SCHEME and SYLLABUS

for

BACHELOR OF TECHNOLOGY

in

MECHANICAL ENGINEERING

DEPARTMENT OF MECHANICAL ENGINEERING

J.C.BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA, FARIDABAD

J. C. Bose University of Science and Technology, YMCA, Faridabad
(formerly YMCA University of Science and Technology)
A State Govt. University established wide State Legislative Act. No. 21 of 2009
SECTOR-6, FARIDABAD, HARYANA-121006

GOLDEN JUBILEE YEAR
(1969-2019)

VISION

J C Bose University of Science & Technology, YMCA, Faridabad aspires to be a nationally and internationally acclaimed leader in technical and higher education in all spheres which transforms the life of students through integration of teaching, research and character building.

MISSION

- To contribute to the development of science and technology by synthesizing teaching, research and creative activities.
- To provide an enviable research environment and state-of-the-art technological exposure to its scholars.
- To develop human potential to its fullest extent and make them emerge as world class leaders in their professions and enthuse them towards their social responsibilities.

Department of Mechanical Engineering

VISION

To be a centre of excellence by producing high caliber, competent and self-reliant mechanical engineers, who possess scientific temperament and would engage in activities relevant to industries with ethical values and flair to research.

MISSION

- To provide efficient engineers for global requirements by imparting quality education.
- To explore, create and develop innovations in various aspects of engineering through industries and institutions.
- To emphasize on practical skills and socially relevant technology.

ABOUT THE PROGRAMME

J C Bose University of Science & Technology, YMCA, Faridabad established in 2009, formerly known as YMCA Institute of Engineering, Faridabad, was established in year 1969 as a Joint Venture of Govt. of Haryana and National Council of YMCA of India with active assistance from overseas agencies of West Germany to produce highly practical oriented personnel in specialized fields of engineering to meet specific technical manpower requirements of industries. Mechanical Engineering Department was started in 1969 and has been conducting B.Tech Course in Mechanical Engineering of 4-Years duration since 1997. Students are admitted through centralized counseling nominated by state government in 1st Year and 2nd year through lateral entry entrance test. The total intake for the B.Tech programme is 120 and 24 through LEET in second year. Besides under graduate degree courses, it is also running M.Tech Mechanical Engineering Course (with specialization in Manufacturing Technology and Automation) and Ph.D. All courses are duly approved by AICTE/ UGC. The Mechanical Engineering Department has been well known for its track record of employment of the pass out students since its inception.

The Department has four storey building with 08 class rooms, 14 laboratory, three workshops, twelve offices, Seminar Hall and Conference Hall. It has established Centre of Excellence with Danfoss Industries (P) Ltd in the area of 'Climate and Energy' and one with Daikin in the field of 'Refrigeration and Air Conditioning'. It has excellent faculty with 9 Professors, 04 Associate Professors and 15 Assistant Professors. The various syllabi of UG/PG courses in Mechanical Engineering Department, has been prepared with active participation from Industry. The Department is organizing number of expert lectures from industry experts for students in every semester. Seven month training is mandatory for every B.Tech student. Emphasis has been given on project work and workshop for skill enhancement of students. Choice based credit system allows students to study the subjects of his/her choice from a number of elective courses /audit courses.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO-1:
To train students with practical skills and experimental practices related to core and applied areas of mechanical engineering to expand their knowledge horizon beyond books..

PEO-2:
To enable students to design, develop and maintain mechanical equipments which are useful for the society.

PEO-3:

To improve team building, team working and leadership skills of the students with high regard for ethical values and social responsibilities.

PEO- 4:
To enable students to communicate effectively and demonstrate the knowledge of project management and independent research.

PROGRAMME OUTCOMES (POs)

Engineering Graduates will be able to:

1)Engineering Knowledge: Apply knowledge of mathematics, science, engineering fundamentals, and mechanical engineering to the solution of engineering problems.

2)Problem Analysis: Identify, formulate, review literature and analyze mechanical engineering problems to design, conduct experiments, analyze data and interpret data.

3)Design /Development of Solutions: Design solution for mechanical engineering problems and design system component of processes that meet the desired needs with appropriate consideration for the public health and safety, and the cultural, societal and the environmental considerations.

4)Conduct Investigations of Complex Problems: Use research based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions in mechanical engineering.

5)Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to mechanical engineering activities with an understanding of the limitations.

6)The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to mechanical engineering practice.

7)Environment and Sustainability: Understand the impact of the mechanical engineering solutions in societal and environmental contexts, and demonstrate the knowledge and need for sustainable development.

8)Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the mechanical engineering practice.

9)Individual and Team Work: Function affectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings in mechanical engineering.

10)Communication: Communicate effectively on complex engineering activities with the engineering committee and with society at large, such as, being able to comprehend and write affective reports and design documentation, make effective presentations in mechanical engineering.

11)Project Management and Finance: Demonstrate knowledge & understanding of the mechanical engineering principles and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments in mechanical engineering.

12)Life- Long Learning: Recognize the need for, and the preparation and ability to engage in independent research and lifelong learning in the broadest contest of technological changes in mechanical engineering.

PROGRAM SPECIFIC OUTCOMES(PSOs):

1) To apply practical skills, knowledge of engineering fundamentals and mechanical engineering, to industries and institutions.

2) To explore, create and develop innovations in various aspects of engineering. The student will be ready to take-up career or to pursue higher studies with high regard to ethical values and social responsibilities.

J.C.BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA, FARIDABAD

SYNOPSIS OF

SCHEME OF STUDIES & EXAMINATIONS

4 YEARS BACHELOR of TECHNOLOGY PROGRAMME IN

MECHANICAL ENGINEERING

SEMESTER I – VIII

(w.e.f. Session 2018-19)

B. TECH SCHEME CREDITS CALCULATIONS

S.No.	Category of Courses	Contact Hours	Credits
1.	Programme Core Courses (PCC)	71	63
2.	Basic Science Courses (BSC)	28	25
3.	Engineering Science Courses (ESC)	32	23
4.	Humanities and Social Sciences including Management Courses (HSMC)	4	3
5.	Programme Elective Courses (PEC)	15	15
6.	Open Elective Courses (OEC)	9	9
7.	Skill Enhancement Courses (SEC)	24	22
8.	Mandatory Audit Courses (MAC)	4	0
9.	Massive Open Online Courses (MOOCS)	0	0*
	Total	**187**	**160**

Note: ***** MOOCS course will be opted by students any time during their B. Tech programme to earn extra credits of maximum 20, to get honours in B.Tech.

SEMESTER WISE SUMMARY OF THE PROGRAMME

S.No.	Semester	No. of Contact Hours	Marks	Credits
1.	I	25	650	19.5
2.	II	26	600	18.5
3.	III	32	900	28
4.	IV	28	750	21
5.	V	26	700	20
6.	VI	24	750	21
7.	VII/VIII	26	800	22
8.	VIII/VII	One Semester	500	10
	Total	**187**	**5650**	**160**

PROGRAMME CORE COURSES (PCC)

S.No.	Code	Name of the Course	No. of Contact Hours	No. of Credits	Semester
1.	PCC-ME-201	Thermodynamics	3	3	III
2.	PCC-ME-203	Strength of Material	3	3	III
3.	PCC-ME-205	Fluid Mechanics and Machines	4	4	III
4.	PCC-ME-207	Mechanics of Solids Lab	2	1	III
5.	PCC-ME-209	Fluid Mechanics and Machines Lab	2	1	III
6.	PCC-ME-202	Applied Thermodynamics	4	4	IV
7.	PCC-ME-204	Materials Engineering	3	3	IV
8.	PCC-ME-206	Kinematics of Machines	3	3	IV
9.	PCC-ME-208	Advanced Strength of Materials	3	3	IV
10.	PCC-ME-210	Manufacturing Processes	3	3	IV
11.	PCC-ME-212	Thermal Lab –I	2	1	IV
12.	PCC-ME-214	Materials Engineering Lab	2	1	IV
13.	PCC-ME-216	Kinematics of Machines Lab	2	1	IV
14.	PCC-ME-301	Heat and Mass Transfer	3	3	V
15.	PCC-ME-303	Dynamics of Machines	3	3	V
16.	PCC-ME-305	Design of Machine Elements- I	4	4	V
17.	PCC-ME-307	Refrigeration and Air-conditioning	3	3	V
18.	PCC-ME-309	Thermal Lab- II	2	1	V
19.	PCC-ME-311	Dynamics of Machines Lab	2	1	V
20.	PCC-ME-302	CAD/ CAM	3	3	VI
21.	PCC-ME-304	Manufacturing Technology	3	3	VI
22.	PCC-ME-306	Design of Machine Elements – II	3	3	VI
23.	PCC-ME-308	CAD/ CAM Lab	2	1	VI
24.	PCC-ME-401	Automation in Manufacturing	3	3	VII/ VIII
25.	PCC-ME-403	Operations Research	3	3	VII/ VIII
		Total	**71**	**63**	

BASIC SCIENCE COURSES (BSC)

S.No.	Code	Name of Course	No. of Contact Hours	No. of Credits	Semester
1.	BSC-103	Mathematics-I	4	4	I
2.	BSC-102	Chemistry	4	4	I
3.	BSC-105	Chemistry Lab	3	1.5	I
4.	BSC-101	Physics	4	4	II
5.	BSC-106	Mathematics- II	4	4	II
6.	BSC-104	Physics Lab	3	1.5	II
7.	BSC-202	Mathematics-III	3	3	III
8.	BSC-01	Biology	3	3	III
		Total	**28**	**25**	

ENGINEERING SCIENCE COURSES (ESC)

S.No.	Code	Name of Course	No. of Contact Hours	No. of Credits	Semester
1.	ESC-101	Basics of Electrical Engineering	4	4	I
2.	ESC-105	Basics of Electrical Engineering Lab	2	1	I
3.	ESC-104	Workshop- I	4	2	I
4.	ESC-103	Programming for Problem Solving	3	3	II
5.	ESC-105	Programming for Problem Solving Lab	4	2	II
6.	ESC-102	Engineering Graphics and Drawing	4	2	II
7.	ESC-106	Workshop- II	4	2	II
8.	ESC-201	Basics of Electronics Engineering	3	3	III
9.	ESC-203	Engineering Mechanics	4	4	III

		Total	**32**	**23**	

HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT COURSES (HSMC)

S.No.	Code	Name of Course	No. of Contact Hours	Credits	Semester
1.	HSMC-101	English	2	2	I
2.	HSMC-1002	English Lab	2	1	I
		Total	**4**	**3**	

PROGRAMME ELECTIVE COURSES (PEC)

S.No.	Name of Course	No. of Contact Hours	No. of Credits	Semester
1.	ProgrammeElective I	3	3	VI
2.	ProgrammeElective II	3	3	VI
3.	ProgrammeElective III	3	3	VII/ VIII
4.	ProgrammeElective IV	3	3	VII/ VIII
5.	ProgrammeElective V	3	3	VII/ VIII
	Total	**15**	**15**	

OPEN ELECTIVE COURSES (OEC)

S.No.	Name of Course	No. of Contact Hours	No. of Credits	Semester
1.	Open Elective Course I	3	3	V
2.	Open Elective Course II	3	3	VI
3.	Open Elective Course III	3	3	VII/ VIII

	TOTAL	**9**	**9**	

SKILL ENHANCEMENT COURSES (SEC)

S.No.	Code	Name of Course	No.of Contact Hours	Credits	Semester
1.	SEC-WS-201	Workshop III	4	2	III
2.	SEC-WS-202	Workshop IV	4	2	IV
3.	SEC-WS-301	Workshop V	4	2	V
4.	SEC-WS-302	Workshop VI	4	2	VI
5.	SEC-WS-403	Workshop VII	4	2	VII/ VIII
6.	SEC-401	Project (Major)	4	2	VII/ VIII
7.	SEC-402	Industrial Training	One semester	10	VIII/ VII
		Total	**24**	**22**	

MANDARORY AUDIT COURSES (MC)

S.No.	Code	Name of Course	No. of Contact Hours	Credits	Semester
1.	MC-01	Environmental Science	2	0	IV
2.	MC-02	Essence of Indian Traditional Knowledge	2	0	V
		Total	**4**	**0**	

PROGRAMME ELECTIVE COURSE-I (PEC-I) (Semester-VI)

S.No.	Code	Name of Course	Contact Hours	Credits
1	PEC-ME-302	Industrial Engineering	3	3

2.	PEC-ME-304	Internal Combustion Engines	3	3
3.	PEC-ME-306	Welding Technology	3	3
4.	PEC-ME-308	Air Craft Technology	3	3
5.	PEC-ME-310	Maintenance Engineering	3	3
6	PEC-ME-312	Reliability, Availability & Maintainability	3	3

Note: Students will have to select any one out of the list.

PROGRAMME ELECTIVE COURSE-II (PEC-II) (Semester-VI)

S.No.	Code	Name of Course	Contact Hours	Credits
1.	PEC-ME-322	New Venture Creation	3	3
2.	PEC-ME-324	Gas Dynamics and Jet Propulsion	3	3
3.	PEC-ME-326	Numeric Control of Machine Tools and Robotics	3	3
4.	PEC-ME-328	Automobile Engineering	3	3
5.	PEC-ME-330	Visionary Learning in Manufacturing	3	3
6.	PEC-ME-332	Finite Element Analysis	3	3

Note: Students will have to select any one out of the list.

PROGRAMME ELECTIVE COURSE-III (PEC-III) (Semester- VII/ VIII)

S.No.	Code	Name of Course	Contact Hours	Credits
1.	PEC-ME-401	Tribology	3	3
2.	PEC-ME-403	Design and Optimization	3	3
3.	PEC-ME-405	Mechanical Vibrations	3	3
4.	PEC-ME-407	Product Design and Development	3	3
5.	PEC-ME-409	Design of Transmission Systems	3	3
6.	PEC-ME-411	Tool Design	3	3

Note: Students will have to select any one out of the list.

PROGRAMME ELECTIVE COURSE-IV (PEC-IV) (Semester- VII/ VIII)

S.No.	Code	Name of Course	Contact Hours	Credits
1.	PEC-ME-421	Power Plant Engineering	3	3
2.	PEC-ME-423	Design of Thermal Systems	3	3
3.	PEC-ME-425	Air Conditioning Equipments	3	3
4.	PEC-ME-427	Non Conventional Energy Resources Utilization	3	3
5.	PEC-ME-429	Energy Conservation and Management	3	3
6	PEC-ME-431	Maintenance Engineering And Management	3	3

Note: Students will have to select any one out of the list.

PROGRAMME ELECTIVE COURSE-V (PEC-V) (Semester-VII/ VIII)

S.No.	Code	Name of Course	Contact Hours	Credits
1.	PEC-ME-441	Flexible Manufacturing Systems	3	3
2.	PEC-ME-443	Total Quality Management	3	3
3.	PEC-ME-445	Project Management	3	3
4.	PEC-ME-447	Marketing Management	3	3
5.	PEC-ME-449	Metallurgy	3	3
6.	PEC-ME-451	Mechatronics Systems	3	3
7.	PEC-ME-453	Process Planning and Cost Estimation	3	3
8.	PEC-ME-455	Micro and Nano Manufacturing	3	3
9.	PEC-ME-457	Composite Materials	3	3
10.	PEC-ME-459	Principles of Management	3	3

OPEN ELECTIVE COURSES- I (OEC- I) (Semester V)

Students have to select any one Open Elective Course-I from the list of courses offered by Computer Engineering Department or the Civil Engineering Department:

Courses offered by Computer Engineering Department

S.No.	Code	Name of Course	No. of Contact Hours	Credits
1.		Intelligent Systems	3	3
2.		Cyber laws and Security	3	3
3.		Soft Computing	3	3
4.		Web Technology and Information Retrieval	3	3
5.		Intellectual Property and Rights	3	3

Courses offered by Civil Engineering Department

S.No.	Code	Name of Course	No. of Contact Hours	Credits
1.		Environmental Engineering	3	3
2.		Traffic Engineering and Managenment	3	3
3.		Contracts Management	3	3
4.		Solid and Hazardous Waste Management	3	3
5.		Air and Noise Pollution and Control	3	3

OPEN ELECTIVE COURSES- II (OEC- II) (Semester VI)

Students have to select any one Open Elective Course-II from the list of courses offered by Electrical Engineering Department or the Electronics Engineering Department:

Courses offered by Electrical Engineering Department

S.No.	Code	Name of Course	No. of Contact Hours	Credits
1.		Renewable Energy Systems	3	3
2.		High Voltage Engineering	3	3
3.		Smart Grids	3	3
4.		Utilization of Electrical Power & Traction	3	3
5.		Electrical Energy Conservation and Auditing	3	3

Courses offered by Electronics Engineering Department

S.No.	Code	Name of Course	No.of Contact Hours	Credits
1.		Microprocessor and Interfacing	3	3
2.		Digital Signal Processing	3	3
3.		Instrumentation and Control	3	3
4.		Data Communication and Networking	3	3

OPEN ELECTIVE COURSES- III (OEC- III) (Semester VII/ VIII)

Students have to select any one Open Elective Courses-III from the list of courses offered by Humanities Department or the Management Department:

Courses offered by HAS Department

S. No.	Code	Name of Course	No.of Contact Hours	Credits
1.		Soft Skills for Engineers	3	3
2.		Physics and Our World	3	3
3.		Introduction to Astrophysics and Cosmology	3	3
4.		Waste Management in our Daily Life	3	3
5.		Environmental Conservation	3	3

Courses offered by MBA Department

S.No.	Code	Name of Course	No.of Contact Hours	Credits
1.		Human Resource Management	3	3
2.		Finance and Accounting	3	3
3.		Industrial Psychology	3	3
4.		Entrepreneur Development	3	3
5.		Economics	3	3

GRADING SCHEME

Marks %	Grade	Grade points	Category
90-100	O	10	Outstanding
80<marks<90	A+	9	Excellent
70<marks< 80	A	8	Very good
60<marks< 70	B+	7	Good
50<marks< 60	B	6	Above average
45<marks< 50	C	5	Average
40<marks< 45	P	4	Pass
<40	F	0	Fail
	Ab	0	Absent

Percentage calculation= CGPA * 9.5

MECHANICAL ENGINEERING

(III-VIII SEM)

J.C.BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA, FARIDABAD
SCHEME OF STUDIES & EXAMINATIONS
B.TECH 2nd YEAR (SEMESTER – III) MECHANICAL ENGINEERING (2018-19)

Course No.	Course Title	Teaching Schedule				Marks for Sessionals	Marks for End Term Examination		Total Marks	Credits	Course Type
		L	T	P	Total		Theory	Practical			
PCC-ME-201	Thermodynamics	3	-	-	3	25	75	-	100	3	PCC
PCC-ME-203	Strength of Materials	3	1	-	4	25	75	-	100	4	PCC
PCC-ME-205	Fluid Mechanics and Machines	3	1	-	4	25	75	-	100	4	PCC
ESC-201	Basics of Electronics Engineering	3	-	-	3	25	75	-	100	3	ESC
ESC-203	Engineering Mechanics	3	1	-	4	25	75	-	100	4	ESC
BSC-201	Mathematics III	3	-	-	3	25	75	-	100	3	BSC
BSC-01	Biology	3	-	-	3	25	75	-	100	3	BSC
PCC-ME-207	Strength of Materials Lab	-	-	2	2	15	-	35	50	1	PCC
PCC-ME-209	Fluid Mechanics and Machines Lab	-	-	2	2	15	-	35	50	1	PCC
SEC-WS-201	Workshop- III	-	-	4	4	30	-	70	100	2	SEC
	Total	**21**	**3**	**8**	**32**	**235**	**525**	**140**	**900**	**28**	

Note: Exams Duration will be as under
(a) Theory exams will be of 03 hours duration.
(b) Practical exams will be of 02 hours duration
(c) Workshop exam will be of 03 hours duration

J.C.BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA, FARIDABAD
SCHEME OF STUDIES & EXAMINATIONS
B.TECH 2nd YEAR (SEMESTER – IV) MECHANICAL ENGINEERING (2018-19)

Course No.	Course Title	Teaching Schedule				Marks for Sessionals	Marks for End Term Examination		Total Marks	Credits	Course Type
		L	T	P	Total		Theory	Practical			
PCC-ME-202	Applied Thermodynamics	3	1	-	4	25	75	-	100	4	PCC
PCC-ME-204	Materials Engineering	3	-	-	3	25	75	-	100	3	PCC
PCC-ME-206	Kinematics of Machines	3	-	-	3	25	75	-	100	3	PCC
PCC-ME-208	Advanced Strength of Materials	3	-	-	3	25	75	-	100	3	PCC
PCC-ME-210	Manufacturing Processes	3	-	-	3	25	75	-	100	3	PCC
PCC-ME-212	Thermal Lab- I	-	-	2	2	15	-	35	50	1	PCC
PCC-ME-214	Materials Engineering Lab	-	-	2	2	15	-	35	50	1	PCC
PCC-ME-216	Kinematics of Machines Lab	-	-	2	2	15	-	35	50	1	PCC
MC - 02	Environmental Science	2	-	-	2	-	-	-	-	-	MAC
SEC-WS-202	Workshop- IV	-	-	4	4	30	-	70	100	2	SEC
	Total	**17**	**1**	**10**	**28**	**200**	**375**	**175**	**750**	**21**	

Note: Exams Duration will be as under

(a) Theory exams will be of 03 hours duration.
(b) Practical exams will be of 02 hours duration
(c) Workshop exam will be of 03 hours duration

J.C.BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA, FARIDABAD
SCHEME OF STUDIES & EXAMINATIONS
B.TECH 3rd YEAR (SEMESTER – V) MECHANICAL ENGINEERING (2018-19)

Course No.	Course Title	Teaching Schedule				Marks for Sessionals	Marks for End Term Examination		Total Marks	Credits	Course Type
		L	T	P	Total		Theory	Practical			
PCC-ME-301	Heat and Mass Transfer	3	-	-	3	25	75	-	100	3	PCC
PCC-ME-303	Dynamics of Machines	3	-	-	3	25	75	-	100	3	PCC
PCC-ME-305	Design of Machine Elements- I	3	1	-	4	25	75	-	100	4	PCC
PCC-ME-307	Refrigeration and Air- conditioning	3	-	-	3	25	75	-	100	3	PCC
	Open Elective Course- I	3	-	-	3	25	75	-	100	3	OEC
PCC-ME-309	Thermal Lab- II	-	-	2	2	15	-	35	50	1	PCC
PCC-ME-311	Dynamics of Machines Lab	-	-	2	2	15	-	35	50	1	PCC
MC - 03	Essence of Indian Traditional Knowledge	2	-	-	2	-	-	-	-	-	MAC
SEC-WS-301	Workshop-V	-	-	4	4	30	-	70	100	2	SEC
	Total	**17**	**1**	**8**	**26**	**185**	**375**	**140**	**700**	**20**	

Note: Exams duration will be as under
(a) Theory exams will be of 03 hours duration.
(b) Practical exams will be of 02 hours duration
(c) Workshop exam will be of 03 hours duration

J.C.BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA, FARIDABAD
SCHEME OF STUDIES & EXAMINATIONS
B.TECH 3rd YEAR (SEMESTER – VI) MECHANICAL ENGINEERING (2018-19)

Course No.	Course Title	Teaching Schedule				Marks for Sessionals	Marks for End Term Examination		Total Marks	Credits	Course Type
		L	T	P	Total		Theory	Practical			
PCC-ME-302	CAD/ CAM	3	-	-	3	25	75	-	100	3	PCC
PCC-ME-304	Manufacturing Technology	3	-	-	3	25	75	-	100	3	PCC
PCC-ME-306	Design of Machine Elements- II	3	-	-	3	25	75	-	100	3	PCC
	Programme Elective Course- I (PEC-ME-302-312)	3	-	-	3	25	75	-	100	3	PEC
	Programme Elective Course-II (PEC-ME-322-332)	3	-	-	3	25	75	-	100	3	PEC
	Open Elective Course- II	3	-	-	3	25	75	-	100	3	OEC
PCC-ME-308	CAD/ CAM Lab	-	-	2	2	15	-	35	50	1	PCC
SEC-WS-302	Workshop-VI	-	-	4	4	30	-	70	100	2	SEC
	Total	**18**	-	**6**	**24**	**195**	**450**	**105**	**750**	**21**	

Note: Exams Duration will be as under

(a) Theory exams will be of 03 hours duration.
(b) Practical exams will be of 02 hours duration
(c) Workshop exam will be of 03 hours duration

J.C.BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA, FARIDABAD
SCHEME OF STUDIES & EXAMINATIONS
B.TECH 4th YEAR (SEMESTER – VII/ VIII) MECHANICAL ENGINEERING (2018-19)

Course No.	Course Title	Teaching Schedule				Marks for Sessionals	Marks for End Term Examination		Total Marks	Credits	Course Type
		L	T	P	Total		Theory	Practical			
PCC-ME-401	Automation in Manufacturing	3	-	-	3	25	75	-	100	3	PCC
PCC-ME-403	Operations Research	3	-	-	3	25	75	-	100	3	PCC
PEC 402-420	Programme Elective Course-III (PEC-ME-401-411)	3	-	-	3	25	75	-	100	3	PEC
PEC 421-440	Programme Elective Course-IV (PEC-ME-421-431)	3	-	-	3	25	75	-	100	3	PEC
PEC 441-460	Programme Elective Course- IV (PEC-ME-441-459)	3	-	-	3	25	75	-	100	3	PEC
	Open Elective Course- III	3	-	-	3	25	75	-	100	3	OEC
SEC-401	Project (Major)	-	-	4	4	30	-	70	100	2	SEC
SEC-WS-403	Workshop-VII	-	-	4	4	30	-	70	100	2	SEC
	Total	**18**	**-**	**8**	**26**	**210**	**450**	**140**	**800**	**22**	

Note: Exams Duration will be as under
(a) Theory exams will be of 03 hours duration.
(b) Practical exams will be of 02 hours duration
(c) Workshop exam will be of 03 hours duration

J.C.BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA, FARIDABAD
SCHEME OF STUDIES & EXAMINATIONS
B.TECH 4th YEAR (SEMESTER – VIII/ VII) MECHANICAL ENGINEERING (2018-19)

Credits: 10 (SEC)

S.No.	Course No.	Title	Teaching Schedule	Examination Schedule (Marks)		
				Annual Exam	Continuous Assessment	Total
1.	SEC-402	Industrial Training	6 Months	350	150	500

Procedure for Annual Exam and Continuous Assessment of Industrial Training:

(A) Annual Exams Marks

1. Training Evaluation 100 Marks
2. Training Seminar 100 Marks
3. Training Viva 150 Marks

(B) Continuous Assessment Marks

1. Assessment by UniversityFaculty 50 Marks
2. Assessment by Industrial Guide 50 Marks
3. Conduct Marks 50 Marks

Total: 500 Marks

PCC-ME-201 THERMODYNAMICS
B. Tech (Mechanical Engineering) III Semester

No. of Credits: 3
L T P Total
3 0 0 3

Sessional: 25 Marks
Theory: 75 Marks
Total: 100 Marks
Duration of Exam: 3 Hours

Pre- Requisite: Nil

Successive: Applied Thermodynamics, Heat and Mass Transfer, IC Engines, Refrigeration and Air Conditioning

Course Objectives:

The objective of studying this course is to understand and apply the concepts of thermodynamic properties and their relationships, laws of thermodynamics and thermodynamic behavior of pure substances to solve engineering problems.

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

1. Understand the basic concepts of thermodynamics and apply energy balance to systems and control volumes, in situations involving heat and work interactions.
2. Analyze performance of energy conversion devices and cycles.
3. Evaluate properties of pure substances, gases and their mixtures in various processes.
4. Learn to differentiate between high grade and low grade energies and understand the II law limitations on energy conversion.

