GOVERNMENT COLLEGE OF TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University)

Coimbatore–641 013.

Curriculum For

B.E. Production Engineering

(Full Time)

2022

Regulations

OFFICE OF THE CONTROLLER OF EXAMINATIONS
GOVERNMENT COLLEGE OF TECHNOLOGY
THADAGAM ROAD, COIMBATORE - 641 013.
PHONE : 0422 - 2433355
e-mail: gctcoe@gct.ac.in

GOVERNMENT COLLEGE OF TECHNOLOGY

(An Autonomous Institution affiliated to Anna University)

Coimbatore - 641 013

VISION AND MISSION OF THE INSTITUTION

VISION

To emerge as a centre of excellence and eminence by imparting futuristic technical education in keeping with global standards, making our students technologically competent and ethically strong so that they can readily contribute to the rapid advancement of society and mankind**.**

MISSION

- To achieve academic excellence through innovative teaching and learning practices.
- To enhance employability and entrepreneurship.
- To improve the research competence to address societal needs.
- To inculcate a culture that supports and reinforces ethical, professional behaviours for a harmonious and prosperous society.

GOVERNMENT COLLEGE OF TECHNOLOGY
(An Autonomous Institution Affiliated to Anna University)
Coimbatore–641013.

DEPARTMENT OF PRODUCTION ENGINEERING

VISION AND MISSION OF THE DEPARTMENT

VISION

To be recognized globally for outstanding education, industrial orientation and research leading to grooming competitive engineers, who are innovative, entrepreneurial and successful in advanced fields of engineering and research.

MISSION

- To educate, motivate and prepare the students to know the fundamental and technical skills in Production Engineering through effective teaching learning Methodologies.
- To impart the employability and entrepreneurship skills to the students by industry – institute interactions.
- To encourage students to undertake research and development activities for the societal needs with high ethical standards.
- To imbibe communication skills, professional and ethical standards in the minds of the young engineers by continuous learning and professional activities.

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DEPARTMENT OF PRODUCTION ENGINEERING

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO 1: Analyze, evaluate, improve and design engineered systems and processes using modern engineering tools and approaches and demonstrate in-depth knowledge of state of art in production engineering practices, and problem-solving processes.

PEO 2: Communicate effectively across disciplines and cultures, possess team work skills, management and leadership skills, entrepreneurship abilities and work effectively in diverse environments.

PEO 3: Have professional and ethical attitude, multidisciplinary approach to solve problems, creativity to innovate systems and processes with consideration for societal, ethical and environmental factors, and display motivation for life-long learning.

GOVERNMENT COLLEGE OF TECHNOLOGY
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Coimbatore–641013.
DEPARTMENT OF PRODUCTION ENGINEERING

PROGRAMME OUTCOMES (POs)

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified need with appropriate consideration for the public health and safety and the cultural, societal and 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.
5. **Modern tool usage:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to complex 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 the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering 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.
12. **Life-long learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

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DEPARTMENT OF PRODUCTION ENGINEERING

PROGRAMME SPECIFIC OUTCOMES (PSOs)

The production engineering graduates will be able to

PSO1: design the manufacturing processes, products, equipment, tooling and create the necessary environment for the manufacturing of products that meet specific materials and other requirements.

PSO2: apply the comprehensive knowledge of engineering possessions of industrial engineering to develop effective value-added products and services and become robust in quality control.

PSO3: achieve distinction in applying the management tools and techniques and advanced manufacturing technologies to create a competitive advantaged product and develop optimal decision-making skills with sustainable practices.

GOVERNMENT COLLEGE OF TECHNOLOGY, COIMBATORE – 641 013.

B.E. PRODUCTION ENGINEERING (FULL TIME)

FIRST SEMESTER

Sl. No.	Course Code	Course Title	Category	CA Mark	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
THEORY										
	22PMC1Z0	Induction Programme	MC	-	-	-	-	-	-	0
1	22PHS1Z1	தமிழர் மரபு Heritage of Tamils	HSMC	40	60	100	1	0	0	1
2	22PHS1Z2	Values and Ethics	HSMC	40	60	100	3	0	0	3
3	22PBS1Z1	Linear Algebra and Calculus	BS	40	60	100	3	1	0	4
4	22PBS1Z2	Engineering Physics	BS	40	60	100	3	0	0	3
5	22PBS103	Engineering Chemistry	BS	40	60	100	3	0	0	3
6.	22PES101	Basics of Electrical and Electronics Engineering	ES	40	60	100	3	0	0	3
PRACTICAL										
7	22PHS1Z3	Cambridge English	HSMC	60	40	100	0	0	2	1
8	22PBS1Z4	Chemistry Laboratory	BS	60	40	100	0	0	3	1.5
9	22PES1Z2	Engineering Graphics	ES	60	40	100	1	0	4	3
TOTAL				**420**	**480**	**900**	**17**	**1**	**9**	**22.5**

SECOND SEMESTER

Sl. No.	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
THEORY										
1	22PHS2Z4	தமிழரும் தொழில் நுட்பமும் Tamils and Technology	HSMC	40	60	100	1	0	0	1
2	22PHS2Z5	Professional English	HSMC	40	60	100	2	1	0	3
3	22PBS205	Differential Equations and Numerical Methods	BS	40	60	100	3	1	0	4
4	22PBS206	Materials Science	BS	40	60	100	3	0	0	3
5	22PES203	Python Programming	ES	40	60	100	3	0	0	3
6	22PMC2Z1	Environmental Science and Engineering	MC	40	60	100	3	0	0	0
		NCC Credit Course(Optional)					2	0	0	0
PRACTICAL										
7	22PBS2Z7	Physics Laboratory	BS	60	40	100	0	0	3	1.5
8	22PES2Z4	Workshop Practice	ES	60	40	100	0	0	3	1.5
9	22PES205	Python Programming Laboratory	ES	60	40	100	0	0	3	1.5
TOTAL				**420**	**480**	**900**	**15**	**2**	**9**	**18.5**

GOVERNMENT COLLEGE OF TECHNOLOGY, COIMBATORE – 641 013.

B.E. PRODUCTION ENGINEERING (FULL TIME)

THIRD SEMESTER

Sl. No.	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
THEORY										
1	22PES306	Thermal Systems and Heat Transfer	ES	40	60	100	3	1	0	4
2	22PES307	Engineering Mechanics (Common to CIVIL, EEE & PRODN Branches)	ES	40	60	100	3	0	0	3
3	22PPC301	Machine Tools and Processes	PC	40	60	100	3	0	0	3
4	22PPC302	Engineering Metallurgy	PC	40	60	100	3	0	0	3
5	22PPC303	Manufacturing Technology	PC	40	60	100	3	0	0	3
6	22PMC3Z2	Constitution of India (Common to all Branches)	MC	40	60	100	3	0	0	0
PRACTICAL										
7	22PPC304	Metallurgy Laboratory and Thermal Science Laboratory	PC	60	40	100	0	0	3	1.5
8	22PPC305	Manufacturing Processes Laboratory	PC	60	40	100	0	0	3	1.5
TOTAL				**360**	**440**	**800**	**18**	**1**	**6**	**19**

FOURTH SEMESTER

Sl. No.	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
THEORY										
1	22PBS408	Applied Probability and Statistics	BS	40	60	100	3	1	0	4
2	22PPC406	Fluid Mechanics and Machinery (Common to MECH & PRODN Branches)	PC	40	60	100	3	0	0	3
3	22PPC407	Mechanics of Materials	PC	40	60	100	3	1	0	4
4	22PPC408	CNC Technology	PC	40	60	100	3	0	0	3
5	22PPC409	Process Planning and Cost Estimation (Common to MECH & PRODN Branches)	PC	40	60	100	3	0	0	3
PRACTICAL										
6	22PES408	Engineering Exploration	ES	60	40	100	0	0	3	1.5
7	22PPC410	Strength of Materials and Fluid Machinery Laboratory (Common to MECH & PRODN Branches)	PC	60	40	100	0	0	3	1.5
8	22PPC411	Production Drawing	PC	60	40	100	0	0	3	1.5
TOTAL				**380**	**420**	**800**	**15**	**2**	**9**	**21.5**

GOVERNMENT COLLEGE OF TECHNOLOGY, COIMBATORE – 641 013.

B.E. RODUCTIONENGINEERING

FIFTHSEMESTER

Sl. No.	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
THEORY										
1	22PPC512	Operations Research Techniques	PC	40	60	100	3	1	0	4
2	22PPC513	Mechanics of Machines	PC	40	60	100	3	1	0	4
3	22PPC514	Metrology and Computer Aided Inspection	PC	40	60	100	3	0	0	3
4	22PPC515	Production Planning and Control	PC	40	60	100	3	0	0	3
5	22PPC516	Theory of Metal Cutting	PC	40	60	100	3	0	0	3
6	22PPE$XX	Professional Elective I	PE	40	60	100	3	0	0	3
PRACTICAL										
7	22PPC517	Metrology Laboratory	PC	60	40	100	0	0	3	1.5
8	22PPC518	Modelling Laboratory	PC	60	40	100	0	0	3	1.5
TOTAL				**360**	**440**	**900**	**18**	2	**6**	**23**

SIXTHSEMESTER

Sl. No.	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
THEORY										
1	22PPC619	Automation and CIM	PC	40	60	100	3	0	0	3
2	22PPC620	Machine Elements Design	PC	40	60	100	3	1	0	4
3	22PPC621	Fluid Power Drives and Controls	PC	40	60	100	3	0	0	3
4	22PPC622	Statistical Quality Control and Reliability Engineering	PC	40	60	100	3	1	0	4
5	22PPE$XX	Professional Elective II	PE	40	60	100	3	0	0	3
6	22#OE$XX / 22PPE$XX	Open Elective I / Professional Elective VII	OE/PE	40	60	100	3	0	0	3
PRACTICAL										
7	22PES609	Design thinking for Production Engineering	ES	100	--	100	0	0	3	1.5
8	22PEE601	Automation and Control Systems Laboratory	EEC	60	40	100	0	0	3	1.5
TOTAL				**400**	**400**	**800**	**18**	**2**	**6**	**23**

GOVERNMENT COLLEGE OF TECHNOLOGY, COIMBATORE – 641 013.

B.E. PRODUCTIONENGINEERING

SEVENTHSEMESTER

Sl. No.	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
THEORY										
1	22PHS706	Total Quality Management Concepts	HSMC	40	60	100	3	0	0	3
2	22PPC723	Additive Manufacturing	PC	40	60	100	3	0	0	3
3	22PPC724	Jigs, Fixtures and Press Tools	PC	40	60	100	3	0	0	3
4	22PPE$XX	Professional Elective III	PE	40	60	100	3	0	0	3
5	22PPE$XX	Professional Elective IV	PE	40	60	100	3	0	0	3
6	22#OE$XX / 22PPE$XX	Open Elective II / Professional Elective VIII	OE / PE	40	60	100	3	0	0	3
PRACTICAL										
7	22PPC725	Simulation Laboratory	PC	60	40	100	0	0	3	1.5
8	22PEE702	Engineering Projects in Community Service	EEC	60	40	100	0	0	4	2
9	22PEE703	Internship	EEC	100	-	100	-	-	-	4
TOTAL				**460**	**440**	**900**	**18**	**0**	**7**	**25.5**

EIGHTH SEMESTER

Sl. No.	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
THEORY										
1	22PPE$XX	Professional Elective V	PE	40	60	100	3	0	0	3
2	22PPE$XX	Professional Elective VI	PE	40	60	100	3	0	0	3
PRACTICAL										
3	22PEE804	Capstone Project	EEC	60	40	100	0	0	16	8
TOTAL				**140**	**160**	**300**	**6**	**0**	**16**	**14**

Note:

Internship of four consecutive weeks or two 2 consecutive weeks which are completed during the vacation of fourth (and / or) fifth (and / or) sixth semester shall be considered here.

TOTAL CREDITS: **167**

CURRICULAMDESIGNFORCBCS2022REGULATIONS

FULL TIME B.E PRODUCTION ENGINEERING (U.G) SUMMARY

S.No	Category	Credits Per Semester								Total Credits	Total Credits in %	Credits as per AICTE Model Curriculum
		I	II	III	IV	V	VI	VII	VIII			
1	**HSMC**	5	4					3		12	7.19	12
2	**BS**	11.5	8.5		4					24	14.37	25
3	**ES**	6	6	7	1.5		1.5			22	13.17	24
4	**PC**			12	16	20	14	7.5		69.5	41.62	48
5	**PE**					3	3	6	6	18	10.78	18
6	**OE**						3	3		6	3.59	18
7	**EEC**						1.5	6	8	15.5	9.28	15
8	**MC**	0	0	0						0	0	0
Total		**22.5**	**18.5**	**19**	**21.5**	**23**	**23**	**26.5**	**14**	**167**	**100**	**160**

CATEGORYWISE CREDIT DISTRIBUTION

HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT (HSMC)

Sl. No.	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	22PHS1Z1	தமிழர்மரபு Heritage of Tamils	HSMC	40	60	100	1	0	0	1
2	22PHS1Z2	Values and Ethics	HSMC	40	60	100	3	0	0	3
3	22PHS1Z3	Cambridge English	HSMC	60	40	100	0	0	2	1
4	22PHS2Z4	தமிழரும்தொழில்நுட்பமும் Tamils and Technology	HSMC	40	60	100	1	0	0	1
5	22PHS2Z5	Professional English	HSMC	40	60	100	2	1	0	3
6	22PHS706	Total Quality Management Concepts	HSMC	40	60	100	3	0	0	3

BASIC SCIENCE (BS)

Sl. No.	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	22PBS1Z1	Linear Algebra and Calculus	BS	40	60	100	3	1	0	4
2	22PBS1Z2	Engineering Physics	BS	40	60	100	3	0	0	3
3	22PBS103	Engineering Chemistry	BS	40	60	100	3	0	0	3
4	22PBS1Z4	Chemistry Laboratory	BS	60	40	100	0	0	3	1.5
5	22PBS205	Differential Equations and Numerical Methods	BS	40	60	100	3	1	0	4
6	22PBS206	Materials Science	BS	40	60	100	3	0	0	3
7	22PBS2Z7	Physics Laboratory	BS	60	40	100	0	0	3	1.5
8	22PBS408	Applied Probability and Statistics	BS	40	60	100	3	1	0	4

ENGINEERINGSCIENCE(ES)

Sl. No.	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	22PES101	Basics of Electrical and Electronics Engineering	ES	40	60	100	3	0	0	3
2	22PES1Z2	Engineering Graphics	ES	60	40	100	1	0	4	3
3	22PES203	Python Programming	ES	40	60	100	3	0	0	3
4	22PES2Z4	Workshop Practice	ES	60	40	100	0	0	3	1.5
5	22PES205	Python Programming Laboratory	ES	60	40	100	0	0	3	1.5
6	22PES306	Thermal Systems and Heat Transfer	ES	40	60	100	3	1	0	4
7	22PES307	Engineering Mechanics	ES	40	60	100	3	0	0	3
8	22PES408	Engineering Exploration	ES	100	-	100	0	0	3	1.5
9	22PEE609	Design thinking for Production Engineering	ES	100	0	100	0	0	3	1.5

PROFESSIONAL CORE (PC)

Sl. No.	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	22PPC301	Machine Tools and Processes	PC	40	60	100	3	0	0	3
2	22PPC302	Engineering Metallurgy	PC	40	60	100	3	0	0	3
3	22PPC303	Manufacturing Technology	PC	40	60	100	3	0	0	3
4	22PPC304	Metallurgy Laboratory and Thermal Science Laboratory	PC	60	40	100	0	0	3	1.5
5	22PPC305	Manufacturing Processes Laboratory	PC	60	40	100	0	0	3	1.5
6	22PPC406	Fluid Mechanics and Machinery	PC	40	60	100	3	0	0	3
7	22PPC407	Mechanics of Materials	PC	40	60	100	3	1	0	4
8	22PPC408	CNC Technology	PC	40	60	100	3	0	0	3
9	22PPC409	Process Planning and Cost Estimation Common to MECH & PRODN Branches)	PC	40	60	100	3	0	0	3
10	22PPC410	Strength of Materials and Fluid Machinery Laboratory	PC	60	40	100	0	0	3	1.5
11	22PPC411	Production Drawing	PC	60	40	100	0	0	3	1.5
12	22PPC512	Operations Research Techniques	PC	40	60	100	3	1	0	4
13	22PPC513	Mechanics of Machines	PC	40	60	100	3	1	0	4
14	22PPC514	Metrology and Computer Aided Inspection	PC	40	60	100	3	0	0	3
15	22PPC515	Production Planning and Control	PC	40	60	100	3	0	0	3
16	22PPC516	Theory of Metal Cutting	PC	40	60	100	3	0	0	3
17	22PPC517	Metrology Laboratory	PC	60	40	100	0	0	3	1.5
18	22PPC518	Modelling Laboratory	PC	60	40	100	0	0	3	1.5
19	22PPC619	Automation and CIM	PC	40	60	100	3	0	0	3
20	22PPC620	Machine Elements Design	PC	40	60	100	3	1	0	4
21	22PPC621	Fluid Power Drives and Controls	PC	40	60	100	3	0	0	3
22	22PPC622	Statistical Quality Control and Reliability Engineering	PC	40	60	100	3	1	0	4
23	22PPC723	Additive Manufacturing	PC	40	60	100	3	0	0	3
24	22PPC724	Jigs, Fixtures and Press Tools	PC	40	60	100	3	0	0	3
25	22PPC725	Simulation Laboratory	PC	60	40	100	0	0	3	1.5

PROFESSIONAL ELECTIVE COURSES: VERTICALS			
Vertical 1	**Vertical 2**	**Vertical 3**	**Vertical 4**
AUTOMATION	**PRODUCT DESIGN AND DEVELOPMENT**	**MANUFACTURING PROCESSES AND CONCEPTS**	**INDUSTRIAL ENGINEERING AND QUALITY CONTROL**
22PPE$01 Mechatronic Systems	22PPE$07 Design for Manufacture and Assembly	22PPE$14 Micro manufacturing Processes	22PPE$22 Production Management
22PPE$02 Robotics and Machine Vision System	22PPE$08 Finite Element Techniques	22PPE$15 Advanced Welding Technology	22PPE$23 Supply Chain Management
22PPE$03 Electronics Manufacturing Technology	22PPE$09 Computer Aided Design	22PPE$16 Advanced Casting Technology	22PPE$24 Plant Layout and Material Handling
22PPE$04 Smart Manufacturing	22PPE$10 Product Design and Process Engineering	22PPE$17 Lean Manufacturing (Common to MECH & PRODN Branches)	22PPE$25 Engineering Economics and Management
22PPE$05 Modern Control Technology	22PPE$11 Industrial Ergonomics	22PPE$18 Green Manufacturing	22PPE$26 Six Sigma
22PPE$06 Image Processing in Manufacturing	22PPE$12 Robust Design	22PPE$19 Unconventional Manufacturing Processes	22PPE$27 Non Destructive Testing Techniques
-	22PPE$13 Composite Materials	22PPE$20 Production of Automotive Components	22PPE$28 Total Productive Maintenance
-	-	22PPE$21 Surface Engineering and Tribology	22PPE$29 Power Plant Engineering
-	-	-	22PPE$30 Industrial Safety Engineering

PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICAL 1 – AUTOMATION

Sl. No.	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	22PPE$01	Mechatronic Systems	PE	40	60	100	3	0	0	3
2	22PPE$02	Robotics and Machine Vision System	PE	40	60	100	3	0	0	3
3	22PPE$03	Electronics Manufacturing Technology	PE	40	60	100	3	0	0	3
4	22PPE$04	Smart Manufacturing	PE	40	60	100	3	0	0	3
5	22PPE$05	Modern Control Technology	PE	40	60	100	3	0	0	3
6	22PPE$06	Image Processing in Manufacturing	PE	40	60	100	3	0	0	3

VERTICAL 2 - PRODUCT DESIGN AND DEVELOPMENT

Sl. No.	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	22PPE$07	Design for Manufacture and Assembly	PE	40	60	100	3	0	0	3
2	22PPE$08	Finite Element Techniques	PE	40	60	100	3	0	0	3
3	22PPE$09	Computer Aided Design	PE	40	60	100	3	0	0	3
4	22PPE$10	Product Design and Process Engineering	PE	40	60	100	3	0	0	3
5	22PPE$11	Industrial Ergonomics	PE	40	60	100	3	0	0	3
6	22PPE$12	Robust Design	PE	40	60	100	3	0	0	3
7	22PPE$13	Composite Materials	PE	40	60	100	3	0	0	3

VERTICAL 3 - MANUFACTURING PROCESSES AND CONCEPTS

Sl. No.	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	22PPE$14	Micro manufacturing Processes	PE	40	60	100	3	0	0	3
2	22PPE$15	Advanced Welding Technology	PE	40	60	100	3	0	0	3
3	22PPE$16	Advanced Casting Technology	PE	40	60	100	3	0	0	3
4	22PPE$17	Lean Manufacturing (Common to MECH & PRODN Branches)	PE	40	60	100	3	0	0	3
5	22PPE$18	Green Manufacturing	PE	40	60	100	3	0	0	3
6	22PPE$19	Unconventional Manufacturing Processes	PE	40	60	100	3	0	0	3
7	22PPE$20	Production of Automotive Components	PE	40	60	100	3	0	0	3
8	22PPE$21	Surface Engineering and Tribology	PE	40	60	100	3	0	0	3

VERTICAL 4 - INDUSTRIAL ENGINEERING AND QUALITY CONTROL

Sl. No.	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	22PPE$22	Production Management	PE	40	60	100	3	0	0	3
2	22PPE$23	Supply Chain Management	PE	40	60	100	3	0	0	3
3	22PPE$24	Plant Layout and Material Handling	PE	40	60	100	3	0	0	3
4	22PPE$25	Engineering Economics and Management	PE	40	60	100	3	0	0	3
5	22PPE$26	Six Sigma	PE	40	60	100	3	0	0	3
6	22PPE$27	Non Destructive Testing Techniques	PE	40	60	100	3	0	0	3
7	22PPE$28	Total Productive Maintenance	PE	40	60	100	3	0	0	3
8	22PPE$29	Power Plant Engineering	PE	40	60	100	3	0	0	3
9	22PPE$30	Industrial Safety Engineering	PE	40	60	100	3	0	0	3

OPEN ELECTIVES (OE)

Sl. No	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1.	22COE$01	Disaster Management and Mitigation	OE	40	60	100	3	0	0	3
2.	22COE$02	Water Sanitation and Health	OE	40	60	100	3	0	0	3
3.	22MOE$03	Nanotechnology and Surface Engineering	OE	40	60	100	3	0	0	3
4.	22MOE$04	Industrial Safety Management	OE	40	60	100	3	0	0	3
5.	22EOE$05	Renewable Power Generation Systems	OE	40	60	100	3	0	0	3
6.	22EOE$06	Smart Grid Technology	OE	40	60	100	3	0	0	3
7.	22LOE$07	CMOS VLSI Design	OE	40	60	100	3	0	0	3
8.	22LOE$08	Mobile Communication	OE	40	60	100	3	0	0	3
9.	22POE$09	Rapid Prototyping	OE	40	60	100	3	0	0	3
10	22POE$10	Managerial Economics	OE	40	60	100	3	0	0	3
11.	22NOE$11	Measurement and Control	OE	40	60	100	3	0	0	3
12.	22NOE$12	Industrial Automation	OE	40	60	100	3	0	0	3
13.	22SOE$13	Programming in Java	OE	40	60	100	3	0	0	3
14.	22SOE$14	Network Essential	OE	40	60	100	3	0	0	3
15.	22I0E$15	Video creation and editing	OE	40	60	100	3	0	0	3
16.	22IOE$16	Digital marketing	OE	40	60	100	3	0	0	3
17.	22BOE$17	Principles Of Food Technology	OE	40	60	100	3	0	0	3
18.	22BOE$18	Biology For Engineers	OE	40	60	100	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSE (EEC)

Sl. No.	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	22PEE601	Automation and Control Systems Laboratory	EEC	60	40	100	0	0	3	1.5
2	22PEE702	Engineering Projects in Community Service	EEC	60	40	100	0	0	4	2
3	22PEE703	Internship	EEC	100	-	100	-	-	-	4
4	22PEE804	Capstone Project	EEC	60	40	100	0	0	16	8

MANDATORY COURSE (MC)

Sl. No.	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	22PMC1Z0	Induction Programme	MC	-	-	-	-	-	-	0
2	22PMC2Z1	Environmental Science and Engineering	MC	40	60	100	3	0	0	0
3	22PMC3Z2	Constitution of India	MC	40	60	100	3	0	0	0

VALUEADDEDCOURSE

Sl. No.	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	22PVA$06	Yoga for Youth Empowerment	EEC	100	-	100	1	0	0	1
2	22PVA$07	Basics of Civil Engineering	EEC	100	-	100	1	0	0	1
3	22PVA$08	Metallography	EEC	100	-	100	1	0	0	1
4	22PVA$09	Design of Experiments using Taguchi Concept	EEC	100	-	100	1	0	0	1
5	22PVA$10	Entrepreneurship Development	EEC	100	-	100	1	0	0	1
6	22PVA$11	Patents System in Engineering	EEC	100	-	100	1	0	0	1
7	22PVA$12	Industrial case studies	EEC	100	-	100	1	0	0	1
8	22PVA$13	Project Management	EEC	100	-	100	1	0	0	1
9	22PVA$14	Professional Skills	EEC	100	-	100	1	0	0	1
10	22PVA$15	Solar Energy Systems	EEC	100	-	100	1	0	0	1
11	22PVA$16	Wind Energy Systems	EEC	100	-	100	1	0	0	1
12	22PVA$17	Refrigeration Systems	EEC	100	-	100	1	0	0	1
13	22PVA$18	Air Conditioning Systems	EEC	100	-	100	1	0	0	1

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Coimbatore–641013.

PRODUCTION ENGINEERING

22PMC1Z0	INDUCTION PROGRAMME	SEMESTER I

Details of the Programme:

Day 0: College Admission

Day1: Orientation Programme

Day2 Onwards: Induction Programme

Activities:
Physical activity,
Playground Events,
Yoga Practices,
Literary, Proficiency modules,
Team Building,
Lectures by Eminent people,
Familiarization to department,
Branch oriented information,
Motivational speakers,
Talent exposure,
Quiz completion,
Visit to local areas….etc

B.E.PRODUCTION ENGINEERING

22PHS1Z1	தமிழர் மரபு **Heritage of Tamils** (Common to all Branches)					**SEMESTER I**
PREREQUISITES		**CATEGORY**	**L**	**T**	**P**	**C**
NIL		**HSMC**	**1**	**0**	**0**	**1**

UNIT – I	**LANGUAGE AND LITERATURE**	**3 Periods**

Language Families in India - Dravidian Languages – Tamil as a Classical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature- Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

UNIT – II	**HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE**	**3 Periods**

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role ofTemples in Social and Economic Life of Tamils.

UNIT – III	**FOLK AND MARTIAL ARTS**	**3 Periods**

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

UNIT – IV	**THINAI CONCEPT OF TAMILS**	**3 Periods**

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature- Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

UNIT – V	**CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE**	**3 Periods**

Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

Contact Periods:
Lecture: 15 Periods Tutorial:0 Periods Practical:0 Periods Total: 15 Periods

TEXT BOOK:

1	தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2	கணினித்தமிழ் – முனைவர் இல.சுந்தரம் . (விகடன் பிரசுரம்).
3	கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4	பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)

REFERENCES:

1	Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2	Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by:International Institute of Tamil Studies).
3	Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
4	The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by:International Institute of Tamil Studies).
5	Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by:Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation,Tamil Nadu)
6	Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
7	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
8	Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) –Reference Book.

22PHS1Z1	தமிழர் மரபு Heritage of Tamils (Common to all Branches)	SEMESTER I

PREREQUISITES	CATEGORY	L	T	P	C
NIL	HSMC	1	0	0	1

அலகு I	மொழி மற்றும் இலக்கியம்	3 Periods

இந்திய மொழிக் குடும்பங்கள்- திராவிட மொழிகள்- தமிழ் ஒரு செம்மொழி- தமிழ் செவ்விலக்கியங்கள் –சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை-சங்க இலக்கியத்தில் பகிர்தல் அறம்-திருக்குறளில் மேலாண்மைக் கருத்துக்கள்-தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்தசமயங்களின் தாக்கம்-பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள்-சிற்றிலக்கியங்கள்-தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி-தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு II	மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை– சிற்பக் கலை	3 Periods

நடுகல் முதல் நவீன சிற்பங்கள் வரை – ஐம்பொன் சிலைகள்– பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள்-பொம்மைகள் – தேர்செய்யும் கலை – சுடுமண் சிற்பங்கள் – நாட்டுப்புறத் தெய்வங்கள் – குமரிமுனையில் திருவள்ளுவர் சிலை – இசைக் கருவிகள் – மிருதங்கம், பறை,வீணை, யாழ் , நாதஸ்வரம் – தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு III	நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்	3 Periods

தெருக்கூத்து, கரகாட்டம்-வில்லுப்பாட்டு-கணியான் கூத்து-ஒயிலாட்டம்-தோல்பாவைக் கூத்து-சிலம்பாட்டம் – வளரி-புலியாட்டம் - தமிழர்களின்விளையாட்டுகள்.

அலகு IV	தமிழர்களின் திணைக் கோட்பாடுகள்	3 Periods

தமிழகத்தின் தாவரங்களும், விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்கஇலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் – தமிழர்கள் போற்றியஅறக்கோட்பாடு –சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் – சங்ககால நகரங்களும் துறை முகங்களும் – சங்ககாலத்தில் ஏற்றுமதி மற்றும்இறக்குமதி – கடல் கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு V	இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு	3 Periods

இந்திய விடுதலைபோரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறப்பகுதிகளில்தமிழ்ப் பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் – இந்திய மருத்துவத்தில்சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப்
புத்தகங்களின் அச்சு வரலாறு.

Contact Periods:
Lecture: 15 Periods Tutorial:0 Periods Practical:0 Periods Total: 15 Periods

TEXT BOOK:

1	தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2	கணினித்தமிழ் – முனைவர் இல.சுந்தரம் . (விகடன் பிரசுரம்).
3	கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4	பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)

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7	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
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22PHS1Z2	VALUES AND ETHICS (Common to all Branches)	SEMESTER I

PREREQUISITES	CATEGORY	L	T	P	C
NIL	HSMC	3	0	0	3

Course Objectives	1. To understand and appreciate the ethical issues faced by an individual in profession, society and polity. 2. To learn about Engineering Ethics and case studies. 3. To understand the negative health impacts of certain unhealthy behaviours. 4. To appreciate the need and importance of physical, emotional health and social health. 5. To get familiar with the global issues.	
UNIT – I	**BEING GOOD AND RESPONSIBLE**	**9 Periods**
Morals, Values and Ethics - Integrity - Work Ethics - Service Learning - Civic Virtue - Respect for Others - Living Peacefully - Caring - Sharing - Honesty - Courage - Valuing Time - Cooperation - Commitment - Empathy - Self-Confidence – Character.		
UNIT – II	**ENGINEERING AS SOCIAL EXPERIMENTATION**	**9 Periods**
Engineering Ethics: Senses of 'Engineering Ethics' - variety of moral issued - types of inquiry - moral dilemmas - moral autonomy - Models of Professional Roles. Engineering as Experimentation – Engineers as responsible Experimenters – Research Ethics - Codes of Ethics – Industrial Standards - A Balanced Outlook on Law – Case studies : Chernobyl disaster and Titanic disaster.		
UNIT – III	**ADDICTION AND HEALTH**	**9 Periods**
Peer pressure - Alcoholism: Ethical values, causes, impact, laws, prevention – ill effects of smoking - Prevention of Suicides; Sexual Health: Prevention and impact of pre-marital pregnancy and SexuallyTransmitted Diseases. Drug Abuse: Abuse of different types of legal and illegal drugs: Ethical values, causes, impact, laws and prevention.		
UNIT – IV	**PROFESSIONAL ETHICS**	**9 Periods**
Abuse of Technologies**:** Hacking and other cyber crimes, Addiction to mobile phone usage, Video games and Social networking websites.		
UNIT – V	**GLOBAL ISSUES**	**9 Periods**
Multinational corporations - Environmental ethics - computer ethics - weapons development - engineers as managers - consulting engineers - engineers as expert witnesses and advisors - Code of Conduct – Corporate Social Responsibility.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Mike W Martin and Roland Schinzinger,* ***"Ethics in Engineering"****, 4 th Edition, McGraw-Hill, New York 2017.*
2	*Govindarajan M, Natarajan S and Senthil Kumar VS,* ***"Engineering Ethics"****, Prentice Hall of India, New Delhi, 2013.*

REFERENCES:

1	*Dhaliwal, K.K ,* ***"Gandhian Philosophy of Ethics: A Study of Relationship between his Presupposition and Precepts",*** *Writers Choice, New Delhi, India,2016,.*
2	*Jayshree suresh, B.S.Raghavan,* ***"Human values and professional ethics"****, S.Chand & company Ltd, New Delhi, 2nd Edition, 2007.*
3	*L.A. and Pagliaro, A.M,* ***"Handbook of Child and Adolescent Drug and Substance Abuse: Pharmacological, Developmental and Clinical Considerations",*** *Wiley Publishers, U.S.A,2012.*
4	*Pandey, P. K(2012),* ***"Sexual Harassment and Law in India"****, Lambert Publishers, Germany,2012,.*
5	*Kiran D.R,* ***"Professional ethics and Human values",*** *Tata McGraw Hill, New Delhi, 2007.*

6	*Edmund G See Bauer and Robert L Barry,* ***"Fundamentals of Ethics for Scientists and Engineers"****, Oxford University Press, Oxford, 2001.*
7	*David Ermann and Michele S Shauf,* ***"Computers, Ethics and Society"****, Oxford University Press, 2003.*
8	*Govindarajan M, Natarajan S, Senthil Kumar V. S,* ***"Engineering Ethics"****, Prentice Hall of India, New Delhi, 2004.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Follow sound morals and ethical values scrupulously to prove as good citizens.	K3
CO2	Assess the relevance of ethics and morals in engineering and to learn case studies.	K3
CO3	Describe the concept of addiction and how it will affect the physical and mental health.	K2
CO4	Identify ethical concerns while using advanced technologies.	K2
CO5	Judge the code of conduct, Environmental ethics and computer ethics.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping:

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	3	3	3	3	3	3	-	-	1	-
CO2	-	-	-	-	-	3	1	3	3	-	-	-	1	1	1
CO3	-	-	-	-	-	3	1	3	3	2	3	-	-	-	-
CO4	-	-	-	-	-	3	3	3	3	1	3	1	1	1	2
CO5	-	-	-	-	-	3	3	3	3	-	1	3	1	1	2
22PHS1Z2	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**1**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping:

CO1	6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.1, 8.2.2, 9.1.1, 9.1.2 ,9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 11.2.1, 11.3.1
CO2	6.1.1, 6.2.1, 7.1.1, 8.1.1, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1
CO3	6.1.1, 6.2.1, 7.1.1, 8.1.1, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.2.1, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 11.2.1, 11.3.1
CO4	6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3 ,9.2.4, 9.3.1, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 11.2.1, 11.3.1, 11.3.2, 12.1.1
CO5	6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 11.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2

ASSESSMENT PATTERN – THEORY:

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	30	20	20	-	-	100
CAT2	30	30	20	20	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	30	30	20	20	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	30	30	20	20	-	-	100
ESE	30	30	20	20	-	-	100

22PBS1Z1	LINEAR ALGEBRA AND CALCULUS (Common to all Branches)	SEMESTER I

PREREQUISITES	CATEGORY	L	T	P	C
NIL	BS	3	1	0	4

Course Objectives	1. To acquire knowledge of system of equations, eigenvalues, eigenvectors, diagonalization of matrices and reduction of quadratic forms to canonical forms. 2. To obtain the knowledge of analyze the functions using Limits and derivative recognize the appropriate tools of differential calculus to solve applied problems. 3. To obtain the knowledge of definite and improper integration and recognize the appropriate tools of Integral Calculus to solve applied problems 4. To develop the skills in solving the functions of several variables by partial derivatives. 5. To acquire knowledge of multiple integration and related applied problems in various geometry	
UNIT – I	**LINEAR ALGEBRA**	**9+3 Periods**
Consistency of System of Linear Equations - Eigen values and eigenvectors - Diagonalization of matrices by orthogonal transformation - Cayley-Hamilton Theorem - Quadratic to canonical forms.		
UNIT – II	**DIFFERENTIAL CALCULUS**	**9+3 Periods**
Limit and continuity of function - Rolle's theorem - Mean value theorems - Taylor's and Maclaurin's theorems. Application of Differential Calculus: Radius of curvature, Centre of curvature, Circle of curvature and Evolutes of a curve.		
UNIT – III	**INTEGRAL CALCULUS**	**9+3 Periods**
Evaluation of definite integral by trigonometric substitution - Convergence and Divergence of improper integrals - Beta & Gamma functions and their properties - Applications of definite integrals to evaluate surface areas and volume of revolution (Cartesian coordinates only).		
UNIT – IV	**PARTIAL DERIVATIVES AND ITS APPLICATIONS**	**9+3 Periods**
Partial derivatives - total derivative - Taylor's series – Jacobians - Maxima, minima and saddle points - Method of Lagrange multipliers.		
UNIT – V	**MULTI VARIABLE INTEGRAL CALCULUS**	**9+3 Periods**
Double integral - Area as double integral - change of order of integration in double integrals - Triple Integrals - Volume as Triple Integral. Change of variables: Cartesian to polar, Spherical polar coordinates, Cylindrical polar coordinates.		
Contact Periods : **Lecture: 45 Periods Tutorial: 15 Periods Practical: 0 Periods Total: 60 Periods**		

TEXT BOOK

1	*Veerarajan T.,* ***"Engineering Mathematics I"****, Tata McGraw-Hill Education(India)Pvt. Ltd, New Delhi,2015.*
2	*David C.Lay,* ***"Linear Algebra and Its Application"****, Pearson Publishers, 6th Edition, 2021.*

REFERENCES

1	*B.S.Grewal,* ***"Higher Engineering Mathematics"****, Khanna Publishers, 44th Edition, 2017.*
2	*Howard Anton,* ***"Elementry Linear Algebra"****, 11th Edition, Wiley Publication, 2013.*
3	*Narayanan.S and Manicavachagom Pillai. T.K. –* ***"Calculas Vol I and Vol II",*** *S.chand & Co, Sixth Edition, 2014.*
4	*H.K. Dass,* ***"Advance Engineering Mathematics"****, S. Chand and company, Eleventh Edition, 2015.*
5	*Jain R.K. and Iyengar S.R.K.,* ***"Advanced Engineering Mathematics"****, Narosa Publicaitons, Eighth Edition, 2012.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Solve the linear system of equations, diagonalize matrix by orthogonal transformation and reduce quadratic form to canonical form.	K5
CO2	Compare and contrast the ideas of continuity and differentiability and use them to solve engineering problems.	K5
CO3	Acquire fluency in integration of one variable and apply them to find surface area and volumes.	K5
CO4	Apply the techniques of partial derivatives in functions of several variables.	K5
CO5	Use multiple integration for finding area, surface and volume of different geometry.	K5

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping:

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	1	1	-	-	-	-	-	-	-	1	2	1	1
CO2	3	3	1	1	-	-	-	-	-	-	-	1	2	1	1
CO3	3	3	1	1	-	-	-	-	-	-	-	1	2	1	1
CO4	3	3	1	1	-	-	-	-	-	-	-	1	2	1	1
CO5	3	3	1	1	-	-	-	-	-	-	-	1	2	1	1
22PBS1Z1	**3**	**3**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**1**	**1**
1 – Slight, 2 – Moderate, 3 – Substantial															

b) CO and Key Performance Indicators Mapping

CO1	1.1.1, 1.1.2, 2.1.1, 2.1.3, 2.2.1, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 2.4.4, 3.1.1, 3.2.1, 3.3.1, 4.1.1, 4.1.2, 12.2.1
CO2	1.1.1, 1.1.2, 2.1.1, 2.1.3, 2.2.1, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 2.4.4, 3.1.1, 3.2.1, 3.3.1, 4.1.1, 4.1.2, 12.2.1
CO3	1.1.1, 1.1.2, 2.1.1, 2.1.3, 2.2.1, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 2.4.4, 3.1.1, 3.2.1, 3.3.1, 4.1.1, 4.1.2, 12.2.1
CO4	1.1.1, 1.1.2, 2.1.1, 2.1.3, 2.2.1, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 2.4.4, 3.1.1, 3.2.1, 3.3.1, 4.1.1, 4.1.2, 12.2.1
CO5	1.1.1, 1.1.2, 2.1.1, 2.1.3, 2.2.1, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 2.4.4, 3.1.1, 3.2.1, 3.3.1, 4.1.1, 4.1.2, 12.2.1

ASSESSMENT PATTERN – THEORY:

Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	40	30	10	-	-	100
CAT2	20	40	30	10	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	20	40	30	10	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	20	40	30	10	-	-	100
ESE	20	40	30	10	-	-	100

22PBS1Z2	ENGINEERING PHYSICS (Common to all Branches)	SEMESTER I

PREREQUISITES	CATEGORY	L	T	P	C
NIL	BS	3	0	0	3

Course Objectives	1.To understand the basics about crystal systems and defects. 2.To understand the principle, characteristics, working and applications of laser and optical fiber. 3.To solve problems in bending of beams. 4.To solve quantum mechanical problems with the understanding of Quantum Principles. 5.To understand the properties, production and applications of ultrasonic waves.	
UNIT – I	**CRYSTAL PHYSICS**	**9 Periods**
Introduction – Crystalline and amorphous materials – Lattice – Unit Cell –Crystal system - Bravais lattices – Miller indices – Reciprocal lattice - d spacing in cubic lattice – Calculation of number of atoms per unit cell – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC, and HCP structures – Crystal defects – Point, line and surface defects.		
UNIT – II	**LASER PHYSICS AND FIBER OPTICS**	**9 Periods**
Introduction- Principle of laser action - characteristics of laser - Spontaneous emission and Stimulated emission –Einstein's coefficients - population inversion – methods of achieving population inversion – Optical Resonator -Types of Lasers – Principle, construction and working of CO_2 Laser - applications of laser. Introduction – Basic Principles involved in fiber optics- Total internal reflection–Propagation of light through optical fiber –Derivation for Numerical Aperture and acceptance angle - fractional index change.		
UNIT – III	**PROPERTIES OF MATTER**	**9 Periods**
Elasticity- Hooke's law- stress-strain diagram - Factors affecting elasticity – Moment (Q) - Couple (Q) – Torque (Q) – Beam - Bending moment - Depression of a cantilever –Twisting Couple- Young's modulus by uniform bending - I shaped girders.		
UNIT – IV	**QUANTUM PHYSICS AND APPLICATIONS**	**9 Periods**
Limitations of classical Physics - Introduction to Quantum theory - Dual nature of matter and radiation- de-Broglie wavelength in terms of voltage, energy, and temperature –Heisenberg's Uncertainty principle – verification – physical significance of a wave function- Schrödinger's Time independent and Time dependent wave equations –- Particle in a one dimensional potential well - Scanning Electron Microscope (SEM)-Transmission Electron Microscope (TEM).		
UNIT – V	**ULTRASONICS**	**9 Periods**
Introduction - properties of ultrasonic waves - production of ultrasonic waves -Magnetostriction effect- Magnetostriction generator- Piezoelectric effect- Piezoelectric generator- Acoustic grating - Determination of wavelength and velocity of ultrasonic waves-cavitation - applications- ultrasonic drilling- ultrasonic welding- ultrasonic soldering and ultrasonic cleaning-Non- destructive Testing- Pulse echo system.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*K. Rajagopal**, "Engineering Physics"**, PHI Learning Private Limited, 2015.*
2	*P. K. Palanisamy, "**Engineering Physics-I",** Scitech publications Private Limited, 2015.*
3	*M. Arumugam, "**Engineering Physics"**, Anuradha Publishers, 2010.*

REFERENCES:

1	*Arthur Beiser, "**Concepts of Modern Physics"**, Tata McGraw-Hill, 2010.*
2	*D. Halliday, R. Resnick and J. Walker,"**Fundamentals of Physics"**, 6th Edition, John Wiley and Sons, 2001.*
3	*William T. Silfvast, "**Laser Fundamentals"**, 2nd Edition, Cambridge University Press, New York 2004.*
4	*M. N. Avadhanulu and P.G. Kshirsagar, "**A Textbook of Engineering Physics"**, S. Chand and Company Ltd, 2010.*
5	*R. K. Gaur and S. L. Gupta, "**Engineering Physics",**Dhanpat Rai Publishers, 2009.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Interpret the crystal structure and analyse the type of defect	K4
CO2	Explain the principle, characteristics, working and applications of laser and optical fiber Analyse and solve problems in laser and optical fiber	K4
CO3	Solve problems in bending of beams Apply the knowledge in construction of buildings	K3
CO4	Explain the importance of quantum mechanics Solve problems in basic quantum physics Apply the wave equations in real time problems	K3
CO5	Explain the properties and production of ultrasonic waves Apply ultrasonic waves for industrial problems	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping:

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	-	-	-	-	-	-	-	-	-	-	2	1	1
CO2	3	1	-	-	-	-	-	-	-	-	-	-	1	1	1
CO3	3	2	-	-	-	-	-	-	-	-	-	-	1	-	1
CO4	2	2	-	-	-	-	-	-	-	-	-	-	1	-	-
CO5	2	1	-	-	-	-	-	-	-	-	-	-	1	1	-
22PBS1Z2	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**1**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping:	
CO1	1.1.1, 1.2.1, 1.3.1, 2.1.1, 2.1.3, 2.2.3, 2.3.1, 2.4.1
CO2	1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.3.1, 2.4.1
CO3	1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.1, 2.2.3, 2.2.4, 2.3.1, 2.4.1
CO4	1.1.1, 1.2.1, 1.3.1, 2.1.1, 2.1.3, 2.2.3, 2.3.1, 2.4.1
CO5	1.1.1, 1.2.1, 1.3.1, 2.1.1, 2.1.3, 2.3.1, 2.4.1

ASSESSMENT PATTERN – THEORY:							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	30	15	15	10	-	100
CAT2	30	30	15	15	10	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	40	40	20	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	40	40	20	-	-	-	100
ESE	30	30	15	15	10	-	100

22PBS103	ENGINEERING CHEMISTRY (Common to CIVIL, MECH & PRODN Branches)	SEMESTER I

PREREQUISITES	CATEGORY	L	T	P	C
NIL	BS	3	0	0	3

Course Objectives	1. To understand the hardness of water, boilers troubles and its treatments. 2. To know about the nomenclature, preparations, properties and industrial applications of various polymers. 3. To acquire basic knowledge about the nanoparticles, its preparations, properties, types and applications in various fields. 4. To understand the basic principles of corrosion, mechanism and its protection methods. 5. To impart the knowledge of preparations, properties of various engineering materials like cements, lubricants and super capacitors.

