfaces.

Solid modeling: Constructive solid geometry (C-rep) and Boundary representation (B-rep). Graphics standards: GKS, DXF and IGES standards - Parametric design programmes.

Finite element modeling and analysis: types of analysis, degrees of freedom, element and structure- stiffness equation, assembly procedure. Database concepts and data base management systems - SQL.

LAB EXERCISES

- Part modelling using CAD
- Assembly using CAD
- Manufacturing analysis using CAM
- Engineering analysis using CAE

TEXT BOOKS:

1. Newman.W.M. andSproull, R.F., Principles of interactive computer graphics,McGraw Hill Pub., II Ed., 1989.

REFERENCES:

1. Anand, V.B., Computer Graphics and Geometric Modeling for Engineers, John Wiley and Sons, Inc., 2000.
2. Zeid,I and Sivasubramanian, R., CAD/CAM, Tata McGraw-Hill, 2007.

COURSE OUTCOMES

- Summarize the concepts and applications of CAD.
- Elaborate fundamental of computers, networks, transformations techniques, geometric modeling solid modeling and finite element modeling
- Distinguish various concepts and techniques used for Product design and to develop product design skills.

PRPC27 MECHATRONICS AND INDUSTRIAL AUTOMATION (Theory & Lab)

L	T	P	C
2	0	2	3

PREREQUISITE: Fluid mechanics and Machinery, Engineering mechanics

COURSE OBJECTIVE:

- To study hydraulic and pneumatic systems, sensors and their applications

Introduction - overviews, principles and application of hydraulic, pneumatic, electric controls system.

Hydraulic system, hydraulic components - pressure-flow-direction controls valves – proportional , servo, cartridge(logic) valves- accumulator, accessories. Hydraulic components symbols- Design and application of hydraulic circuits of machine tool, press, Mobile hydraulic.

Pneumatic system, pneumatic components - pressure-flow-direction controls valves - pneumatic components symbols- Design and application of pneumatic circuits of machine tool.

Semi automats-automats-transfer lines - automatic assembly - transfer devices and feeders- classifications and applications-job orienting and picking devices- setting of automats and transfer lines.

Introduction to mechatronics, mechatronics system, Microprocessors and their applications, Sensors and Principles, PLC system, examples of mechatronics systems.

LAB EXERCISES:

1. Design, simulate and testing of Pneumatic and Electro Pneumatic circuits for engineering applications using actuators and control valves (pressure, flow and direction).
2. Design, simulate and testing of Hydraulic and Electro Hydraulic circuits for engineering applications using actuators and control valves (pressure, flow and direction).
3. Design, simulate and testing of PLC circuits for engineering applications using sensors.
4. Using MAT Lab/ SCI lab -Study on Robot programming and operation with vision systems

TEXTBOOKS:

1. Michael J. Pinches and John G. Ashby, Power Hydraulics, Prentice Hall, 1989.
2. DudleytA.Pease and John, J. Pippenger, Basic Fluid Power, Prentice Hall, 1983.

REFERENCES:

1. Doeblin, E.O. Measurement Systems, McGraw Hill, 1995.
2. Mechatronics 3/e,W, Bolton (Addison Wesley, ISBN 981-235-874-9.
3. Geoffrey Boothroyd, Assembly Automation and Product Design,Hardcover , 1992.
4. Rexroth- hydraulic training manual.

COURSE OUTCOMES:

- Understand hydraulic devices and their applications.
- Analyze the integrated product design
- Generate electro-hydraulic, electro-pneumatic solutions

PRPC28 ANALYSIS OF PRODUCTION SYSTEMS AND IELAB

L	T	P	C
2	0	2	3

PREREQUISITES: Operations research

COURSE OBJECTIVES:

- To understand production function, Design of Product, Planning functions, Material Planning and Layout and Scheduling

Engineering Economy and Costing: Elementary cost accounting and methods of depreciation; break-even analysis, techniques for evaluation of capital investments.

Production Planning: Forecasting techniques – causal and time series models, moving average, exponential smoothing, trend and seasonality

Capacity and aggregate production planning; master production scheduling; MRP and MRP-II Scheduling and priority dispatching

Inventory – functions, costs, classifications, deterministic and probabilistic inventory models, quantity discount; perpetual and periodic inventory control systems.

IE LAB EXERCISES

The objective of this lab is to have practical exposure on operations management and also to study on the ergonomic aspects of human evaluation.

Part-A Operations Management

1. Forecasting Models
2. Inventory Models
3. Scheduling Case studies
4. Material Requirements Planning
5. Project management

Part-B Ergonomics Study

1. Performance rating using stop watch
2. Peg board experiment
3. Time study trainer
4. Fitness study using treadmill
5. Fitness study using ergo cycle

TEXT BOOKS:

1. Buffa, E.S., "Modern Production/Operations Management", 8th edition, John Wiley sons, 2003.

2. Elsayed A Elsayed, Thomas O. Boucher, “Analysis and control of Production System”, Prentice Hall, 2002.

REFERENCES:

1. Samuel Eilon, "Elements of Production Planning and control", Universal Book Corp., 1999.
2. Krajervaki and Ritzman, "Operations management", Prentice Hall, 2009
3. Norman Gaither, Greg Frazier, Operations Management, Thomson Learning, 9th Edition, 2002.
4. Monks J.G. Operations Management, McGraw Hill, 2004

COURSE OUTCOMES:

- Effective Forecasting of Production functions
- Enhanced Planning of Product Design and Service Operations
- Facility Planning and Project Management

PRPC29 MANUFACTURING SYSTEM SIMULATION (Theory & Lab)

L	T	P	C
3	0	2	4

PREREQUISITES: Applied statistics, Resource Management Techniques

COURSE OBJECTIVES:

- To study various simulation software
- To simulate various production system model

Introduction to Simulation - Components of a system, Types of models, Monte Carlo Simulation, Steps in simulation, applications -Discrete Event Simulation – components of DES -Time advance mechanism.

Introduction – probability mass function, probability density function, Statistical models –Discrete distributions – Bernoulli, Binomial, Poisson, Geometric- Continuous distributions –Normal, Uniform, Exponential Gamma, Triangular Empirical Distributions

Properties of random numbers- Random number generation techniques – midsquare, mid product Constant multiplier, linear, additive congruential. Test for random numbers- uniformity, independence- Kolmogorov simronov test, chi squareRuns test, Gap test, poker test, autocorrelation test Random variate generation-Inverse transform Acceptance rejection, convolution method

Input Analysis Methods-Examples-Verification of simulation models- Validation of simulation models-Measure of performance and their estimation- Output Analysis Methods-Transient and steady state behavior – Evaluation of alternate system design – Simulation Based Optimization (SBO).

Simulation packages spreadsheet, witness, Arena etc., Simulation of queuing models, inventory models, Material handling, assembly systems, logistics and supply chains –Tutorial.

LAB EXERCISES

ARENA

Exercise 1: Simulation of Single Server Queuing

System. Exercise 2: Simulation of manufacturing shop

SIMQUICK

Exercise 3: Simulation of supply chain Inventory System

Exercise 4: Simulation of Multiple Servers Queuing System

Exercise 5: Simulation of batch shop manufacturing process

WITNESS

Exercise 6: Simulation of multi machine assignment system

Exercise 7: Simulation of Manufacturing and material handling systems

Exercise 8: Simulation of supply chain inventory system

GPSS

Exercise 9: Simulation of Job shop System

Exercise 10: Simulation of queuing System

Demo on QUEST, UGRIP, Systat, GAMS

TEXTBOOK:

1. Banks, Carson, Nelson and Nicol, Discrete-Event System Simulation,Prentice Hall of India Fourth Edition, 2005.

REFERENCES:

1. A. M. Law and W. D. Kelton, Simulation, Modeling and Analysis, McGraw-Hill ,Third Edition,2000.
2. Geoffrey Gordon, System simulation,Prentice Hall of India, second edition.

COURSE OUTCOMES:

- Understand the basics of Discrete event system simulation
- Apply several tests
- Acquire knowledge about the design/evaluation of different manufacturing systems using simulation modeling.
- Model and simulate using ARENA,SIMQUICK,WITNESS, Flexsim
- Familiarize QUEST, UGRIP, Systat
- Simulate job shop system and queuing system

PROGRAMME ELECTIVE (PE)

PRPE10 UNCONVENTIONAL MACHINING PROCESSES

L	T	P	C
3	0	0	3

PREREQUISITES: Machining Technology

COURSE OBJECTIVES:

- To understand several non-traditional machining process in micro and precision manufacturing field
- To select suitable machining process for materials considering their merits and demerits

Introduction - Classification - process economy - Mechanical machining - Types - Ultrasonic machining (USM) - Abrasive Jet Machining (AJM) - Abrasive Flow Machining (AFM) - Water Jet Machining (WJM) - Operating principle - Process parameters - Applications - Limitations.

Electro chemical machining - Chemical material removal - Types - Electro chemical machining (ECM) - Electro chemical drilling (ECD) - Electro chemical grinding (ECG) - Electro chemical honing (ECH) - Shaped tube electrolytic machining - Operating principle - Process parameters - Applications - Limitations.

Thermo electrical machining - Types – Electrical discharge machining (EDM) - Electrical discharge wire cutting (EDWC) - Electron beam machining (EBM) - Ion Beam Machining (IBM)-Plasma Arc Machining (PAM) - Operating principle - Process parameters - Applications – Limitations

Laser materials processing - Laser types - Processes - Laser beam machining (LBM) – Laser cutting (LC) – Laser drilling (LD) - Laser marking and engraving (LM) - Laser micromachining (LMM) - Laser engineered net shaping (LENS) - Applications - Limitations.

Special processing technologies - Rapid Prototyping - Methods - Fused Deposition Modeling (FDM) - Laminated Object Manufacturing (LOM) - Selective laser sintering (SLA) - Solid Ground curing (SGC) - 3D printing (3DP) - Processing of integrated circuits - Micro and nano fabrication technologies.

TEXT BOOKS:

1. Abdel, H. and El-Hofy, G. “Advanced Machining Processes”, McGraw-Hill, USA, 2005.
2. Wellar, E.J. "Non-Traditional Machining Processes", Society of Manufacturing

Engineers Publications, 2nd Edition, Michigan, 1984.

REFERENCES:

1. Steen, W.M. and Watkins, K. “Laser Materials Processing”, Springer London Ltd, 2003.
2. Groover, M.P. “Fundamentals of modern manufacturing processes - Materials, Processes and Systems”, 3rd Edition, John Wiley and Sons Inc., 2007.

COURSE OUTCOMES:

- Understand the contribution of non-traditional machining process in micro and precision manufacturing field.
- Select suitable machining process for suitable materials
- Summarizes the merits and demerits of the non-traditional manufacturing process.

PRPE11 PRECISION ENGINEERING (Theory& Lab)

L	T	P	C
2	0	2	3

PREREQUISITES: Machining technology

COURSE OBJECTIVES:

- To provide and enhance technical knowledge in precision engineering, its components and applications.

Precision machining – Concepts and significance – Classification - Top down – Bottom up approaches– Precision and micromachining - Machining of micro-sized components - Ultra precision machining grinding

Lithography – Photolithography - Electron beam lithography – Ion Beam lithography - Deep UV lithography–MEMS – Principle – Elements – Characteristics – Applications- Design and fabrication approaches.

Micro-manufacturing- Limits of capability of conventional mechanical manufacturing-Micro- machining-concepts-Types–Tools–Electrical Discharge Micro-Machining–Wire cut EDMM– Electro Chemical Micro-Machining-Abrasive Jet Micromachining - Laser based micromachining

Nano surface generation-Concepts and applications-Types- Ductile mode of machining- Diamond turning of parts to nanometer accuracy – ELID grinding – Chemo Mechanical Polishing- Magnetorhelogical finishing.

Precision metrology –In-process measurement of position of processing point - Post process and online measurement of dimensional features -Mechanical measuring systems - Optical measuring systems - Electron beam measuring systems – Scanning Tunneling – Atomic Force Microscope.

Precision Lab exercises

1. Exercise on Micro-turning operation on DT-110 Multi-process micro-machining center.
2. Exercise on Micro-milling operation on DT-110 Multi-process micro-machining center.
3. Exercise on Micro-drilling operation on DT-110 Multi-process micro-machining center.

TEXT BOOKS:

1. SeropeKalpakjain, "Manufacturing Engg. and Technology", Pearson Education, 2005
2. V.K.Jain, "Introduction to Micromachining", Narosa Publishing House, 2010

REFERENCES :

1. M.J. Madou, "Fundamentals of Micro Fabrication", CRC Press, 2002

2. Mark J. Jackson, "Micro Fabrication and Nano machining", Taylor and Francis, 2006

3. Yi Qin, "Micro-Manufacturing Engineering and Technology", Elsevier Publication,2010

COURSE OUTCOMES:

- Understand the concept of precision engineering, its principles and importance as applicable to instruments and machines.

PRPE12 MATERIAL HANDLING & STORAGE

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To understand about material handling systems
- To understand material storage methods
- To understand automation in material transfer

Introduction to material handling- Principle of material handling equipment-layout and aerial handling systems- Types of material handling systems.