Course Contents:

Unit 1:

Fundamentals - System & Control volume; Property, State & Process; Exact & Inexact differentials; Work - Thermodynamic definition of work; examples; Displacement work; Path dependence of displacement work and illustrations for simple processes; electrical, magnetic, gravitational, spring and shaft work. (5)

Unit 2:

Temperature, Definition of thermal equilibrium and Zeroth law; Temperature scales; Various Thermometers- Definition of heat; examples of heat/work interaction in systems- First Law for Cyclic & Non-cyclic processes; Concept of total energy E ; Demonstration that E is a property; Various modes of energy, Internal energy and Enthalpy. (5)

Unit 3:

Definition of Pure substance, Ideal Gases and ideal gas mixtures, Real gases and real gas mixtures, Compressibility charts- Properties of two phase systems - Constant temperature and Constant pressure heating of water; Definitions of saturated states; P-v-T surface; Use of steam tables and R134a tables; Saturation tables; Superheated tables; Identification of states & determination of properties, Mollier's chart. (8)

Unit 4:

First Law for Flow Processes - Derivation of general energy equation for a control volume; Steady state steady flow processes including throttling; Examples of steady flow devices; Unsteady processes; examples of steady and unsteady I law applications for system and control volume. (5)

Unit 5:

Second law - Definitions of direct and reverse heat engines; Definitions of thermal efficiency and COP; Kelvin-Planck and Clausius statements; Definition of reversible process; Internal and external irreversibility; Carnot cycle; Absolute temperature scale. (5)

Unit 6:

Clausius inequality; Definition of entropy S ; Demonstration that entropy S is a property; Evaluation of S for solids, liquids, ideal gases and ideal gas mixtures undergoing various processes; Determination of s from steam tables- Principle of increase of entropy; Illustration of processes in T-s coordinates; Definition of Isentropic efficiency for compressors, turbines and nozzles- Irreversibility and Availability, Availability function for systems and Control volumes undergoing different processes, Lost work. Second law analysis for a control volume. Exergy balance equation and Exergy analysis.(8)

Unit 7:

Thermodynamic cycles - Basic Rankine cycle; Basic Brayton cycle; Basic vapor compression cycle and comparison with Carnot cycle. (4)

Text Books:

1. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, Fundamentals of Thermodynamics, John Wiley and Sons.

2. Jones, J. B. and Duggan, R. E., 1996, Engineering Thermodynamics, Prentice-Hall of India

3. Moran, M. J. and Shapiro, H. N., 1999, Fundamentals of Engineering Thermodynamics, John Wiley and Sons.

4. Nag, P.K, 1995, Engineering Thermodynamics, Tata McGraw-Hill Publishing Co. Ltd.

PCC-ME-203
STRENGTH OF MATERIALS
B. Tech (Mechanical Engineering) III Semester

No. of Credits: 4
L T P Total
3 1 0 4

Sessional: 25 Marks
Theory: 75 Marks
Total: 100 Marks
Duration of Exam: 3 Hours

Pre- Requisite: Elementary Engineering Mechanics

Successive: Advance Strength of Materials, Machine Design

Course Objectives:

- To understand the nature of stresses developed in simple geometries such as bars, cantilevers, beams, shafts, cylinders and spheres for various types of simple loads.
- To calculate the elastic deformation occurring in various simple geometries for different types of loading.

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

1. To recognise nature of internal stresses that will develop within the components
2. To evaluate the strains and deformation that will result due to theelastic stresses develope within the materials for simple types of loading.
3. To make out concept of Moment of Inertia
4. Analysis of Torsion of various shafts
5. Analysis of Axial & Hoop Stress.

Course Contents:

Unit 1:

Deformation in solids- Hooke's law, stress and strain tension, compression and shear stresses elastic constants and their relations- volumetric, linear and shear strains-principal stresses and principal planes- Mohr's circle. **(8)**

Unit 2 :

Shear Force and Bending diagram: Beams and types transverse loading on beams- shear force and bend moment diagrams, Types of beam supports, simply supported and overhanging beams, cantilevers. Theory of bending of beams,bending stress

distribution and neutral axis, shear stress distribution, pointand distributed loads. **(8)**

Unit3:
Moment of inertia about an axis and polar moment of inertia, deflection of a beam using double integration method, computation of slopes and deflection in beams, Maxwell's reciprocal theorems.**(8)**

Unit4:
Torsion, stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at both ends, stresses and deflection of helical springs. (**8)**

Unit5:
Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure **(8)**

Text Books:

1. Egor P. Popov, Engineering Mechanics of Solids, Prentice Hall of India, New Delhi, 2001.

2. R. Subramanian, Strength of Materials, Oxford University Press, 2007.

3. Ferdinand P. Been, Russel Johnson Jr and John J. Dewole, Mechanics of Materials, TataMcGr awHill Publishing Co. Ltd., New Delhi 2005.

PCC-ME-205 FLUID MECHANICS AND FLUID MACHINES

B. Tech (Mechanical Engineering) III Semester

No. of Credits: 4
L T P Total
3 1 0 4

Sessional: 25 Marks
Theory: 75 Marks
Total: 100 Marks
Duration of Exam: 3 Hours

Pre- Requisite: Nil

Successive: Heat and Mass Transfer

Course Outcomes (COs): At the end of the course, the student shall be able to:

CO 1- Expedite the properties of fluid along with pressure measurement techniques and concept of stability.

CO 2- Understand the characteristics of fluid and application of continuity and Bernoulli's equation.

CO 3- Conceptualisation of boundary layer, laminar and turbulent flow.

CO 4- Analyse flows through pipes and open channels.

CO5- Evaluating performance of pumps and turbines.

Course Contents :

Unit 1:

Definition of fluid, Newton's law of viscosity, Units and dimensions- properties of fluids,mass density, specific volume, specific gravity, viscosity, compress ibility and surfacetension, Control volume- application of continuity equation and momentum equation,Incompressible flow, Berno ulli's equation and its applications.**(9)**

Unit 2:

Exact flow solutions in channels and ducts, Couette and Poisuielle flow, laminar flow through circular conduits and circular annuli- concept of boundary layer – measures ofboundary layer thickness Darcy Weisbach equation, friction factor, Moody's dia gram. **(9)**

Unit 3:

Need for dimensional analysis – methods of dimension analysis – Similitude – types ofsimilitude Dimensionless parameters –application of dimensionless parameters – Modelanalysis. **(6)**

Unit 4:

Euler's equation – theory of Rotodynamic machines – various efficiencies – velocitycomponents at entry and exit of the rotor, velocity triangles Centrifugal pumps, wo rkingprinciple, work done by the impeller, performance curves Cavitation in pum ps-Reciprocating pump – working principle. **(8)**

Unit 5:

Classification of water turbines, heads and efficiencies, velocity triangles- Axial, radial andmixed flow turbinesPelton wheel, Francis turbine and Kaplan turbines, work ing principles –draft tube-Specific speed, unit quantities, performance curves for turbines – governing ofturbines. **(8)**

Text Books:

1. Fluid Mechanics – Streeter V L and Wylie E B; McGraw Hill
2. Mechanics of Fluids – I H Shames; McGraw Hill

Reference Books:

1. Fluid Mechanics and Fluid Power Engineering – D.S. Kumar; S.K. Kataria and Sons, New Delhi.
2. Introduction to Fluid Mechanics and Fluid Machines – S.K. Som and G. Biswas; TMH Publications, New Delhi.
3. Fluid Mechanics and Machinery – S.K. Agarwal; TMH; New Delhi.
4 Fluid Mechanics by Frank M. White; McGraw Hill.

ESC- 201 BASIC ELECTRONICS ENGINEERING

B. Tech III Semester

No. of Credits: 3
L T P Total
3 0 0 3

Sessional: 25 Marks
Theory: 75 Marks
Total: 100 Marks
Duration of Exam: 3 Hours

Pre- Requisite: Physics

Successive: Mechatronics, Automation in Manufacturing

Course Objectives:

To provide an overview of electronic device components to Mechanical engineering students.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Understand the principles of semiconductor devices and their applications.

2. Design an application using Operational amplifier.

3. Understand the working of timing circuits and oscillators.

4. Understand logic gates, flip flop as a building block of digital systems.

5. Learn the basics of Electronic communication system.

Course Contents:

Unit 1:

Semiconductor Devices and Applications: Introduction to P-N junction Diode and V-I characteristics, Half wave and Full-wave rectifiers, capacitor filter. Zener diode and its characteristics, Zener diode as voltage regulator. Regulated power supply IC based on 78XX and 79XX series, Introduction to BJT, its input-output and transfer characteristics, BJT as a single stage CE amplifier, frequency response and bandwidth.

Unit 2:

Operational amplifier and its applications: Introduction to operational amplifiers, Op-amp input modes and parameters, Op-amp in open loop configuration, op-amp with negative feedback, study of practical op-amp IC 741, inverting and non-inverting amplifier applications: summing and difference amplifier, unity gain buffer, comparator, integrator and differentiator.

Unit 3:

Timing Circuits and Oscillators: RC-timing circuits, IC 555 and its applications as astable and mono-stable multi-vibrators, positive feedback, Barkhausen's criteria for oscillation, R-C phase shift and Wein bridge oscillator.

Unit 4:

Digital Electronics Fundamentals :Difference between analog and digital signals, Boolean algebra, Basic and Universal Gates, Symbols, Truth tables, logic expressions, Logic simplification using K- map, Logic ICs, half and full adder/subtractor, multiplexers, de-multiplexers, flip-flops, shift registers, counters, Block diagram of microprocessor/microcontroller and their applications.

Unit 5:

Electronic Communication Systems: The elements of communication system, IEEE frequency spectrum, Transmission media: wired and wireless, need of modulation, AM and FM modulation schemes, Mobile communication systems: cellular concept and block diagram of GSM system.

Text /Reference Books:

1. Floyd ," Electronic Devices" Pearson Education 9th edition, 2012.

2. R.P. Jain , "Modern Digital Electronics", Tata Mc Graw Hill, 3rd Edition, 2007.

3. Frenzel, "Communication Electronics: Principles and Applications", Tata Mc Graw Hill, 3rd Edition, 2001

ESC-202 ENGINEERING MECHANICS

B. Tech III Semester

No. of Credits: 4
L T P Total
3 1 0 4

Sessional: 25 Marks
Theory: 75 Marks
Total: 100 Marks
Duration of Exam: 3 Hours

Pre- Requisite: Physics, Mathematics

Successive: Kinematics of Machines, Dynamics of Machines, Strength of Materials

Course Objectives:

The objective of this Course is to provide an introductory treatment of Engineering Mechanics to all the students of engineering, with a view to prepare a good foundation for taking up advanced courses in the area in the subsequent semesters.

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

CO 1- Understand the basic force system equilibrium

CO 2- Apply principles of friction in engineering problems.

CO 3- Expedite concept of Structure analysis.

CO 4- Explore Centroid and virtual work concept

CO5 - Review of particle dynamics

CO6 - Develop of Kinetics of Rigid Bodies

Course Content:

Unit 1:

Introduction to Engineering Mechanics covering, Force Systems Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static In-determinancy.

Unit 2:

Friction covering, Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack;

Unit 3:

Basic Structural Analysis covering, Equilibrium in three dimensions; Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members; Beams & types of beams; Frames & Machines;

Unit 4:

Centroid and Centre of Gravity covering, Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia-Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook.

Unit 5:

Virtual Work and Energy Method- Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems with friction, mechanical efficiency. Conservative forces and potential energy (elastic and gravitational), energy equation for equilibrium.Applications of energy method for equilibrium. Stability of equilibrium.

Unit 6:

Review of particle dynamics- Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton's 2nd law (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy.Impulse-momentum (linear, angular); Impact (Direct and oblique).

Unit 7:

Introduction to Kinetics of Rigid Bodies covering, Basic terms, general principles in dynamics; Types of motion, Instantaneous centre of rotation in plane motion and simple problems; D'Alembert's principle and its applications in plane motion and connected bodies; Work energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation;

Text/Reference Books:

1. Irving H. Shames (2006), Engineering Mechanics, 4th Edition, Prentice Hall

2. F. P. Beer and E. R. Johnston (2011), Vector Mechanics for Engineers, Vol I - Statics, Vol II, – Dynamics, 9th Ed, Tata McGraw Hill

3. R. C. Hibbler (2006), Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press.

4. Hibler and Gupta (2010),Engineering Mechanics (Statics, Dynamics) by Pearson Education

5. Reddy Vijaykumar K. and K. Suresh Kumar(2010), Singer's Engineering Mechanics

6. Bansal R.K.(2010), A Text Book of Engineering Mechanics, Laxmi Publications

7. Khurmi R.S. (2010), Engineering Mechanics, S. Chand & Co.

. Tayal A.K. (2010), Engineering Mechanics, Umesh Publications

BSC 202 MATHEMATICS III

B. Tech III Semester

No. of Credits: 3
L T P Total
3 3 0 3

Sessional: 25 Marks
Theory: 75 Marks
Total: 100 Marks
Duration of Exam: 3 Hours

Pre- Requisite: Mathematics I and II

Successive: Engineering Mechanics, Operations Research

Course Objectives:

- To introduce the solution methodologies for second order Partial Differential Equations with applications in engineering
- To provide an overview of probability and statistics to engineers.

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

- CO1: solve field problems in engineering involving PDEs.
- CO2: formulate and solve problems involving random variables
- CO3: apply statistical methods for analysing experimental data.
- CO4: understand the concept of probability.

Course Contents:

Unit 1:

Definition of Partial Differential Equations, First order partial differential equations, solutions of first order linear PDEs; Solution to homogenous and non-homogenous linear partial differential equations of second order by complimentary function and particular integral method. Second-order linear equations and their classification, Initial and boundary conditions, D'Alembert's solution of the wave equation; Duhamel's principle for one dimensional wave equation. Heat diffusion and vibration problems, Separation of variables method to simple problems in Cartesian coordinates. The Laplacian in plane, cylindrical and spherical polar coordinates, solutions with Bessel functions and Legendre functions. One dimensional diffusion equation and its solution by separation of variables. (14 hours)

Unit 2:

Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality. Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities.

Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.(12 hours)

Unit 3:

Basic Statistics, Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation. Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, Tests for single mean, difference of means, and difference of standard deviations. Test for ratio of variances - Chi-square test for goodness of fit and independence of attributes. (12 hours)

Textbooks/References:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

2. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.

3. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003 (Reprint).

4. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.

BSC 01 BIOLOGY

B. Tech III Semester

No. of Credits: 3
L T P Total
3 00 3

Sessional: 25 Marks
Theory: 75 Marks
Total: 100 Marks
Duration of Exam: 3 Hours

Pre- Requisite: Nil

Successive: Environmental Science

Course Objectives:

To Learn the Basic concept of Biology related to Engineers, Genetics, Biomolecules, Enzymes, Information Transfer, Macromolecular analysis, Metabolism, Microbiology

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

1. Classify enzymes and distinguish between different mechanisms of enzyme action.
2. Identify DNA as a genetic material in the molecular basis of information transfer.
3. Analyze biological processes at the reductionist level
4. Apply thermodynamic principles to biological systems.
5. Identify and classify microorganisms.

Unit 1: Introduction

Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline. Why we need to study biology? Discuss how biological observations of 18th Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor. These examples will highlight the fundamental importance of observations in any scientific inquiry.

Unit 2: Classification

Purpose: To convey that classification per se is not what biology is all about.The underlying criterion, such as morphological, biochemical or ecological be highlighted. Hierarchy of life forms at phenomenological level. A common thread weaves this hierarchy Classification. Discuss classification based on (a) cellularity- Unicellular or multicellular (b) ultrastructure- prokaryotes or eucaryotes. (c) energy and Carbon utilization -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricoteliec, ureotelic (e) Habitata- acquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life. A given organism can come under different category based on classification. Model organisms for the study of biology come from different groups. E.coli, S.cerevisiae, D. Melanogaster, C. elegance, A. Thaliana, M. musculus

Unit 3: Genetics

Purpose: To convey that "Genetics is to biology what Newton's laws are to Physical Sciences" Mendel's laws, Concept of segregation and independent assortment. Concept of allele.Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasis to be give not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring.Concepts of recessiveness and dominance.Concept of mapping of phenotype to genes. Discuss about the single gene disorders in humans. Discuss the concept of complementation using human genetics.

Unit 4: Biomolecules

Purpose: To convey that all forms of life has the same building blocks and yet the manifestations are as diverse as one can imagine Molecules of life. In this context discuss monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids and proteins.Nucleotides and DNA/RNA.Two carbon units and lipids.

Unit 5: Enzymes

Purpose: To convey that without catalysis life would not have existed on earth Enzymology : How to monitor enzyme catalyzed reactions. How does an enzyme catalyze reactions. Enzyme classification. Mechanism of enzyme action. Discuss at least two examples. Enzyme kinetics and kinetic parameters. Why should we know these parameters to understand biology? RNA catalysis.

Unit 6: Information Transfer

Purpose: The molecular basis of coding and decoding genetic information is universal Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA structure- from single stranded to double helix to nucleosomes. Concept of genetic code.Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination.

Unit 7: (5 hours). Macromolecular analysis

Purpose: How to analyses biological processes at the reductionistic level Proteins- structure and function. Hierarch in protein structure.Primary secondary, tertiary and quaternary structure.Proteins as enzymes, transporters, receptors and structural elements.

Unit 8: (4 hours)- Metabolism

Purpose: The fundamental principles of energy transactions are the same in physical and biological world. Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergoinc reactions.Concept of Keq and its relation to standard free energy.Spontaneity.ATP as an energy currency. This should include the breakdown of glucose to CO2 + H2O (Glycolysis and Krebs cycle) and synthesis of glucose from CO2 and H2O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge

Unit 9: (3 hours)- Microbiology

Concept of single celled organisms.Concept of species and strains.Identification and classification of microorganisms.Microscopy.Ecological aspects of single celled organisms.Sterilization and media compositions.Growth kinetics.

Textbooks/ References:

1) Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd

2) Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H., John Wiley and Sons

3) Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company

4) Molecular Genetics (Second edition), Stent, G. S.; and Calender, R.W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher

5) Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. Brown Publishers

PCC-ME-207 STRENGTH OF MATERIALS LAB

B. Tech (Mechanical Engineering) III Semester

No. of Credits: 1	Sessional: 15 Marks
L T P Total	Practical: 35 Marks
0 0 2 2	Total : 50 Marks
	Duration of Exam: 02 Hours

Pre- Requisite: Strength of Materials

Successive: Machine Design

Course Objectives:

The objective of the Mechanics of Solid lab is to demonstrate the basic principles in the area of strength and mechanics of materials and structural analysis

Course Outcomes (COs): At the end of the course, the student shall be able to:

CO 1- Learn the principles of mechanics of solid and engineering.

CO 2- Preparation of formal laboratory reports describing the results of experiments.

CO 3-Acquire to operate basic instruments in mechanics of materials lab.

CO 4- Able to understand the concepts of stress, strain of materials and ability to interpret the data from the experiments.

List of Experiments:

1. To perform the Brinell hardness test.
2. To perform the Rockwell hardness test.
3. To perform the Vickers hardness test on Universal Hardness Tester.
4. To study the Erricson sheet metal testing machine & perform the Erricson sheet metal test.
5. To perform the Impact tests (Izod&Charpy) on Impact Testing Machine.
6. To perform the tensile test on Universal Testing Machine.
7. To perform compression & bending tests on UTM.
8. To perform the shear test on UTM.
9. To perform the torsion test on a Torsion Testing Machine.
10. To draw shear Force, Bending Moment Diagrams for a simply Supported Beam under Point and Distributed Loads.

PCC-ME-209: FLUID MECHANICS & MACHINES LAB

B. Tech (Mechanical &Automation Engineering) III Semester

No. of Credits: 1	Sessional: 15 Marks
L T P Total	Practical: 35 Marks
0 0 2 2	Total : 50 Marks
	Duration of Exam: 02 Hours

Pre- Requisite: Fluid Mechanics

Successive : Fluid Machines

Course Objectives:

To learn the various concepts of stability, continuity and Bernoulli's equation; various losses through pipes; to learn the determination of hydraulic coefficients and velocity profile.

Course Outcomes (COs): At the end of the course, the student shall be able to:

CO 1-Understand the techniques and concept of stability.

CO 2-Learning continuity and Bernoulli's equation.

CO 3-Analyse discharge measuring devices and hydraulic coefficients.

CO 4-Knowledge of different types of pipe losses and determine the velocity profile in a pipe.

List of Experiments:

1. To verify the Bernoulli's Theorem.
2. To determine coefficient of discharge of Venturimeter & Orificemeter.
3. To determine the coefficient of discharge of a Notch (V and Rectangular types).
4. To determine the friction factor for the pipes.
5. To determine the coefficient of contraction, velocity and discharge of an orifice.
6. To determine the minor losses due to sudden enlargement, sudden contraction and bends.
7. To draw the constant head; constant-speed and constant efficiency curves of Pelton turbine.
8. To draw the constant head; constant speed and constant efficiency curves of Francis turbine
9. To draw the constant head; constant speed and constant efficiency curves of Kaplan turbine.
10. To study the constructional details and draw the characteristic curves of Centrifugal pump.
11. To study the constructional details and draw the characteristic curves of Reciprocating pump.
12. To analyze the construction details of a Gear oil pump and its performance curves.

SEC-WS- 201 WORKSHOP –III
B.Tech- III Semester

No. of credits: 2				Internal:	30 Marks
L	**T**	**P**	**Total**	External:	70 Marks
0	0	4	4	Total:	100 Marks
				Duration of Exam:	3 Hours

Pre-requisite: Turning, Milling, Welding, Refrigeration & air conditioning.

Successive: Conventional machines, welding, refrigeration & air conditioning etc.

Course Objectives: To understand mechanical engineering by introduction of conventional machines, Welding, Refrigeration & Air Conditioning.

Course Outcomes (COs): After studying this course the students will be able to:

1. Understand the safety measures of mechanical workshop.
2. Learn the functions of various conventional machines, arc & gas, metal inert gas/metal active gas (MIG/MAG) arc welding techniques.
3. Prepare different jobs by turning and milling operation.
4. Perform different operations in refrigeration & air conditioning shop.
5. Perform different welding operations.

List of Exercises:

(Turning, Milling, Welding and Refrigeration & Air Conditioning Workshop)

1. To understand various safety measures, working principle & specifications of various conventional machines (lathe, milling, shaper, grinder etc).
2. To study elements of single point cutting tools and multiple point cutting tools.
3. To prepare single point brazed tool with carbide tip on a mild steel shank involving milling and brazing operation.
4. To prepare a job involving centering, facing, plain turning and step turning.
5. To prepare a job by machining on milling/ shaper machine and surface grinding on surface grinder.
6. To prepare a straight continuous bead in different current setting in flat position by arc welding on a mild steel plate.
7. To prepare straight continuous bead run on mild steel plate in flat position by MIG/MAG arc welding.
8. To set oxy-acetylene plant for flames and fusion run without filler rod (flat position) by gas welding.
9. To create fillet weld in lap joint on mild steel plate in flat position by arc welding .
10. To study refrigeration and air conditioning tools and refrigeration cycles.
11. To study different types of refrigerant use in refrigeration cycle.
12. To perform cutting and flaring operation of ferrous and non ferrous tubes.
13. To perform Swaging and Brazing of ferrous and non ferrous tubes.

Note:- At least nine exercises should be performed from the above list; remaining three may either be performed from above list or designed by the concerned institution as per the scope of the syllabus and facilities available in the institute.

PCC-ME 202 APPLIED THERMODYNAMICS
B. Tech (Mechanical Engineering) IV Semester

No. of Credits: 4
L T P Total
3 1 0 4

Sessional: 25 Marks
Theory: 75 Marks
Total: 100 Marks
Duration of Exam: 3 Hours

Pre- Requisite: Thermodynamics

Successive: Heat and Mass Transfer, Refrigeration and Air- Conditioning, IC Engines.

Course Objectives: The objective of this course is to gain a comprehensive knowledge of various cycles, gas dynamics, pschyrometry, nozzles, turbines and heating values of fuel.

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

1. Get a good understanding of various practical power cycles and heat pump cycles.
2. Analyze energy conversion in steam turbines and learn about the types and heating values of fuels.
3. Understand phenomena occurring in high speed compressible flows.
4. Evaluate the performance of reciprocating compressors.

Course Contents:.

Unit 1:

Introduction to solid, liquid and gaseous fuels– Stoichiometry, exhaust gas analysis- First law analysis of combustion reactions Heat calculations using enthalpy tablesAdiabatic flame temperature chemical equilibrium and equilibrium composition calculations using free energy. **(8)**

Unit 2:

Vapor power cycles Rankine cycle with superheat, reheat and regeneration,exergy analysis. Super-critical and ultra super-critical Rankine cycle Gas power cycles, Air standard Otto , Diesel and Dual cycles-Air standard Brayton cycle, effect of reheat, regeneration and inter cooling - Combined gas and vapor power cycles- Vapor compression refrigeration cycles, refrigerants and their properties. **(12)**

Unit 3:

Properties of dry and wet air,use of pschyrometric chart, processes involving heating/coolingand h umidification/dehumidification, dew point. **(4)**

Unit 4:

Basics compressible flow. Stagnation properties, Isentropic flow of a perfect gas through anozzle, choked flow, subsonic and supersonic flows - normal shocks- use of ideal gas tables

for isentropic flow and normal shock flow Flow of steam and refrigerant through nozzle , super saturation- compressible flow in diffusers, efficiency of nozzle and diffuser. **(8)**

Unit 5:

Reciprocating compressors, staging of reciprocating compressors, optimal stage pressureratio, effect of intercooling, minimum work for multistage reciprocating compressors. **(5)**

Unit 6:

Analysis of steam turbines, velocity and pressure compounding of steam turbines **(3)**

Text Books:

1. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, *Fundamentals ofTher modynamics*, John Wiley and Sons.

2. Jones, J. B. and Duggan, R. E., 1996, *Engineering Thermodynamics*, Prentice-Hall of India

3. Moran, M. J. and Shapiro, H. N., 1999, *Fundamentals of Engineering Thermodynamics*,John Wiley and Sons.

4. Nag, P.K, 1995, *Engineering Thermodynamics*, Tata McGraw-Hill Publishing Co. Ltd

PCC-ME-204 MATERIALS ENGINEERING
B. Tech (Mechanical Engineering) IV Semester

No. of Credits: 3
L T P Total
3 0 0 3

Sessional: 25 Marks
Theory: 75 Marks
Total: 100 Marks
Duration of Exam: 3 Hours

Pre- Requisite: Chemistry

Successive: Advanced Solids of Mechanics, Machine Design

Course Objectives:

Understanding of the correlation between the internal structure of materials, theirmechanical properties and various methods to quantify their mechanical integrity and failure criteria.