UNIT – I	**WATER TECHNOLOGY**	**9 Periods**

Water- sources - types of impurities, Hardness - temporary and permanent – units - ppm and mg/L. Boiler troubles: Scale and sludge, Boiler corrosion, Caustic embrittlement, Priming & foaming. Treatment of boiler feed water: Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) and External treatment – Ion exchange process. Municipal water treatment: primary treatment and disinfection (UV, Ozonation, break-point chlorination). Desalination of brackish water: Reverse Osmosis.

UNIT – II	**POLYMERIC MATERIALS**	**9 Periods**

Definitions and nomenclatures. Preparation, properties and uses of industrially important polymers such as polyethylene, polypropylene, polystyrene and poly (vinyl chloride). Engineering polymers: Preparation, properties and uses of Nylon and Polycarbonates. Organic polymers - Poly acetylene and Poly lactide.

UNIT – III	**NANO MATERIALS**	**9 Periods**

Nanomaterials and bulk materials; Size-dependent properties (optical, electrical and mechanical) types of nanomaterials: Definition, properties and uses of – nanoparticle, nanorod and nanotube. Preparation of nanomaterials: chemical vapour deposition, electrochemical deposition. Applications of nanomaterials in medicine, agriculture and electronics.

UNIT – IV	**CORROSION**	**9 Periods**

Corrosion- Definition -Classifications: Chemical Corrosion and Electro chemical corrosion mechanism-Pilling Bedworth rule– Galvanic series and its importance- Preventing Methods-Cathodic protection (sacrificial anode and impressed current conversion method). Protective Coatings-Inorganic coating-surface preparation-Electro plating method applied to Cr and Ni, Organic coating- paints - constituents and functions.

UNIT – V	**ENGINEERING MATERIALS**	**9 Periods**

Cement – manufacture - setting and hardening of cement. Lubricants: Solid lubricants (Graphite & Molybdenum sulphide) hydrodynamic mechanism of lubrication. Bio fuels: Biogas and biodiesel. Supercapacitors:Storage principle, types and examples.

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1	*Jain P. C. & Monica Jain.,* ***"Engineering Chemistry",*** *16th Edition, DhanpatRai Publishing Company (P) Ltd, New Delhi, 2015.*
2	*S.S.Dara,* ***"A text book of Engineering Chemistry"****, Chand Publications, 2014.*

REFERENCES:

1	*Joel R. Fried,* ***"Polymer Science and Technology",*** *Prentice Hall of India Pvt. Ltd., 3rd Edition 2019.*
2	*Friedrich Emich,* ***"Engineering Chemistry",*** *Scientific International Ltd, 2017.*
3	G.B.Sergeev, ***"Nanochemistry"***, Elsevier, 2013.
4	*Baboian, Robert,* ***"NACE Corrosion Engineer's Reference Book",*** *4th Edition,2016.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Interpret the different types of hardness related problems.	K3
CO2	Recognize the different types of polymeric materials, properties and its specific applications.	K2
CO3	Implement the basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technological applications.	K3
CO4	Describe about the corrosion of the machinery they use in their fields and understand the mechanisms to adopt the preventive measures by various techniques.	K2
CO5	Discuss about the various engineering materials such as cement, lubricants, green fuels and super capacitors which are used in engineering applications.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	2	2	1	2	-	2	1	2	1	-	-	1	-	1	1
CO2	2	2	1	1	-	-	-	-	-	-	-	1	2	-	-
CO3	2	2	1	1	-	-	-	-	1	-	-	1	2	-	-
CO4	2	2	1	1	-	-	1	1	-	-	-	1	2	2	2
CO5	2	2	1	1	1	2	2	-	-	-	-	1	2	2	2
22PBS103	**2**	**2**	**1**	**2**	**1**	**1**	**1**	**1**	**1**	**-**	**-**	**1**	**2**	**1**	**1**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping	
CO1	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.2.1, 2.2.2, 2.3.1, 3.1.5, 4.1.1, 4.2.1, 4.3.1, 4.3.4, 6.2.1, 7.1.1, 8.2.1, 8.2.2, 9.3.1
CO2	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.2.1, 2.2.2, 2.3.1, 3.1.5, 4.1.1, 4.2.1
CO3	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.2.1, 2.2.2, 2.3.1, 3.1.5, 4.1.1, 4.2.1, 4.3.1, 9.3.1
CO4	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.2.1, 2.2.2, 3.1.5, 4.1.1, 4.2.1, 7.2.2, 8.2.2
CO5	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.2.1, 2.2.2, 2.3.1, 3.1.5, 4.1.1, 4.2.1, 4.3.1, 5.1.1, 6.1.1, 7.1.1, 7.2.2

ASSESSMENT PATTERN – THEORY:

Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	40	20	20	-	-	100
CAT2	20	40	20	20	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	20	40	20	20	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	20	40	20	20	-	-	100
ESE	20	40	20	20	-	-	100

22PES101	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING (Common to CIVIL, MECH, PRODN, CSE, IT & IBT Branches)	SEMESTER I

PREREQUISITES	CATEGORY	L	T	P	C
NIL	ES	3	0	0	3

Course Objectives	1.To study the basic concepts of electric circuits, electronic devices and communication engineering. 2. To know the fundamentals of DC and AC machines. 3. To familiar with the basics of Analog and digital electronics. 4. To understand the basics of House wiring. 5. To introduce the components of Electrical installations and energy conservation.	
UNIT – I	**ELECTRICAL CIRCUITS**	**9 Periods**
Electrical circuit elements (R, L and C) - Voltage and Current sources – Ohm's Law – Kirchoff laws – Time domain analysis of First order RL and RC circuits – Representation of sinusoidal waveforms – Average, RMS and Peak values – Phasor representation – Real, Reactive, Apparent power and power factor.		
UNIT – II	**ELECTRICAL MACHINES AND MEASUREMENTS**	**9 Periods**
Construction, Principle of Operation, basic equations and Types, Characteristics and Applications of DC generators, DC motors, Single phase Transformer, Single phase and Three phase Induction motor. Operating principles of Moving coil, Moving iron Instruments (Ammeter and Voltmeters).		
UNIT – III	**ANALOG AND DIGITAL ELECTRONICS**	**9 Periods**
Analog Electronics: Semiconductor devices – P-N junction diode, Zener diode, BJT, Operational amplifier – principle of operation, Characteristics and applications. Digital Electronics: Introduction to numbers systems, basic Boolean laws, reduction of Boolean expressions and implementation with logic gates.		
UNIT – IV	**FUNDAMENTAL OF COMMUNICATION AND TRANSDUCERS**	**9 Periods**
Types of Signals: Analog and Digital Signals – Modulation and Demodulation: Principles of Amplitude and Frequency Modulations – Resistive, Inductive, capacitive Transducers- Introduction.		
UNIT – V	**ELECTRICAL INSTALLATIONS AND ENERGY CONSERVATION**	**9 Periods**
Single phase and three phase system – phase, neutral and earth, basic house wiring -tools and components, different types of wiring - basic safety measures at home and industry – Energy efficient lamps - Energy billing. Introduction to UPS and SMPS.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*R.Muthusubramaniam, R.Salivaganan, Muralidharan K.A.,* ***"Basic Electrical and Electronics Engineering"*** *Tata McGraw Hill , Second Edition 2010*
2	*Mittle V.N and Aravind Mittal,* ***"Basic Electrical Engineering",*** *Tata McGraw Hill, Second Edition, New Delhi, 2005.*

REFERENCES:

1	*D.P.Kothari, I.J. Nagrath,* ***"Basic Electrical Engineering"****, Tata McGraw Hill, 2010.*
2	*Nagsarkar T.K and Sukhija M.S,* ***"Basic Electrical Engineering"****, Oxford Press, 2005.*
3	*E.Hughes****,"Electrical and Elecronics Technology"****, Pearson, 2010.*
4	*Mohmood Nahvi and Joseph A.Edminister,* ***"Electric Circuits"****, Shaum Outline series, McGraw Hill,*

	Sixth edition, 2014.
5	*Premkumar N and Gnanavadivel J,* ***"Basic Electrical and Electronics Engineering"****, Anuradha Publishers, 4th Edition, 2008.*
6	*Allan S Morris,* ***"Measurement and Instrumentation Principles"*** *Elsevier, First Indian Edition, 2008.*
7	*S.L. Uppal,* ***'Electrical Wiring Estimating and Costing'****, Khanna publishers, New Delhi, 2006.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Analyze the DC and AC circuits	K4
CO2	Describe the operation and characteristics of Electrical Machines	K4
CO3	Classify and compare various semiconductor devices and Digital electronics.	K3
CO4	Infer the concept of Communication engineering and Transducers.	K2
CO5	Assemble and implement electrical wiring and electrical installations	K6

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping:

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	3	3	2	1	-	-	-	-	-	-	-	1	-	-
CO2	2	2	3	2	1	-	2	1	-	-	-	-	1	-	-
CO3	3	2	3	2	1	-	-	-	-	1	-	-	-	1	-
CO4	2	3	3	2	-	-	3	-	-	-	-	1	-	1	-
CO5	2	2	3	2	-	-	-	-	-	-	-	-	-	-	-
22PES101	**3**	**3**	**3**	**2**	**1**	**-**	**1**	**1**	**-**	**1**	**-**	**1**	**1**	**1**	**-**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.1, 1.2.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.3.3, 5.2.1, 5.2.2.
CO2	1.1.1, 1.2.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.3.1, 5.2.1, 5.2.2, 7.2.1, 7.2.2, 8.1.1.
CO3	1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 5.2.1, 5.2.2, 10.3.1.
CO4	1.1.1, 1.2.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 7.1.1, 7.1.2, 7.2.1, 12.3.1, 12.3.2.
CO5	1.1.1, 1.2.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.3.3.

ASSESSMENT PATTERN – THEORY:

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	30	40	-	-	-	100
CAT2	35	35	20	10	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	25	25	50		-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	25	25	40	10	-	-	100
ESE	35	35	20	10	-	-	100

22PBS1Z4	CHEMISTRY LABORATORY (Common to all Branches)	SEMESTER I

PREREQUISITES	CATEGORY	L	T	P	C
NIL	BS	0	0	3	1.5

Course Objectives	To inculcate the practical applications of Chemistry to students and make them apply in the fields of engineering and technology.

LIST OF EXPERIMENTS			
1.	Estimation of hardness by EDTA method.		
2	Conductometric titration of mixture of strong acid and weak acid using strong base.		
3.	Estimation of chloride by Argentometric method.		
4.	Potentiometric titration of ferrous iron by dichromate.		
5.	Determination of Saponification value of an oil.		
6.	Estimation of Iron by Spectrophotometry.		
7.	Estimation of Dissolved Oxygen.		
8.	Estimation of HCl by pH titration.		
9.	Estimation of Copper in brass sample.		
10.	Estimation of Manganese in Pyrolusite ore.		
11.	Anodiziation of aluminium.		
12.	Determination of corrosion rate and inhibitor efficiency of mild steel in acid media by weight loss method.		
Contact Periods:			
Lecture: 0 Periods	**Tutorial: 0 Periods**	**Practical: 45 Periods**	**Total: 45 Periods**

REFERENCE BOOKS:

1	*A.O. Thomas, "**Practical Chemistry**", Scientific Book Centre, Cannanore, 2006.*
2	*Vogel's "**Text book of Quantitative Analysis**", Jeffery G H, Basset J. Menthom J, Denney R.C., 6th Edition, EBS, 2009.*

COURSE OUTCOMES: Upon the completion of the course, the student will be able to:		Bloom's Taxonomy Mapped
CO1	Analyze the quality of water samples with respect to their hardness and DO.	K3
CO2	Determine the amount of metal ions through potentiometric and spectroscopic techniques.	K3
CO3	Infer the strength of acid, mixtures of acids by pH meter and conductivity cell.	K3
CO4	Estimate the chloride, manganese and copper from various samples.	K3
CO5	Interpret the corrosion rate determination and anodizing method.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping:

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	-	-	-	-	-	-	-	-	-	1	1	1
CO2	2	1	-	-	-	-	-	-	-	-	-	-	-	1	-
CO3	2	1	-	1	-	-	-	-	-	-	-	-	-	1	-
CO4	2	1	-	-	-	-	-	-	-	-	-	-	-	1	-
CO5	2	1	1	1	-	-	1	-	-	-	-	-	2	2	2
22PBS1Z4	**2**	**1**	**1**	**1**	**-**	**-**	**1**	-	-	-	-	-	**1**	**1**	**1**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping:	
CO1	1.1.1, 1.2.1, 2.3.1, 3.1.5
CO2	1.1.1, 1.2.1, 1.3.1, 2.1.2
CO3	1.1.1, 1.2.1, 2.1.3, 4.1.3
CO4	1.2.1, 1.3.1, 2.3.1
CO5	1.1.1, 1.2.1, 1.3.1, 2.3.1, 3.1.5, 4.2.1, 7.1.1

22PES1Z2	ENGINEERING GRAPHICS (Common to all branches)	SEMESTER I

PREREQUISITES	CATEGORY	L	T	P	C
NIL	ES	1	0	4	3

Course Objectives	1. To Understand the geometrical constructions. 2. To Study the various types of projections. 3. To Identify different section of solids. 4. To Perform the development of surfaces and view of solids. 5. To Familiarize with CAD packages.

UNIT – I	**GEOMETRICAL CONSTRUCTIONS AND PLANE CURVES**	**3+12 Periods**

Principles of Engineering Graphics and their significance - Basic geometrical constructions. Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Drawing of tangents and normal to the above curves.

UNIT – II	**ORTHOGRAPHIC PROJECTIONS**	**3+12 Periods**

Introduction to Orthographic Projection - Conversion of pictorial views to orthographic views. Projection of points - Projection of straight lines with traces - Projection of planes (polygonal and circular surfaces) inclined to both the principal planes.

UNIT – III	**PROJECTION AND SECTION OF SOLIDS**	**3+12 Periods**

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids, when the axis is inclined to both the principal planes by rotating object method. Sectioning of prisms, pyramids, cylinder and cone in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section.

UNIT – IV	**DEVELOPMENT OF SURFACES AND ISOMETRIC PROJECTIONS**	**3+12 Periods**

Development of lateral surfaces of simple and sectioned solids – prisms, pyramids, cylinder and cone. Principles of isometric projection – isometric scale – isometric projections of simple solids and truncated solids - prisms, pyramids, cylinder, cone- combination of two solid objects in simple vertical positions.

UNIT – V	**COMPUTER AIDED DRAFTING**	**3+12 Periods**

Introduction to computer aided drafting package to make 2D Drawings. Object Construction: Page layout – Layers and line types – Creating, editing and selecting the geometric objects. Mechanics: Viewing, annotating, hatching and dimensioning the drawing – Creating blocks and attributes. Drafting: Create 2D drawing. A number of chosen problems will be solved to illustrate the concepts clearly.
(Demonstration purpose only, not to be included in examination).

Contact Periods:
Lecture: 15 Periods Tutorial: 0 Periods Practical: 60 Periods Total: 75 Periods

TEXT BOOKS:

1	*K.Venugopal, **"Engineering Graphics"**, New Age International (P) Limited, 2016.*
2	*K.V.Natarajan, **"A text book of Engineering Graphics"**, Dhanalakashmi Publishers, Chennai, 2016.*

REFERENCES:

1	*K.L.Narayana and P.Kannaiah,* ***"Text book on Engineering Drawing"****, 2nd Edition, SciTech Publications (India) Pvt. Ltd, Chennai, 2009.*
2	*N.S.Parthasarathy and Vela Murali,* ***"Engineering Graphics"****, Oxford University Press, New Delhi, 2015.*
3	*K.R.Gopalakrishna,* ***"Engineering Drawing" (Vol. I&II combined),*** *Subhas Publications, Bangalore, 2014.*
4	*Basant Agarwal and C.M.Agarwal,* ***"Engineering Drawing"****, Tata McGraw Hill Publishers, New Delhi, 2013.*
5	*Kevin Lang and Alan J.Kalameja, "****AutoCAD 2012 Tutor for Engineering Graphics"****, Cengage Learning Publishers, 1st Edition, 2011.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Acquire on representing solids as per international standards.	K3
CO2	Impart knowledge on different types of projections.	K3
CO3	Generate and interrupt the true shape of section.	K3
CO4	Develop the various surfaces according to the standards.	K3
CO5	Know the concept of computers in drafting engineering diagrams.	K6

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping:

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	1	1	1	1	2	-	3	1	3	1	3	3	2	2
CO2	3	1	1	1	1	2	-	3	1	3	1	3	3	2	2
CO3	3	1	1	1	1	2	-	3	1	3	1	3	3	2	2
CO4	3	1	1	1	1	2	-	3	1	3	1	3	3	2	2
CO5	3	1	1	1	1	2	-	3	1	3	1	3	3	2	3
22PES1Z2	**3**	**1**	**1**	**1**	**1**	**2**	**-**	**3**	**1**	**3**	**1**	**3**	**3**	**2**	**2**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping	
CO1	1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.3, 2.4.2, 3.1.2, 3.1.4, 3.2.1, 4.3.3, 5.1.1, 6.2.1, 8.1.1, 8.2.1, 8.2.2, 9.2.1, 9.2.4, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.1, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO2	1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.3, 2.4.2, 3.1.2, 3.1.4, 3.2.1, 4.3.3, 5.1.1, 6.2.1, 8.1.1, 8.2.1, 8.2.2, 9.2.1, 9.2.4, 10.1.1, 10.1.2, 10.2.1, 10.3.1, 10.3.2, 11.3.1, 12.1.1, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO3	1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.3, 2.4.2, 3.1.2, 3.1.4, 3.2.1, 4.3.3, 5.1.1, 6.2.1, 8.1.1, 8.2.1, 8.2.2, 9.2.1, 9.2.4, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.1, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO4	1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.3, 2.4.2, 3.1.2, 3.1.4, 3.2.1 ,4.3.3, 5.1.1, 6.2.1, 8.1.1 , 8.2.1, 8.2.2, 9.2.1, 9.2.4, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.1, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO5	1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.3, 2.4.2, 3.1.2, 3.1.4, 3.2.1, 4.3.3, 5.1.1, 6.2.1, 8.1.1, 8.2.1, 8.2.2, 9.2.1, 9.2.4, 10.1.1, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.1, 12.2.1, 12.2.2, 12.3.1, 12.3.2

22PHS2Z4	தமிழரும் தொழில் நுட்பமும் TAMILS AND TECHNOLOGY (Common to all Branches)	SEMESTER II

PREREQUISITES	CATEGORY	L	T	P	C
NIL	HSMC	1	0	0	1

UNIT – I	WEAVING AND CERAMIC TECHNOLOGY	3 Periods

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW)– Graffiti on Potteries.

UNIT – II	DESIGN AND CONSTRUCTION TECHNOLOGY	3 Periods

Designing and Structural construction House & Designs in household materials during Sangam Age- Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.

UNIT – III	MANUFACTURING TECHNOLOGY	3 Periods

Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and gold-Coins as source of history - Minting of Coins – Beads making-industries Stone beads -Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.

UNIT – IV	AGRICULTURE AND IRRIGATION TECHNOLOGY	3 Periods

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

UNIT – V	SCIENTIFIC TAMIL & TAMIL COMPUTING	3 Periods

Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.

Contact Periods:
Lecture: 15 Periods Tutorial:0 Periods Practical:0 Periods Total: 15 Periods

TEXT BOOK:

1	தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2	கணினித்தமிழ் – முனைவர் இல.சுந்தரம் . (விகடன் பிரசுரம்).
3	கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4	பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)

REFERENCES:

1	Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2	Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by:International Institute of Tamil Studies).
3	Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
4	The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by:International Institute of Tamil Studies).
5	Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by:Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation,Tamil Nadu)
6	Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
7	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
8	Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) –Reference Book.

22PHS2Z4	தமிழரும் தொழில் நுட்பமும் TAMILS AND TECHNOLOGY (Common to all Branches)	SEMESTER II

PREREQUISITES	CATEGORY	L	T	P	C
NIL	HSMC	1	0	0	1

அலகு I	நெசவு மற்றும் பானைத் தொழில்நுட்பம்	3 Periods

சங்க காலத்தில் நெசவுத் தொழில் – பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள்– பாண்டங்களில் கீறல் குறியீடுகள்.

அலகு II	வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்	3 Periods

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு- சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும்– சிலப்பதிகாரத்தில் மேடைஅமைப்பு பற்றிய விவரங்கள் – மாமல்லபுரச் சிற்பங்களும், கோவில்களும்-சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் – நாயக்கர் காலக் கோயில்கள்-மாதிரிகட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சிஅம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் – செட்டிநாட்டு வீடுகள் – பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ-சாரோசெனிக் கட்டிடக் கலை.

அலகு III	உற்பத்தித் தொழில் நுட்பம்	3 Periods

கப்பல் கட்டும் கலை – உலோகவியல் – இரும்புத் தொழிற்சாலை – இரும்பை உருக்குதல், எஃகு – வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் – நாணயங்கள் அச்சடித்தல் – மணி உருவாக்கும் தொழிற்சாலைகள் – கல்மணிகள் , கண்ணாடி மணிகள் – சுடுமண் மணிகள் – சங்கு மணிகள் – எலும்புத்துண்டுகள் – தொல்லியல் சான்றுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைகக்ள்.

அலகு IV	வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்	3 Periods

அணை, ஏரி, குளங்கள் , மதகு – சோழர்காலக் குமுழித்தூம்பின் முக்கியத்துவம் – கால்நடை பராமரிப்பு – கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் – வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் – கடல்சார்அறிவு – மீன்வளம் – முத்து மற்றும் முத்துக்குளித்தல் – பெருங்கடல் குறித்த பண்டைய அறிவு –அறிவுசார் சமூகம்.

அலகு V	அறிவியல் தமிழ் மற்றும் கணினித்தமிழ்	3 Periods

அறிவியல் தமிழின் வளர்ச்சி- கணினித்தமிழ் வளர்ச்சி- தமிழ் நூல்களை மின்பதிப்பு செய்தல் – தமிழ் மென்பொருட்கள் உருவாக்கம் – தமிழ் இணையக் கல்விக்கழகம் – தமிழ் மின் நூலகம் – இணையத்தில் தமிழ் அகராதிகள் – சொற்குவைத் திட்டம்.

Contact Periods:
Lecture: 15 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 15 Periods

TEXT BOOK:

1	தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2	கணினித்தமிழ் – முனைவர் இல.சுந்தரம் . (விகடன் பிரசுரம்).
3	கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4	பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)

REFERENCES:

1	Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2	Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by:International Institute of Tamil Studies).
3	Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
4	The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by:International Institute of Tamil Studies).
5	Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by:Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation,Tamil Nadu)
6	Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
7	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
8	Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) –Reference Book.

22PHS2Z5	PROFESSIONAL ENGLISH (Common to all Branches)	SEMESTER II

PREREQUISITES	CATEGORY	L	T	P	C
NIL	HSMC	2	1	0	3

Course Objectives	1. To engage learners in meaningful language activities to improve their LSRW skills 2. To enhance learners' awareness of general rules of writing for specific audiences 3. To help learners understand the purpose, audience, contexts of different types of writing 4. To develop analytical thinking skills for problem solving in communicative contexts 5. To demonstrate an understanding of job applications and interviews for internship and placements

UNIT – I	**FUNDAMENTALS OF COMMUNICATION**	**9 Periods**

Listening –Listening to Personal Introduction and Filling a form
Speaking - Self Introduction; Introducing someone in a formal context
Reading -Reading Biographies/ Autobiographies and E-mails relevant to technical contexts.
Writing - Writing Biographies/ Autobiographies; Drafting Professional E-mails.
Grammar - Present Tense (Simple Present, Present Progressive, Present Perfect, Present Perfect Continuous); Parts of Speech
Vocabulary - Word Formation with Prefixes; Antonyms; Portmanteau Words

UNIT – II	**SUMMATION AND PROBLEM SOLVING**	**9 Periods**

Listening-Listening to Short-Stories / Personal Experiences/Watching Movies.
Speaking - Narrating Personal Experiences / Events and Short Stories
Reading-Reading Travelogues and Books.
Writing - Report on an event (Field Trip, Industrial Visit, Educational Tours etc.), Review on Books and Movies.
Grammar –Past Tense (Simple Past, Past Progressive, Past Perfect, Past Perfect Continuous); Impersonal Passive
Vocabulary - Word Formation with suffixes; Synonyms; Phrasal Verbs.

UNIT– III	**DESCRIPTION OF A PROCESS / PRODUCT**	**9 Periods**

Listening - Listening to Digital Marketing Advertisements for Product /Process Descriptions
Speaking –Describing/Interpreting a Picture; Giving instructions to use the product.
Reading – Reading Advertisements, Gadget Reviews; User Manuals.
Writing - Writing Definitions; Product /Process Description; Transcoding; Content Writing
Grammar -Future Tense(Simple Future, future continuous, Future Perfect, Future Perfect Continuous); If Clauses
Vocabulary - Homonyms; Homophones, One Word Substitutes.

UNIT– IV	**EXPRESSION**	**9 Periods**

Listening – Listening to/Watching Formal Job interviews or Celebrity Interviews
Speaking – Participating in a Face to Face or Virtual Interview (Job/Celebrity Interview), virtual interviews
Reading – Company profiles, Statement of Purpose, (SOP), Excerpts of interview with professionals from Newspaper, Magazine and other Resources
Writing – Job / Internship Application – Cover letter & Resume
Grammar – Question types: 'Wh' / Yes or No/ and Tags; Subject- Verb Agreement.
Vocabulary – Idiomatic Expressions

UNIT – V	**PUBLIC SPEAKING**	**9 Periods**

Listening – Listening to Ceremonious Speeches on You Tube and Jotting down phrases
Speaking – Delivering Welcome Address; Introducing the Chief-Guest; Proposing Vote of Thank and Felicitation
Reading – Excerpts of Speeches from Newspaper, Magazines and Motivational BooksWriting – Drafting a Welcome Address, Introduction to the Chief-Guest, Vote of Thanks and Felicitation
Grammar–CommonErrors
Vocabulary – Commonly Confused Words

Contact Periods:
Lecture: 30 Periods Tutorial: 15 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOK

1	***English for Science & Technology*** *Cambridge University Press, 2021. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.*
2	***Communicative English,*** *Global Publishers, Chennai 2017 by Dr.J.Anbazhagan Vijay*

REFERENCES

1	*Raman.Meenakshi,Sharma.Sangeeta(2019).* ***Professional English.*** *Oxford University Press. New Delhi.*
2	***Learning to Communicate*** *– Dr. V. Chellammal, Allied Publishing House, New Delhi,2003*
3	***Using English****, Orient Blackswan, Chennai, 2017 by Board of Editors*
4	***OER****(Authentic Open Educational Resources)*

COURSE OUTCOMES: On completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Participate in a basic communicative task.	K3
CO2	Analyse problems in order to arrive at feasible solutions and communicate them orally and in the written format.	K3
CO3	Describe a product or process or mechanism.	K2
CO4	Present their opinions in a planned and logical manner, and draft effective resumes in context of job search.	K3
CO5	Deliver speeches at formal functions.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	-	-	1	-	-	2	-	-	3	3	-	-	-	1	-
CO2	-	1	1	-	-	2	-	-	1	3	-	1	-	1	-
CO3	-	-	-	1	-	-	-	-	-	3	-	-	-	1	-
CO4	-	-	1	-	-	-	-	-	2	3	-	-	-	1	-
CO5	-	-	-	-	-	-	-	-	2	2	-	-	-	1	-
22PHS2Z5	**-**	**1**	**1**	**1**	**-**	**1**	**-**	**-**	**2**	**3**	**-**	**1**	**-**	**1**	**-**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping	
CO1	3.3.2, 6.1.1, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2
CO2	2.1.1, 2.2.3, 2.2.4, 3.1.2, 6.2.1, 9.2.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 12.3.1, 12.3.2
CO3	4.1.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2
CO4	3.3.2, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2
CO5	9.2.2, 9.2.3, 9.2.4, 10.1.1, 10.1.3, 10.2.1, 10.2.2

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	-	12	88	-	-	-	100
CAT2	-	18	82	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	-	100	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	-	100	-	-	-	100
ESE	-	20	80	-	-	-	100

22PBS205	DIFFERENTIAL EQUATIONS AND NUMERICAL METHODS (Common to all branches except CSE & IT Branches)	SEMESTER II

PREREQUISITES	CATEGORY	L	T	P	C
NIL	BS	3	1	0	4

Course Objectives	1. To gain knowledge of methods to solve higher order differential equations with constant and variable coefficients. 2. To be familiar with forming partial differential equations and solving partial differential equations of standard types of first order and homogeneous linear differential equations. 3. To be familiar with numerical interpolation, numerical differentiation and numerical integration. 4. To acquire the knowledge of numerical solution to first order ordinary differential equations using single and multi step techniques. 5. To gain the knowledge of numerical solution to second order partial differential equations using explicit and implicit methods.

UNIT – I	**ORDINARY DIFFERENTIAL EQUATIONS**	**9+3 Periods**
Higher order linear differential equations with constant coefficients -variable coefficients: Cauchy-Euler equation, Cauchy-Legendre equation-Method of variation of parameters-Simultaneous first order linear equations with constant coefficients.		
UNIT – II	**PARTIAL DIFFERENTIAL EQUATIONS**	**9+3 Periods**
Formation of partial differential equations – First order partial differential equations – Standard types and Lagrange's type – Homogeneous linear partial differential equation of second and higher order with constant coefficients.		
UNIT – III	**INTERPOLATION, NUMERICAL DIFFERENTIATION AND INTEGRATION**	**9+3 Periods**
Solution of polynomial and transcendental equations: Newton-Raphson method-Interpolation with equal interval: Newton's forward and backward difference formulae-Interpolation with unequal intervals: Lagrange's formulae-Numerical Differentiation: Newton's formulae-Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules.		
UNIT – IV	**NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS**	**9+3 Periods**
First order ordinary differential equations: Taylor's series method-Euler and modified Euler's methods-Runge- Kutta method of fourth order -Milne's and Adam's predicator-corrector methods.		
UNIT – V	**NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS**	**9+3 Periods**
Partial differential equations: Finite difference method for two dimensional Laplace equation and Poisson equation- Implicit and explicit methods for one dimensional heat equation (Bender-Schmidt and Crank-Nicholson methods)-Finite difference explicit method for wave equation.		
Contact Periods: **Lecture: 45 Periods Tutorial: 15 Periods Practical: 0 Periods Total: 60 Periods**		

TEXT BOOK

1	*Veerarajan.T,* ***"Engineering Mathematics"****, Revised Edition 2018, McGraw Hill Education (India) Private Limited*
2	*P. Kandasamy, K. Thilagavathy, K. Gunavathi,* ***" Numerical Methods"****, S. Chand & Company, 3rd Edition, Reprint 2013.*

REFERENCES

1	*B.S.Grewal,* ***" Higher Engineering Mathematics"****, Khanna Publishers, New Delhi, 44th Edition, 2018.*
2	*SrimantaPal,* ***"Numerical Methods Principles, Analyses and Algorithms"****, Oxford University Press, New Delhi, I st Edition 2009.*
3	*Raisinghania.M..D,* ***"Ordinary And Partial Differential Equations"****, 20th Edition, S. Chand Publishing,2020*
4	*S.S. Sastry,* ***"Introductory methods of numerical analysis"****, PHI, New Delhi, 5th Edition, 2015.*
5	*Ward Cheney, David Kincaid,* ***"Numerical Methods and Computing,*** *Cengage Learning, Delhi, 7th Edition 2013.*
6	*S. Larsson, V. Thomee,* ***"Partial Differential Equations with Numerical Methods"****, Springer, 2003.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Solve higher order linear differential equation with constant and variable coefficients and simultaneous differential equation.	K5
CO2	Form partial differential equations and find solutions of first and higher order partial differential equations.	K5
CO3	Obtain approximate solutions for transcendental equations and problems on interpolation, differentiation, integration.	K5
CO4	Find the numerical solutions of first order ordinary differential equations using single and multi step techniques.	K5
CO5	Solve second order partial differential equations using explicit and implicit methods.	K5

COURSE ARTICULATION MATRIX

a) CO and PO Mapping:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	3	3	-	1	-	-	-	-	-	-	-	1	2	2	2
CO2	3	3	-	1	-	-	-	-	-	-	-	1	2	2	2
CO3	3	3	-	1	-	-	-	-	-	-	-	1	2	2	2
CO4	3	3	-	1	-	-	-	-	-	-	-	1	2	2	2
CO5	3	3	-	1	-	-	-	-	-	-	-	1	2	2	2
22PBS205	**3**	**3**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**2**	**2**
1 – Slight, 2 – Moderate, 3 – Substantial															

b) CO and Key Performance Indicators Mapping:

CO1	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 4.1.1, 12.2.1
CO2	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 4.1.1, 12.2.1
CO3	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 4.1.1, 12.2.1
CO4	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 4.1.1, 12.2.1
CO5	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 4.1.1, 12.2.1

ASSESSMENT PATTERN – THEORY:

Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	40	20	20	-	-	100
CAT2	20	40	20	20	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	20	40	20	20	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	20	40	20	20	-	-	100
ESE	20	40	20	20	-	-	100

22PBS206	MATERIALS SCIENCE (Common to MECH & PRODN Branches)	SEMESTER II

PREREQUISITES	CATEGORY	L	T	P	C
NIL	BS	3	0	0	3

Course Objectives	1. To understand the properties of conducting materials. 2. To acquire knowledge in the basics of semiconducting materials and solar energy Conversion techniques. 3. To understand the properties, types and applications of magnetic and superconducting materials. 4. To acquire knowledge in the properties and applications of nanomaterials. 5. To understand the properties and applications of advanced engineering materials.

UNIT – I	**CONDUCTING MATERIALS**	**9 Periods**

Introduction to Conductors – classical free electron theory of metals – Draw backs of classical theory – quantum theory - Electrical and Thermal conductivity of Metals – Derivation of Wiedemann – Franz law – Lorentz number — Fermi distribution function - effect of temperature – density of energy states – calculation of Fermi energy- carrier concentration in metals.

UNIT – II	**SEMICONDUCTING MATERIALS AND SOLAR CELLS**	**9 Periods**

Introduction – Intrinsic and extrinsic semiconductors (Qualitative) - Fermi level - carrier concentration in intrinsic semiconductor-solar cells: P-N junction- generation of electron hole pair- photoconduction- solar cell I-V characteristics-solar PV module- cell mismatch in a module, effect of shadowing- classification of solar PV systems - Applications of solar photovoltaic system- grid interactive PV power generation, telecommunication and signaling.

UNIT – III	**MAGNETIC AND SUPERCONDUCTING MATERIALS**	**9 Periods**

Origin of magnetic moment-Classification of magnetic materials - dia, para and ferromagnetic materials- domain theory – types of energy – hysteresis – hard and soft magnetic materials – superconducting materials and their properties- BCS theory of superconductivity (qualitative) -Type I and Type II superconductors - High temperature superconductors- applications for superconducting materials-Magnetic levitation-cryotron.

UNIT – IV	**NANOMATERIALS**	**9 Periods**

Introduction – Quantum confinement effect- Nano materials-preparation- top-down and bottom-up methods – Ball milling -Physical vapour deposition- sputtering - chemical vapour deposition- solgel method- Properties and applications of nano materials-carbon nanotubes (CNT)- Structures and types- synthesis: Laser ablation- Electric arc discharge method - Properties and applications of carbon nanotubes.

UNIT – V	**ADVANCED ENGINEERING MATERIALS**	**9 Periods**

Metallic glasses: melt spinning process, properties and applications - Shape memory alloys (SMA): two different phases-types of shape memory alloys, characteristics of SMA- Ni-Ti alloy -applications of SMA– Nonlinear optical materials (NLO) : properties of Nonlinear optical materials-polarization, second harmonic generation- Birefringence – optical Kerr effect.

Contact Periods:
Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

TEXT BOOK :

1	*K.Rajagopal , "**Engineering Physics**", 3rd edition, PHI Learning Private Ltd, 2015.*
2	*B H. Khan," **Non conventional Energy Resources**", 3rd edition, McGraw Hill Education Private Limited, 2015.*

REFERENCES :

1	*A.Marikani, "**Engineering Phyiscs"**, PHI Learning Private limited, 2013.*
2	*P.K.Palanisamy, "**Engineering Physics–II"** , Scitech Publications (India) Pvt. Ltd, 2015.*
3	*Chetan Singh Solanki, "**Solar Photovoltaics – Fundamentals, Technologies and Applications"**, 3rd edition, PHI Learning Private limited 2015.*
4	*William D Callister Jr., and David G. Rethwisch , "**Materials science & Engineering** : **An introduction",** 9 th edition , Wiley (2014)*
5	*Charles P.Poole, Jr; Frank J.Owens, "**Introduction to Nanotechnology"**, Wiley India, 2012.*
6	*S. M. Sze, "**Semiconductor Devices**: **Physics and Technology"**, 3 rd edition, Wiley (2015).*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Calculate the Fermi energy and the carrier concentration in metals.	K4
CO2	Analyze the characteristics of solar cells.	K4
CO3	Select the magnetic and super conducting materials for the desired application.	K4
CO4	Choose the method to synthesis a nanomaterial.	K5
CO5	Apply the advanced engineering materials in various fields.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	2	-	-	-	-	-	-	-	-	-	-	1	1	1
CO2	3	3	1	-	-	-	-	-	-	-	-	-	1	1	1
CO3	3	2	1	-	-	-	-	-	-	-	-	-	2	1	2
CO4	3	2	-	1	-	-	-	-	-	-	-	-	1	1	2
CO5	3	2	1	-	-	-	-	-	-	-	-	-	1	1	2
22PBS206	**3**	**3**	**1**	**1**	-	-	-	-	-	-	-	-	**2**	**1**	**2**

1 – Slight, 2 – Moderate, 3 – Substantial

CO AND KEY PERFORMANCE INDICATORS MAPPING	
CO1	1.1.1, 1.1.2, 1.2.1, 1.3.1, 2.1.1, 2.1.3, 2.2.3, 2.2.4, 2.4.1, 2.4.2, 2.4.3, 2.4.4
CO2	1.1.1, 1.1.2, 1.2.1, 1.3.1, 2.1.1, 2.1.3, 2.2.3, 2.2.4, 2.3.1, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.5
CO3	1.1.1, 1.1.2, 1.2.1, 1.3.1, 2.1.1, 2.1.3, 2.2.3, 2.2.4, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.5
CO4	1.1.1, 1.1.2, 1.2.1, 1.3.1, 2.1.1, 2.1.3, 2.2.3, 2.2.4, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 4.1.2, 4.1.3
CO5	1.1.1, 1.1.2, 1.2.1, 1.3.1, 2.1.1, 2.1.3, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.5

ASSESSMENT PATTERN – THEORY:							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	25	30	25	20	-	-	100
CAT2	25	30	25	20	-	-	100
Individual Assessment 1/ Case study 1 /Seminar 1 / Project	40	40	20	-	-	-	100
Individual Assessment 2/ Case study 2 /Seminar 2 / Project	40	40	20	-	-	-	100
ESE	25	30	25	20	-	-	100

B.E.PRODUCTION ENGINEERING

22PES203	PYTHON PROGRAMMING (Common to MECH & PRODN Branches)	SEMESTER II

PREREQUISITES	CATEGORY	L	T	P	C
NIL	ES	3	0	0	3

Course Objectives	1. To solve problems using Python conditionals and loops statements. 2. To define Python functions and use function calls to modularize the program. 3. To use Python data structures, simple data – lists, tuples, complex data – dictionaries. 4. To do input/output operations with files in Python.	
UNIT – I	**INTRODUCTION**	**9 Periods**
Fundamentals of Computing – Identification of Computational Problems -Algorithms, building blocks of algorithms - statements, control flow, notation - pseudo code, flow chart, programming language –Data, Expressions, variables and keywords, precedence of operators, comments. Python Interactive and script mode.		
UNIT – II	**CONDITIONAL AND LOOPING STATEMENTS**	**9 Periods**
Conditional Statements: Boolean values and operators, simple (if), alternative (if-else), chained conditional (if-elif-else) and Nested. Iteration: while, for, break, continue, pass; nested loops.		
UNIT – III	**FUNCTION AND STRING**	**9 Periods**
Function: structure of a function, return values, parameters, local and global scope, recursion. String – operations, functions, methods and slicing.		
UNIT – IV	**LIST, TUPLE AND DICTIONARY**	**9 Periods**
List – creation, operations, functions, methods and slicing; tuple creation and methods, Multiple assignment statements. Dictionaries: operations and methods; advanced list processing – list comprehension.		
UNIT – V	**FILES AND EXCEPTIONS**	**9 Periods**
Files and exception: Types of files, reading and writing files, Different file modes, copying a file; command line arguments, Exceptions: handling exceptions, modules, packages.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Kenneth Leroy Busbee and Dave Braunschweig,* ***"Programming Fundamentals, A Modular Structured Approach"****, 2nd Edition, Creative Commons Attribution-Share A like 4.0 International License.*
2	*Yashavant Kanetkar and Aditya Kanetkar,* ***"Let us Python"****, First Edition, 2019, BPB Publications*

REFERENCES:

1	*Allen B. Downey,* ***"Think Python: How to Think like a Computer Scientist"****, 2nd Edition, O'Reilly Publishers, 2016.*
2	*G Venkatesh and MadhavanMukund,* ***"Computational Thinking: A Primer for Programmers and Data Scientists"****, 1st Edition, Notion Press, 2021.*
3	*John V Guttag,* ***"Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data"****, Third Edition, MIT Press*

4	*Paul Deitel and Harvey Deitel,* ***"Python for Programmers"****, Pearson Education, 1st Edition, 2021.*
5	*Eric Matthes,* ***"Python Crash Course, A Hands – on Project Based Introduction to Programming"****, 2nd Edition, No Starch Press, 2019.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Develop algorithms to simple computational problems.	K3
CO2	Write simple conditional Python programs.	K3
CO3	Write simple Python programs using loops and functions.	K3
CO4	Create Python lists, tuples and dictionaries.	K3
CO5	Read from a file and write into a file using Python.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping:

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	3	1	2	-	-	-	-	-	2	2	1	1	2	1
CO2	2	2	1	3	-	-	-	1	-	1	-	-	1	2	1
CO3	1	3	2	2	-	-	1	-	-	1	-	-	1	2	1
CO4	3	3	2	2	-	-	-	-	-	1	-	-	1	2	1
CO5	1	2	3	2	-	-	1	-	1	1	1	-	1	2	1
22PES203	**2**	**3**	**2**	**3**	**-**	**-**	**1**	**1**	**1**	**2**	**1**	**1**	**1**	**2**	**1**

1 – Slight, 2 – Moderate, 3 – Substantial

CO and Key Performance Indicators Mapping	
CO1	1.1.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 3.1.4, 3.2.1, 4.1.1, 4.1.2, 4.2.1, 4.3.4, 10.1,1, 10.1.2, 10.1.3, 10.3.1, 11.2.1, 11.3.1, 12.3.2
CO2	1.1.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 3.1.4, 3.2.1, 3.3.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 8.1.1, 10.1.2, 10.1.3
CO3	1.3.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.4,3.1.6,3.2.1,3.2.2,3.4.2,4.1.1,4.1.2, 4.2.1, 4.3.1, 4.3.4, 7.2.2, 10.1.2, 10.1.3
CO4	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.4.1,2.4.2,2.4.3,2.4.4,3.1.4,3.1.6,3.2.1,3.2.2, 3.4.2, 4.1.1, 4.2.1, 4.3.3, 4.3.4, 10.1.2
CO5	1.3.1,2.1.1,2.1.2,2.1.3,2.2.3,2.4.2,2.4.3,2.4.4,3.1.1,3.1.2,3.1.3,3.1.4,3.1.5,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,3.3.2,3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.3.2, 4.3.4, 7.2.2, 9.1.1, 10.1.2, 11.3.1

ASSESSMENT PATTERN – THEORY:

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	30	30	20	-	-	100
CAT2	20	30	30	20	-	-	100
Individual Assessment 1/ Case study 1 /Seminar 1 / Project	20	30	30	20	-	-	100
Individual Assessment 2/ Case study 2 /Seminar 2 / Project	20	30	30	20	-	-	100
ESE	20	30	30	20	-	-	100

B.E.PRODUCTION ENGINEERING

22PMC2Z1	ENVIRONMENTAL SCIENCE AND ENGINEERING (Common to all Branches)	SEMESTER II

PREREQUISITES	CATEGORY	L	T	P	C
NIL	MC	3	0	0	0

Course Objectives	1. To study the modern agriculture related problems, natural resources and its harnessing methods. 2.To study the interrelationship between living organism and environment. 3. To educate the people about causes of pollutions and its controlling methods. 4. To impart the knowledge of various environmental threats and its consequences. 5. To study the various water conservation methods, Act, Population policy, Welfare programs.