Fixed Path Equipment- flexible-path equipment - Conveyers-automated guided vehicles (AGV) - Applications of AGV Production line equipments-pick and place robots-transfer devices-feeder lines, robotic devices

Conveyors-storage equipments-Automated ware houses- types of storage systems- small containers - unit load containers - rack and shelving

Automated storage and retrieval systems-methods of protecting materials for packages - auxiliary equipments -automated identifications systems

TEXTBOOKS:

1.Groover, M.P. "Automation ,Production systems and computer integrated manufacturing" Part V , P HAllInc.New Delhi, 2007

REFERENCE BOOKS:

1. Apple, J.M. "Materials handling systems design", The Ronald Press Co.N.Y. 2001

COURSE OUTCOMES

- Classify various material handling and and storage systems
- Identify various fixed path equipment
- Summarize various packaging techniques

PRPE13 MANUFACTURING OF COMPOSITE MATERIALS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the properties of composite materials
- To classify the composites based on properties
- To design metal matrix composite

FRP composites – Fiber types, fiber forms and properties, matrices type and properties, lamina, laminate, orthotrophy, anisotrophy, composites

Macro and micro-mechanical analysis and properties, Failure theories – Tsai – Hill, Tsai-Wu

Primary and secondary manufacturing of composites – Lay-up, Autoclave Molding filament Winding, Pultrusion, Compression Molding, RTM, RIM, SRIM, machining, drilling and routing

Metal matrix composites – Manufacturing route Design, Structural and testing, application

Ceramic matrix composites – Manufacturing routes and application

TEXTBOOKS:

1. Mein Schwartz., “Composite Materials Handbook”, McGraw Hill, 1992
2. AutarK.Kaw, “Mechanics of Composite Materials”, CRC Press, 2005.

REFERENCE BOOKS:

1. “ASM Hand book on Composites”, Volume 21, 2001

COURSE OUTCOMES:

- Define fundamentals of composite material strength and its mechanicalbehavior
- Classification of composites –matrix composites, metal matrix composites, Ceramic matrix composites reinforcement – particle reinforced composites, fiber reinforced composites
- Analysis of fiber reinforced Laminate design for different combinations of plies with different orientations of the fiber.

PRPE14 MACHINE TOOL TECHNOLOGY

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand different types of machine tools
- To analyse the source of vibration in machine structure
- To apply automation in machine control

Classification of machine tools - features construction and operation of basic machine tools - different types and mechanics of transmission of machine tool motion - kinematic structure of machine tools

Mechanical drives for rotational movement - stepped and step less O/P - mechanical drives for reciprocation

Strength and rigidity of machine tool structures - design of lathe beds - design of drill columns - analysis of spindle bearings hydrodynamic bearings - stack slip motion - hydrostatic bearings-

Vibration of machine - sources of vibration

Semi automation - automatic machines with mechanic controls.

TEXTBOOK:

1. Sen, G.C. and Bhattacharya, A., "Principles of machine tools", New Central Book Agency, Calcutta, 2006.

REFERENCE BOOKS:

1. Mehta, N.K., "Machine tool design", Tata McGraw Hill Co., N.Delhi , 2008.

COURSE OUTCOMES:

- Classify different types of machine tools
- Analyse vibration of machine structures
- Design lathe beds,drill columns

PRPE15 INDUSTRIAL ROBOTICS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the components of robot
- To understand the drives and programs used to actuate the robot
- To utilize robot technology in various applications

Fundamentals of Robotics: Definition - robot classification - robot arm geometry - power sources, application areas - control techniques - path control - robot controller operation - open loop and closed loop systems.

End of arm tooling and sensors: characteristics - classification - special purpose tools - Typical designs, compliance in Wrists. End Effectors: types, mechanical and other types of griper - types of sensors and applications.

Robot Programming And Languages: Language classification - program commands, arm motion, task point diagram - on line/off line programming, sample programs, program analysis - AI and experts systems.

Robot Applications: Robot applications in manufacturing - material transfer and machine loading / unloading - Processing operations like welding and painting - Assembly operations - Inspection Automation. Robot cell layouts - multiple robots and machine interference.

Recent developments: Recent developments in advanced Robotics –Modular concept - Special applications of robotics - micro robotics, Bio robotics - technologies and applications.

TEXTBOOKS:

1. Keramas,J.G. " Robot Technology Fundamentals", Delmer Publisher, 2002
2. Jain, K.C, and Aggarwal, L.N., "Robotics Principles and Practice", Khanna Publishers, 2001

REFERENCE BOOKS:

1. Groover, M.P., "Industrial Robotics", McGraw Hill International Editions, 2008.
2. Deb, S.R., "Robotics Technology and Flexible automation", Tata McGraw Hill Pub., New Delhi, 1994.

COURSE OUTCOMES:

- Explain the basic concepts, parts of robots and types of robots
- Identify the various drive systems for robot, sensors and their applications in robots, programming of robots
- Discuss about the various applications of robots, justification, implementation and safety of robot

PRPE16 PLANT ENGINEERING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To exemplify different types of plants and its functions
- To analyse the principles used in plants maintenance
- To understand the safety methods in plants

Organization of the plant engineering function-Classification of maintenance work-Electric power supply system's-Electric generators and turbines-compressors, ventilation and air-conditioning Producer Gas Plants-operation and safety aspects in P.G. Compressor and Oxygen plants Material handling system-AS and RS (Automatic Storage and Retrieval System)-AGV and robotics- piping system design and components-Pollution control and plant safety

Noise and vibration control - safety in plant operations, fire and electrical protection and prevention security equipment

Lubrication and corrosion**-** Synthetic and solid lubricants -lubrication systems - causes and control deterioration - paints and protective coatings.

TEXTBOOKS:

1. Rosaler, R.C. "Standard HandBook of Plant Engineering", 3rd Edition, McGraw Hill, 2002.

REFERENCE BOOK:

1. Lindley and Higgins, "Maintenance Engineers Hand Book", 7th Edition, McGraw HillProfessional, 2008.

COURSE OUTCOMES

- Understand the different type of plant and material handling system AS and RS (Automatic Storage and Retrieval System)-AGV and robotics
- Define the principles, functions and practices adapted in industry for the successful management of maintenance activities.
- Know about safety in plant operation, fire and electrical protection and prevention security equipment

PRPE17 NON-DESTRUCTIVE TESTING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study and understand various Non Destructive Evaluation and Testing methods, theory and their industrial applications.

OVERVIEW OF NDT: NDT Versus Mechanical testing, Overview of the Non Destructive Testing Methods for the detection of manufacturing defects as well as material characterisation. Relative merits and limitations, Various physical characteristics of materials and their applications in NDT., Visual inspection – Unaided and aided.

SURFACE NDE METHODS: Liquid Penetrant Testing - Principles, types and properties of liquid penetrants, developers, advantages and limitations of various methods, Testing Procedure, Interpretation of results. Magnetic Particle Testing- Theory of magnetism, inspection materials Magnetisation methods, Interpretation and evaluation of test indications, Principles and methods of demagnetization, Residual magnetism.

THERMOGRAPHY AND EDDY CURRENT TESTING: Thermography- Principles, Contact and non contact inspection methods, Techniques for applying liquid crystals, Advantages and limitation - infrared radiation and infrared detectors, Instrumentations and methods, applications. Eddy Current Testing- Generation of eddy currents, Properties of eddy currents, Eddy current sensing

elements, Probes, Instrumentation, Types of arrangement, Applications, advantages, Limitations, Interpretation/Evaluation.

ULTRASONIC TESTING (UT) AND ACOUSTIC EMISSION: Ultrasonic Testing-Principle, Transducers, transmission and pulse-echo method, straight beam and angle beam, instrumentation, data representation, A/Scan, B-scan, C-scan. Phased Array Ultrasound, Time of Flight Diffraction. Acoustic Emission Technique – Principle, AE parameters, Applications

RADIOGRAPHY: Principle, interaction of X-Ray with matter, imaging, film and film less techniques, types and use of filters and screens, geometric factors, Inverse square, law, characteristics of films - graininess, density, speed, contrast, characteristic curves, Penetrameters, Exposure charts, Radiographic equivalence. Fluoroscopy- Xero-Radiography, Computed Radiography, Computed Tomography

TEXT BOOKS:

1. Baldev Raj, T.Jayakumar, M.Thavasimuthu “Practical Non-Destructive Testing”, Narosa Publishing House, 2009.
2. Ravi Prakash, “Non-Destructive Testing Techniques”, 1st revised edition, New Age International Publishers, 2010

REFERENCES:

1. ASM Metals Handbook,”Non-Destructive Evaluation and Quality Control”, American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17.
2. Paul E Mix, “Introduction to Non-destructive testing: a training guide”, Wiley, 2nd Edition New Jersey, 2005
3. Charles, J. Hellier,“ Handbook of Nondestructive evaluation”, McGraw Hill, New York 2001.
4. ASNT, American Society for Non Destructive Testing, Columbus, Ohio, NDT Handbook,Vol. 1, Leak Testing, Vol. 2, Liquid Penetrant Testing, Vol. 3, Infrared and Thermal Testing Vol. 4, Radiographic Testing,

COURSE OUTCOMES:

- Upon completion of this course, the students can able to use the various Non Destructive Testing and Testing methods understand for defects and characterization of industrial components.

PRPE18 MICRO FABRICATION PROCESSES

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:

- To perform various micro fabrication processes to achieve very concise tolerances in micron level materials removal applications.

Micro manufacturing and fabrication- Classification- Substrates- Processes- Dimensions- Devices- Traditional vs advanced processes- Microforming- Micromolding- Microcasting- Microjoining- Clean rooms- Applications.

Laser micro processing- laser classification- interaction effects- parameters- mechanism- laser ablation- Laser assisted chemical etching-Techniques- Direct writing- Mask projection- Interference- Mirco-cutting, welding, drilling- Marking and engraving.

Semiconductor manufacturing - processes- Integrated circuit Manufacturing - Pattern transfer - E beam and X ray lithography - Etching - Doping - Diffusion and ion implantation - PVD- CVD- Process integration - CMOS - BiCMOS - Process monitoring.

Solar cell materials and processing- Crystalline Si Cell- Amorphous Si Cell - Thin Film Cell Technologies- Space and Concentrator Cells- Organic and Dye Sensitized Cells- Recent advancement.

Self assembly - Basics - Cheerios effect - Static, dynamic, template driven self assembly - assembly via capillary forces - structured surface - assembly by folding - magnetically and mechanically driven dynamic systems - self propelled systems.

REFERENCES:

1. V. K. Jain, "Micromanufacturing Processes", CRC Press, 2013.
2. Sami Franssila, "Introduction to Microfabrication", 2nd Edition, Wiley, 2010.
3. Narendra B. Dahotre, Sandip P. Harimkar, "Laser fabrication and machining of Materials", Springer, 2008.
4. Gary S. May, “Fundamentals of Semiconductor manufacturing”, Wiley, 2006
5. AugustinMcEvoy, L. Castaner, Tom Markvart, "Solar Cells: Materials, Manufacture and Operation", 2nd Edition, Elsevier, 2013.
6. John. A. Pelesko “Self assembly: the science of things that put themselves together”, Chapman& Hall/CRC, 2007

COURSE OUTCOMES:

- Students can perform various micro fabrication techniques to achieve micron level materials removal

PRPE19 SURFACE ENGINEERING

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:

- To apply various surface protection techniques to protect metallic materials from degradation and wear

Introduction- Significance of surface engineering- Solid surface- Surface energy- Superficial layer- Physico-chemical parameters- Properties of the superficial layer- Surface coating- Classification. Physical vapor deposition (PVD): Ion plating- Sputter deposition- Reactive deposition- Magnetron sputtering- Chemical vapor deposition (CVD)- Ion implantation- Electron beam technology- Applications.

Thermal Spraying Techniques- Flame Spraying, Atmospheric Plasma Spraying (APS), Vacuum Plasma Spraying (VPS), Detonation-Gun Spraying (D-GUN), High-Velocity Oxy-Fuel (HVOF) Spraying-Applications.

Laser surface engineering- Laser transformation hardening - Laser remelting- Laser alloying- Laser cladding- Laser ablation- Pulsed laser deposition- Laser doping - Laser crystallization- Laser surface texturing- Laser shock peening.

Methods of characterization-Microstructure- Mechanical: Adhesion-Hardness- Residual stress- Friction-Wear- Physical: Porosity-Density- Electrical: Conductivity- Magnetic- Chemical.

REFERENCES:

1.Tadeusz Burakowski, TadeuszWierzchon, “Surface Engineering of Metals- Principles, equipment and technologies”, CRC Press, 1999.

2. Lech Pawlowski, "The Science and Engineering of Thermal Spray Coatings", 2nd Edition, John Wiley & Sons, 2008.

3. William M. Steen, JyotirmoyMazumder, “Laser Material Processing”, 4th Edition, Springer Verlag, 2010.

COURSE OUTCOMES:

- Perform different surface protection techniques like PVD, thermal spray techniques and laser surface modification techniques for the protection of metallic surfaces

PRPE20 - INTRODUCTION TO FRICTION COMPOSITES

L	T	P	C
3	0	0	3

Introduction: Laws of friction- types of friction- wear- types of wear- mechanism involved in wear.