Course Outcomes (COs)

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

CO1. Understand the basics of structure, imperfection and deformation of crystalline materials

CO2. Define various mechanical properties of materials andrecognizemethods of their measurement

CO3. Discussmechanisms/theories of failure and get acquainted with fracture mechanics under static/dynamic loads

CO4. Explain methods of heat treatment of steels, draw transformation diagrams and interpret microstructure development

CO5. Appreciateconcept of solid solutions and interpret binary phase diagrams, especially the Fe-C system

CO6. Describe properties of ferrous and non-ferrous alloys

Course Contents:

Unit 1:

Crystal Structure: Unit cells, Metallic crystal structures, Ceramics. Imperfection in solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress. **(6)**

Unit 2:

Mechanical Property measurement: Tensile, compression and torsion tests; Young's modulus, relations between true and engineering stress-strain curves, generalized Hooke's law, yielding and yield strength, ductility, resilience, toughness and elastic recovery; Hardness: Rockwell, Brinell and Vickers and their relation to strength. **(6)**

Unit 3:

Static failure theories: Ductile and brittle failure mechanisms, Tresca, Von-mises, Maximum normal stress, Mohr-Coulomb and Modified Mohr-Coulomb; Fracturemechanics: Introduction to Stress-intensity factor approach and Griffith criterion. Fatigue failure: High cycle fatigue, Stress-life approach, SN curve, endurance and fatigue limits, effects of mean stress using the Modified Goodman diagram; Fracture with fatigue, Introduction to non-destructive testing (NDT) **(8)**

Unit 4:

Alloys, substitutional and interstitial solid solutions Phase diagrams: Interpretation of binary phase diagrams and micro structure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron Iron-carbide phase diagram and microstrctural aspects of ledeburite, austenite, ferrite and cementite, cast iron. **(6)**

Unit 5:

Heat treatment of Steel: Annealing, tempering, normalising and spheroidising, isothermal transformation diagrams for Fe-C alloys and microstructure development. Continuous cooling curves and interpretation of final microstructures and properties- austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening **(6)**

Unit 6:

Alloying of steel, properties of stainless steel and tool steels, maraging steels cast irons;grey, white, malleable and spheroidal cast irons copper and copper alloys; brass, bron and cupro nicke Aluminium and AlCu Mg alloys Nickel based superalloys and Titaniumalloys **(8)**

Text Books:

1. W. D. Callister, 2006, "Materials Science and Engineering-An Introduction", 6th Edition, Wiley India.
2. Kenneth G. Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 4th Indian Reprint, 2002.
3. V. Raghavan, "Material Science and Engineering', Prentice Hall of India Private Limited, 1999.
4. U. C. Jindal, "Engineering Materials and Metallurgy", Pearson, 2011.

PCC-ME-206 KINEMATICS OF MACHINES
B.Tech (Mechanical Engineering) IV Semester

No. of Credits: 3		Sessional:	25 Marks
L T P	Total	Theory:	75 Marks
3 0 0	3	Total :	100 Marks
		Duration of Exam:	3 hrs.

Pre- Requisite: Engineering Mechanics

Successive: Dynamics of Machines, Design of Machine Elements

Course Objectives:

To develop the concept of geometric aspects of motion and its profile in various machine members.

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

CO 1- Describe the concepts of machines, mechanisms and related terminologies.

CO 2- Analyze planar mechanism for displacement, velocity and acceleration graphically

CO 3- Develop the concept of Synthesis of Mechanisms.

CO 4- Analyze various motion transmission elements like gears, gear trains.

CO 5-Learn the analysis and geometry of CAM profiles.

CO 6- Explore the concept of Brakes and its applications.

Course Contents:

UNIT 1 **Mechanism and Machine:** Links, Kinematic pairs, Degree of freedom, Kinematic Chain, Binary, Ternary, Quaternary Links and Joints, Inversions of Mechanisms, Application Lower Pairs **:** Pantograph, Straight Line Mechanisms, Approximate Straight Line Motion Mechanism:Steering gears: Davis Steering gear, Ackermann Steering gear, Universal Hook's Joint

UNIT 2: **Motion Analysis in Mechanism:** Concept ofInstantaneous centre method to analyze Velocity in Simple Mechanism, Method for locating an instantaneous centre. Relative Velocity method to analyze Velocity and acceleration, Rubbing velocity at pin joints. Coriolis acceleration component.

UNIT 3: **Synthesis of Mechanisms:** Kinematics synthesis of Mechanisms, Type, number and dimensional synthesis, function generation, path generation and body guidance, Two and three position synthesis of four bar and slider crank mechanisms by graphical methods, Freudenstein's equation, precision positions, structural error; Chebychev spacing, transmission angle, problems.

UNIT 4: **Gears:** Concept of gears and its type, Terminology, Law of gearing, velocity of sliding, Forms of Teeth, Cycloid profile teeth, Length of path of contact, length of arc of contact, Number of pairs of teeth in contact, Interference in involute gears, Minimum number of teeth to avoid interferences on gear and wheel, Concept of Helical gears, spiral gears, Gear Trains**:** Types of gear trains: simple gear train, compound gear train, Reverted gear train, Epicyclic gear train.

UNIT 5: **Cams:** Types of followers, Nomenclature of followers, Motion of follower, Simple harmonic motion of follower, Uniform acceleration and retardation, Cycloidal motion, cam profile construction, cam profile for roller followers.

UNIT 6: **Brakes and Dynamometers:** Types of brake: Simple shoe brake, Band Brake, Band and Block brake, Internal expanding shoe brake, Dynamometer, Absorption Dynamometer: Prony brake dynamometer, Transmission Dynamometer: Epi-cyclic train dynamometer.

Text Books:

1. Theory of Machines and Mechanisms: Joseph EdwardShigley and John JosephUicker, Jr. Second Edition, MGH, New York.
2. Theory and Machines: V.P. Singh, Dhanpat Rai & Company.
3. Theory and Machines: S.S. Rattan, Tata McGraw Hill.

References:

1. NPTL lectures

PCC-ME-208 ADVANCED STRENGTH OF MATERIALS
B. Tech (Mechanical Engineering) IV Semester

No. of Credits: 3
L T P Total
3 0 0 3

Sessional: 25 Marks
Theory: 75 Marks
Total: 100 Marks
Duration of Exam: 3 Hours

Pre- Requisite: Engineering Mechanics, Strength of Materials

Successive: Design of Machine Elements, Design and Optimization

Course Objectives:

The objective is to present the mathematical and physical principles in understanding the linear continuum behavior of solids.

Course Outcomes (COs); After the completion of this course, the students will be able to;

CO1:Understand the deformation behavior ofsolids under different types of loading and obtain mathematical solutions for simple geometries.

CO2: Evaluate the behaviour and strength of structural elements subjected to three dimensional stress system.

CO3:Apply and use energy methods to find force, stress and displacement in simple structures.

CO 4- Understand and predict behaviour of meterials by using various theories of failures.

CO 5- Knowl of stress functions, and calculate stresses in rotating rings, discs, and curved beams.

Course Contents:

Unit 1:
Introduction to Cartesian tensors, Strains: Concept of strain, derivation of small strain tensor and compatibility, principal strain and directions, strain invariants,problems.

Unit 2:
Stress: Derivation of Cauchy relations and differential equations of equilibriumand symmetry equations, principal stresses and directions,stressinvariants,Constitutive equations Generalized Hooke's law,stress strain relations for Isotropic material,problems

Unit 3:
Theories of Elastic Failure: Various theories of elastic failures with derivations and graphical representations, applications to problems of 2- dimensional and 3 dimensional stress system with (i) Combined direct loading and bending, and (ii) combined torsional and direct loading. Problems.

Unit 4:
Energy methods. Definitions, expressions for strain energy stored in a body when load is applied (i) gradually, (ii) suddenly and (iii) with Impact, strain energy of beams in bending, beam deflections, strain energy of shafts in twisting, energy methods in determining spring deflection, Castigliano's & Maxwell's theorems. Numericals.

Unit 5:
Rotating Rings & Discs: Stresses in uniform rotating rings & discs, rotating discs of uniform strength, stresses in rotating cylinders, hollow cylinders & solids cylinders. Numericals.

Unit 6:
Bending of Curved Bars: Bending of beams with large initial curvature, position of neutral axis for rectangular, trapezoidal and circular cross sections, stress in crane hooks, stress in circular rings subjected to tension or compression.

Text Books:

1. G. T. Mase, R. E. Smelser and G. E. Mase, Continuum Mechanics for Engineers, Third Edition, CRC Press, 2004.
2. Y. C. Fung, Foundations of Solid Mechanics, Prentice Hall International, 1965.
3. Lawrence. E. Malvern, Introduction to Mechanics of a Continuous Medium, Prentice Hall International, 1969.
4. LS SARINATH:Advanced mechanics of solids, McGraw Hill,2009
5. Sadhu Singh, Strength of Material

PCC-ME-210 MANUFACTURING PROCESSES
B.Tech (Mechanical Engineering) IV Semester

No. of Credits: 3
L T P Total
3 0 0 3

Sessional: 25 Marks
Theory: 75 Marks
Total: 100 Marks
Duration of Exam: 3 Hours

Pre- Requisite: Nil

Successive: Manufacturing Technology, Welding Technology

Course Objectives:

To motivate and challenge students to understand and develop an appreciation of the processes in correlation with material properties which change the shape, size and form of the raw materials into the desirable product by conventional methods.

Course Outcome (COs): At the end of the course, the student shall be able to:

CO 1- Demonstrate the knowledge about different sand moulding and metal casting processes.

CO 2- Understand the plastic deformation of metals under rolling, extrusion, forging and sheet metal working.

CO 3- Analyze the mechanics of chip formation and to identify the factors related to tool wear, machinability and cutting tool materials.

CO4- Learn about different machining tools and processes like turning, milling, drilling, gear cutting and additive manufacturing.

CO5- Acquire knowledge about basic welding processes and their selection for fabrication of different components.

Course Contents:

Unit 1:

Conventional machining processes**:** Casting and moulding: Metal casting processes and equipment, Heat transfer and solidification, shrinkage, riser design, casting defects and residual stresses. **(5)**

Unit 2:

Introduction to bulk and sheet metal forming, plastic deformation and yield criteria;fundamentals of hot and cold working processes; load estimation for bulk forming (forging,rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending) principlesof powder metallurgy.**(5)**

Unit 3:

Metal cutting: Single and multi-point cutting; Orthogonal cutting system, various force components: Chip formation, merchant circle,velocity relationshipTool wear and tool life,Economics of metal

cutting, Surface finish and integrity, Machinability, Evaluation of machinabililty machinability index. (11)

Unit 4:

Cutting tool materials: requirement of cutting tool material, classification of tool material Cutting fluids: functions of cutting fluids, requirement of good cutting fluids, Types of cutting fluids (4)

Unit 5:

Gear manufacturing methods: different gear manufacturing methods, gear hobbing, gear shaping, gear forming, gear finishing methods. (5)

Turning, Drilling, Milling and finishing processes, Introduction to CNC machining. **(3)**

Unit 6:

Additive manufacturing: Rapid prototyping and rapid tooling. **(3)**

Unit 7:

Joining/fastening processes: Physics of welding, brazing and soldering; design considerationsin welding, Solid and liquid state joining processes; Adhesive bonding. **(4)**

Text Books:

1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition) Pearson India, 2014

2. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems

3. Degarmo, Black &Kohser, Materials and Processes in Manufacturing

4. Amitabh Ghosh and Asok Kumar Mallik, Manufacturing Science, Affiliated East-West Press Private Limited.

PCC-ME-212 THERMAL LAB-I

B. Tech (Mechanical Engineering) IV Semester

No. of Credits: 1

L T P Total

0 0 2 2

Sessional: 15 Marks
Theory : 35 Marks
Total : 50 Marks
Duration of Exam: 2 Hours

Pre- Requisite: Thermodynamics, Applied Thermodynamics

Successive: IC Engines, Air craft Technology, Gas Dynamics and Jet Propulsion.

Course Objectives:

The aim of this course is to familiarize students with the various energy conversion devices and their performance.

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

1. Understand the basic components of a power plant.

2. Learn about the various types of boilers and their parts.

3. Gain knowledge ofthe working of four stroke and two stroke engines.

4. Do the performance testing of I.C. engines.

List of Experiments:

1. To study the function and working of various mountings and accessories in a boiler.
2. To study the construction and working of some low pressure boilers.
3. To study the construction and working of some high pressure boilers.
4. To study the basic elements of a power plant.
5. To study the construction and working of 2 stroke & 4 stroke diesel engine.
6. To study the construction and working of 2 stroke & 4 stroke petrol engine.
7. To prepare heat balance sheet on multi-cylinder diesel engine/petrol engine.
8. To prepare variable speed performance test of a multi-cylinder/single cylinder petrol engine/diesel engine and prepare the curves (i) bhp, ihp, fhp vs speed (ii) volumetric efficiency & indicated specific fuel consumption vs speed.
9. To prepare the graph between curves (i) bhp, ihp, fhp vs speed by using variable compression test rig.
10. Study of Valve Timing Diagram for an I. C. Engine.
11. Study the engine cooling system.

PCC-ME-214 MATERIALS ENGINEERING LAB
B. Tech (Mechanical Engineering) IV Semester

No. of Credits: 1
L T P Total
0 0 2 2

Sessional: 15 Marks
Theory : 35 Marks
Total : 50 Marks
Duration of Exam: 2 Hours

Pre- Requisite: Material Science

Successive: Metallurgy

Course Objectives:

The overall objective of the course is to provide the students with hands-on microstructures of Material and its structure.

Course Outcomes (COs): After studying this course, students will be:

CO 1- Learn the principles of materials science and engineering though lab investigation.

CO 2- Prepare formal laboratory reports describing the results of experiments.

CO 3- Operate basic instruments in materials science and engineering.

CO 4- Understand the basics structure of materials and ability to interpret the data from the experiments.

List of Experiments:

1. To study crystal structures with the help of models.
2. To study crystal imperfections with the help of models.
3. To prepare a small specimen and mount it using hot mounting press.
4. To study optical metallurgical microscope.
5. To analyze microstructures of given Mild Steel/Aluminum specimen.
6. To analyze microstructure of given Grey cast iron specimen.
7. To harden and temper a given steel specimen.
8. To anneal a given hardened steel specimen.
9. To analyze microstructure of quench hardened steel specimen.
10. To analyze the properties of various types of plastics.

PCC-ME-216 KINEMATICS OF MACHINES LAB
B. Tech (MechanicalEngineering) IV Semester

No. of Credits: 1	Sessional : 15Marks
L T P Total	Practical : 35 Marks
0 0 2 2	Total : 50 Marks
	Duration of Exam : 2 Hours

Pre- Requisite: Kinematics of Machines

Successive: Dynamics of Machines

Course Objectives:

To demonstrate the basic elements of machine members and its arrangement to make a mechanism, such as mechanisms, cam, gears etc.

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

CO 1-Understand the various practical demonstrations of mechanism.

CO 2- Describe friction between belt and pulley.

CO 3-Expedite the knowledge of Gears and Gear Train

CO4- Appreciate concept of CAM and Followers

CO5- Discuss Brake mechanisms and dynamo theories

List of Experiments:

1. Kinematics of four bar, slider crank, crank rocker, double crank, double rocker and Oscillating cylinder mechanisms.
2. To plot slider displacement, velocity and acceleration against crank rotation for single slider crank mechanism.
3. To find coefficient of friction between belt and pulley.
4. To generate spur gear involutes tooth profile using simulated gear shaping process.
5. To study various types of gears- Helical, cross helical worm and bevel gear.
6. Estimation of Velocity ratios of simple, compound, epicyclic and differential gear trains
7. To Study Cam profile by using Cam Analyser.
8. To find out BHP of dynamometers.
9. To fabricate the working Models based on inversions, Gear trains, Brakes etc.

MC-02: ENVIRONMENTAL SCIENCE

No. of Credits: 0	Sessional	: 25Marks
L T P Total	Practical	: 75 Marks
2 0 0 2	Total	: 100 Marks
	Duration of Exam	: 3 Hours

Course Objectives:

To familiarise the students with environmental concepts such as; natural resources of energy, ecosystems, biodiversity and its conservation, pollution,

Course outcomes (COs) ; After the completion of this course, the students will be able to;
1. To provide the students a detailed knowledge on the threats and challenges to the environment due to developmental activities.
2. To identify the natural resources and suitable methods for their conservation and sustainable development.
3. To focus importance of ecosystem and biodiversity for maintaining ecological balance.
4. To learn about various attributes of pollution management and waste management practices.
5. To describe the social issues both rural and urban environment and environmental legislation.

Unit 1: THE MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES Definition, scope and importance. Need for public awareness.

Unit 2: NATURAL RESOURCES -----
Renewable And Non-Renewable Resources Natural resources and associated problems, ***Forest resources***: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people. ***Water resources***: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. ***Mineral resources***: Use and exploitation, environmental effects of extracting and mineral resources, case studies. ***Food resources***: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. ***Energy resources***: Growing energy needs, renewable and non- renewable energy sources, use of alternate energy sources. Case studies. Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification., Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

Unit 3: ECOSYSTEMS –
Concept of an ecosystem Structure and Concept of an ecosystem, Structure and function of an ecosystem. Producers, consumers and decomposers, Energy flow in the ecosystem. Ecological succession. Food chains, food webs and ecological pyramids, Introduction, types, characteristic features, structure and function of the following ecosystem: a) Forest ecosystem b) Grassland ecosystem c) Desert ecosystem d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

Unit 4: Biodiversity And Its Conservation----
Definition: genetic, species and ecosystem diversity. Biogeographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option

values. Biodiversity at global, National and local levels. India as a mega-diversity nation. Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: insitu and ex-situ conservation of biodiversity.

Unit 5: ENVIRONMENTAL POLLUTION-----

Definition, Causes, effects and control measures of: Air pollution b) Water pollution c) Soil pollution d) Marine pollution e) Noise pollution f) Thermal pollution g) Nuclear hazards, Solid waste Management: Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. Pollution case studies. Disaster management: floods, earthquake, cyclone and landslides.

Unit 6: SOCIAL ISSUES AND THE ENVIRONMENT---

From Unsustainable to Sustainable development Urban problems related to energy. Water conservation, rain water harvesting, watershed management. Resettlement and rehabilitation of people; its problems and concerns. Case studies, Environmental ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies. Wasteland reclamation. Consumerism and waste products, Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and Control of Pollution) Act , Wildlife Protection Act. Forest Conservation Act. Issues involved in enforcement of environmental legislation , Public awareness.

Unit 7: HUMAN POPULATION AND THE ENVIRONMENT

Population growth, variation among nations. Population explosion, Family Welfare Programme, Environment and human health, Human Rights, Value Education. HIV/AIDS. Women and Child Welfare. Role of Information Technology in Environment and human health. Case Studies.

Unit 8: FIELD WORK:

Visit to a local area to document environmental assets-river, forest, grassland, hill, mountain, Visit to a local polluted site, Urban, Rural, Industrial, Agricultural, Study of common plants, insects, birds. Study of simple ecosystems, pond, river, hill slopes, etc.

TEXT/ REFERENCES

1. “Perspectives in Environmental Studies” by A. Kaushik and C. P. Kaushik, New age international publishers.
2. “Environmental Studies by Benny Joseph”, Tata McGraw Hill Co, New Delhi
3. “Environmental Science: towards a sustainable future” by Richard T. Wright. 2008 PHL Learning Private Ltd. New Delhi.
4. “Environmental Engineering and science” by Gilbert M. Masters and Wendell P. Ela 2008 PHI Learning Pvt Ltd.
5. “Environmental Science” by Daniel B. Botkin& Edwards A. Keller, Wiley INDIA edition.
6. “Fundamentals of Ecology” by Odum, E.P., Barrick, M. and Barret, G.W. Thomson Brooks/Cole Publisher, California, 2005

SEC-WS-202 WORKSHOP-IV

B.Tech - IV Semester

No. of credits: 2				Internal:	30 Marks
L	**T**	**P**	**Total**	External:	70 Marks
0	0	4	4	Total:	100 Marks
				Duration of Exam:	3 Hours

Pre-requisite: Turning, Milling, Welding, Refrigeration and air conditioning.

Successive: Conventional machines, arc, gas, metal inert gas/metal active gas (MIG/MAG) arc welding & refrigeration and air conditioning etc.

Course Objectives: To understand the basics of mechanical engineering by conventional machines, welding, refrigeration and air conditioning and exercises.

Course Outcomes (COs): After studying this course the students will be able to:

6. Perform various operations on lathe, milling, shaper, drilling and grinding machines.
7. Understand the function and use of various metrological tools and gauges.
8. Create various jobs by arc, gas, MIG/MAG welding.
9. Dismantling and assembly of compressors and identify various parts of compressor.

List of Exercises:
(Turning, Milling, Welding & RAC Workshop)

14. To perform multi operational job (facing, centering, turning, knurling, threading, grooving, chamfering etc) on lathe machine.
15. To understand the use of various metrological tools and gauges such as bore gauge, micrometer (inside and outside), slip gauge, sine bar, snap gauge and plug gauge etc.
16. To perform a job of taper machining/V-shape machining on milling/shaping machine.
17. To perform grinding of multi point cutting tool (milling cutters) on tool and cutter grinder.
18. To lay weaved bead & prepare T-joint in flat position by arc welding on mild steel plate.
19. To prepare closed butt joint on mild steel plate in flat position by MIG/MAG welding.
20. To perform cutting operation in mild steel plate by oxy-acetylene gas welding.
21. To prepare a raised edge joint without filler metal rod by gas welding.
22. Dismantling and assembling of single cylinder compressor.
23. Dismantling and assembling of dual cylinder reciprocating compressor.
24. Dismantling and assembling of rotary open & closed type compressor.
25. To perform gasket cutting for single & dual cylinder, rotary open & close type compressor.

Note:- At least nine exercises should be performed from the above list; remaining three may either be performed from above list or designed by the concerned institution as per the scope of the syllabus and facilities available in the institute.

PCC-ME- 301 HEATS AND MASS TRANSFER
B. Tech (Mechanical Engineering) V Semester

No. of Credits: 3
L T P Total
3 0 0 3

Sessional: 25 Marks
Theory: 75 Marks
Total: 100 Marks
Duration of Exam: 3 Hours

Pre- Requisite: Thermodynamics

Successive: Thermal Lab- II, Design of Thermal Systems

Course Objectives:

- The aim of the course is understnad the concept of Heat Transfer such as; conduction, convection and radiation, analysis, and design of heat exchangers.

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

1. To formulate and analyze of the three modes of heat transfer.
2. Obtaining exact solutions for the temperature variation
3. Designing of devices such as heat exchangers and also estimate the insulation needed to reduce heat losses where necessary.
4. Conceptualization of mode of mass transfer.

Course Contents :

Unit1:
Introduction to three modes of heat transfer, Derivation of heat balance equation- Steady one dimensional solution for conduction heat transfer in Cartesian, cylindrical and spherical geometry, concept of conduction and film resistances, critical insulation thickness, lumped system approximation and Biot number, heat transfer through pin fins- Two dimensional conduction solutions for both steady and unsteady heat transfer-approximate solution to unsteady conduction heat transfer by the use of Heissler charts.**(12)**

Unit 2:
Heat convection,basic equations, boundary layers- Forced convection, external and internal flows- Natural convective heat transfer- Dimensionless parameters for forced and free convection heat transfer-Correlations for forced and free convection- Approximate solutions to laminar boundary layer equations (momentum and energy) for both internal and external flow- Estimating heat transfer rates in laminar and turbulent flow situations using appropriate correlations for free and forced convection. **(8)**

Unit 3:
Interaction of radiation with materials, definitions of radiative properties, Stefan Boltzmann's law, black and gray body radiation, Calculation of radiation heat transfer between surfaces using radiative properties, view factors and the radiosity method.**(8)**

Unit 4:
Types of heat exchangers, Analysis and design of heat exchangers using bothLMTD and ε-NTU methods.**(6)**

Unit 5:
Boiling and Condensation heat transfer, Pool boiling curve **(3)**

Unit 6:

Introduction and modes of mass transfer, Mass and mole concentrations, , molecular diffusion, eddy diffusion, fick's law, General equation of mass diffusion in stationary media, Diffusion of water vapours through air, Convective mass transfer and it's correlations. **(3)**

Text Books:

1. A. Bejan, Heat Transfer John Wiley, 1993
2. J.P.Holman, Heat Transfer, Eighth Edition, McGraw Hill, 1997.
3. F.P.Incropera, and D.P. Dewitt, Fundamentals of Heat and Mass Transfer, John Wiley, Sixth Edition, 2007.
4. MassoudKaviany, Principles of Heat Transfer, John Wiley, 2002
5. Yunus A Cengel, Heat Transfer : A Practical Approach, McGraw Hill, 2002

PCC-ME-303 DYNAMICS OF MACHINES
B.Tech (Mechanical Engineering) V Semester

No. of Credits: 3		Sessional:	25 Marks
L T P	Total	Theory:	75 Marks
30 0	3	Total:	100 Marks
		Duration of Exam:	3 Hours

Pre- Requisite: Kinematics of Machines, Engineering Mechanics

Successive: Tribology

Course Objectives:

The aim of the course is to analysis of Forces acting in a mechanism such as; Governor, Gyroscope and to have knowledge of vibration in a mechanism.

Course Outcomes; After the completion of this course, the students will be able to

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

CO 1- Understand the Static and Inertia Force Analysis.

CO 2- Explore the concept of Balancing of rotating and reciprocating masses.

CO 3- Have Knowledge of concept of Mechanical Governor.

CO 4-Develop the concept of Gyroscope and its application.

CO5- Analysis of automotives stability.

CO 5-Explore the concept of Mechanical Vibration and fix the vibration problems in the machines.

Course Contents:

UNIT I **Static and Inertia Force Analysis:** Static force analysis of planer mechanisms, dynamic force analysis including inertia and frictional forces of planer mechanisms.D-Alembert's Principle,Forces on the reciprocating parts of an engine considering friction and inertia of moving parts,dynamically equivalent system, Torque exerted on the crank shaft, considering the weight of the connecting rod.

UNIT II **Balancing:** Balancing rotating mass in single and several planes, Balancing of reciprocating engine, concept of Partial balancing, Primary and secondary balancing of multi-cylinder inline engine and radial engine, Method of direct and reverse cranks.

UNIT III **Governors:** Types of Governor, Watt Governor, Porter governor, Proell Governor, Hartnell Governor, Wilson-Hartnell governor, Sensitivity, Stability, Isochronisms, Hunting, Governor Effort and Power, controlling force.

UNIT IV **Gyroscopic effect:** Spinning and precession, gyroscopic couple, Effect of Gyroscopic couple on the stability of automotive vehicles: Stability of four wheelers & two wheelers.

UNIT V **Mechanical Vibration**: Definition, parts of vibration, types: longitudinal, transverse, torsional, transient, Free and Forced Vibration of single DOF ,Vibration Absorber : tuned and damped absorber (qualitative treatment only), un-tuned viscous damper.

UNIT VI **Vibration Analysis:** Introduction, Influence coefficient, Stiffness Matrix, Flexibility Matrix, Natural Frequencies and Normal Modes, Calculation of natural frequencies by Rayleigh method, Vibration Isolation.

Text Books:

1. Theory of Machines and Mechanisms: JosephEdwardShigley and JohnJosephUicker, Jr. Second Edition, MGH, New York.
2. Theory and Machines: V.P. Singh, Dhanpat Rai & Company.
3. Theory and Machines: S.S. Rattan, Tata McGraw Hill.

References:

1. NPTL lectures
2. Mechanism and Machines: J S Rao,
3. Mechanical Vibrations :G.K.Grover – Nem Chand & Bros., Roorkee, INDIA

PCC-ME-305 DESIGN OF MACHINE ELEMENTS-I
B. Tech (Mechanical Engineering) V Semester

No. of Credits: 4	Sessional: 25 Marks
L T P Total	Theory: 75 Marks
3 1 0 4	Total : 100 Marks
	Duration of Exam: 3 Hours

Pre- Requisite: Kinematics of Machines, Strength of Materials

Successive: Design of Machine Elements II

Course Objectives:

To study the concept and details of material selection, allowable stresses and factor of safety. To study the design of keys, coupling, cotter joints, various types of springs, various types of clutches, thick cylinder and thin cylinders.

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

CO 1- Explore different concepts & considerations of machine design.

CO 2- Understand design of different types of mechanical joints.

CO 3- Have Knowledge of Design of different types of keys & couplings.

CO 4- Discuss and Design transmission shafts against bending and torsion axial loads

CO 5- Design different type's springs used for suspension etc.

CO 6- Conceptualise the design of different types of clutches.