UNIT – I	**ENVIRONMENTAL ENERGY RESOURCES**	**9 Periods**
Food-effects of modern agriculture, fertilizers, pesticides, eutrophication & biomagnifications-Energy resources: renewable resources - Hydro Energy, Solar & Wind. Non-renewable resources – Coal and Petroleum - harnessing methods.		
UNIT – II	**ECO SYSTEM AND BIODIVERSITY**	**9 Periods**
Eco system and its components - biotic and abiotic components. Biodiversity: types and values of biodiversity, hot spots of biodiversity, endangered and endemic species, conservation of biodiversity: In situ and ex situ conservation. Threats to biodiversity-destruction of habitat, habit fragmentation, hunting, over exploitation and man-wildlife conflicts. The IUCN red list categories.		
UNIT – III	**ENVIRONMENTAL POLLUTION**	**9 Periods**
Air pollution, classification of air pollutants – sources, effects and control of gaseous pollutants SO_2, NO_2, H_2S, CO, CO_2 and particulates. Water pollution - classification of water pollutants, organic and inorganic pollutants, sources, effects and control of water pollution. Noise pollution - decibel scale, sources, effects and control.		
UNIT – IV	**ENVIRONMENTAL THREATS**	**9 Periods**
Global warming-measure to check global warming - impacts of enhanced Greenhouse effect, Acid rain-effects and control of acid rain, ozone layer depletion- effects of ozone depletion, disaster management - flood, drought, earthquake and tsunami.		
UNIT – V	**SOCIAL ISSUES AND ENVIRONMENT**	**9 Periods**
Water conservation, rain water harvesting, e-waste management, Pollution Control Act, Wild life Protection Act. Population growth- exponential and logistic growth, variation in population among nations, population policy. Women and Child welfare programs. Role of information technology in human and health, COVID-19 - effects and preventive measures.		
Contact Periods: **Lecture:45 Periods Tutorial: 0 Periods Practical: 0 Periods Total:45 Periods**		

TEXT BOOK:

1	*Sharma J.P., **"Environmental Studies"**, 4th Edition, University Science Press, New Delhi 2016.*
2	*Anubha Kaushik and C.P.Kaushik**, "Environmental Science and Engineering"**, 7th Edition, New Age International Publishers, New Delhi, 2021.*

REFERENCES:

1	*A K De, **"Environmental Chemistry"**, 8th Edition, New Age International Publishers, 2017.*
2	*G. Tyler Miller and Scott E. Spoolman, **"Environmental Science"**, Cengage Learning India Pvt, Ltd, Delhi, 2014.*
3	*Erach Bharucha, **"Textbook of Environmental Studies"**, Universities Press(I) Pvt, Ltd, Hyderabad, 2015.*
4	*Gilbert M.Masters**, "Introduction to Environmental Engineering and Science"**, 3rd Edition, Pearson Education, 2015.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Recognize and understand about the various environmental energy resources and the effective utility of modern agriculture.	K2
CO2	Acquire knowledge about the interaction of biosphere with environment and conservation methods of bio diversity.	K2
CO3	Be aware of the sources of various types of pollution, their ill effects and preventive methods.	K2
CO4	Identify and take the preventive measures to control the environmental threats and effects of Global warming, Ozone depletion, Acid rain, and natural disasters.	K2
CO5	Demonstrate an idea to save water and other issues like COVID -19.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping:

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	1	1	1	-	-	3	-	-	-	-	-	1	1	1
CO2	-	-	1	-	-	-	3	-	-	-	-	-	-	-	-
CO3	2	1	1	1	-	-	3	-	-	-	-	-	2	2	2
CO4	2	1	1	1	-	-	3	-	-	-	-	-	2	2	2
CO5	-	1	1	1	-	2	3	-	-	-	-	-	-	1	-
22PMC2Z1	**2**	**1**	**1**	**1**	**-**	**1**	**3**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**1**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping:	
CO1	1.2.1, 1.4.1, 2.1.2, 2.3.1, 3.1.5, 3.2.1, 4.3.1, 7.1.1, 7.1.2, 7.2.1
CO2	3.1.5, 7.1.1, 7.1.2, 7.2.1
CO3	1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.3.1, 3.1.5, 3.2.1, 4.1.3, 4.3.1, 7.1.1, 7.1.2, 7.2.1
CO4	1.2.1, 1.4.1, 2.1.2, 2.3.1, 3.1.5, 4.1.3, 4.3.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2
CO5	2.1.2, 2.2.2, 3.1.5, 4.1.3, 4.3.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2

ASSESSMENT PATTERN – THEORY :

Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	40	20	20	-	-	100
CAT2	20	40	20	20	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	20	40	20	20	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	20	40	20	20	-	-	100
ESE	20	40	20	20	-	-	100

B.E.PRODUCTION ENGINEERING

22PBS2Z7	PHYSICS LABORATORY (Common to all Branches)	SEMESTER II

PREREQUISITES	CATEGORY	L	T	P	C
NIL	BS	0	0	3	1.5

Course Objectives	1. To impart practical knowledge on the concept of properties of matter and utilize the experimental techniques to measure the properties 2. To impart practical knowledge on the modulii of elasticity 3. To analyze the properties of semiconductors 4. To learn practically the basic electronic concepts of transistor and logic gates 5. To realize the principle, concepts and working of a solar cell and study the properties of ferromagnetic material 6. To understand the concept of quantum physics
S. No.	**LABORATORY EXPERIMENTS**
1.	Determination of refractive index of the glass and given liquid – Spectrometer diffraction method
2.	Determination of Planck's constant
3.	Determination of Young's Modulus of the material in the form of bar – Cantilever Bending -Koenig's Method
4.	a) Particle size determination using diode laser b) Determination of numerical aperture and acceptance angle in an optical fiber
5.	Hall effect - Determination of semiconductor parameters
6.	Determination of band gap of semiconductor material
7.	Determination of velocity of sound and compressibility of the given liquid-Ultrasonic Interferometer
8.	Determination of moment of inertia of disc and rigidity modulus of a wire-Torsional pendulum
9.	Transistor characteristics
10.	Solar cell characteristics
11.	Determination of Hysteresis losses in a Ferromagnetic material-B-H curve unit
12.	Logic Gates – Verification and Construction

Contact Periods:
Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Determine refractive index and compressibility of liquids, micro size of particles and numerical aperture of an optical fibre	K5
CO2	Measure the Young's and rigidity modulii of the given material	K5
CO3	Determine the bandgap of a given semiconductor material and identify the type of semiconductor and its carrier concentration through Hall measurement	K5
CO4	Analyze the characteristics of transistor and verify the truth table of logic gates	K4
CO5	Measure the efficiency of a solar cell and energy loss associated with the ferromagnetic material by plotting B-H curve	K5
CO6	Determine the Planck's constant and work function	K5

B.E.PRODUCTION ENGINEERING

COURSE ARTICULATION MATRIX:															
a) CO and PO Mapping:															
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	1	1
CO2	3	2	-	-	-	-	-	-	-	-	-	-	1	1	1
CO3	3	2	-	-	-	-	-	-	-	-	-	-	1	1	1
CO4	3	2	-	-	-	-	-	-	-	-	-	-	1	1	1
CO5	3	2	-	-	-	-	-	-	-	-	-	-	1	1	1
CO6	3	2	-	-	-	-	-	-	-	-	-	-	1	1	1
22PBS2Z7	**3**	2	-	-	-	-	-	-	-	-	-	-	**2**	**1**	**1**
1 – Slight, 2 – Moderate, 3 – Substantial															

b) CO and Key Performance Indicators Mapping:	
CO1	1.1.1, 1.1.2, 1.2.1, 1.3.1, 2.1.1, 2.1.3, 2.4.1, 2.4.2, 2.4.3, 2.4.4
CO2	1.1.1,1.1.2, 1.2.1, 1.3.1, 2.1.1, 2.1.3, 2.4.1, 2.4.2, 2.4.3, 2.4.4
CO3	1.1.1,1.1.2, 1.2.1, 1.3.1, 2.1.1, 2.1.3, 2.4.1, 2.4.2, 2.4.3, 2.4.4
CO4	1.1.1,1.1.2, 1.2.1, 1.3.1, 2.1.1, 2.1.3, 2.4.1, 2.4.2, 2.4.3, 2.4.4
CO5	1.1.1, 1.1.2, 1.2.1, 1.3.1, 2.1.1, 2.1.3, 2.4.1, 2.4.2, 2.4.3, 2.4.4
CO6	1.1.1, 1.1.2, 1.2.1, 1.3.1, 2.1.1, 2.1.3, 2.4.1, 2.4.2, 2.4.3, 2.4.4

B.E.PRODUCTION ENGINEERING

22PES2Z4	WORKSHOP PRACTICE (Common to all Branches)				SEMESTER II
PREREQUISTES	CATEGORY	L	T	P	C
NIL	ES	0	0	3	1.5

Course Objectives	1. To make various basic prototypes in the carpentry trade such as Half Lap joint, Lap Tee joint, Dovetail joint, Mortise & Tenon joint. 2. To make various welding joints such as Lap joint, Lap Tee joint, Edge joint, Butt joint and Corner joint. 3. To make various moulds in foundry such as Cube, Straight pipe, Vpulley, and Conical bush. 4. To make various components using sheet metal such as Tray, Frustum of cone and Square box. 5. To understand the working and identify the various components of CNC Machines

LIST OF EXPERIMENTS

1. Introduction to use of tools and equipment's in Carpentry, Welding, Foundry and Sheet metal
2. Safety aspects in Welding, Carpentry, Foundry and sheet metal.
3. Half Lap joint and Dovetail joint in Carpentry.
4. Welding of Lap joint and Butt joint and T-joint.
5. Preparation of Sand mould for Cube, Conical bush, Pipes and V pulley
6. Fabrication of parts like Tray, Frustum of cone and Square box in sheet metal
7.CNC Machines demonstration and lecture on working principle.
8.Electrical wiring and simple house wiring.

Contact periods:			
Lecture: 0 Periods	**Tutorial: 0 Periods**	**Practical: 45 Periods**	**Total: 45 Periods**

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Safely Use tools and equipment's used in Carpentry, Welding, Foundry and Sheet metal to create basic joints.	K2
CO2	Prepare sand mould for various basic pattern shapes.	K3
CO3	Fabricate parts like Tray, Frustum of cone and Square box in sheet metal.	K3
CO4	Practice on the Welding and Carpentry	K3
CO5	Demonstrate the working of CNC Machines.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping:

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	2	1	3	1	2	3	3	2	3	2	-	-
CO2	2	2	3	2	1	3	3	2	3	3	2	3	2	2	2
CO3	2	2	3	2	1	3	3	2	3	3	2	3	2	2	3
CO4	2	2	3	2	1	3	3	2	3	3	2	3	2	2	2
CO5	2	2	3	2	3	-	-	2	3	3	2	2	2	2	3
22PES2Z4	**2**	**2**	**3**	**2**	**2**	**3**	**2**	**2**	**3**	**3**	**2**	**3**	**2**	**2**	**2**

1 – Slight, 2 – Moderate, 3 – Substantial

B.E.PRODUCTION ENGINEERING

b) CO and Key Performance Indicators Mapping:	
CO1	1.2.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.2.4, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1,3.3.2, 3.4.1, 4.1.1, 4.1.4, 4.2.1, 4.3.1, 5.2.2, 5.3.2, 6.1.1, 6.2.1,7.1.2, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.3.1, 12.1.1, 12.2.2, 12.3.1, 12.3.2
CO2	1.2.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.2.4, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 4.1.1, 4.1.4, 4.2.1, 4.3.1, 5.2.2, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.2, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.3.1, 12.1.1, 12.2.2, 12.3.1, 12.3.2
CO3	1.2.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.2.4, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1,3.3.2, 3.4.1, 4.1.1, 4.1.4, 4.2.1, 4.3.1, 5.2.2, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.2, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.3.1, 12.1.1, 12.2.2, 12.3.1, 12.3.2
CO4	1.2.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.2.4, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1,3.3.2, 3.4.1, 4.1.1, 4.1.4, 4.2.1, 4.3.1, 5.2.2, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.2, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.3.1, 12.1.1, 12.2.2, 12.3.1, 12.3.2
CO5	1.2.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.2.4, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1,3.3.2, 3.4.1, 4.1.1, 4.1.4, 4.2.1, 4.3.1,5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.2, 7.1.1, 7.2.2, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.3.1, 12.2.2, 12.3.1, 12.3.2

B.E.PRODUCTION ENGINEERING

22PES205	PYTHON PROGRAMMING LABORATORY (Common to MECH & PRODN Branches)	SEMESTER II

PREREQUISITES	CATEGORY	L	T	P	C
NIL	ES	0	0	3	1.5

Course Objectives	1. To implement problems using different Python conditionals statements. 2. To implement Python loop statements and functions. 3. To implement Python data structures - lists, tuples and dictionaries. 4. To check the code for run time errors with exceptions.

LIST OF EXPERIMENTS :

1. Expressions and operators.
    a. Find the area of circle/square/triangle.
    b. Implementation of simple calculator (using operators - %,/,//,*,+,-)
2. Conditional statements.
    a. Find the given number is odd or even.
    b. Find the grade of the given mark. (maximum 5 grades)
3. Loops
    a. Print the even numbers from 1 to N
    b. Print only the numbers which are not divisible by 5. (use continue statement in loop)
4. String
    a. Implementation of slicing of a string (with positive, negative and both positive and negative indices)
    b. Implementation of functions and methods in a string
5. List
    a. Modify the given list using different methods
    b. Find the length, minimum value, maximum value and sum of the given list using list functions.
    c. Traverse and print the list using for loop.
6. Tuple
    a. Create a Tuple from a list and print the reverse of Tuple using method reverse
    b. Traverse the Tuple and search for the given element.
7. Dictionary
    a. Create a dictionary with 4 items, modify the 3rd item value as “Happy”
    b. Work with all dictionary methods.
    c. Delete the dictionary
8. Files
    a. Open a file in Read mode and print its content
    b. Get the input from user and write it into a file.
    c. Copy a file to another file
9. Exception handling
    a. Write a program to handle the ValueError/NameError/IndexError
    b. Write a program to illustrate the use of else and finally block in Exception handling

Contact Periods:
Lecture: 0 Period Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods

B.E.PRODUCTION ENGINEERING

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Implement simple computational problems.	K3
CO2	Implement simple conditional programs.	K3
CO3	Use loops and functions for solving problems.	K3
CO4	Implement Python lists, tuples and dictionaries.	K3
CO5	Read from a file and write into a file using Python.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	2	2	1	1	-	-	-	-	-	2	2	1	1	2	1
CO2	2	2	2	2	1	-	-	1	-	1	-	-	1	2	1
CO3	2	2	2	1	-	-	1	-	1	1	-	-	1	2	1
CO4	2	2	1	2	1	-	-	-	-	1	-	-	1	2	1
CO5	-	1	1	1	-	-	1	-	1	1	1	1	1	2	1
22PES205	**2**	**2**	**2**	**2**	**1**	**-**	**1**	**1**	**1**	**2**	**1**	**1**	**1**	**2**	**1**

1 – Slight, 2 – Moderate, 3 – Substantial

CO and Key Performance Indicators Mapping:	
CO1	1.1.1, 1.3.1, 2.1.1, 2.1.2, 2.2.2, 2.2.3, 2.3.2, 2.4.2, 3.1.1, 3.1.2, 3.1.6, 3.3.1, 4.1.1, 4.2.1, 4.3.3, 10.1.1, 10.1.2, 10.1.3, 10.3.1, 11.3.1, 11.3.2, 12.3.2
CO2	1.1.1, 1.1.2, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 3.1.6, 3.2.1, 3.2.3, 3.3.1, 3.4.1, 4.1.1, 4.1.2, 4.3.1, 4.3.3, 5.1.2, 8.1.1, 10.1.2, 10.1.3
CO3	1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.2.2, 2.2.3, 2.4.2, 2.4.3, 3.1.2, 3.1.6, 3.2.1, 3.2.2, 3.3.1, 4.1.4, 4.3.1, 4.3.2, 7.2.2, 9.2.1, 10.1.2, 10.1.3
CO4	1.1.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.4.1, 2.4.4, 3.1.2, 3.2.1, 4.1.2, 4.1.4, 4.2.2, 4.3.3, 4.3.4, 5.2.1, 10.1.2
CO5	2.1.2, 2.2.1, 2.2.2, 2.4.4, 3.1.2, 3.3.1, 3.3.2, 4.3.1, 4.3.3, 4.3.4, 7.2.2, 9.1.1, 10.1.2, 11.3.2, 12.2.1,

22PES306	**THERMAL SYSTEMS AND HEAT TRANSFER** *(Use of Approved Steam table and Refrigeration and Air conditioning table is permitted)*	**SEMESTER III**

PREREQUISITES	CATEGORY	L	T	P	C
NIL	ES	3	1	0	4

Course Objectives	*To enable the students to understand the basic laws of Thermodynamics, Heat and mass transfer and the principle of operation of thermal equipment like IC engine, boiler, and refrigerator etc.,	
UNIT- I	**THERMODYNAMICS**	**(9+3 Periods)**
Thermodynamic systems - zeroth law, first and second laws of thermodynamics, applications, steady flow energy equation, ideal gas processes - calculation for work done, heat transfer and entropy changes.		
UNIT- II	**POWER PLANTS**	**(9+3 Periods)**
Properties of steam: P-V, T-S, and H-S diagrams- Rankine cycle (without reheat and regeneration), Steam power plant, Brayton cycle, gas turbine power plant, cogeneration and combined cycle power plants.		
UNIT- III	**IC ENGINES**	**(9+3 Periods)**
Carnot cycle, Otto, diesel cycles, Principles of operations of IC Engines, valve and port timing diagrams, indicator diagrams; diesel fuel pump and injector, need for cooling and lubrication of IC engines, coil and magneto ignition systems, mechanical, brake thermal and indicated thermal efficiencies.		
UNIT- IV	**REFRIGERATION AND AIR-CONDITIONING**	**(9+3 Periods)**
Refrigeration- vapour compression cycle - vapour absorption cycle, comparison between vapour compression and absorption systems. Psychrometry, Psychrometric chart– processes– summer and winter air conditioning systems.		
UNIT- V	**HEAT TRANSFER**	**(9+3 Periods)**
Heat conduction through plane and cylinder, critical thickness of insulation, natural and forced convection. Radiation, Surface emission properties, Stefan-Boltzmann law, Kirchhoff'slaw.		
Contact Periods: **Lecture: 45 Periods Tutorial: 15 Periods Practical: 0 Periods Total: 60 Periods**		

TEXT BOOK:

1	*Mahesh M Rathore, "**Thermal Engineering**", McGraw Hill Education (India) Private Limited, Chennai, 2010.*
2	*Yunus A Cengel**" Introduction to Thermodynamics and Heat Transfer",** McGraw Hill Inc., New York, 2007.*

REFERENCES:

1	*Nag.P.K ,**"Engineering Thermodynamics",**TataMcGraw-Hill,NewDelhi,2008.*
2	*R.K.Rajput **"Thermal Engineering",** Laxmi Publications (P) Ltd, 6th edition New Delhi, 2006.*
3	*Kothandaraman.C.P.,Domkundwar.S .and A.V.Domkundwar **"Acourse in T hermal Engineering",** Dhanpat Rai and Sons.,5th edition, 2000.*
4	*Holman.J.P **"Heat and MassTransfer",** 3rd Edition, McGraw-Hill, 2007.*
5	*GanesanV **"Internal Combustion Engines",** Tata McGraw Hill Publishing company, New Delhi ,2007.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Determine the change of properties and energy transfer during different thermodynamic processes in closed system using idealgas.	K3
CO2	Calculate the thermal efficiency of the Rankine cycle.	K3
CO3	Determine the air standard efficiency of the Otto cycle and Diesel cycle.	K3
CO4	Describe the vapour compression and vapour absorption refrigeration systems.	K2
CO5	Calculate the heat flow rate in a plane wall and hollow cylinder by conduction.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	2	3	2	2	2	-	-	-	1	3	1	1	-	1	1
CO2	2	3	2	2	2	-	-	-	1	3	2	1	-	1	1
CO3	2	3	2	2	2	-	-	-	1	3	3	1	-	1	1
CO4	-	1	1	2	2	-	-	-	1	3	1	1	-	1	1
CO5	2	3	2	2	2	-	-	-	1	3	3	1	-	1	1
22PES306	**2**	**3**	**2**	**2**	**2**	-	-	-	**1**	**3**	**2**	**1**	-	**1**	**1**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.1, 1.1.2, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.4, 3.1.1, 3.1.2, 3.1.6, 3.3.1, 3.4.1, 4.1.1, 4.1.2, 4.3.1, 4.3.3, 4.3.4, 5.1.1, 5.2.1, 5.2.2, 5.3.1, 9.2.1, 10.1.1, 10.1.2, 10.1.3, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.2.2, 12.3.2
CO2	1.1.1,1.1.2.1.3.1,2.1.1,2.1.2,2.1.3,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.4,3.1.1,3.1.2,3.1.6,3.3.1,3.4.1,4.1.1,4.1.2,4.3.1,4.3.3,4.3.4,5.1.1,5.2.1,5.2.2,5.3.1,9.2.1,10.1.1,10.1.2,10.1.3,10.2.2,10.3.1,10.3.2,11.3.1,11.3.2,12.2.2,12.3.2
CO3	1.1.1,1.1.2,1.3.1,2.1.1,2.1.2,2.1.3,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.4,3.1.1,3.1.2,3.1.6,3.3.1,3.4.1,4.1.1,4.1.2,4.3.1,4.3.3,4.3.4,5.1.1,5.2.1,5.2.2,5.3.1,9.2.1,10.1.1,10.1.2,10.1.3,10.2.2,10.3.1,10.3.2,11.1.1,11.2.1,11.3.1,11.3.2,12.2.2,12.3.2
CO4	2.1.1,2.4.4,3.1.2,3.1.6,3.3.1,3.4.1,4.1.1,4.2.1,4.3.1,4.3.4,5.1.2,5.2.1,5.2.2,9.2.1,10.1.1,10.1.2,10.1.3,10.2.2,10.3.1,10.3.2,11.3.1,12.2.2,12.3.2
CO5	1.1.1,1.1.2,1.3.1,2.1.1,2.1.2,2.1.3,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.4,3.1.1,3.1.2,3.1.6,3.3.1,3.4.1,4.1.1,4.1.2,4.3.1,4.3.3,4.3.4,5.1.1,5.2.1,5.2.2,5.3.1,9.2.1,10.1.1,10.1.2,10.1.3,10.2.2,10.3.1,10.3.2,11.1.1,11.2.1,11.3.1,11.3.2,12.2.2,12.3.2

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	10	30	60	-	-	-	100
CAT2	15	35	50		-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	40	60	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	35	65	-	-	-	100
ESE	10	30	60	-	-	-	100

22PES307	ENGINEERING MECHANICS (Common to CIVIL, EEE & PRODN Branches)	SEMESTER III

PREREQUISITES	CATEGORY	L	T	P	C
NIL	ES	3	0	0	3

Course Objectives	*To learn the basic principles and concepts of force system. *To gain knowledge on different kinds of friction. *To understand the concepts of centre of gravity and moment of inertia. *To understand the Kinematics and kinetics of rigid body motion. *To study the dynamics of particles, impulse and momentum Principles.	
UNIT- I	**BASIC CONCEPTS OF FORCES**	**(9 Periods)**
Basic Concepts and Principles of Forces– Laws of Mechanics – System of forces in Plane – Free body Diagrams- resultant of a force system – resolution and composition of forces – Lami's theorem – moment of a force – physical significance of moment-Varignon's theorem – resolution of a force and couple system– forces in space – addition of concurrent forces in space – equilibrium of a particle in space.		
UNIT- II	**STATIC AND DYNAMIC FRICTION**	**(9 Periods)**
Frictional resistance – classification of friction- laws of friction – coefficient of friction-angle offriction –angle of repose– cone of friction – advantages - equilibrium of a body on a rough inclinedplane –ladder friction – rope friction – wedge friction		
UNIT- III	**PROPERTIES OF SECTION**	**(9 Periods)**
Centroid and Centre of Gravity for simple & Composite sections– theorems of moment of inertia Determination of moment of inertia of various sections –Product of Inertia – Principal moment of inertia of plane areas - Mass moment inertia of circular plate, Cylinder, Cone, Sphere.		
UNIT- IV	**BASICS OF DYNAMICS - KINEMATICS**	**(9 Periods)**
Kinematics and kinetics – displacements, velocity and acceleration - Equations of motion –Rectilinear motion of a particle with uniform velocity, uniform acceleration, varying acceleration– motion under gravity – relative motion – curvilinear motion of particles – projectiles– angle of projection – range – time of flight and maximum height		
UNIT- V	**BASICS OF DYNAMICS - KINETICS**	**(9 Periods)**
Newton's second law of motion – linear momentum – D'Alembert's principle, Dynamic equilibrium– equation of particles-principle of work and energy –law of conservation of energy –Principle of impulse and momentum – Equations of momentum – Laws of conservation of momentum. Impact – Time of compression, restitution, collision – Co-efficient of restitution – types of impact – collision of elastic bodies by direct central impact and oblique impact – collision of small body with a massive body – Kinetic energy of a particle.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*F.B. Beer and E.R. Johnson, **"Vector Mechanics for Engineers",** Tata Mc.Graw Hill Pvt Ltd,11th Edition, 2013.*
2	*Rajasekaran S &Sankara Subramanian, "**Fundamentals of Engineering Mechanics**", Vikas Publishing House Pvt Ltd. 3rdEdition, 2017*

REFERENCES:

1	*S. Timoshenko and Young, "**Engineering Mechanics**", McGraw Hill, 4th Edition, 2017.*
2	*Bansal R.K, "**A Text Book of Engineering Mechanics**", Laxmi Publications, 2015.*
3	*R.C. Hibbeller, "**Engineering Mechanics**", Prentice Hall of India Ltd, 14th Edition, 2017.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Familiarize the principles and Concepts of Mechanics.	K2
CO2	Calculate the friction force acting on a plane under various conditions.	K3
CO3	Determine the centre of gravity and moment of inertia for different sections.	K3
CO4	Predict the Rectilinear and curvilinear motion of particles.	K3
CO5	Evaluate the dynamics of particles using kinetic principles.	K4

COURSE ARTICULATION MATRIX:

	a) CO and PO Mapping														
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	3	2	1	-	-	2	-	-	-	-	-	-	1	2	2
CO2	3	2	1	-	-	2	-	-	-	-	-	1	-	2	3
CO3	3	3	1	-	-	2	-	-	-	-	-	-	-	2	3
CO4	3	3	1	-	-	2	-	-	-	-	-	1	1	2	3
CO5	3	3	1	-	-	2	-	-	-	-	-	1	1	2	3
22PES307	**3**	**3**	**1**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**2**	**3**
1 – Slight, 2 – Moderate, 3 – Substantial															
	b) CO and Key Performance Indicators Mapping														
CO1	1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.2.3, 2.2.4, 2.3.1, 2.4.1, 2.4.2, 2.4.3, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 6.1.1														
CO2	1.1.1, 1.1.2, 1.2.1,1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.2.1, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 6.1.1, 12.2.2														
CO3	1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 6.1.1														
CO4	1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 6.1.1, 12.2.2														
CO5	1.1.1, 1.1.2, 1.2.1,1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 6.1.1, 12.2.2														

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	30	30	10	-	-	100
CAT2	30	30	30	10	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	30	30	30	10	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	30	30	30	10	-	-	100
ESE	30	30	30	10	-	-	100

22PPC301	MACHINE TOOLS AND PROCESSES	SEMESTER III

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	0	0	3

Course Objectives	*To study different machine tools working principle and understand different types of mechanism using some special machine tools	
UNIT- I	**MACHINE TOOLS AND PROCESSES FOR PRODUCING ROUND SHAPES**	**(9 Periods)**
Engine Lathe – functions; work holding devices in lathe – functions – Chuck, Centre, Dogs, Steady Rest and Follower Rest; Mechanism of lathe – Apron, Feed, Tumbler Gear; various operations performed in Lathe – facing, turning, chamfering and knurling – relative positions of tool and job – Taper turning methods. Drilling machines – specifications, types - feed mechanism, operations – drill bit nomenclature.		
UNIT- II	**MACHINE TOOLS AND PROCESSES FOR PRODUCING VARIOUS SHAPES**	**(9 Periods)**
Milling – specifications – types - cutter nomenclature – types of cutters – milling processes – indexing – gear forming in milling – gear generation - gear shaping and gear hobbing. Broaching – specifications, types, tool nomenclature, broaching operations.		
UNIT- III	**SPECIAL PURPOSE MACHINE TOOLS**	**(9 Periods)**
Shaper machine – planner machine-slotter machine-working principle –types of operations – types of mechanism used-applications.		
UNIT- IV	**ABRASIVE MACHINING AND FINISHING OPERATIONS**	**(9 Periods)**
Abrasives - bonded abrasives - Grinding process- wheel, gear grinding operations and machines - grinding fluids - Design Consideration for Grinding - Finishing operations: Lapping, Honing, Burnishing- economics of grinding and finishing operation.		
UNIT- V	**MACHINE TOOL STRUCTURE AND AUTOMATION**	**(9 Periods)**
Machine tools structures -erecting and testing of machine tools- Vibration and chatters in machining- Automation: Capstan and Turret lathe - single spindle and multi spindle automats - Swiss type and automatic screw machines-Feeding Mechanisms-Transfer mechanism-Tracer controller Mechanism.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Hajra Choudhry S.K. and Bose S.K., **"Workshop Technology Vol II",** Media Promoters and Publishers Pvt. Ltd., Bombay,12th edition, 2007.*
2	*Sharma P.C., **"A Text Bookof Production Technology",**S.Chand and Company Ltd., New Delhi, 10th Revised edition, 2010*

REFERENCES:

1	*Khanna, O.P and Lal, M **"A Text Bookof Production Technology"**, Vol.II, DhanpatRai Publications (P) ltd.,1st Edition, 2009.*
2	*SeropeKalpakjian and Steven R.Schmid, **"Manufacturing Engineering and Technology"**, Addison Wesley Longman (Singapore) Pvt. Ltd, Delhi, 2009.*
3	*Jain R.K. and Gupta S.C"**Production Technology**"Khanna Publisher, New Delhi, 2012.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Describe about various mechanism used in machine tools.	K2
CO2	Explain the processes involved in production of round shaped components.	K2
CO3	Explain the processes involved in production of prismatic and contour shapes.	K2
CO4	Discuss about various finishing operations.	K2
CO5	Explain the machine tool structure and mechanisms of automation.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	2	1	1	3	3	3	3	-	1	3	3	3	2	1	-
CO2	2	3	3	3	3	3	3	-	1	3	3	3	3	-	2
CO3	2	3	3	3	3	3	3	-	1	3	3	3	3	-	2
CO4	2	3	3	3	3	3	3	-	1	3	3	3	3	-	2
CO5	2	3	3	3	3	3	3	-	1	3	3	3	3	2	3
22PPC301	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**-**	**1**	**3**	**3**	**3**	**3**	**1**	**2**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1,1.3.1,1.4.1,2.2.2,2.2.3,2.2.4,3.1.1,3.1.5,3.2.1,3.2.3,4.1.1,4.1.2,4.1.3,4.2.1,4.3.1,4.3.4, 5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,6.1.1,6.2.1,7.1.1,7.1.2,7.2.1,7.2.2,9.2.1,9.3.1,10.1.1,10.1.2, 10.1.3,10.2.1,10.2.2,10.3.1,10.3.2,11.1.1,11.2.1,11.3.1,11.3.2,12.1.1,12.1.2,12.2.1,12.2.2, 12.3.1,12.3.2
CO2	1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.2,2.2.3,2.2.4,2.3.1,2.4.2,2.4.3,2.4.4,3.1.1,3.1.2,3.1.3, 3.1.4,3.1.5,3.1.6,3.2.1,3.2.3,3.3.2,3.4.1,4.1.1,4.1.2,4.1.3,4.1.4,4.2.1,4.3.1,4.3.4,5.1.1,5.1.2, 5.2.1,5.2.2,5.3.1,5.3.2,6.1.1,6.2.1,7.1.1,7.1.2,7.2.1,7.2.2,9.2.1,9.3.1,10.1.1,10.1.2,10.1.3, 10.2.1,10.2.2,10.3.1,10.3.2,11.1.1,11.2.1,11.3.1,12.1.1,12.1.2,12.2.1,12.2.2,12.3.1,12.3.2
CO3	1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.2,2.2.3,2.2.4,2.3.1,2.4.2,2.4.3,2.4.4,3.1.1,3.1.2,3.1.3, 3.1.4,3.1.5,3.1.6,3.2.1,3.2.3,3.3.2,3.4.1,4.1.1,4.1.2,4.1.3,4.1.4,4.2.1,4.3.1,4.3.4,5.1.1,5.1.2, 5.2.1,5.2.2,5.3.1,5.3.2,6.1.1,6.2.1,7.1.1,7.1.2,7.2.1,7.2.2,9.2.1,9.3.1,10.1.1,10.1.2,10.1.3, 10.2.1,10.2.2,10.3.1,10.3.2,11.1.1,11.2.1,11.3.1,12.1.1,12.1.2,12.2.1,12.2.2,12.3.1,12.3.2
CO4	1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.2,2.2.3,2.2.4,2.3.1,2.4.2,2.4.3,2.4.4,3.1.1,3.1.2,3.1.3, 3.1.4,3.1.5,3.1.6,3.2.1,3.2.3,3.3.2,3.4.1,4.1.1,4.1.2,4.1.3,4.1.4,4.2.1,4.3.1,4.3.4,5.1.1,5.1.2, 5.2.1,5.2.2,5.3.1,5.3.2,6.1.1,6.2.1,7.1.1,7.1.2,7.2.1,7.2.2,9.2.1,9.3.1,10.1.1,10.1.2,10.1.3, 10.2.1,10.2.2,10.3.1,10.3.2,11.1.1,11.2.1,11.3.1,12.1.1,12.1.2,12.2.1,12.2.2,12.3.1,12.3.2
CO5	1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.2,2.2.3,2.2.4,2.3.1,2.4.2,2.4.3,2.4.4,3.1.1,3.1.2,3.1.3, 3.1.4,3.1.5,3.1.6,3.2.1,3.2.3,3.3.2,3.4.1,4.1.1,4.1.2,4.1.3,4.1.4,4.2.1,4.3.1,4.3.4,5.1.1,5.1.2, 5.2.1,5.2.2,5.3.1,5.3.2,6.1.1,6.2.1,7.1.1,7.1.2,7.2.1,7.2.2,9.2.1,9.3.1,10.1.1,10.1.2,10.1.3, 10.2.1,10.2.2,10.3.1,10.3.2,11.1.1,11.2.1,11.3.1,12.1.1,12.1.2,12.2.1,12.2.2,12.3.1,12.3.2

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	15	50	10	25	-	-	100
CAT2	15	68	17	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	40	50	10	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	50	40	10	-	-	100
ESE	15	60	25	-	-	-	100

22PPC302	ENGINEERING METALLURGY	SEMESTER III

PREREQUISITES	CATEGORY	L	T	P	C
MATERIALS SCIENCE	PC	3	0	0	3

Course Objectives	*To study the phase diagrams, various heat treatment methods, principles of foundry, welding and powder metallurgy and to acquire knowledge on testing materials, properties and application of various methods.	
UNIT- I	**CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS**	**(9 Periods)**
Constitution of alloys – Solid solutions, substitutional and interstitial –phase diagrams, Isomorphous, eutectic, peritectic, eutectoid and peritectoid reactions, Iron – Iron carbide equilibrium diagram.		
UNIT- II	**HEAT TREATMENT AND SURFACE TREATMENT**	**(9 Periods)**
Definition – Full annealing, process annealing, stress relief, recrystallisation - spheroidizing – normalising, hardening and tempering of steels – austempering, martempering - Isothermal transformation diagrams – cooling curves superimposed on I.T diagram- CCR - hardenability, Jominy end quench test - Case hardening, carburising, nitriding, cyaniding, carbonitriding–Flame and Induction hardening.		
UNIT- III	**FERROUS AND NON FERROUS METALS**	**(9 Periods)**
Plain carbon steels – alloy steels - Effect of alloying elements (Mn, Si, Cr, Mo, V , Ni, Ti& W) on properties of steel - stainless and tool steels – Gray, White, Malleable, Spheroidal graphite - alloy cast irons – heat resistant steels and die steels. Copper, Aluminium, Nickel, Magnesium, Titanium, Lead, Tin - Important alloys - their composition, properties and applications - Material Specification and standards.		
UNIT- IV	**FOUNDRY AND POWDER METALLURGY**	**(9 Periods)**
Solidification of pure metals and alloys – melting – super heating – fluxing – micro and macro segregation – hot tears – heat transfer and structural change - Production of powders, mixing, blending, compacting, sintering and hot pressing – secondary operations- application of powder metallurgy – advantages and limitations.		
UNIT- V	**WELDING METALLURGY AND TESTING OF MATERIALS**	**(9 Periods)**
Weldability – heat distribution during welding and thermal effects on parent metals – HAZ – factors affecting HAZ - hardening, cracking, distortion and residual stresses – stress relief treatment of welds – Mechanical tests - tension, compression, impact, hardness, Non Destructive Testing basic principles and testing method for Radiographic testing, Ultrasonic testing, Magnetic Particle inspection and Liquid penetrant inspection test - Eddy current testing.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Higgins R.A **"Engineering Metallurgy**", Viva books (p) ltd., 6th edition, 1998.*
2	*Dieter, G.E "**Mechanical metallurgy, SI metric edition**", McGraw-Hill, 1988.*
3	*Sydney H.Avner "**Introduction to Physical Metallurgy**", Tata McGraw Hill Book Company, 1994.*

REFERENCES:

1	*William D Callsber "**Material Science and Engineering**", Wiley India pvt Ltd 2007.*
2	*LakhtinYu."**Engineering Physical Metallurgy and Heat Treatment**", Mir Publisher,1985.*
3	*Kenneth G.Budinski and Michael K.Budinski "**Engineering Materials**", Prentice-Hall of India Private Limited, 4th Indian Reprint 2002.*
4	*GUY.A.G "**Elements of Physical Metallurgy**", Oxford & IBH Pub.Co, 1990.*
5	*O.P.Khanna "**Material Science And Metallurgy**", Dhanpat Rai Publication, 2011.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Predict the alloy components and its composition variation with respect to temperature changes.	K3
CO2	Select suitable materials and heat treatment methods for various industrial applications.	K2
CO3	Explain various ferrous and nonferrous materials and their applications.	K2
CO4	Apply the knowledge of foundry and powder metallurgy to solve various industrial production processes	K3
CO5	Describe welding metallurgy and various Non-destructive testing methods to meet industrial requirements.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	2	2	2	2	-	-	-	-	1	3	2	1	3	-	-
CO2	2	2	2	3	-	-	-	-	1	3	2	1	3	-	-
CO3	2	2	2	3	-	-	-	-	1	3	1	1	3	-	-
CO4	2	2	2	3	-	-	-	-	1	3	2	1	3	-	-
CO5	2	2	2	3	-	-	-	-	1	3	2	1	3	-	-
22PPC302	**2**	**2**	**2**	**3**	-	-	-	-	**1**	**3**	**2**	**1**	**3**	-	-

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.2.2, 2.2.3, 2.2.4, 2.4.2, 2.4.4, 3.1.1, 3.1.2, 3.1.5, 3.1.6, 3.3.1, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.3.1, 4.3.4, 9.2.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.3.1, 12.2.2, 12.3.1
CO2	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.2.2, 2.2.3, 2.2.4, 2.4.2, 2.4.4, 3.1.1, 3.1.2, 3.1.5, 3.1.6, 3.3.1, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.2.1, 4.3.1, 4.3.4, 9.2.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.3.1, 12.2.2, 12.3.1
CO3	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.2.2, 2.2.3, 2.2.4, 2.4.2, 2.4.4, 3.1.1, 3.1.2, 3.1.5, 3.1.6, 3.3.1, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.2.1, 4.3.1, 4.3.4, 9.2.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.2.2, 12.3.1
CO4	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.2.1, 2.2.2, 2.2.3, 2.4.2, 2.4.4, 3.1.1, 3.1.2, 3.1.5, 3.1.6, 3.3.1, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.2.1, 4.3.1, 4.3.4, 9.2.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.3.1, 12.2.2, 12.3.1
CO5	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.2.1, 2.2.2, 2.2.3, 2.4.2, 2.4.4, 3.1.1, 3.1.2, 3.1.5, 3.1.6, 3.3.1, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.2.1, 4.3.1, 4.3.4, 9.2.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.3.1, 12.2.2, 12.3.1

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	15	68	17	-	-	-	100
CAT2	15	52	33	-	-		100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	20	60	20	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	20	60	20	-	-	-	100
ESE	30	50	20	-	-	-	100

22PPC303	MANUFACTURING TECHNOLOGY	SEMESTER III

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	0	0	3

Course Objectives	*To enable the students to understand the concepts of basic manufacturing processes and fabrication techniques, such as metal casting, metal joining, metal forming, sheet metal and manufacture of plastic components.	
UNIT- I	**METAL CASTING PROCESSES**	**(9 Periods)**
Sand Casting : Sand Mould – Type of patterns – Pattern Materials – Pattern allowances – Moulding sand Properties and testing – Cores –Types and applications – Moulding machines– Types and applications; Melting furnaces : Blast and Cupola Furnaces; Principle of special casting processes : Shell – investment – Ceramic mould – Pressure die casting – Centrifugal Casting – CO_2 process – Stir casting; Defects in Sand casting.		
UNIT- II	**JOINING PROCESSES**	**(9 Periods)**
Operating principle, basic equipment, merits and applications of Fusion welding processes: Gas welding – Types – Flame characteristics; Manual metal arc welding – Gas Tungsten arc welding – Gas metal arc welding – Submerged arc welding – Electro slag welding; Operating principle and applications of Resistance welding – Plasma arc welding –Thermit welding – Electron beam welding – Friction welding and Friction Stir Welding; Brazing and soldering; Weld defects: types, causes and cure.		
UNIT- III	**METAL FORMING PROCESSES**	**(9 Periods)**
Hot working and cold working of metals – Forging processes – Open, impression and closed die forging– forging operations. Rolling of metals– Types of Rolling – Flat strip rolling – shape rolling operations – Defects in rolled parts. Principle of rod and wire drawing – Tube drawing – Principles of Extrusion – Types – Hot and Cold extrusion.		
UNIT- IV	**SHEET METAL PROCESSES**	**(9 Periods)**
Sheet metal characteristics – shearing, bending and drawing operations – Stretch forming operations – Formability of sheet metal – Test methods –special forming processes-Working principle and applications – Hydro forming – Rubber pad forming – Metal spinning– Introduction of Explosive forming, magnetic pulse forming, peen forming, Super plastic forming – Micro forming.		
UNIT- V	**MANUFACTURE OF PLASTIC COMPONENTS**	**(9 Periods)**
Types and characteristics of plastics – Moulding of thermoplastics – working principles and typical applications – injection moulding – Plunger and screw machines – Compression moulding, Transfer Moulding – Typical industrial applications – introduction to blow moulding – Rotational moulding – Film blowing – Extrusion – Thermoforming – Bonding of Thermoplastics.		
Contact Periods: **Lecture: 45 Periods** **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**		

TEXT BOOK:

1	*HajraChouldhary S. K. and HajraChouldhary A. K.**"Elements of Workshop Technology -Volume I",** Media promoters and Publishers Private Limited, Mumbai, 2008.*
2	*Kalpakjian. S "**Manufacturing Engineering and Technology**", Pearson Education India Edition, 2018*

REFERENCES:

1	*Sharma, P.C., "**A TEXT BOOK of production Technology**", S.Chand and Co. Ltd., 2004.*
2	*P.N. Rao "**Manufacturing Technology Foundry, Forming and Welding**", TMH-2003; 2ndEdition, 2003.*
3	*Roy. A. Lindberg **"Processes and Materials of Manufacture",** PHI / Pearson Education, 2006*
4	*R.K. Rajput "**A Textbook of Manufacturing Technology (Manufacturing Processes)"**Laxmi Publications Limited, New Delhi, 2019.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Describe the fundamentals and different types of metal casting process.	K1, K2
CO2	Explain the different types and processes of metal joining process.	K4
CO3	Explain the concepts of metal forming processes.	K4
CO4	Describe various sheet metal forming processes.	K1, K2
CO5	Discuss different processes used in making plastic parts.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	2	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	1	-	2
CO3	3	-	-	-	-	-	-	-	-	-	-	-	1	-	2
CO4	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO5	2	-	-	-	-	-	-	-	-	-	-	-	1	-	-
22PPC303	**3**	-	-	-	-	-	-	-	-	-	-	-	**1**	-	**1**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.3.1, 1.4.1; 14.1.1
CO2	1.3.1, 1.4.1; 14.1.1; 15.1.1
CO3	1.3.1, 1.4.1; 14.1.1; 15.1.1
CO4	1.3.1, 1.4.1; 14.1.1
CO5	1.3.1, 1.4.1; 14.1.1

ASSESSMENT PATTERN– THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	25	25	20	10	10	10	100
CAT2	25	25	20	10	10	10	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	25	25	20	10	10	10	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	25	25	20	10	10	10	100
ESE	25	25	20	10	10	10	100

22PMC3Z2	CONSTITUTION OF INDIA *(Common to all Branches)*	SEMESTER III

PREREQUISITES	CATEGORY	L	T	P	C
NIL	MC	3	0	0	0

Course Objectives	*The objective of the course is to familiarize the students on the role, powers and functions of Indian government. Also understand the recent acts in India.	
UNIT- I	**INTRODUCTION AND EMERGENCY PROVISIONS**	**(9 Periods)**
Historical Background: The Company rule, The Crown rule - Constituent Assembly: Composition, Objectives - Preamble and Salient features of the Indian Constitution - Fundamental Rights, Fundamental Duties, Directive Principles of state policy, Emergency Provisions - National Emergency, President Rule, Financial Emergency.		
UNIT- II	**SYSTEM OF GOVERNMENT**	**(9 Periods)**
Parliamentary system: merits, demerits, reasons for adopting parliamentary system – Federal system: Evaluation of federal features –Centre-State relations: Legislative, Administrative and Financial relations – Local Government: Panchayati Raj and urban local government.		
UNIT- III	**UNION AND STATE GOVERNMENT**	**(9 Periods)**
President of India: Election, Powers and functions - Prime Minister and Cabinet: Structure and functions – Governor: Powers and functions - Chief Minister and Council of Ministers: Functions.		
UNIT- IV	**ORGANS OF GOVERNANCE AND RECENT ACTS**	**(9 Periods)**
Parliament: Lok Sabha and Rajya Sabha, Composition and powers - State Legislative Assembly and Legislative Council: Composition and powers - Judicial System in India: Structure and features - Supreme Court and High Court: Composition, Jurisdiction, Recent acts in significance-RTI, Citizenship act, POCSO act.		
UNIT- V	**POLITICAL DYNAMICS**	**(9 Periods)**
Political parties: Party system, Recognition of National and State parties – Elections: Electoral system and reforms – Pressure groups – National Integration: Obstacles, National Integration Council – Foreign Policy: Principles and Objectives.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Period**		

TEXT BOOK:

1	*National portal of India, "**The Constitution of India**" (Full Text), https://legislative.gov.in/constitution-of-india*
2	*Dr.B.R.Ambedkar, "**The Constitution of India**", SudhirPrakashan, 2020*

REFERENCES:

1	*Durga Das Basu, "**Introduction to the Constitution of India**, LexisNexis, 2022*
2	*P.M.Bakshi, "**The Constitution of India**", LexisNexis, 2020*
3	*Subash C Kashyap, "**Our Parliament**", National Book Trust, 2021*
4	*Subash C Kashyap, "**Our Political System**", National Book Trust, 2011*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Know the evolution of Indian Constitution and its basic premises.	K1
CO2	Explain the system of governance in India.	K2
CO3	Describe the structure of Union and State Governments	K2
CO4	Obtain the knowledge of functions of Legislature and Judiciary	K1
CO5	Know the political system of India	K1

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping															
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	1	-	1	1	-	-	-	-	-	-
CO3	-	-	-	-	-	2	-	1	1	-	-	-	-	-	-
CO4	-	-	-	-	-	1	-	1	2	-	-	-	-	-	-
CO5	-	-	-	-	-	2	-	2	1	-	-	-	-	-	-
22PMC3Z2	-	-	-	-	-	**2**	-	**1**	**1**	-	-	-	-	-	-
1 – Slight, 2 – Moderate, 3 – Substantial															
b) CO and Key Performance Indicators Mapping															
CO1	6.1.1, 6.2.1, 8.1.1, 8.2.1, 8.2.2, 9.1.2														
CO2	6.1.1, 6.2.1, 8.1.1, 8.2.1, 8.2.2, 9.1.2														
CO3	6.1.1, 6.2.1, 8.1.1, 8.2.1, 8.2.2														
CO4	6.1.1, 6.2.2, 9.1.2, 9.2.1														
CO5	6.2.2, 8.1.1,8.2.2, 9.1.2, 9.2.1														

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	50	50	-	-	-	-	100
CAT2	50	50		-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	50	50	-	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	50	50	-	-	-	-	100
ESE	50	50	-	-	-	-	100

22PPC304	METALLURGY LABORATORY AND THERMAL SCIENCE LABORATORY	SEMESTER III

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	0	0	3	1.5

22PPC304	(A) METALLURGY LABORATORY

Course Objectives	*To impart the skill of micro structural examination, defect examination and heat treatment of ferrous and nonferrous materials.