Brake system and Assembly: Basic requirements and functions of braking system, Types of brakes, hydraulic brake system, compressed air brake system, parking brakes, dual power brake system, regenerative brake system, fail-safe brake, anti –

lock braking system, electronic brake fore distribution, anti-skid braking system, brake efficiency and testing, weight transfer, braking ratio.

Types of Friction Materials & Applications: Friction Materials -Definition and Nature- Overview of types- Organic Friction Materials- Ceramic Friction Materials- Sintered Friction Materials- Applications of friction materials with industrial case studies.

Ingredients & Manufacturing: Raw Materials- Classification of raw materials: Fillers, Binders, Friction Modifiers, Structural Reinforcement- Properties of raw materials- Manufacturing Process– Industrial case studies.

Characterizations: Types of Characterizations: Physical, Chemical, Mechanical, Thermal, Tribologicaland Microstructural characterization as per industrial standards– case studies.

REFERENCES:

1. Automotive Brake Systems, Robert Bosh GmbH, 1995, First edition, USA.
2. ASM Handbook, Friction, Lubrication, and Wear Technology, Volume18, 1992, USA.
3. Peter J.Blau, Friction Science and Technology- From Concepts to Applications, Second Edition, 2009, CRC Press, USA.
4. Rudolf Limpert, Brake design and safety, II edition, SAE International, Warrendale,1999.

COURSE OUTCOMES:

- Demonstrate knowledge of brake systems principles and operations.
- Identify various raw materials and different types of friction composites.
- Study industrial standard practices in testing the friction composites and brake systems
-

PRPE21 PROCESSING OF POLYMERIC COMPOSITES

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:

- To enable students to understand the methods of preparation, properties and applications of thermoplastic materials covering commodity, engineering and high performance plastics.

Methods of manufacturing - Properties and applications of polyethylene - LDPE - LLDPE- HDPE, HMWHDPE- UHMWHDPE - Cross linked polyethylene- Chlorinated polyethylene - Polypropylene - Homopolymers - Copolymers.

Methods of manufacturing - Properties and applications of poly(vinyl chloride)- Poly (vinylidene chloride)- Poly(vinyl alcohol) - Poly(vinyl acetate)- Chlorinated poly(vinyl chloride)- Plastisols, Poly vinylpyrrolidiene, Polystyrene, HIPS, EPS, SAN, EVA, EPDM, ABS.

Methods of manufacturing - properties and applications of Acrylates - Poly (methyl methacrylate) - Polyacrylonitrile. Aliphatic polyamides –Aromatic polyamides- Polyethylene terephthalate - Polybutylene terephthalate - Polyacetals and copolymers -Polycarbonates- Thermoplastic polyurethane (TPU)

Methods of manufacturing- Properties and applications of Fluoro polymers - Polytetrafluoroethylene, Polychlorofluoroethylene, Thermoplastic polyurethanes, Biodegradable polymers - poly ξ–caprolactone and copolymers - polylactic acid- Bacterial polyhydroxy alkonates.

Preparation, properties and applications of High performance Thermoplastic materials PPS, PO, Polysulphone, Polyether Sulphone, PEEK, Polyimide. Biopolymer-cotton wool, collagen, hyaluroran.

TEXT BOOKS:

1. J.A.Brydson, “Plastics Materials”, Butterworth- Heinemann - Oxford, 6th Ed., 1995.
2. Feldman.D and Barbalata.A, “Synthetic Polymers”, Chapman Hall, 1996.

REFERENCES:

1. OlagokeOlabisi, “Hand Book of Thermoplastics”, Marcel Decker, inc., 1997
2. K.J. Saunders, “Organic Polymer chemistry”, Chapman & Hall, NY, 1988.
3. Irvin.I. Rubin, “Hand Book of Plastic Materials and Technology”, Wiley Interscience, NY, 1990.
4. Charles Gebelein, Biotechnological Polymers: Medical, pharmaceutical and industrial applications, CRC press,1993

COURSE OUTCOMES:

- Familiarize in manufacturing process of plastic
- Acquire skills in selecting polymeric materials for specific applications
- Demonstrate basic knowledge of degradable plastics

PRPE22 SUSTAINABLE MANUFACTURING (Theory & Lab)

L	T	P	C
2	0	2	3

PREREQUISITES: Fundamentals of Manufacturing

COURSE OBJECTIVES

- To understand the importance of sustainable manufacturing
- To study various tools/techniques of sustainable manufacturing
- To perform Life Cycle Assessment and assess environmental impacts of manufacturing processes
- To develop eco friendly products/processes

Sustainable Manufacturing - Concept of Triple bottom line, Environmental, Economic and Social Dimensions of Sustainability, Relation between lean and sustainable manufacturing.

Tools and Techniques – Environmental Conscious Quality Function Deployment, Life cycle assessment, Design for Environment, R3 and R6 cycles, Design for Disassembly, Design for recycling, Eco friendly product design methods.

Environmental Impact Assessment Methods –CML, EI 95 and 99, ISO 14001 EMS and PAS 2050 standards, Environmental Impact parameters.

Sustainability Assessment – Concept Models and Various Approaches, Product Sustainability and Risk/Benefit assessment– Corporate Social Responsibility.

Sustainable characteristics of manufacturing processes - Energy efficiency analysis of manufacturing processes - Software packages for sustainability analysis and LCA - Scope of sustainable manufacturing centres.

Laboratory Exercises:

Sustainability Analysis, Life Cycle Assessment, Design for Environment, Sustainable product design

Software packages used: Sustainability Xpress, GaBi, Simpro.

TEXTBOOKS:

1. G. Atkinson, S. Dietz, E. Neumayer, “Handbook of Sustainable Manufacturing”. Edward Elgar Publishing Limited, 2007.
2. D. Rodick, Industrial Development for the 21st Century: Sustainable Development Perspectives, UN New York, 2007.

REFERENCES :

1. P. Lawn, Sustainable Development Indicators in Ecological Economics, Edward Elgar Publishing Limited.
2. S. Asefa, The Economics of Sustainable Development, W.E. Upjohn Institute for Employment Research, 2005.

COURSE OUTCOMES:

- Recognize the need for sustainable manufacturing
- State-of-art tools and techniques of sustainable manufacturing
- Design Eco friendly processes/products

PRPE23 RAPID PROTOTYPING, TOOLING AND MANUFACTURING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To understand need of rapid prototyping process
- To understand about different Rapid prototyping process
- To understand tools used in Rapid prototyping techniques

Introduction- Need for the compression in product development, History of RP systems, Survey of applications, Growth of RP industry, Classification of RP systems.

Principle, process parameters, process details and applications of various RP processes - Stereo lithography systems, Selective Laser Sintering, Fused Deposition Modeling, Laminated Object Manufacturing, Solid Ground Curing, Laser Engineered Net Shaping, 3D Printing.

Rapid Tooling: Indirect rapid tooling - silicone rubber tooling, aluminum filled epoxy tooling, spray metal tooling, Direct rapid tooling - direct AIM, copper polyamide, sand casting tooling, laminate tooling, soft tooling Vs hard tooling.

Rapid Manufacturing Process Optimization- Factors influencing accuracy, data preparation errors, part building errors, errors in finishing, influence of part build orientation.

Allied Processes: Vacuum casting, surface digitizing, surface generation from point cloud, surface modification, data transfer to solid models.

TEXTBOOKS:

1. Pham D T and Dimov S S, "Rapid Manufacturing", Verlag, 2001.
2. Paul F Jacobs, "Stereo lithography and other RP&M Technologies", SME, 1996.

REFERENCE BOOKS:

1. Terry Wohlers, "Wohlers Report 2001", Wohlers Associates, 2008.

COURSE OUTCOMES

- Understand the principle, parameters and applications of R P processes
- Recognize various types of rapid tooling
- Identify different allied processes

PRPE24 FINITE ELEMENT METHODS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To apply partial differential equations in element analysis
- To evaluate the element shape using FEM
- To apply numerical methods in element analysis

Introduction-Different approaches in Finite Element Method - Steps involved in FEM--Types Of Elements Used

Interpolation Polynomials - Linear elements Shape function - Finite Element Formulation Of Field Problems

Classification of partial differential equations - Finite Element Formulation Of Solid Mechanics Problems

Axial force member - element matrices for axial force members - Truss element analysis of pinned truss - Two dimensional elasticity problems-Numerical Methods In FEM

Evaluation of shape functions - Solution of finite element equations - Cholesky decomposition, Skyline storage - Computer implementation.

TEXTBOOK:

1. Larry J Segerlind ," Applied Finite Element Analysis", John Wiley, 1984

REFERENCE BOOKS:

1. K.J.Bathe, "Finite Element Procedures", Prentice Hall, 1994.
2. Huebner and E.A.Thornton, "The Finite Element Method for Engineers", John Wiley,2008

COURSE OUTCOMES

- Obtain expertise in formulating finite element models for structurals thermal and vibrational problems.
- Obtain ability to solve FE models using numerical solutions.

PRPE25 PRODUCT DEVELOPMENT STRATEGIES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the complexities in product development
- To gain knowledge on tools/techniques of product development
- To recognize the need for design to suit environment

Product development versus design, types of design and redesign, modern product development process, reverse engineering and redesigning product development process, examples of product development process, scoping product development – S-curve, new product development.

Gathering customer needs, organizing and prioritizing customer needs, establishing product function, FAST method, establishing system functionality.

Tear Down and Experimentation- Tear down method, post teardown report, benchmarking and establishing engineering specifications, product portfolios.

Generating Concepts- Information gathering, brain ball, C-sketch/6-3-5 method, morphological analysis, concept selection, technical feasibility, ranking, measurement theory, DFMA, design for robustness

Design for the Environment: DFE methods, life cycle assessment, weighted sum assessment method, techniques to reduce environmental impact – disassembly, recyclability, remanufacturing regulations and standards, analytical and numerical model solutions.

TEXTBOOKS:

1. Kevin Otto and Kristin Wood, “Product Design – Techniques in Reverse Engineering and New Product Development”, Pearson Education, 2004.
2. Karl T Ulrich and Stephen D Eppinger, “Product Design and Development”, McGraw Hill, 1994.

COURSE OUTCOMES:

- Explain modern product development process
- Design for the Environment through DFE method life cycle assessment
- Gather customer needs

PRPE26 DESIGN FOR MANUFACTURE AND ASSEMBLY

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To identify opportunities for design.
- To address technical considerations of design and manufacturing.
- To utilize DFM and Concurrent Engineering Principles on a "real life" project.

Engineering design – Kinds of design – Design process steps – Factors influencing design – Concurrent Engineering – Material selection process – Evaluation methods for material selection

Process capability analysis – Cumulative effect of tolerances – Centrality analysis – Compound assembly – Selective and Interchangeable assembly – Grouped Datum systems

Design for castings – Design for weldments – Design for forgings – Design for sheet metal formed parts – Design for powder metallurgy parts – Design for plastic parts

Design for machining – Design for economy – Design for clampability – Design for ease of assembly – Design for disassembly

Advances in DFMA- Design for robustness – Axiomatic design – Design for environment – DFA index – Poka Yoke – Lean principles – Six sigma concepts – Computer aided DFA using software.

TEXTBOOKS:

1. Dieter, G.E., Engineering Design: A Materials and processing Approach, McGraw Hill Co. Ltd, 2000.
2. Boothroyd, G., Assembly, Automation and product design, CRC press, 2005.

REFERENCES

1. Eggert, R.J., Engineering Design, Pearson Education, Inc. New Jersey, 2005.
2. KalandarSaheb, S.D and Prabhakar, O., Engineering Design for Manufacture, ISPE 1999. 3Boothroyd, DFMA.

COURSE OUTCOMES

- Identify opportunities for design.
- Address technical considerations of design and manufacturing.
- Utilize DFM and Concurrent Engineering Principles on a "real life" project.

PRPE27 VIBRATION AND NOISE ENGINEERING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the sources of vibration and noise in automobiles and make design modifications to reduce the vibration and noise and improve the life of the components.

BASICS OF VIBRATION: Introduction, classification of vibration: free and forced vibration, undamped and damped vibration, linear and non-linear vibration, response of damped and undamped systems under harmonic force, analysis of single degree and two degree of freedom systems, torsional vibration, determination of natural frequencies.

BASICS OF NOISE: Introduction, amplitude, frequency, wavelength and sound pressure level, addition, subtraction and averaging decibel levels, noise dose level, legislation, measurement and analysis of noise, measurement environment, equipment, frequency analysis, tracking analysis, sound quality analysis.

AUTOMOTIVE NOISE SOURCES: Noise Characteristics of engines, engine overall noise levels, assessment of combustion noise, assessment of mechanical noise, engine radiated noise, intake and exhaust noise, engine necessary contributed noise, transmission noise, aerodynamic noise, tire noise, brake noise.

CONTROL TECHNIQUES: Vibration isolation, tuned absorbers, un-tuned viscous dampers, damping treatments, application dynamic forces generated by IC engines, engine isolation, crank shaft damping, modal analysis of the mass elastic model shock absorbers.