Course Contents:

UNIT I **Principles of Mechanical Design:** General considerations & procedure of design of machine elements, Engineering materials & their mechanical properties, Selection of material, theories of failures, static loading, factor of safety under different loading conditions, stress concentration, Concept of fatigue failures for dynamic loading.

UNIT II **Mechanical Joints:** Design of riveted &welding jointsunder different static load conditions. Design of screwed joints against static load, eccentrical loading, Design of cotter joints and knuckle joint.

UNIT III **Keys& Couplings:** Design of different type of keys; sunk key, saddle key, tangent key, round key & splines. Design of different shaft couplings against torque; Rigid & Flexible couplings.

UNIT IV **Transmission Shafts:** Design of shaft subjected to static loading: pure torsion, simple bending, combined bending and torsion, combined bending torsion and axial loads. Design of shafts for fluctuating loads.

UNIT V **Springs:** Terminologies of springs, Different type of springs**,** Design of helical springs for static & dynamic loading, Eccentric loading, Surge in springs, Springs in series & parallel connection, Type of leaf springs, Design of leaf springs.

UNIT VI **Clutches:** Various types of clutches, Design of friction clutches; Single plate clutch, Multi-plate clutch, Cone clutch& Centrifugal clutch.

Text Books:

1. Mechanical Engineering Design: Joseph Edward Shigley-MGH, New York.
2. Design of Machine Elements – V.B. Bhandari – MGH.
3. Norton, R. L., Machine design: an integrated approach, Prentice Hall.

Web Links:

NPTEL Courses, http://www.nptel.ac.in

PCC-ME-307 REFRIGERATION AND AIR-CONDITIONING

B. Tech (Mechanical Engineering) V Semester

No. of Credits: 3	Sessional: 25 Marks
L T P Total	Theory: 75 Marks
3 0 0 3	Total : 100 Marks
	Duration of Exam: 3 Hours

Pre- Requisite: Thermodynamics

Successive: Air Conditioning Equipments

Course Objectives:

To familiarize with refrigeration systems and air Conditioning.

Course Outcomes (COs): At the end of the course, the student shall be able to:

CO 1- Understand the air refrigeration, vapour compression refrigeration, vapour absorption, steam jet refrigeration systems and different type of refrigerants.

CO 2- Expedite the working of single stage, multistage and cascade refrigeration.

CO 3- Have knowledge of psychrometry and different psychrometric processes. Understand and evaluate cooling and heating load and design of HVAC system.

CO 4- Develop and design RAC systems and evaluate different expansion and control devices.

Course Contents:

Unit 1: Classification of refrigeration systems
Advanced vapour compression cycles, Refrigerants and their mixtures: properties and characteristics - Ozone depletion and global warming issues –

Unit 2: System components:
Compressors, Condensers, Expansion devices and Evaporators -Performance matching of components of refrigeration systems,Advanced absorption refrigeration systems and their components.

Unit 3: Review of Psychrometry and Air-conditioning processes -
Comfort air conditioning and Cooling load calculations - Applications of AC systems –

Unit 4: Concept of enthalpy potential – Air washers, Cooling towers , Evaporative condensers , Cooling and dehumidifying coils.

Text Books:

1. Gosney, W.B, Principles of Refrigeration, Cambridge University Press, 1982.
2. Stoecker, W.F. and Jones, J.W., Refrigeration and Air conditioning, Tata McGraw Hill, 1986.
3. Arora, C.P., Refrigeration and Air conditioning, Tata McGraw Hill, 2nd Edition, 2000.
4. Kuehn, T.H., Ramsey, J.W. and Threlkeld, J.L., Thermal Environmental Engineering, 3rd Edition, Prentice Hall, 1998.

PCC-ME- 309 THERMAL LAB- II

B. Tech(Mechanical Engineering) V Semester

No. of Credits: 1
L T P Total
0 0 2 2

Sessional: 15 Marks
Practical : 35 Marks
Total : 50 Marks
Duration of Exam: 2 Hours

Pre- Requisite: Refrigeration and Air Conditioning, Heat and Mass Transfer

Successive: Air conditioning Equipments, Design of Thermal Systems

Course outcomes (Cos) ; At the end of the course, the student shall be able to:

1. Familiarize COP associated with refrigeration systems.
2. Understand basic function of refregeration component .
3. Explore thermal conductivity and convection process.
4. Find out heat transfer coefficient of heat exchangers.

List of Experiments:

1. To determine the COP and draw P-H & T-S diagram for compression refrigeration system.

2. To study the cut section model of reciprocating and rotary refrigerant compressor.

3.To determine the COP and capacity of an ice plant.

4. To determine the COP of vapor absorption system.

5.To determine the COP of water cooler.

6. To determine the thermal conductivity of an insulating power.

7. To find the Stefan-Boltzmann constant for thermal radiation.

8. (i)To Plot temperature distribution along the pin fin under natural convective conditions and compare with the theoretical temperature distribution along it.
(ii) To find the effectiveness of the pin fin.

9. (i)To Plot temperature distribution along the pin fin under forced convective conditions and compare with the theoretical temperature distribution along it.
(ii) To find the effectiveness of the pin fin.

10. To find overall heat transfer coefficient and effectiveness of a shell & tube heat exchange under parallel and counter flow conditions.

11. To measure the emissivity of the gray body (plate) at a given temperature.

PCC-ME-311 DYNAMICS OF MACHINES LAB

B. Tech (MechanicalEngineering) V Semester

No. of Credits: 1	Sessional:	15 Marks
L T P Total	Practical:	35 Marks
0 0 2 2	Total:	50 Marks
	Duration of Exam:	2 Hours

Pre- Requisite: Kinematics of Machines, Dynamics of Machines

Successive: Tribology

Course Objective:

To demonstrate the effects of various forces in balancing, governing and directing in a mechanism.

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

CO 1- Understand Balancing of forces

CO 2- Estimate Moment of inertia of a body,

CO 3-Learn the Special purpose mechanism (governor, Gyroscope Cam and followers etc) used in designing of a machine

CO 4- Account for frequencies of Mechanical Vibration

List of Experiments:

1. To carry out static balancing on static balancing machine.
2. To carry out dynamic balancing on dynamic balancing machine.
3. To determine the moment of inertia of connecting rod by tri-flair suspension pendulum.
4. To determine the moment of inertia of connecting rod by compound pendulum method.
5. To Prepare performance characteristic Curves, and to find stability & sensitivity on Proell, Porter Governors and Hartnell Governor.
6. To Determine gyroscopic couple on Motorized Gyroscope.
7. To determine the natural frequency of undamped torsional vibration of a single rotor shaft system.
8. To determine the frequency of damped force vibration of a spring mass system.
9. To fabricate working Models using Gyroscopic, Balancing and Vibration concepts.

MC 03: Essence of Indian Knowledge Tradition Pt-I

No. of Credits: 0	Sessional: 25 Marks
L T P Total	Theory: 75 Marks
3 0 0 3	Total : 100 Marks
	Duration of Exam: 3 Hours

भारतीयिवEा◌ंसार – 1

Course objective

The course aims at imparting basic principles of thought process, reasoning and inferencing. Sustainability is at the core of Indian Traditional knowledge Systems connecting society and nature. Holistic life style of yogic science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions. Part-I focuses on introduction to Indian Knowledge Systems, Indian perspective of modern scientific world-view, and basic principles of Yoga and holistic health care system.

Course Contents Basic structure of Indian Knowledge System: अ’◌ादशिवEा◌ं -४वेद,४उपवेद (आयुवőद, धनुवőद,– गzवJवेद, ’थापr आिद) ६वेदांग (◌ंिशH◌ा, कB, ◌ंिनSb, fŋ◌ाकरण, Ů◌ोि◌ंतष, छं द) ४ उपाङ्ग (धमJशा◌ं, मीमांसा, पुराण, तकJ शा◌ं) Modern Science and Indian Knowledge System– Yoga and Holistic Health care– Case studies–

References

1) V. Sivaramakrishnan (Ed.), Cultural Heritage of India-course material, Bharatiya,Vidya Bhavan, Mumbai. 5th Edition, 2014
2) Swami Jitatmanand, Modern Physics and Vedant, Bharatiya Vidya Bhavan•
3) Swami Jitatmanand, Holistic Science and Vedant, Bharatiya Vidya Bhavan•
4) Fritzof Capra, Tao of Physics
5) Fritzof Capra, The Wave of life• VN Jha (Eng. Trans.), Tarkasangraha of Annam Bhatta, International Chinmay• Foundation, Velliarnad, Arnakulam Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkata
6) GN Jha (Eng. Trans.), Ed. RN Jha, Yoga-darshanam with Vyasa Bhashya,
7) Vidyanidhi Prakashan, Delhi 2016 RN Jha, Science of Consciousness Psychotherapyand Yoga Practices, Vidyanidhi
8) Prakashan, Delhi 2016 P B Sharma (English translation), Shodashang Hridayan

9) Pedagogy: Problem based learning, group discussions, collaborative mini projects.
Outcome: Ability to understand, connect up and explain basics of Indian traditional knowledge in modern scientific perspective.

SEC-WS- 301-WORKSHOP – V
B.Tech - V Semester

No. of credits: 2				Internal:	30 Marks
L	**T**	**P**	**Total**	External:	70 Marks
0	0	4	4	Total:	100 Marks
				Duration of Exam:	3 Hours

Pre-requisite: Turning, Milling, Welding, Refrigeration and air conditioning.
Successive: Conventional and non conventional machines, CNC machines, arc, metal inert gas/metal active gas(MIG/MAG) arc welding & refrigeration and air conditioning etc.

Course Objectives:

To understand the mechanical engineering by conventional and non conventional machines, welding, and refrigeration and air conditioning exercises.

Course Outcomes (COs): At the end of the course, the student shall be able to:

CO-1-Understand the function and use of CNC machines, broaching machine and electric discharge machine (EDM) .
CO 2- Perform various operations on lathe & milling machines.

CO 3- Develop the part program for machining component on CNC machining center and turning center.

CO 4- Prepare jobs on arc, metal inert gas/metal active gas (MIG/MAG), and oxy-acetylene gas welding.

CO 5- Dismantle and assembly of single phase A.C motor assorted relay and capacitor.

CO 6-Test of various electrical devices to be used in air conditioners and coolers.

List of Exercises:
(Turning, Milling, Welding & RAC Workshop)

1. To prepare a slot/keyway in a component on milling / shaper machine.
2. To study working principle and parts of broaching and electric discharge machine.
3. To study main features and parts of CNC machining center and turning center.
4. prepare part program for machining component on
5. To prepare a job on lathe machine including facing, centering, plain turning, taper turning, threading, drilling and chamfering operations.
6. To prepare straight continuous bead inside/outside corner joints in flat position on mild steel plate by arc welding.
7. To prepare lap joint in flat position on mild steel plate by MIG/MAG welding.
8. To perform brazing on copper sheet to copper pipe with copper brazing filler metal/rod by gas welding.
9. To perform brazing on mild steel sheet to mild steel pipe with brass filler metal/rod by gas welding.
10. To study, dismantling, assembling and troubleshooting of single phase A.C motor.

11. To study assorted relays, capacitors and their testing along with applications.
12. To study and tracking out various electrical circuits used in room and desert coolers.
13. To study testing and uses of assorted selector switches.

Note:- At least nine exercises should be performed from the above list; remaining four may either be performed from above list or designed by the concerned institution as per the scope syllabus and facilities available in the institute

PCC-ME-302 CAD/CAM
B.Tech (Mechanical Engineering) VI Semester

No. of Credits: 3
L T P Total
3 0 0 3
Duration of Exam: 3 Hours

Sessional: 25 Marks
Theory: 75 Marks
Total : 100 Marks

Pre- Requisite: Engineering Drawing, Manufacturing Processes
Successive: Automation in Manufacturing, Mechatronics

Course Objectives:
To understand the fundamentals of CAD and CAM for development of mechanical systems.

Course Outcomes (COs): At the end of the course, the student shall be able to:

CO 1- Understand the basic fundamentals of computer aided designing.
CO 2- Learn development of curves, surfaces, solid models for mechanical designs and FEA.
CO 3- Understand basics of NC, CNC, DNC and robotics
CO 4- Acquire knowledge about advanced manufacturing systems like FMS, CIM, CAPP etc.

Course Contents:

***UNIT I* Basics of CAD:**
Need and Scope of Computer Aided Design, Fundamental of CAD and computer graphics- Application areas, Comparison of CAD with Manual designing, Benefits of CAD, Concept of layers, advanced concepts of CAD software- blocks, UCS, 3D-line, 3D objects, 2-D geometrical transformations, Matrix representations and homogeneous coordinates, composite transformations, transformations between coordinate systems. 2-D viewing, 3-D Geometric transformations, composite transformations, Importance of transformations.

***UNIT II* Curves and Surfaces:**
Representation of circle, Arc, Ellipse, parabola and hyperbola. Synthetic Curves**;** Concept of continuity, Cubic Spline: equation, properties and blending. Bezier Curve: equations, properties; Properties and advantages of B-Splines and NURBS. Types of surfaces used in automotive industry along with their applications.

***UNIT III* Solid Modelling:**
Geometry and Topology, Comparison of wireframe, surface and solid models, Properties of solid model, properties of representation schemes, Concept of Half-spaces, Boolean operations. Schemes: B-rep, CSG, Sweep representation, ASM, Primitive instancing, Cell Decomposition Techniques.

***UNIT IV* Finite Element Analysis:**
Finite element method, Review of stress-strain relation and generalized Hooke's Law, Plane stress and Plane strain conditions; Failure and its type; FOS, Types of FEA. Theories of Failure, Principal stresses and strains, Von-mises stress and Deflection in structural systems. Pre processing, Elements type, Material defining, Meshing- coarse and fine, optimal mesh,

loading and constraints, boundary conditions, solvers, post processing and reviewing the results, validation of the CAE results, Case study using ANSYS software.

UNIT V **Computer Aided Manufacturing**:
Introduction to NC, DNC & CNC, NC components, NC coordinate systems, Point to point, line and contouring systems, open and close loop control system, Steps in NC manufacturing, Advantages, Disadvantages and Applications of NC, Features of CNC system, components and tooling of machining centre and CNC turning centre, Automatic tool changer, Feedback devices: Encoders and linear scale, Features of DNC and adaptive control systems. Part programming fundamentals, Manual Part Programming, APT Programming, Geometric & motion commands, Post processor commands, Safety measures in CNC programming. Role of NC/CNC technology in modern manufacturing,

UNIT VI **Robotics:**
Introduction to robotic technology, Joints and links used in robots, Robot physical configurations, Joint drive systems, Robot control systems, End effectors, Sensors in robotics, Robot motion systems, Technical features of robot like work volume, precision of movement, speed of movement, weight carrying capacity, Programming methods of robot, Robot programming languages, Intelligent robots, Vision systems, Applications of Industrial robots, Safety measures.

UNIT IV **CAM Concepts:**
Flexible Manufacturing System**;** Components of FMS, FMS equipment & control, Operational problem in FMS, Automated guided vehicle systems, Automated storage and retrieval system, Computer Integrated Manufacturing; Elements of CIM, CIM hierarchy, Computer Aided Process Planning; Introduction to CAPP, Variant & Generative methods of CAPP, advantages of CAPP.

Text Books:
1. Ibrahim Zeid *CAD/CAM - Theory and practice Tata McGraw Hill* Publishers.
2. Salomon, D. *Transformations and projections in computer graphics* Springer.
3. Rao, P.N., CAD / CAM Principles and Applications, McGraw Hill Publishers, New Delhi, 2010.
4. M.P.Groover , Automation, production systems and Computer-integrated Manufacturing, Eastern Economy Edition.

Reference Books:
1. Yoram Koren, Computer Control of Manufacturing Systems, McGraw Hill Publications, 2005.
2. Nanua Singh , System approach to Computer-integrated design and manufacturing, , Wiley India.
3. T. C. Chang, R. A. Wysk and H. P. Wang, Computer Aided Manufacturing, Pearson

PCC-ME-304 MANUFACTURING TECHNOLOGY
B.Tech (Mechanical Engineering) VI Semester

No. of Credits: 3 Sessional: 25 Marks
L T P Total Theory: 75 Marks
3 0 0 3 Total : 100 Marks
Duration of Exam: 3 Hours

Pre- Requisite: Manufacturing Processes
Successive: Welding Technology, Automation in Manufacturing, Mechatronics

Course Objectives:

- To provide knowledge on machines tools for manufacturing various components.

Course Objectives (COs): At the end of the course, the student shall be able to:

CO 1- Acquire knowledge about press tools and dies and Jigs and Fixtures.

CO 2- Learn about the different aspects of metrology and surface measurement.

CO 3- Understand the different assembly practices.

CO 4- Understand the basics principles of non-conventional machining processes and their applications.

Course Contents:

Unit 1: Tooling for conventional and non-conventional machining processes:
Mould and die design, Press tools, Cutting tools; Holding tools: Jigs and fixtures, principles, applications and design; press tools – configuration, design of die and punch; principles of forging die design. **(12)**

Unit 2: Metrology
Dimensions, forms and surface measurements, Limits, fits and tolerances; linear and angular measurements; comparators; gauge design; inter ferometry; Metrology in tool wear and part quality including surface integrity, alignment and testing methods; tolerance analysis in manufacturing and assembly. Process metrology for emerging machining processes such as micro-scale machining, Inspection and workpiece quality. **(16)**

Unit 3: Assembly practices:
Manufacturing and assembly, process planning, selective assembly, Material handling and devices. **(6)**

Unit 4: Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultrasonic Machining, principles and process parameters **(5)**

Unit 5: Electrical Discharge Machining,
principle and processes parameters, MRR, surface finish,
tool wear, dielectric, power and control circuits, wire EDM; Electro-chemical machining (ECM), etchant & maskant, process parameters, MRR and surface finish. **(8)**
Unit 6:

Laser Beam Machining (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining components **(3)**

Text Books:

1. Manufacturing Technology – Metal cutting and machine Tools: P.N. Rao, T.M.H, New Delhi
2. Workshop Technology -Vol II (Machine Tools) B.S Raghuwanshi, dhanpat Rai and Company.
3. Manufacturing Processes- H S Shan, Cambridge University Press 2nd Edition 2017.

Reference Books:

1. Manufacturing Engg. & Tech, Kalpakian, Serope Addison -Wisly Publishing Co. New York.
2. Modern Machining Processes: P.C. Pandey & H.S. Shan, T.M.H. Company, New Delhi
3. Text Book of Production Engineering: P.C. Sharma, S.Chand & Sons.

Web Links:

NPTEL Video Lecture ,Web: http://nptel.ac.in

PCC-ME-306 DESIGN OF MACHINE ELEMENTS- II
B. Tech (Mechanical Engineering) VI Semester

No. of Credits: 3	Sessional: 25 Marks
L T P Total	Theory: 75 Marks
3 0 0 3	Total : 100 Marks
	Duration of Exam: 3 Hours

Pre- Requisite: Strength of Materials, Design of Machine Elements- I

Successive: Design and Optimisation, Tribology

Course Objectives:

To study essential concepts of fatigue design and factor of safety selection. To study design components such as shaft design of static and dynamic loading, keys, cylinder, clutches, springs and mechanical joints.

Course Outcomes (COs): At the end of the course, the student shall be able to:

CO 1- Expose the students to the Design for Production and for variable loading.

CO 2- Impart in depth knowledge of designing of screws and different types of fasteners.

CO 3- Design bearings, selection of bearings for different aspects & lubricants with their properties.

CO 4-Knowledge of gears, design of different types of gears with considerationof maximum power transmission and gear lubrication.

CO 5- Learn in depth knowledge of flywheels and their design.

CO 6- Understand the design procedure for miscellaneous components such as connecting rod, crankshaft and C- clamp.

Course Contents:

***UNIT I* Design for Production**:

Ergonomic and value engineering considerations in design, Role of processing in design, Design considerations for casting, forging and machining. Variable Loading: Different types of fluctuating/ variable stresses, Fatigue strength considering stress concentration factor, surface factor, size factor, reliability factor etc., Fatigue design for finite and infinite life against combined variable stresses using Goodman and Soderberg's Criterion, Fatigue design using Miner's equation, Problems.

***UNIT II* Design of Screws and Fasteners**:

Thread standards and definitions, mechanics of power screws, threaded fasteners, fastener stiffness.

***UNIT III* Design of Bearings**:

Selection of ball and roller bearing based on static and dynamic load carrying capacity using load-life relationship, Selection of Bearings from manufacturer's catalogue, types of lubrication – Boundary, mixed and hydrodynamic lubrication, Design of journal bearings using Raimondi and Boyd's Charts, Lubricants and their properties, Selection of suitable lubricants, Design Problems.

***UNIT IV* Gears**:

Classification, Selection of gears, Terminology of gears, Force analysis, Selection of material for gears, Beam & wear strength of gear tooth, Form or Lewis factor for gear tooth, Dynamic load on gear teeth -Barth equation and Buckingham equation and their comparison, Design of spur, helical, bevel & worm gear including the Consideration for maximum power transmitting capacity, Gear Lubrication, Design Problems.

***UNIT V* Design of Flywheels**:

Turning moment diagram, coefficient of fluctuation of energy and speed, design of solid and rimmed flywheel**.**

***UNIT VI* Design of Miscellaneous Components**:

Crane hook, C-clamp, Machine Frame, Crank Shaft and Connecting Rods.

Text Books:

1. Mechanical Engineering Design- Joseph Edward Shigley-Mc Graw Hill Book Co.
2. Design of Machine Elements – V.B. Bhandari – Tata McGraw Hill, New Delhi.

Reference Books*:*

1. Engineering design – George Dieter, McGraw Hill, New York.
2. Machine Design an Integrated Approach: Robert L.Norton, Second Edition –Addison Wisley Longman.

PCC-ME-308 CAD-CAM LAB

B.Tech (Mechanical Engineering) VI Semester

No. of Credits: 1 Sessional: 15 Marks
L T P Total Theory : 35 Marks
0 0 2 2 Total : 50 Marks
Pre- Requisite: Engineering Drawing
Successive: Design and Optimization

Course Objectives:
To understand the fundamentals of CAE tools for mechanical systems and practicing in the field of computer aided manufacturing.

Course outcomes (COs): At the end of the course, the student shall be able to:

CO 1- Display & exploring CAD modelling package.
CO 2- Learn the techniques of 3D modelling of various mechanical parts.
CO 3- Prepare part programs on CNC machine.
CO 4- Learn about the computer aided assistance available for manufacturing.

List of Experiments#

1. Introduction to CAE tools and working with sketch mode
2. Working with creating features, Point, Axis and Planes.
3. Working with the tools like Hole, Round, Chamfer, Fillet, Pattern, Copy, Rotate, Move and Mirror.
4. Working with advanced modeling tools (Sweep, Blend, Variable section Sweep, Swept Blend & Helical Sweep).
5. Assembly modeling, Generating, editing and modifying drawings in CATIA/ Solid works/ProE.
6. FEA of the cantilever beam with concentrated load and UDL using CAE tools
7. To perform facing, step & taper turning using CNC turning centre.
8. To perform grooving, threading operation using CNC turning centre
9. To draw a triangle in particular frame by using KR-16 robotic arm
10. To construct an array of 3*3 by using robotic arm
11. To study some general features guidance technologies and traffic management system of Automated Guided Vehicles (AGVs).
12. To study the basic concept of Machine Vision System

 # 10 experiments are to be covered. Out of above list first 06 are compulsory and any 04 can be opted from last 06 experiments.

SEC-WS- 302- WORKSHOP- VI

B.Tech- VI Semester

No. of credits: 2				Internal:	30 Marks
L	**T**	**P**	**Total**	External:	70 Marks
0	0	4	4	Total:	100 Marks
				Duration of Exam:	3 Hours

Pre-requisite: Turning, Milling, Welding, Refrigeration and air conditioning.

Successive: Conventional and non conventional machines, arc, metal inert gas/metal active gas (MIG/MAG), tungsten inert gas (TIG) arc welding ,gas welding & refrigeration and air conditioning etc .

Course Objectives: To understand the mechanical engineering by conventional and non conventional machines, welding, refrigeration and air conditioning and exercises.

Course Outcomes (COs): At the end of the course, the student shall be able to:

1. Cut gears on a work piece by gear hobbing /gear shaper.
2. Create various jobs on conventional lathe, milling/shaper and CNC turning centre.
3. Prepare various jobs by Arc, MIG/MAG, TIG and Gas welding techniques.
4. Learn troubleshooting of all metering devices, testing of leakage in refrigeration system and electrical wiring of coolers, deep freezers and room air conditioners.

List of Exercises:

(Turning, Milling, Welding & RAC Workshop)

26. To prepare a job consisting of drilling, tapping, recessing/spline, chamfering operations etc on milling/shaper and drilling machine.
27. To prepare a bush on lathe machine (facing, drilling, boring, turning, chamfering operations etc).
28. To perform gear cutting operation by gear hobbing/gear shaper.
29. To prepare the part program for machining a mild steel component on CNC turning center.
30. To prepare straight continuous bead in upward and downward direction in vertical position and closed butt joint in horizontal position on mild steel plate by arc welding.
31. To prepare T-fillet joint in flat position on mild steel plate by MIG/MAG welding.
7. To prepare straight continuous bead on stainless steel/aluminum sheet by TIG welding.
8. To prepare butt joint in flat position on mild steel sheet with mild steel copper coated (MSCC) filler rod by gas welding.
9. To find out the storage capacity of a refrigerator.
10. To study different types of metering devices along with their dismantling and assembling procedures and troubleshooting.
11. To identify leakage in a refrigeration system.
12. To perform electrical wiring of refrigerators, coolers, deep freezers, multi-temperature units and room air conditioners.

Note:- At least nine exercises should be performed from the above list; remaining three may either be performed from above list or designed by the concerned institution as per the scope of the syllabus and facilities available in the institute.

PCC-ME 401 AUTOMATION IN MANUFACTURING
B. Tech. VII/VIII Semester

No. of Credits: 3
L T P Total
3 0 0 3

Sessional: 25 Marks
Theory: 75 Marks
Total: 100 Marks
Duration of Exam: 3 Hours

Pre- Requisite: CAD/CAM, Manufacturing Processes, Manufacturing Technology

Successive: Mechatronics

Course Objectives:

To get familiarisation with automation concept in modern manufacturing such as; CAD/CAM,sensors, pneumatics, hydraulics and CNC

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

CO1: Understand various types of automation and their elements.
CO2: Analyse, design, implement and maintaining flexible manufacturing systems.
CO3: Understand various materials handling system.
CO4: Analyse industrial control system and system modelling.

Course Contents:

Unit 1:
Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations, introduction to automation productivity.

Unit 2:
Low cost automation: Mechanical & Electro mechanical Systems, Pneumatics and Hydraulics, Illustrative Examples and case studies.
Introduction to Modeling and Simulation: Product design, process route modeling,

Unit 3:
Overview of Material Handling Systems - Rotary feeders, oscillating force feeder, vibratory feeder, elevator type and Centrifugal type feeders, Principles and Design Consideration, Material Transport Systems, Storage Systems.

Unit 4:
Components, Classification and Overview of Manufacturing Systems, Manufacturing Cells, GT and Cellular Manufacturing, FMS, FMS and its Planning and Implementation, Flow lines.

Unit 5:
Industrial Control Systems, Process Industries Verses Discrete - Manufacturing, Industries Continuous Verses Discrete Control, Computer Process and its Forms. Sensors Actuators and other Control System Components.

Unit 6:
Introduction/need for system Modeling, Building Mathematical Model of a manufacturing Plant, Modern Tools – Artificial neural network sin manufacturing automation, AI in manufacturing, Fuzzy decision and control, robots and application of robots for automation

Text Books:

(i) Mikell P. Groover, Automation, Production Systems, and Computer - integrated Manufacturing, prentice Hall
(ii) SeropeKalpakjian and Steven R. Schmid, Manufacturing Engineering and Technology, 7th edition, Pearson
(iii) YoramKoren, Computer control of manufacturing system, 1st edition
(iv) Ibrahim Zeid, CAD/CAM: Theory & Practice, 2nd edition.