LIST OF EXERCISES

1. Study of metallurgical microscope
2. Preparation of specimen for micro-examination
3. Study of Iron Carbon Equilibrium diagram
4. Study of microstructure of materials
   - -Steel (low carbon steel, high carbon steel, HSS, spheroidised steel)
   - -Cast iron (grey, white, SG)
   - -Non Ferrous (brass, aluminium, silicon alloy)
   - -Composites (MMC and PMC)
5. Study of Heat Treatment processes (Annealing, Normalizing, Hardening and Tempering)
6. Study of non-destructive tests
   - -Liquid penetrant test
   - -Ultrasonic inspection
   - -Magnetic particle inspection
   - -Radiography
7. Determination of Hardenability by Jominy end quench test.

Contact Periods:
Lecture: 0 Periods **Tutorial: 0 Periods** **Practical: 22.5 Periods** **Total: 22.5 Periods**

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Prepare specimen for microscopic examination.	K2
CO2	Identify the microstructures of ferrous and nonferrous metals.	K3
CO3	Realize the effect of heat treatment on the properties of materials.	K3
CO4	Select suitable non-destructive tests for finding flaws in a material.	K3
CO5	Determine Hardenability by Jominy end quench test.	K3

COURSE ARTICULATION MATRIX:

	a) CO and PO Mapping														
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	2	3	1	1	-	1	-	-	1	-	1	-	2	1	1
CO2	2	3	1	1	-	1	-	-	1	-	1	-	2	1	1
CO3	2	1	-	1	-	1	1	-	1	-	1	-	2	1	1
CO4	3	2	1	1	-	1	-	-	1	-	1	-	2	1	1
CO5	3	2	1	1	-	1	-	-	1	-	1	-	2	1	1
22PPC304 (A)	**3**	**3**	**1**	**1**	**-**	**1**	**1**	**-**	**1**	**-**	**1**	**-**	**2**	**1**	**1**
1 – Slight, 2 – Moderate, 3 – Substantial															

	b) CO and Key Performance Indicators Mapping
CO1	1.2.1. 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.2.4, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2,4.3.1, 6.1.1, 6.2.1, 9.1.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 11.3.1
CO2	1.2.1. 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.2.4, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2,4.3.1, 6.1.1, 6.2.1, 9.1.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 11.3.1
CO3	1.2.1. 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.2.4, 2.4.2, 2.4.3, 2.4.4, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2,4.3.1, 6.1.1, 6.2.1, 9.1.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 11.3.1
CO4	1.2.1. 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.2.4, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2,4.3.1, 6.1.1, 6.2.1, 9.1.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 11.3.1
CO5	1.2.1. 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.2.4, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2,4.3.1, 6.1.1, 6.2.1, 9.1.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 11.3.1

22PPC304	(B) THERMAL SCIENCE LABORATORY

Course Objectives	*To demonstrate and conduct performance test on internal combustion engines, compressors and blowers.

LIST OF EXERCISES

1. Valve timing diagram of single cylinder diesel engine.
2. Port timing diagram of single cylinder petrol engine.
3. Performance and heat balance test on 4 stroke diesel engine.
4. Economic speed test on diesel engine.
5. Retardation test to find frictional power of a diesel engine.
6. Performance test on constant speed blower.
7. Performance test on variable speed blower.
8. Performance test on reciprocating air compressor.

Contact Periods:
Lecture: 0 Periods Tutorial: 0 Periods Practical: 22.5 Periods Total: 22.5 Periods

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Recognize how the valves on a diesel engine operate.	K2
CO2	Recognize how the ports in a gasoline engine operate.	K2
CO3	Analyze the performance characteristics of diesel engines.	K4
CO4	Evaluate the performance parameters of blowers.	K5
CO5	Analyze the air compressor characteristics.	K4

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	2	1	3	2	2	3	-	-	2	-	1	1	2	1
CO2	2	2	1	3	2	2	3	-	-	2	-	1	1	2	1
CO3	3	3	3	3	3	2	3	-	2	3	2	2	1	2	1
CO4	3	3	3	3	3	2	3	-	1	3	2	1	1	2	1
CO5	3	3	3	3	3	2	3	-	2	3	2	2	1	2	1
22PPC304 (B)	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**-**	**1**	**3**	**2**	**2**	**1**	**2**	**1**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.2.4, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.4, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2,4.3.1, 5.1.1, 5.1.2, 5.3.2, 6.1.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 10.1.1, 10.1.2, 10.2.2, 10.3.1, 12.1.1, 12.2.1
CO2	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.2.4, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.4, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2,4.3.1, 5.1.1, 5.1.2, 5.3.2, 6.1.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 10.1.1, 10.1.2, 10.2.2, 10.3.1, 12.1.1, 12.2.1
CO3	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.4, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2,4.3.1, 5.1.1, 5.1.2, 5.3.2, 6.1.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.1.1, 9.2.1, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.2.2, 10.3.1, 11.1.1, 11.1.2, 11.2.1, 12.1.1, 12.2.1

CO4	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.4, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2,4.3.1, 5.1.1, 5.1.2, 5.3.2, 6.1.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.1.1, 9.2.1, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.2.2, 10.3.1, 11.1.1, 11.1.2, 11.2.1, 12.1.1, 12.2.1
CO5	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.4, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2,4.3.1, 5.1.1, 5.1.2, 5.3.2, 6.1.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.1.1, 9.2.1, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.2.2, 10.3.1, 11.1.1, 11.1.2, 11.2.1, 12.1.1, 12.2.1

22PPC305	MANUFACTURING PROCESSES LABORATORY	SEMESTER III

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	0	0	3	1.5

Course Objectives	* To practice various machining operations in lathe, radial drilling, shaper, grinder and milling machine.

LIST OF EXERCISES

1. Study of construction details of different types of lathes and tools.
2. Study of various accessories used in lathe.
3. Study of different types of tools used in lathe and the measuring instruments.
4. Exercises on models using conventional Lathes:
   - ❖ Facing, Plain turning, Step turning and Parting
   - ❖ Groove cutting, Knurling and Chamfering.
   - ❖ Form turning and Taper turning
   - ❖ Thread cutting (Internal and external - V and Square)
5. V-Groove cutting in Shaping machine.
6. Drilling, Tapping using Radial drilling machine.
7. Surface grinding using Surface Grinder.
8. Spur Gear milling.
9. Helical Gear milling.
10. Gear shaping.
11. Gear hobbing.
12. Making hexagonal hole using Slotting machine.
13. Letter cutting in vertical Milling machine.

Contact Periods:
Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Explain the constructional details of different types of lathe.	K2
CO2	Perform various lathe machining operations	K3
CO3	Set up machines like shaper, grinding and milling machine for various applications.	K3
CO4	Manufacture gears using forming and generating methods of gear manufacturing.	K4
CO5	Operate machines tools for various assembly and fabrication tasks and expose to time management.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping															
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	2	2	3	2	1	3	1	2	3	3	1	3	3	1	-
CO2	2	2	3	2	1	3	1	2	3	3	1	3	3	1	-
CO3	2	2	3	2	1	3	1	2	3	3	1	3	3	1	-
CO4	2	2	3	2	1	3	1	2	3	3	1	3	3	1	-
CO5	2	2	3	2	1	3	1	2	3	3	1	3	3	1	-
22PPC305	**2**	**2**	**3**	**2**	**1**	**3**	**1**	**2**	**3**	**3**	**1**	**3**	**3**	**1**	**-**
1 – Slight, 2 – Moderate, 3 – Substantial															

b) CO and Key Performance Indicators Mapping	
CO1	1.2.1. 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.2.4, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2,4.3.1, 5.2.2, 5.3.2, 6.1.1, 6.2.1, 7.1.2, 8.2.1, 8.2.2, 9.1.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2,10.3.1, 11.3.1, 12.1.1, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO2	1.2.1. 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.2.4, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2,4.3.1, 5.2.2, 5.3.2, 6.1.1, 6.2.1, 7.1.2, 8.2.1, 8.2.2, 9.1.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2,10.3.1, 11.3.1, 12.1.1, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO3	1.2.1. 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.2.4, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2,4.3.1, 5.2.2, 5.3.2, 6.1.1, 6.2.1, 7.1.2, 8.2.1, 8.2.2, 9.1.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2,10.3.1, 11.3.1, 12.1.1, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO4	1.2.1. 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.2.4, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2,4.3.1, 5.2.2, 5.3.2, 6.1.1, 6.2.1, 7.1.2, 8.2.1, 8.2.2, 9.1.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2,10.3.1, 11.3.1, 12.1.1, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO5	1.2.1. 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.2.4, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2,4.3.1, 5.2.2, 5.3.2, 6.1.1, 6.2.1, 7.1.2, 8.2.1, 8.2.2, 9.1.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2,10.3.1, 11.3.1, 12.1.1, 12.2.1, 12.2.2, 12.3.1, 12.3.2

22PBS408	APPLIED PROBABILITY AND STATISTICS	SEMESTER IV

PREREQUISITES	CATEGORY	L	T	P	C
NIL	BS	3	1	0	4

Course Objectives	*To provide students with the foundations of probabilistic and statistical methods and analysis techniques mostly used in various applications in engineering and science like modeling of processes and predictions based on processes.	
UNIT- I	**PROBABILITY AND RANDOM VARIABLES**	**(9+3Periods)**
Sample spaces–Events-Probability Axioms–Conditional Probability–Independent Events–Total Probability-Baye'stheorem. Random Variables**:** Distribution Functions–Expectation–Moments - Moment Generating Functions.		
UNIT- II	**PROBABILITY DISTRIBUTIONS**	**(9+3Periods)**
Discrete function: Binomial, Poisson, Geometric-Continuous function: Uniform, Exponential, Normal, Gamma, (Mean, Variance, Moment generating function and Simple problems)- Functions of random variables.		
UNIT- III	**JOINT PROBABILITY DISTRIBUTIONS**	**(9+3Periods)**
Two dimensional Discrete and Continuous random variable- Marginal and Conditional probability distribution functions- Independence- Covariance- Correlation.		
UNIT- IV	**TESTING OF HYPOTHESIS**	**(9+3Periods)**
Large samples: Tests for Mean and proportions– Small samples: Tests for Mean,Variance and Attributes using t, F, Chi–Square distribution.		
UNIT- V	**DESIGN OF EXPERIMENTS**	**(9+3Periods)**
One-way classification, two-way classification and Latin Square Design.		
Contact Periods: **Lecture: 45 Periods Tutorial: 15 Periods Practical: 0 Periods Total: 60 Periods**		

TEXT BOOK:

1	*Veerarajan.T, "**Probability and Statistics, Random Processes and Queuing Theory and Queuing Networks**", Second reprint 2016, McGraw Hill Education (India) Private Limited.*
2	*Shelton M.Ross, "**Introduction to Probability and Statistics for Engineers and Scientists**"Sixth edition, 2021, Elsevier.*

REFERENCES:

1	*Gupta S.C and Kapoor V.K, "**Fundamentals of Mathematical Statistic''**, Sultan Chand & Sons, New Delhi.Reprint 2015.*
2	*Gupta S.P, "**Statistical Methods**", Sultan Chand & Sons, New Delhi.Reprint 2015.*
3	*Douglas C. Montgomery and George C. Runger, "**Applied Statistics and Probability for Engineers**'' (6th edition), 2016, John Wiley & Sons.*
4	*Hwei Hsu,"**Schaum's Outline of Probability, Random Variables and Random Processes**", 2017, McGraw Hill Education.*
5	*Roy D Yates, "**Probability and Stochastic Processes a friendly introduction for Electrical and Computer engineers**", John Wiley & sons, third edition 2015.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Obtain the concept of probability and the general discrete probability distribution function and continuous probability distribution function.	K3
CO2	Explain the some probability mass functions and probability density functions.	K3
CO3	Explicate the joint probability distributions for discrete and continuous random variables.	K3
CO4	Describe hypothesis testing in general and in practice.	K3
CO5	Interpret the F probability distribution as the number of groups and the sample size change. Conduct and interpret one-way, two-way and Latin square ANOVA.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping														
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	3	3	2	2	-	-	-	-	-	-	-	2	-	1	-
CO2	3	3	2	2	-	-	-	-	-	-	-	2	-	1	-
CO3	3	3	2	2	-	-	-	-	-	-	-	2	-	1	-
CO4	3	3	2	2	-	-	-	-	-	-	-	2	-	1	-
CO5	3	3	2	2	-	-	-	-	-	-	-	2	-	1	-
22PBS408	**3**	**3**	**2**	**2**	-	-	-	-	-	-	-	**2**	-	**1**	-
1 – Slight, 2 – Moderate, 3 – Substantial															

b) CO and Key Performance Indicators Mapping	
CO1	1.1.1, 1.1.2, 2.1.1, 2.1.3, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 2.4.4, 2.4.4, 12.2.1
CO2	1.1.1, 1.1.2, 2.1.1, 2.1.3, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 2.4.4, 2.4.4, 12.2.1
CO3	1.1.1, 1.1.2, 2.1.1, 2.1.3, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 2.4.4, 2.4.4, 12.2.1
CO4	1.1.1, 1.1.2, 2.1.1, 2.1.3, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 2.4.4, 2.4.4, 12.2.1
CO5	1.1.1, 1.1.2, 2.1.1, 2.1.3, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 2.4.4, 2.4.4, 12.2.1

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	50	30	-	-	-	100
CAT2	20	50	30	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	20	50	30	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	20	50	30	-	-	-	100
ESE	20	50	30	-	-	-	100

22PPC406	FLUID MECHANICS AND MACHINERY *(Common to MECH & PRODN Branches)*	SEMESTERIV			
PREREQUISITES	**CATEGORY**	**L**	**T**	**P**	**C**
NIL	**PC**	**3**	**0**	**0**	**3**

Course Objectives	* To understand the Fluid properties, types of fluid flow, dimensional analysis and performance of pumps and turbines.	
UNIT- I	**FLUID PROPERTIES**	**(9 Periods)**
Units and Dimensions – Fluid properties – Density, Specific gravity, Viscosity, Surface tension, Capillarity, Compressibility and Bulk modulus – Pascal's Law – pressure measurements – manometers - Fluid statics - Total pressure and centre of pressure on submerged surfaces.		
UNIT- II	**FLUID KINEMATICS AND DYNAMICS**	**(9 Periods)**
Types of fluid flow and flow lines – control volume – continuity equation in one - dimension and three dimension – velocity potential and stream function - Energy equation – Euler and Bernoulli's equations – Applications of energy equations - Flow meters - Laminar and Turbulent flow through pipes –Hagen poisullie equation – Darcy Weisbach formula – Applications.		
UNIT- III	**DIMENSIONAL ANALYSIS**	**(9 Periods)**
Need for dimensional analysis – Dimensional Homogeneity – Rayleigh's and Buckingham methods of dimensional analysis –Problems. Model study and Similitude – scale effects and distorted model.		
UNIT- IV	**TURBINES**	**(9 Periods)**
Classification – construction, working principles and design of Pelton wheel, Francis and Kaplan Turbines - work done and efficiency - specific speed - operating characteristics - Governing of Turbines – Problems.		
UNIT- V	**PUMPS**	**(9 Periods)**
Classification of pumps - Centrifugal pump - working principle - work done and efficiency – Multistage pumps - Reciprocating pumps - work done and efficiency - negative slip - air vessels - indicator diagram – Problems.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*P.N.Modi and S.N.Seth, **"Hydraulics and Fluid Mechanics, Including Hydraulic Machines"**,StandardBookHouse,NewDelhi,2015.*
2	*R.K.Bansal, **"Fluid Mechanics and Hydraulic Machines"**, Laxmi Publications (P) Ltd., NewDelhi,2018.*

REFERENCES:

1	*SubramanyaK.,**"FlowinOpenchannels"**,TataMcGraw-HillPublishingCompany,2015.*
2	*S.Ramamurtham and R.Narayanan, **"Hydraulics Fluid Mechanics and Fluid Machines"** DhanpatRai Publishing Company(P)Limited, 2014.*
3	*R.K.Rajput,**"AText Book of Fluid Mechanics and Hydraulic Machines"**, S.Chandand Company, NewDelhi ,2015.*
4	*D.S.Kumar, **"Fluid Mechanics and Fluid Power Engineering"**, S.K.Kataria& Sons, NewDelhi,2012.*
5	*G.K.Batchelor, **"An Introduction to Fluid dynamics",** Cambridge University Press, June 2012.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the fluid properties and its applications.	K4
CO2	Gain knowledge on fluid flows to solve practical problems	K4
CO3	Apply the concepts of dimensional analysis for fluid flow problems	K4
CO4	Analyze the performance of turbines and design of turbines.	K4
CO5	Analyze the performance of pumps and design of pumps.	K4

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	2	1	-	1	-	-	-	-	-	-	-	-	-	2	1
CO2	2	1	-	1	-	-	-	-	-	-	-	-	-	2	1
CO3	2	1	-	1	-	-	-	-	-	-	-	-	-	2	1
CO4	2	1	1	3	-	-	-	-	-	-	-	-	-	2	1
CO5	2	1	1	3	-	-	-	-	-	-	-	-	-	2	1
22PPC406	**2**	**1**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**1**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.1, 1.3.1, 1.4.1, 2.1.3, 2.2.3, 2.3.1, 2.4.1, 4.1.2
CO2	1.3.1, 1.4.1, 2.1.3, 2.2.3, 2.3.1, 2.4.1, 4.1.2
CO3	1.2.1, 1.3.1, 1.4.1, 2.1.3, 2.2.3, 2.3.1, 4.1.2
CO4	1.1.1, 1.3.1,2.1.2,2.1.3, 2.3.2, 3.2.2, 3.4.2, 4.1.1, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.3
CO5	1.1.1, 1.3.1, 2.1.2, 2.1.3, 2.3.2, 3.2.2, 3.4.2, 4.1.1, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.3

ASSESSMENT PATTERN– THEORY

Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	30	30	20	-	-	100
CAT2	20	30	30	20	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	20	30	30	20	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	20	30	30	20	-	-	100
ESE	20	30	30	20	-	-	100

22PPC407	MECHANICS OF MATERIALS	SEMESTER IV

PREREQUISITES	CATEGORY	L	T	P	C
ENGINEERING MECHANICS	PC	3	1	0	4

Course Objectives	*To understand the basic concepts of stress, strain, shear force, bending moment, deflection of beams under different loading conditions, theory of columns and applications of torsion.	
UNIT- I	**STRESS AND STRAIN**	**(9 + 3 Periods)**
Stress and strain at a point-Tension, compression, shear stresses - Hooke's law - Compound bars – lateral strain - Poisson's ratio -Volumetric strain - Bulk modulus - Relationship among elastic constants – stress strain diagrams for mild steel and cast iron-Ultimate stress - Yield stress-Factor of safety - Thermal stresses - Thin cylinders - Strain energy due to axial force - Resilience- Stress due to gradual load, suddenly applied load and Impact load.		
UNIT- II	**SHEAR FORCE AND BENDING MOMENT**	**(9 + 3 Periods)**
Beams – Types of Beams - Types of loads, supports - Shear force – Bending moment – sign convention - shear force and bending moment diagrams for cantilever, simply supported and over hanging beams with concentrated , uniformly distributed and uniformly varying load-Relationship between rate of loading, shear force, bending moment- Point of contra flexure.		
UNIT- III	**THEORY OF BENDING AND COMPLEX STRESSES**	**(9 + 3 Periods)**
Theory of bending-Bending equation-Section Modulus-Stress distribution at a cross section due to bending moment and shear force for cantilever, simply supported beams with point, UDL loads (Rectangular, circular, I & T sections only) -combined direct and bending stresses, Kernel of section (Rectangular, Circular Sections only). 2D State of stress - 2D Normal and shear stresses on any plane-Principal stresses and Principal planes-Principal Strains and direction-Mohr's circle of stress.		
UNIT- IV	**DEFLECTION OF BEAMS AND THEORY OF LONG COLUMNS**	**(9 + 3 Periods)**
Determinations of deflection curve – Relation between slope, deflection and radius of curvature – Slope and deflection of beam at any section by Double integration method and Macaulay's method - Concept of Conjugate beam method (Theory only)- Euler's theory of long Columns- Expression of crippling load for various end conditions-Effective length-Slenderness ratio-limitations of Euler equation - Rankine formula for columns.		
UNIT- V	**THEORY OF TORSION**	**(9 + 3 Periods)**
Torsion of shafts - Torsion equation - Polar modulus- Stresses in Solid and Hollow circular shafts - Torsional rigidity - Power transmitted by the shaft – Angle of Twist - Strain energy due to Torsion - Modulus of rupture – Torsional resilience – Combined bending and Torsion - Stresses in helical springs - Deflection of helical spring-Leaf springs.		
Contact Periods: **Lecture: 45 Periods Tutorial: 15 Periods Practical: 0 Periods Total: 60 Periods**		

TEXT BOOK :

1	*Sadhu Singh **"Strength of Materials",** Khana Publishers, New Delhi, 2014.*
2	*R.K .Rajput**"Strength of Materials",** S. Chand & Company Ltd., New Delhi 2018.*

REFERENCES:

1	*Dr.B.C. Punmia, Ashok Kumar Jain and Arun Kumar Jain **"Mechanics of Materials",** Lakshmi Publications Pvt Ltd, New Delhi, 2002.*
2	*Kazimi, **"Solid Mechanics",** Tata McGraw Hill, New Delhi, 2001.*
3	*Robert L.Mott**"Applied Strength of Materials",** PHI Learning Pvt. Ltd, New Delhi, 2009.*
4	*Jindal U C, **"Textbook on Strength of Materials",** Asian Books Pvt. Ltd., 2007*
5	*Ramamrutham S and Narayan R **"Strength of Materials",**Dhanpat Rai and Sons, New Delhi, 2000.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the stress, strain and modulus for different materials.	K2
CO2	Describe the concept of shear force and bending moment diagrams of beams.	K3
CO3	Identify and calculate complex stresses in beams with different loading conditions.	K3
CO4	Find the deflection behaviour of beams and slender columns.	K3
CO5	Apply the concepts of torsion in shafts and springs.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	2	3	-	1	-	-	-	-	-	-	-	1	1	1	1
CO2	1	2	2	1	-	-	-	-	-	1	-	1	1	-	1
CO3	2	3	1	2	1	-	-	-	-	1	-	1	1	1	2
CO4	2	3	1	1	1	-	-	-	-	-	-	1	1	1	2
CO5	1	3	1	1	1	-	-	-	-	-	-	1	1	1	1
22PPC407	**2**	**3**	**2**	**2**	**1**	-	-	-	-	**1**	-	**1**	**1**	**1**	**2**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.4, 4.1.2, 4.1.3, 4.2.1, 12.2.1, 12.2.2
CO2	1.3.1, 2.1.3, 2.2.1, 2.2.3, 2.4.1, 2.4.2, 2.4.3, 3.1.1, 3.1.3, 3.1.4, 3.1.6, 3.2.3, 3.3.1, 4.1.2, 4.3.3, 4.3.4, 10.1.2, 10.3.1, 12.2.1, 12.3.1
CO3	1.1.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.4, 3.1.1, 3.1.4, 3.2.2, 3.4.1, 4.1.2, 4.1.3, 4.2.1, 4.3.2, 4.3.3, 5.1.2, 5.2.1, 10.1.1, 10.2.2, 12.1.2, 12.3.2
CO4	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.4.1, 2.4.3, 2.4.4, 3.1.1, 3.1.5, 3.2.1, 4.1.2, 4.1.3, 4.3.1, 5.1.1, 5.1.2, 12.1.1, 12.2.2
CO5	1.3.1, 2.1.1, 2.1.2, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.5, 3.1.6, 3.4.1, 4.1.1, 4.2.1, 4.3.2, 5.1.2, 5.3.2, 12.1.1, 12.2.1

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	40	30	-	-	-	100
CAT2	20	40	40	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	30	40	30	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	20	40	40	-	-	-	100
ESE	30	40	30	-	-	-	100

22PPC408	CNC TECHNOLOGY	SEMESTER IV

PREREQUISITES	CATEGORY	L	T	P	C
MACHINE TOOLS AND PROCESSES	PC	3	0	0	3

Course Objectives	*To enable the students to understand CNC machines constructional features, working and programming.	
UNIT- I	**INTRODUCTION TO CNC MACHINE TOOLS**	**(9 Periods)**
Evolution of CNC Technology, principles, features, advantages, applications, CNC and DNC concept, types of control systems, CNC controllers, characteristics, interpolators, types of CNC Machines – turning centre, machining centre, grinding machine, Vertical turret lathe, turn – mill centre, EDM.		
UNIT- II	**STRUCTURE OF CNC MACHINE TOOL**	**(9 Periods)**
CNC Machine building, structural details, configuration and design, guide ways – Friction, Anti friction and other types of guide ways, elements used to convert the rotary motion to a linear motion – Screw and nut, recirculating ball screw, planetary roller screw, recirculating roller screw, rack and pinion, spindle assembly, torque transmission elements – gears, timing belts, flexible couplings, Bearings.		
UNIT- III	**DRIVES AND CONTROLS**	**(9 Periods)**
Spindle drives, feed drives – stepper motor, servo principle, DC and AC servomotors, Linear motors. Open loop and closed loop control, Axis measuring system – synchro, synchro-resolver, gratings, moiré fringe gratings, encoders, inductosyn, laser interferometer.		
UNIT- IV	**CNC PROGRAMMING**	**(9 Periods)**
Coordinate system, structure of a part program, G & M Codes, tool length compensation, cutter radius and tool nose radius compensation, do loops, subroutines, canned cycles, mirror image, parametric programming, machining cycles, programming for machining centre and turning centre for Fanuc controller - Generation of CNC codes from CAM packages.		
UNIT- V	**TOOLING AND WORK HOLDING DEVICES**	**(9 Periods)**
Cutting tool materials for CNC machine tools – Carbides, Ceramics, CBN, PCD – inserts classification - qualified, semi qualified and preset tooling, tooling for Machining and Turning centre, ATC, APC, work holding devices for rotating and fixed work parts, economics of CNC, maintenance of CNC machines.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*HMT Limited, "**Mechatronics**", Tata McGraw-Hill Publishing Company Limited, New Delhi, 2007*
2	*Mike Mattson, "**CNC Programming Principles and Applications**", Delmar Cengage learning, 2010*

REFERENCES:

1	*Evans K., Polywka J. and Stanley Gabrel., "**Programming of CNC Machines**", Third Edition – Industrial Press Inc, New York, 2007*

2	*Madison J., "**CNC Machining Hand Book**", Industrial Press Inc., 1996.*
3	*Smid P., "**CNC Programming Hand book**", Industrial Press Inc., 2007 Third Edition*
4	*Radhakrishnan P., "**Computer Numerical Control Machines**", New Central Book Agency, 2002.*
5	*Rao P.N., "**CAD/CAM Principles and Applications**", Tata McGraw-Hill Publishing Company Limited, New Delhi, 2010.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Describe the evolution and principle of CNC machine tools and types of control systems.	K3
CO2	Apply knowledge in current terminology to describe the CNC machines and its types.	K3
CO3	Describe constructional features of CNC machine tools, drives and positional transducers used in CNC machine tools.	K3
CO4	Generate CNC programs for popular CNC controllers.	K6
CO5	Describe tooling and work holding devices for CNC machine tools.	K4

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	2	1	1	2	2	3	1	-	1	3	-	1	1	-	-
CO2	2	1	1	2	3	3	1	-	1	3	1	1	1	-	-
CO3	2	1	1	2	3	3	1	-	1	3	1	1	2	-	-
CO4	2	1	1	-	2	-	-	-	1	3	-	2	-	3	-
CO5	2	1	1	-	2	3	3	1	1	3	2	1	2	-	-
22PPC408	**2**	**1**	**1**	**2**	**3**	**3**	**2**	**1**	**1**	**3**	**1**	**2**	**2**	**1**	**-**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1, 1.3.1, 2.1.3, 2.2.3,2.2.4, 2.3.1, 3.1.4,3.1.5,3.1.6, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 5.1.1, 5.1.2, 5.3.1, 6.1.1, 6.2.1, 7.1.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 12.2.2.
CO2	1.2.1, 1.3.1, 2.1.3, 2.2.3,2.2.4, 2.3.1, 3.1.4,3.1.5,3.1.6, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.2.2.
CO3	1.2.1, 1.3.1, 2.1.3, 2.2.3,2.2.4, 2.3.1, 3.1.4,3.1.5,3.1.6, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.2.2.
CO4	1.2.1, 1.3.1, 2.1.3, 2.2.3,2.2.4, 2.3.1, 3.1.4,3.1.5,3.1.6, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 12.1.2, 12.2.1, 12.2.2.
CO5	1.2.1, 1.3.1, 2.1.3, 2.2.3,2.2.4, 2.3.1, 3.1.4,3.1.5,3.1.6, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1,11.3.1, 12.2.2.

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	15	68	17	-	-	-	100
CAT2	15	52	-	-	-	33	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	40	40	20	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	-	-	-	-	100	100
ESE	9	59	16	-	-	16	100

22PPC409	**PROCESS PLANNING AND COST ESTIMATION** (*Common to MECH & PRODN Branches)*	**SEMESTER IV**

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	0	0	3

Course Objectives	*To introduce the process planning concepts, cost estimation for various manufacturing process.	
UNIT- I	**INTRODUCTION TO PROCESS PLANNING**	**(9 Periods)**
Aims and Objectives, Place of process planning in Manufacturing cycle - Process and Production Planning. Drawing interpretation, Dimensional tolerance vs Production processes.		
UNIT- II	**PROCESS PLANNING STEPS**	**(9 Periods)**
Design of a process plan – Selection of production processes, tools and process parameters- Positioning and work holding devices, Selection of inspection devices and tools, Documenting the process plan. Computer-Aided Process Planning (CAPP) – Benefits, Architecture and approaches.		
UNIT- III	**INTRODUCTION TO COST ESTIMATION**	**(9 Periods)**
Importance, Types, Purpose, Components, Procedure, Classification of costs, Cost elements, Cost ladder, Overhead expenses, Break-even analysis - Concept, make or buy decision, assumptions, merits and demerits of breakeven analysis. Applications - Linear, multi product break-even analysis.		
UNIT- IV	**PRODUCT LIFE CYCLE MANGEMENT AND PRODUCTION COST ESTIMATION**	**(9 Periods)**
Product life cycle management - Estimation of production cost for - cast components, welded components, forged components, powder metallurgy parts.		
UNIT- V	**ESTIMATION OF MACHINING TIME AND COST**	**(9 Periods)**
Estimation of Machining time – Lathe operations, Drilling, Milling, Shaping, Planing and Grinding, Cost estimation for machining processes.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Panneerselvam, R. and Sivasankaran, P. "**Process Planning and Cost Estimation**", PHI Learning (P) Ltd., New Delhi, 2015.*
2	*Adithan, M. "**Process Planning and Cost Estimation**", New Age International (P) Ltd., Chennai, 2015.*

REFERENCES:

1	*Thomas E.Vollmann, "**Manufacturing Planning and Control Systems**", Galgotia Publications Pvt. Ltd., New Delhi, 1998.*
2	*Samuel Eilon, "**Elements of Production Planning and Control**", MacMillan, London, 1985.*
3	*Kesavan, R. Elanchezhian, C. and Vijayaramanath, B., "**Process Planning and Cost Estimation**",*

	New Age International (P) Ltd., Chennai, 2019.
4	*Narang, B.S. and Kumar, V., "**Production and Costing**", Khanna Publishers, 2014.*
5	*Banga,T.R. and Sharma, S.C., "**Mechanical Estimating and Costing**", Khanna Publishers, New Delhi, 2001.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Discuss the concept of process planning.	K2
CO2	Describe the steps involved in process planning.	K3
CO3	Discuss about cost estimation and Break Even analysis.	K3
CO4	Estimate the manufacturing cost for welded, forged components and powder metallurgy parts.	K4
CO5	Calculate the machining time and cost for various machining processes.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping															
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	-	-	-	-	-	-	-	-	1	-	1	2	-	-
CO2	2	1	-	-	2	-	-	-	-	1	-	1	2	1	-
CO3	2	3	-	-	-	-	-	-	-	-	2	1	2	-	-
CO4	2	3	-	-	-	-	-	-	-	-	-	1	2	-	-
CO5	2	3	-	-	-	-	-	-	-	-	-	1	2	-	-
22PPC409	**2**	**2**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**1**	**1**	**1**	**2**	**1**	**-**
1 – Slight, 2 – Moderate, 3 – Substantial															

b) CO and Key Performance Indicators Mapping	
CO1	1.3.1, 1.4.1, 10.1.1, 10.1.2, 12.2.1, 12.2.2
CO2	1.3.1, 1.4.1, 2.2.4, 5.1.1, 5.2.1, 5.3.1, 10.1.1, 10.1.2, 12.2.1, 12.2.2
CO3	1.1.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 11.1.1, 11.2.1, 12.2.1, 12.2.2
CO4	1.1.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 12.2.1, 12.2.2
CO5	1.1.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 12.2.1, 12.2.2

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	15	68	17	-	-	-	100
CAT2	15	52	33	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	50	50		-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	50	50	-	-	-	100
ESE	9	43	48	-	-	-	100

22PES408	ENGINEERING EXPLORATION	SEMESTER IV

PREREQUISITES	CATEGORY	L	T	P	C
NIL	ES	0	0	3	1.5

Course Objectives	* To provide an introduction to the engineering field. It is designed to help the student to learn about engineering and how it is useful in our everyday life.	
UNIT- I	**INTRODUCTION**	**(15 Periods)**
Introduction to Engineering and Engineering study: Difference between science and engineering, scientist and engineer needs and wants, various disciplines of engineering, some misconceptions of engineering, expectation for the 21st century engineer and Graduate Attributes.		
UNIT- II	**ENGINEERING DESIGN**	**(15 Periods)**
Engineering Requirement, Knowledge within Engineering disciplines, Engineering advancements , Problem definition , Idea generation through brain storming and researching, solution creation through evaluating and communicating , text/analysis, final solution and design improvement.		
UNIT- III	**ENGINEERING DISCIPLINES**	**(15 Periods)**
Types of motion, mechanical power system, mechanical power formula, mechanical design, etc.,		
Contact Periods: **Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods**		

REFERENCES:

1	*Ryan A Brown, Joshua W. Brown and Michael Berkihiser: "**Engineering Fundamentals: Design, Principles, and Careers**", Goodheart-Willcox Publisher, Second edition, 2014.*
2	*Saeed Moaveni, "**Engineering Fundamentals: An Introducton to Engineering**", Cengage learning, Fourth Edition, 2011.*

COURSE OUTCOMES Upon Completion of the course, the students will be able to		Bloom's Taxonomy Mapped
CO1	Explain technological and engineering development , change and impacts of engineering	K2
CO2	Complete initial steps (Define a problem list criteria and constraints , Brainstorm potential solutions and document ideas) in engineering designs	K3
CO3	Communicate possible solutions through drawings and prepare project reports.	K3
CO4	Draw sketches to a Design problem.	K3
CO5	Apply the concept of engineering fundamentals in Electronics and Instrumentation Engineering.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping															
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	2	-	1	3	1	2	-	1	2	1	1	1	1	-	-
CO2	2	-	1	3	1	2	-	1	2	1	1	1	1	-	-
CO3	2	-	1	3	1	2	-	1	2	1	1	1	1	-	-
CO4	2	-	1	3	1	2	-	1	2	1	1	1	1	-	-
CO5	2	-	1	3	1	2	-	1	2	1	1	1	1	-	-
22PES408	**2**	**-**	**1**	**3**	**1**	**2**	**-**	**1**	**2**	**1**	**1**	**1**	**1**	**-**	**-**
1 – Slight, 2 – Moderate, 3 – Substantial															

b) CO and Key Performance Indicators Mapping	
CO1	1.2.1, 1.3.1, 3.1.1, 3.1.4, 3.1.6, 4.1.1, 4.1.3, 4.1.4, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 6.2.1, 8.1.1, 9.1.1, 9.2.2, 9.2.3, 9.3.1, 10.1.2, 10.1.3, 11.3.1, 12.1.2, 12.3.1
CO2	1.2.1, 1.3.1, 3.1.1, 3.1.4, 3.1.6, 4.1.1, 4.1.3, 4.1.4, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 6.2.1, 8.1.1, 9.1.1, 9.2.2, 9.2.3, 9.3.1, 10.1.2, 10.1.3, 11.3.1, 12.1.2, 12.3.1
CO3	1.2.1, 1.3.1, 3.1.1, 3.1.4, 3.1.6, 4.1.1, 4.1.3, 4.1.4, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 6.2.1, 8.1.1, 9.1.1, 9.2.2, 9.2.3, 9.3.1, 10.1.2, 10.1.3, 11.3.1, 12.1.2, 12.3.1
CO4	1.2.1, 1.3.1, 3.1.1, 3.1.4, 3.1.6, 4.1.1, 4.1.3, 4.1.4, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 6.2.1, 8.1.1, 9.1.1, 9.2.2, 9.2.3, 9.3.1, 10.1.2, 10.1.3, 11.3.1, 12.1.2, 12.3.1
CO5	1.2.1, 1.3.1, 3.1.1, 3.1.4, 3.1.6, 4.1.1, 4.1.3, 4.1.4, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 6.2.1, 8.1.1, 9.1.1, 9.2.2, 9.2.3, 9.3.1, 10.1.2, 10.1.3, 11.3.1, 12.1.2, 12.3.1

22PPC410	**STRENGTH OF MATERIALS AND FLUID MACHINERY LABORATORY** *(Common to MECH & PRODN Branches)*	**SEMESTER IV**

PREREQUISITES	CATEGORY	L	T	P	C
ENGINEERING MECHANICS	PC	0	0	3	1.5

Course Objectives	* To understand the basics of different testing methods for different materials. * To study the behaviour of fluid system in pumps and turbines

22PPC410 (A) STRENGTH OF MATERIALS

LIST OF EXERCISES

1. Tension Test on steel rods using Universal Testing Machine.
2. Bending Test on rolled steel Joist Beam.
3. Double shear test on mild steel rod.
4. Torsion Test on Mild steel rod
5. Tension and Compression Test on Springs
6. Deflection test on simply supported aluminum beam
7. Deflection Test on Cantilever Beam
8. Hardness tests on metals like Mild Steel, Brass, Copper and Aluminum
9. Bend Test on Steel rod
10. Compression Test
11. Impact test-izod and charpy

22PPC410 (B) FLUID MACHINERY LABORATORY

LIST OF EXERCISES

1.Calibration of Venturimeter
2.Flow through Mouthpiece
3.Determination of Darcy's friction factor
4.Performance Study of Roto dynamic pumps: Centrifugal pump and Submersible pump
5. Performance Study of Positive displacement pumps: Reciprocating pump, Gear oil pump and Single screw pump.
6. Load test on Turbines: Pelton wheel, Francis turbine and Kaplan Turbine.