SOURCE OF NOISE AND CONTROL: Methods for control of engine noise, combustion noise, mechanical noise, predictive analysis, palliative treatments and enclosures, automotive noise control principles, sound in enclosures, sound energy absorption, sound transmission through barriers

TEXT BOOKS:

1. SingiresuS.Rao, “Mechanical Vibrations”, 5th Edition, Pearson Education, 2010

REFERENCES:

1. Benson H. Tongue, “Principles of Vibrations”, 2nd Edition, Oxford University, 2007
2. David Bies and Colin Hansen, “Engineering Noise Control – Theory and Practice”,4th

3. Edition, E and FN Spon, Taylore&Francise e-Library, 2009
4. William T. Thomson, Marie Dillon Dahleh, ChandramouliPadmanabhan, "Theory of
5. Vibration with Application", 5th Edition Pearson Education, 2011
6. Grover. G.T., "Mechanical Vibrations", Nem Chand and Bros., 1996

COURSE OUTCOMES:

- Understanding causes, source and types of vibrations in machineries
- Gaining knowledge in sources and measurement standard of noise
- Ability to design and develop vibrations and noise control systems.

PRPE28 CONCEPTS OF ENGINEERING DESIGN

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study about fundamental design standards and needs
- To learn about human and product factors involved in design concepts and rapid prototyping methods

DESIGN FUNDAMENTALS: Importance of design- The design process- Considerations of Good Design –Morphology of Design –Organization for design– Computer Aided Engineering – Designing to codes and standards – Concurrent Engineering – Product and process cycles – Technological Forecasting – Market Identification – Competition Bench marking.

CUSTOMER ORIENTED DESIGN & SOCIETAL CONSIDERATIONS: Identification of customer needs- customer requirements- Quality Function Deployment- Product Design Specifications- Human Factors in Design – Ergonomics and Aesthetics. Societal consideration - Contracts – Product liability – Protecting intellectual property – Legal and ethical domains – Codes of ethics – Ethical conflicts – Environment responsible design-future trends in interaction of engineering with society.

DESIGN METHODS: Creativity and Problem Solving –Creativity methods-Theory of Inventive Problem Solving(TRIZ)– Conceptual decomposition-Generating design concepts-Axiomatic Design – Evaluation methods-Embodiment Design-Product Architecture Configuration Design-Parametric Design. Role of models in design-Mathematical Modeling – Simulation – Geometric Modeling –Rapid prototyping-Finite Element Analysis– Optimization – Search Methods.

MATERIAL SELECTION PROCESSING AND DESIGN: Material Selection Process – Economics – Cost Vs Performance – Weighted property Index –

Value Analysis – Role of Processing in Design – Classification of Manufacturing Process – Design for Manufacture – Design for Assembly –Designing for castings, Forging, Metal Forming, Machining and Welding Residual Stresses – Fatigue, Fracture and Failure.

PROBABILITY CONCEPTS IN DESIGN FOR RELIABILITY: Probability – Distributions - Test of Hypothesis – Design of Experiments – Reliability Theory – Design for Reliability – Reliability centered Maintenance-Robust design – FMEA.

TEXT BOOK:

1. Dieter, George E., "Engineering Design - A Materials and Processing Approach", McGraw Hill, International Editions, Singapore, 2000.

REFERENCES:

1. Suh, N.P., "The principles of Design", Oxford University Press, NY.1990.
Karl T. Ulrich and Steven D. Eppinger "Product Design and Development" McGraw Hill Edition 2000

COURSE OUTCOMES:

- Demonstration of fundamental design standards and customer needs
- Understand human and product factors involved in design concepts
- Application of engineering design concepts

PRPE29 ENGINEERING OPTIMIZATION

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:

- To perform different optimization techniques to solve various engineering problems

Introduction: Introduction to engineering optimization - General principles – Classification - Problem formulation & their classifications – Classical optimization techniques – Single variable and multivariable optimization-Single and Multi objectives-Pareto Optimal solutions.

Unconstrained Optimization Techniques: Techniques of unconstrained optimization – Golden section, Random, Pattern and Gradient search methods – Interpolation methods.

Constrained Optimization Techniques: Optimization with equality and inequality constraints - Direct methods – Indirect methods using penalty functions.

Unconventional Optimization Techniques: Genetic Algorithms, Particle Swarm Optimization, Simulated Annealing and Ant Colony algorithm.

Applications: Structural applications – Design of simple truss members - Design applications – production planning, controlling and scheduling – Facility layout applications, etc.

TEXT BOOKS:

1. S.S. Rao, "Engineering Optimization – Theory & Practice", New Age International (P) Limited, New Delhi, 2009.
2. Kalyanamoy Deb, "Optimization for Engineering Design Algorithms and Examples", Prentice Hall of India Pvt. Ltd., 2006.

REFERENCES:

1. C. Johnson Ray, "Optimum Design of Mechanical Elements", Wiley, John & Sons,Digitized 2007.
2. D.E.Goldberg, "Genetic Algorithms in Search, Optimization and Machine", Barnen, AddisonWesley, New York, 1989.
3. C.S.Rao, "Optimization Techniques", DhanpatRai& Sons, New Delhi

COURSE OUTCOMES:

- Able to perform classical optimization techniques
- Able to perform constrained and unconstrained optimization techniques
- Able to perform optimization techniques for design of simple truss members, production planning and scheduling

PRPE30 COMPUTATIONAL FLUID DYNAMICS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce governing equations of viscous fluid flows

- To introduce numerical modelling and its role in the field of fluid flow and heat transfer
- To enable students to understand the various discretization methods, solution procedures and turbulence modelling.
- To create confidence to solve complex problems in the field of fluid flow and heat transfer by using high speed computers.

GOVERNING EQUATIONS AND BOUNDARY CONDITIONS: Basics of computational fluid dynamics – Governing equations of fluid dynamics – Continuity, Momentum and Energy equations – Chemical species transport – Physical boundary conditions Time-averaged equations for Turbulent Flow – Turbulent– Kinetic Energy Equations – Mathematical behaviour of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations.

FINITE DIFFERENCE AND FINITE VOLUME METHODS FOR DIFFUSION: Derivation of finite difference equations – Simple Methods – General Methods for first and second order accuracy – Finite volume formulation for steady state One, Two and Three – dimensional diffusion problems –Parabolic equations – Explicit and Implicit schemes – Example problems on elliptic and parabolic equations – Use of Finite Difference and Finite Volume methods.

FINITE VOLUME METHOD FOR CONVECTION DIFFUSION: Steady one-dimensional convection and diffusion – Central, upwind differencing schemes properties of discretization schemes – Conservativeness, Boundedness, Transportiveness, Hybrid, Power-law, QUICK Schemes.

FLOW FIELD ANALYSIS: Finite volume methods -Representation of the pressure gradient term and continuity equation –Staggered grid – Momentum equations – Pressure and Velocity corrections – Pressure Correction equation, SIMPLE algorithm and its variants – PISO Algorithms.

TURBULENCE MODELS AND MESH GENERATION: Turbulence models, mixing length model, Two equation (k-Є) models – High and low Reynolds number models – Structured Grid generation – Unstructured Grid generation – Mesh refinement – Adaptive mesh – Software tools.

TEXT BOOKS:

1. Versteeg, H.K., and Malalasekera, W., "An Introduction to Computational Fluid Dynamics: The finite volume Method", Pearson Education Ltd.Second Edition, 2007.
2. Ghoshdastidar, P.S., "Computer Simulation of flow and heat transfer", Tata McGraw Hill Publishing Company Ltd., 1998.

REFERENCES:

1. Patankar, S.V. "Numerical Heat Transfer and Fluid Flow", Hemisphere Publishing Corporation,2004.
2. Chung, T.J. "Computational Fluid Dynamics", Cambridge University, Press, 2002.
3. Ghoshdastidar P.S., "Heat Transfer", Oxford University Press, 2005
4. Muralidhar, K., and Sundararajan, T., "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, New Delhi, 1995.
5. ProdipNiyogi, Chakrabarty, S.K., Laha, M.K. "Introduction to Computational Fluid Dynamics", Pearson Education, 2005.
6. Anil W. Date "Introduction to Computational Fluid Dynamics" Cambridge University Press, 2005.

COURSE OUTCOMES:

- Perform numerical modelling and its role in the field of fluid flow and heat transfer
- Use various discretization methods, solution procedures and turbulence modelling to solve flow and heat transfer problems.

PRPE31 EXPERIMENTAL STRESS ANALYSIS

L	T	P	C
3	0	0	3

PREREQUISITES

- Strength of Materials.

COURSE OBJECTIVES:

To understand the basic aspects of experimental stress analysis that includes exhaustive treatment of the most versatile techniques like photo elasticity and strain gauges and also a brief introduction to the emerging techniques like digital image correlation.

Overview of Experimental Stress Analysis- Optical Methods Work as Optical Computers- Stress, Strain and Displacement Fields- Physical Principle of Strain Gauges, Photo elasticity and Moiré- Introduction to Moiré, Brittle Coatings and Holography- Hologram Interferometry, Speckle Methods- Introduction to Shearography, TSA, DIC and Caustics- Fringe Patterns – Richness of Qualitative Information

Multi-Scale Analysis in Experimental Mechanics- Selection of an Experimental Technique- Introduction to Transmission Photo elasticity- Ordinary and Extraordinary Rays- Light Ellipse, Passage of Light Through a Crystal Plate- Retardation Plates, Stress-optic Law- Plane Polariscope- Jones Calculus

Circular Polariscope-Determination of Photoelastic Parameters at an Arbitrary Point- Tardy's Method of Compensation-Calibration of Photo elastic Materials-Fringe Thinning Methodologies Photo elasticity Ordering Fringe in Miscellaneous-Topics in Transmission Photoelasticity -Three Dimensional Photoelasticity

Overview of Digital Photo elasticity-Introduction to Photoelastic Coatings-Correction Factors for Photoelastic Coatings-Coating Materials, Selection of Coating Thickness, Industrial Application of Photoelastic Coatings-Calibration of Photoelastic Coatings, Introduction to Brittle Coatings-Analysis of Brittle Coatings - Introduction to Strain Gauges-Strain Sensitivity of a Strain Gauge, Bridge Sensitivity, Rosettes

Strain Gauge Alloys, Carriers and Adhesives-Performance of Strain Gauge System-Strain Gauge Selection-Bonding of a Strain Gauge-Soldering, Accounting for Transverse Sensitivity Effects-Correction Factors for Special Applications-Special Gauges

REFERENCE BOOKS:

1. K. Ramesh, e-Book on Experimental Stress Analysis, IIT Madras, 2009. URL: http://apm.iitm.ac.in/smlab/kramesh/book_5.htm
2. K. Ramesh, Digital Photoelasticity â€“ Advanced Techniques and Applications, Springer, 2000.
3. W.N. Sharpe (Ed.), Springer Handbook of Experimental Solid Mechanics, Springer, 2008.
4. J.W. Dally and W.F. Riley, Experimental Stress Analysis, McGraw-Hill, 1991.

COURSE OUTCOMES:

- Understand stress strain analysis with its relation
- Recognize materials structure and testing methods

PRPE32 DESIGN OF AUTOMATED MANUFACTURING SYSTEM

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand pneumatic, electric, hydraulic and electronic systems in automation of mechanical operations.

FUNDAMENTAL CONCEPTS OF INDUSTRIAL AUTOMATION: Fundamental concepts in manufacturing and automation, definition of automation, reasons for automating. Types of production and types of automation, automation strategies, levels of automation.

TRANSFER LINES AND AUTOMATED ASSEMBLY: General terminology and analysis, analysis of transfer lines without storage, partial automation. Automated flow lines with storage buffers. Automated assembly-design for automated assembly, types of automated assembly systems, part feeding devices, analysis of multi-station assembly machines.AS/RS, RFID system, AGVs, modular fixturing. Flow line balancing.

PNEUMATIC CONTROL: Components, constructional details, filter, lubricator, regulator, constructional features, types of cylinders, control valves for direction, pressure and flow, air motors, air hydraulic equipments. PNEUMATIC CONTROL SYSTEM DESIGN: General approach to control system design, symbols and drawings, schematic layout, travel step diagram, circuit, control modes, program control, sequence control, cascade method, Karnaugh-Veitch mapping.

PROGRAMMABLE AUTOMATION: Special design features of CNC systems and features for lathes and machining centers. Drive system for CNC machine tools. Introduction to CIM; condition monitoring of manufacturing systems. DESIGN FOR HIGH SPEED AUTOMATIC ASSEMBLY: Introduction, Design of parts for high speed feeding and orienting, high speed automatic insertion. Analysis of an assembly. General rules for product design for automation. DESIGN OF MECHATRONIC SYSTEMS: Stages in design, traditional and mechatronic design, possible design solutions. Case studies-pick and place robot, engine management system.