PCC-ME-403 OPERATIONS RESEARCH
B. Tech (Mechanical Engineering) VII/VIII Semester

No. of Credits: 3
L T P Total
3 0 0 3

Sessional: 25 Marks
Theory: 75 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Pre- Requisite: Mathematics III

Course Objectives:

Study the role of operational research in decision making.

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

CO 1 Understand the role of operations research in decision-making, and its applications in industry and able to formulate and design real-world problems through models & experiments.

CO 2 Knowledge of various types of deterministic models like linear programming, transportation model and ability to solve real world problems.

CO 3 Understand and apply various types of stochastic models like waiting line model, project line model, simulation in real world situations.

CO 4 Deduce the relationship between a linear program and it's dual and perform sensitivity analysis to determine the direction and magnitude of change of a model's optimal solution as the data change.

CO 5 Describe different decision making environments and apply decision making process in the existent and futuristic state of affairs.

Course Contents:

UNIT I **Introduction:** Definition, role of operations research in decision-making, applications in industry. Concept on O.R. model building –Types & methods.

UNIT II **Programming (LP):** Programming definition, formulation, solution- graphical, simplex, BIG-M methods, Duality, PRIMAL-DUAL relations-its solution, shadow price, economic interpretation, dual-simplex, post-optimality & sensitivity analysis, problems.

UNIT III **Deterministic Model:** Transportation model-balanced & unbalanced, north west rule, Vogel's Method, least cost or matrix minimal, Stepping stone method, MODI methods, degeneracy, assignment, travelling salesman, problems.

UNIT IV **Waiting Line Models:** Introduction, queue parameters, M/M/1 queue, performance of queuing systems, applications in industries, problems.

UNIT V **Project Line Models:** Network diagram, event, activity, defects in network, PERT & CPM, float in network, variance and probability of completion time, project cost- direct, indirect, total, Introduction to crashing of network & resources leveling in project, problems.

UNIT VI **Simulation and Decision Theory:** Introduction, design of simulation, models & experiments, model validation, process generation, time flow mechanism, Monte Carlo methods- its applications in industries, Decision process, SIMON model, types of decision making environment - certainty, risk, uncertainty, decision making with utilities, problems.

Note: Concerned software's may be used to solve OR problems.

Text Books:

1. Operation Research – TAHA, PHI, New Delhi.
2. Quantitative Techniques- Vohra, TMH, New Delhi

Reference Books:

1. Operation Research- Gupta & Sharma, National Publishers, New Delhi.
2. Introduction to Operations Research – Churchman, Ackoff, Arnoff. Pub. John Wiley
3. Principles of operation Research (with Applications to Managerial Decisions) byH.M.Wagher, Prentice Hall of India, New Delhi.
4. Operation Research – Sharma, Gupta, Wiley Eastern, New Delhi.
5. Operation Research – Philips, Revindran, Solgeberg, Wiley ISE.

Web Links:

http://nptel.ac.in/courses/112106134/

http://nptel.ac.in/courses/112106131/

SEC-WS-403-WORKSHOP – VII
B.Tech-VII Semester

No. of credits: 2				Internal:	30 Marks
L	**T**	**P**	**Total**	External:	70 Marks
0	0	4	4	Total:	100 Marks
				Duration of Exam:	3 Hours

Pre-requisite: Turning, Milling, CNC, Welding, Refrigeration and air conditioning.
Successive: Lathe, milling, CNC, arc, gas, metal inert gas/metal active gas (MIG/MAG) arc welding, resistance welding, submerged arc welding (SAW) & refrigeration and air conditioning etc.

Course Objectives: To understand the mechanical engineering by conventional and non-conventional machines, metal cutting & welding by arc, MIG/MAG, resistance and refrigeration and air conditioning.

Course Outcomes (COs): After studying this course the students will be able to:

1. Prepare jobs on lathe and milling machine.
2. Develop various jobs using arc, resistance, MIG/MAG and Submerged Arc welding (SAW).
3. Understand the fundamentals of refrigeration and air conditioning rigs and cold storage plants.
4. Rectify some electrical and mechanical faults in window & split type air conditioners.
5. Prepare some jobs by machining it on CNC wire cut EDM.

List of Exercises:
(Turning, Milling, CNC, Welding & RAC Workshop)

1. To perform eccentric turning on a component using lathe machine.
2. To perform taper cutting on dead center using lathe machine.
3. To perform radius cutting on milling machine using rotary table.
4. To develop a cavity on a component using CNC wire cut EDM.
5. To prepare padding bead in flat position and closed butt joint in vertical upward/downward position on mild steel plate by arc welding.
6. To prepare corner joint on mild steel plate in flat position by MIG/ MAG welding.
7. To prepare lap joint on mild steel sheet using Spot/Seam/projection welding.
8. To prepare straight continuous bead on mild steel plate in flat position using SAW.
9. To calculate C.O.P and capacities of industrial refrigeration rig, cold storage plant, split air conditioner rig and room air conditioner rig.
10. To identify and rectify the electrical and mechanical faults in window & split type air conditioners.
11. To flush dehydrate and evacuate the refrigeration system.
12. To pull down the temperature of cold storage plant to specific temperature.

Note:- At least nine exercises should be performed from the above list; remaining three may either be performed from above list or designed by the concerned institution as per the scope of the syllabus and facilities available in the institute.

PEC-ME-302 INDUSTRIAL ENGINEERING (PEC-I)
B.Tech (Mechanical Engineering)VI Semester

No. of Credits: 3		Sessional:	25 Marks
L T P Total		Theory:	75 Marks
3 0 0 3		Total:	100 Marks
		Duration of Exam:	3 Hours

Pre- Requisite: Manufacturing Process

Successive: Advanced Manufacturing Processes

Course Objectives:

To study various concepts and practises of industrial engineering used in industries. Able to design, develop, implement, and improve production systems that include people, materials, information, equipment and environments aligned with success of companies.

Course Outcomes (COs): At the end of the course, the student shall be able to:

CO 1- Describe and apply various techniques of method study and work measurement.

CO 2- Discuss production system and factors affecting productivity and strategies for its improvement.

CO 3- Learn various manufacturing cost components and perform cost analysis.

CO 4- Apply sales forecasting and materials management techniques.

CO 5- Identify objectives, variables and apply techniques and strategies for production planning & control of a production system.

Course Contents:

UNIT I **Production system and Productivity:** Introduction to production systems, Aim of production systems, generalized model of Production systems, Types of production system, Life cycle approach to production management, Plant location, Plant layout, objectives and types. Productivity, various methods of productivity measurement, Factors effecting productivity, Strategies for improving productivity.

UNIT II **Manufacturing Cost Analysis:** Fixed & variable costs, Direct, indirect & overhead costs, & Job costing, Recovery of overheads, Standard costing, Cost control, Cost variance Analysis - Labour, material, overhead in volume, rate & efficiency, Break even analysis, Numerical Problems.

UNIT III **Work Study:** Definition, Objectives, Method study, Principle of motion economy, Techniques of method study – Various charts, THERBLIGS, Work measurement -

various methods, Time Study - PMTS, determining time, Work sampling. Numerical problems.

UNIT IV **Materials Management :** Definition, importance of materials management in manufacturing industries, Relevant costs, Inventory control models - Economic order quantity (EOQ), Economic batch quantity (EBQ) with & without shortage, Inventory control systems - P,Q,Ss Systems, determination of order point & safety stock, Selective inventory control - ABC, FSN, SDE, VED,SCM , Numerical Problems.

UNIT V **Forecasting:** Importance, Objectives, Forecasting and Prediction, Types, Classification of Forecasting Methods, Forecast Errors, Costs and Accuracy of Forecasts, Numerical Problems.

UNIT VI **Production Planning & Control (PPC) :** Objectives & variables of PPC, Aggregate planning - Basic Concept, its relations with other decision areas, Decision options - Basic & mixed strategies, Master production schedule (MPS), Scheduling Operations, Gantt chart, Sequencing - Johnson algorithm for n-Jobs- 2 machines, n-Jobs-3 machines, 2 Jobs n-machines, n-Jobs m-machines, Numerical Problems.

Text Books:

1. Production & Operations Management – Chary, TMH, New Delhi.
2. Modern Production Management – S.S. Buffa, Pub.John Wiley.

Reference Books:

1. Operations Management - Schroeder, McGraw Hill ISE.
2. Operation Management - Monks, McGraw Hill ISE.
3. Production & Operations Management - Martinich, John Wiely SE.
4. Industrial & Systems Engineering - Turner, Mize, Case, Prentice Hall Pub.
5. Industrial Engineering & Operations Management – SK Sharma, Pub-S. K.Kataria
6. Industrial Engineering – Ravi Shankar, Galgotia Pub.

Web Links:

http://nptel.ac.in/courses/112107143/

http://nptel.ac.in/courses/112107142/

PEC-ME-304 INTERNAL COMBUSTION ENGINES (PEC- I)

B. Tech (Mechanical Engineering) VI Semester

No. of Credits: 3	Sessional: 25 Marks
L T P Total	Theory: 75 Marks
3 0 0 3	Total : 100 Marks
	Duration of Exam: 3 Hours

Pre- Requisite: Applied Thermodynamics

Successive: Automobile Engineering, Gas Dynamics and Jet Propulsion

Course Objectives:

To familiarize with functioning of IC engines, its performance analysis.

Course Outcomes (COs): At the end of the course, the student shall be able to:

CO 1- Understand the applications of Air Standard Cycles associated with IC engines.

CO 2- Analyze carburetion, injection and ignition systems with new technologies.

CO 3- Conceptualize the testing of engines.

CO 4- Knowledge of Lubrication and Cooling systems and fuel cells.

Course Contents:

Unit1: Air Cycles

Review of ideal cycles; Details of fuel-air cycles,

Unit 2: Combustion

Combustion in SI and CI engines, Combustion stages, Combustion chambers and Abnormal combustion.

Unit 3: Fuel System

Fuel supply systems in SI and CI engines, carburettors, Port fuel injection, Direct injection and Common rail injection.

Unit 4: Ignition system

Unit 5: Lubrication system and cooling system.

Unit 6: Testing of IC engines, Engine emissions and control.

Unit 7: Advanced IC Engine concepts.

Text Books:

1. Obert E. F, "Internal Combustion Engines and Air Pollution", Harper and Row Publication Inc. NY, 1973.
2. Heisler H, "Advanced Engine Technology", Edward Arnold, 1995.
3. Heywood J. B, "Internal Combustion Engine Fundamentals", McGraw Hill Book Co. NY, 1989
4. Heldt P. M, "High Speed Combustion Engines", Oxford & IBH publishing Co. India, 1985.
5. Stockel M W, Stockel T S and Johanson C, "Auto Fundamentals", The Goodheart, Wilcox Co. Inc., Illinois, 1996.

PEC-ME-306 WELDING TECHNOLOGY (PEC- I)
B. Tech (Mechanical Engineering) VI Semester

No. of Credits: 3	Sessional: 25 Marks
L T P Total	Theory: 75 Marks
3 0 0 3	Total : 100 Marks
	Duration of Exam: 3 Hours

Pre- Requisite: Manufacturing Process

Successive: Project work

Course Objectives:

To study essential concepts for welding processes.To study various techniques for weld testing.To study the concept special welding processes and welding automation.

Course Outcome (COs): At the end of the course, the student shall be able to:

CO 1- Lay down Principles and applications of oxyacetylene and electric arc welding.

CO 2- Understand various types of weld testing.

CO 3- Have Knowledge of techniques of welding automation.

CO 4- Describe methods of advanced and special welding processes.

Course Contents:

UNIT I **Oxy-Acetylene Welding:** Introduction: Welding processes and their principles, Industrial Applications, Principles of Oxy- Acetylene Welding, Procedure, Types of flames, Poping, Flash Back and Fire.Equipment and Accessories: Torches, Regulators, Pressure Gauges, Gas Cylinders, Filler Rods and Welding Fluxes.Welded Joints and their Defects: Types of Joints and Welding Positions, Common Welding Defects and their control.

UNIT II **Electric Arc Welding:** Principle of Electric Arc Welding: Principle, Welding Procedure, Arc Length, Arc Force and Arc Blow.Equipment and Accessories: Welding Machines, A.C. and D.C. Transformers, Motor Generators, Rectifiers, Use of Tong Tester for measuring welding currents, Types of Electrodes and Indian system of classification and coding of covered Electrodes for Mild Steels.

UNIT III **Special and Allied Welding Processes:** ResistanceWelding: Principle, Types and Applications, Equipment and Machinery required.Metal Inert Gas Arc Welding (MIG): Principle, Advantage of Gas Shielded Arc Welding, Types of Metal Transfer, Welding Equipment and Shielding Gases, MIG Welding and its

components.CO_2 Welding: Difference from MIG Welding, Principle of operation, Welding Equipments, Welding Parameters, Joint Design, Welding Procedure, Advantages, Disadvantages and Applications.Tungsten Inert Gas Arc Welding: Welding Equipment-Electrodes, Inert gases and Torches, Inert gas shielded, Spot weldingProcesses.Submerged ArcWelding: Principle of the Process and its Applications, Fluxes and Welding Rods.Soldering and Brazing: Soft and Hard Solders, Fluxes, Soldering Iron, Soldering procedure, principle of Brazing and different methods of Brazing, Comparison between Brazing and Soldering.

UNIT IV **Destructive Testing of Welds:** Destructive tests: their advantage and Types such as Tensile Test, Bend Test, Impact Test, Hardness Test, Fatigue Tests, Equipment required and the test piece Geometry. Computer systems for Welding Engineering:Introduction, computer systems, software for welding engineers,magdata, weldcost, weldvol, distortcalc, cutbest, weldbest, ferrite predictor and weld selector.

UNIT V **Non Destructive Testing of Welds:** Non Destructive Tests: their Advantages and Limitations, Comparison with Destructive Tests, Visual Examination, Dye Penetrant Inspection, Magnetic Particle Inspection, X-Rays and Gamma Rays Inspection and Ultrasonic Inspection of Welds.Standards/ codes for welding.

UNIT VI **Automation in Welding:**Introduction, Manual Welding, Semi-Automatic Welding, Automatic Welding, Welding Mechanization, Flexible Automated Welding, Robotic Welding, Types of Welding Robots, Robot Selection Mechanics, Joint tracking system.

Text Books:

1. Welding and Welding Technology by R. Little- Tata McGraw Hill Publication.
2. Welding Processes and Technology by R. S. Parmar- Khanna Publication.

Reference Books:

1. Welding Technology by Koeingsberger, J. R. Adair- Macmillan.
2. Welding Technology by Rossi- Mc Graw Hill Publications.
3. Welding Handbook, Eighth Edition, Vol. 1 & 2- American Welding Society.

PEC-ME-308 AIRCRAFT TECHNOLOGY (PEC- I)

B. Tech (Mechanical Engineering) VI Semester

No. of Credits: 3		Sessional:	25 Marks
L T P	Total	Theory:	75 Marks
3 0 0	3	Total :	100 Marks
		Duration of Exam:	3 Hours

Pre- Requisite: Thermodynamics, Fluid Mechanics

Successive: Project

Course Objectives:

To understand the principles of operation of aircrafts,aerodynamics, general familiarization of aircraft engine systems, maintenance procedures and standard practices.

Course Outcomes (COs): At the end of the course, the student shall be able to:

CO 1- Explore principles of flight and the basic thermodynamics involved.

CO 2- Have knowledge of Propulsion fundamentals and application of gas turbine system in aircraft.

CO 3- Understand aerodynamics, different aircraft systems, inspection and maintenance.

CO 4- Explore different aviation systems along with fighter crafts.

Course contents:

UNIT I **Principles of Flight:** History of flights, Aircraft configurations, Flight control systems; Mechanical control, Powered control, Fly-By-Wire and digital Fly-By-Wire control systems, flying limits, Airframe & engine manufacturers.

UNIT II **Aircraft Thermodynamics:** First law of thermodynamics, Second law of thermodynamics, Air standard cycles, Brayton cycle & its variants.

UNIT III **Aircraft Propulsion:** Thrust, Thrust equation, Propulsive efficiency, Factors effecting thrust, Fundamentals of gas turbine engines,Aircraft engine construction, Classification of compressors; centrifugal and axial compressor, Effect of pressure, velocity & temperature change through the compressor, classification of combustion chambers and performance, classification of gas turbines & operation, convergent/divergent nozzles, Type of aircraft engines; turbo jet,turbo-prop & turbo fan engines.

UNIT IV Aerodynamics of Airplanes: Basics of aerodynamics, Wing airfoil profile and effects, Thrust, drag, lift & gravity, Control surfaces; aileron, elevator, rudder, slat, flap & spoiler, servo tab etc. Thrust reversers.

UNIT V Engine Systems, Inspection& Maintenance: Fuel system, Lubrication system, Compressor air flow control system, Turbine vanes and blade cooling, Full authority digital electronic engine control, Engine starting and ignition, Fire protection system, Engine Inlet cowling anti icing, environmental control system, engine indicating system, Standard practices of aero engine maintenance, engine overhauling, Bore scope inspection.

UNIT V Miscellaneous Aviation: Concepts and flight ofHelicopter, Drone, Air taxi, Rocket etc.History & overview of air war fare, Difference between civil & fighter craft aerodynamics & engines, Development &types of fighter crafts, fighter craft weapons & firing, Safety, maintenance & emergency features. Maritime fighters.

References:

1. Kermode, A.C. Flight without formulae, Pearson Education; 11th edition, 2011
2. Anderson, J.D. Introduction to flights, McGraw-Hill 8th edition 2015
3. Engineering Thermodynamics- P K Nag, Tata McGraw Hill
4. Thermodynamics: An Engineering Approach- Cengel and Boles, McGraw Hill Company
5. Hill P.G & Peterson, C.R. "Mechanics & Thermodynamics of propulsion" Pearson education (2009)
6. United Technologies' Pratt & Whitney, "The Aircraft Gas Turbine Engine and its Operation
7. Kroes& Wild, "Aircraft Power Plants", 7th Edition- McGraw Hill, New York, 1994
8. Mekinley, J.L and R.D. Bent, Aircraft Power Plants, McGraw Hill 1993
9. Teager, S, "Aircraft Gas Turbine Technology, McGraw Hill 1997.
10. Aviation Maintenance Technician Hand Book- Power Plant Volume -2 FAA-H-8083-32

PEC-ME-310 MAINTENANCE ENGINEERING (PEC- I)
B. Tech (Mechanical Engineering) VI Semester

No. of Credits: 3				Sessional:	25 Marks
L	T	P	Total	Theory:	75 Marks
3	0	0	3	Total :	100 Marks
				Duration of Exam:	3 Hours

Pre- Requisite: Manufacturing Process, Industrial Engineering

Successive: Nil

Course Objectives:

The objective of the course is to provide the students with the fundamental concepts, the necessary knowledge and the basic skills related to systems maintenance function. The course intends to expose the students to the concept of maintenance optimal policies.

Course Outcomes: At the end of course the students will be able to:

CO 1 Understand the importance of the maintenance and process improvement functions within industry.

CO 2 Gain the necessary knowledge about the types of maintenance and know how to use them to design maintenance systems.

CO 3 Learn how to apply various condition monitoring techniques and optimal maintenance policies.

CO 4 Understand basic concepts of TPM.

Course Contents:

Unit I Maintenance Management

Relevance of Maintenance: an over view, maintenance services, problems of the plant manager, automation and maintenance. Requirements of Maintenance Engineering Department, Basic Principles of maintenance Engineering — Importance and benefits of sound Maintenance systems –Maintenance organization – Definitions and terms used in Maintenance Engineering.

Unit II. Classification of maintenance approach

Introduction, Planned Maintenance- Unplanned Maintenance, Preventive Maintenance- Corrective Maintenance- Basic Principle and objective, advantages, disadvantages, Basic requirements.

Unit-III: Condition Monitoring- Different condition monitoring Techniques; Visual, performance, fluid and vibration monitoring. Fluid condition and particle monitoring; Wear debris analysis; Vibration monitoring methods; Vibration data collection; Techniques; Instruments.

Unit IV : Optimal Maintenance Policies

Introduction, Factors affecting the maintenance policies, Maintenance categories – Comparative merits of each category, Repair/Discard decisions-Factors affecting the R/D decisions, Cost comparison for R/D decisions, optimal module size, safety in Maintenance, Economics of maintenance.

Unit V: Total Productive Maintenance

Development and scope of concept, tero technology, basic systems of TPM procedure and steps of TPM, productivity circle

Text Book and References

1. Industrial Maintenance – H.P.Garg
2. Ind. Maint. Management – S.K.Srivastava
3. Collacot R.A.- Mechanical fault diagnosis and condition monitoring
4. Hunt, T.M., (1993), Handbook of wear debris analysis and particle detection in liquids, Elsevier applied science, London and New York
5. Dhillon, B.S. (2002). Engineering Maintenance: A Modern Approach. CRC Press, Boca Raton, Florida.
6. Jardine, A.K.S. and Tsang, A.H.C. (2006). Maintenance, Replacement, and Reliability: Theory and Applications. CRC Press, Taylor & Francis Group, ISBN 0-8493-3966-0.
7. Rao, B. (1996), Handbook of condition monitoring, Elsevier advanced technology, Oxford.
8. Ross, S.M. (1970). Applied Probability Models with Optimization Applications. Holden Day, San Francisco.

PEC-ME-312 RELIABILITY, AVAILABILITY & MAINTAINABILITY (PEC- I)
B. Tech (Mechanical Engineering) VI Semester

No. of Credits: 3				Sessional:	25 Marks
L	T	P	Total	Theory:	75 Marks
3	0	0	3	Total :	100 Marks
				Duration of Exam:	3 Hours

Course Objective:

The objective of the course is to provide the students with the fundamental concepts, the necessary knowledge and the basic skills related to systems reliability, availability and maintainability.

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

CO 1 Evaluate the reliability of a system and its subcomponents

CO 2 Gain the necessary knowledge about failure distributions and apply failure maintenance techniques.

CO 3 Perform reliability analysis of a system and designing the same

CO 4 Estimate systems availability and maintainability,

CO 4 Develop the Markov model for the mechanical systems.

Unit 1:

Introduction to Reliability Availability and Maintainability (RAM), Development of RAM Engineering, Reliability Availability and Maintainability utilization factors, down time consequences.Failure data analysis, MTBF, MTBR, MTTR, Reliability improvement and apportionment;

Unit II:

Concept of terro-technology; Statistical distribution associated with reliability engg.; Quantitative measures of reliability, Bath tub curve; Quantitative; Fault tree analysis (FTA),Failure mode and effect analysis (FMEA), Failure mode, effect and criticality analysis (FMECA).

Unit III:

Reliability engineering fundamentals and applications, Historical perspectives, Definition of Reliability, Role of Reliability evaluation, Reliability assessment, relationship between Differ ent Reliability functions, typical Hazard functions, Mean time to failure, Cumulative Hazard function and average failure rate,

Unit IV: Application of Probability distribution function in Reliability evaluation combinational Aspects of Reliability, Markov models optimization of system Reliability, Heuristic Methods applied to optimal system Reliability.

Unit V:

Maintainability : Definition and application of Maintainability Engineering, Factors affecting Maintainability. Maintainability design criteria, operating and down time categories, Mean time to activity restore equipment, Mean Maintenance man hours, Mean time for corrective and Preventive Maintenance, measures of maintainability and measures to assure maintainability.

Unit VI: Availability, types of Availability, Steady state availability, approaches to increase equipment Availability, Markov analysis of availability.

References:

1. Reliability Engineering Fundamentals R. Ramakumar

2 Maintainability, Availability and DimitriKececelogu

3. Reliability Engineering Govil

4. Reliability Engineering Balguruswamy

5. Elsayed A. Elsayed, Reliability is Engineering, Addison Wesley, 1996 •

6.Cher Ming Tan, “Reliability Assessment of Integrated Circuits and its misconception”, Nova Science Publisher, Inc, 2011

PEC-ME-322 NEW VENTURE CREATION (PEC- II)
B. Tech (Mechanical Engineering) VI Semester

No. of Credits: 3
L T P Total
3 0 0 3

Sessional: 25 Marks
Theory: 75 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Pre- Requisite: Industrial Engineering

Successive: Production Planning and Control

Course Objectives:

To understand entrepreneurship and entrepreneurial process in context of economic development.Able to launch a new venture by identifying the entrepreneurial opportunities, support and resource requirements.

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

CO1 Acquire knowledge about entrepreneur and entrepreneurship.

CO2 Understand the various activities involved in establishment of small scale enterprises.

CO3 Understand the operational issues of small scale enterprises.

CO4 Understand the performance appraisal methods and growth strategies.

CO5 Comprehend the life cycle approach of production management.

Course Contents:

UNIT I **Entrepreneur and Entrepreneurship:** Introduction; Entrepreneur and Entrepreneurship; Role of entrepreneurship in economic development; Entrepreneurial competencies andmotivation; Institutional Interface for Small Scale Industry/Enterprises.

UNIT II **Establishing Small Scale Enterprise:** Opportunity Scanning and Identification; Creativity and product development process; Market survey and assessment; choice of technology and selection of site.

UNIT III **Planning a Small Scale Enterprises:** Financing new/small enterprises; Techno Economic Feasibility Assessment; Preparation of Business Plan; Forms of business organization/ownership.

UNIT IV **Operational Issues in SSE:** Financial management issues; Operational/project management issues in SSE; Marketing management issues in SSE; Relevant business and industrial Laws.

UNIT V **Performance appraisal and growth strategies:** Management performance assessment and control; Causes of Sickness in SSI, Strategies for Stabilization and Growth.

UNIT VI **Life cycle of production management:** Stages in life cycle of production management and Major managerial Decisions involved in each stage.

Text Books:

1. Bruce R Barringer and R Duane Ireland, Entrepreneurship: Successfully Launching New Ventures, 3rd ed., Pearson Edu., 2013.
2. D.F. Kuratko and T.V. Rao, Entrepreneurship: A South-Asian Perspective, Cengage Learning, 2013.

Reference Books:

1. Dr. S.S. Khanka, Entrepreneurial Development (4th ed.), S Chand & Company Ltd., 2012.
2. Dr. Vasant Desai, Management of Small Scale Enterprises, Himalaya Publishing House, 2004.

PEC-ME-324 GAS DYNAMICS AND JET PROPULSION (PEC- II)
B. Tech (Mechanical Engineering) VI Semester

No. of Credits: 3	Sessional: 25 Marks
L T P Total	Theory: 75 Marks
3 0 0 3	Total : 100 Marks
	Duration of Exam: 3 Hours

Pre- Requisite: Thermodynamics, Applied Thermodynamics

Successive: Aircraft Technology

Course Objectives:
To understand the features of compressible isentropic flows and irreversibilities likeshocks.

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

1. To apply gas dynamics principles to jet and space propulsion systems.
2. To understand concept of Non-isentropic flow
3. To familerise with rocket engines
4. To get acknowledge of Nozzle and diffuser.

Course Contents:
Unit1:
Compressible flow, definition, Mach waves and Mach cone, stagnation states, Mass, momentum and energy equations of one-dimensional flow, Isentropic flow through variable area ducts, nozzle s and diffusers, subsonic and supersonic flow I variable area ducts, choked flow, Area-Mach number relations for isentropic flow

Unit2:
Non-isentropic flow in constant area ducts, Rayleigh and Fanno flows, Normal shock relations, oblique shock relations, isentropic and shock tables

Unit3
Theory of jet propulsion, thrust equation, thrust power and propulsive efficiency, Operating principle and cycle analysis of ramjet, turbojet, turbofan and turboprop engines.