Contact Periods:
Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Apply knowledge of compression, tension, shear and torsion testing procedures on materials.	K3
CO2	Know the deflection and bending behavior of different types of beams.	K3
CO3	Find the hardness of different metals.	K3
CO4	Find the flow properties of fluids at different places.	K3
CO5	Conduct performance tests on pumps and turbines.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	1	1	2	-	1	-	1	-	1	-	2	1	1	-	1
CO2	1	-	1	-	1	-	-	-	-	-	2	1	1	-	1
CO3	1	-	1	-	-	-	-	-	1	-	-	1	1	-	1
CO4	-	1	-	2	1	-	1	-	-	-	-	-	-	2	1
CO5	-	1	-	2	1	-	1	-	-	-	-	-	-	2	1
22PPC410	**1**	**1**	**1**	**1**	**1**	-	**1**	-	**1**	-	**1**	**1**	**1**	**1**	**1**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.3.1, 2.1.1, 2.1.2, 2.4.2, 2.4.4, 3.1.1, 3.1.4, 3.1.5, 3.2.2, 3.4.1, 3.4.2, 5.1.2, 5.2.1, 7.2.2, 9.1.2, 9.3.1, 11.1.1, 11.1.2, 12.1.2, 12.2.2
CO2	1.1.1, 3.1.1, 3.1.5, 3.1.6, 3.2.3, 5.3.1, 5.3.2, 11.1.1, 11.2.1, 12.1.1, 12.3.2
CO3	1.2.1, 3.1.3, 3.1.4, 3.1.6, 3.4.1, 9.3.1, 12.2.1, 12.3.1
CO4	2.1.2, 2.1.3, 2.3.1, 2.4.2, 4.1.3, 4.2.1, 4.3.1, 4.3.3, 5.2.1, 5.3.2, 7.1.1
CO5	2.1.2, 2.1.3, 2.3.1, 2.4.2, 4.1.3, 4.2.1, 4.3.1, 4.3.3, 5.2.1, 5.3.2, 7.1.1

22PPC411	PRODUCTION DRAWING	SEMESTER IV

PREREQUISITES	CATEGORY	L	T	P	C
ENGINEERING GRAPHICS	PC	0	0	3	1.5

Course Objectives	*To provide hands on training on assembly drawings and impart knowledge on various types of machine parts & joints and to create knowledge about important features of assembled parts used in major engineering applications.	
UNIT- I	**CONVENTIONS, ABBREVIATIONS AND SYMBOLS**	**(3 Periods)**
Interrupted views- Partial views of symmetrical objects- Conventional representation of intersection curves- Square ends and openings, adjacent parts- Common machine elements.		
UNIT- II	**FITS AND TOLERANCES**	**(6 Periods)**
Description of tolerances and grades- Types of fits and their description- Shaft and hole basis systems- Selection of fits from standard tables- Fits for different applications- Examples- Geometrical tolerances- Surface finish conventions.		
UNIT- III	**PREPARATION OF ASSEMBLY DRAWINGS AND COMPONENT DRAWINGS**	**(36 Periods)**
Cotter joint, Knuckle joint, Flange coupling, Universal coupling, Foot step bearing, Plummer block, Connecting rod ends, Cross heads, Screw jack, Lathe tailstock, Stop valves, Non-return valve.		
Contact Periods: **Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Gopalakrishna K.R "**Machine Drawing in First Angle Projection**", Subhas Stores, Bangalore, 2017.*
2	*Bhatt.N.D "**Machine Drawing**", Charotar Publishing House Pvt. Ltd., 51st edition, 2022.*

REFERENCES:

1	*Gill, P.S. "**Text Book of Machine Drawing**", S.K.Kataria and Sons, Publishers and Distributors, Delhi, 2013.*
2	*PSG College of Technology "**Design Data Book**", KalikathirAchchagam, 2012.*
3	*Narayana, K.L., Kannaiah, P. and Venkata Reddy, K. "**Machine Drawing**", New Age International Publishers, 6th edition 2019.*
4	*Dr. Dahwan, R.K.,"**A Textbook of Machine Drawing**", S Chand & company Ltd., 2015.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Describe the conventions in assembly drawing	K2
CO2	Discuss the Fits and Tolerances	K3
CO3	Explain the Geometric Dimensioning & Tolerancing	K3
CO4	Identify machining and surface finish symbols.	K2
CO5	Construct an assembly drawing of various machine units.	K4

COURSE ARTICULATION MATRIX:

	a) CO and PO Mapping														
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	2	1	1	-	-	-	-	-	-	2	-	1	2	-	-
CO2	2	1	1	-	-	-	-	-	-	2	-	1	2	-	-
CO3	2	1	1	-	-	-	-	-	-	2	-	1	2	-	-
CO4	2	1	1	-	-	-	-	-	-	2	-	1	2	-	-
CO5	2	1	1	-	-	-	-	-	-	2	-	1	2	-	-
22PPC411	**2**	**1**	**1**	-	-	-	-	-	-	**2**	-	**1**	**2**	-	-
1 – Slight, 2 – Moderate, 3 – Substantial															

	b) CO and Key Performance Indicators Mapping
CO1	1.1.1, 1.2.1, 1.3.1, 2.1.2, 2.1.3, 2.3.1, 2.3.2, 3.1.1, 3.1.2, 3.1.4, 3.1.6, 3.2.1, 3.3.1, 10.1.1, 10.1.2, 10.3.1, 10.3.2, 12.2.1, 12.2.2
CO2	1.1.1, 1.2.1, 1.3.1, 2.1.2, 2.1.3, 2.3.1, 2.3.2, 3.1.1, 3.1.2, 3.1.4, 3.1.6, 3.2.1, 3.3.1, 10.1.1, 10.1.2, 10.3.1, 10.3.2, 12.2.1, 12.2.2
CO3	1.1.1, 1.2.1, 1.3.1, 2.1.2, 2.1.3, 2.3.1, 2.3.2, 3.1.1, 3.1.2, 3.1.4, 3.1.6, 3.2.1, 3.3.1, 10.1.1, 10.1.2, 10.3.1, 10.3.2, 12.2.1, 12.2.2
CO4	1.1.1, 1.2.1, 1.3.1, 2.1.2, 2.1.3, 2.3.1, 2.3.2, 3.1.1, 3.1.2, 3.1.4, 3.1.6, 3.2.1, 3.3.1, 10.1.1, 10.1.2, 10.3.1, 10.3.2, 12.2.1, 12.2.2
CO5	1.1.1, 1.2.1, 1.3.1, 2.1.2, 2.1.3, 2.3.1, 2.3.2, 3.1.1, 3.1.2, 3.1.4, 3.1.6, 3.2.1, 3.3.1, 10.1.1, 10.1.2, 10.3.1, 10.3.2, 12.2.1, 12.2.2

22PPC512	**OPERATIONS RESEARCHTECHNIQUES** *(Use of Approved Statistical Table is Permitted)*	SEMESTER V

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	1	0	4

Course Objective	• To provide an in-depth understanding of definition, scope, objectives, phases, models and limitations of operations research and to familiarize various tools of optimization, decision making and simulation, as applicable in particular scenarios in industry for better management of various resources.	
UNIT- I	**LINEAR MODELS**	**(9+3 Periods)**
The phases of operations research study- formation of Linear programming model - Graphical method - Simplex algorithm – artificial variables technique - Big M method - Duality - Dual Simplex method.		
UNIT- II	**TRANSPORTATION, ASSIGNMENT AND SEQUENCING PROBLEMS**	**(9+3 Periods)**
Transportation Models – Formulation – Basic feasible solution by North West Corner method - Least Cost Method - Vogel's Approximation Method - Optimality test - MODI method - Degeneracy. Assignment problem - formulation – Hungarian method – unbalanced assignment problem. Sequencing problem: processing 'n' jobs through two machines and three machines, processing two jobs through 'n' machines.		
UNIT- III	**NETWORK MODELS**	**(9+3 Periods)**
Shortest route - Minimal spanning tree - Maximum flow models - Project network - CPM and PERT networks - Critical path scheduling – Cost analysis and Crashing the network.		
UNIT- IV	**QUEUEING THEORY AND SIMULATION**	**(9+3 Periods)**
Queueing models - Queueing systems and structures - Notation - parameter - Single Server and multi server models-Poisson input-exponential service – constant rate service- infinite population. Simulation- random number generation- application of simulation for queuing and maintenance problems.		
UNIT- V	**DECISION MODELS**	**(9+3 Periods)**
Game theory – Two person zero sum games – Graphical solution- Arithmetic solution. Replacement models - Replacement of items that deteriorate with time – value of money changing with time – not changing with time - Replacement of items that fails suddenly - individual and group replacement policy.		
Contact Periods: **Lecture: 45 Periods Tutorial: 15 Periods Practical: 0 Periods Total: 60 Periods**		

TEXT BOOK:

1	*P.K. Gupta and D.S. Hira,* ***"Problems in Operations Research (Principles and Solutions)"****, S.Chand and Co. Ltd., 2013*
2	*Panneerselvam, R,* ***"Operations Research",*** *2nd Edition, Prentice – Hall of India, New Delhi, 2006*

REFERENCES:

1	*Taha H.A, **"Operations research"**, 8th Edition, Prentice – Hall of India, New Delhi, 2006.*
2	*Sharma S.D, **"Operations Research"** Kedarnath Ram Nath and Co.Meerut, 2009.*
3	*Don. T. Phillips, Ravindren A and James Solberg, **"Operations Research"**, John Wiley and sons, 1987.*
4	*J.K Sharma, **"Operations Research - Theory and Applications"**, Macmillan Publications India Ltd, 2013*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Identify and formulate operational research models from the verbal description of a real system and apply suitable operations research technique to solve Linear Programming Problems.	K4
CO2	Apply operations research techniques like Sequencing, Transportation, assignment algorithms to Industrial optimization problems.	K3
CO3	Use network scheduling techniques like PERT, CPM for solving project management problems.	K4
CO4	Analyze various models and apply suitable analytical method or simulation technique to solve queueing problems.	K4
CO5	Apply suitable decision making tools for Replacement and Game theory problems for achieving optimization.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	3	2	2	3	-	-	-	1	3	1	1	-	2	2
CO2	2	3	2	2	3	-	-	-	1	3	2	1	-	2	2
CO3	2	3	2	2	3	-	-	-	1	3	3	1	-	2	2
CO4	2	3	2	2	3	-	-	-	1	3	1	1	-	2	2
CO5	2	3	2	2	3	-	-	-	1	3	3	1	-	2	2
22PPC512	**2**	**3**	**2**	**2**	**3**	**-**	**-**	**-**	**1**	**3**	**2**	**1**	**-**	**2**	**2**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.1, 1.1.2, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.4, 3.1.1, 3.1.2, 3.1.6, 3.3.1, 3.4.1, 4.1.1, 4.1.2, 4.3.1, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 9.2.1, 10.1.1, 10.1.2, 10.1.3, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.2.2, 12.3.2.
CO2	1.1.1, 1.1.2, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.4, 3.1.1, 3.1.2, 3.1.6, 3.3.1, 3.4.1, 4.1.1, 4.1.2, 4.3.1, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 9.2.1, 10.1.1, 10.1.2, 10.1.3, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 11.3.2, 12.2.2, 12.3.2.
CO3	1.1.1, 1.1.2, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.4, 3.1.1, 3.1.2, 3.1.6, 3.3.1, 3.4.1, 4.1.1, 4.1.2, 4.3.1, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 9.2.1, 10.1.1, 10.1.2, 10.1.3, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 11.3.2, 12.2.2, 12.3.2.
CO4	1.1.1, 1.1.2, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.4, 3.1.1, 3.1.2, 3.1.6, 3.3.1, 3.4.1, 4.1.1, 4.1.2, 4.3.1, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 9.2.1, 10.1.1, 10.1.2, 10.1.3, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.2.2, 12.3.2.
CO5	1.1.1, 1.1.2, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.4, 3.1.1, 3.1.2, 3.1.6, 3.3.1, 3.4.1, 4.1.1, 4.1.2, 4.3.1, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 9.2.1, 10.1.1, 10.1.2, 10.1.3, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 11.3.2, 12.2.2, 12.3.2.

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	15	18.3	66.7	-	-	-	100
CAT2	15	18.3	50	16.7	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	-	100	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	-	100	-	-	-	100
ESE	9	11	64	16	-	-	100

22PPC513	MECHANICS OF MACHINES	SEMESTER V

PREREQUISITES	CATEGORY	L	T	P	C
22PES307 – ENGINEERING MECHANICS 22PPC407 – MECHANICS OF MATERIALS	PC	3	1	0	4

Course Objectives	• To familiarize the basic concepts of mechanisms and machinery. • To make the students to know the importance of balancing and the effect of friction and vibration in different machine parts. • To make the students to learn about various gear train configurations and kinematic analysis of cam-follower motion.	
UNIT- I	**MECHANISMS**	**(9+3 Periods)**
Machine structure - Kinematic link, pair and chain-Constrained motion - Degrees of freedom - Slider crank and crank rocker mechanisms - inversions, applications - Introduction to kinematic analysis and synthesis of simple mechanisms - Determination of velocity and acceleration of simple mechanisms.		
UNIT- II	**FRICTION**	**(9+3 Periods)**
Types of friction - Friction in pivot, collar and thrust bearings - Plate and disc clutches - Belt (flat and V) and Rope drives - Ratio of tensions - Effect of centrifugal and initial tension - Condition for maximum power transmission.		
UNIT- III	**GEARING AND CAMS**	**(9+3 Periods)**
Gear – Types and profile – nomenclature of spur and helical gears – laws of gearing – interference – requirement of minimum number of teeth in gears – gear trains – simple, compound and reverted gear trains – determination of speed and torque in epicyclic gear trains – Cam – Types of cams and followers – Cam design for different follower motions.		
UNIT- IV	**BALANCING**	**(9+3 Periods)**
Static and dynamic balancing - Single and several masses in different planes - Primary and secondary balancing of reciprocation masses – Balancing of single and multi cylinder engines.		
UNIT- V	**VIBRATION**	**(9+3 Periods)**
Free, forced and damped vibration of single degree of freedom systems - force transmitted to supports - vibration isolation - vibration absorption - torsional vibration of shaft – Single and multi rotor systems-Critical speed of shafts.		
Contact Periods: **Lecture: 45 Periods Tutorial: 15 Periods Practical: 0 Periods Total: 60 Periods**		

TEXT BOOK:

1	*Rattan, S.S., **"Theory of Machines"**, McGraw-Hill Education India, New Delhi, 2019.*
2	*Bansal Dr.R.K. and Brar Dr.J.S., **"Theory of Machines"**, Laxmi Publications (P) Ltd., New Delhi, 2016.*

REFERENCES:

1	*Uicker, J.J., Pennock G.R and Shigley, J.E., "**Theory of Machines and Mechanisms",** 4th Edition, Oxford University Press, 2014.*
2	*Thomas Bevan, "**Theory of Machines**", 3rd Edition, Pearson Education India, 2009.*
3	*Robert L. Norton, "**Kinematics and Dynamics of Machinery**", McGraw-Hill Education India, New Delhi, 2009.*
4	*Rao,J.S. and Dukkipati, R.V. "**Mechanism and Machine Theory**", Second Edition, New Age International Publishers, 2006.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the basic concepts of various mechanisms and perform velocity and acceleration analysis of simple mechanisms.	K3
CO2	Describe the effect of friction on power transmission.	K3
CO3	Discuss the basic principles of gears and cams.	K2
CO4	Perform static and dynamic balancing of high speed rotary and reciprocating machines.	K3
CO5	Analyze free and forced vibrations of machines, engines and structures.	K4

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO2**	**PSO3**
CO1	2	3	-	-	-	-	-	-	-	-	-	1	2	-	-
CO2	2	3	-	-	-	-	-	-	-	-	-	1	2	-	-
CO3	2	3	-	-	-	-	-	-	-	-	-	1	2	-	-
CO4	2	3	-	-	-	-	-	-	-	-	-	1	2	-	-
CO5	2	3	-	-	-	-	-	-	-	-	-	1	2	-	-
22PPC513	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**-**	**-**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.1, 1.1.2, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 12.2.1, 12.2.2
CO2	1.1.1, 1.1.2, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 12.2.1, 12.2.2
CO3	1.1.1, 1.1.2, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 12.2.1, 12.2.2
CO4	1.1.1, 1.1.2, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 12.2.1, 12.2.2
CO5	1.1.1, 1.1.2, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 12.2.1, 12.2.2

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	15	18.3	66.7	-	-	-	100
CAT2	15	18.3	66.7	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	-	100	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	-	100	-	-	-	100
ESE	9	11	80	-	-	-	100

22PPC514	METROLOGY AND COMPUTERAIDED INSPECTION	SEMESTER V

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	0	0	3

Course Objective	• To impart knowledge on different kind of traditional and latest computer aided measuring instruments with appropriate parameters of measuring components.	
UNIT- I	**GENERAL CONCEPTS OF MEASUREMENT**	**(9 Periods)**
Definition – need for measurements and inspection – objectives of metrology - standards of measurement – accuracy and precision – errors in measurement –limits, fits and tolerances – interchangeability and selective assembly – calibration of instruments. Principles of light interference. Taylor's principles - design of gauges.		
UNIT- II	**LINEAR AND ANGULAR MEASUREMENTS**	**(9 Periods)**
Linear measuring instruments: Vernier instruments, micrometers, height gauge, dial indicators, bore gauges, slip gauges, comparators. Angle measuring instruments: bevel protractors, sprit level, sine bar, autocollimator, angle dekkor and clinometers – interferometry.		
UNIT- III	**FORM MEASUREMENT**	**(9 Periods)**
Screw thread terminology- Measurement of effective diameter by two wire and three wire methods - errors in threads-Measurement of pitch, profile errors and total composite errors, Gear tooth terminology-Methods of measurements of runout, pitch, profile, lead, backlash, tooth thickness-composite method of inspection - Parkinson gear tester, Measurement of surface finish - Stylus probe instruments : profilometer-Tomlinson and Talysurf instrument -straightness, flatness and roundness measurement.		
UNIT- IV	**LASER METROLOGY**	**(9 Periods)**
Laser in engineering metrology – methods of laser metrology – precision instruments based on laser – laser interferometer – applications of laser in industry – linear and angular measurement – optical methods for fast non contact online measurement – scanning laser beam.		
UNIT- V	**COMPUTER AIDED INSPECTION**	**(9 Periods)**
Automated inspection - online and offline inspection, sensor technology for manufacturing process monitoring and inspection - flexible inspection systems – non contact inspection methods – automatic gauging and size control system – coordinate measuring machine – non contact CMM using electro optical sensors for dimensional metrology – non contact sensors for surface finish measurements – machine vision systems and its applications.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Gupta. I.C, **"A text book of Engineering Metrology"**, Dhanpat Rai and Sons, Delhi, 2018.*
2	*Groover M.P, **"Automation, Production systems and Computer Integrated Manufacturing",**Prentice Hall India Ltd., 2021.*

REFERENCES:

1	*Jain.R.K.,* ***"Engineering Metrology",*** *Khanna Publishers, Delhi, 2022.*
2	*Galyer J F W., and Shotbolt C.R.,* ***"Metrology for Engineers",****English Language Book Society ELBS, Fifth Edn.,*
3	***"Handbook of industrial metrology",*** *Predntice hall of India Ltd.,*
4	*D.D.Ford "****Laser Metrology and Machine Performance"*** *WIT Press.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Describe the general concepts of measurements.	K2
CO2	Elaborate the concepts of linear and angular measurements	K4
CO3	Explain the concepts various geometric and form measurements.	K4
CO4	Describe various measurement concepts involved in laser metrology.	K2
CO5	Discuss about recent measuring machines and the basic concepts of computer aided inspection.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	-	1	1	1	-	-	-	-	-	-	-	-	1	-
CO2	2	-	1	1	1	-	-	-	-	-	-	-	-	2	-
CO3	2	-	1	2	1	-	-	-	-	-	-	-	-	2	-
CO4	2	-	1	1	2	-	-	-	-	-	-	-	-	2	-
CO5	2	-	2	2	2	-	-	-	-	-	-	-	-	2	-
22PPC514	**2**	**-**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.3.1, 3.1.1, 4.1.1, 5.2.1; 14.1.1
CO2	1.3.1, 1.4.1, 3.1.1, 4.1.1, 5.2.1, 14.1.1; 14.1.2
CO3	1.3.1, 1.4.1, 3.1.1, 4.1.1, 5.2.1, 14.1.1, 14.1.2
CO4	1.3.1, 1.4.1, 3.1.1, 4.1.1, 5.2.1, 14.1.1; 14.1.2
CO5	1.3.1, 1.4.1, 3.1.1, 4.1.1, 5.2.1, 14.1.1; 14.1.2

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	25	25	20	10	10	10	100
CAT2	25	25	20	10	10	10	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	25	25	20	10	10	10	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	25	25	20	10	10	10	100
ESE	25	25	20	10	10	10	100

22PPC515	PRODUCTION PLANNING AND CONTROL	SEMESTER V

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	0	0	3

Course Objective	• Tostudyvariousproductionplanningandcontrolactivitiesinindustries.	
UNIT- I	**INTRODUCTION**	**(9 Periods)**
Objectives and benefits of planning and control-Functions of production control-Types of production- job- batch and continuous-Product development and design-Marketing aspect - Functional aspects-Operational aspect-Durability and dependability aspect-aesthetic aspect. Profit consideration-Standardization, Simplification and specialization-Value analysis.		
UNIT- II	**COSTESTIMATION**	**(9 Periods)**
Importance, Types, Purpose, Components, Procedure, Classification of costs, Cost elements, Cost ladder, Overhead expenses, Break-even analysis - Concept, make or buy decision, assumptions, merits and demerits of break even analysis. Applications - Linear, multi product break-even analysis.		
UNIT- III	**WORKSTUDY**	**(9 Periods)**
Productivity - concepts - Method study, basic procedure, Selection criteria, Recording techniques – Motion study, principles, Micro motion and memo motion study - Work measurement - Time study - Steps in making time study, Computation of standard time - Other work measurement techniques.		
UNIT- IV	**OPERATIONSPLANNINGANDSCHEDULING**	**(9 Periods)**
Components of operations planning and scheduling systems – Aggregate planning – MPS – MRP – Capacity Planning, Process – Routing, Techniques – Scheduling, Principles, Types and Strategies Methodology - Dispatching-Progress reporting and expediting-Lead time, Techniques for aligning completion times and due dates.		
UNIT- V	**MATERIALSPLANNINGANDCONTROL**	**(9 Periods)**
Materials Planning and control, scope, Techniques – Purchasing, Functions, Methods, Procedure, parameters, Supplier selection – Make or Buy Decision – Store and storekeeping, Codification, Functions, Organising, Methods, Accounts of stores, valuation methods, storage, protection and Interrelationship.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Samson Eilon* ***"Elements of production planning and control"****, Universal book traders, 2014.*
2	*Stephen N. Chapman* ***"The fundamentals of production planning and control"****, Pearson education, 2009.*

REFERENCES:

1	*AnilKumar, Suresh"****ProductionandOperationsManagement",****NewAgeinternational,2018.*

2	*Mart and Telsang, **"Industrial Engineering and Production Management"**, S. Chandand Company,Firstedition, 2011.*
3	*Jain. K.C. & Aggarwal. L.N., **"Production Planning Control and Industrial Management"**, Khanna Publishers, 2014.*
4	*Norman Gaither, G. Frazier, **"Operations Management"** 9th Edition, Thomson learning IE, 2007*
5	*Kanishka Bedi, **"Production and Operations management"**, 2nd Edition, Oxford university press, 2007.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Describe the various aspects of product development	K2
CO2	Explain the cost estimation processes.	K3
CO3	Explain about the method, motion studies and work measurement.	K3
CO4	Explain about various techniques of operations planning and scheduling.	K2
CO5	Describe various aspects of materials planning and control.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	2	2	3	3	3	3	3	1	2	3	3	3	3	3	2
CO2	3	3	2	3	3	3	3	-	1	3	3	3	2	1	3
CO3	3	3	2	3	3	3	3	-	1	3	3	3	2	2	3
CO4	2	3	3	3	3	3	3	-	2	3	3	3	3	2	2
CO5	2	3	3	3	3	3	3	-	2	3	3	3	2	3	2
22PPC515	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**1**	**2**	**3**	**3**	**3**	**3**	**3**	**3**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.2.2. 2.2.3,2.2.4, 2.3.1, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5,3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 11.3.2, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2.
CO2	1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.11, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.3.1, 3.4.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 11.2.1, 11.3.1, 11.3.2, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2.
CO3	1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.11, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.3.1, 3.3.2, 3.4.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 11.2.1, 11.3.1, 11.3.2, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2.
CO4	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.1.1, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 11.2.1, 11.3.1, 11.3.2, 12.1.2, 12.2.1, 12.2.2.
CO5	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2,

	4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.1.1, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 11.2.1, 11.3.1, 11.3.2, 12.1.2, 12.2.1, 12.2.2.

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category *	**Rememberin g (K1) %**	**Understandin g (K2) %**	**Applying (K3) %**	**Analyzin g (K4) %**	**Evaluating (K5) %**	**Creatin g (K6) %**	**Total %**
CAT1	20	60	20	-	-	-	100
CAT2	25	55	20		-		100
Individua l Assessme nt 1 /Case Study 1/ Seminar 1 / Project1	40	40	20	-	-	-	100
Individua l Assessme nt 2 /Case Study 2/ Seminar 2 / Project 2	40	40	20	-	-	-	100
ESE	10	58	32	-	-	-	100

22PPC516	THEORYOFMETALCUTTING	SEMESTER V

PREREQUISITES	CATEGORY	L	T	P	C
22PES307 – ENGINEERING MECHANICS 22PPC301 – MACHINE TOOLS AND PROCESSES	PC	3	0	0	3

Course Objective	• To familiarize students about the basic mechanics, thermal, wear and optimum cutting speed for maximum production rate, minimum production cost in metal cutting processes.	
UNIT-I	**ORTHOGONALCUTTING**	**(9Periods)**
Basic mechanism of chip formation, Techniques for study of chip formation, types of chips, Chip breaker, Orthogonal verses Oblique cutting, Shear plane angle, Cutting force and velocity relationship in orthogonal cutting, Modern theories in Mechanics of cutting, Review of Merchant and Lee Shaffer Theories-limitations, applications.		
UNIT-II	**OBLIQUECUTTING**	**(9Periods)**
Direction of Chip flow, Normal Velocity and Effective Rake angles, Relationship between rake angles, values of various angles for machining of brittle, ductile and elastic materials, Cutting ratio in oblique cutting, Shear angle and Velocity relationship, Stabler's rule, Oblique cutting applications.		
UNIT-III	**THERMALASPECTSOFMACHINING**	**(9Periods)**
Heat distributions in machining, Experimental determination and analytical calculation of cuttingtool temperature, measurement of temperature, Heat in primary shear Zone, Heat in Tool and Work Interface, Heat in Areas of Sliding, effects of various parameters on temperature, Cutting fluids; Effects of cutting fluid, functions, requirements, types and selection, commercially available cutting fluids.		
UNIT-IV	**CUTTINGTOOLMATERIALS,TOOLLIFEANDTOOLWEAR**	**(9Periods)**
Essential requirements of tool materials, Structure and properties of High speed steel and Cemented carbides, development in tool materials, ISO specification for inserts and tool holders ,tool life, conventional and accelerated tool life tests, concept of machinability index, economics ofmachining, Reasons for failure of cutting tools and mechanisms and measurements of wear in single and multi-point cutting tools		
UNIT-V	**ECONOMICS OF METALMACHINING**	**(9Periods)**
Nomenclature of Single point and Multi point cutting tools. Gilbert's model – Analysis for Optimum Cutting Speed – Optimum cutting speed for maximum production – Optimum cutting speed for Minimum cost with cost as objective criterion.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Shaw.M.C.**"Metalcuttingprinciples",**oxfordClaredonpress,2005.*
2	*Juneja. B. L and Sekhon.G.S**, "Fundamentals of metal cutting and machine tools",** New Age International pvt. Ltd., 2003.*

REFERENCES:

1	*BoothroidD.G.&KnightW.A.,* ***"Fundamentalsofmachiningandmachinetools",*** *Marcel Dekker,Newyork,2006.*
2	*Bhattacharya.A.* ***"MetalCuttingTheoryandpractice",*** *CentralBookPublishers,India,2000.*
3	*Cyril Donaldson, H. LeCain George, V. C. Goold, Joyjeet Ghose,* ***"Tool Design",*** *Tata Mc Graw Hill, Fifth edition, 2017.*
4	*Frank W. Wilson,* ***"Fundamentals of Tool Design",*** *ASTME PHI 2010.*
5	*HMT* ***"ProductionTechnology",*** *HMTpublication,2017*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Elaborate the mechanisms of chip formation in different metal cutting processes.	K3
CO2	Differentiate between Orthogonal and Oblique cutting and its uses.	K2
CO3	Explain the thermal effects of cutting process and its removal methods.	K3
CO4	Predict the effects of cutting parameters on Tool life.	K3
CO5	Calculate optimum cutting speed and tool life for minimum production cost and maximum production rate.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	3	2	2	1	1	1	2	1	2	1	2	2	2
CO2	2	2	3	2	2	1	1	1	2	1	2	1	2	2	2
CO3	2	2	3	2	2	1	1	1	2	1	2	1	2	2	2
CO4	2	2	3	2	2	1	1	1	2	1	2	1	2	2	2
CO5	2	2	3	2	2	1	1	1	2	1	2	1	2	2	2
22PPC516	**2**	**2**	**3**	**2**	**2**	**1**	**1**	**1**	**2**	**1**	**2**	**1**	**2**	**2**	**2**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.2, 2.1.3, 2.2.1, 2.2.4, 2.3.2, 2.4.1, 2.4.4, 3.1.4, 3.1.5, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.2.1, 4.2.2, 4.3.1, 4.3.3, 5.1.1, 5.1.2,5 5.2.1, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.2.2, 8.2.1, 8.2.2, 9.1.2, 9.2.2, 9.2.3, 9.3.1, 10.1.2, 10.1.3, 10.2.1, 10.3.1, 11.1.1, 11.1.2, 11.2.1, 11.3.1, 11.3.2, 12.1.1, 12.3.2.
CO2	11.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.2.1, 2.2.4, 2.3.2, 2.4.1, 2.4.4, 3.1.4, 3.1.5, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.2.1, 4.2.2, 4.3.1, 4.3.3, 5.1.1, 5.1.2,5 5.2.1, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.2.2, 8.2.1, 8.2.2, 9.1.2, 9.2.2, 9.2.3, 9.3.1, 10.1.2, 10.1.3, 10.2.1, 10.3.1, 11.1.1, 11.1.2, 11.2.1, 11.3.1, 11.3.2, 12.1.1, 12.3.2.
CO3	11.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.2.1, 2.2.4, 2.3.2, 2.4.1, 2.4.4, 3.1.4, 3.1.5, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.2.1, 4.2.2, 4.3.1, 4.3.3, 5.1.1, 5.1.2,5 5.2.1, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.2.2, 8.2.1, 8.2.2, 9.1.2, 9.2.2, 9.2.3, 9.3.1, 10.1.2, 10.1.3, 10.2.1, 10.3.1, 11.1.1, 11.1.2, 11.2.1, 11.3.1, 11.3.2, 12.1.1, 12.3.2.
CO4	1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.2.1, 2.2.4, 2.3.2, 2.4.1, 2.4.4, 3.1.4, 3.1.5, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.2.1, 4.2.2, 4.3.1, 4.3.3, 5.1.1,

	5.1.2,5 5.2.1, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.2.2, 8.2.1, 8.2.2, 9.1.2, 9.2.2, 9.2.3, 9.3.1, 10.1.2, 10.1.3, 10.2.1, 10.3.1, 11.1.1, 11.1.2, 11.2.1, 11.3.1, 11.3.2, 12.1.1, 12.3.2.
CO5	1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.2.1, 2.2.4, 2.3.2, 2.4.1, 2.4.4, 3.1.4, 3.1.5, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.2.1, 4.2.2, 4.3.1, 4.3.3, 5.1.1, 5.1.2,5 5.2.1, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.2.2, 8.2.1, 8.2.2, 9.1.2, 9.2.2, 9.2.3, 9.3.1, 10.1.2, 10.1.3, 10.2.1, 10.3.1, 11.1.1, 11.1.2, 11.2.1, 11.3.1, 11.3.2, 12.1.1, 12.3.2.

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Rememberin g (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	12	48	40	-	-	-	100
CAT2	12	48	40	-	-	-	100
Individual Assessme nt 1 /Case Study 1/ Seminar 1 / Project1	12	48	40	-	-	-	100
Individual Assessme nt 2 /Case Study 2/ Seminar 2 / Project 2	12	48	40	-	-	-	100
ESE	12	48	40	-	-	-	100

22PPC517	METROLOGY LABORATORY	SEMESTER V

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	0	0	3	1.5

Course Objectives	*To familiarize the basic concepts of measurements, various linear, angular and form measuring equipment, and their principles of operation.

LIST OF EXERCISES

1. Study and use of Measuring Instruments.
2. Calibration of Dial gauge using Dial Calibration Tester.
3. Measurement of external taper angle using sine bar and slip gauges.
4. Measurement of internal and external dovetail angle using rollers.
5. Measurement of internal angle using spheres.
6. Measurement of external angle using rollers and slip gauges.
7. Measurement of spur gear tooth thickness using gear tooth vernier calliper.
8. Measurement of internal diameter and depth of the cylinder using spheres.
9. Measurement of effective diameter and pitch of screw thread using three wire method and pitch gauge.
10. Optical profile projector - Measurement of gear tooth parameters and screw thread parameters.
11. Tool maker's microscope – Measurement of cutting tool geometry and screw threads parameters.
12. Straightness measurement using Autocollimator.
13. Study of Co-ordinate Measuring Machine.
14. Study of surfcorder for surface roughness measurement.

Contact Periods:
Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Explain the general concepts of measurements.	K2
CO2	Apply and identify correct symbols, abbreviations and units for all measurements.	K4
CO3	Perform some linear, angular and form measurements, and record observations.	K4
CO4	Calibrate the measuring instruments.	K2
CO5	Explain about various methods of traditional and modern measurements that are used in the industry to measure product dimensions.	K2

COURSE ARTICULATION MATRIX:

	a) CO and PO Mapping														
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	-	1	1	1	-	-	-	-	-	-	-	-	1	1
CO2	2	-	1	1	1	-	-	-	-	-	-	-	-	2	2
CO3	2	-	1	2	1	-	-	-	-	-	-	-	-	2	2
CO4	2	-	1	1	2	-	-	-	-	-	-	-	-	2	2
CO5	2	-	2	2	2	-	-	-	-	-	-	-	-	2	2
22PPC517	**2**	**-**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**
	1 – Slight, 2 – Moderate, 3 – Substantial														

	b) CO and Key Performance Indicators Mapping
CO1	1.3.1, 3.1.1, 4.1.1, 5.2.1; 14.1.1
CO2	1.3.1, 1.4.1, 3.1.1, 4.1.1, 5.2.1; 14.1.1; 14.1.2
CO3	1.3.1, 1.4.1, 3.1.1, 4.1.1, 5.2.1, 14.1.1; 14.1.2
CO4	1.3.1, 1.4.1, 3.1.1, 4.1.1, 5.2.1, 14.1.1; 14.1.2
CO5	1.3.1, 1.4.1, 3.1.1, 4.1.1, 5.2.1, 14.1.1; 14.1.2

22PPC518	MODELLINGLABORATORY	SEMESTER V

PREREQUISITES	CATEGORY	L	T	P	C
22PPC411 - PRODUCTION DRAWING	PC	0	0	3	1.5

Course Objectives	*To prepare assembly drawings using standard CAD packages. *To design the solid models by creating parts and assemble them using 3D modelling software systems.

LIST OF EXERCISES

Exercises on modelling of mechanical components using packages like AutoCAD / Mechanical Desktop/Inventor/SolidWorks/ Creo /CATIA/Unigraphics etc…

- Simple two dimensional geometry creations and modification using drafting module.
- Detailing and documentation of a typical production drawing
- Attributes and data extraction from a drawing
- Creation of simple solid models using CSG and B-rep Approach
- Surface Modelling
- Generation of assembly drawings of Sleeve and cotter joint, Tail stock and Crane hook
- Preparation of assembly models of

  Screw jack

  Crane hook

  Flanged coupling

  Clapper box

  Universal coupling

  Machine vice

Drill jig assembly

Contact Periods:
Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the basics of graphics generation, 2-Dimensional and 3-Dimensional concepts involved in Computer Aided Design.	K2
CO2	Create 2D assembly drawings.	K3
CO3	Use the commands to create and edit the 3D surface model.	K3
CO4	Use the commands to create and edit the 3D solid model.	K3
CO5	Make the assembly of various solid models and create 3D assembly model.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping															
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO2**	**PSO3**
CO1	1	1	1	-	3	-	-	-	-	1	-	1	2	2	-
CO2	1	1	1	-	3	-	-	-	-	1	-	1	2	2	-
CO3	1	1	1	-	3	-	-	-	-	1	-	1	2	2	-
CO4	1	1	1	-	3	-	-	-	-	1	-	1	2	2	-
CO5	1	1	1	-	3	-	-	-	-	1	-	1	2	2	-
22PPC518	**1**	**1**	**1**	**-**	**3**	**-**	**-**	**-**	**-**	**1**	**-**	**1**	**2**	**2**	**-**
1 – Slight, 2 – Moderate, 3 – Substantial															
b) CO and Key Performance Indicators Mapping															
CO1	1.3.1, 2.1.1, 2.1.3, 3.1.1, 3.1.6, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 10.1.1, 10.3.1, 12.2.1, 12.2.2														
CO2	1.3.1, 2.1.1, 2.1.3, 3.1.1, 3.1.6, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 10.1.1, 10.3.1, 12.2.1, 12.2.2														
CO3	1.3.1, 2.1.1, 2.1.3, 3.1.1, 3.1.6, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 10.1.1, 10.3.1, 12.2.1, 12.2.2														
CO4	1.3.1, 2.1.1, 2.1.3, 3.1.1, 3.1.6, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 10.1.1, 10.3.1, 12.2.1, 12.2.2														
CO5	1.3.1, 2.1.1, 2.1.3, 3.1.1, 3.1.6, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 10.1.1, 10.3.1, 12.2.1, 12.2.2														

22PPC619	AUTOMATION AND CIM	SEMESTER VI

PREREQUISITES	CATEGORY	L	T	P	C
22PPC301 – MACHINE TOOLS AND PROCESSES	PC	3	0	0	3

Course Objectives	* To provide knowledge on various automated manufacturing activities. * To familiarize the application of computer technology in the manufacturing activities. * To enable the students to understand the smooth transition from conventional manufacturing to automated production and computer integrated manufacturing.

UNIT- I	FUNDAMENTALS OF AUTOMATION AND CIM	(9 Periods)

Concept of automation - Basic Elements of an Automated system – Advanced automation functions – Levels of Automation – Ten Strategies for Automation, Concept of automation in industry - classification, mechanization and automation. Evolution of CIM - CIM Hardware and Software – Data base Requirement of CIM – Concurrent engineering – Principles – Design and development. Production economics.

UNIT- II	AUTOMATION IN MANUFACTURING	(9 Periods)

Automation in machine tools - Mechanical feeding and tool changing - machine tool control transfer automaton, automated flow lines - Methods of work part transport transfer - Line efficiency. Simulation in assembly line - Analysis of Automated flow lines - General terminology and analysis of transfer lines - without and with buffer storage, partial automation, Implementation of automated flow lines. Buffer stock - Mechanical buffer storage control function.

UNIT- III	AUTOMATED MATERIAL HANDLING AND STORAGE SYSTEMS	(9 Periods)

Storage system performance, Storage location strategies, Conventional storage methods and equipment. Automated storage systems-Automated Storage/Retrieval systems, Carousel storage systems. Engineering analysis of storage systems. Industrial Robot applications-Material handling, Processing operations, Assembly and Inspection.

UNIT- IV	GROUP TECHNOLOGY AND FMS	(9 Periods)

Group Technology – Part families – Part Classification and Coding – Production flow Analysis – Cellular manufacturing – Cell design – Application considerations in Group Technology. Concepts of FMS – Comparison with Conventional Manufacturing – Economic Justification – Components of FMS – Types of Flexibility – FMS Applications and Benefits.

UNIT- V	CONTROL SYSTEMS	(9 Periods)

Process industries and Discrete manufacturing industries – levels of automation, variables and parameters – Continuous control systems – Steady state optimization, Adaptive control - Computer process control – control requirements, capabilities and forms of computer process control – Computer process monitoring, Direct Digital Control, Distributed Control systems – Hardware components for automation and process control – Discrete process control – Logic control, Sequencing - Programmable Logic controllers.