ELEMENTS OF HYDRAULIC SYSTEMS: Pumps and motors- types, characteristics. Cylinders, types, typical construction details. Valves for control of direction, flow and pressure, types, typical construction details. HYDRAULIC SYSTEM DESIGN: Power pack–elements, design. Pipes- material, pipe fittings. seals and packing. maintenance of hydraulic systems. Selection criteria for cylinders, valves, pipes. Heat generation in hydraulic system ADVANCED TOPICS IN HYDRAULICS AND PNEUMATICS**:** Electro pneumatics, ladder diagram. Servo and Proportional valves - types, operation, application. Hydro-Mechanical servo systems. PLC- construction, types, operation, programming

TEXT BOOKS:

1. Mikell P Groover, “Automation Production Systems and Computer-Integrated Manufacturing” Pearson Education, New Delhi, 2001.
2. Bolton W, “Mechatronics“, Pearson Education, 1999.

REFERENCES:

1. Mikell P Groover, "Industrial Robots – Technology Programmes and Applications" , McGraw Hill , New York, USA. 2000.
2. Steve F Krar, "Computer Numerical Control Simplified", Industrial Press, 2001.
3. JoffreyBoothroyd, Peter Dewhurst and Winston A. Knight, "Product Design for manufacture and Assembly", CRC Press, 2011

COURSE OUTCOMES:

- Knowledge of industrial automation by transfer lines and automated assembly lines.
- Understanding of automated controls using pneumatic and hydraulic systems
- Ability to understand electronic control systems in metal machining and other manufacturing processes.

PRPE33 DESIGN AND ANALYSIS OF EXPERIMENTS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To provide an introduction to fundamental concepts of statistical Process control
- To enhance student understanding of the complexities of Statistical Analysis and control chart interpretation

Introduction- Planning of experiments – Steps – Need - Terminology: Factors, levels, variables, experimental error, replication, Randomization, Blocking, Confounding.

Single Factor Experiments- ANOVA rationale - Sum of squares – Completely randomized design, Randomized block design, effect of coding, Comparison of treatment means – Newman Kuel's test, Duncan's Multiple Range test, Latin Square Design, Graeco-Latin Square Design, Balanced incomplete design.

Factorial Experiments-Main and interaction effects –Two and three Factor full factorial Designs, 2^k deigns with Two and Three factors-Unreplicated design-Yate's Algorithm

Special Experimental Designs: Blocking in factorial design, Confounding of 2^k design, nested design-Response Surface Methods.

Taguchi Techniques- Fundamentals of Taguchi methods, Quality Loss function, orthogonal designs, application to Process and Parameter design.

TEXT BOOKS:

1. Montgomery, D.C. "Design and Analysis of Experiments", John Wiley and Sons, 5th Edition,2002.

REFERENCE BOOKS:

1. Hicks,C.R. "Fundamental concepts in the Design of Experiments", Holt, Rinehort and Winston, 2000.
2. Bagchi, T.P. "Taguchi Methods explained", PHI, 2002.
3. Ross, P.J. "Taguchi Techniques for quality Engineering", Prentice Hall, 2000.

COURSE OUTCOMES:

- Create steps, need and terminology for experiments
- Know about factorial experiments and special experimental techniques
- Apply Taguchi techniques for various design problems

PRPE34 AGILE MANUFACTURING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To enable manufacturing enterprises to be competitive by dynamically reconfiguring software, equipment and organization structures.

Types of Production- The Agile Production Paradigm- History of Agile Manufacturing- Agile Manufacturing Vs Mass Manufacturing, Agile Manufacturing Vs Mass Customization- Agile Manufacturing Research Centers.

Agile Practices- Agile practice for product development - Manufacturing agile practices - understanding the value of investing in people, Concept models of Agile Manufacturing- Infusing managerial principles for enabling agility.

Implementing technology to enhance agility- Implementing new technology – reasons – guidelines preparation for technology implementation - A checklist, technology applications that enhance agility - agile technology make-or-buy decisions.

Performance Measurement and Costing: Measurement of agility – methods – Scoring and Fuzzy approaches – Costing for Agile Manufacturing practices – Activity Based Costing.

Creating the learning factory: Imperative for success, factory becoming a learning factory, building a road map for becoming a learning factory - core capabilities, guiding vision, leadership that fits, ownership and commitment, pushing the envelope, prototypes, integration, learning challenges for learning manufacturing business.

TEXTBOOKS:

1. Gunasekaran A, "Agile Manufacturing, 21st Strategy Competitiveness Strategy", Elsevier Publications, 2001.
2. Montgomery J C and Levine L O, "The Transition to Agile Manufacturing – Staying Flexible for Competitive Advantage", ASQC Quality Press, Wisconsin, 1995.

REFRENCE BOOKS:

1. Goldman S L, Nagal R N and Preiss K, "Agile Competitors and Virtual Organizations", Van Nostrand Reinhold, 1995.

2. Brian H Maskell, "Software and the Agile Manufacturer, Computer Systems and World Class Manufacturing, Productivity Press, 1993

COURSE OUTCOMES

- Understanding recent trends in manufacturing
- Customization of product for manufacturing
- Implementation of new technology

PRPE35 INTEGRATED MATERIALS MANAGEMENT

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study the fundamentals of Integrated Materials Management, Inventory Management, Material Handling and to ensure that continuity of supply of materials to the users is maintained by avoiding out of stock situation.

Introduction to Integrated Materials Management – need, scope, functions and objectives of Materials Management. Purchasing function – purchase budget and materials budget – Source selection and development -Negotiations in purchasing - public buying - JIT concept

Inventory Management- Functions – Associated Costs – Classification – ABC – VED – FSN analysis - Basic EOQ model. Inventory control systems – Periodic Review – P system and Continuous review systems – Q systems – Lead-time analysis – Reorder point level Calculations.

MRP – Introduction – Terminology – Types of demand input to the MRP – Working Principle of MRP – Output of MRP – advantages and disadvantages. Stores Management: Stores function types of stores – storage procedures- stock verification and stock accounting – stores records

Material Handling: layout, selection of equipment, principles of materials handling – Packaging, types of material handling equipment

Introduction to Supply Chain Management – Understanding the supply chain – Supply chain performance – Supply chain Drivers and Obstacles – Supplier selection and Supplier evaluation

TEXTBOOKS:

1. Gopalakrisnan, P. “Purchasing and Materials Management”, McMillan Company, 2006
2. Telsang, M.“Industrial Engineering and Production Management”, S.Chand and Company, 2006

REFERENCE BOOKS:

1. Chary, S.N.“Production and Operations Management”, Tata McGraw Hill, 2006
2. Chopra, S. “Supply chain management”, Prentice Hall,2008

COURSE OUTCOMES:

- Understand various concepts and functions of material management
- Classification of inventory management
- Summarize Material handling and Logistic

PRPE36 LEAN MANUFACTURING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce the fundamentals of Lean Manufacturing and Components for Lean including: Waste identification and elimination (value stream analysis), 5S, JIT, Kaizen and Poke Yoke.

Objectives of lean manufacturing-key principles and implications of lean manufacturing- traditional Vs lean manufacturing. Value creation and waste elimination- main kinds of waste- pull production-different models of pull production-continuous flow-continuous improvement/Kaizen- worker involvement -cellular layout- administrative lean.

Standard work -communication of standard work to employees -standard work and flexibility - visual controls-quality at the source- 5S principles -preventative maintenance-total quality management-total productive maintenance - changeover/setup time -batch size reduction - production levelling.

Value Stream Mapping-The as-is diagram-the future state map-application to the factory simulation scenario-line balancing -Poke Yoke – overall equipment effectiveness. One Piece Flow-Process razing techniques – cells for assembly line – case studies

Introduction - elements of JIT - uniform production rate - pull versus push method-Kanban system - small lot size - quick, inexpensive set-up - continuous improvement. Optimised production technology.

Team establishment, transformation process, Project Management, Lean implementation, Reconciling lean with other systems- lean six sigma-lean and ERP-lean with ISO 9001:2000.

TEXTBOOKS:

1. Askin R G and Goldberg J B, “Design and Analysis of Lean Production Systems”, John Wiley and Sons Inc., 2003.
2. Hobbs, D.P. “Lean Manufacturing implementation”, Narosa Publisher, 2004.

REFERENCE BOOKS:

1. Micheal Wader, “Lean Tools: A Pocket Guide to Implementing Lean Practices”, Productivity and Quality Publishing Pvt Ltd, 2002.
2. Michael L George, David T Rowlands, Bill Kastle, “What is Lean Six Sigma”, McGraw Hill, New York, 2004.

3.Kenichi Sekine, “One-Piece Flow”, Productivity Press, Portland, Oregon, 1992.

4. Alan Robinson “Continuous Improvement in Operations”, Productivity Press, Portland, Oregon, 1991.
5. Poke - Yoke, "Improving Product Quality by Preventing Defects", Productivity Press, 1992.

COURSE OUTCOMES:

- Identify the waste and how to eliminate those waste
- Know the recent trends of manufacturing like just in time (JIT) and Pull Push system
- Implementation of some modern tool like 5S, Poke-Yoke and Kaizen in an organization

PRPE37 TOTAL QUALITY MANAGEMENT

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To facilitate understanding of Quality Management principles and tools.

Understanding quality, quality, competitiveness and customers, building quality chains, managing quality, quality in all functions, models and frame works for total quality management, Early TQM frameworks – quality award models – the four Ps and three Cs of TQM - a new model for TQM.

The TQM approach – commitment and policy – creating or changing the culture – effective leadership – excellence in leadership.

Design, innovation and improvement – the design process – quality function deployment (QFD) – the house of quality – specifications and standards - design in the service sectors – failure mode effect and criticality analysis (FMECA) – The links between good design and managing the business.

Human Resource Management - Introduction – strategic alignment of HRM policies – effective communication – employee empowerment and involvement – training and development – teams and team work – review, continuous improvement and conclusions – organizing people for quality – quality circles or kaizen teams.

Quality and Environmental Management Systems: Benefits of ISO registration - ISO 9000 series of standards ISO 9001 requirements – implementation – documentation – writing the documents – internal audits – registration - ISO 14000 series standards – concepts of ISO 14001 – requirements of ISO 14001 – benefits of EMS – integrating ISO 14000 with ISO 9000 – relationship between health and safety.

REFERENCE BOOKS:

1. Oakland J S, "Total Quality Management - Text with Cases", Butterworth – Heinemann – An Imprint of Elseiver, First Indian Print, 2005.
2. Besterfield D H et al, "Total Quality Management", Pearson Education Private Limited, 2004.

COURSE OUTCOMES:

- Apply TQM principle for continuous process improvement
- Lead teams for quality production
- Utilization of modern tool like QFD, FMECA to design and manage the business.

PRPE38 SUPPLY CHAIN MANAGEMENT

L	T	P	C
3	0	0	3

PREREQUISITES: Operations Research, Quality, Reliability & Safety Engineering

COURSE OBJECTIVES:

- To provide an insight on the fundamentals of supply chain strategy, logistics, sourcing and outsourcing supply chain networks, tools and techniques.

Evolution of supply chain-essentials of SCM-structure of supply chain, examples-process views-decision phases, issues - aligning supply chain with business strategy –supply chain decision variables, performance measures-new challenges - reverse logistics.

Supply chain configuration design - factors involved - sourcing, models for strategic alliances – supplier selection, outsourcing and procurement process – facility location and capacity allocation - modeling approaches LP, MILP - network design in uncertain environment – evaluation using simulation models.

Demand forecasting-collaborative forecasting models-bullwhip effect-information sharing - aggregate planning in supply chain- strategies-multi echelon inventory planning-models- discounting- risk pooling- centralized versus decentralized systems.

Roles of transportation- tradeoffs in transportation design-modes of transportation and their design - vehicle routing and scheduling - models - packaging-pricing and revenue management.

Role of IT in supply chain -IT infrastructure-CRM-SRM-e-business-RFID-supply chain collaboration-Decision Support System (DSS) for supply chain- selection of DSS for supply chain.

TEXTBOOKS:

1. Supply Chain Management: Strategy, Planning and Operations-Sunil Chopra, Peter Meindl, Prentice Hall India , 3rd ed., 2007.

REFERENCES:

1. Designing and Managing the Supply Chain: Concepts, Strategies, and Cases-David Simchi-Levi, Philip Kaminsky, Edith Simchi-Levi, Tata McGraw Hill, 3rd ed, 2007.

2. Modeling the supply chain, J. Shapiro, Thomson, 2nd ed., 2002

COURSE OUTCOMES:

- Define structure of supply chain
- Design supply chain configuration
- Analyze the role of Transportation in SCM

OPEN ELECTIVE (OE)

PROE10 OPERATIONS MANAGEMENT

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand various components and functions of operation management such as Aggregate Planning, process planning, production scheduling, Assembly Line Balancing.