Unit 4;
Types of rocket engines, propellants & feeding systems, ignition and combustion, theory of rocket propulsion, performance study, staging, terminal and characteristic velocity, space flights

Text Books:
1. Ahmed F. El-Sayed, Aircraft Prpoulsion and Gas Turbine Engines, CRC Press, 2008.
2. H.S. Mukunda, "Understanding Aerospace Chemical Propulsion", Interline Publishing, 2004.
3. Hill P. and Peterson C., Mechanics & Thermodynamics of Propulsion, Addison Wesley, 1992.
4. Zucrow N. J., Aircraft and Missile Propulsion, Vol.I& II, John Wiley, 1975.
5. Sutton G.P., Rocket Propulsion Elements, John Wiley, New York, 1986.

PEC-ME-326 NUMERIC CONTROL OF MACHINE TOOLS AND ROBOTICS
(PEC-II)
B. Tech (Mechanical Engineering) VI Semester

No. of Credits: 3		Sessional:	25 Marks
L T P Total		Theory:	75 Marks
3 0 0 3		Total :	100 Marks
		Duration of Exam:	3 Hours

Pre- Requisite: Manufacturing Process

Successive: CAD/CAM, Flexible manufacturing Systems

Course Objectives:

To study and familiarize the students with the advanced machines like NC, CNC, DNC and robotics. To study the basic steps in manufacturing a component on a CNC machine.

Course Outcomes (COs): At the end of the course, the student shall be able to:

1. Understand the basic concepts of numerical control.
2. Identify and understand the basic programming codes and develop the part programs for various operations.
3. Learn about the computer numerical control, direct numerical control, distributed numerical control and adaptive control systems
4. Understand the basic physical configurations and technical features of a robot and its various programming methods.

Course Contents:

UNIT 1. **Numeric Control:** Introduction to numerical control components axes of NC machine tools, open and close loop control, actuation and feedback systems, Point to point, lined and contouring systems, Tooling for NC systems, Steps in NC manufacturing, Machining and turning centers and their features, ATC and APC.

UNIT 2. **NC programming:** Input media and coding formats. Manual part programming for lathe, drilling and milling machines, cutter diameter and length compensation, Computer assisted part programming languages APT, EXPAT, ADAPT, COMPACT, CAD/CAM approach of programming.

UNIT 3. **Computer numerical control:** Direct numerical control and distributed numerical control, adaptive control.

UNIT 4. **Robotics:** Industrial robots and their applications for transformational and handling activities, Configuration and motions, Actuators, sensors and end effectors, Features like work envelop, precision of movements, weight carrying capacity, Robot programming languages, Vision systems, Introduction to intelligent robots.

Text Books

1. CAD/CAM: computer-aided design and manufacturing - M. P. Groover, E. W. Zimmers, Prentice-Hall

2. Computer Aided Manufacturing - T. K. Kundra, Tata McGraw-Hill Education

Reference Books

1. Computer Control of Manufacturing Systems - Y. Koren, Tata McGraw-Hill Education

2. Automation, Production systems, and Computer-Integrated Manufacturing - M. P. Groover, Pearson Education

PEC-ME-328 AUTOMOBILE ENGINEERING (PEC- II)
B. Tech (Mechanical Engineering) VI Semester

No. of Credits: 3		Sessional:	25 Marks
L T P	Total	Theory:	75 Marks
3 0 0	3	Total :	100 Marks
		Duration of Exam:	3 Hours

Pre- Requisite: Thermodynamics, Dynamics of Machines, I. C. Engines

Successive: Project

Course Objectives:
To understand the construction and working principle of various parts of an automobile

Course Outcomes (COs): At the end of the course, the student shall be able to:

CO 1- Understand the principle of automobiles drive and advances in automobiles.

CO 2- Explore the concept of various types of clutch.

CO 3- Learn about various types of steering system along with merits and demerits.

CO 4- Knowledge of the various types of hybrid vehicles.

CO 5- Development and understanding of hydrogen based technology for pollution control.

Course Contents:
Unit1;
Types of automobiles, vehicle construction and layouts, chassis, frame and body, vehicle aerodynamics, IC engines- components, function and materials, variable valve timing (VVT). Engine auxiliary systems, electronic injection for SI and CI engines, unit injector system, rotary distributor type and common rail direct injection system, transistor based coil ignition & capacitive discharge ignition systems, turbo chargers (WGT, VGT), engine emission control by 3-way catalytic converter system, Emission norms (Euro & BS).

Unit2:
Transmission systems, clutch types & construction, gear boxes- manual and automatic gear shift mechanisms, Over drive, transfer box, flywheel, torque converter, propeller shaft, slip joints, universal joints, differential and rear axle, Hotchkiss drive and Torque tube drive.

Unit3
Steering geometry and types of steering gear box, power steering, types of front axle, types of suspension systems, pneumatic and hydraulic braking systems, antilock braking system (ABS), electronic brake force distribution (EBD) and traction control.

Unit 4:
Alternative energy sources, natural gas, LPG, biodiesel, bio-ethanol, gasohol and hydrogen fuels in automobiles, modifications needed, performance, combustion & emission characteristics of alternative fuels in SI and CI engines, Electric and Hybrid vehicles, application of Fuel Cells

.**Text books:**
1. Kirpal Singh, Automobile Engineering, 7th ed., Standard Publishers, New Delhi, 1997.

2. Jain K.K. and Asthana R.B., Automobile Engineering, Tata McGraw Hill, New Delhi, 2002.
3. Heitner J., Automotive Mechanics, 2nd ed., East-West Press, 1999.
4. Heisler H., Advanced Engine Technology, SAE International Publ., USA, 1998.

PEC-ME-330 VISIONARY LEARNING IN MANUFACTURING (PEC-II)

B. Tech (Mechanical Engineering) VI Semester

No. of Credits: 3	Sessional: 25 Marks
L T P Total	Theory: 75 Marks
3 0 0 3	Total : 100 Marks
	Duration of Exam: 3 Hours

Pre- Requisite: Manufacturing technology

Successive: Project

Course Objectives:
To get familaristaion observation skill, planning and controlling of production process

Course Outcomes (COs): At the end of the course, the student shall be able to:

CO 1- Understand the SMEs and VLCI concept.

CO 2- Explore the concept of 3S and flow line observation.

CO 3- Learn about Lean concept.

CO 4- Knowledge V-map 2& 3

CO 5- Development and understanding Hie- Junka plan

Course Contents:

Unit 1: Introduction Manufacturing system; SMEs and their characteristics; Challenges of small and Medium Industries; Introduction to VLCI; Visionary Leadership; Quality of good leadership; Challenges to lead SMEs; Motivation and Attitude. .

Unit 2: Observation Skill: Cleanininess in factory, Introduction to 3S, Method of implementation of 3 S; result review technique of 3S; Application of 3 S and its advantages. Concept of Ergonomics, , Material Flow line; Optimisation of Material Handling equipments.

Unit 3: Concept of Lean, JIT and Agile Manufacturing; V-map technique of observation; Preparation of Flow chart of V-map 1; Evaluation of V-map 1; Tier concept, typical Tier structure, Benefits of V mapping , Challenges with V-mapping.

Unit 4: V map 2: Standardise work principle; Productivity improvement; Tree of Productivity; Introduction to V-map 3; steps for drawing V-map3; Cycle time and its calculation; Preperation of SWCT chart.

Unit 5: Introduction to Hie-Junka planning. Methodology of Hie-Junka review and control. Concept of ZED (Zero defect Zero effect), Model of Maturity Assessment, Case studies of Indian study, A comparative study of Indian and Japan's model of quality programme, Understanding of Kizen.

Text Books:

1. Observation skill by :Sharad Anerao, Anand Group

2. Study material Developed by VLCI

Refence Books:

1. A Revolution in Manufacturing: The SMED System: Single-minute Exchange of Die System : shigeo Shingo

2.The Six Sigma Way: How to Maximize the Impact of Your Change and Improvement Efforts : Peter Pande, Robert Neuman, Roland Cavanagh Level - Wiley .

3. Toyota Production System: Beyond Large-Scale Production : Taiichi Ono

PEC-ME-332 FINITE ELEMENT ANALYSIS (PEC- II)
B. Tech (Mechanical Engineering) VI Semester

No. of Credits: 3		Sessional:	25 Marks
L T P	Total	Theory:	75 Marks
3 0 0	3	Total :	100 Marks
		Duration of Exam:	3 Hours
No. of Credits: 3		Sessional:	25 Marks
L T P	Total	Theory:	75 Marks
3 0 0	3	Total :	100 Marks
		Duration of Exam:	3 Hours

PEC-ME-401 TRIBOLOGY (PEC-III)
B. Tech (Mechanical Engineering) VII/VIII Semester

No. of Credits: 3		Sessional:	25 Marks
L T P	Total	Theory:	75 Marks
3 0 0	3	Total :	100 Marks
		Duration of Exam:	3 Hours

Pre- Requisite: Fluid Mechanics

Successive: None

Course Objectives:

The main objective of this course is to study the concepts of friction and wear and to minimize their effects by lubrication on different surfaces.

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

CO 1 Apply the basic theories of friction, wear and lubrication to predictions about the frictional behavior of commonly encountered sliding interfaces.

CO 2 Describe the types and uses of Wear.

CO 3 Describe the types and uses of Lubricants.

CO 4 Understand about the Film Lubrication Theory.

CO 5 Understand Surface Engineering and Materials for Bearings.

Course Contents:

UNIT I **Surfaces and Friction**: Topography of Engineering surfaces- Contact between surfaces - Sources of sliding Friction -Adhesion Ploughint- Energy dissipation mechanisms, Friction Characteristics of metals - Friction of non-metals. Friction of

lamellar solids - friction of Ceramic materials and polymers - Rolling Friction. Source of Rolling Friction - Stick slip motion - Measurement of Friction.

UNIT II **Wear- Types of wear:** Simple theory of Sliding Wear Mechanism of sliding wear of metals - Abrasive wear. Materials for Adhesive and Abrasive wear situations - Corrosive wear - Surface Fatigue wear situations - Brittle Fracture wear - Wear of Ceramics and Polymers - Wear Measurements.

UNIT III **Lubricants and Lubrication Types:** Types and properties of Lubricants - Testing methods - Hydrodynamic Lubrication – Elasto hydrodynamic lubrication- Boundary Lubrication - Solid Lubrication Hydrostatic Lubrication.

UNIT IV **Film Lubrication Theory:** Fluid film in simple shear - Viscous flow between very close parallel plates - Shear stress variation, Reynolds Equation for film Lubrication - High speed unloaded journal bearings - Loaded journal bearings - Reaction torque on the bearings -Virtual Coefficient of friction - The Somerfield diagram.

UNIT V **Surface Engineering and Materials for Bearings:** Surface modifications - Transformation Hardening, surface fusion - Thermo chemical processes - Surface coatings - 103 Plating and anodizing Fusion Processes - Vapour Phase processes - Materials for rolling Element bearings - Materials for fluid film bearings - Materials for marginally lubricated and dry bearings.

Text/Reference Books:

1. I.M. Hutchings, Tribology, Friction and Wear of Engineering Material, Edward Arnold
2. T.A. Stolarski, Tribology in Machine Design , Industrial Press Inc
3. E. P.Bowden and Tabor.D., Friction and Lubrication , Heinemann Educational Books Ltd 4. A. Cameron, Basic Lubrication theory , Longman, U.K.., 1981.
5. M. J.Neale (Editor), Tribology Handbook, Newnes. Butter worth, Heinemann, U.K

PEC-ME-403 DESIGN AND OPTIMIZATION (PEC-III)
B. Tech (Mechanical Engineering) VII/VIII Semester

No. of Credits: 3		Sessional:	25 Marks
L T P Total		Theory:	75 Marks
3 0 0 3		Total:	100 Marks
		Duration of Exam:	3 Hours

Pre- Requisite: Operation Research

Successive: None

Course Objectives:

The main objective of this course is to introduce the optimisation of design techniques.

Course Outcomes (COs): At the end of the course, the student shall be able to:

CO 1- Have knowledge of Introduction to design optimization

CO 2- Illustrate different approaches for optimization.

CO 3- Understand about the application optimization in mechanical design.

CO 4- Learn different optimization techniques.

Course Contents:

UNIT I **Introduction to Optimum design:** Introduction to detail design optimization by simulation, prototyping and optimum. Selection of configuration, materials and processes.

UNIT II **Optimization Approach:** Classical mathematical methods of optimization. Mechanical System Design problem-economic political environment, issues of human safety & welfare, and professional ethics. Optimum mechanical design concepts.

UNIT III Overview and application of optimization methods to machine elements and mechanical system design. Prototyping, simulation, and use of standards for detail design optimization.

UNIT IV **Optimization Techniques:** Optimum selection of material & processes in mechanical design using material selection charts and optimization methods.

UNIT V **Applications:** Optimizing product design functionality, aesthetics and economics by employing industrial design principles and by suitable selection of material & processing including use of polymers, composites and other non-metallic materials.

CO 5- Knowledge of different practical applications of optimization with respect to functionality, asthetics, economics & materials.

Text/Reference Books:

1. H. Adeli. Advances in Design Optimization.
2. Robert F. RHYDER, Manufacturing Process Design and Optimization, New York: Marcel Dekker,
3. S.S.Rao, Optimization: Theory & Application Wiley Eastern
4. K. Deb, Optimization for Engineering Design, Prentice Hall India
5. J.S.Arora, Introduction to Optimum Design, McGraw Hill

PEC-ME-405 MECHANICAL VIBRATIONS (PEC-III)
B. Tech (Mechanical Engineering) VII/VIII Semester

No. of Credits: 3		Sessional:	25 Marks
L T P	Total	Theory:	75 Marks
3 0 0	3	Total :	100 Marks
		Duration of Exam:	3 Hours

Pre- Requisite: Engineering Mechanics, Strength of Materials

Successive: Nil

Course Objectives:

To study essential concepts for mechanical vibrations induced in various equipments. To study single degree of freedom, two degree of freedom system, vibration absorber and analyze effects of vibrations on mechanical equipment.

Course Outcomes (COs): At the end of the course, the student shall be able to:

1. Learn vibrations leading to analysis of first degree of freedom.
2. Understand two degree of vibration and vibration isolation and transmissibility
3. Be Familiarized with multi degree of freedom systems using various numerical methods
4. Understand the influence and stiffness coefficients
5. Understand the transient vibrations

Course Contents:

UNIT 1. Introduction: Harmonic motion, periodic motion, vibration terminology.

UNIT 2.Single Degree of freedom Systems: Free and forced vibrations with and without damping, magnification factor, transmissibility and isolation.

UNIT 3. Two degree of Freedom Systems: Generalized co-ordinates, principal co-ordinates, derivation of equation of motion, co-ordinate coupling, Lagrange's equation.

UNIT 4. Vibration Absorber: Tuned absorber, determination of mass ratio, tuned and damped absorber (qualitative treatment only), untuned viscous damper.

UNIT 5. Multi Degree of Freedom system: Derivation of equation, calculation of natural frequencies by Rayleigh, Stodala, matrix, matrix iteration and Holzer methods.

UNIT 6. Vibration Analysis: Introduction, Influence coefficient, Stiffness Matrix, Flexibility Matrix, Natural Frequencies and Normal Modes.

UNIT 7. Transient Vibrations: Impulse Excitation, Arbitrary Excitation, Response to step Excitation, Base Excitation Solution by Laplace Transforms, Response Spectrum, Runge-kutta Method.

UNIT 8 . Automotive Noise Control

Noise Characteristics of engines, Assessment of mechanical noise, Transmission noise. Control Techniques:Noise levels, Static and Dynamic Balancing, Methods of controlling noise in engines.

Text Books:

1. Mechanical Vibration – V.P.Singh, Dhanpat Rai & Sons.
2. Mechanical Vibration : G.K.Grover – Nem Chand & Bros., Roorkee, INDIA

Reference Books:

1. Thomson, W.T, "Theory of Vibration with Applications", CBS Pub. & Distributors, 3rd Ed, 1988.
2. Tse, Morse and Hinkle, " Mechanical Vibration", prentice Hall of India Ltd, 1987
3. Schaum Outline Series, "Mechanical Vibration", Mc Graw Hill Book Company, 1990.
4. Lindley and Higgins, "Maintenance Engineering Hand Book" McGraw Hill Book Company, 1977.

PEC-ME-407 PRODUCT DESIGN AND DEVELOPMENT (PEC-III)
B. Tech (Mechanical Engineering) VII/VIII Semester

No. of Credits: 3		Sessional:	25 Marks
L T P Total		Theory:	75 Marks
3 0 0 3		Total :	100 Marks
		Duration of Exam:	3 Hours

Pre- Requisite: Design of Machine Elements

Successive: Nil

Course Objectives:

To study essential concepts of product design and development. To design components for manufacture in industries, industrial design process and its management, product design methods, product specifications and product development.

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

CO1 Understand the basic concepts of product design and development.

CO2 Understand the various activities involved in product planning and process development.

CO3 Discuss the different steps involved in target specifications establishment and concept generation.

CO4 Discuss various product design methods.

CO5 Comprehend the concept of design for manufacture.

CO6 Understand the basic concepts of industrial design and prototyping.

Course Contents:

UNIT 1. **Introduction:** Design theory, design materials, human factors in design, man-machine system, applied ergonomics, characteristics of successful product development, challenges to product development.

UNIT 2. **Development process and product planning:** Generic development process, Concept development, product development process flows, product planning process, identify customer needs.

UNIT 3. **Product specifications and concept generation:**Product specification, steps to establish the target specifications, Concept generation, five step concept generation method, concept selection, concept screening, concept testing, product architecture

UNIT 4. **Product design methods**: Creative and rational, clarifying objectives - the objective tree method, establishing functions- the function analysis method, setting requirements – the performance specification method, determining characteristics – the QFD method, generating alternatives – morphological chart method, evaluating alternatives – the weighted objective method, improving details – the value engineering method and design strategies.

UNIT 5. **Design for manufacture:** Estimating manufacturing cost, reducing component, assembly and support costs, design for assembly, design for disassembly, design for environment, design for graphics and packaging, effective prototyping – principle and planning

UNIT 6. **Industrial design:** Its need, impact and quality, industrial design process and its management, legal issues in product design, design resources, economics and management of product development projects.

UNIT 7. **Prototyping:** Basics and principles of prototyping, prototyping technologies, planning for prototypes

Text Books

1. K.T. Ulrich and S.D. Eppinger, “Product design and development”, Tata McGraw Hill
2. Chitale& Gupta, “Product Development”, Tata McGraw Hill
3. Monks, J. G., “Operations Management”, McGraw Hill, 1997.
4. George Dietor, A material and Processing approach, McGraw Hill

PEC-ME-409 DESIGN OF TRANSMISSION SYSTEMS (PEC-III)
B. Tech (Mechanical Engineering) VII/VIII Semester

No. of Credits: 3	Sessional: 25 Marks
L T P Total	Theory: 75 Marks
3 0 0 3	Total : 100 Marks
	Duration of Exam: 3 Hours

Pre- Requisite: Kinematics of Machines, Design of Machine Elements

Successive: Nil

Pre- Requisite: Machine Design

Successive: Project

Course Objectives:

The main objective of this course is to design different tools used in the industries for metal cutting, metal forming, work piece holding and inspection purposes.

Course Outcomes (COs): At the end of the course, the student shall be able to:

- **CO1-** Select and use different cutting tools and their materials according to machining operations and work piece materials.
- **CO 2-** Select the material and design different gauges.
- **CO 3-** Design jigs and fixtures for conventional and NC machining.
- **CO 4-** Understand the concepts of press tools.
- **CO 5-** Design single point and multipoint cutting tools

Course Contents:

UNIT I **Tool Geometry, Tool &Work Piece Material:** Common work and Tool materials, Tool inserts, Specifications of inserts and tool holders, Physical principle in metal cutting: Chip formation and types of chips, work done in cutting, BUE on metal cutting, curling & contraction of chip , work hardening, quality of machines surfaces.

UNIT II **Basic Principles of Tool Design:** Tool design – An overview, signature of single point tools, Design of single point turning tool, ISO tool shapes, design of flat and circular form tools, milling cutter.

UNIT III **Introduction to Jigs and fixtures, Work holding devices:** Basic principle of six point location, Locating methods and devices, Principle of clamping and Types of

clamps, Design of jigs: Type of Drill bushes, Classification of drill jigs, Design of drill jigs, Design of fixtures: Design of milling fixtures.

UNIT IV **Press Working Operations:** Types of Presses, Tonnage required, Blanking Tool and parts, Piercing Tool, Progressive Tool and parts, strip layout, scrap calculation for Blanking and Piercing operations**.**

UNIT V **Brief introduction of CNC machines work holding devices:** Tool design for CNC machines, Fixture design for CNC Machine, Cutting tools for CNC Machine, Tool holding methods for CNC Machine, ATC and APC for CNC Machine, Tool presetting for CNC Machine.

UNIT VI **Gauges and Gauge Design:** introduction, elements and their function,Design of Plug Gauges and Ring Gauges, Standards, materials for gauges, maintenance and safety of gauges.

Text Books:

1. Fundamentals of Tool Design – Donaldson – TMH

2.Theory of Metal Cutting and Tool Design – Arshinov – Mir Publishers, Moscow

Reference Books:

1.Fundamentals of Tool Design- ASTME

2. Tool Design- H.W, Pollack – Tarapouevala

3. Jigs and fixtures - P. H. Joshi – McGraw Hill

4.An introduction to Jigs and Fixtures- M.HA Kempster – Whitaker & Sons Ltd.

5. Fundamentals of Tool Design, F.W.Wilson, ASME, PHI, New Delhi

PEC-ME-411 TOOL DESIGN (PEC-III)

B. Tech (Mechanical Engineering) VII/VIII Semester

No. of Credits: 3		Sessional:	25 Marks
L T P Total		Theory:	75 Marks
3 0 0 3		Total :	100 Marks
		Duration of Exam:	3 Hours

Pre- Requisite: Machine Design

Successive: Project

Course Objectives:

The main objective of this course is to design different tools used in the industries for metal cutting, metal forming, work piece holding and inspection purposes.

Course Outcomes (COs): At the end of the course, the student shall be able to:

- **CO1-** Select and use different cutting tools and their materials according to machining operations and work piece materials.
- **CO 2-** Select the material and design different gauges.
- **CO 3-** Design jigs and fixtures for conventional and NC machining.
- **CO 4-** Understand the concepts of press tools.
- **CO 5-** Design single point and multipoint cutting tools

Course Contents:

UNIT I **Tool Geometry, Tool &Work Piece Material:** Common work and Tool materials, Tool inserts, Specifications of inserts and tool holders, Physical principle in metal cutting: Chip formation and types of chips, work done in cutting, BUE on metal cutting, curling & contraction of chip , work hardening, quality of machines surfaces.

UNIT II **Basic Principles of Tool Design:** Tool design – An overview, signature of single point tools, Design of single point turning tool, ISO tool shapes, design of flat and circular form tools, milling cutter.

UNIT III **Introduction to Jigs and fixtures, Work holding devices:** Basic principle of six point location, Locating methods and devices, Principle of clamping and Types of clamps, Design of jigs: Type of Drill bushes, Classification of drill jigs, Design of drill jigs, Design of fixtures: Design of milling fixtures.

UNIT IV **Press Working Operations:** Types of Presses, Tonnage required, Blanking Tool and parts, Piercing Tool, Progressive Tool and parts, strip layout, scrap calculation for Blanking and Piercing operations**.**

UNIT V **Brief introduction of CNC machines work holding devices:** Tool design for CNC machines, Fixture design for CNC Machine, Cutting tools for CNC Machine, Tool holding methods for CNC Machine, ATC and APC for CNC Machine, Tool presetting for CNC Machine.

UNIT VI **Gauges and Gauge Design:** introduction, elements and their function,Design of Plug Gauges and Ring Gauges, Standards, materials for gauges, maintenance and safety of gauges.

Text Books:

1. Fundamentals of Tool Design – Donaldson – TMH

2.Theory of Metal Cutting and Tool Design – Arshinov – Mir Publishers, Moscow

Reference Books:

1.Fundamentals of Tool Design- ASTME

2. Tool Design- H.W, Pollack – Tarapouevala

3. Jigs and fixtures - P. H. Joshi – McGraw Hill

4.An introduction to Jigs and Fixtures- M.HA Kempster – Whitaker & Sons Ltd.

5. Fundamentals of Tool Design, F.W.Wilson, ASME, PHI, New Delhi

PEC-ME-421 POWER PLANT ENGINEERING (PEC-IV)
B. Tech (Mechanical Engineering) VII/VIII Semester

No. of Credits: 3		Sessional:	25 Marks
L T P Total		Theory:	75 Marks
3 0 0 3		Total :	100 Marks
		Duration of Exam:	3 Hours

Pre- Requisite: Applied Thermodynamics

Successive: Non Conventional Energy Resource Utilization

Course Objectives:
To provide an overview of power plants and the associated energy conversion issues.

Course Outcomes (COs): At the end of the course, the student shall be able to:

CO 1- Understand the principles and components of steam power plants.

CO 2- Analyze the working of a Gas power plant and the related cycles.

CO 3- Learn about the utility and applications of nuclear power plant.

CO 4- Grasp the essentials of installation and commissioning of hydro-electric power plants and gain a kknowledge of various factors affecting non-conventional power plants.

CO 5- Analyse the economical and environmental issues related with the power plants.

Course Contents:

Unit 1:
Coal based thermal power plants, basic Rankine cycle and its modifications, layout of modern coal power plant, super critical boilers, FBC boilers, turbines, condensers, steam andheating rates, subsystems of thermal power plants, fuel and ash handling, draught system, feed water treatment, binary cycles and cogeneration systems

Unit 2:
Gas turbine and combined cycle power plants, Brayton cycle analysis and optimization, components of gas turbine power plants, combined cycle power plants, Integrated Gasifier based Combined Cycle (IGCC) systems.

Unit 3:
Basics of nuclear energy conversion, Layout and subsystems of nuclear power plants, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor, Pressurized Heavy Water Reactor (PHWR), Fast Breeder Reactors (FBR), gas cooled and liquid metal cooled reactors, safety measures for nuclear power plants.

Unit 4:
Hydroelectric power plants, classification, typical layout and components, principles of wind, tidal, solar PV and solar thermal, geothermal, biogas and fuel cell power systems

Unit 5:

Energy, economic and environmental issues, power tariffs, load distribution parameters, load curve, capital and operating cost of different power plants, pollution control technologies including waste disposal options for coal and nuclear plants.

Text Books:

1. Nag P.K., Power Plant Engineering, 3rd ed., Tata McGraw Hill, 2008.
2. El Wakil M.M., Power Plant Technology, Tata McGraw Hill, 2010.
3. Elliot T.C., Chen K and Swanekamp R.C., Power Plant Engineering, 2nd ed., McGraw Hill, 1998.

PEC-ME-423 DESIGN OF THERMAL SYSTEMS (PEC-IV)
B. Tech (Mechanical Engineering) VII/VIII Semester

No. of Credits: 3	Sessional: 25 Marks
L T P Total	Theory: 75 Marks
3 0 0 3	Total : 100 Marks
	Duration of Exam: 3 Hours

Pre- Requisite: Thermodynamics

Successive: Non Conventional Energy Resource Utilization

Course Objectives:

To understand various types of thermal and air-conditioning processes.

Course Outcomes (COs): At the end of the course, the student shall be able to:

CO 1- Understand the heat load estimation of air-conditioning system.

CO 2- General procedure of heat exchanger design in air-conditioning systems.

CO 3- Complete analysis of vapor compression refrigeration system.

CO 4- Environmental consideration in design of thermal systems.

CO 5-Knowledge of thermodynamics of the refrigeration systems.

CO 6- Design of thermal systems.