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOK:

1	*Mikell P. Groover,* ***"Automation, Production Systems and Computer Integrated Manufacturing"****, Pearson education (P) Ltd., New Delhi, 4th edition, 2016.*
2	*Radhakrishnan, P., Subramaniyan, S. and Raju, V.,* ***"CAD/CAM/CIM"****, New Age International (P) Ltd., 4th edition, 2018.*

REFERENCES:

1	*James A. Rehg and Henry W. Kraebber, **"Computer Integrated Manufacturing**", 3rd edition, Pearson Education (P) Ltd., New Delhi, 2005.*
2	*Chris McMahon, and Jimmie Browne, "**CAD/CAM Principles, Practice and manufacturing Management**", Pearson Education (P) Ltd, 2nd edition, 2000.*
3	*Kant Vajpayee, S., "**Principles of Computer Integrated Manufacturing**", Prentice Hall of India Limited, 3rd edition 2010.*
4	*Paul G. Rankey, "**Computer Integrated Manufacturing**", Prentice Hall, 2004.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Discuss the fundamentals of automation and CIM.	K2
CO2	Describe the automation in manufacturing.	K3
CO3	Describe the material handling and storage systems.	K3
CO4	Explain the concept of group technology and flexible manufacturing system.	K3
CO5	Describe the fundamentals of Control systems.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO 5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO 2**	**PSO 3**
CO1	2	1	1	-	1	-	-	-	-	-	-	1	2	-	-
CO2	2	1	1	-	1	-	-	-	-	-	-	1	2	-	-
CO3	2	1	1	-	1	-	-	-	-	-	-	1	2	-	-
CO4	2	1	1	-	1	-	-	-	-	-	-	1	2	-	-
CO5	2	1	1	-	1	-	-	-	-	-	-	1	2	-	-
22PPC619	**2**	**2**	**1**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**-**	**-**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.3.1, 1.4.1, 2.1.1, 2.1.3, 3.1.1, 3.1.6, 5.1.1, 12.2.1, 12.2.2
CO2	1.3.1, 1.4.1, 2.1.1, 2.1.3, 3.1.1, 3.1.6, 5.1.1, 12.2.1, 12.2.2
CO3	1.3.1, 1.4.1, 2.1.1, 2.1.3, 3.1.1, 3.1.6, 5.1.1, 12.2.1, 12.2.2
CO4	1.3.1, 1.4.1, 2.1.1, 2.1.3, 3.1.1, 3.1.6, 5.1.1, 12.2.1, 12.2.2
CO5	1.3.1, 1.4.1, 2.1.1, 2.1.3, 3.1.1, 3.1.6, 5.1.1, 12.2.1, 12.2.2

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Rememberin g (K1) %**	**Understandin g (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	15	68.4	16.6	-	-	-	100
CAT2	15	68.4	16.6	-	-	-	100
Individual Assessme nt 1 /Case Study 1/ Seminar 1 / Project1	-	50	50	-	-	-	100
Individual Assessme nt 2 /Case Study 2/ Seminar 2 / Project 2	-	50	50	-	-	-	100
ESE	9	59	32	-	-	-	100

22PPC620	MACHINEELEMENTSDESIGN *(Use of Approved Data Book is permitted)*	SEMESTER VI

PREREQUISITES	CATEGORY	L	T	P	C
22PPC513 - MECHANICS OF MACHINES	PC	3	1	0	4

Course Objectives	* To familiarize the various steps involved in the Design Process. * To make the students to learn the designing procedure for shafts, energy storing elements and flexible elements like Belt, Pulley and chain etc. *To train the students to design the different type of bearings and gears using standard procedure.	
UNIT- I	**PRINCIPLES OF DESIGN**	**(9+3 Periods)**
Fundamentals of Machine Design - Phases of Design, Design Consideration - Standards and Codes - Selection of Materials - Design against Static and Dynamic Load - Modes of Failure, Factor of Safety, Principal Stresses, Theories of Failure - Stress Concentration, Stress Concentration Factors, Variable Stress, Fatigue Failure, Endurance Limit, Design for Finite and Infinite Life, Soderberg and Goodman Criteria.		
UNIT- II	**SHAFTS AND BEARING**	**(9+3 Periods)**
Design of solid and hollow shafts based on strength, rigidity and critical speed. Sliding contact and rolling contact bearings.		
UNIT- III	**JOINTS, COUPLINGS AND SPRINGS**	**(9+3 Periods)**
Design of welded joints, Bolted joints (brackets) - Design of flange couplings - Design of helical and leaf springs.		
UNIT- IV	**FLEXIBLE ELEMENTS**	**(9+3 Periods)**
Selection of flat and V belts and pulleys. Roller chains.		
UNIT- V	**GEARS AND GEAR BOXES**	**(9+3 Periods)**
Design of spur and helical gears based on strength and wear considerations. Design of gear box: geometric progression - standard step ratio - ray diagram, kinematic layout - design of sliding mesh and constant mesh gear box.		
Contact Periods: **Lecture: 45 Periods Tutorial: 15 Periods Practical: 0 Periods Total: 60 Periods**		

TEXT BOOK:

1	*Bhandari, V.B.* ***"Design of Machine Elements",*** *McGraw-Hill Education India, 4th edition, 2017.*
2	*Sharma, P.C. and Aggarwal, D.K.* ***"A Text Book of Machine Design",*** *S.K. Kataria & sons, 2013.*

REFERENCES:

1	*Shigley, J.E. and Mischke, C.R. "**Mechanical Engineering Design**", McGraw-Hill Book Co., 8th edition, 2008.*
2	*Spotts, M.F., Shoup, T.E. and Hornberge, L.E. "**Design of Machine Elements**", Pearson Education India, 8th edition, 2019.*
3	*Jalaludeen, S. Md. "**A Text Book of Machine Design**", Anuradha Publications, 2010.*
4	*Khurmi, R. S. and Gupta, J. K.,"**A Textbook of Machine Design**", S Chand & company Ltd., 25th edition, 2020.*
5	*Robert L. Norton, "**Machine Design**", Pearson Education, 5th edition, 2018.*
6	*PSG College of Technology "**Design Data Book**", Kalikathir Achchagam, 2012.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Estimate safety factors of simple structures exposed to static and repeated loads.	K3
CO2	Design the shafts and bearings.	K4
CO3	Design the welded joints, bolted joints, couplings and springs.	K4
CO4	Design the drives - chain drives and belt drives.	K4
CO5	Design the spur gears, helical gears and gear boxes.	K4

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO12**	**PS O1**	**PS O2**	**PS O3**
CO1	2	3	1	-	-	-	-	-	-	2	1	2	2	-	-
CO2	2	3	2	-	-	-	-	-	-	2	1	2	2	-	-
CO3	2	3	2	-	-	-	-	-	-	2	1	2	2	-	-
CO4	2	3	2	-	-	-	-	-	-	2	1	2	2	-	-
CO5	2	3	2	-	-	-	-	-	-	2	1	2	2	-	-
22PPC620	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**1**	**2**	**2**	**-**	**-**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.1, 1.1.2, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.4, 3.1.1, 3.1.4, 3.1.6, 10.1.1, 10.1.2, 10.1.3, 10.3.1, 11.3.1, 12.2.1, 12.2.2, 12.3.2.
CO2	1.1.1, 1.1.2, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.4, 3.1.1, 3.1.4, 3.1.6, 3.3.1, 3.4.1, 10.1.1, 10.1.2, 10.1.3, 10.3.1, 11.3.1, 12.2.1, 12.2.2, 12.3.2
CO3	1.1.1, 1.1.2, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.4, 3.1.1, 3.1.4, 3.1.6, 3.3.1, 3.4.1, 10.1.1, 10.1.2, 10.1.3, 10.3.1, 11.3.1, 12.2.1, 12.2.2, 12.3.2
CO4	1.1.1, 1.1.2, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.4, 3.1.1, 3.1.4, 3.1.6, 3.3.1, 3.4.1, 10.1.1, 10.1.2, 10.1.3, 10.3.1, 11.3.1, 12.2.1, 12.2.2, 12.3.2
CO5	1.1.1, 1.1.2, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.4, 3.1.1, 3.1.4, 3.1.6, 3.3.1, 3.4.1, 10.1.1, 10.1.2, 10.1.3, 10.3.1, 11.3.1, 12.2.1, 12.2.2, 12.3.2

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Rememberin g (K1) %**	**Understandin g (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	15	18.3	66.7	-	-	-	100
CAT2	15	18.3	66.7	-	-	-	100
Individual Assessme nt 1 /Case Study 1/ Seminar 1 / Project1	-	-	100	-	-	-	100
Individual Assessme nt 2 /Case Study 2/ Seminar 2 / Project 2	-	-	100	-	-	-	100
ESE	9	11	80	-	-	-	100

22PPC621	FLUID POWER DRIVES ANDCONTROLS	SEMESTER VI

PREREQUISITES	CATEGORY	L	T	P	C
22PPC406 – Fluid Mechanics and Machinery	PC	3	0	0	3

Course Objective	• Tomakethestudentstodesignthehydraulicandpneumaticcircuitsfordifferentapplications .	
UNIT-I	**BASICPRINCIPLES**	**(9 Periods)**
Hydraulic Principles; Hydraulic Fluids; Hydraulic pumps – Classification, Characteristics, Pump Selection, Pumping Circuits; Hydraulic actuators – Classification, Cylinder Mounting, Selection,Characteristics;Hydraulicvalves–Pressure,Flow,DirectionControls,Applications,Symbols		
UNIT- II	**HYDRAULICCIRCUITS**	**(9 Periods)**
Hydraulic circuits- Reciprocating, Quick Return, Sequencing, Synchronizing, Regenerative circuit, Double pump hydraulic system; Application circuits–Press, Milling Machine, Planner, ForkLift, etc.		
UNIT-III	**POWERGADGETSINHYDRAULICS**	**(9 Periods)**
Accumulators–Classification,Circuits;PressureIntensifierandCircuit;SafetyCircuits;Mechanical hydraulic servo system; Selection of components. Installation and Maintenance of Hydraulic power pack; Troubleshooting of fluid power circuits.		
UNIT- IV	**PNEUMATICSYSTEMS**	**(9 Periods)**
Pneumatic Fundamentals; Control Elements; Logic Circuits; Position sensing, Pressure sensing; Electrical controls: Various switches; Electro Pneumatic and Electro Hydraulic Circuits.		
UNIT- V	**DESIGNANDSELECTIONOFPNEUMATICCIRCUITS**	**(9 Periods)**
Design of Pneumatic circuits – Classic, Cascade, Step counter, Combination methods; PLC and Microprocessors-Uses; Selection criteria for Pneumatic components; Installation and Maintenance of Pneumatic power pack ; Fault finding; Case studies.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Anthony Esposito,* ***"Fluid Power with Applications",*** *Pearson Education India, 7th edition,2013.*
2	*AndrewParr,* ***"HydraulicsandPneumatics:ATechnician'sandEngineer'sGuide",*** *Butterworth–Heinemann3rd edition,2011.*

REFERENCES:

1	*DudleyA Pease and John J Pippenger* ***"Basic Fluid Power",*** *Prentice Hall PTR, 2nd edition 1987.*
2	*John J Pippenger and Tyler G Hicks* ***"Industrial Hydraulics",*** *McGraw Hill,2nd edition, 1970.*
3	*J. Michael, Pinches and HohnG.Ashby* ***"Power Hydraulics",*** *Prentice Hall, 1989*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Describe the principle of fluid power.	K2
CO2	Describe the components of hydraulics.	K2
CO3	Design the hydraulic circuits for automation.	K3
CO4	Describe the components of pneumatics.	K2
CO5	Design the pneumatic circuits for automation.	K2

COURSE ARTICULATION MATRIX:

	a) CO and PO Mapping														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO 2**	**PSO3**
CO1	2	-	2	-	2	-	-	-	-	1	-	1	2	2	-
CO2	2	-	2	-	2	-	-	-	-	1	-	1	2	2	-
CO3	2	3	2	-	2	-	-	-	-	1	-	1	2	2	-
CO4	2	-	2	-	2	-	-	-	-	1	-	1	2	2	-
CO5	2	3	2	-	2	-	-	-	-	1	-	1	2	2	-
22PPC621	**2**	**2**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**1**	**-**	**1**	**2**	**2**	**-**
	1 – Slight, 2 – Moderate, 3 – Substantial														
	b) CO and Key Performance Indicators Mapping														
CO1	1.1.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.1, 2.4.4, 3.1.1, 3.1.6, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 10.1.1, 10.3.1, 12.2.1, 12.2.2														
CO2	1.1.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.1, 2.4.4, 3.1.1, 3.1.6, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 10.1.1, 10.3.1, 12.2.1, 12.2.2														
CO3	1.1.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.1, 2.4.4, 3.1.1, 3.1.6, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 10.1.1, 10.3.1, 12.2.1, 12.2.2														
CO4	1.1.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.1, 2.4.4, 3.1.1, 3.1.6, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 10.1.1, 10.3.1, 12.2.1, 12.2.2														
CO5	1.1.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.1, 2.4.4, 3.1.1, 3.1.6, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 10.1.1, 10.3.1, 12.2.1, 12.2.2														

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Rememberin g (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	15	40	45	-	-	-	100
CAT2	15	40	45	-	-	-	100
Individual Assessme nt 1 /Case Study 1/ Seminar 1 / Project1	15	40	45	-	-	-	100
Individual Assessme nt 2 /Case Study 2/ Seminar 2 / Project 2	15	40	45	-	-	-	100
ESE	15	40	45	-	-	-	100

22PPC622	STATISTICAL QUALITY CONTROLAND RELIABILITY ENGINEERING	SEMESTER VI

PREREQUISITES	CATEGORY	L	T	P	C
22PPC515- PRODUCTION PLANNING AND CONTROL	PC	3	1	0	4

Course Objective	*To introduce the concept of SQC, understand process control, acceptance sampling procedure and to learn the concept of reliability.	
UNIT- I	**INTRODUCTION AND PROCESS CONTROL FOR VARIABLES**	**(9+3 Periods)**
Introduction, definition of quality, basic concept of quality, definition of SQC, benefits and limitation of SQC, Quality assurance, Quality cost-Variation in process- factors-Theory of control chart- uses of control chart – Control chart for variables – X chart, R chart and σ chart.		
UNIT- II	**PROCESS CONTROL FOR ATTRIBUTES**	**(9+3 Periods)**
Control chart for attributes –control chart for proportion or fraction defectives – p chart and np chart – control chart for defects – C and U charts, State of control and process out of control identification in charts. Process capability – process capability studies and simple problems.		
UNIT- III	**ACCEPTANCE SAMPLING**	**(9+3 Periods)**
Lot by lot sampling – types – probability of acceptance in single, double, multiple sampling techniques – O.C. curves – producer's Risk and consumer's Risk. AQL, LTPD, AOQL concepts-standard sampling plans for AQL and LTPD- uses of standard sampling plans.		
UNIT- IV	**LIFE TESTING - RELIABILITY**	**(9+3 Periods)**
Life testing – Objective – failure data analysis, Mean failure rate, mean time to failure, mean time between failure, hazard rate, system reliability, series, parallel and mixed configuration – simple problems. Maintainability and availability – simple problems. Acceptance sampling based on reliability test – O.C Curves.		
UNIT- V	**QUALITY AND RELIABILITY**	**(9+3 Periods)**
Reliability improvements – techniques- use of Pareto analysis – design for reliability – redundancy unit and standby redundancy – Optimization in reliability – Product design – Product analysis – Product development – Product life cycles.		
Contact Periods: **Lecture: 45 Periods Tutorial: 15 Periods Practical: 0 Periods Total: 60 Periods**		

TEXT BOOK:

1	*Grant, Eugene.L, Richard Leavenworth* ***"Statistical Quality Control",*** *McGraw-Hill, 7th edition, 2017.*
2	*L.S.Srinath* ***"Reliability Engineering****", Affiliated East west press, 2005.*

REFERENCES:

1	*Monohar Mahajan, **"Statistical Quality Control**", Dhanpat Rai and Sons, 2016.*
2	*R.C.Gupta, **"Statistical Quality control",** Khanna Publishers, 10th edition, 1998.*
3	*Besterfield D.H **"Quality Control",** Prentice Hall, 1994.*
4	*Sharma S.C., **"Inspection Quality Control and Reliability",** Khanna Publishers, 2008.*
5	*Connor, P.D.T.O **"Practical Reliability Engineering",** John Wiley, 1993.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Describe the basic concepts involved in manufacturing process control for variables.	K2
CO2	Describe various process control charts for attributes.	K3
CO3	Explain the concepts of acceptance sampling.	K3
CO4	Explain the life testing techniques, failure data analysis and mean failure rate.	K3
CO5	Describe Pareto analysis and product design, development and life cycle concepts.	K4

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	1	1	-	-	-	-	-	-	-	-	2	-	2
CO2	2	2	1	1	-	-	-	-	-	-	-	-	2	-	2
CO3	2	1	1	1	-	-	-	-	-	-	-	-	2	-	2
CO4	2	1	2	2	-	-	-	-	-	-	-	-	2	-	2
CO5	2	2	2	2	-	-	-	-	-	-	-	-	2	-	2
22PPC622	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**2**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.2.2, 2.2.3, 2.2.4, 2.4.2, 2.4.4, 3.1.1, 3.1.2, 3.1.5, 3.1.6, 4.2.1, 4.2.2
CO2	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.2.2, 2.2.3, 2.2.4, 2.4.2, 2.4.4, 3.1.1, 3.1.2, 3.1.5, 3.1.6, 4.2.1, 4.2.2
CO3	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.2.2, 2.2.3, 2.2.4, 2.4.2, 2.4.4, 3.1.1, 3.1.2, 3.1.5, 3.1.6, 4.2.1, 4.2.2
CO4	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.4.2, 2.4.4, 3.1.1, 3.1.2, 3.1.5, 3.1.6, 3.3.1, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.2.1, 4.3.1
CO5	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.2.1, 2.2.2, 2.2.3, 2.4.2, 2.4.4, 3.1.1, 3.1.2, 3.1.5, 3.1.6, 3.3.1, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.2.1, 4.3.1

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Rememberin g (K1) %**	**Understandin g (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	30	50	-	-	-	100
CAT2	10	30	50	10	-	-	100
Individual Assessme nt 1 /Case Study 1/ Seminar 1 / Project1	10	30	50	10	-	-	100
Individual Assessme nt 2 /Case Study 2/ Seminar 2 / Project 2	10	30	50	10	-	-	100
ESE	10	30	50	10	-	-	100

22PES609	DESIGN THINKING FOR PRODUCTION ENGINEERING	SEMESTER VI

PREREQUISITES	CATEGORY	L	T	P	C
22PPC518 – MODELLING LABORATORY	ES	0	0	3	1.5

Course Objectives	• Impart design skills to analyze design thinking issues and apply the tools and techniques of design.

LIST OF EXERCISES

DESIGN THINKING PROCESS AND PRACTICE

Design thinking: Definition, Origin of design thinking, Importance of design thinking, Problem-solving, Understanding design thinking and its process model, Design thinking tools.

EXERCISES

1. **Brainstorming for Printability:** Identify a simple, functional mechanical component suitable for 3D printing.
2. **Component Sketching and Design Planning:** Develop detailed 2D sketches of your chosen mechanical component using AutoCAD / SOLIDWORKS / CATIA / Creo
3. **Building 3D Model:** Translate 2D sketch into a functional 3D model using CAD software.
4. **Design analysis:** Analyse 3D Model component using Ansys Software
5. **Design Optimization for 3D Printing:** Analyze and modify the design for optimal printability and material efficiency.
6. **Slicing Software and Print Preparation:** Get familiar with slicing software and prepare the 3D model design for printing.
7. **3D Printing Process and Monitoring:** Print the optimized design using a 3D printer and monitor the progress.
8. **Prototype Evaluation and Quality Check:**Analyze the printed component for accuracy, functionality, and surface finish.
9. **Functional Testing and Performance Evaluation:** Test the functionality of your 3D printed component according to its intended purpose.
10. **Design Iteration and Future Improvements for Product Development:** Analyze the results and consider a real world problem related to that component and provide potential improvements for future iterations and product development.
11. **Explore IOT applications in Production Engineering**
12. **Explore DOE software tools.**

Contact Periods:
Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Prepare 3D component model using suitable software tools.	K3
CO2	Design and analyse the component using suitable software tools.	K4
CO3	Choose the suitable material and other parameters for making a functional prototype.	K4
CO4	Fabricate a functional prototype using 3D Printing.	K3
CO5	Apply design thinking to identify and solve production engineering problems.	K6

COURSE ARTICULATION MATRIX:

	a) CO and PO Mapping														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	2	2	3	2	2	1	1	1	2	1	2	2	2	1	2
CO2	2	2	3	2	2	1	1	1	2	1	2	2	2	1	2
CO3	2	2	3	2	2	1	1	1	2	1	2	2	2	1	2
CO4	2	2	3	2	2	1	1	1	2	1	2	2	2	1	2
CO5	2	2	3	2	2	1	1	1	2	1	2	2	2	1	2
22PES609	**2**	**2**	**3**	**2**	**2**	**1**	**1**	**1**	**2**	**1**	**2**	**2**	**2**	**1**	**2**
	1 – Slight, 2 – Moderate, 3 – Substantial														
	b) CO and Key Performance Indicators Mapping														
CO1	1.1.2, 1.3.1, 1.4.1, 2.1.2, 2.2.3, 2.4.1, 2.4.2, 2.4.4, 3.1.1, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 3.1.1, 4.1.2, 4.1.3, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 7.1.1, 7.1.2, 7.2.2, 8.1.1, 9.1.1, 10.10.1, 10.2.1, 11.1.1, 11.1.2, 11.2.1, 11.3.1, 11.3.2, 12.1.1, 12.2.2, 12.3.1, 12.3.2														
CO2	1.1.2, 1.3.1, 1.4.1, 2.1.2, 2.2.3, 2.4.1, 2.4.2, 2.4.4, 3.1.1, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 3.1.1, 4.1.2, 4.1.3, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 7.1.1, 7.1.2, 7.2.2, 8.1.1, 9.1.1, 10.10.1, 10.2.1, 11.1.1, 11.1.2, 11.2.1, 11.3.1, 11.3.2, 12.1.1, 12.2.2, 12.3.1, 12.3.2														
CO3	1.1.2, 1.3.1, 1.4.1, 2.1.2, 2.2.3, 2.4.1, 2.4.2, 2.4.4, 3.1.1, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 3.1.1, 4.1.2, 4.1.3, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 7.1.1, 7.1.2, 7.2.2, 8.1.1, 9.1.1, 10.10.1, 10.2.1, 11.1.1, 11.1.2, 11.2.1, 11.3.1, 11.3.2, 12.1.1, 12.2.2, 12.3.1, 12.3.2														
CO4	1.1.2, 1.3.1, 1.4.1, 2.1.2, 2.2.3, 2.4.1, 2.4.2, 2.4.4, 3.1.1, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 3.1.1, 4.1.2, 4.1.3, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 7.1.1, 7.1.2, 7.2.2, 8.1.1, 9.1.1, 10.10.1, 10.2.1, 11.1.1, 11.1.2, 11.2.1, 11.3.1, 11.3.2, 12.1.1, 12.2.2, 12.3.1, 12.3.2														
CO5	1.1.2, 1.3.1, 1.4.1, 2.1.2, 2.2.3, 2.4.1, 2.4.2, 2.4.4, 3.1.1, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 3.1.1, 4.1.2, 4.1.3, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 7.1.1, 7.1.2, 7.2.2, 8.1.1, 9.1.1, 10.10.1, 10.2.1, 11.1.1, 11.1.2, 11.2.1, 11.3.1, 11.3.2, 12.1.1, 12.2.2, 12.3.1, 12.3.2														

22PEE601	AUTOMATION AND CONTROLSYSTEMS LABORATORY	SEMESTER VI

PREREQUISITES	CATEGORY	L	T	P	C
NIL	EEC	0	0	3	1.5

Course Objectives	• To train the students to simulate the simple applications in hydraulic and pneumatic kits. • To train the students to control the speed of electrical drives.

LIST OF EXERCISES

1. Design and simulation of systems using single acting actuator and Pneumatic elements.
2. Design and simulation of system using double acting actuator, Pneumatic elements and Electro Pneumatic elements.
3. Design and simulation of system using double acting actuator and PLC.
4. Design and simulation of hydraulic system – sequencing circuit, air-oil intensifier circuit, meter-in and meter-out circuit.
5. Design and simulation of hydraulic system with PLC – sequencing circuit, meter-in and meter- out circuit, high-low circuit, on delay timer control circuit.
6. Speed control of AC motor.
7. Speed control of DC motor.
8. PID controller with temperature control system.
9. Servo controller using servo motor.
10. Stepper motor interfacing with 8051 micro-controller.
11. Computerized data logging system.

Contact Periods:
Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Design and develop the simple industrial application of basic pneumatic circuits.	K3
CO2	Design and develop the simple industrial application of electro pneumatic circuits.	K3
CO3	Design and develop the simple industrial application of hydraulic circuits.	K3
CO4	Design and develop the simple industrial application of electro hydraulic control circuits.	K3
CO5	Control the speed and temperature of electrical drives.	K3

COURSE ARTICULATION MATRIX:

	a) CO and PO Mapping														
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	2	2	-	1	-	-	1	1	-	1	2	2	-
CO2	2	2	2	2	-	1	-	-	1	1	-	1	2	2	-
CO3	2	2	2	2	-	1	-	-	1	1	-	1	2	2	-
CO4	2	2	2	2	-	1	-	-	1	1	-	1	2	2	-
CO5	2	2	2	2	-	1	-	-	1	1	-	1	2	2	-
22PEE601	**2**	**2**	**2**	**2**	**-**	**1**	**-**	**-**	**1**	**1**	**-**	**1**	**2**	**2**	**-**
	1 – Slight, 2 – Moderate, 3 – Substantial														
	b) CO and Key Performance Indicators Mapping														
CO1	1.1.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.1, 2.4.4, 3.1.1, 3.1.6, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 10.1.1, 10.3.1, 12.2.1, 12.2.2														
CO2	1.1.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.1, 2.4.4, 3.1.1, 3.1.6, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 10.1.1, 10.3.1, 12.2.1, 12.2.2														
CO3	1.1.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.1, 2.4.4, 3.1.1, 3.1.6, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 10.1.1, 10.3.1, 12.2.1, 12.2.2														
CO4	1.1.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.1, 2.4.4, 3.1.1, 3.1.6, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 10.1.1, 10.3.1, 12.2.1, 12.2.2														
CO5	1.1.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.1, 2.4.4, 3.1.1, 3.1.6, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 10.1.1, 10.3.1, 12.2.1, 12.2.2														

22PHS706	TOTAL QUALITY MANAGEMENT CONCEPTS	SEMESTER VII

PREREQUISITES	CATEGORY	L	T	P	C
NIL	HSMC	3	0	0	3

Course Objective	• To impart knowledge to develop a product with the required quality at a reasonable price and to satisfy the requirements under various quality standards.	
UNIT- I	**INTRODUCTION**	**(9 Periods)**
Definition of quality, dimensions of quality, quality planning, quality costs concepts - basic concepts of total quality management, principles of TQM, leadership concepts - quality council, quality statements, strategic planning- steps in strategic planning- Deming philosophy, barriers to TQM implementation.		
UNIT- II	**TQM PRINCIPLES**	**(9 Periods)**
Customer satisfaction - customer perception of quality - customer retention, employee involvement - motivation, empowerment, performance appraisal, continuous process improvement – Juran trilogy, PDSA cycle, 5S concept, kaizen, supplier partnership - supplier rating – performance measures- Malcom Balridge National Quality Award.		
UNIT- III	**TOOLS AND TECHNIQUES**	**(9 Periods)**
Benchmarking - benchmarking process - quality function deployment (QFD) - house of quality - Taguchi quality loss function - total productive maintenance (TPM) - pillars of TPM - Failure Mode Effective Analysis (FMEA) - Failure rate- types of FMEA - stages of FMEA.		
UNIT- IV	**OLD AND NEW TQM CONCEPTS**	**(9 Periods)**
Seven old and new tools of quality - process capability. Six sigma – history –objectives- concepts – implementation - methodologies – DMAIC – DMADV – case studies.		
UNIT- V	**QUALITY SYSTEMS**	**(9 Periods)**
Need for ISO 9000 and other quality system - ISO 9001:2015 quality system – elements - implementation of quality system - documentation - quality auditing - QS 9000, ISO 14000 - concept, requirements and benefits- integrating ISO 14000 with ISO 9000 – OSHSAS 18001 – TS 16949.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Dale H.Besterfield* ***"Total Quality Management"****, Pearson Education, 2008*
2	*Subburajramasamy* ***"Total Quality Management",*** *Tata McGraw Hill, 2008.*

REFERENCES:

1	*James R. Evans and William M. Lindsay,* ***"The Management and Control of Quality",*** *(6thEdition), South-Western (Thomson Learning), 2005.*
2	*Janakiraman,B and Gopal, R.K,* ***"Total Quality Management – Text and Cases",*** *Prentice Hall (India) Pvt. Ltd., 2006.*
3	*Suganthi,L and Anand Samuel,* ***"Total Quality Management",*** *Prentice Hall (India) Pvt. Ltd., 2006.*
4	*Chapman and Hall,* ***"Total Quality Management",*** *2nd Edition,1995.*
5	*P.N .Mukherjee,* ***"Total Quality Management",*** *Prentice- Hall of India Private Limited, 2006.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Apply the principle of strategic planning, Deming philosophy and leadership concepts in industries.	K2
CO2	Apply the principle of TQM in industries.	K4
CO3	Select appropriate quality tools to meet industrial requirements.	K4
CO4	Apply the six sigma concepts in industries.	K2
CO5	Implement appropriate quality standards for industries.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	2	-	1	1	1	-	-	-	1	-	-	-	-	-	1
CO2	1	-	1	1	1	-	-	-	-	-	-	-	-	-	2
CO3	2	-	2	1	1	-	-	-	-	-	-	-	-	-	2
CO4	1	-	2	2	2	-	-	-	-	-	-	-	-	-	2
CO5	2	-	2	2	2	-	-	-	-	-	-	-	-	-	2
22PHS706	**2**	**-**	**2**	**1**	**1**	**-**	**-**	**-**	1	**-**	**-**	**-**	**-**	**-**	**2**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.3.1, 1.4.1, 3.1.1, 4.1.1, 5.2.1; 14.1.1
CO2	1.3.1, 1.4.1, 3.1.1, 4.1.1, 5.2.1; 14.1.1, 14.1.2
CO3	1.3.1, 1.4.1, 3.1.1, 3.2.1, 4.1.1, 5.2.1, 14.1.1; 14.1.2
CO4	1.3.1, 1.4.1, 3.1.1, 4.1.1, 5.2.1, 14.1.1; 14.1.2
CO5	1.3.1, 1.4.1, 3.1.1, 3.2.1, 4.1.1, 5.2.1, 14.1.1; 14.1.2

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Rememberin g (K1) %**	**Understandin g (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	25	25	20	10	10	10	100
CAT2	25	25	20	10	10	10	100
Individual Assessme nt 1 /Case Study 1/ Seminar 1 / Project1	25	25	20	10	10	10	100
Individual Assessme nt 2 /Case Study 2/ Seminar 2 / Project 2	25	25	20	10	10	10	100
ESE	25	25	20	10	10	10	100

22PPC723	ADDITIVE MANUFACTURING	SEMESTER VII

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	0	0	3

Course Objective	• To educate the students with fundamental and advanced knowledge in the field of Additive Manufacturing technology and associated Aerospace, Architecture, Art, Medical and Industrial applications.	
UNIT- I	**INTRODUCTION**	**(9 Periods)**
Need - Development of AM systems – AM process chain - Impact of AM on Product Development - Virtual Prototyping- Rapid Tooling – RP to AM - Classification of AM processes – Benefits – Applications - Case studies.		
UNIT- II	**REVERSE ENGINEERING AND CAD MODELING**	**(9 Periods)**
Basic concept- Digitization techniques – Model reconstruction – Data Processing for Rapid Prototyping: CAD model preparation, Data requirements – Geometric modeling techniques: Wireframe, surface and solid modeling – data format interfacing, Part orientation and support generation, Support structure design, Model Slicing, Tool path generation.		
UNIT- III	**LIQUID BASED AND SOLID BASED ADDITIVE MANUFACTURING SYSTEMS**	**(9 Periods)**
Stereo lithography Apparatus (SLA): Principle, pre-build process, part-building and post-build processes, photo polymerization of SL resins, part quality and process planning, recoating issues, materials, advantages, limitations and applications. Solid Ground Curing (SGC): working principle, process, strengths, weaknesses and applications. Fused deposition Modeling (FDM): Principle, details of processes, process variables, types, products, materials and application. Laminated Object Manufacturing (LOM): Working Principles, details of processes, products, materials, advantages, limitations and applications.		
UNIT- IV	**POWDER BASED ADDITIVE MANUFACTURING SYSTEMS**	**(9 Periods)**
Selective Laser Sintering (SLS): Principle, process, indirect and direct SLS - powder structures, materials, post processing, surface deviation and accuracy, Applications. Laser Engineered Net Shaping (LENS): Processes, materials, products, advantages, limitations and applications – case Studies, Selective Laser Melting and Electron Beam Melting.		
UNIT- V	**OTHER ADDITIVE MANUFACTURING SYSTEMS**	**(9 Periods)**
Three dimensional Printing (3DP): Principle, basic process, Physics of 3DP, types of printing, process capabilities, material system. Solid based, Liquid based and powder based AM systems - Demerits, Applications and case studies. Shape Deposition Manufacturing (SDM), Ballastic Particle Manufacturing (BPM), Bio Additive Manufacturing.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Chua Chee Kai and Leong Kah Fai,* ***"Rapid Prototyping: Principles and Applications in Manufacturing",*** *John Wiley AND Sons, 1997.*
2	*Paul F. Jacobs,* ***"Stereo-lithography and other RP & M Technologies",*** *from Rapid Prototyping to Rapid Tooling, SME/ASME,1996*

REFERENCES:

1	*Ian Gibson, David Rosen, Brent Stucker, Mahyar Khorasani* ***"Additive manufacturing technologies".*** *3rd edition Springer Cham, Switzerland, 2021.*
2	*Chua, C.K., Leong K.F. and Lim C.S.* ***"Rapid prototyping: Principles and applications"****, second edition, World Scientific Publishers, 2010.*
3	*Gebhardt, A.,* ***"Rapid prototyping"****, Hanser Gardener Publications, 2003.*
4	*Liou, L.W. and Liou, F.W* ***"Rapid Prototyping and Engineering applications: A tool box for prototype development"****, CRC Press, 2011.*
5	*Hilton, P.D. and Jacobs, P.F* ***"Rapid Prototyping and Engineering applications: A tool box for prototype development"****, CRC press, 2005.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Describe the need and fundamentals of Additive Manufacturing (AM) systems.	K3
CO2	Create and analyze 2D and 3D models using CAD modelling software, discuss the fundamentals of Reverse Engineering and integrating with manufacturing systems.	K3
CO3	Describe liquid based and solid based additive manufacturing systemsand their applications.	K3
CO4	Apply knowledge of powder based additive manufacturing techniques in the field of manufacturing and other fields.	K3
CO5	Discuss other variety of Additive Manufacturing (AM) technologies and apply their potential to support design and manufacturing and case studies relevant to customized manufacturing.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	2	2	2	-	2	-	3	-	3	3	3	3	1	1	-
CO2	2	2	3	3	3	-	3	-	3	3	1	2	-	2	1
CO3	2	2	3	2	3	-	3	-	3	3	1	2	2	1	-
CO4	2	2	3	2	3	-	3	-	3	3	1	2	2	3	1
CO5	2	2	3	2	3	3	3	-	3	3	1	3	1	3	-
22PPC723	**2**	**2**	**3**	**2**	**3**	**1**	**3**	**-**	**3**	**3**	**2**	**3**	**2**	**2**	**1**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 5.2.2, 5.3.1, 5.3.2, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 11.2.1, 11.3.1, 11.3.2, 12.1.1, 12.1.2, 12.2.2, 12.3.1, 12.3.2.
CO2	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.2, 12.2.2, 12.3.1, 12.3.2.
CO3	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 3.1.1, 3.1.2, 3.1.3,

	3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.3.1, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.2, 12.2.2, 12.3.1, 12.3.2.
CO4	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.3.1, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.2, 12.2.2, 12.3.1, 12.3.2.
CO5	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.3.1, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.1, 12.1.2, 12.2.2, 12.3.1, 12.3.2.

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	15	52	33	-	-	-	100
CAT2	15	68	17	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	50	25	25	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	-	100	-	-	-	100
ESE	9	75	16	-	-	-	100

22PPC724	JIGS, FIXTURES AND PRESS TOOLS *(Use of approved data book is permitted)*	SEMESTER VII

PREREQUISITES	CATEGORY	L	T	P	C
22PPC303-MANUFACTURING TECHNOLOGY	PC	3	0	0	3

Course Objective	• To introduce the fundamental concepts of various types of jigs, fixtures and dies.	
UNIT- I	**LOCATING AND CLAMPING PRINCIPLES**	**(9 Periods)**
Tool design objectives - tool design in manufacturing - planning the design - principles ofsupporting and locating elements- referencing, basic rules of locating - planes of movement -locating from a flat surface - locating from internal and external diameter - external profile -principles of clamping and work holding – types - non mechanical clamping- clampingaccessories - materials used in tools.		
UNIT- II	**JIGS**	**(9 Periods)**
Components of jigs - Drill bushes – different types of jigs – plate, latch, channel, box, angle plate, post, turnover, pot jigs - Automatic drill jigs - Rack and pinion operated, air operated jigs - design and development of jigs for simple components.		
UNIT- III	**FIXTURES**	**(9 Periods)**
General principles of milling boring, lathe and broaching fixtures - Grinding, planning andshaping fixtures, assembly, Inspection and welding fixtures- modular fixtures - design and development of fixtures for simple component.		
UNIT- IV	**PRESS TOOLS AND SHEARING**	**(9 Periods)**
Press working terminology – types - Punch and die elements - Types of Sheet metal shearingoperations - Blanking and Piercing - Mechanism of Shearing – Centre of Pressure, Die clearance, Calculation of force requirements, methods of reducing cutting force - Design of simple progressive dies for blanking and piercing.		
UNIT- V	**BENDING, FORMING, DRAWING AND MISCELLANEOUS DIES**	**(9 Periods)**
Bending, forming and drawing dies – types - design and development of above dies - design considerations in forging -extrusion –recent trends in tool design – computer aids for sheet metal forming analysis – basic introduction.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*K.Venkataraman **"Design of Jigs, Fixtures and Presstools**", John Wiley & Sons, 2015*

REFERENCES:

1	*B Donaldson, B.H. Lecain, Goold V.V **"Tool Design",** TMH Edition, 2012*
2	*P.H.Joshi **"Jigs and Fixtures",** Mcgraw Hill Education, 2010*
3	*P.H.Joshi, "**Press Tools Design And Construction**", S Chand & Company, 2017*
4	*Fred H Colvin, Lucian L Haas, "**Jigs and Fixtures**", Maxwell Press, 2022*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the fundamentals of work holding devices, locators and clamps.	K2
CO2	Discuss about various types of jigs and design simple jigs.	K3
CO3	Discuss about various types of fixtures and design simple fixtures.	K3
CO4	Discuss about the various elements of die and design simple dies for sheet metal shearing operation.	K2
CO5	Discuss about various sheet metal forming operations and recent trends.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	1	2	2	2	1	3	3	-	1	3	2	3	1	2	1
CO2	2	3	2	3	3	3	3	-	1	3	2	3	3	2	1
CO3	2	3	2	3	3	3	3	-	1	3	2	3	3	2	1
CO4	2	3	2	3	3	3	3	-	1	3	2	3	3	2	1
CO5	2	3	2	3	3	3	3	-	1	3	2	3	3	2	1
22PPC724	**2**	**3**	**2**	**3**	**3**	**3**	**3**	**-**	**1**	**3**	**2**	**3**	**3**	**2**	**1**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1, 2.1.2, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.4.4, 3.1.1, 3.1.3, 3.1.5, 3.2.3, 3.3.1, 3.4.1, 4.1.1, 4.1.2, 4.3.4, 5.2.1, 5.3.1, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO2	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 3.3.2, 3.4.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.4, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO3	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 3.3.2, 3.4.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.4, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO4	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 3.3.2, 3.4.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.4, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO5	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 3.3.2, 3.4.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.4, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	60	20	-	-	-	100
CAT2	25	55	20		-		100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	40	40	20	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	40	40	20	-	-		100
ESE	10	58	32	-	-	-	100

22PPC725	SIMULATIONLABORATORY	SEMESTER VII

PREREQUISITES	CATEGORY	L	T	P	C
22PPC619 - MACHINE ELEMENTS DESIGN	PC	0	0	3	1.5

Course Objectives	*To gain practical experience in handling Finite Element analysis & CAM software packages.

LIST OF EXERCISES

Finite Element Modelling and Analysis

- Exercises on Modelling and Meshing on 1D, 2D and 3D models.
- Exercises on Solution and Post processing of 1D, 2D and 3D models.
- Structural analysis of a fixed beam
- Structural analysis of a cantilever beam
- Structural analysis of a simply supported beam
- Structural analysis of a link element
- Structural analysis of aluminium bracket
- Modelling using axisymmetry
- Plane stress analysis
- Modal analysis of cantilever beam
- Heat distribution in rectangular slab
- Thermal analysis of 2D heat sink
- Exercise on coupled field analysis

CAM software

- Designing of connecting rod using CAM software
- Exercise on 2D part development and NC contour tool path generation

Contact Periods:
Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Explain the basics used to create and manipulate geometric models in computer using ANSYS. &Master CAM	K2
CO2	Describe about the failure criteria and Vonmises stress for various models.	K3
CO3	Do structural and thermal analysis of various models.	K3
CO4	Predict the natural frequencies and modes shapes using Modal analysis	K3
CO5	Use ANSYS and Master CAM software for any engineering applications.	K3

COURSE ARTICULATION MATRIX:

	a) CO and PO Mapping														
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	2	2	1	-	3	-	-	-	-	1	-	1	2	2	-
CO2	2	2	1	-	3	-	-	-	-	1	-	1	2	2	-
CO3	2	2	1	-	3	-	-	-	-	1	-	1	2	2	-
CO4	2	2	1	-	3	-	-	-	-	1	-	1	2	2	-
CO5	2	2	1	-	3	-	-	-	-	1	-	1	2	2	-
22PPC725	**2**	**2**	**1**	**-**	**3**	**-**	**-**	**-**	**-**	**1**	**-**	**1**	**2**	**2**	**-**
	1 – Slight, 2 – Moderate, 3 – Substantial														
	b) CO and Key Performance Indicators Mapping														
CO1	1.1.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.1, 2.4.4, 3.1.1, 3.1.6, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 10.1.1, 10.3.1, 12.2.1, 12.2.2														
CO2	1.1.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.1, 2.4.4, 3.1.1, 3.1.6, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 10.1.1, 10.3.1, 12.2.1, 12.2.2														
CO3	1.1.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.1, 2.4.4, 3.1.1, 3.1.6, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 10.1.1, 10.3.1, 12.2.1, 12.2.2														
CO4	1.1.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.1, 2.4.4, 3.1.1, 3.1.6, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 10.1.1, 10.3.1, 12.2.1, 12.2.2														
CO5	1.1.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.1, 2.4.4, 3.1.1, 3.1.6, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 10.1.1, 10.3.1, 12.2.1, 12.2.2														

22PEE702	ENGINEERING PROJECTS IN COMMUNITY SERVICE	SEMESTER VII

PREREQUISITES	CATEGORY	L	T	P	C
NIL	EEC	0	0	4	2

Course Objective	• To provide an environment where teams of students can exercise their engineering skills by being exposed to realistic systems and customers and at the same time helping their community.

LIST OF EXERCISES

Problem identification – Identifying the issues within the community -Preliminary survey - Preparing a questionnaire, formats and survey forms. - A preliminary survey including the socio-economic conditions of the allotted habitation - Different types of surveys, tools and techniques for collecting the information. - Analysis of collected data and mapping of issues with the solutions available. - Based on the survey and the specific requirements of the habitation, Community Awareness Campaigns – Identifying the factors – Normalization of factors and finding the path way for problem solution – Selection of problem from the community and mapping of issues - Planning for working: Aim, objective and scope, time line - Application of engineering knowledge and tools for solutions

Validation of the solution by supervising the execution of solution - Measuring the attainment of the solution: Feedback from community

Contact Periods:
Lecture: 0 Periods Tutorial: 0 Periods Practical: 60 Periods Total: 60 Periods

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Identify engineering related problems in the community.	K2
CO2	Analyze and Design different solutions to solve the problems of community.	K4
CO3	Apply economical solution to those problems in the field.	K4
CO4	To understand complexity and ambiguity	K1
CO5	Connections with professionals and community members for learning and career opportunities	K2

COURSE ARTICULATION MATRIX:

	Course Articulation Matrix														
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	2	2	-	1	2	1	-	2	-	1	-	1	1	1
CO2	-	2	2	-	1	2	1	-	2	-	1	-	1	1	1
CO3	-	2	2	-	1	2	1	-	2	-	1	-	1	1	1
CO4	-	2	2	-	1	2	1	-	2	2	1	-	1	1	1
CO5	-	2	2	-	1	2	1	-	2	2	1	-	1	1	1
22PEE702	-	2	2	-	1	2	1	-	2	1	1	-	1	1	1
	1 – Slight, 2 – Moderate, 3 – Substantial														

22PEE804	CAPSTONE PROJECT	SEMESTER VIII

PREREQUISITES	CATEGORY	L	T	P	C
NIL	EEC	0	0	16	8

Course Objectives	*To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. *To train the students in preparing project reports and to face reviews and viva voce examination.

LIST OF EXERCISES

A project topic must be selected by the students in consultation with their guides. The aim of the project work is to deepen comprehension of principles by applying them to a new problem which may be the design and fabrication of a device for a specific application, a research project with a focus on an application needed by the industry/society, a computer project, a management project or a design project.

The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated jointly by external and internal examiners constituted by the Head of the Department based on oral presentation and the project report.