Overview of Production System, Objectives of Operation Management, Scope of Operations Management, Operations Management Frame work, Relationship of operations with other Functional areas, Manufacturing Vs Service sector, Operations Decision making, Production Design Process and Process choices

Measures of capacity, Factors affecting capacity, Capacity planning, Systematic approach to capacity planning, Long-term and short-term capacity decisions, Tools for capacity planning, Capacity Requirement planning- Business process outsourcing

Aggregate Planning strategies and methods-Pure and mixed strategies-Transportation method- LPP method

Master Production Schedule, MRP-Lot sizing methods - Wagner and whitens algorithm, MRP II, CRP

Assembly Line Balancing – algorithms, Group technology – Production Flow analysis – Rank order clustering, Business Process Reengineering-JIT

TEXTBOOKS:

1. Analysis and control of Production System by Elsayed A Elsayed, Thomas O. Boucher,
Prentice Hall publications, 1993

2. Buffa, E.S., "Modern Production/Operations Management", 7th edition, John Wiley sons,2007.

REFERENCE BOOKS:

1. Krajewski and Ritzman, "Operations management", Addison Wesley Pub. Co, 2007

2.Norman Gaither, Greg Frazier, Operations Management, Thomson Learning, 9th Edition,2002. 3.Monks J.G. Operations Management, McGraw Hill, 2004

COURSE OUTCOMES

- Perform production management tasks.
- Describe the various components and functions of production planning and control such as capacity planning, aggregate planning, process planning, production scheduling, line balancing.
- Know the recent trends like manufacturing requirement Planning (MRP II) and Master production schedule (MPS)

PROE11 PROJECT MANAGEMENT

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the concepts of project definition, life cycle, Market and demand analysis, Financial analysis and systems approach and to handle the complex tasks of time estimation and project scheduling, including PERT and CPM

Introduction **-** Project Management: An Overview – Types, Characteristics of Projects – Project life cycle. Identification of investment opportunities - Screening and Selection, Project Appraisal

Market and demand analysis- market survey-demand forecasting methods-Technical analysis – manufacturing process, materials-product mix, plant location-project charts and layouts.

Financial analysis – cash flows for project appraisal- Investment evaluation using capital budgeting techniques - net present value, profitability index internal rate of return, payback period, accounting rate of return

Mathematical Techniques for project evaluation – Linear programming, goal programming, Network technique for Project Management – CPM, PERT, Multiple projects and constraints, scheduling.

Organization systems for project implementation- Work Breakdown-coordination and control- Project Management Soft wares

TEXTBOOKS:

1. Prasanna Chandra, “Projects – Planning, Analysis, Financing, Implementation and Review”, Tata McGraw Hill,4th Ed, 1997

REFERENCE BOOKS:

1. Mike Field and Laurie Keller, "Project Management", Thompson Business press, 2002
2. Gido and Clements, "Successful project management", Thompson south-western, 2nd edition 2003
3. John M Nicholas, "Project Management for business and technology", Pearson Education Asia, 2nd edition, 2001
4. Bhavesh M Patel, "Project Management – Strategic Financial planning, Evaluation and control", Vikas publishing house, 2000
5. S.Choudry "Project Management", ", Tata McGraw Hill,27th edition, 2006

COURSE OUTCOMES:

- Understand the Method for Project Identification & appriasial
- Develop & Analyze quantitative models for Project selection & Scheduling.

PROE12 VALUE ENGINEERING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To give a brief account of value analysis and engineering tool for productivity improvement and removing unnecessary cost through case studies

An Overview Of Value Engineering-Concepts and approaches of value analysis and engineering -importance of value, Function - identity, clarify – analysis

Evaluation of VE-Evaluation of function, Problem setting system, problem solving system, setting and solving management - decision - type and services problem, evaluation of value

Results accelerators, Basic steps in using the systems

Understanding the decision environment, Effect of value analysis on other work in the business- Life Cycle Cost (LCC), Case studies

VE Level Of Effort-VE Team, coordinator, designer, different services, definitions, construction management contracts, value engineering case studies, Effective

organization for value work, function analysis system techniques- FAST diagram, Case studies.

TEXTBOOKS:

1. Parker, D.E., "Value Engineering Theory", Sundaram publishers, 1990.

REFERENCE BOOKS:

1. Khanna, O.P., "Industrial Engineering and Management", DhanpatRai and Sons, 1999.

COURSE OUTCOMES:

- Understand the concept and approaches of value analysis and engineering
- Justify the value of money and value of product
- Implementation of Value Engineering in any type of organization

PROE13 ARTIFICIAL INTELLIGENCE & EXPERT SYSTEMS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study the concepts of Artificial Intelligence
- To understand the methods of solving problems using Artificial Intelligence
- To learn about the components of decision support system and expert systems.

Aspects of intelligence and AI - heuristic search - logic programming and reasoning - automatic programming-scope of AI-in manufacturing - components of intelligent manufacturing-

Requirements of AI languages - Languages Lisp and Prolog - simple programs

Knowledge engineering- protocol analysis - fuzzy logic - Semantic networks, learning systems - inference engine

Vision programs - factory vision systems - machine learning

Features of Experts systems - applications in manufacturing planning and control.

TEXTBOOKS:

1.Simons, G.L., "Introducing Artificial Intelligence", NCC Publications, 1984

REFERENCE BOOKS:

*1.*Maus, R and Keyes J Handbook of Expert Systems in manufacturing McGraw Hill, 1991
2. Ernest R Tello, "Mastering AI tools and techniques"

COURSE OUTCOMES:

- Describe the basic concepts, Operations and Principles of Artificial Intelligence
- Recognize the basic concepts, Operations and Principles of Fuzzy Logic
- Employ the concept of AI & fuzzy logic in Manufacturing Environments

PROE14 PROCESSING AND MANUFACTURING OF SEMICONDUCTORS

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:

• To learn what is semiconductor and its classification and also various models in fabrication and manufacturing techniques of semiconductor.

Introduction to semiconductors – Energy band theory – Classification – Intrinsic and extrinsic – P-type and N-type – P-N junction diode – semiconductor device design – photo-voltaic cells, bipolar and MOSFET transistor – applications

Basic requirements for semiconductor manufacturing - clean room – yield model – Wafer IC manufacturing – feature micro fabrication technologies – PSM – IC industry – New Materials – Bonding and layer transfer – devices – micro fabrication industries

Processing sequence – Oxidation – Growth kinetics, thin oxide growth, oxide quality – photolithography – Exposure tools, pattern transfer, deep UV sub-micron, E-beam lithography, X-Ray lithography – Etching – Wet chemical and dry etching

Doping – diffusion, Ion implantation – Physical and chemical vapour deposition – Planarization – chemical mechanical planarization – chemical-mechanical polish (CMP) – maintenance and troubleshooting

Modern semiconductor manufacturing – Process integration – Bipolar technology, CMOS technology – CMOS fabrication sequence – BiCMOS technology – Packaging – Die separation, Package types, attachment methods

REFERENCES:

1. Yoshio Nishi, Robert Doering, "Handbook of Semiconductor Manufacturing Technology", Second Edition, CPC press, 2008
2. Gary S. May, Costas J. Spanos, "Fundamentals of Semiconductor Manufacturing and Process Control", Wiley- interscience, 2006
3. Hwaiyu Geng, "Semiconductor Manufacturing Handbook", McGraw Hill Professional, 2005

COURSE OUTCOME:

- To understand semiconductor and its types.
- To understand and apply various processing techniques to fabricate semiconductors.

PROE15- AUTOMOBILE COMPONENT MANUFACTURING PROCESSES

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:

- To learn the basic processes available to make an automobile part/product. It will help the students to select the best manufacturing process based on quality/time/cost/ mechanical properties.

Introduction: Classification and comparison of manufacturing processes. Criteria for selection of a process.

Casting: Casting of engine block - conventional and expendable pattern, Casting for cylinder heads, connecting rod and gudgeon pins, Casting of piston, upset forging of valves, piston ring manufacturing & Engine bearing manufacturing, Manufacturing of friction plates, Manufacture of composite friction lining, Casting of gear box casing,

precision forging of gears, Continuous casting of propeller shaft, Forging of rear axles, casting of rear axle casing, wheels, brake drum.

Metal Forming: Basic concepts and classification of forming processes. Thermoforming, hydro forming & press forming, welding of body panels, Rolling, Extrusion, Wire drawing, Spinning. Powder metallurgy, steps involved, applications.

Advanced Manufacturing Processes: Use of EDM, ECM, ECG, USM, PAM, LBM for manufacturing of automobile components. Super Finishing Processes: Introduction to Grinding, Lapping, Honning, Buffing, Barrel Tumbling, Burnishing, Powder coating, Polishing.

Recent advances Application of sensors and actuators – Emission control system – catalytic converter – Hydro forming of exhaust manifold and lamp housing – stretch forming of Auto body panels – MMC liners – thermal barrier coating of Engine head and valves – Selection of materials for Auto components.

REFERENCES:

1. Hajra Choudhury, Elements of Workshop Technology, Vol-I and Vol-II Asia Publishing House, 1996.
2. R.K.Jain and S.C.Gupta, Production Technology, Hanna Publishers, 1997.
3. H.M.T. Production Technology-Hand Book, Tata McGraw Hill, 1990
4. Philip F Ostwald and Jairo Munuz, "Manufacturing Processes and Systems", John Wiley & Sons, New York, 1998.
5. Kalpakjian, "Manufacturing Engineering and Technology", Pearson Education, 2005.

COURSE OUTCOME:

- Identify and select the methods of forging – for gudgeon pin, Crankshaft, connecting rod, camshaft, rocker arm, gears, shaft & axles, material suitability for above components ,casting equipment's, forging defects
- Select the non-conventional machining like EDM, ECM, ECG,USM,PAM,LBM for manufacturing automobile components

PROE16 LASER MATERIALS PROCESSING

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:

- To study the different processes of laser methods and their characteristics.
- To know various surface treatment techniques to protect degradation and wear.

Fundamentals of laser - properties - spectrum and wavelength - types of laser - laser components - interaction of laser radiation with materials.

Laser surface treatment - laser transformation hardening - advantages over conventional processes - laser surface melting - laser alloying - laser cladding.

Introduction to laser welding - process arrangement - process mechanisms - operating characteristics - process variations - applications.

Introduction - methods of cutting - theoretical models of cutting - practical performance -applications - process variations - drilling - applications.

Laser marking-engraving-methods and processing-applications-laser cleaning-laser shock processing-laser peening-laser engineered net shaping

REFERENCES:

1. William M. Steen, “Laser Material Processing”, Springer Verlag, 2003.
2. K.Thyagarajan, Ajoy K.Ghatak, “Lasers, Theory and Applications”, Plenum Press, 1981.
3. J.F. Reddy, “Industrial Applications of Lasers”, Academic Press, New York, 1978.
4. Michael Bass, “Laser Materials Processing”, Elsevier Science, 1983.

MINOR (MI)

PRMI10 MANUFACTURING PROCESSES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To perform different machining operations like turning, drilling, milling and finishing.
- To predict tool life and tool failure

CASTING: Types of pattern - Types of cores - Green Sand Molding - Tools and equipment - Cupola and Blast Furnaces

WELDING: Welding Principle and Types - Gas Welding – GMAW – TIG – MIG – Plasma Welding – Resistance Welding - Friction welding

FORMING: Classification of Forming – Forging and its Types – Upsetting –Extrusion of Solid Rod – Rolling of Plate – Drawing of wire – Sheet metal operations

MACHINE TOOL: Studies on Centre Lathe – Drilling – Milling– Shaper – Grinding

MACHINING: SPCT geometry – Orthogonal Cutting – Machining cylindrical Job – Gear Cutting –Taper turning and Thread Cutting Methods

TEXT BOOKS:

1. NagendraParashar,andMittal,R.K,Elementsofmanufacturingprocesses,Prentice Hall of India PrivateLimited,1st Edition,2003
2. HajraChoudhurySK,BoseHKandHajraChoudhuryAK,ElementsofWorkshopTechnology,Vol.I , Vol.II,Media promotersand PublishersPvt. Ltd. 12th Edition,2007.

REFERENCES:

1.Khanna,O.PandLal,M,ATextbook of ProductionTechnology,Vol.II, DhanpatRai Publications (P)ltd.,1st Edition, 2009.

2.H.M.T, Production Technology, Tata McGrawHill Publishing Co.Ltd, 1st Edition, 2008.
3.ASMHandbook, Machining.

COURSE OUTCOMES:

- Summarizethe theoryofmetal cuttingandcompute cuttingforces involved from Mohr's circle.
- Recognizevarious partsof lathe list the accessories and explain various operations performed.
- Explain the construction of drilling, boring, reaming and milling machines and explain operations performed

PRMI11 CAD, CAM and CAE (Theory & Lab)

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To understand geometric modeling and graphic standards of CAD systems
- To understand basics of CAM
- To understand finite element modeling and DBMS

Basic concepts of CAD, CAD workstation, CAD software, application of CAD, Interactive graphics: point plotting techniques, Transformations techniques, viewing operations.

Geometric modeling: Wireframe modeling, Surface modeling, Solid modeling. Graphics standards, Parametric design, Visual realism.

Computer aided manufacturing: NC/CNC, computer aided process monitoring - adaptive control, computer-aided process planning.

Production planning - capacity planning - shop floor control - computer integrated manufacturing systems, application.

Finite element modeling and analysis: types of analysis, degrees of freedom, element and structure-stiffness equation, assembly procedure. Database concepts and data base management systems - SQL.