Course Contents:

***UNIT I* Psychrometry of Air Conditioning Processes**:

Design Conditions & Load Calculations Psychrometric Processes in Air Conditioning Equipments, Analysis of Air Conditioning systems for summer & winter conditions, Inside &out side design conditions for comfort, Industrial Air Conditioning. Cooling & Heating Load calculations- Heat transfer through building structures, solar heat gain, Infiltration & ventilation air, Internal heat gain, Occupancy & Product load, Room sensible heat factor, Effective sensible heat factor & Grand sensible heat factor, capacity of the plant. Design & Selection of Air conditioning ApparatusHeat & moisture transfer in Air conditioning apparatus, Enthalpy potential, Analysis of Coil & Spray Equipments, Design of Cooling & Dehumidifying coils, Design of Air Washer & Cooling Towers.

***UNIT II* Analysis of Complete Vapour Compression System:** Design and Balancing

of System Components, Type of Refrigerant Compressors, Condensers, Evaporators & Expansion devices used in Vapour Compression Refrigeration Cycles, Design and Selection of individual components and their performance characteristics, Use of P-H charts for different Refrigerants in performance predication of the cycle. Analysis of the complete vapour-compression system and determination of 'Balance Points' using Graphical and Analytical methods, system simulation.Layout & selection of Refrigerant, water and Brine pipings for the designed system. Selection of Refrigeration and Air conditioning Controls for the system.

UNIT III **Design of Turbomachines:** Principles of Design of turbo machines, Design of axial flow turbine stage, Design of axial flow compressor stage, Design of centrifugal compressor.

UNIT IV **Design of Heat Exchanger :** Study of design aspects, fluid flow and heat transfer characteristics, Material requirement of heat exchange equipments, Liquid - to liquid and Liquid - to - gas heat exchange systems, Familiarity with use of design related standards and codes, Design of Heat exchanger.

UNIT V **Optimization of Design of Thermal Systems:** like condenser, evaporator, cooling tower for minimum cost and maximum performance, Development of computer program for design, Environmental consideration in design of thermal systems, Analysis of thermal systems using FEM.

Reference Books:

1. Refrigeration & Air Conditioning - by C.P. Arora - TMH
2. Refrigeration & Air Conditioning - by Manohar Prasad – New Age International.
3. Principles of Refrigeration (S.I. Units) - by Roy J.Dossat - AWL.
4. Air Conditioning Engineering - by W,P.Jones - Butterwouth.
5. Heating, Ventilating and Air Conditioning - by Mc Quistion, Parker &Spitler - John Wiley Publishing Co.
6. Refrigeration & Air Conditioning Data Book - Manohar Prasad – New Age International
7. Ashrae Hand Book - Fundamentals
8. Refrigeration & Air Conditioning-Stoecker& Jones - Wiley
9. Refrigeration & Air Condioning - by P.L.Ballaney - Khanna Publishers.

PEC-ME-425 AIR - CONDITIONING EQUIPMENTS (PEC-IV)
B. Tech (Mechanical Engineering) VII/VIII Semester

No. of Credits: 3
L T P Total
3 0 0 3

Sessional: 25 Marks
Theory : 75 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Pre- Requisite: Thermodynamics, Refrigeration and Air Conditioning

Successive: None

Course Objectives:

To study and understand the concept of different equipments used in Refrigeration & Air Conditioning Systems and their working.

Course Outcomes (COs): At the end of the course, the student shall be able to:

CO 1- Understand the construction and working principles of different type of filters, Humidifiers and dehumidifiers and their need.

CO 2- Learning working of condenser and cooling tower used in RAC system.

CO 3- Concepts of Evaporators.

CO 4- Application of compressors used in RAC systems.

CO 5- Utilisation of fans and pumps used in RAC systems.

CO 6- Understand working of Expansion devices and electric motors used in RAC systems.

Course Contents:

UNIT I **Filters:** Air Cleaning, Air Filters, Methods of Air Cleaning, Different types of Air Filters, Selection of Air Filters, Performance of air Filters, Odour Removal, Humidifiers: Need of Humidifiers, Methods of Humidification, Various types of Humidifiers, Dehumidifiers: Need of Dehumidifiers, Methods of Dehumidification and Various types of Dehumidifiers.

UNIT II **Condensers and Cooling Towers:** Types of Cooling Medium and their Selection, Air and Water cooled Condensers, Economic Operation of Condenser, Different Types of Water Cooled Condensers, Spray Ponds, Cooling Towers, Natural, Forced and Induced Draft Cooling Towers, Design Analysis of Cooling Towers, Performance Analysis of Condensers and Cooling Towers.

UNIT III **Evaporators:** Factors Considered for Design of Evaporators, Evaporator Types: Flooded and Dry Evaporators, Natural and Forced Convection, Shell and Tube, Shell

and Coil, Plate type and Secondary Evaporators. Application of Fins, Temperature distribution and Heat flow in Evaporator, Pressure drop, Fouling correction factor, Selection of Evaporators.

UNIT IV **Compressors:** Reciprocating, Rotary, Scroll, Centrifugal, Screw and Thermo-Compressor Compressors (Excluding the Analysis), Factors Affecting the Performance of Reciprocating Compressor, Capacity Control of Compressors, Compressors for Eco-friendly Refrigerants, Variable Drive Compressor and Future Trends in Refrigeration Compressors and Selection of Compressors, Inverter based technology and variable refrigerant flow system.

UNIT V **Fans:** Types, Axial Flow Fans, Centrifugal Fans, Total Pressure Developed by Fan, Fan air power and Efficiencies, Problems, Pumps: Types, Reciprocating, Gear or Rotary and Centrifugal Pumps, , Selection of Fans and Pumps.

UNIT VI **Expansion Devices:** Capillary tube, Automatic Expansion, Thermostatic Expansion, High-Side float, Low-Side Float and Solenoid Control Valves, Electronic expansion valve, Introduction to Electric Motors and their Applications, Variable speed motors, variable frequency drive for motors, Introduction to Motor Starting Relays and Motor Overload Protector.

Text Books:

1. Refrigeration and Air Conditioning by C.P. Arora – TMH.
2. Refrigeration and Air Conditioning by S.C.Domkundwar – Dhanpat Rai & Sons
3. Refrigeration and Air Conditioning by D.S. Kumar- Kataria and Sons

Reference Books:

1. Carrier Hand Book for HVAC Engineers.

PEC-ME-427 NON CONVENTIONAL ENERGY RESOURCES UTILIZATION
(PEC-IV)
B. Tech (Mechanical Engineering) VII/VIII Semester

No. of Credits: 3

L T P Total
3 0 0 3

Sessional: 25 Marks
Theory : 75 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Pre- Requisite: Thermodynamics

Successive: None

Course Objectives:

To study energy resources, energy planning and their utilization.

Course Outcomes (COs): At the end of the course, the student shall be able to:

CO 1- Understand about the types of energy resources and energy requirement.

CO 2- Complete understanding about production and utility of bio-gas and wind energy.

CO 3-Knowledge of the utility of solar energy.

CO 4- Familiarization of the project evaluation & review technique (PERT) & critical path method (CPM).

CO 5- Understanding tidal and wave energy as alternate resource.

Course Contents:

UNIT I **Energy Resources and their Utilization :** Indian and global energy sources, Energy exploited, Energy planning, Energy parameters (energy intensity, energy-GDP elasticity), Introduction to various sources of energy, Solar thermal, Photovoltaic, Water power, Wind energy, Biomass, Ocean thermal, Tidal and wave energy, Geothermal energy, Hydrogen energy systems, Fuel cells, Decentralized and dispersed generation. Economics. Impact of renewable energy generation on environment, Kyoto Protocol, Cost of electricity production from different energy sources, Energy options for Indian economy.

Solar Radiations: Extra terrestrial radiation, Spectral distribution, Solar constant, Solar radiations on earth, Measurement of solar radiations, Solar radiation geometry, Flux on a plane surface, Latitude, Declination angle, Surface azimuth angle, Hour angle, Zenith angle, Solar altitude angle expression for angle between incident beam and the normal to a plane surface (no derivation), Local apparent time, Apparent motion of sun, Day length, Solar radiation data for India.

UNIT II **Solar Energy:** Solar thermal power and it's conversion, Solar collectors, Flat plate, Performance analysis of flat plate collector, Solar concentrating collectors, Types of concentrating collectors, Thermodynamic limits to concentration, Cylindrical collectors, Thermal analysis of solar collectors, Tracking CPC and solar swing. Solar thermal energy storage, Different systems, Solar pond. Applications, Water heating, Space heating & cooling, Solar distillation, Solar pumping, Solar cooking, Greenhouses, Solar power plants.

Solar photovoltaic system: Photovoltaic effect, Efficiency of solar cells, Semiconductor materials for solar cells, Solar photovoltaic system, Standards of solar photovoltaic system, Applications of PV system, PV hybrid system.

UNIT III **Biogas:** Photosynthesis, Bio gas production, Aerobic and anaerobic bio-conversion process, Raw materials, Properties of bio gas, Producer gas, Transportation of bio gas, bio gas plant technology & status, Community biogas plants, Problems involved in bio gas production, Bio gas applications, Biomass conversion techniques, Biomass gasification, Energy recovery from urban waste, Power generation from liquid waste, Biomass cogeneration, Energy plantation, Fuel properties, Biomass resource development in India.

UNIT IV **Wind Energy*:*** Properties of wind, Availability of wind energy in India, wind velocity, Wind machine fundamentals, Types of wind machines and their characteristics, Horizontal and Vertical axis wind mills, Elementary design principles, Coefficient of performance of a wind mill rotor, Aerodynamic considerations in wind mill design, Selection of a wind mill, Wind energy farms, Economic issues, Recent development.

UNIT V **Tidal Power:** Tides and waves as sources of energy, Fundamentals of tidal power, Use of tidal energy, Limitations of tidal energy conversion systems.
Hydrogen Energy: Properties of hydrogen in respect of its use as source of renewable energy, Sources of hydrogen, Production of hydrogen, Storage and transportation, Problems with hydrogen as fuel, Development of hydrogen cartridge, Economics of hydrogen fuel and its use.

UNIT VI **Thermoelectric Systems:** Kelvin relations, power generation, Properties of thermoelectric materials, Fusion Plasma generators.
Geothermal energy: Structure of earth's interior, Geothermal sites, earthquakes &

volcanoes, Geothermal resources, Hot springs, Steam ejection, Principal of working, Types of geothermal station with schematic representation, Site selection for geothermal power plants. Advanced concepts, Problems associated with geothermal conversion.

Ocean Energy: Principle of ocean thermal energy conversion, Wave energy conversion machines, Power plants based on ocean energy, Problems associated with ocean thermal energy conversion systems, Thermoelectric OTEC, Developments of OTEC,

Reference Books:

1. Bansal Keemann, Meliss," Renewable energy sources and conversion technology", Tata McGraw Hill.

2. Kothari D.P., "Renewable energy resources and emerging technologies", Prentice Hall of India Pvt. Ltd.

3. Ashok V. Desai, "Non conventional Energy", New Age International Publishers Ltd.

PEC-ME-429 ENERGY CONSERVATION AND MANAGEMENT (PEC-IV)

B. Tech (Mechanical Engineering) VII/VIII Semester

No. of Credits: 3		Sessional:	25 Marks
L T P Total		Theory:	75 Marks
3 0 0 3		Total:	100 Marks
		Duration of Exam:	3 Hours

Pre- Requisite: Applied Thermodynamics

Successive: Nil

Course Objectives:
To understand the energy data from industries and carry out energy audit for energy savings.

Course Outcomes (COs) : At the end of the course, the student shall be able to:

CO 1- Understand energy & power scenario of world.

CO 2- Gain a knowledge of , how components of EB billing, HT and LT supply.

CO 3- Understand the basics of thermal systems.
CO 4- Analyze the thermal systems and its different components.

CO 5- Understanding Energy Economics.

Course Contents:

Unit 1:
Introduction to energy & power scenario of world, National Energy consumption data, environmental aspects associated with energy utilization; Energy Auditing- need, types, methodology and barriers, role of energy managers, instruments of energy auditing.

Unit 2:
Components of EB billing, HT and LT supply, transformers, cable sizing; Concept of capacitors, power factor improvement, harmonics; Electric motors- motor efficiency computation, energy efficient motors; Illumination- Lux, Lumens, types of lighting, efficacy, LED lighting and scope of energy conservation in lighting.

Unit 3:
Thermal systems, Boilers, Furnaces and Thermic Fluid heaters- efficiency computation and energy conservation measures; Steam distribution and usage,steam traps, condensate recovery, flash steam utilization; Insulation & Refractories.

Unit 4:
Thermal systems, Boilers, Furnaces; pumps, fans, blowers, compressed air systems, Refrigeration& Air Conditioning systems, Cooling Towers, DG sets.

Unit 5:
Energy Economics- discount period, payback period, internal rate of return, net present value; Life Cycle costing- ESCO concept.

Text Books:
1. Witte L.C. , Schmidt P.S. and Brown D.R., Industrial Energy Management and Utilization,

Hemisphere Publ., Washington, 1988..
2. Callaghn P.W., Design and Management for Energy Conservation, Pergamon Press, Oxford, 1981.
3. Murphy W.R. and McKay G., Energy Management, Butterworths, London, 1987.
4. Energy Manager Training Manual , Bureau of Energy Efficiency (BEE) under Ministry of Power, GOI, 2004 (available at www.energymanager training.com).

PEC-ME-431 MAINTENANCE ENGINEERING AND MANAGEMENT (PEC IV)
B. Tech (Mechanical Engineering) VII/VIII Semester

No. of Credits: 3	Sessional: 25 Marks
L T P Total	Theory: 75 Marks
3 0 0 3	Total : 100 Marks
	Duration of Exam: 3 Hours

Course Objectives:

The objective of the course is to provide the students with the fundamental concepts, the necessary knowledge and the basic skills related to systems maintenance function. The course intends to expose the students to the concept of maintenance optimal policies.

Course Outcomes: At the end of course the students will be able to:

CO1: Understand the maintenance function and its objectives

CO2: Gain the necessary knowledge about the types of maintenance and know how to use them when design maintenance systems

CO3: Have understanding of the condition monitoring and optimal maintenance policies.

CO4: Explore basic concepts of TPM.

Unit I: Maintenance Management

Relevance of Maintenance: an over view, maintenance services, problems of the plant manager, automation and maintenance. Requirements of Maintenance Engineering Department, Basic Principles of maintenance Engineering — Importance and benefits of sound Maintenance systems –Maintenance organization – Definitions and terms used in Maintenance Engineering.

Unit II: Classification of maintenance approach

Introduction, Planned Maintenance- Unplanned Maintenance, Preventive Maintenance- Corrective Maintenance- Basic Principle and objective,advantages, disadvantages, Basic requirements.

Unit-III: Condition Monitoring- Different condition monitoring Techniques; Visual, performance, fluid and vibration monitoring. Fluid condition and particle monitoring; Wear debris analysis; Vibration monitoring methods; Vibration data collection; Techniques; Instruments.

Unit IV Optimal Maintenance Policies

Introduction, Factors affecting the maintenance policies, Maintenance categories – Comparative merits of each category,Repair/Discard decisions-Factors affecting the R/D

decisions, Cost comparison for R/D decisions, optimal module size, safety in Maintenance, Economics of maintenance.

Unit V: Total Productive Maintenance

Development and scope of concept, technology, basic systems of TPM procedure and steps of TPM, productivity circle

Text Book and References

1. Industrial Maintenance – H.P.Garg
2. Ind. Maint. Management – S.K.Srivastava
3. Collacot R.A.- Mechanical fault diagnosis and condition monitoring
4. Hunt, T.M., (1993), Handbook of wear debris analysis and particle detection in liquids, Elsevier applied science, London and New York
5. Dhillon, B.S. (2002). Engineering Maintenance: A Modern Approach. CRC Press, Boca Raton, Florida.
6. Jardine, A.K.S. and Tsang, A.H.C. (2006). Maintenance, Replacement, and Reliability: Theory and Applications. CRC Press, Taylor & Francis Group, ISBN 0-8493-3966-0.
7. Rao, B. (1996), Handbook of condition monitoring, Elsevier advanced technology, Oxford.
8. Ross, S.M. (1970). Applied Probability Models with Optimization Applications. Holden Day, San Francisco.

PEC-ME-441 FLEXIBLE MANUFACTURING SYSTEMS (PEC-V)

B. Tech (Mechanical Engineering) VII/VIII Semester

No. of Credits: 3		Sessional:	25 Marks
L T P	Total	Theory:	75 Marks
3 0 0	3	Total :	100 Marks
		Duration of Exam:	3 Hours

Pre- Requisite: Industrial Engineering, Automation in Manufacturing

Successive: None

Course Objectives:

To understand the design, planning and operational concepts of FMS and learn about the different tools and techniques for analyzing the same.

Course Outcomes (COs):

CO 1- Understand FMS and job-shop and mass production manufacturing systems.

CO 2- Knowledge of concept and design of flexible manufacturing cells.

CO 3- Explore processing stations and material handling systems used in FMS environments.

CO 4- Analyze the production management problems in planning, loading, scheduling, tool management and breakdown in a typical FMS.

CO 5- Design and analyze FMS using analytical techniques.

Course Contents:

UNIT I **Understanding of FMS:** Evolution and classifications of Manufacturing Systems, Definition, Objective and Need, Components, Merits, Demerits and Applications of FMS.

UNIT II **Flexible Manufacturing Cell:** Part families, parts classification and coding, types of classification and coding systems. Machine cell design: The composite part concept, types of cell designs, determining the best machine arrangement.

UNIT III **FMS Processing Stations:** Machining Centers, Turning centers, CMM, Washing/ Deburring station, etc. Different Layouts and their Salient features.

UNIT IV **Material Handling Systems:** An introduction, Conveyor, AGV, ASRS, Robots, etc. and their salient features.

UNIT V **Management Technology:** Tool Management, Configuration planning and routing, Production Planning and Control, Scheduling and control, Computer Networks and Control.

UNIT VI **Design of FMS:** Performance Evaluation, Analytical models of FMS, Case studies: Typical FMS problems from researches papers.

Text Books:

1. Groover,M.P "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India Pvt.Ltd. New Delhi 2009

Reference Books:

1. Tempelmeier.H and Kuhn.H. "Flexible Manufacturing system: Decision support for design and operation", John Wiley and Sons 2003.

2. Maleki A. "Flexible Manufacturing Systems: the technology and management". Prentice Hall International –2009

PEC-ME-443 TOTAL QUALITY MANAGEMENT(PEC-V)
B. Tech (Mechanical Engineering) VII/VIII Semester

No. of Credits: 3	Sessional: 25 Marks
L T P Total	Theory: 75 Marks
3 0 0 3	Total : 100 Marks
	Duration of Exam: 3 Hours

Pre- Requisite: Industrial Engineering

Successive: Nil

Course Objectives:
To facilitate the understanding of total quality management principles and processes

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

1. Understand the basic framework of Quality and TQM.
2. Illustrate the aspects of various TQM principles and factors.
3. Understand various Quality and Management tools..
4. Describe TQM tools and techniques.
5. Explain Quality Management systems like ISO 9000 and 14000.

Course Contents:

UNIT I

Introduction, need for quality, evolution of quality; Definitions of quality, product quality and service quality; Basic concepts of TQM, TQM framework, contributions of Deming, Juran and Crosby. Barriers to TQM; Quality statements, customer focus, customer orientation & satisfaction, customer complaints, customer retention; costs to quality.

UNIT II

TQM principles; leadership, strategic quality planning; Quality councils- employee involvement, motivation; Empowerment; Team and Teamwork; Quality circles, recognition and reward, performance appraisal; Continuous process improvement; PDCE cycle, 5S, Kaizen; Supplier partnership, Partnering, Supplier rating & selection.

UNIT III

The seven traditional tools of quality; New management tools; Six sigma- concepts, methodology, applications to manufacturing, service sector including IT, Bench marking process; FMEA- stages, types.

UNIT IV

TQM tools and techniques, control charts, process capability, concepts of six sigma, Quality Function Development (QFD), Taguchi quality loss function; TPM- concepts, improvement needs, performance measures.

Quality systems, need for ISO 9000, ISO 9001-9008; Quality system- elements,

documentation,; Quality auditing, QS 9000, ISO 14000- concepts, requirements and benefits; TQM implementation in manufacturing and service sectors.

Text Books:

1. Besterfield D.H. et al., Total qualityManagement, 3rd ed., Pearson Education Asia, 2006.
2. Evans J.R. and Lindsay W.M., The management and Control of Quality, 8th ed., first Indian edition, Cengage Learning, 2012.
3. Janakiraman B. and Gopal R.K., Total Quality Management, Prentice Hall India, 2006.
4. Suganthi L. and Samuel A., Total Quality Management, Prentice Hall India, 2006.

PEC-ME-445 PROJECT MANAGEMENT (PEC-V)
B. Tech (Mechanical Engineering) VII/VIII Semester

No. of Credits: 3

L T P Total
3 0 0 3

Sessional: 25 Marks
Theory : 75 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Pre- Requisite: Operation Research

Successive: None

Course Objectives:

To develop project Management and develop decision making skill.

Course outcomes (Cos) : At the end of the course, the student shall be able to:

1. Illustrate the types of projects and project appraisal & selection.
2. Describe and develop project network.
3. Illustrate the role of human factors in a project.
4. Develop and solve Project evaluation & review technique (PERT) & Critical path method (CPM).
5. Analyze how to control & monitor a project.

Course Contents:

***UNIT I Introduction*& Overview:** Definitions, Types of projects, Project life cycle (Project phases) and decisions.

***UNIT II Go*/ No go decisions** based on: a) Project Identification and Screening, b) Project Appraisal: Market, Technical, social, Ecological & Financial, c) Project Selection: Pragmatic, pair wise, MADM approach.

***UNIT III* Development of Project Network:** Project description, Work break down structure, Nomenclature, Rules for drawing and representation, consistency and Redundancy in Project Networks, Matrix representation, Basic Scheduling with Networks (Forward & Backward Pass)

***UNIT IV* CPM& PERT:** Activity times, Completion, Floats, Probability (ND usage), Examples, and Problems.

***UNIT V* Project Monitoring & Control:** Project adjustments, Crashing: Direct & Indirect cost, Normal & Crash: duration & cost, Resource leveling: Types, usage, leveling, Problems, Managing Risk.

***UNIT VI* Role of Human Factors and Project completion:** Dealing with people Team Building and Leadership in Projects, commitment, work culture, motivation, coordination, attitude, innovation. Project Completion, Review and Future Directions

Course Outcomes (COs): At the end of the course, the student shall be able to:

Text Books:

1. Project Management: A Life Cycle Approach by Arun Kanda. (PHI Learning)
2. Project Management: Engineering, Technology, and Implementation by Shtub, Bard and Globerson,, PH Inc.

Reference Books:

1. Project Management by Clifford Gray and Erik Larson. (Tata McGraw Hill Edition)
2. Management Guide to PERT/ CPM by Wiest, JD and Levy F.K. (PHI)
3. Industrial Engg. & Mgmt. by Dr Ravi Shankar.Galgotia Publications.

Web Links:

1. https://en.wikipedia.org/wiki/Project_management
2. http://freevideolectures.com/Course/2371/Project-and-Production-Management/2
3. https://www.youtube.com/watch?v=DdDzybQ_9vM

PEC-ME-447 MARKETING MANAGEMENT(PEC-V)

B. Tech (Mechanical Engineering) VII/VIII Semester

No. of Credits: 3		Sessional:	25 Marks
L T P Total		Theory:	75 Marks
3 0 0 3		Total:	100 Marks
		Duration of Exam:	3 Hours

Pre- Requisite: Industrial Engineering

Successive: Nil

Course Objectives:
To familiarize the students with the basics of marketing management.

Course Outcomes (COs): At the end of the course, the student shall be able to:

CO1 Describe the role of marketing management in industries.

CO2 Understand role of marketing strategies in planning for markets.

CO3 Relate product life cycle with marketing strategies.

CO4 Explain the role of forecasting in product management.

CO5 Perform marketing audit to identify the weak links.

Course Contents:

UNIT 1. Introduction to Marketing function: genesis, the marketing concept. Marketing Management System: objectives, its interfaces with other functions in the organisation. Environment of Marketing- Economic Environment, Market: market segmentation. Consumer-buyer behaviour models.Sociocultural environment.Legal Environment.Ethical issues in marketing.

UNIT 2. Marketing Strategy: Marketing planning and Marketing programming. The concept of marketing mix, Product policy; the concept of product life cycle.New product decisions. Test marketing- Pricing Management of distribution: channels of distribution. Advertising and production.The concept of Unique Selling Proposition.

UNIT 3. Implementation and Control: The marketing organization- alternative organization structures; the concept of product management. Administration of the marketing programme, sales forecasting; marketing and sales budgeting; sales management; management of sales force.Evaluation of marketing performance; sales analysis; control of marketing effort; marketing audit.

Text Books:

1. Enis, B.M. Marketing Classics: A Selection of Influential Articles, New York, McGraw Hill, 1991.
2. Kotler, Philip and Armstrong, G. Principles of Marketing. New Delhi, Prentice Hall of India, 1997.

3. Kotler, Philip. Marketing Management: Analysis, Planning, Implementation and Control, New Delhi, Prentice Hall of India, 1994.
4. Ramaswamy, VS and Namakumari, S. Marketing Management: Planning, Control, New Delhi, MacMillan, 1990.
5. Stanton, William, J. Fundamentals of Marketing. New York, McGraw Hill, 1994.
6. Neelamegham, S. Marketing in India: Cases and Readings. New Delhi, Vikas 1988.

PEC-ME-449 METALLURGY (PEC-V)
B. Tech (Mechanical Engineering)VII /VIII Semester

No. of Credits: 3		Sessional:	25 Marks
L T P	Total	Theory:	75 Marks
3 0 0	3	Total :	100 Marks
		Duration of Exam:	3 Hours

Pre- Requisite: Material Science, Manufacturing Processes

Successive: Tool Design

Course Objectives

To study various concepts of transformation in metals

Course out Comes (COs): At the end of the course, the student shall be able to:

CO 1- Acquire knowledge of various types of solid solution and phase diagram.
CO 2- Develop utility and applications of metallographic.
CO 3- Understanding the iron-carbon diagram and effect of alloying elements.
CO 4- Learn heat treatment process and various factors affecting the heat treatment process.

Course Contents:

UNIT I **Solid Solutions:** Types of Solid Solutions, Substitutional Solid Solution, Disordered Substitutional Solid Solution, Ordered Substitutional Solid Solution, Interstitial Solid Solution, Hume Rothery's Rules

UNIT II **Phase Diagrams:** Systems, Phases and Structural Constituents, Cooling Curves, Phase Diagrams, Interpretation of Phase Diagrams, Gibb's Phase Rule, Classification of Equilibrium Diagrams, Two Metals Completely Soluble in Liquid and Solid State, Peritectic Reaction, Eutectoid Transformation, Peritectoid Transformation

UNIT III **Iron - Carbon System:** Iron, Allotrophy, Micro-constituents of Iron and Steel, Iron - Carbon Equilibrium Diagram, Effect of Alloying Elements on the Properties of Steels, Pearlite Transformation, T.T.T. Diagram, MartensiteTransformation, Austenite Grain Size and Grain Size Control

UNIT IV **Metallography:** Introduction and Definition, Metallurgical Microscope, Preparation of Specimen, Micro and Macro Examination, Electron Microscope

UNIT V **Heat Treatment Processes:** Classification of Heat Treatment Processes, Purpose of Heat Treatment, Principles of Heat Treatment, Annealing-Definition, Purpose and Concepts of (a) Stress Relieving (b) Process Annealing (c) Spheroidising and Full Annealing.