Contact Periods:
Lecture: 0 Periods Tutorial: 0 Periods Practical: 240 Periods Total: 240 Periods

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Identify problem specification for development and analyse conceptual design, methodology of solution for the problem.	K3
CO2	Devise solution and build physical model /test if required, as per industry / research / societal need, with due consideration of environmental aspects.	K5
CO3	Follow and value health, safety and ethical practices during project.	K2
CO4	Contribute as an individual or in a team in development of technical projects and express technical ideas, strategies and methodologies in written form.	K6
CO5	Identify problem specification for development and analyse conceptual design, methodology of solution for the problem.	K5

COURSE ARTICULATION MATRIX:

	a) CO and PO Mapping														
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	3	3	3	3	3	3	3	3	2	1	2	3	3	3	3
CO2	3	3	3	3	3	3	3	3	2	1	2	3	3	3	3
CO3	2	2	2	2	1	2	2	3	3	3	3	3	3	3	3
CO4	2	2	2	2	1	2	2	3	3	3	3	3	3	3	3
CO5	2	2	2	2	1	2	2	3	3	3	3	3	3	3	3
22PEE804	**3**	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
	1 – Slight, 2 – Moderate, 3 – Substantial														

	b) CO and Key Performance Indicators Mapping
CO1	1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 10.1.1, 10.1.3, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO2	1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 10.1.1, 10.1.3, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO3	1.2.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.5, 3.3.1, 4.1.1, 4.1.2, 4.3.3, 5.1.1, 5.1.2, 6.1.1, 7.1.1, 7.1.2, 8.1.1, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 11.2.1, 11.3.1, 11.3.2, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO4	1.2.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.5, 3.3.1, 4.1.1, 4.1.2, 4.3.3, 5.1.1, 5.1.2, 6.1.1, 7.1.1, 7.1.2, 8.1.1, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 11.2.1, 11.3.1, 11.3.2, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO5	1.2.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.5, 3.3.1, 4.1.1, 4.1.2, 4.3.3, 5.1.1, 5.1.2, 6.1.1, 7.1.1, 7.1.2, 8.1.1, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 11.2.1, 11.3.1, 11.3.2, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2

22PPE$01	MECHATRONIC SYSTEMS	SEMESTER $

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	• Introducing the overview of multi-domain engineering integration, key elements of mechatronics system and, understanding the concepts of integration and design of mechatronics system.	
UNIT- I	**MECHATRONICS SYSTEMS AND SENSORS**	**(9 Periods)**
Introduction to Mechatronics Systems, Key Elements, Ways of Integration – Hardware and Software. Sensors – Characteristics – Static and Dynamic, Types - Linear, Rotational, Velocity Acceleration, Force, Torque, Flow, Temperature, Proximity, Optical, Micro and Nano Sensors, Selection of Sensors. Analog and Digital Signals - Signal Condition Module – Amplifiers - Inverting Amplifier, Non-Inverting Amplifier, Instrumentation Amplifier, Filters, A/D and D/A Converter.		
UNIT- II	**ACTUATORS**	**(9 Periods)**
Electrical Actuators and Its Characteristics – DC Motors, AC Motors - Servo Motor and Stepper Motor. AC Drives - H-Bridge Circuits and Stepper Motor Driving Circuits - Switching Devices – Mechanical, Solenoids, Relays - Overview of Fluid Power Actuators and Control - Types and Characteristics of Micro and Nano Actuators.		
UNIT- III	**SYSTEM MODELING AND CONTROL**	**(9 Periods)**
Transfer Function - Mechanical System Modeling – Characterization of System Time Response – Stable and Unstable System - Open Loop and Closed Loop Control Systems. Controllers - P, PD, PI, PID Controllers - Comparison of Control Realization in Hardware – Microprocessor – Microcontroller – PLC.		
UNIT- IV	**MICROCONTROLLERS**	**(9 Periods)**
8051 Microcontrollers – Architecture, Address Modes, Instruction Sets, Programming Exercises - Memories – Different Types – Different I/O Devices, Stepper and Servo Motor Interface. Overview of Advanced Microcontrollers - Typical Applications.Introduction of RFID Control Systems.		
UNIT- V	**MECHATRONICS SYSTEM DESIGN AND APPLICATIONS**	**(9 Periods)**
Stages in Designing Mechatronics Systems – Traditional and Mechatronic Design – Mechatronics System Elements and Architecture of CNC Machine, Serial Manipulator, Engine Management System, Car Production and its Assembly Line Automation.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Bolton .W.,**"Mechatronics"** ,Pearson Education Limited, 5th Edition, 2011*
2	*Devadas Shetty, Richard A. Kolk, **"Mechatronics System Design**", CENGAGE Learning Custom Publishing, 2nd International student edition, 2010.*

REFERENCES:

1	*Mazidi. M.A and Mazidi .M.J., MCkinlay.R.D, "**The 8051 Microcontroller and Embedded Systems Using Assembly and C**", Pearson India, 2 nd Edition, 2008.*
2	*Patranabis D.,**"Sensor and Actuators",**Prentice Hall of India Pvt Ltd., 2nd edition,2005.*
3	*Vijayaraghavan G.K., BalasundaramM.S , Ramachandran K.P. , **"Mechatronics: Integrated Mechanical Electronic Systems**, Willey, 2008.*
4	John P. Bentley., ***"Principle of Measurement systems",**Pearson Prentice Hall, Fourth edition,2005.*
5	K. Ogata, ***"Modern Controls Engineering"**, Prentice Hall of India Pvt. Ltd., New Delhi, 2005.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Identify suitable sensors to develop mechatronics systems.	K2
CO2	Recognize the appropriate actuators and its drives for integration.	K1
CO3	Develop the mathematical model of the mechanical systems elements for control.	K3
CO4	Use the microcontroller for input and output interfacing.	K3
CO5	Demonstrate the steps involved mechatronic system integration for automation for various applications.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	1	-	1	1	1	-	-	-	-	-	-	-	-	1	1
CO2	1	-	2	1	1	-	-	-	-	-	-	-	-	2	-
CO3	2	-	2	2	2	-	-	-	-	-	-	-	-	2	-
CO4	1	-	1	1	2	-	-	-	-	-	-	-	-	1	-
CO5	1	-	2	2	2	-	-	-	-	-	-	-	-	2	-
22PPE$01	**2**	**-**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**1**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1, 3.1.1; 4.1.1, 5.1.2, 14.1.1
CO2	1.2.1, 2.1.1; 4.1.1; 5.1.1, 14.1.1
CO3	1.1.1, 1.3.1, 1.4.1; 3.1.1, 4.1.1; 5.1.1, 14.1.1
CO4	1.2.1, 3.1.1; 4.1.1, 5.1.2, 14.1.1
CO5	1.1.1, 1.3.1, 1.4.1; 3.1.1, 4.1.1; 5.1.1, 14.1.1, 14.2.2

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	25	25	20	10	10	10	100
CAT2	25	25	20	10	10	10	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	25	25	20	10	10	10	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	25	25	20	10	10	10	100
ESE	25	25	20	10	10	10	100

22PPE$02	ROBOTICS AND MACHINE VISION SYSTEM	SEMESTER $

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	*To familiarize students with the concepts and techniques of robot manipulator, its kinematics, programming and build confidence to evaluate, choose and incorporate robots in engineering systems.	
UNIT- I	**FUNDAMENTALS OF ROBOT**	**(9 Periods)**
Robotics – Introduction – Basic structure – Classification of robot and Robotic systems – Specifications of Robots - laws of robotics – work space, precision movement. Drives and Controls systems: Hydraulic systems, power supply – servo valve – hydraulic motor – DC servo motors – stepper motors – operation – selection of system – control system – servo control.		
UNIT- II	**ROBOT MOTION ANALYSIS**	**(9 Periods)**
Kinematics of Robot: Introduction, Matrix Representation, homogeneous transformation, forward and inverse kinematics, Inverse kinematics Programming, Degeneracy, dexterity, velocity and static forces, Basics of trajectory planning.		
UNIT- III	**GRIPPERS AND SENSORS**	**(9 Periods)**
Robot end effectors: Types of end effectors – Mechanical grippers – Types of Gripper mechanisms – Grippers force analysis – Other types of grippers – Vacuum cups – Magnetic grippers – Adhesive grippers – Robot end effectors interface. Sensors: Position sensors – Potentiometers, encoders, - LVDT, Velocity sensors, Acceleration Sensors, Force, Pressure and Torque sensors, Touch and Tactile sensors, Proximity, Range and sniff sensors.		
UNIT- IV	**PROGRAMMING AND APPLICATION**	**(9 Periods)**
Types of programming – programming languages sample program for different types of robots – Industrial Applications: Application of robots in processing operations – Assembly and inspections – Material handling – Loading and unloading– AI and Robotics.		
UNIT- V	**MACHINE VISION**	**(9 Periods)**
Introduction – image processing Vs image analysis, image acquisition, digital images – sampling and quantization – image definition, levels of computation. Image processing Techniques: Data reduction – Windowing, digital conversion. Segmentation– Thresholding, Connectivity, Noise reduction, Edge detection, Segmentation, Region growing and Region splitting, Binary morphology and grey morphology operation – feature extraction.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Saeed B.Niku **"Introduction to Robotics: Analysis, Systems, Applications"**, 2nd edition, Pearson Education India, PHI 2003 (ISBN 81- 7808-677-8)*
2	*M.P.Groover **"Industrial Robotics – Technology, Programming and Applications"**, McGraw- Hill, USA, 1986.*

REFERENCES:

1	*Janakiraman P.A **"Robotics and image processing"**, Tata McGraw Hill, 1995.*
2	*YoremKoren, **"Robotics for Engineers"**, McGraw-Hill, USA, 1992.*
3	*Richard D.Klafter, Thomas A.Chmielewski and Michael Negin **"Robotic Engineering, An Integrated Approach"**, Prentice Hall Inc, Englewoods Cliffs, NJ, USA, 1989.*
4	*Foley, Wan Dam, Feiner and Hughes **"Computer Graphics Principles & Practice"**, Pearson Education -2003*
5	*Ramesh Jam, RangachariKasturi, Brain G.Schunck **"Machine Vision"**, Tata McGraw Hill.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the basic concepts like various configurations, classification and parts of robots.	K2
CO2	Explain the concept of kinematics, degeneracy, dexterity and trajectory planning.	K2
CO3	Describe various end effectors and sensors used in robots.	K2
CO4	Explain the concept of Artificial Intelligence in robots, various types of robot programming and its applications.	K3
CO5	Demonstrate the image processing and image analysis techniques by machine vision system.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	2	2	2	1	2	-	2	-	3	3	1	3	1	1	1
CO2	3	3	2	2	2	-	-	-	3	3	1	3	2	2	1
CO3	3	2	2	1	2	-	1	-	2	3	1	3	2	2	2
CO4	2	3	2	3	3	-	-	-	3	3	1	3	2	3	2
CO5	2	3	2	3	3	-	-	-	3	3	1	3	2	3	2
22PPE$02	**3**	**3**	**2**	**2**	**3**	**-**	**1**	**-**	**3**	**3**	**1**	**3**	**2**	**3**	**2**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.3.1, 2.3.2, 2.4.4, 3.1.1, 3.1.2, 3.1.4, 3.2.2, 3.3.1, 3.3.2, 4.2.2, 5.1.2, 5.2.1, 5.2.2, 7.1.1, 7.1.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.2.
CO2	1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.4, 3.1.1, 3.1.2, 3.2.1, 3.3.1, 3.3.2, 4.1.2, 4.1.4, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 9.1.1, 9.2.1, 9.2.2, 9.2.3, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO3	1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.3.1, 2.3.2, 3.1.1, 3.1.4, 3.2.3, 3.3.1, 3.3.2, 4.1.2, 4.1.4, 5.1.1, 5.2.1, 5.2.2, 7.1.1, 9.1.1, 9.2.1, 9.2.2, 9.2.3, 10.1.1, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.3.1, 12.3.2
CO4	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.4, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 4.1.1, 4.1.2, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.2.
CO5	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 4.1.1, 4.1.2, 4.1.4, 4.2.1, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.1, 12.1.2, 12.2.2, 12.3.2.

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	26	74	-	-	-	-	100
CAT2	26	58	16	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	60	40	-	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	40	40	20	-	-	-	100
ESE	44	40	16	-	-	-	100

22PPE$03	ELECTRONICS MANUFACTURING TECHNOLOGY	SEMESTER $

PREREQUISITES	CATEGORY	L	T	P	C
22PES101-BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING	PE	3	0	0	3

Course Objectives	*To understand wafer preparation and PCB fabrication, the types of Mounting Technologies and components for electronics assembly & SMT process in detail. *To know various Defects, Inspection Equipments SMT assembly process and repair, rework and quality aspects of Electronics assemblies.	
UNIT- I	**INTRODUCTION TO ELECTRONICS MANUFACTURING**	**(9 Periods)**
History, definition, wafer preparation by growing, machining, and polishing, diffusion, microlithography, etching and cleaning, Printed circuit boards, types- single sided, double sided,multi layer and flexible printed circuit board, design, materials, manufacturing, inspection.		
UNIT- II	**COMPONENTS AND PACKAGING**	**(9 Periods)**
Introduction to packaging, types-Through hole technology (THT) and Surface mount technology (SMT), Through hole components – axial, radial, multi leaded, odd form. Surface mount components-active, passive. Interconnections - chip to lead interconnection, die bonding, wire bonding, TAB, flip chip, chip on board, multi chip module, direct chip array module, leaded, leadless, area array and embedded packaging, miniaturization and trends.		
UNIT- III	**SURFACE MOUNT TECHNOLOGY PROCESS**	**(9 Periods)**
Introduction to the SMT Process, SMT equipment and material handling systems, handling of components and assemblies - moisture sensitivity and ESD, safety and precautions needed, IPC and other standards, stencil printing process - solder paste material, storage and handling, stencils and squeegees, process parameters, quality control. Component placement- equipment type, flexibility, accuracy of placement, throughput, packaging of components for automated assembly, Cp and Cpk and process control. soldering- reflow process, process parameters, profile generation and control, solder joint metallurgy, adhesive, underfill and encapsulation process - applications, materials, storage and handling, process and parameters.		
UNIT- IV	**INSPECTION AND TESTING**	**(9 Periods)**
Inspection techniques, equipment and principle - AOI, X-ray. Defects and Corrective action - stencil printing process, component placement process, reflow soldering process, underfill andencapsulation process, electrical testing of PCB assemblies- In circuit test, functional testing,fixtures and jigs.		
UNIT- V	**REPAIR, REWORK, QUALITY AND RELIABILITY OF ELECTRONICS ASSEMBLIES**	**(9 Periods)**
Repair tools, methods, rework criteria and process, thermo-mechanical effects and thermalmanagement, Reliability fundamentals, reliability testing, failure analysis, design formanufacturability, assembly, reworkability, testing, reliability and environment.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Ratan Sengupta**, "A Beginners Guide to Surface Mount Technology",** Bluerose Publishers, 2023*
2	*Prasad R**. "Surface Mount Technology –Principles and practice"**, Chapman and Hall, 1997*

REFERENCES:

1	*Tummala R.R. "**Fundamentals of microsystem packaging**", Mc-Graw Hill, 2001*
2	*P Viswanadham and P Singh "**Failure Modes and Mechanisms in Electronic Packages**", Chapman and Hall, 1997*
3	*Zarrow P and Kopp D "**Surface Mount Technology Terms and Concepts**", Elsevier Science and Technology, 1997*
4	*Harper C.A., "**Electronic Packaging and Interconnection Handbook**", McGraw Hill Inc.,New York, 1997*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Describe wafer preparation and PCB fabrication process.	K2
CO2	Use different types of mounting technologies for electronic assemblies.	K3
CO3	Perform quality inspection on the PCBs.	K3
CO4	Repair and rework of Electronics assemblies.	K3
CO5	Describe the quality and reliability aspects of Electronics assemblies.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	2	2	2	1	3	3	-	1	3	2	3	1	2	1
CO2	2	3	2	3	3	3	3	-	1	3	2	3	3	2	3
CO3	2	3	2	3	3	3	3	-	1	3	2	3	3	2	3
CO4	2	3	2	3	3	3	3	-	1	3	2	3	3	2	3
CO5	2	3	2	3	3	3	3	-	1	3	2	3	3	2	3
22PPE$03	**2**	**3**	**2**	**3**	**3**	**3**	**3**	**-**	**1**	**3**	**2**	**3**	**3**	**2**	**3**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1, 2.1.2, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.4.4, 3.1.1, 3.1.3, 3.1.5, 3.2.3, 3.3.1, 3.4.1, 4.1.1, 4.1.2, 4.3.4, 5.2.1, 5.3.1, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO2	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 3.3.2, 3.4.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.4, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO3	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 3.3.2, 3.4.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.4, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2

CO4	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 3.3.2, 3.4.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.4, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO5	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 3.3.2, 3.4.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.4, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	50	50	-	-	-	-	100
CAT2	50	50		-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	33.33	33.33	33.33	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	33.33	33.33	33.33	-	-	-	100
ESE	42	42	16	-	-	-	100

22PPE$04	SMART MANUFACTURING	SEMESTER $

PREREQUISITES	CATEGORY	L	T	P	C
22PPC408 - CNC TECHNOLOGY	PE	3	0	0	3

Course Objective	• To familiarize the students about various components of Intelligent manufacturing systems.	
UNIT- I	**COMPONENTS OF EXPERT SYSTEMS**	**(9 Periods)**
Expert system concept – comparisons – stages in Expert system - Knowledge Representation – Types - comparison of Knowledge Representation Schemes – Inference engine – Inference models –Forward, backward chaining - Knowledge acquisition – Optimization and Knowledge based systems.		
UNIT- II	**INTELLIGENT MANUFACTURING**	**(9 Periods)**
Machine Learning - Intelligent Manufacturing – System Components – System architecture and Data flow – System operation – Flexible Assembly Systems – Tool management.		
UNIT- III	**TECHNOLOGY BASED SYSTEMS**	**(9 Periods)**
Design of mechanical parts – Refinement Approach – Model based approach – Design of mechanisms – Feature based design – Knowledge based design for Automated Assembly – Process planning – Feature recognition – Machining Optimization – Knowledge Based Systems.		
UNIT- IV	**KNOWLEDGE BASED SYSTEM FOR GROUP TECHNOLOGY**	**(9 Periods)**
Models and Algorithms – Cluster Analysis Method – Knowledge based systems for GT – Models and Algorithms for Machine layout – Knowledge based Systems for machine layout – scheduling - Models and Algorithms – Knowledge Based Systems.		
UNIT- V	**INDUSTRIAL APPLICATION AND RECENT ADVANCES**	**(9 Periods)**
Industrial application of Artificial Intelligence and Expert systems – Robotic vision systems, image processing techniques– application to object recognition and inspection - Application of Artificial Neural Networks – Fuzzy Logic and Genetic Algorithms in manufacturing – ANN for tool wear monitoring – Fuzzy control of machine tools.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Andrew Kusiak,* ***"Intelligent Manufacturing Systems",*** *Prentice Hall, 1998.*
2	*Mohammed Jamshidi, "Design and Implementation of Intelligent Manufacturing systems", Prentice Hall, 1995.*

REFERENCES:

1	*Mitsugen, Runweicheng "**Genetic Algorithms in Engineering Design**", JohWiley, 1997.*
2	*Elaine Rich "**Artificial Intelligence**", TMH, 1995.*
3	*Ibrahim Zeid "**CAD/CAM Theory and Practice**", McGraw Hill, 1998.*
4	*Robert Levine et al "**A Comprehensive guide to AI and Expert Systems**", McGraw Hill Inc, 1986.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Identify various components of expert systems.	K3
CO2	Describe the Architecture and components of intelligent manufacturing systems.	K3
CO3	Explain the process of designing mechanisms and Process planning with Knowledge based Systems.	K3
CO4	Discuss the Applications of knowledge based systems in Group Technology.	K3
CO5	Discuss the various recent advances and industrial applications of Artificial intelligence and Expert systems.	K3

COURSE ARTICULATION MATRIX:

	a) CO and PO Mapping														
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	2	2	3	3	3	-	3	-	3	3	1	3	1	3	2
CO2	2	2	3	3	3	-	3	-	3	3	1	3	1	3	2
CO3	2	2	3	3	3	-	3	-	3	3	1	3	1	3	2
CO4	2	2	3	3	3	-	3	-	3	3	1	3	1	3	2
CO5	2	2	3	3	3	-	3	-	3	3	1	3	1	3	2
22PPE$04	**2**	**2**	**3**	**3**	**3**	**-**	**3**	**-**	**3**	**3**	**1**	**3**	**1**	**3**	**2**
	1 – Slight, 2 – Moderate, 3 – Substantial														
	b) CO and Key Performance Indicators Mapping														
CO1	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 5.2.2, 5.3.1, 5.3.2, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 11.2.1, 11.3.1, 11.3.2, 12.1.1, 12.1.2, 12.2.2, 12.3.1, 12.3.2.														
CO2	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.2, 12.2.2, 12.3.1, 12.3.2.														
CO3	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.3.1, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.2, 12.2.2, 12.3.1, 12.3.2.														
CO4	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.3.1, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.2, 12.2.2, 12.3.1, 12.3.2.														
CO5	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.3.1, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.1, 12.1.2, 12.2.2, 12.3.1, 12.3.2.														

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	15	52	33	-	-	-	100
CAT2	15	68	17	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	50	50	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	50	50	-	-	-	100
ESE	9	75	16	-	-	-	100

22PPE$05	MODERN CONTROL TECHNOLOGY	SEMESTER $

PREREQUISITES	CATEGORY	L	T	P	C
22PPC301- MACHINE TOOLS AND PROCESSES 22PPC408 - CNC TECHNOLOGY	PE	3	0	0	3

Course Objective	• To familiarize the architecture of the modern control techniques, the basics of control systems, operational amplifiers and mechanical systems and to provide an in-depth knowledge on control system components, Feedback Systems and Logic Controller systems and their functions.	
UNIT- I	**INTRODUCTION TO CONTROL SYSTEMS**	**(9 Periods)**
Introduction – control systems – open loop control systems – closed loop control systems - transfer function – analog and digital control systems – classifications of control systems. Microprocessor based control : microprocessor system hardware operation – interfacing a microprocessor controller – basics of controller programming – microprocessor based controllers.		
UNIT- II	**OPERATIONAL AMPLIFIERS AND SIGNAL CONDITIONING**	**(9 Periods)**
Operational amplifiers – special interface circuits – signal transmission. Switches, relays and semi conductors: Switches– toggle switches, Push button switches, and other switches. Relays– electromechanical relays – solid state relays. Power Transistors – silicon controlled rectifiers – Triacs, Trigger devices.		
UNIT- III	**MECHANICAL SYSTEMS AND ACTUATORS**	**(9 Periods)**
Behavior of mechanical components – energy – response of the whole mechanical system – gears – clutches and brakes– other power transmitting techniques. Electrical linear actuators – hydraulic systems – pneumatic systems – flow control valves.		
UNIT- IV	**CONTROL SYSTEM COMPONENTS**	**(9 Periods)**
Potentiometer – error detector – magnetic amplifier – hydraulic elements – synchros – stepper motors – tachogenerators– servomechanisms – modulators and demodulators – PID controllers – servo motors.		
UNIT- V	**FEED BACK AND LOGIC CONTROL SYSTEMS**	**(9 Periods)**
On – off controllers – fuzzy logic controllers – Programmable logic controller: overview of PLC systems – input and output modules – power supplies – general PLC programming procedures – auxiliary commands and functions – ladder diagrams – timer functions – counter functions.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Kilian, **"Modern Control Technology Components and Design"**, 2nd edition, Delmar Publication Ltd., 2008.*

REFERENCES:

1	*Gopal M., **"Control Systems – Principles and Design"**, 2nd edition, Tata McGraw Hill Publishing Co.Ltd,, New Delhi, 2006.*

2	*John.W.Webb and Ronald A.Reis,* ***"Programmable Logic Controllers – Principles and Applications"****, Prentice Hall Inc., New Jersy, 2003.*
3	*Sivanandam S.N.,* ***"Control Systems Engineering"****, Vikas Publishing House Pvt.Ltd., New Delhi, 2001.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Describe the applications of the modern control techniques in present engineering scenario.	K3
CO2	Explain the basics of control systems, operational amplifiers and mechanical systems.	K3
CO3	Demonstrate control system components, Feedback Systems and Logic Controller systems and their functions.	K3
CO4	Elaborate the various components of the control system	K3
CO5	Analyse various types of controllers and program a simple PLC circuit based on the feedback and control system	K4

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	2	2	3	3	3	-	3	-	3	3	1	3	1	3	2
CO2	2	2	3	3	3	-	3	-	3	3	1	3	1	3	2
CO3	2	2	3	3	3	-	3	-	3	3	1	3	1	3	2
CO4	2	2	3	3	3	-	3	-	3	3	1	3	1	3	2
CO5	2	2	3	3	3	-	3	-	3	3	1	3	1	3	2
22PPE$05	**2**	**2**	**3**	**3**	**3**	**-**	**3**	**-**	**3**	**3**	**1**	**3**	**1**	**3**	**2**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 5.2.2, 5.3.1, 5.3.2, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 11.2.1, 11.3.1, 11.3.2, 12.1.1, 12.1.2, 12.2.2, 12.3.1, 12.3.2.
CO2	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.2, 12.2.2, 12.3.1, 12.3.2.
CO3	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.3.1, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.2, 12.2.2, 12.3.1, 12.3.2.
CO4	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.3.1, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.2, 12.2.2, 12.3.1, 12.3.2.
CO5	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.3.1, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.1, 12.1.2, 12.2.2, 12.3.1, 12.3.2.

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	15	52	33	-	-	-	100
CAT2	15	68	17	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	50	50	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	50	50	-	-	-	100
ESE	9	75	16	-	-	-	100

22PPE$06	IMAGE PROCESSING IN MANUFACTURING	SEMESTER $

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	• To provide knowledge on computer vision, Image acquisition, distribution, processing and analysis.	
UNIT- I	**COMPUTER VISION**	**(9 Periods)**
Computer Imaging. Computer Vision and Image Processing. Human Visual Perception. Image Representation. Image Geometry. Sampling and Quantization. Levels of computation; Point level, Local level, Global level and object level. Digital Image Properties.		
UNIT- II	**IMAGE ACQUISITION**	**(9 Periods)**
Charge coupled devices: Principle, Surface channel CCD.s, Buried channel CCD.s, sensitivity and resolution, Noise and Hot Pixels, Blooming, Image Smear, Linear CCD Sensors, Image Sensors . Line scan cameras. CMOS image sensors. Video standards. Colour images: various colour models. Other Image Sources: Ultrasound imaging devices, computer tomography, Magnetic resonance imaging. Optics: Lens equation, Image resolution, Depth of field, View volume and Exposure.		
UNIT- III	**IMAGE DISTRIBUTION**	**(9 Periods)**
Frame Grabbing. Camera interfaces and protocols. Compression Techniques. Lossless compression: Run Length Encoding, Huffman coding, Arithmetic coding - Lossy compression: Discrete cosine transform, JPEG coding, Discrete wavelet transform. Image Standards: BMP, GIF, TIFF, PNG, PCX, JPG, DICOM standard.		
UNIT- IV	**IMAGE PROCESSING**	**(9 Periods)**
Gray scale operations: Histogram, Look up tables. Spatial Image filtering: smoothing, Guassian, Gradient, Laplacian. Frequency Filtering: FFT, Morphology Functions: Thresolding, Binary Morphology and Gray level Morpology.		
UNIT- V	**IMAGE ANALYSIS**	**(9 Periods)**
Pixel value analysis: Line profile, Quantify areas, Centroid function, Linear averages, Edge detection and enhancement, Segmentation and labeling. Quantitative analysis: Counting objects, Measuring Distances, Complex particle measurements. Image calibration. Pattern matching techniques. Character recognition. Applications in Manufacturing.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Janaki Raman P.A,* ***"Robotics and Image Processing",*** *Tata McGraw Hill, 1995*
2	*Milan Sonka, Vaclav Hlavac, Roger Boyle,* ***"Image Processing, Analysis and Machine Vision",*** *PWS Publishing, 1995*

REFERENCES:

1	*Ramesh Jai, Rangachar Kasthuri, Brain Gschunch,, "**Machine Vision**", McGraw Hill International Edition, 1995*
2	*Thomas Klinger, "**Image processing with LabView and IMAQ Vision**", Prentice Hall, 2003*
3	*Rafeal C Gonzalez, Richard E Woods, **"Digital Image Processing"**, Second Edition, Pearson Education, 1992*
4	*Christian Demant, Bernd Streicher-Abel, Carsten Garnica, "**Industrial Image Processing: Visual Quality Control in Manufacturing",** Springer, 2013*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Describe the basic principles of computer vision and image formation in the manufacturing system.	K2
CO2	Explain the concepts of various image distribution and image transform techniques.	K3
CO3	Describe the basic concepts of image perception and representation, image processing and analysis.	K3
CO4	Apply various image analysis techniques in manufacturing applications.	K4
CO5	Analyze the images using various analyzing methods.	K4

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	1	2	2	2	1	3	3	-	1	3	2	3	1	2	3
CO2	2	3	2	3	3	3	3	-	1	3	2	3	3	2	3
CO3	2	3	2	3	3	3	3	-	1	3	2	3	3	2	3
CO4	2	3	2	3	3	3	3	-	1	3	2	3	3	2	3
CO5	2	3	2	3	3	3	3	-	1	3	2	3	3	2	3
22PPE\$06	**2**	**3**	**2**	**3**	**3**	**3**	**3**	**-**	**1**	**3**	**2**	**3**	**3**	**2**	**3**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.1, 2.4.3,3.1.1, 3.1.2,3.1.3, 3.1.6, 3.2.1,3.3.1, 3.3.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 7.1.1, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.2, 12.2.1,12.3.2.
CO2	1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.1, 2.4.3, 3.1.1, 3.1.2, 3.1.3, 3.1.6, 3.2.1, 3.3.1, 3.3.2, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 7.1.1, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.2, 12.2.1, 12.3.1, 12.3.2
CO3	1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.2.1, 2.2.3, 2.3.1, 2.4.1, 2.4.3, 3.1.1, 3.1.2, 3.1.3, 3.1.6, 3.2.1, 3.3.1, 3.3.2, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 7.1.1, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.2, 12.2.1, 12.3.1, 12.3.2

CO4	1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.2.1, 2.2.3, 2.3.1, 2.4.1, 2.4.3, 3.1.1, 3.1.2, 3.1.3, 3.1.6, 3.2.1, 3.3.1, 3.3.2,3.4.2, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 7.1.1, 9.1.1, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.2, 12.2.1, 12.3.1, 12.3.2
CO5	1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.2.1, 2.2.3, 2.3.1, 2.4.1, 2.4.3, 3.1.1, 3.1.2, 3.1.3, 3.1.6, 3.2.1, 3.3.1, 3.3.2, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 7.1.1, 7.2.1, 9.1.1, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 11.3.2, 12.1.2, 12.2.1, 12.2.2, 12.3.2

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	50	50		-	-	-	100
CAT2	50	50			-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	33.33	33.33	33.33	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	33.33	33.33	33.33	-	-	-	100
ESE	42	42	16	-	-	-	100

22PPE$07	DESIGN FOR MANUFACTURE AND ASSEMBLY	SEMESTER $

PREREQUISITES	CATEGORY	L	T	P	C
22PPC301 – MACHINE TOOLS AND PROCESSES 22PPC302 – ENGINEERING METALLURGY 22PPC303 – MANUFACTURING TECHNOLOGY	PE	3	0	0	3

Course Objectives	• To acquire knowledge of the general design principles of Manufacturing. • To familiarize various assembly methods and processes and design for assembly guidelines.	
UNIT- I	**DESIGN PRINCIPLE**	**(9 Periods)**
Structure and classification of Industrial Robots, Terminology of robot motion, Die cast Robots and Foundry Robots- advantages, applications. Robotic automation in permanent mold foundries.		
UNIT- II	**FORMDESIGN**	**(9 Periods)**
Factors affecting casting design - Grey iron castings, steel castings, malleable iron castings – Non ferrous alloys: Aluminium castings – Pressure die castings – factors affecting weldment design – Gas and Arc welding.		
UNIT- III	**FORMED METAL COMPONENTS AND NON-METALLIC PARTS DESIGN**	**(9 Periods)**
Metal extrusion – cold headed pats – fine blanking – Tube and section bends – powder metal parts – thermo setting plastic parts – reinforced - plastic/composite parts.		
UNIT- IV	**MACHINED COMPONENTS DESIGN**	**(9 Periods)**
Design for machinability – design for economy – design for clampability – design for accessibility. Turned parts – drilled parts – milled parts, planned, shaped and slotted parts – Ground parts – parts produced by EDM.		
UNIT- V	**TECHNOLOGY REQUIREMENT AND ASSEMBLY**	**(9 Periods)**
Product design requirements for group technology concepts and CNC machining – part family concept – mechanical assemblies – general recommendations - design rules for rivets, screw fasteners, gaskets and seals. Press and snap fits.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*James G.Bralla* ***"Hand book of product design for manufacture",*** *Mc Graw Hill Book Co., Second edition, 1999.*
2	*Robert Matousek* ***"Engineering Design – A systematic approach",*** *Blackie and Son Ltd, London*
3	*Geoffrey Boothroyd, PeterDewhurst, Winston A. Knight* ***"Product design for manufacture and assembly",*** *Taylor and Francis group, 2011.*

REFERENCES:

1	*Harry Peck,* ***"Design for manufacture"****, Pitman publications, 1983.*
2	*Trucks H.E.,* ***"Design for Economic Production, Society of Manufacturing engineers",*** *Michigan 2nd Edition1987*
3	*Karl T.Ulrich and Steven D Eppinger* ***"Product Design and Development",*** *Tata McGraw Hill, 3rd edition, 2008*
4	*Oliver R.Wade,* ***"Tolerance Control in design and Manufacturing",*** *Industrial Press Inc., New York Publications, 1967.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the basic design principles and use of tolerances in manufacturing.	K2
CO2	Describe the concepts of form design for various metals and alloys involving in casting process.	K2
CO3	Describe the design concepts of formed metals and plastic components.	K3
CO4	Explain the concepts of various machined parts design for manufacturing.	K3
CO5	Explain the assembly concepts for manufacturing and its technology requirements.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	3	2	2	1	-	-	-	-	-	-	-	-	1	-	-
CO2	2	1	2	1	-	-	-	-	-	-	-	-	1	-	-
CO3	2	1	2	1	-	-	-	-	-	-	-	-	1	-	-
CO4	2	1	2	1	-	-	-	-	-	-	-	-	1	-	-
CO5	2	1	2	1	-	-	-	-	-	-	-	-	1	-	-
22PPE$07	**3**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.1, 2.4.3,3.1.1, 3.1.2,3.1.3, 3.1.6, 3.2.1,3.3.1, 3.3.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 7.1.1, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.2, 12.2.1,12.3.2.
CO2	1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.1, 2.4.3, 3.1.1, 3.1.2, 3.1.3, 3.1.6, 3.2.1, 3.3.1, 3.3.2, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 7.1.1, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.2, 12.2.1, 12.3.1, 12.3.2
CO3	1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.2.1, 2.2.3, 2.3.1, 2.4.1, 2.4.3, 3.1.1, 3.1.2, 3.1.3, 3.1.6, 3.2.1, 3.3.1, 3.3.2, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 7.1.1, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.2, 12.2.1, 12.3.1, 12.3.2
CO4	1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.2.1, 2.2.3, 2.3.1, 2.4.1, 2.4.3, 3.1.1, 3.1.2, 3.1.3, 3.1.6, 3.2.1, 3.3.1, 3.3.2,3.4.2, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 7.1.1, 9.1.1, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.2, 12.2.1, 12.3.1, 12.3.2
CO5	1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.2.1, 2.2.3, 2.3.1, 2.4.1, 2.4.3, 3.1.1, 3.1.2, 3.1.3, 3.1.6, 3.2.1, 3.3.1, 3.3.2, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 7.1.1, 7.2.1, 9.1.1, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 11.3.2, 12.1.2, 12.2.1, 12.2.2, 12.3.2

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	40	40	20	-	-	-	100
CAT2	30	30	40	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	45	45	10	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	35	35	30	-	-	-	100
ESE	30	40	30	-	-	-	100

22PPE$08	FINITEELEMENTTECHNIQUES	SEMESTER $

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	• To familiarize the students in principles involved in discretization, finite element approach and can solve the simple engineering problems.	
UNIT- I	**INTRODUCTION TO FINITE ELEMENT METHOD (FEM)**	**(9 Periods)**
Historical background; Basic concept of FEM; Discrete and continuous models; Boundary and Initial value problems; Discretization - Convergence requirements.		
UNIT- II	**FORMULATION OF ELEMENT CHARACTERISTIC MATRICES**	**(9 Periods)**
One dimensional governing equation - Structural and heat transfer problems; Variational method; Weighted residual methods; Principle of minimization of potential energy.		
UNIT- III	**ONE DIMENSIONAL PROBLEMS**	**(9 Periods)**
Shape functions; Problems in axial loaded members, trusses, beams, heat transfer through composite walls and fins; Gauss elimination and Cholesky method of solving equations.		
UNIT- IV	**TWO DIMENSIONAL PROBLEMS**	**(9 Periods)**
Linear triangular and rectangular elements – Shape functions: Pascal's triangle - Concept of plane stress and plane strain. Solution of simple problems in structural and heat transfer models.		
UNIT- V	**HIGHER ORDER ELEMENTS**	**(9 Periods)**
Applications of higher order elements; Lagrangian and serendipity elements; Isoparametric elements - Jacobian transformation.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Reddy, J.N.* ***"Introduction to the Finite Element Method",*** *McGraw Hill, Intl, 4th edition, 2020.*
2	*Singiresu S. Rao* ***"The Finite Element Method in Engineering",*** *Butterworth Heinemann., 5th edition, 2011.*

REFERENCES:

1	Tirupathi R. Chandrupatala and Ashok D. Belegundu **"Introduction to Finite Elements in Engineering",** Pearson Education India, 4th edition, 2015.
2	David V. Hutton **"Fundamentals of Finite Element Analysis",** McGraw Hill Education, 2017.
3	Larry J. Segerlind **"Applied Finite Element Analysis",** John Wiley and Sons, 2nd edition, 1985.
4	Logan, D.L. "A first course in Finite Element Method", Thomson Asia Pvt. Ltd., 2002.
5	Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt **"Concepts and Applications of Finite Element Analysis",** 4th Edition, Wiley Student Edition, 2002.

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Discuss the fundamentals of finite element technique	K2
CO2	Formulate the structural and heat transfer problems	K3
CO3	Solve the one-dimensional structural and heat transfer problems	K4
CO4	Implement the formulation techniques to solve two-dimensional problems using linear triangular and rectangular elements.	K3
CO5	Describe the higher order elements	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping															
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	2	3	1	-	-	-	-	-	-	-	-	1	2	-	-
CO2	2	3	1	-	-	-	-	-	-	-	-	1	2	-	-
CO3	2	3	1	-	-	-	-	-	-	-	-	1	2	-	-
CO4	2	3	1	-	-	-	-	-	-	-	-	1	2	-	-
CO5	2	3	1	-	-	-	-	-	-	-	-	1	2	-	-
22PPE$08	**2**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**-**	**-**
1 – Slight, 2 – Moderate, 3 – Substantial															
b) CO and Key Performance Indicators Mapping															
CO1	1.1.1, 1.1.2, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.4, 3.1.1, 3.1.6, 12.2.1, 12.2.2														
CO2	1.1.1, 1.1.2, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.4, 3.1.1, 3.1.6, 12.2.1, 12.2.2														
CO3	1.1.1, 1.1.2, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.4, 3.1.1, 3.1.6, 12.2.1, 12.2.2														
CO4	1.1.1, 1.1.2, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.4, 3.1.1, 3.1.6, 12.2.1, 12.2.2														
CO5	1.1.1, 1.1.2, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.4, 3.1.1, 3.1.6, 12.2.1, 12.2.2														

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	15	18.3	66.7	-	-	-	100
CAT2	15	18.3	66.7	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	-	100	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	-	100	-	-	-	100
ESE	9	11	80	-	-	-	100

22PPE$09	COMPUTERAIDEDDESIGN	SEMESTER $

PREREQUISITES	CATEGORY	L	T	P	C
22PES1Z7-ENGINEERINGGRAPHICS 22PPC411–PRODUCTIONDRAWING	PE	3	0	0	3

Course Objective	• To provide an overview of how computers can be employed to in design the mechanical component.	
UNIT- I	**INTRODUCTION**	**(9 Periods)**
Fundamentals of Computer Graphics-Product cycle- Design process- sequential and concurrent engineering- Computer aided design – CAD system architecture- Computer graphics – co-ordinate systems- 2D and 3D transformations homogeneous coordinates - Line drawing -Clipping- viewing transformation.		
UNIT- II	**GEOMETRIC MODELING**	**(9 Periods)**
Representation of curves- Hermite curve- Bezier curve- B-spline curves-rational curves- Techniques for surface modeling – surface patch- Coons and bicubic patches- Bezier and B-splinesurfaces. Solid modeling techniques- CSG and B-rep.		
UNIT- III	**VISUAL REALISM**	**(9 Periods)**
Hidden line-surface removal algorithms, shading, colouring, computer animation.		
UNIT- IV	**ASSEMBLY PARTS**	**(9 Periods)**
Assembly modeling, interference position and orientation, Geometric tolerance, tolerance analysis, tolerance synthesis, mechanism simulation and interface checking.		
UNIT- V	**CAD STANDARDS**	**(9 Periods)**
Standards for computer graphics- Graphical Kernel System (GKS) - standards for exchange images Open Graphics Library (OpenGL) - Data exchange standards - IGES, STEP, CALS etc. - communication standards.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Ibrahim Zeid* ***"Mastering CAD CAM"****, Tata McGraw-Hill PublishingCo.2007*
2	*D.Hearn and M.P.Baker* ***"Design of Computer Graphics"****, Prentice Hall Inc., 1992*

REFERENCES:

1	*Chris McMahon and Jimmie Browne* ***"CAD/CAM Principles"****, Practice and Manufacturing management "Second Edition, Pearson Education, 1999.*

2	*Radhakrishnan P, SubramanyanS. and RajuV.,* ***"CAD/CAM/CIM"****, 2nd Edition, New Age International (P) Ltd, New Delhi,2000.*
3	*Donald Hearn and M. Pauline Baker* ***"Computer Graphics"****, Prentice Hall, Inc,1992.*
4	*Foley, Wan Dam, Feiner and Hughes* ***"Computer graphics principles & practice"****, Pearson Education -2003*
5	*William M Neumann and Robert F.Sproul* ***"Principles of Computer Graphics"****, McGraw Hill Book Co. Singapore, 1989.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand the fundamental of computer graphics, 2D and 3D transformation in CAD.	K2
CO2	Familiar about the geometric, surface and solid modelling techniques.	K2
CO3	Develop the line, surface and solid removal algorithm and creation of computer animation.	K3
CO4	Identify the importance of tolerance during assembly of components.	K2
CO5	Explain the various standards used in Computer Aided Design.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	3	3	1	2	2	-	-	1	3	3	1	2	3	3	2
CO2	3	3	2	3	2	-	-	-	3	3	2	3	3	3	3
CO3	3	3	2	2	2	-	-	-	2	3	1	3	2	3	3
CO4	2	2	2	2	1	-	-	-	3	3	2	3	3	3	2
CO5	2	2	2	3	2	-	-	1	2	3	2	2	2	3	2
22PPE$09	**3**	**3**	**2**	**3**	**2**	**-**	**-**	**1**	**3**	**3**	**2**	**3**	**3**	**3**	**3**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.2.1, 3.3.1, 3.3.2, 4.1.4, 4.2.1, 4.2.2, 4.3.3, 5.1.1, 5.1.2, 5.2.1, 8.1.1, 9.1.1, 9.1.2, 9.2.1, 9.2.3, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.3.2.
CO2	1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.4, 3.2.1, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.2, 4.1.4, 4.2.1, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 9.1.1, 9.2.1, 9.2.2, 9.2.3, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.2, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2.
CO3	1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 3.1.1, 3.1.2, 3.1.4, 3.2.1, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.2, 4.1.4, 4.3.2, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 9.2.1, 9.2.3, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.3.1, 12.3.2.
CO4	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.1, 2.2.2, 2.3.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.2, 4.1.4, 4.3.2, 5.2.1, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.2, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.2.
CO5	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.4, 3.2.1, 3.3.1, 3.3.2, 4.1.2, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 8.2.1, 9.2.1, 9.2.2, 9.2.3, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.2, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.3.2.