LAB EXERCISES: Part modelling using CAD, Turning operation using CNC, Engineering analysis using CAE

REFERENCE BOOKS:

1. Anand, V.B., Computer Graphics and Geometric Modeling for Engineers, John Wiley and Sons, Inc., 2000.
2. Zeid,I and Sivasubramanian, R., CAD/CAM, Tata McGraw-Hill, 2007.
3.Mikell P. Groover and Emory W. Zimmers, Jr., CAD/CAM Computer Aided and Manufacturing Eastern Economy Edition,PHI
4.Larry J Segerlind ,“ Applied Finite Element Analysis”, John Wiley, 1984
5.YoramKoren, "Computer Control of Manufacturing Systems", McGraw Hill Book co. New Delhi, 1986.

COURSE OUTCOMES

- Summarize the concepts and applications of CAD and modelling
- CNC code generation for CNC Turning
- Finite element analysis using software

PRMI12 UNCONVENTIONAL MACHINING PROCESSES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand several non-traditional machining process in micro and precision manufacturing field
- To select suitable machining process for materials considering their merits and demerits

Unconventional machining Process – Need – classification – Brief overview.

Abrasive Jet Machining – Water Jet Machining – Abrasive Water Jet Machining – Ultrasonic Machining.(AJM, WJM, AWJM and USM). Working Principles – equipment used – Process parameters – MRR- Applications.

Electric Discharge Machining (EDM)- working Principle-equipment-Process Parameters-Surface Finish and MRR- electrode / Tool -Tool Wear – Dielectric – Flushing –Wire cut EDM – Applications.

Chemical machining and Electro-Chemical machining (CHM and ECM)-Etchants – Maskant -techniques of applying maskants - Process Parameters – Surface finish and MRR-Applications. Principles of ECM- equipment-Surface Roughness and MRR Electrical circuit-Process Parameters-ECG and ECH - Applications.

Laser Beam machining and drilling (LBM), plasma Arc machining (PAM) and Electron Beam Machining (EBM). Principles – Equipment –Types - Beam control techniques – Applications.

TEXT BOO KS:

1. Abdel,H.andEl-Hofy,G."AdvancedMachiningProcesses",McGraw-Hill,USA,2005.
2. Pandey P.C. and Shan H.S. "Modern Machining Processes" Tata McGraw-Hill, New Delhi, 2007.

REFERENCES:

1. Benedict. G.F. "Nontraditional Manufacturing Processes" Marcel Dekker Inc., New York, 1987.
2. McGeough, "Advanced Methods of Machining" Chapman and Hall, London (1998).
3. Paul De Garmo, J.T.Black, and Ronald.A.Kohser, "Material and Processes in Manufacturing" 8th Edition, Prentice Hall of India Pvt. Ltd., New Delhi , 2001.

COURSE OUTCOMES:

- Understand the contribution of non-traditional machining process in micro and precision manufacturing field.
- Select suitable machining process for suitable materials
- Summarizes the merits and demerits of then on-traditional manufacturing process

PRMI13 INDUSTRIAL ENGINEERING AND MANAGEMENT

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the concepts of Industrial Engineering, Operational Research Techniques, Simulation, Supply Chain Management and Quality Engineering.

Introduction to Industrial Engineering – Method study, Time study, Motion Economy, Value Analysis, Demand Forecasting, Scheduling

Production Planning and Control - Inventory Control, Material Requirement Planning, Aggregate Planning, Material Handing, Group technology, Facility planning, Design of Product and Process Layouts.

Supply Chain Management - Understanding the Supply Chain, Achieving Strategic Fit, Drivers and Metrics, Designing the Supply Chain Network - Managing Cross Functional Drivers in a Supply Chain.

Operational Research Techniques – Linear Programming, Transportation, Assignment models, Queuing Theory, Simulation.

COURSE OUTCOMES:

- Summarize different techniques for production planning and control like inventory control and Material requirement.
- Apply optimization in utilization of resources like queuing uncertainty and mathematical modeling are involved
- Perform work measurements and computerized layout planning

REFERENCES

1. Sunil Chopra and Peter Meindel , Supply Chain Management: Strategy, Planning, and Operation, Prentice Hall of India, 2002.
2. R.Paneerselvam, Production and Operations Management, (3rd edition) PHI Learning Pvt Ltd,2012.
3. Jerry Banks, Discrete Event System Simulation, Prentice Hall ,2010.
4. Hamdy A. Taha, Operations Research an Introduction, Prentice Hall ,1997.
5. O.P.Khanna, Industrial Engineering and Management, Dhanpat Rai, 1980.

PRMI14 QUALITY ENGINEERING

L	T	P	C
3	0	0	3

PREREQUISITES: Probability and Statistical Methods

COURSE OBJECTIVES:

- To impart knowledge to enable the students to design and implement Statistical Process Control in any industry
- To design and implement acceptance sampling inspection methods in industry

QUALITY FUNDAMENTALS

Importance of quality- evolution of quality- definitions of quality- dimensions of quality- quality control- quality assurance- areas of quality- quality planning- quality objectives and policies quality costs- economics of quality- quality loss function- Quality Gurus and their contributions.

CONTROL CHARTS FOR VARIABLES

Process variation- preliminary decisions- control limits and their computation- construction and application of X bar, R and S charts- warning and modified control limits- process adjustment for trend,- Comparison of process variation with specification limits

STATISTICAL PROCESS CONTROL

Process stability- process capability study using control charts- capability evaluation- Cp, Cpk and Cpm – machine capability study- gauge capability study- setting statistical tolerances for components and assemblies - individual measurement charts- X-chart, moving average and moving range chart.

CONTROL CHARTS FOR ATTRIBUTES

Limitations of variable control charts- Control charts for fraction non-conforming- p and np charts, variable sample size, - Control chart for nonconformities (defects)- c, u, demerits control chart- applications.

ACCEPTANCE SAMPLING

Need- economics of sampling- sampling procedure- single and double sampling- O.C. curves-Average outgoing quality- Average sample number- Average total inspection- Multiple and sequential sampling- Design of sampling plans.

COURSE OUTCOMES:

- Control the quality of processes using control charts for variables in manufacturing industries.
- Control the occurrence of defective product and the defects in manufacturing companies.
- Control the occurrence of defects in services.
- Achieve savings in rupees to the companies through quality control and improvement programmes.

TEXT BOOK:

1. Douglus C. Montgomery, “Introduction to Statistical Quality Control”, John Wiley & Sons, 2004.

REFERENCES:

1. Krishnaiah K.,” Applied Statistical Quality Control and Improvement”, PHI, 2014.
2. Eugene L. Grant and Richard S. Leaven Worth, “Statistical Quality Control”, TMH, Seventh Edition, 2000.
3. Dale H. Besterfield, Quality Control, Pearson Education Asia, Seventh Edition, 2004.

Essential programme laboratory Requirement (ELR)

PRLR10MANUFACTURING PROCESSES LAB– I

L	T	P	C
0	0	3	2

PREREQUISITE COURSES: Branch specific course and Workshop practice

COURSE OBJECTIVES:

- To perform all lathe operations to produce a component of their need.

EXERCISE-1: Step turning

EXERCISE-2: Taper turning and parting off

EXERCISE-3: Knurling

EXERCISE-4: Thread cutting

EXERCISE-5:Boring

EXERCISE-6: Eccentric turning

EXERCISE-7: Copy turning

COURSE OUTCOMES:

- Summarize the machine tool construction.
- Create work pieces by turning, boring using lathe and drilling machine.
- Utilize different machine tool attachments

PRLR12 MANUFACTURINGPROCESSES LAB– II

L	T	P	C
0	0	3	2

PREREQUISITE COURSES: Workshop practical and Metallurgy and Materials Engineering

COURSE OBJECTIVES:

- To perform various operations on special machines like milling machine, drilling machine, grinding machine and slotting machine.

EXERCISE-1: Shaping rectangular block or cube

EXERCISE-2: Slot cutting/ Step-cutting/ V-lock

EXERCISE-3: Milling rectangular block or cube

EXERCISE-4: T -Slot milling

EXERCISE-5: Spur gear cutting

EXERCISE-6: Surface grinding

EXERCISE-7: Single point tool grinding

EXERCISE-8: Spur and Helical gear generation on hobbing machine

EXERCISE-9: Complex shaped component production using EDM.

EXERCISE-10: Drilling

COURSE OUTCOMES:

- Hands on Experience on lathe machine, Milling machine, drilling machine
- Hands on experience on casting methods.
- Hands on experience on welding

PRLR13 WELDABILITY AND FORMABILITY TESTING LAB

L	T	P	C
0	0	3	2

PREREQUISITE COURSES: Metallurgy and Materials Engineering

COURSE OBJECTIVES:

- To weld materials effectively and evaluate weldment properties

LAB EXERCISES

1. Arc butt welding of mild steel
2. Arc lap welding of mild steel
3. Macrostructure and microstructure evaluation of nugget zone
4. Bending testing on welded plates.
5. Hardness test on weldments

COURSE OUTCOMES:

- Application of welding knowledge to fabricate sound parts
- Application of testing knowledge to evaluate the quality of weldments.

FORMABILITY TESTINGLAB

PREREQUISITE COURSES: Metallurgy and Materials Engineering

COURSE OBJECTIVES:

- To test the formability of sheet metals

LAB EXERCISES

1. Tensile testing
2. Three point bend test
3. Deep drawing test

COURSE OUTCOME:

- Able to test sheet metals and evaluate their properties

PRLR14 MACHINE DRAWING PRACTICE

L	T	P	C
1	1	2	4

PREREQUISITES: Engineering Graphics

COURSE OBJECTIVES

- To prepare the precise machine drawings for manufacture of components.
- To facilitate better product design.
- To interpret and generate suggestions about drawings.

Conventions, Abbreviations and symbols: Conventional representations of interrupted views, symmetrical objects, intersection curves, square ends and openings, adjacent parts,

Common machine elements, springs, gear drives–Abbreviations, designation and composition of ferrous materials, nonferrous materials and engineering drawing.

Limits, Fits and Tolerances, tolerance grades, fundamental deviation, indication of tolerances- classification, system, selection and indication of fits, geometrical tolerances, surface texture.

Screw threads and threaded fasteners,types of bolts and nuts, locking pins, screws. Rivetjoints, Keys and welded joints.

Assembly Drawing: Cotter and pin joints, couplings, clutches, pulleys and pipe joints.

Assembly Drawing: Bearings, heat engine parts, valves, pumps and machine parts.

TEXTBOOK:

1.Gopalakrishna, K. R., Machine Drawing, Subhas stores, Bangalore, 16th Edition,2002.

REFERENCES:

1. Varghese, P. L. and John, K.C., Machine Drawing, Jovast Publishers, 1993.
2. BIS, SP:46 -1988 - Engineering Drawing Practicefor Schools and Colleges, 1992.
3. Facultyof Mechanical Engineering, PSGCollegeof Technology, DesignData Book, M/s.DPV Printers, Coimbatore, 1993.

COURSE OUTCOMES:

- Prepare the precise machine drawings for manufacturing of components.
- Facilitate better product design.
- Interpret and give suggestion about the drawings.

PRLR15 PRODUCTION DRAWING AND COST ESTIMATION

L	T	P	C
1	0	2	2

PREREQUISITES: Machine Drawing, Design of machine elements

COURSE OBJECTIVES

- To understand the fundamentals of manufacturing drawings
- To develop process sheets and production drawing for various assemblies
- To perform cost and time estimation

Review of Current international standards (ISO) and Indian Standards (IS) - Geometric Dimensioning and Tolerancing-Centrality Analysis-Compound Assembly.

Process Sheet -Fundamentals-Contents -Preparation of process sheet for various components. Manufacturing Drawings: Surface texture indication on drawing-welds symbolic representation of drawings. Given a sub-assembly/assembly to prepare manufacturing drawings of components, Sample exercises on CAD-preparation of manufacturing Drawings.

Re-dimensioning and Tolerance Charting: Introduction to re-dimensioning to suit manufacturing requirements-manufacturing datum-functional datum. Introduction to tolerance charting

Cost Estimation: Preparation of Process chart for a given component-estimation of setting time and machining time-estimation of material cost, labour cost and overhead cost based on supplied data-Kaizen costing-Activity Based costing-Lifecycle costing.

TEXTBOOK:

1.IS :10714,10715,10716,10717,11669,10719,813,919,2709,8000 pt 1 to 10721,11158 and AWS/ISO

REFERENCES:

1.Siddeshwar and Kanniah ,"Machine Drawing",Tata McGraw Hill 2001

2.Gopalakrishna, K.R., "Machine Drawing" 16th Edition, Subhas Stores, 2002.

3. Wade, O. "ToleranceControl in design and manufacturing", IndustrialPress, 1972

COURSE OUTCOMES:

- Interpretation of contents of production drawing
- Development of process sheet and manufacturing drawings
- Systematic estimation of cost and time

Advanced level courses for B.Tech (HONORS)

PRHO10 TOLERANCETECHNOLOGY

L	T	P	C
3	0	0	3

(Use of approved design data book is permitted in the examination)

PREREQUISITE COURSE: Machine drawing practice

COURSE OBJECTIVE:

- To recognize the importance of tolerances
- To perform tolerance analysis

Introduction to Geometric Dimensioning and Tolerancing, Scope, Definitions, and General Dimensioning, General Tolerancing and Related Principles, Symbology, Datum Referencing, Tolerances of Location, Tolerances of Form, Profile, Orientation, and Runout

Properties of the surface, Principles for tolerancing, Principles for geometrical tolerancing. Profile tolerancing, Tolerancing of cones, Positional tolerancing, Projected tolerance zone, Substitute elements, Maximum material requirement, Envelope requirement, Least material requirement.