UNIT VI **Case Hardening and Surface Treatment:** Carburizing, Pack Carburizing, Gas Carburizing, Nitriding, Cyaniding, Flame Hardening, Induction Hardening

Text Books:

1. Elements of Physical Metallurgy – Albert G.Guy – Addison Wesley
2. Metallurgy for Engineers - Rollason – Edward Arnold Publishers
3. Mechanical Metallurgy – Dieter – McGraw Hill
4. Physical Metallurgy for Engineers – Clark – Eastern Western Publishers
5. Elements of Material Science -Vlack - Addison Wesley
6. Engineering Physical Metallurgy - Lakhtin – CBS Publications

PEC-ME-451 MECHATRONICS SYSTEMS(PEC-V)

B. Tech (Mechanical Engineering) VII/VIII Semester

No. of Credits: 3	Sessional: 25 Marks
L T P Total	Theory: 75 Marks
3 0 0 3	Total : 100 Marks
	Duration of Exam: 3 Hours

Pre- Requisite: Basic Electronics Engineering

Successive: Automation in Manufacturing

Course Objectives:

Getting familiarisation of mechatronics such as; sensor, actuator, smart material, micromechatronic,

Course Outcome (COs): At the end of the course, the student shall be able to:

- **CO 1-** Generate conceptual design for mechatronics products based on potential custom requirements.
- **CO 2-** Select appropriate sensors and actuators.
- **CO 3-** Design a control system for effective functioning of Mechatronics systems using digit electronics, microprocessors, microcontrollers and PLC.
- **CO 4-** Develop system model for mechanical system.
- **CO 5-** Understand hardware tools to build mechatronics system.

Course Contents:

UNIT I:

Introduction: Definition of Mechanical Systems, Philosophy and approach; Systems and Design: Mechatronic approach, Integrated Product Design, Modeling, Analysis and Simulation, Man-Machine Interface;

Sensors and transducers: classification, Development in Transducer technology, Opto-electronics-Shaft encoders, CD Sensors, Vision System, etc.;

UNIT II

Drives and Actuators: Hydraulic and Pneumatic drives, Electrical Actuators such as servo motor and Stepper motor, Drive circuits, open and closed loop control; Embedded Systems: Hardware Structure, Software Design and Communication, Programmable Logic Devices, Automatic Control and Real Time Control Systems;

UNIT III

Smart materials: Shape Memory Alloy, Piezoelectric and Magnetostrictive Actuators: Materials, Static and dynamic characteristics, illustrative examples for positioning, vibration isolation, etc.;

UNIT IV

Micromechatronic systems: Microsensors, Microactuators; Micro-fabrication techniques LIGA Process: Lithography, etching, Micro-joining etc. Application examples; Case studies Examples of Mechatronic Systems from Robotics Manufacturing, Machine Diagnostics, Road vehicles and Medical Technology.

Text Books:

1) Mechatronics System Design, Devdas Shetty & Richard A. Kolk, PWS Publishing Company (Thomson Learning Inc.)
2) Mechatronics: A Multidisciplinary Approach, William Bolton, Pearson Education
3) A Textbook of Mechatronics ,R.K.Rajput, S. Chand & Company Private Limited
4) Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, William Bolton, Prentice Hall

PEC-ME-453 PROCESS PLANNING AND COST ESTIMATION (PEC-V)

B. Tech (Mechanical Engineering) VII/VIII Semester

No. of Credits: 3		Sessional:	25 Marks
L T P	Total	Theory:	75 Marks
3 0 0	3	Total :	100 Marks
		Duration of Exam:	3 Hours

Pre- Requisite: Manufacturing processes, Industrial Engineering

Successive: Nil

Course Objectives:

To introduce process planning concepts to make cost estimation for various products

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

Course Outcome (COs): At the end of the course, the student shall be able to:

CO1 Understand the basic concepts of process planning.

CO2 Understand the various activities involved in process planning.

CO3 Comprehend the basic elements of cost.

CO4 Compute the machining time in various operation's.

CO5 Compute the cost of different production processes.

Course Contents:

UNIT I

Introduction of Process Planning- methods of process planning, drawing interpretation, material evaluation, steps in process selection, production equipment and tooling selection

UNIT II

Process planning activities- process parameter calculation for various production processes, selection of jigs and fixtures, selection of quality assurance methods, documents for process planning, economics of process planning, case studies

UNIT III **Introduction** to cost estimation-
importance of costing and estimation, methods of costing,
elements of cost estimation, types of estimates, estimating procedure, estimation of labor cost, material cost, allocation of overhead charges, calculation of depreciation cost

UNIT IV **Machining** time estimation-
importance of machine time calculation, machining time for
different lathe operations, drilling and boring time calculations, Machining time calculation for Milling, Shaping, Planing and Grinding

UNIT V: Production costs-
different production processes for different jobs, estimation of forging cost,
estimation of welding cost, estimation of foundry cost, estimation of machining cost

Text Books:

1. Peter Scalon, Process Planning, Design/ Manufacture Interface, Elsevier Sci.&Tech. 2002.
2. Ostwaal P.F. and Munez J., Manufacturing Processes and Systems, 9th ed., John Wiley 1998.
3. Chitale A.V. and Gupta R.C., Product Design and Manufacturing, 2nd ed., Prentice Hall 2002.

PEC-ME-455 MICRO AND NANO MANUFACTURING (PEC-V)
B. Tech (Mechanical Engineering) VII/VIII Semester

No. of Credits: 3		Sessional:	25 Marks
L T P	Total	Theory:	75 Marks
3 0 0	3	Total :	100 Marks
		Duration of Exam:	3 Hours

Pre- Requisite: Material Science, Physics

Successive: None

Course Objectives:

The objective of this course is to familiarize the students with the processes and techniques of micro and nano manufacturing.

Course Outcomes (COs): At the end of the course, the student shall be able to:

CO 1- Understand manufacturing considerations at the micro and nano scale.

CO 2- Understand design-and-analysis methods and tools used for micro and nano manufacturing.

CO 3- Select manufacturing methods, techniques and process parameters for material processing quality.

CO 4- Design and select industrially-viable processes, equipment and manufacturing tools for specific industrial products.

Course Contents:

UNIT I **Introduction:** Importance of Nano-technology, Emergence of Nanotechnology, Bottom-up and Top-down approaches, challenges in Nanotechnology.

Nano materials Synthesis and Processing: Methods for creating Nanostructures; Processes for producing ultrafine powders- Mechanical grinding; Wet Chemical Synthesis of nanomaterials- solgel process, Liquid solid reactions; Gas Phase synthesis of nanomaterials- Furnace, Flame assisted ultrasonic spray pyrolysis; Gas Condensation Processing(GPC), Chemical Vapour Condensation(CVC)- Cold Plasma Methods, Laser ablation, Vapour – liquid –solid growth, particle precipitation aided CVD, summary of Gas Condensation Processing(GPC).

UNIT II **Structural Characterization:** X-ray diffraction, Small angle X-ray Scattering, Optical Microscope and their description, Scanning Electron Microscopy (SEM), Scanning Probe Microscopy (SPM), TEM and EDAX analysis, Scanning Tunneling Microscopy (STM), Atomic force Microscopy (AFM).

Spectroscopic characterizations: Basic concepts of spectroscopy, operational principle and application for analysis of nanomaterials, UV-VIS-IR Spectrophotometers, Principle of operation and application for band gap measurement, Raman spectroscopy.

UNIT III **Surface Characterization:** X-ray Photoelectron Spectroscopy (XPS), Auger electron spectroscopy, Low Energy Ion Scattering Spectroscopy (LEISS), Secondary Ion Mass Spectroscopy (SIMS), Rutherford Backscattering Spectroscopy (RBS).
Thermal Characterization of Nanomaterials: DTA, TGA, DSC (Principle and Applications), Determination of thermo physical parameters.

UNIT IV **Micro-fabrication Techniques:** Lithography, Thin Film Deposition and Doping, Etching and Substrate Removal, Substrate Bonding. MEMS Fabrication Techniques, Bulk Micromachining, Surface Micromachining, High- Aspect-Ratio Micromachining.

UNIT V **Nanofabrication Techniques:** E-Beam and Nano-Imprint Fabrication, Epitaxy and Strain Engineering, Scanned Probe Techniques, Self-Assembly and Template Manufacturing.

UNIT VI **MEMS Devices and Applications:** Pressure sensor, Inertial sensor, Optical MEMS and RF-MEMS, Micro-actuators for dual-stage servo systems.

Text Books:

1. Mark James Jackson, Microfabrication and Nanomanufacturing, CRC Press, 2005.
2. Gabor L. Hornyak, H.F Tibbals, Joydeep Dutta & John J Moore, Introduction to Nanoscience and Nanotechnology, CRC Press, 2009.

Reference Books:

1. Ray F. Egerton , Physical Principles of Electron Microscopy: An Introduction to TEM, SEM, and AEM , Springer, 2005.
2. Robert F Speyer, Thermal Analysis of Materials, Marcel Dekker Inc, New York, 1994.
3. B.D. Cullity - Elements of X-Ray Diffraction, 3rd edition, Prentice Hall, 2002.

PEC-ME-457 COMPOSITE MATERIALS (PEC-V)
B. Tech (Mechanical Engineering) VII/VIII Semester

No. of Credits: 3		Sessional:	25 Marks
L T P Total		Theory:	75 Marks
3 0 0 3		Total :	100 Marks
		Duration of Exam:	3 Hours

Pre- Requisite: Materials Engineering

Successive: Manufacturing Technology

Course Objectives:
1. To understand the mechanical behaviour of composite materials
2. To get an overview of the methods of manufacturing composite materials

Course Outcomes (COs): At the end of the course, the student shall be able to:

1. Gain knowledge of Overview of the mechanical behaviour and application of composite materials.
2. Explore Knowledge of Manufacturing of composite materials.
3. Understnad theory of laminates.
4. Explore static bending analysis.

Course Contents:

Unit 1:

Definition and applications of composite materials, Fibers- glass, carbon, ceramic and aramid fibers; Matrices- polymer, graphite, ceramic and metal matrices; characteristics of fibers and matrices. Lamina- assumptions, macroscopic viewpoint, generalized Hooke;s law, reduction of homogeneous orthotropic lamina, isotropic limit case, orthotropic stiffness matrix, commercial material properties, rule of mixtures, transformation matrix, transformed stiffness.

Unit 2:

Manufacturing of composite materials, bag moulding, compression moulding, pultrusion, filament welding, other manufacturing processes

Unit 3:

Basic assumptions of laminated anisotropic plates, symmetric laminates, angle ply laminates, cross ply laminates, laminate structural moduli, evaluation of lamina properties, determination of lamina stresses, maximum stress and strain criteria, von Mises Yield criterion for isotropic materials, generalized Hill's criterion for anisotropic materials, Tsai-Hill's criterion for composites, prediction of laminate failure, thermal analysis of composite laminates

Unit 4:

Analysis of laminated plates- equilibrium equations of motion, energy formulation, static bending analysis, buckling analysis, free vibrations, natural frequencies

Text Books:

1. Gibson R.F. Principles of Composite Material Mechanics, second edition, McGraw Hill, 1994.
2. Hyer M.W., Stress Analysis of Fiber- Reinforced Composite Materials, McGraw Hill, 1998.

PEC-ME-459 PRINCIPLES OF MANAGEMENT (PEC-V)

B. Tech (Mechanical Engineering) VII/VIII Semester

No. of Credits: 3	Sessional: 25 Marks
L T P Total	Theory: 75 Marks
3 0 0 3	Total : 100 Marks
	Duration of Exam: 3 Hours

Pre- Requisite: Industrial Engineering

Course Objectives:
To understand the principles of management and their application to the functioning of an Organization

Course Outcomes: (COs) : At the end of the course, the student shall be able to:

Upon completion of this course, the students will get
1. To understand of Principle of Management
2. To develop skill of Planning
3. To explore purpose of Organizing
4. To know Controlling strategies.

Course Contents:

Unit 1:
Definition of management, science or art, manager vs entrepreneur; Types of managers-managerial roles and skills; Evolution of management- scientific, human relations, system and contingency approaches; Types of Business Organizations, sole proprietorship, partnership, company, public and private enterprises; Organization culture and environment; Current trends and issues in management.

Unit 2:
Nature and purpose of Planning, types of Planning, objectives, setting objectives, policies, Strategic Management, Planning Tools and Techniques, Decision making steps & processes.

Unit 3:
Nature and purpose of Organizing, formal and informal organization, organization structure, types, line and staff authority, departmentalization, delegation of authority, centralization and decentralization, job design, human resource management, HR planning, Recruitment selection, Training & Development, Performance Management, Career planning and Management.

Unit 4:
Directing, individual and group behavior, motivation, motivation theories, motivational techniques, job satisfaction, job enrichment, leadership, types & theories of leadership, effective communication.

Unit 5:
Controlling, system and process of controlling, budgetary and non-budgetary control techniques, use of computers and IT in management control, productivity problems and management, control and performance, direct and preventive control, reporting.

Text Books:
1. Robins S.P. and Couiter M., Management, Prentice Hall India, 10th ed., 2009.
2. Stoner JAF, Freeman RE and Gilbert DR, Management, 6th ed., Pearson Education, 2004.
3. Tripathy PC & Reddy PN, Principles of Management, Tata McGraw Hill, 1999.

PEC-ME-461 Quality Management (PEC-V)

B. Tech (Mechanical Engineering) VII Semester

No. of Credits: 3	Sessional: 25 Marks
L T P Total	Theory: 75 Marks
3 0 0 3	Total : 100 Marks
	Duration of Exam: 3 Hours

Pre- Requisite: Industrial Engineering

Course Objectives:
To understand the principles of Qualitymanagement and application to the funct oning of an Organization

Course Outcomes: (Cos) At the end of the course, the student shall be able to:

Upon completion of this course, the students will get
1. Understand of Principle of Management
2. Develop skill of Planning
3. Explore purpose of Organizing
4. Know Controlling strategies.

Course contents

Unit-I: Quality Concepts: Evolution of Quality Control, concept change, TQM Modern concept, Quality concept in design, Review of design, Evolution of proto type. Control on Purchased Product: Procurement of various products, evaluation of supplies, capacity verification, Development of sources, procurement procedure. Manufacturing Quality: Methods and techniques for manufacture, inspection and control of product, quality in sales and services, guarantee, analysis of claims.

UNIT-II: Quality Management: Organization structure and design, quality function, decentralization, designing and fitting, organization for different type products and company, economics of quality value and contribution, quality cost, optimizing quality cost, seduction program. Human Factor in quality Attitude of top management, cooperation of groups, operators attitude, responsibility, causes of apparatus error and corrective methods.

UNIT-III: Control Charts, Theory of control charts, measurement range, construction and analysis of R charts, process capability study, use of control charts. Attributes of Control Chart, Defects, construction and analysis of charts, improvement by control chart, variable sample size, construction and analysis of C charts.

UNIT -IV : Defects diagnosis and prevention defect study, identification and analysis of defects, correcting measure, factors affecting reliability, MTTF, calculation of reliability,

building reliability in the product, evaluation of reliability, interpretation of test results, reliability control, maintainability, zero defects, quality circle.

UNIT –V: ISO-9000 and its concept of Quality Management, ISO 9000 series, Taguchi method, JIT in some details.

Text / Reference Books:

1. Lt. Gen. H. Lal, “Total Quality Management”, Eastern Limited, 1990.

2. Greg Bounds, “Beyond Total Quality Management”, McGraw Hill, 1994.

3. Menon, H.G, “TQM in New Product manufacturing”, McGraw Hill 1992.

OPEN ELECTIVES COURSES

[OEC]

BY

OTHER DEPARTMENTS

The Syllabus for Open Elective Courses offered by CE and IT Department:

Xxx INTELLIGENT SYSTEMS

No. of Credits: 3
L T P Total
3 0 0 3

Sessional: 25 Marks
Theory: 75 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course Objectives:
To understand the principles of INTELLIGENT SYSTEMS and application to the funct oning of an Organization

Course Outcomes: (Cos) At the end of the course, the student shall be able to:

Upon completion of this course, the students will get
1. To understand of Principle of Intelligent Systems
2. Understanding of Knowledge Presentation
3. Familiarisation of risk in uncertainty.
4. To know Controlling strategies.

UNIT I **Fundamental Issues in IS** : Definition of AI , History ,Domains AI ,AI problems & State space ,Some examples problems representations like Travelling Salespersons, Syntax analysis Problem. Basic issues to solve AI problems, Underlying assumptions, AI techniques, Level of model ,Criteria for success , Control strategies, DFS, BFS

UNIT II **Heuristic Search Techniques**: Generate & Test, Hill Climbing (simple &stipest), Best first search, A*, AO*, Constraint Satisfaction.

UNIT III **Knowledge Representation Issues**: Syntax & Semantic for Propositional logic, Syntax & Semantic for FOPL, Properties for WFF's, Resolution Basics : conversion to clausal form ,Resolution of proposition logic, Resolution algorithms for predicates, Problems with FOPL ,Semantic nets ,Frames ,Scripts

UNIT IV **Reasoning Under Uncertainty**: An introduction, Default reasoning & Closed world assumptions, Model & Temporal logic ,Fuzzy logic, Basian Probabilistic inference Dempster Shafer theory ,Heuristic reasoning methods

UNIT V **Planning & Learning** : Planning, Planning in Situational calculus ,Representation for planning ,Partial order palnning, Partial order palnning algorithm, Learning by

Examples, Learning by Analogy, Explanation based learning, Neurals nets, Genetics algorithms

UNIT VI **Minimax:** Game playing strategy, Natural language processing ,Overview of linguistics , Grammer& Language, Transformation Grammer, Basic Parsing Techniques, Expert System, Architecture of Rule based Expert system ,Non Rule based Expert system.

References:

1. Artificial Intelligence by Elain Rich & Kevin Knight, Tata McGraw Hills Pub.
2. Principals of AI by Nills .J.Nilsson, Pearson Education Pub.
3. Artificial Intelligence by DAN. W.Petterson. Printice Hall of India
4. Artificial Intelligence by Petrick Henry Winston,
5. Artificial Intelligence by Russel and Norvig, Pearson Education Pub.

XXX CYBER LAWS AND SECURITY

No. of Credits: 3
L T P Total
3 0 0 3

Sessional: 25 Marks
Theory: 75 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course Objectives:
To understand the principles of Cyber Laws and
Security and application to the functioning of an Organization

Course Outcomes: (Cos) ; At the end of the course, the student shall be able to:

1. To understand of Principle of Information Systems
2. Understanding of Knowledge Security Threats
3. Familiarisation of Model of Cryptographic Systems
4. To know Security metrics

UNIT I History of Information Systems and its Importance, basics, Changing Nature of Information Systems, Need of Distributed Information Systems, Role of Internet and Web Services, Information System Threats and attacks, Classification of Threats and Assessing Damages Security in Mobile and Wireless Computing- Security Challenges in Mobile Devices, authentication Service Security, Security Implication for organizations, Laptops Security Basic Principles of Information Security, Confidentiality, Integrity Availability and other terms in Information Security, Information Classification and their Roles.

UNIT II Security Threats to E Commerce, Virtual Organization, Business Transactions on Web, E Governance and EDI, Concepts in Electronics payment systems, E Cash, Credit/Debit Cards. Physical Security- Needs, Disaster and Controls, Basic Tenets of Physical Security and Physical Entry Controls, Access Control- Biometrics, Factors in Biometrics Systems, Benefits, Criteria for selection of biometrics, Design Issues in Biometric Systems, Interoperability Issues, Economic and Social Aspects, Legal Challenges

UNIT III Model of Cryptographic Systems, Issues in Documents Security, System of Keys, Public Key Cryptography, Digital Signature, Requirement of Digital Signature System, Finger Prints, Firewalls, Design and Implementation Issues, Policies Network Security- Basic Concepts, Dimensions, Perimeter for Network Protection, Network Attacks, Need of Intrusion Monitoring and Detection, Intrusion

Detection Virtual Private Networks- Need, Use of Tunneling with VPN, Authentication Mechanisms, Types of VPNs and their Usage, Security Concerns in VPN

UNIT IV Security metrics- Classification and their benefits Information Security & Law, IPR, Patent Law, Copyright Law, Legal Issues in Data mIning Security, Building Security into Software Life Cycle Ethics- Ethical Issues, Issues in Data and Software Privacy Cyber Crime Types & overview of Cyber Crimes

References:

1. Godbole,“ Information Systems Security”, Willey
2. Merkov, Breithaupt, “ Information Security”, Pearson Education
3. Yadav, “Foundations of Information Technology”, New Age, Delhi
4. Schou, Shoemaker, “ Information Assurance for the Enterprise”, Tata McGraw Hill
5. Sood,“Cyber Laws Simplified”, Mc Graw Hill
6. Furnell, “Computer Insecurity”, Springer 7. IT Act 2000

XXX SOFT COMPUTING

No. of Credits: 3	Sessional: 25 Marks
L T P Total	Theory: 75 Marks
3 0 0 3	Total : 100 Marks
	Duration of Exam: 3 Hours

Course Objectives:
To understand the principles of Soft Computing
Security and application to the functioning of an Organization

Course Outcomes: (Cos): At the end of the course, the student shall be able to:

1. Understand of Principle of I Neural Networks
2. Understand of Fuzzy Sets
3. Familiarise of Model of Operations on Fuzzy Sets
4. know Fuzzy Logic:

UNIT I **Neural Networks:** History, overview of biological Neuro-system, Mathematical Models of Neurons, ANN architecture, Learning rules, Learning Paradigms-Supervised, Unsupervised and reinforcement Learning, ANN training Algorithms-perceptions, Training rules, Delta, Back Propagation Algorithm, Multilayer Perception Model, Hopfield Networks, Associative Memories, Applications of Artificial Neural Networks.

UNIT II **Fuzzy Logic:** Introduction to Fuzzy Logic, Classical and Fuzzy Sets: Overview of Classical Sets, Membership Function, Fuzzy rule generation.

UNIT III Operations **on Fuzzy Sets:** Compliment, Intersections, Unions, Combinations of Operations, Aggregation Operations.

UNIT IV **Fuzzy Arithmetic:** Fuzzy Numbers, Linguistic Variables, Arithmetic Operations on Intervals & Numbers, Lattice of Fuzzy Numbers, Fuzzy Equations.

UNIT V **Fuzzy Logic:** Classical Logic, Multivalued Logics, Fuzzy Propositions, Fuzzy Qualifiers, Linguistic Hedges. Uncertainty based Information: Information & Uncertainty, Non specificity of Fuzzy & Crisp Sets, Fuzziness of Fuzzy Sets. Genetic Algorithms, Scope & application areas, solution of 0-1Knapsack problem using GA

References:

1. “Fuzzy sets and Fuzzy Logic: Theory and applications”,G.J. Klir,B.Yuan, PHI

2. “Introduction to Fuzzy sets and Fuzzy Logic”, M.Ganesh , PHI

3. “An Introduction to Fuzzy Control”, D Driankov, H Hellendoorn, M Reinfrank, Narosa Publishing Company

4. “Neural Networks: A classroom approach”, Satish Kumar , Tata McGraw Hill

5. Haykin S., “Neural Networks-A Comprehensive Foundations”, Prentice-Hall International, New Jersey, 1999.

XXX WEB TECHNOLOGY AND INFORMATION RETRIEVAL

No. of Credits: 3	Sessional: 25 Marks
L T P Total	Theory: 75 Marks
3 0 0 3	Total : 100 Marks
	Duration of Exam: 3 Hours

Course Objectives:

To understand the principles of Web Technology And Information Retrieval

Course Outcomes: (Cos) : At the end of the course, the student shall be able to:

1. Understand of Principle of I Neural Networks
2. Understanding of Web Search Basics
3. Familiarise of Web Crawlers
4. know Information Retrieval

5 understand Index Construction

UNIT I **Web Server Technology**: Web's Robot global access to information, HTML, HTTP, Accessing a web server, publishing on web server, secure HTTP, Secure Sockets Layer, WWW Proxies, IIS, Case study of apache web server.

UNIT II **Web Search Basics**: Background and history, Anatomy of WWW, Web characteristics, Spam, The web graph, The Web Search Users, search engines, architecture of search engines, search tools, DNS resolution, The URL frontier, Link analysis, Page Rank.

UNIT III **Web Crawlers**: Basics of Web crawling, Various crawling techniques, incremental crawler, parallel crawler, distributed crawlers, focused crawler, agent based crawler, Hidden web Crawler

UNIT IV **Introduction to Information Retrieval**: Information retrieval problem, an inverted index, Processing Boolean queries, The extended Boolean model versus ranked retrieval, an inverted index, Bi-word indexes, Positional indexes, Combination schemes

UNIT V **Index Construction:** Hardware basics, Blocked sort-based indexing, Single-pass in-memory indexing, Distributed indexing, Dynamic indexing, Other types of indexes Index compression: Statistical properties of terms in information retrieval, Heaps' law: Estimating the number of terms, Zipf's law: Modeling the distribution of terms, Dictionary compression, Dictionary as a string, Blocked storage, Postings file compression.

XXX INTELLECTUAL PROPERTY RIGHTS

No. of Credits: 3	Sessional: 25 Marks
L T P Total	Theory: 75 Marks
3 0 0 3	Total : 100 Marks
	Duration of Exam: 3 Hours

Course Objectives:

To understand the principles of intellectual property rights.

Course Outcomes: (Cos) : At the end of the course, the student shall be able to:

1. Explore Principle of Intellectual Property
2. Expedite Introduction to Patents
3. Familiarise of Compulsory License
4. Know Infringement

UNIT I **Introduction to Intellectual Property:** Concept of Intellectual Property, Kinds of Intellectual Property, Economic Importance of Intellectual Property, **Indian Theory on Private Property:** Constitutional Aspects of Property, Constitutional Protection of Property and Intellectual Property, **Economic Development and Intellectual Property Rights Protection**

UNIT II **Introduction to Patents:** Overview, Historical Development, Concepts: Novelty, Utility, **Patentable Subject-matter:** Patent Act, 1970- Amendments of 1999, 2000, 2002 and 2005, Pharmaceutical Products and Process and Patent , Protection, Software Patents, Business Method, Protection of Plant Varieties and Farmers' Rights Act, 2001, Patenting of Micro-organism

UNIT III **Procedure of Obtaining of Patents:** Concepts of a Patent Application,, Specification: Provisional, Complete, Disclosure Aspects, Claims: Principal, Dependant, Omnibus, Examination of Application, Opposition of Application, Sealing of Patents

UNIT IV **Working of Patents – Compulsory License:** Commercialization of Inventions: License- Terms of License Agreement, Assignments of Patents, Revocation of Patents

UNIT V **Infringement:** What is Infringement?, How is Infringement determined? Who is an Infringer? Direct, Contributory and Induced, Defences of Infringement:

5.2.1 Research Exemption, Invalidity, Misuse, Failure to mark, Laches and Estoppel and first sale doctrine

References:

1. W.R. Cornish, Intellectual Property, Sweet & Maxwell, London (2000)

2. P. Narayana, Patent Law, Wadhwa Publication

3. Merges, Patent Law and Policy: Cases and Materials, 1996

4. Brian C. Reid, A Practical Guide to Patent Law, 2nd Edition, 1993

5. Brinkhof (Edited), Patent Cases, Wolters Kluwer.

6. Prof. Willem Hoyng& Frank Eijsvogels, Global Patent Litigation, Strategy and Practice, Wolters Kluwer.

7. Gregory Stobbs, Software Patents Worldwide, Wolters Kluwer.

8. Feroz Ali Khader, The Law of Patents- With a special focus on Pharmaceuticals in India, Lexis Nexis Butterworths Wadhwa, Nagpur.

9. Sookman, Computer Law, 1996

10. N.S. Gopalakrishnan& T.G. Agitha, Principles of Intellectual Property (2009). Eastern Book Company, Lucknow.

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