Tolerancing of flexible parts, Tolerance chains(accumulation of tolerances), Statistical tolerancing.

General geometrical tolerances, Tolerancing principles, Tolerancing of edges, ISO Geometrical Product Specifications (GPS).

REFERENCES:

1. GeneR. Cogorno “GeometricDimensioning and Tolerancingfor Mechanical Design”, McGraw-Hill,2006
2. Georg Henzold “Geometrical Dimensioning and Tolerancing for Design, Manufacturing and Inspection-A Handbookfor Geometrical Product Specification using ISOand ASME Standards”, Elsevier, Second edition
3. Bryan R. Fischer “Mechanical ToleranceStackupand Analysis” AdvancedDimensional Management, Sherwood, Oregon, U.S.A., MarcelDekker,Inc.
4. ASME “Dimensioning and Tolerancing”,Y14.5M-1994 [REVISION OF ANSI Y14.5M-1982 (RI98811)]

COURSE OUTCOMES:

- Interpretation of tolerances
- Perform tolerance analysis

PRHO11 ROBOTICS

L	T	P	C
3	0	0	3

PREREQUISITE COURSE: Computer Integrated Manufacturing

COURSE OBJECTIVE:

- To understand the fundamentals of robotics
- To perform robot programming

Fundamentals of robotics– wrists design -end effectors – actuators - modular robots.

Robot and its peripherals-sensors, machine vision-image processing &analysis-application of artificial intelligence, voice communication-robot control units-motion controls.

Robot kinematics-homogeneous transformations-forward & inverse kinematics-problems of dynamics-differential relationships-motion trajectories-dynamics of a robot control of single multiple link robot-static force analysis.

Robot Programming -different languages-expert systems.

Robot applications in manufacturing-material transfer& machine loading/unloading-processing operations–inspection-automation-robot cell design–control–recent developments and special applications-Micro &Bio robotics.

REFERENCES:

1. Richard D Klafter, Thomas A Chmielewski&Michael Negin,“RoboticEngineering– An Integrated Approach”, PrenticeHall, 1994.
2. Deb, S.R., “RoboticTechnology and FlexibleAutomation”, Tata McGrawHill, 1994.

COURSE OUTCOMES:

- Demonstration of knowledge in robotic engineering
- Develop programming for robot applications

PRHO12 INTELLIGENT MANUFACTURING SYSTEMS

L	T	P	C
3	0	0	3

PREREQUISITE COURSE: Mechatronics and Industrial automation

COURSE OBJECTIVE:

- To understand the basic concepts of intelligent manufacturing
- To develop knowledge base systems for various applications

Basic concepts of Artificial intelligence and expert systems-System Components-System architecture and Data flow– System Operations

Knowledge based systems-knowledge representation– knowledge acquisition and optimization-Knowledge based approaches to design mechanical parts and mechanisms and design for automated assembly

Knowledge based system for material selection–Intelligent process planning system.

Intelligent system for equipment selection-Intelligent system for project management& factory monitoring. Scheduling in manufacturing–scheduling the shopfloor–Diagnosis& trouble shooting

The role of Artificial Intelligence in the factory of the future–Intelligent systems.

REFERENCES:

1. Andrew Kussiak,, “Intelligent Manufacturing Systems”, PrenticeHall , 1990.
2. Simons, G.L,“Introducing Artificial Intelligence”, NCC Pub, 1990.

COURSE OUTCOMES:

- Development of knowledge based systems
- Application of Artificial Intelligence for future automated factories.

PRHO13 TOTAL QUALITYENGINEERING

L	T	P	C
3	0	0	3

PREREQUISITE COURSE: Quality, Reliability and Safety Engineering

COURSE OBJECTIVES:

- To study the quality control tools and ISO Standards
- To understand TQM applications in service sector

Principles of TQM–Quality Gurus and their contributions–Old and New Quality Control tools-Quality Function Deployment–Failure Modes and Effect Analysis–Vendor relations–vendor qualification process–vendor quality surveys–Vendor quality improvement–vendor quality rating and evaluation-ISO9000 standards–ISO14000 standards–Quality Costing–Quality Audit–Product and Process audit–Six Sigma–Benchmarking-TQM in Service Sector–Application case studies on TQM.

REFERENCES:

1. DaleH.Besterfield,“TotalQualityManagement”,PearsonEducationAsia,(Indianreprint 2002)
2. Rose, J.E. Total Quality Management, Kogan PageLtd. 1993.

3. John Bank, The essenceof total quality management, PHI1993.
4. Greg Bounds, Lyle Yorkset al, Beyond Total Quality Management, McGraw Hill,1994.

COURSE OUTCOMES:

- Apply TQM principle for continuous process improvement
- Lead teams for quality production
- Utilization of modern tool like QFD, FMECA to design and manage the business

PRHO14 PRODUCT ANALYSIS AND COST OPTIMIZATION

L	T	P	C
3	0	0	3

PREREQUISITE COURSE: Production drawing and cost estimation

COURSE OBJECTIVES:

- To perform value engineering projects
- To perform cost accounting

New product strategy, market definition-idea generation-design process-forecasting sales potential-product engineering, manufacturing planning-selection of economical process- standardization -simplification– specialization -break even analysis.

Value engineering – evaluation of function determining function-classifying function-evaluation of costs-evaluation of worth-determining worth-evaluation of value-value engineering.

Job plan information phase-speculation phase-analysis phase-development phase-presentation phase-implementation phase-follow up phase- fast diagramming-cost models- lifecycle costs.

Cost accounting-cost estimation

Cost calculations for machined components,welding,casting and forging components- calculation of selling price – activity based cost analysis.

REFERENCES:

1. Samual Eilon, “Elements of Production Planningand Control”,UniversalBookCo, 1984
2. Narang, C.B.S and Kumar V, “Production and Costing”, Khannapublishers ,1983.

COURSE OUTCOMES:

- Execute value engineering projects
- Cost computation for various fabricated products

PRHO15 DECISION SUPPORT SYSTEMS

L	T	P	C
3	0	0	3

PREREQUISITE COURSE: Work Design and Facilities planning

COURSE OBJECTIVES:

- To introduce decision support systems and show their relationship to other computer-based information systems,
- To demonstrates development approaches, and to utilize DSS capacities to support different types of decisions

DSS components- Data warehousing, access, analysis, mining and visualization-modeling and analysis-DSS development -Group support systems- enterprise DSS-supply chain and DSS-knowledge management methods, technologies and tools-Artificial intelligence and expert systems- Representation in logic and schemas, semantic networks, production rules and frames, inference techniques – DSS applications.

REFERENCES:

1. Efraim Turban and Jay E Aronson, Decision Support and Intelligent Systems, Pearson education Asia, Seventh edition, 2005.
2. Elain Rich and Kevin Knight, Artificial intelligence, TMH, 2006.
3. VickiL. Sauter, Decision Support Systems for Business Intelligence John Wiley&Sons.
4. Turban, Decision Support And Business Intelligence Systems,8/E,PearsonEducation India, 2011.
5. FradaBurnstein, Clyde W.Holsapple.,Handbook on Decision Support Systems Springer, 2008.

COURSE OUTCOMES:

- Recognize the importance of decisions in the work and use DSS Software Tools.
- Evaluation of the Success/Failure of Decision Support Systems
- Discuss the advantages/disadvantages of different Types of decision support systems and analyze practical cases from the life for different problems (technical ,management)

PRHO16 KNOWLEDGE MANAGEMENT

L	T	P	C
3	0	0	3

PREREQUISITE COURSE: Work Design and Facilities planning

COURSE OBJECTIVE:

- To understand the fundamental concepts in the study of knowledge and its creation, acquisition, representation, dissemination, use and re-use, and management.

Knowledge society- Drivers of knowledge management-Intellectual capital- KM and learning organizations-Strategic alignment- Evaluation and strategic alignment-Infrastructural development and deployment- Role of CKO-Analyzing business environment-knowledge audit and analysis – designing KM team, system– Technology components- Intranet and Groupware solutions- tools for collaborative intelligence- Social networking-package choices- knowledge security-Integrating with web -based and internal operational & support systems- change management-reward systems- continuous improvement – Intellectual Property Rights.

REFERENCES:

1. GuusSchreiber,Hans Akkermans, Anjo Anjewierden, Robert de Hoog, Nigel Shadbolt, Walter Vande Velde and Bob Wielinga, "Knowledge Engineering and Management", Universities Press, 2004.
2. EliasM.Awad&HassanM.Ghaziri,"KnowledgeManagement",PearsonEducation, 2004.

COURSE OUTCOMES:

- Appreciate the role and use of knowledge in organizations and institutions, and the typical obstacles that Knowledge Management aims to overcome.
- Understandthecoreconcepts,methods,techniques,andtoolsforcomputersupportof knowledge management.
- Understandhowtoapplyandintegrateappropriatecomponentsandfunctionsofvarious knowledge management systems.

PRHO17 PRODUCT LIFECYCLE MANAGEMENT

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:

- To understand product lifecycle management strategies
- To recognizePLM integration with other functions

New Product Development ,Introduction to PLM,Product Data Management(PDM), Views of PLM, PLM Strategies and its Development, Product Design Modeling and simulation in product design. Integration of PLM with other applications,Technology, Forecasting, Virtual product development tools, Product structures

REFERENCES:

1. AnttiSaaksvuori, AnselmiImmonen, " Product LifecycleManagement", Springer, 2005
2. John Stark, " Product lifecycle management: 21st century paradigm for product realization", Springer 2006
3. Michael Grieves, "Product lifecycle management:Driving thenext generation of lean thinking", McGraw-Hill, 2006

COURSE OUTCOMES:

- Understand PLM applications
- Develop product data management tools

PRHO18 TECHNOLOGY MANAGEMENT

L	T	P	C
3	0	0	3

PREREQUISITE COURSE: Operations Research

COURSE OBJECTIVE:

- To understand technology development process
- To recognize technology management issues in the context of advanced manufacturing systems

Definition-scope-components -Issues in managing new technology, Life cycle approach to technology management-Approaches to forecasting, Technology performance parameters. Use of Experts in technology forecasting, planning technological process, Morphological analysis of a Technology system-Techno-Economic feasibility study, Application of multi-criteria decision making techniques in technologies evaluation and selection-AHP, fuzzy AHP-Modes of global technology transfer-Technology–Human Interface-Organization structures and Technology Implementation issues in new technology – Technology Management issues in the context of lean, agile and sustainable systems – Intellectual Property Rights.

REFERENCES:

1. Joseph M. Putti, Management– A Functional Approach, McGraw Hill, 1997
2. Kenneth C. Lauden , MIS: Organisation and Technology, Prentice Hall, 1995
3. James A.Senn, Information technology in Business, Prentice Hall, 1995
4. Ronald J. Jordan, Security analysis and Portfolio Management, Prentice Hall, 1995

COURSE OUTCOMES:

- Develop an awareness of the range, scope, and complexity of technological innovation, and the issues related to managing technological change.
- Understand different approaches to manage innovation, with multi-criteria decision making techniques
- Clearly identify drivers and barriers to technological innovation within an organization.

PRHO19 MULTI-CRITERIA DECISION MAKINGTECHNIQUES

L	T	P	C
3	0	0	3

PREREQUISITE COURSE: Operations Research

COURSE OBJECTIVE:

- To recognize the need for Multi-criteria decision making
- To understand various MCDM methods

Multi-Criteria Decision Making – An Overview – Classification of MCDM methods – Simple Additive Weighting method – Weighted Product method - Network based

MCDM methods – Analytic Hierarchy Process – Revised Analytic Hierarchy Process – Analytic Network Process - Outranking MCDM methods – PROMETHEE , ELECTRE , TOPSIS - Compromise Ranking method - VIKOR, ORESTE – DEMATEL - Fuzzy based MCDM methods – Hybrid MCDM methods – Group Decision Making- Graph Theory and Matrix approach – Goal Programming – Balanced Scorecard Approach - MCDM application areas – Case studies on application of MCDM techniques.

REFERENCES:

1. Belton,V.,Stewart,T.J.MultipleCriteriaDecisionAnalysis:AnIntegratedApproach ,Kluwer AcademicPublishers, Dordrecht, 2003.
2. Triantaphyllou, E., Multi-Criteria Decision Making Methods: A Comparative Study, Springer, 2010.
3. Pedrycz,W.,Ekel,P.,Parreiras,R.,2011.FuzzyMultiCriteriaDecision-Making:Models, Methods and Applications, JohnWiley&Sons, 2011.
4. Kahraman,C.,FuzzyMulti-criteriaDecisionMaking:TheoryandApplicationswith Recent Developments, Springer, 2008.

COURSE OUTCOMES:

- Understanding of various MCDM methods
- Apply MCDM methods for real time applications