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	50	50	-	-	-	-	100
CAT2	46.66	53.33	-	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	33.33	33.33	33.33	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	33.33	33.33	33.33	-	-	-	100
ESE	42	58	-	-	-	-	100

22PPE$10	PRODUCT DESIGN AND PROCESS ENGINEERING	SEMESTER $

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	• To train the students to design the product and to develop the feasible processing technique for specific need.	
UNIT- I	**PRODUCT ENGINEERING**	**(9 Periods)**
Nature and scope of product engineering; creative and organizing for product innovation criteria for product success in life cycle of a product; maintainability engineering.		
UNIT- II	**MODELING AND SIMULATION**	**(9 Periods)**
Modelling and simulation; the role of models in product design mathematical modelling similitude relations; Weighted property index.		
UNIT- III	**MATERIAL SELECTION**	**(9 Periods)**
Material selection; Problems of material selection; Performance characteristics of materials; the materials selection process; economics of materials; Cost versus performance relations; Weighted property index.		
UNIT- IV	**DESIGN CONSIDERATIONS**	**(9 Periods)**
Functional and production design; form design; influence of basis design - mechanical loading and material on form design - form design of gray castings, malleable iron castings, aluminum castings, pressure die castings, plastic mounding, welded fabrications, forging and manufacture by machining methods.		
UNIT- V	**AESTHETIC AND ERGONOMIC CONSIDERATIONS**	**(9 Periods)**
Influence of space, size, weight, etc. on form design; aesthetic and ergonomic considerations; geometric dimensioning and tolerance of product; functional production and inspection datum; tolerance analysis.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*George E.Dieter and Linda C. Schmidt* ***"Engineering design"****, McGraw HillEducation, 6th edition, 2020.*
2	*Robert Matousek* ***"Engineering Design",*** *Blacke and Sons Ltd, 3rd edition, 2007.*

REFERENCES:

1	*Jones J* ***"Design Methods",*** *Wiley, 2nd edition,1992*
2	*Buhl H.R,* ***"Creative Engineering design",*** *Iowa state university press, 1960.*
3	*Benjamin W.Niebel and Alan B.Draper* ***"Product Design and process Engineering",*** *McGraw HillInc., US, 1st edition, 1974.*

4	*Harry peck* ***"Designingfor Manufacturing",*** *Sir Issac Pitman and Sons Ltd, 1973.*
5	*Gladman C.A* ***"Manual for Geometric Analysis of Engineering Designs",*** *Australian Trade publications Ltd, 1966.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Describe the product innovation	K2
CO2	Describe the analytical evaluation of the products	K4
CO3	Select the appropriate material for the product	K4
CO4	Develop the appropriate processing technique for the product	K6
CO5	Incorporate the aesthetic and ergonomic values	K4

COURSE ARTICULATION MATRIX:

	a) CO and PO Mapping														
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	2	2	3	-	-	3	1	-	3	1	-	2	3	-	-
CO2	2	3	2	-	-	2	2	-	2	-	-	-	2	-	-
CO3	1	2	1	2	-	2	2	-	2	-	-	2	2	-	-
CO4	2	-	1	2	-	3	1	-	3	-	-	-	2	-	-
CO5	-	1	1	-	-	2	2	-	2	-	-	-	1	-	-
22PPE$10	**2**	**2**	**2**	**1**	**-**	**3**	**2**	**-**	**3**	**1**	**-**	**1**	**2**	**-**	**-**
	1 – Slight, 2 – Moderate, 3 – Substantial														
	b) CO and Key Performance Indicators Mapping														
CO1	1.1.1, 1.2.1, 1.3.1, 2.1.1, 2.2.2, 2.2.4, 2.4.2, 2.4.4, 3.1.1, 3.1.2, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.4.1, 3.4.2, 6.1.1, 6.2.1, 7.1.2, 9.1.1, 9.2.1, 9.2.2, 9.2.3, 9.3.1, 10.1.1, 10.1.2, 12.1.2, 12.2.2, 12.3.1, 12.3.2														
CO2	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.5, 3.1.6, 3.4.1, 3.4.2, 6.1.1, 7.1.1, 7.1.2, 9.1.1, 9.2.1, 9.2.2, 9.2.3														
CO3	1.4.1, 2.1.1, 2.1.2, 2.2.2, 2.2.4, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.5, 3.1.6, 4.1.1, 4.1.2, 4.1.3, 4.2.1, 4.3.1, 6.1.1, 7.1.1, 7.1.2, 9.1.1, 9.2.1, 9.2.2, 9.2.3, 12.1.2, 12.2.2, 12.3.1, 12.3.2														
CO4	1.3.1, 1.4.1, 3.1.1, 3.1.6, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.2.1, 6.1.1, 6.2.1, 7.1.2, 9.1.1, 9.2.1, 9.2.2, 9.2.3, 9.3.1														
CO5	2.1.1, 2.1.2, 2.4.2, 2.4.4, 3.1.1, 3.1.5, 3.1.6, 6.1.1, 7.1.1, 7.1.2, 9.1.1, 9.2.1, 9.2.2, 9.2.3														

ASSESSMENT PATTERN– THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	-	20	20	50	-	10	100
CAT2	-	20	20	50	-	10	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	20	20	50	-	10	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	20	20	50	-	10	100
ESE	-	20	20	50	-	10	100

22PPE$11	INDUSTRIAL ERGONOMICS	SEMESTER $

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	• Understand the ergonomic principles in order to help workers avoid on-the-job illness and injury. • Improve comfort worker job satisfaction through measures that provide a greater comfort, helping people to perform assigned tasks more naturally.	
UNIT- I	**INPUT MODALITIES**	**(9 Periods)**
Ergonomics for productivity, safety and comfort, multi-disciplinary engineering, human machine system, information theory, coding, compatibility, memory, decision making, attention, text, graphics, symbols, visual and auditory display, representational display, tactual and olfactory display, design of controls.		
UNIT- II	**ANTHROPOMETRY**	**(9 Periods)**
Need for anthropometry, sources of human variability, data collection methodology, measuring procedures and tools, statistical analysis of measured data - percentile calculation, principles of applied anthropometry, ergonomic design guidelines for products, equipment and accessories.		
UNIT- III	**WORK ERGONOMICS**	**(9 Periods)**
Work station design, manual material handling, design of hand tools, muscles and function, physical work capacity, measurement of physiological work, stress and fatigue, work related musculoskeletal disorders, human thermoregulation, protection and thermal comfort.		
UNIT- IV	**ILLUMINATION, NOISE AND VIBRATION**	**(9 Periods)**
Vision and the eye, measurement of light, lighting design, visual fatigue, indoor lighting, measurement of sound, ear protection, design of acoustic environment, industrial noise control, auditory environment, effects of noise, vibration, human error, safety and equipment design.		
UNIT- V	**VIRTUAL ERGONOMICS**	**(9 Periods)**
Digital Human Modeling (DHM), anthropometric models, DHM packages – selection strategies and functionalities, virtual ergonomics evaluation techniques, field of vision, reach envelopes, accessibility and clearance analysis, discomfort analysis, Applications of DHM-Case studies.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Bridger R S,* ***"Introduction to Human Factors and Ergonomics"****, CRC Press, Taylor & Francis Group, 2017*
2	*Martin Helander,* ***"A Guide to Human Factors and Ergonomics"****, CRC Press, Taylor & Francis Group, 2005*

REFERENCES:

1	*Christopher Nemeth,* ***"Human Factors Methods for Design"****, CRC Press, Taylor & Francis Group, 2004*
2	*D Chakrabarti,* ***"Indian Anthropometric Dimensions for ergonomic design practice"****, National Institute of Design, Ahmedabad, 1997*
3	*Duffy V G,* ***"Hand book of digital human modeling: Research for Applied Ergonomics and Human Factor Engineering"****, CRC Press, Taylor & Francis Group, 2009.*
4	*Mark S Sanders,* ***"Human Factors in Engineering and Design"****, McGraw Hill Education, 2013*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Select appropriate input modalities for human machine interaction.	K2
CO2	Apply anthropometric principles for industrial workspace design	K4
CO3	Measure and evaluate human work output by psychophysiological methods.	K3
CO4	Design industrial workspace with required amount of light, sound and vibration.	K4
CO5	Evaluate human machine interaction using virtual ergonomics.	K4

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	1	2	2	2	1	3	3	-	1	3	2	3	1	2	1
CO2	2	3	2	3	3	3	3	-	1	3	2	3	3	2	3
CO3	2	3	2	3	3	3	3	-	1	3	2	3	3	2	3
CO4	2	3	2	3	3	3	3	-	1	3	2	3	3	2	3
CO5	2	3	2	3	3	3	3	-	1	3	2	3	3	2	3
22PPE$11	**2**	**3**	**2**	**3**	**3**	**3**	**3**	**-**	**1**	**3**	**2**	**3**	**3**	**2**	**3**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1, 2.1.2, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.4.4, 3.1.1, 3.1.3, 3.1.5, 3.2.3, 3.3.1, 3.4.1, 4.1.1, 4.1.2, 4.3.4, 5.2.1, 5.3.1, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO2	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 3.3.2, 3.4.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.4, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO3	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 3.3.2, 3.4.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.4, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO4	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 3.3.2, 3.4.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.4, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO5	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 3.3.2, 3.4.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.4, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	15	18.3	66.7	-	-	-	100
CAT2	15	18.3	66.7				100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	20	20	60	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	20	20	60	-	-	-	100
ESE	26	26	48	-	-	-	100

22PPE$12	ROBUSTDESIGN	SEMESTER $

PREREQUISITES	CATEGORY	L	T	P	C
22PBS408-APPLIED PROBABILITY AND STATISTICS	PE	3	0	0	3

Course Objective	• To impart knowledge to design experiments to a problem situation using traditional experimental designs as well as Taguchi Methods.	
UNIT- I	**EXPERIMENTAL DESIGN FUNDAMENTALS**	**(9 Periods)**
Importance of experiments, experimental strategies, basic principles of design, terminology, NOVA, steps in experimentation, sample size, normal probability plot and linear regression models.		
UNIT- II	**SINGLE FACTOR EXPERIMENTS**	**(9 Periods)**
Completely randomized design, Randomized block design, Latin square design – Statisticalanalysis, estimation of model parameters, model adequacy checking, pair wise comparison tests.		
UNIT- III	**MULTIFACTOR EXPERIMENTS**	**(9 Periods)**
Two and three factor full factorial experiments, Randomized block factorial design, Experiments with random factors, rules for expected mean squares, approximate F - tests. 2K factorial Experiments.		
UNIT- IV	**SPECIAL EXPERIMENTAL DESIGNS**	**(9 Periods)**
Blocking and confounding in 2k designs. Two level Fractional factorial design, nested designs, Split plot design, Response Surface Methods.		
UNIT- V	**TAGUCHI METHODS**	**(9 Periods)**
Steps in experimentation, design using Orthogonal Arrays, data analysis, Robust design- control and noise factors, S/N ratios, parameter design, Multi-level experiments, Multi - response optimization.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*A. Mitra **"Fundamentals of Quality Control and Improvement"**, Pearson Publication, 1998*
2	*PhillipJ.Rose**"Taguchitechniques forqualityengineering"**,McGrawHill,1996*

REFERENCES:

1	*Montgomery, D.C., **"Design and Analysis of experiments"**, John Wiley and Sons, Eighth edition, 2012*
2	*Krishnaiah, K. and Shahabudeen, P. **"Applied Design of Experiments and Taguchi Methods"**, PHI learning private Ltd., 2012.*
3	*Nicolo Belavendram **"Quality by Design; Taguchi techniques for industrial experimentation"**, Prentice Hall, 1995.*
4	*J. Krottmaier **"Optimizing Engineering Design"**, McGraw Hill Ltd, 1993*
5	*Madhav Shridhar Phadke, **"Quality Engineering Using Robust Design"**, Prentice Hall, 1985*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Select appropriate tools for robust design.	K2
CO2	Identify and implement single factor experiments	K3
CO3	Identify and implement multi factor experiments	K3
CO4	Apply the concepts of special experiment designs	K4
CO5	Apply the concepts of Taguchi experiment design for practical problems.	K4

COURSE ARTICULATION MATRIX:

	a) CO and PO Mapping														
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	3	2	2	3	3	-	1	-	1	3	1	2	3	3	2
CO2	3	2	2	3	3	-	1	-	1	3	1	2	2	2	3
CO3	3	2	2	3	3	-	1	-	1	3	1	2	2	2	3
CO4	3	2	2	3	3	-	1	-	2	3	1	2	3	2	3
CO5	3	2	2	3	3	-	2	-	2	3	2	2	3	2	3
22PPE$12	**3**	**2**	**2**	**3**	**3**	**-**	**2**	**-**	**2**	**3**	**2**	**2**	**3**	**3**	**3**

1 – Slight, 2 – Moderate, 3 – Substantial

	b) CO and Key Performance Indicators Mapping
CO1	1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.1, 2.4.3, 3.1.1, 3.1.2, 3.1.3, 3.1.6, 3.2.1, 3.3.1, 3.3.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 7.1.1, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.2, 12.2.1, 12.3.2.
CO2	1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.1, 2.4.3, 3.1.1, 3.1.2, 3.1.3, 3.1.6, 3.2.1, 3.3.1, 3.3.2, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 7.1.1, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.2, 12.2.1, 12.3.1, 12.3.2
CO3	1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.2.1, 2.2.3, 2.3.1, 2.4.1, 2.4.3, 3.1.1, 3.1.2, 3.1.3, 3.1.6, 3.2.1, 3.3.1, 3.3.2, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 7.1.1, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.2, 12.2.1, 12.3.1, 12.3.2
CO4	1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.2.1, 2.2.3, 2.3.1, 2.4.1, 2.4.3, 3.1.1, 3.1.2, 3.1.3, 3.1.6, 3.2.1, 3.3.1, 3.3.2, 3.4.2, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 7.1.1, 9.1.1, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.2, 12.2.1, 12.3.1, 12.3.2
CO5	1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.2.1, 2.2.3, 2.3.1, 2.4.1, 2.4.3, 3.1.1, 3.1.2, 3.1.3, 3.1.6, 3.2.1, 3.3.1, 3.3.2, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 7.1.1, 7.2.1, 9.1.1, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 11.3.2, 12.1.2, 12.2.1, 12.2.2, 12.3.2

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	15	18.3	66.7	-	-	-	100
CAT2	15	18.3	66.7	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	20	20	60	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	20	20	60	-	-	-	100
ESE	26	26	48	-	-	-	100

22PPE$13	COMPOSITE MATERIALS	SEMESTER $

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	• To familiarise the fundamentals, classifications of composite materials and to gain knowledge about the manufacturing and testing methods of composites.	
UNIT- I	**INTRODUCTION TO COMPOSITES**	**(9 Periods)**
Definition – Composite Material, Reinforcement and Matrix, Classification of composite materials based on Matrix and Reinforcement, Functional requirements of matrix and reinforcement, Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance, Advantages of composites, Applications of composites in various sectors.		
UNIT- II	**MATRIX AND REINFORCEMENT**	**(9 Periods)**
Matrix: Types of matrix, Mechanical properties and functions – Polymers (Thermosets and Thermoplastics), Metal Matrix, Ceramic Matric, Carbon Matrix. Reinforcement: Types of reinforcement, Natural fibres, Artificial fibre - Glass fibre, Carbon fibre; Metal fibres, Ceramic reinforcements, Rule of Mixtures, Basic principles in the selection of matrix and reinforcement.		
UNIT- III	**POLYMER MATRIX COMPOSITES**	**(9 Periods)**
PMC Manufacturing Methods: Hand Lay-up process, Spray Lay-up, Compression Moulding, Injection Moulding, Resin Transfer Moulding, Pultrusion, Filament winding, Autoclave technique. Laminates - Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates. Applications of PMC in aerospace, automotive industries.		
UNIT- IV	**METAL AND CERAMIC MATRIX COMPOSITES**	**(9 Periods)**
Manufacturing methods of MMC: Powder Metallurgy process, Diffusion bonding, Stir casting, Squeeze casting, Die Casting. Manufacturing methods of CMC: Sintering, Cold isostatic pressing, Hot isostatic pressing, Chemical Vapour Infiltration, Applications of MMC and CMC in aerospace, automotive industries.		
UNIT- V	**TESTING OF COMPOSITES**	**(9 Periods)**
Mechanical testing of composites: Tensile testing, Compressive testing, Intra-laminar shear testing, Inter-laminar shear testing, Fracture testing. Non-Destructive Testing of Composites: Ultrasonic testing, Radiography, Liquid penetrant test, Eddy current test.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Krishnan K. Chawla.,* ***"Composite Materials: Engineering and Science",*** *Third Edition, Springer, 2013*
2	*William D Callister, David G Rethwisch* ***"Materials Science and Engineering"****, Wiley, USA, 2013.*

REFERENCES:

1	*Ronald F. Gibson, "**Principles of Composite Material Mechanics**", CRC Press; 4th Edition, 2016*
2	*Frank L Matthews and R D Rawlings, "**Composite Materials: Engineering and Science**", Taylor and Francis, 2006*
3	*Mallick P.K., **"Fiber-reinforced composites: Materials, manufacturing and Design",** Third Edition, CRC press, 2007*
4	*Deborah D.L. Chung , "**Composite Materials Science and Applications**" , Springer, 2010.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand the fundamentals of composite material and its classification.	K2
CO2	Select the appropriate matrix and reinforcements of composites for real time applications.	K2
CO3	Describe processing methods of polymer matrix composites.	K3
CO4	Comprehend the processing routes of metal and ceramic matrix composites.	K3
CO5	Understand the various methods of testing of composites.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	1	1	1	-	2	2	-	1	3	2	3	-	-	-
CO2	2	2	2	2	-	2	3	-	1	3	2	3	-	-	1
CO3	2	2	2	2	-	2	3	-	1	3	2	3	-	-	1
CO4	2	2	2	2	-	2	3	-	1	3	2	3	-	-	1
CO5	2	3	3	3	-	3	3	3	2	3	2	3	-	-	1
22PPE$13	**2**	**2**	**2**	**2**	**-**	**3**	**3**	**1**	**2**	**3**	**2**	**3**	**-**	**-**	**1**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1, 2.1.1, 2.2.2, 2.2.3, 2.2.4, 3.1.5, 3.1.6, 4.1.1, 4.3.4, 6.1.1, 7.2.1, 7.2.2, 9.2.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO2	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.2.2, 2.2.4, 2.3.1, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.5, 3.1.6, 3.2.3, 3.3.2, 3.4.1, 4.1.4, 4.2.1, 4.3.1, 4.3.3, 4.3.4, 6.1.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO3	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.5, 3.1.6, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 4.1.1, 4.2.1, 4.3.1, 4.3.4, 6.1.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO4	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.5, 3.1.6, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 4.1.1, 4.2.1, 4.3.1, 4.3.4, 6.1.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO5	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.1, 8.2.2, 9.1.1, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	15	60	25	-	-	-	100
CAT2	15	60	25	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	40	40	20	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	40	40	20	-	-	100
ESE	10	65	25	-	-	-	100

22PPE$14	MICRO MANUFACTURING PROCESSES	SEMESTER $

PREREQUISITES	CATEGORY	L	T	P	C
22PPC301 - MACHINE TOOLS AND PROCESSES 22PPC303 – MANUFACTURING TECHNOLOGY	PE	3	0	0	3

Course Objective	• To be familiar with the principles, basic machine tools, and developments in the micro manufacturing process and research trends in the area of micro manufacturing process.	
UNIT- I	**MICRO MACHINING I**	**(9 Periods)**
Mechanical Micro machining – Ultra Sonic Micro Machining – Abrasive Jet Micro Machining – Water Jet Micro Machining – Abrasive Water Jet Micro Machining – Micro turning – Chemical and Electro Chemical Micro Machining – Electric discharge micro machining.		
UNIT- II	**MICRO MACHINING II**	**(9 Periods)**
Beam Energy based micro machining – Electron Beam Micro Machining – Laser Beam Micro Machining – Electric Discharge Micro Machining – Ion Beam Micro Machining –Plasma Beam Micro Machining – Electro Discharge Grinding – Electro Chemical spark micro machining.		
UNIT- III	**NANO POLISHING**	**(9 Periods)**
Abrasive Flow finishing – Magnetic Abrasive Finishing – Magneto rheological finishing – Magneto Rheological abrasive flow finishing - Magnetic Float polishing – Elastic Emission Machining – chemo-mechanical Polishing.		
UNIT- IV	**MICRO FORMING AND WELDING**	**(9 Periods)**
Micro extrusion – Micro and Nano structured surface development by Nano plastic forming and Roller Imprinting – Micro bending with LASER – LASER micro welding – Electron beam for micro welding.		
UNIT- V	**RECENT TRENDS AND APPLICATIONS**	**(9 Periods)**
Metrology for micro machined components – Ductile regime machining– AE based tool wear compensation– Machining of Micro gear, micro nozzle, micro pins – Applications.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Jain V. K,* ***"Micro Manufacturing Processes",*** *CRC Press, Taylor & Francis Group, 2012*

REFERENCES:

1	*Jain V.K.,* ***"Introduction to Micro machining",*** *Narosa Publishing House, 2011*
2	*Bharat Bhushan,* ***"Handbook of nanotechnology",*** *springer, Germany, 2010.*
3	*Jain V.K.,* ***"Advanced Machining Processes",*** *Allied Publishers, Delhi, 2002*
4	*Mcgeough.J.A.,* ***"Micromachining of Engineering Materials",*** *CRC press 2001.*
5	*http://www.cmxr.com/Education/Introduction.html*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Elaborate various mechanical micro machining processes.	K3
CO2	Discuss various beam energy based micro machining processes.	K3
CO3	Demonstrate various methods of nano polishing techniques.	K3
CO4	Explain the micro forming and welding processes.	K3
CO5	Apply the knowledge of micro manufacturing processes into engineering applications.	K3

COURSE ARTICULATION MATRIX:

	a) CO and PO Mapping														
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	2	1	1	2	3	3	1	-	3	3	1	2	2	-	-
CO2	2	1	1	2	3	3	1	-	3	3	1	2	2	-	-
CO3	2	1	1	2	3	3	1	-	3	3	1	2	2	-	-
CO4	2	1	1	2	3	3	1	-	3	3	1	2	2	-	-
CO5	2	1	1	2	3	3	1	-	3	3	1	2	2	-	-
22PPE$14	**2**	**1**	**1**	**2**	**3**	**3**	**1**	**-**	**3**	**3**	**1**	**2**	**2**	**-**	**-**
	1 – Slight, 2 – Moderate, 3 – Substantial														
	b) CO and Key Performance Indicators Mapping														
CO1	1.2.1, 1.3.1, 1.4.1, 2.1.3, 2.2.3, 2.2.4, 2.3.1, 3.1.4, 3.1.5, 3.1.6, 4.1.1, 4.1.2, 4.3.1, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.2, 12.2.2, 12.3.1														
CO2	1.2.1, 1.3.1, 1.4.1, 2.1.3, 2.2.3, 2.2.4, 2.3.1, 3.1.4, 3.1.5, 3.1.6, 4.1.1, 4.1.2, 4.3.1, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.2, 12.2.2, 12.3.1														
CO3	1.2.1, 1.3.1, 1.4.1, 2.1.3, 2.2.3, 2.2.4, 2.3.1, 3.1.4, 3.1.5, 3.1.6, 4.1.1, 4.1.2, 4.3.1, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.2, 12.2.2, 12.3.1														
CO4	1.2.1, 1.3.1, 1.4.1, 2.1.3, 2.2.3, 2.2.4, 2.3.1, 3.1.4, 3.1.5, 3.1.6, 4.1.1, 4.1.2, 4.3.1, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.2, 12.2.2, 12.3.1														
CO5	1.2.1, 1.3.1, 1.4.1, 2.1.3, 2.2.3, 2.2.4, 2.3.1, 3.1.4, 3.1.5, 3.1.6, 4.1.1, 4.1.2, 4.3.1, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.2, 12.2.2, 12.3.1														

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	15	68	17	-	-	-	100
CAT2	15	52	33	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	100	-	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	50	50	-	-	-	100
ESE	9	75	16	-	-	-	100

22PPE$15	ADVANCED WELDING TECHNOLOGY	SEMESTER $

PREREQUISITES	CATEGORY	L	T	P	C
22PPC302– ENGINEERING METALLURGY 22PPC303 – MANUFACTURING TECHNOLOGY	PE	3	0	0	3

Course Objective	• To impart knowledge of basic concepts, principle, procedure, applications and advances in welding processes.

UNIT- I	SOLID STATE WELDING PROCESSES	(9 Periods)

Review of the various pressure welding processes and their applications. Friction, explosive, diffusion, and Ultrasonic welding – principles of operation, process characteristics and application.

UNIT- II	HIGH ENERGY BEAM WELDING	(9 Periods)

Electron Beam welding and Laser Welding : Principles of operation, Heat generation and regulation-Equipment details in typical setup-advantages, disadvantages and applications.

UNIT- III	ELECTRO SLAG WELDING	(9 Periods)

Heat generation, principles of operations, wire and consumables, guide techniques, selection of current, voltage and other process variables, nature of fluxes and their selection. Electro-gas welding Principle of operation and applications, Narrow gap welding.

UNIT- IV	PLASMA ARC WELDING	(9 Periods)

Special features of plasma arc- transferred and non transferred arc, key hole and puddle mode of operation, micro, low and high current plasma arc welding and their applications. Plasma cutting and surfacing and their applications.

UNIT- V	SPECIALWELDING PROCESSES	(9 Periods)

Adhesive bonding and Welding of plastics, Cold pressure welding, High frequency Welding, Stud welding, Under Water welding, Welding automation.

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOK:

1	*Parmer R.S **"Welding Engineering and Technology",** Khanna Publishers, New Delhi,2ndedition, 2010*
2	*Parmer R.S. **"Welding Processes and Technology",** Khanna Publishers, New Delhi, 3rd edition, 2003*

REFERENCES:

1	*Little R.L **"Welding and welding Technology",** Tata McGraw Hill Publishing Co., Ltd., New Delhi, 34th reprint, 2008.*
2	*Tylecote R.F. "**The Solid Phase Welding of Metals**", New York, St. Martin's Press,1968.*

3	*Nadkarni S.V* ***"Modern Arc Welding Technology",*** *Oxford IBH Publishers, 2nd edition, 2005*
4	*Christopher Davis* ***"Laser Welding- Practical Guide"****, Jaico Publishing House, 1994.*
5	*Davis A.C., "****The Science and Practice of Welding****", Cambridge University Press, Cambridge, 10 edition 1993.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Describe the solid state welding processes	K3
CO2	Describe the high energy beam welding processes	K3
CO3	describe the Electro-slag and Electro-gas welding processes	K3
CO4	Describe the plasma arc welding processes	K3
CO5	Describe the special welding techniques for plastics and underwater welding processes	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	2	-	-	-	2	-	3	-	1	-	-	2	2	-	-
CO2	3	-	3	-	1	-	2	-	1	2	1	-	2	-	2
CO3	2	1	2	-	2	-	2	-	-	-	2	2	1	-	-
CO4	2	-	-	-	1	-	2	-	1	2	-	-	-	-	-
CO5	2	1	2	-	1	-	1	-	-	-	-	1	-	-	2
22PPE$15	**3**	**1**	**2**	**-**	**2**	**-**	**2**	**-**	**1**	**1**	**1**	**2**	**1**	**-**	**1**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1, 1.3.1, 2.1.3, 2.2.3,2.2.4, 2.3.1, 3.1.4,3.1.5,3.1.6, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 5.1.1, 5.1.2, 5.3.1, 6.1.1, 6.2.1, 7.1.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 12.2.2.
CO2	1.2.1, 1.3.1, 2.1.3, 2.2.3,2.2.4, 2.3.1, 3.1.4,3.1.5,3.1.6, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.2.2.
CO3	1.2.1, 1.3.1, 2.1.3, 2.2.3,2.2.4, 2.3.1, 3.1.4,3.1.5,3.1.6, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.2.2.
CO4	1.2.1, 1.3.1, 2.1.3, 2.2.3,2.2.4, 2.3.1, 3.1.4,3.1.5,3.1.6, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 12.1.2, 12.2.1, 12.2.2.
CO5	1.2.1, 1.3.1, 2.1.3, 2.2.3,2.2.4, 2.3.1, 3.1.4,3.1.5,3.1.6, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1,11.3.1, 12.2.2.

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	15	68	17	-	-	-	100
CAT2	15	52	33		-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	40	40	20	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	45	45	10	-	-	100
ESE	9	59	16	16	-	-	100

22PPE$16	ADVANCED CASTING TECHNOLOGY	SEMESTER $

PREREQUISITES	CATEGORY	L	T	P	C
22PPC303 – MANUFACTURING TECHNOLOGY	PE	3	0	0	3

Course Objective	• To impart knowledge on various advanced casting techniques.	
UNIT- I	**CASTINGOFMETALS**	**(9 Periods)**
Factors influencing casting of cast iron, steel, aluminium, magnesium, copper - factors influencing the casting practice - casting quality control. X-ray, sand control method - control of casting and casting defects.		
UNIT- II	**ROBOTICS IN METAL CASTING**	**(9 Periods)**
Structure and classification of Industrial Robots, Terminology of robot motion, Die cast Robots and Foundry Robots- advantages, applications. Robotic automation in permanent mold foundries.		
UNIT- III	**ADVANCES IN METAL CASTING**	**(9 Periods)**
Hcasting, shell moulding, investment casting, foam casting, centrifugal casting, Die casting, continuous casting, squeeze casting - processes and parameters. Stir casting.		
UNIT- IV	**CASTING METALLURGY**	**(9 Periods)**
Solidification of pure metals, alloys, dendritic growth, homogeneous and heterogeneous nucleation, constitutional under cooling, defects in casting causes and remedies. Long range and short range solidifying alloys.		
UNIT- V	**COMPUTER AIDED METAL CASTING**	**(9 Periods)**
Use of computer in runner and riser design, solidification front monitoring, expert system in casting defects, software mine-spectroscopy and chemical analysis.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Jain P.L **"Principles of Foundry Technology",** Tata McGraw-Hill Publishers, 4th edition 2008.*
2	*Heineloper& Rosenthal **"Principles of Metal Casting",** Tata McGraw Hill Publishers,2nd edition, 2000.*

REFERENCES:

1	*Jain R.K. and Gupta S.C. **"Production Technology",** Khanna Publishers, New Delhi,17th edition, 2004*
2	*Rao, P. N **"Manufacturing Technology"**, McGraw Hill Publishers , 3rd edition ,2010*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Explain the factors influencing casting of metals.	K3
CO2	Explain the robots in metal casting.	K3
CO3	Explain various advanced casting processes.	K3
CO4	Describe the thermal, metallurgical aspects during solidification in casting.	K4
CO5	Explain the applications of computer in metal casting.	K4

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	2	2	-	1	-	1	1	1	1	1	-	1	3	-	1
CO2	1	2	3	-	-	2	2	1	1	1	-	1	3	-	1
CO3	2	2	1	1	1	2	1	1	1	1	-	1	3	-	1
CO4	1	3	2	1	1	2	1	-	-	1	-	1	3	-	1
CO5	1	2	2	2	2	1	1	1	1	1	-	1	3	-	1
22PPE$16	**2**	**3**	**2**	**1**	**1**	**2**	**2**	**1**	**1**	**1**	**-**	**1**	**3**	**-**	**1**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1, 1.3.1, 2.1.3, 2.2.3,2.2.4, 2.3.1, 3.1.4,3.1.5,3.1.6, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 5.1.1, 5.1.2, 5.3.1, 6.1.1, 6.2.1, 7.1.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 12.2.2.
CO2	1.2.1, 1.3.1, 2.1.3, 2.2.3,2.2.4, 2.3.1, 3.1.4,3.1.5,3.1.6, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.2.2.
CO3	1.2.1, 1.3.1, 2.1.3, 2.2.3,2.2.4, 2.3.1, 3.1.4,3.1.5,3.1.6, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.2.2.
CO4	1.2.1, 1.3.1, 2.1.3, 2.2.3,2.2.4, 2.3.1, 3.1.4,3.1.5,3.1.6, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 12.1.2, 12.2.1, 12.2.2.
CO5	1.2.1, 1.3.1, 2.1.3, 2.2.3,2.2.4, 2.3.1, 3.1.4,3.1.5,3.1.6, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1,11.3.1, 12.2.2.

SSESSMENT PATTERN– THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	45	45	-	-	-	100
CAT2	10	30	30	30			100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	5	50	45	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	10	25	35	30	-	-	100
ESE	10	35	35	20	-	-	100

22PPE$17	LEANMANUFACTURING (Common to MECH & PRODN Branches)	SEMESTER $

PREREQUISITES	CATEGORY	L	T	P	C
22PPC301 - MACHINE TOOLS AND PROCESSES 22PPC303 - MANUFACTURING TECHNOLOGY	PE	3	0	0	3

Course Objective	• To craft the students to acquire knowledge in lean manufacturing tools, understand various phases involved and methodology in implementing lean in manufacturing scenario.	
UNIT- I	**FOUNDATION AND CONCEPTS OF LEAN**	**(9 Periods)**
Historical evolution of lean manufacturing - Objectives of lean manufacturing - Key principles and implications of lean manufacturing - Traditional verses lean manufacturing. – Ford System – Growing Dysfunction — Ten steps to lean production - Necessity of Lean Production – Systems and lean thinking – Construction of Lean Production - Lean images and Lean Activities		
UNIT- II	**LEAN TOOLS AND METHODOLOGY**	**(9 Periods)**
Primary tools – Implementing 5S, Workplace organization – Stability - Just-In-Time –Takt time - One piece flow – Pull, Cellular systems, Six Sigma. SMED: Single minute exchange of dies – Theory and practice of the SMED system - TPM, Pillars of TPM, Conditions for TPM success, TPM implementation process - Overall Equipment Effectiveness - computation of OEE.		
UNIT- III	**VALUE STREAM MAPPING**	**(9 Periods)**
Process Mapping and Value Stream Mapping - Current state map – Future state map – VSM symbols – Mapping tips - Need for process maps - types and its construction - steps in preparing VSM - Comparison of CSVAM and FSVSA – Simulation scenario case studies.		
UNIT- IV	**INTEGRATED QUALITY**	**(9 Periods)**
Development and necessity – Poke Yoke – mistake proofing - quality improvement – Leveling and Visual management. Common errors – Inspection system and Zone control – Using Poke Yokes – Jidoka implementation -Process capability study – Lean six sigma.		
UNIT- V	**LEAN INVOLVEMENT AND CULTURE**	**(9 Periods)**
Necessity of involvement – Waste of Humanity – Activities supporting involvement – Kaizen Circle Activity – Practical Kaizen Training – Key factors in Practical Kaizen Training – Lean Culture – Standardization – Standards and abnormality control – 'Five Why' analysis.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Dennis P* ***"Lean Production Simplified: A Plain Language Guide to the World's Most Powerful Production System",*** *Productivity Press, New York, 2009.*
2	*Liker, J and Meier, D* ***"The Toyota Way"****, Field book, McGraw-Hill, 2010.*

REFERENCES:

1	*Devadasan S R, Mohan Sivakumar V, Murugesh R and Shalij P R,* ***"Lean and Agile Manufacturing: Theoretical, Practical and Research Futurities"****, Prentice Hall of India Learning Limited, New Delhi, 2012.*
2	*Gopalakrishnan N,* ***"Simplified Lean Manufacture: Elements, Rules, Tools and Implementation"****, Prentice Hall of India Learning Private Limited, India, 2010.*
3	*Bill Carreira,* ***"Lean Manufacturing that Works: Powerful Tools for Dramatically Reducing Wastes and Maximizing Profits"****, Prentice Hall of India Learning Private Limited, India, 2009*
4	*Don Tapping, Tom Luyster and Tom Shuker* ***"Value Stream Management: Eight Steps to Planning, Mapping and Sustaining Lean Improvements"****, Productivity Press, New York, USA, 2007*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Describe about the origin and foundation of lean production	K2
CO2	Explain various lean tools and methodologies.	K2
CO3	Explain the methods and processes of Value Stream Mapping.	K2
CO4	Describe about quality in lean system using various techniques.	K3
CO5	Describe about lean involvement and culture.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	2	2	2	3	2	-	3	-	2	3	1	2	2	2	2
CO2	2	3	3	3	3	3	3	1	3	3	2	3	3	3	3
CO3	2	3	2	3	3	-	3	2	3	3	1	3	2	2	3
CO4	2	3	3	3	3	-	3	-	3	3	2	3	2	2	2
CO5	2	3	2	3	3	3	3	2	3	3	2	2	1	2	2
22PPE$17	**2**	**3**	**3**	**3**	**3**	**2**	**3**	**1**	**3**	**3**	**2**	**3**	**2**	**2**	**3**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.4.3, 3.1.1, 3.1.4, 3.2.1, 3.3.1, 3.3.2, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.2, 5.2.2, 5.3.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.1.2, 9.2.1, 9.2.3, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.3.2.
CO2	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.2, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2.
CO3	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.4, 3.1.6, 3.2.1, 3.2.3, 3.3.1, 3.3.2, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.3, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.3.1, 12.3.2.
CO4	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 4.1.2, 4.1.3, 4.1.4, 4.2.1,

	4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.2, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.2
CO5	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.3, 3.3.1, 3.3.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.2, 11.3.1, 11.3.2, 12.1.1, 12.1.2, 12.2.1, 12.3.2

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	50	20	-	-	-	100
CAT2	30	50	20		-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	20	40	40	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	20	40	40	-	-	-	100
ESE	42	42	16	-	-	-	100

22PPE$18	GREENMANUFACTURING	SEMESTER $

PREREQUISITES	CATEGORY	L	T	P	C
22PMC2Z1– ENVIRONMENTAL SCIENCE AND ENGINEERING 22PPC301- MACHINE TOOLS AND PROCESSES 22PPC303- MANUFACTURING TECHNOLOGY	PE	3	0	0	3

Course Objective	• To introduce the foundational concepts and methods of green manufacturing and to discuss fundamental issues in green manufacturing as well as fundamental methods such as lifecycle assessment and sustainability assessment of manufacturing.	
UNIT- I	**OUR ENVIRONMENT**	**(9 Periods)**
The human population and the environment, the human population's effects on the earth, the ecosystem, chemical cycling and succession, the biogeochemical cycles, major global biogeochemical cycles - carbon, carbon-silicate, nitrogen and phosphorus cycles, global warming, greenhouse effect, major greenhouse gases.		
UNIT- II	**MANUFACTURING SYSTEMS**	**(9 Periods)**
Environmental consciousness manufacturing embedded in the society – Sustainability, Principles for Environmentally Conscious Design. Levels of manufacturing systems, environmentally conscious manufacturing- components, system effects and assessment, Life-cycle Assessment.		
UNIT- III	**WATER POLLUTION IN MANUFACTURING SYSTEMS**	**(9 Periods)**
Metalworking fluids- environmental and health impact, Heavy metals in water, MWF pollution prevention through process planning, process modification and in process recycling, water footprint analysis.		
UNIT- IV	**AIR AND SOLID POLLUTION IN MANUFACTURING SYSTEMS**	**(9 Periods)**
Origin of airborne particles in manufacturing, traditional and modern particulates mitigation/elimination techniques. Industrial solid and hazardous waste management, Carbon footprint analysis.		
UNIT- V	**ENVIRONMENTAL MANAGEMENT SYSTEMS**	**(9 Periods)**
Eco-labeling - Design for the Environment, Concepts of ISO 14001 - requirements of ISO 14001 – Environmental Management System – frame work and benefits.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Daniel B Botkin and Edward A Keller,* ***"Environmental Science"****, John Wiley & Sons, Chichester, 2010.*
2	*Kutz, M* ***"Environmentally Conscious Manufacturing****", John Wiley & Sons, 2007.*

REFERENCES:

1	*Christian N. Madu* ***"Handbook of Environmentally Conscious Manufacturing",*** *N Kluwer Academic Publisher, 2001.*
2	*Swamidass, P.M.,* ***"Encyclopedia of Production and Manufacturing Management",*** *Kluwer Academic Publisher, 2000.*
3	*Davim, J.P* ***"Sustainable Manufacturing"****, John Wiley & Sons, 2010.*
4	*Koontz and Odonnel,* ***"Essentials of Management",*** *McGraw Hill 1992.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Discuss the effect of humans on ecosystems and various phenomenon of Eco systems.	K3
CO2	Explain about the environmentally conscious manufacturing systems.	K3
CO3	Evaluate the effects of water pollution by manufacturing systems and their prevention.	K3
CO4	Discuss the effects of air and solid pollution in manufacturing systems.	K3
CO5	Elaborate environmental management systems.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	1	1	1	2	1	3	3	-	1	3	2	3	-	-	1
CO2	2	3	2	3	3	3	3	-	1	3	2	3	-	-	1
CO3	2	3	2	3	3	3	3	-	1	3	2	3	-	-	1
CO4	2	3	2	3	3	3	3	-	1	3	2	3	-	-	1
CO5	2	3	2	3	3	3	3	-	1	3	2	3	-	-	1
22PPE$18	**2**	**3**	**2**	**3**	**3**	**3**	**3**	**-**	**1**	**3**	**2**	**3**	**-**	**-**	**1**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1, 2.2.3, 3.1.1, 3.1.5, 4.1.1, 4.1.2, 4.3.3, 4.3.4, 5.3.1, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2.
CO2	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.3.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 3.3.2, 3.4.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2.
CO3	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.3.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 3.3.2, 3.4.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2.
CO4	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.3.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 3.3.2, 3.4.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2.
CO5	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.3.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 3.3.2, 3.4.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.4, 5.1.1, 5.1.2,

	5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2.

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	15	52	33	-	-	-	100
CAT2	15	68	17	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	50	50	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	75	25	-	-	-	100
ESE	9	75	16	-	-	-	100

22PPE$19	UNCONVENTIONALMANUFACTURING PROCESSES	SEMESTER $

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	• To understand the working principles of various non-traditional machining processes, applications, advantages and limitations.	
UNIT- I	**MECHANICALENERGYMETALREMOVALPROCESSES**	**(9 Periods)**
Needofmodernmachiningprocesses–classificationandselectionoftechnology.Mechanicalprocesses- Abrasive jet machining (AJM), water jet machining (WJM), Abrasive water jet machining (AWJM), Ultrasonic machining (USM)–working principles, equipment, effect of process parameters, applications, advantages and limitations.		
UNIT- II	**ELECTROCHEMICAL AND CHEMICAL METAL REMOVAL PROCESSES**	**(9 Periods)**
Electrochemical machining (ECM), electrochemical grinding (ECG), electrochemical deburring and honing – chemical machining (CHM) – working principles, equipment, effect of process parameters, applications, advantages and limitations.		
UNIT- III	**THERMALMETALREMOVALPROCESSES**	**(9 Periods)**
Electric discharge machining (EDM), wire cut electric discharge machining (WEDM), Plasma arc machining (PAM), Electron beam machining (EBM), Laser beam machining (LBM), Ion beam machining(IBM) – working principles, equipment, effect of process parameters, applications, advantages and limitations.		
UNIT- IV	**FORMINGPROCESSESANDFOUNDRYTECHNIQUES**	**(9 Periods)**
Explosiveforming,Electro–hydraulicforming,electro–magneticforming.Dynapakmachine-highpressuremoulding,squeezecasting,vacuumcastings.		
UNIT- V	**RAPID PROTOTYPING**	**(9 Periods)**
Introduction–advantages–limitations–principle. Rapid prototyping systems–stereo-lithography (SLA), selective laser sintering (SLS), fused deposition modeling (FDM), laminated object manufacturing (LOM), solid ground curing (SGC), three dimensional printing. Application of reverse engineering in rapid prototyping.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*P.C.Pandey **"Modern machining processes",** Tata McGraw Hill publishing company Ltd. 2008.*
2	*P.C.Sharma, **"A TEXT BOOKS of Production Technology"**, S.Chand & Company Ltd. 2009.*

REFERENCES:

1	*Bhattacharya,* ***"New Technology",*** *Institution of Engineers, 1997*
2	*Gary.F.Benedict* ***"Nontraditional machining Processes",*** *Marcell Dekker Inc, 2001*
3	*HMT* ***"Production Technology"****, Tata McGraw Hill Publishers, 2001.*
4	*V.K.Jain* ***"Advanced Machining Process",*** *Allied Publishers PVT Ltd 2007*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Describe the mechanical energy based newer production processes.	K3
CO2	Describe the electrochemical energy based newer production processes.	K3
CO3	Describe the thermal energy based newer production processes.	K3
CO4	Explain the explosive forming and high pressure casting processes.	K3
CO5	Describe various Rapid Prototyping techniques	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	2	3	-	2	2	-	-	-	2	1	1	1	3	-	1
CO2	2	3	-	2	2	-	-	-	2	1	1	2	3	-	1
CO3	2	3	-	2	1	-	-	-	2	1	1	2	3	-	1
CO4	2	3	-	2	1	-	-	-	2	1	1	2	3	-	1
CO5	1	3	-	2	1	-	-	-	1	1	1	2	3	-	1
22PPE$19	**2**	**3**	**-**	**2**	**1**	**-**	**-**	**-**	**2**	**1**	**1**	**2**	**3**	**-**	**1**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 5.2.2, 5.3.1, 5.3.2, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 11.2.1, 11.3.1, 11.3.2, 12.1.1, 12.1.2, 12.2.2, 12.3.1, 12.3.2.
CO2	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.2, 12.2.2, 12.3.1, 12.3.2.
CO3	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.3.1, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.2, 12.2.2, 12.3.1, 12.3.2.
CO4	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.3.1, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.2, 12.2.2, 12.3.1, 12.3.2.
CO5	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.3.1, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.1, 12.1.2, 12.2.2, 12.3.1, 12.3.2.

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	10	63	27	-	-	-	100
CAT2				-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	10	63	27	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	10	63	27	-	-	-	100
ESE	10	63	27	-	-	-	100

22PPE$20	PRODUCTION OF AUTOMOTIVE COMPONENTS	SEMESTER $

PREREQUISITES	CATEGORY	L	T	P	C
22PPC301 - MACHINE TOOLS AND PROCESSES 22PPC302 – ENGINEERING METALLURGY 22PPC303 – MANUFACTURING TECHNOLOGY	PE	3	0	0	3

Course Objective	• To familiarize the students in functional requirements, need based materials and suitable manufacturing processes to produce the automobile components.	
UNIT- I	CYLINDER BLOCK	(9 Periods)
Structure and functions – types – materials – sand casting of cast iron cylinder block- modification and machining - sand, gravity and low pressure casting methods of aluminium cylinder blocks – cylinder liners. Cylinder head – material – construction - heat treatment. Oil pan – function and materials.Gaskets – functions - materials and types.		
UNIT- II	ENGINE PARTS	(9 Periods)
Piston parts - Functions – materials – casting of piston by gravity casting and squeeze casting – modification and heat treatment – machining. Piston rings – Types - materials – functions –piston ring manufacturing. Piston pin types - materials. Forgings ofcrankshaft,connecting rod and gudgeon pins.		
UNIT- III	VALVES AND ACCESSORIES	(9 Periods)
Valve – types – Mechanisms - Materials - production methods - production of push rod, rocker arm and tappets. Camshaft- function and materials – chilled cast iron casting process – finishing operations –production of assembled camshaft - production of propeller shaft.		
UNIT- IV	CLUTCH, GEARBOX AND BRAKES	(9 Periods)
Clutch system, friction lining materials, requirements and manufacturing. Casting of gear box casing, precision forging of gears, gear hobbing, shaping, powder metallurgy, orbital forming of gears, heat treatment and finishing. Braking system - Types- manufacturing methods.		
UNIT- V	BODY PANELS, SUSPENSION AND MISCELLANEOUS	(9 Periods)
Principles of hydro forming - press forming - welding of body panels - resistance welding. Forging of front and rear axles, casting of rear axle casing– leaf spring materials and manufacturing - Manufacturing details - Construction details of wheel mounting –tyres and tube manufacturing - Mechatronics in automobile - Use of plastics in automobile components -Application of sensors and actuators - Automotive quality management system – ISO / TS 16949.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Kirpal Singh **"Automobile Engineering**, Vol I and II", Standard Publishers., 13th edition, 2014.*
2	*William H.Crouse and Anglin **"Automotive Mechanics"**, McGraw Hill Book Co., 10th edition, 2016.*

REFERENCES:

1	*T.K. Garrett, Newton and Steeds* ***"The motor vehicle",*** *13th edition, 2001.*
2	*Narang G.B.S,* ***"Automobile Engineering",*** *Khanna Publishers, 2012.*
3	*Helt P.M.* ***"High speed combustion engines",*** *Oxford and IBM Publishers Co. 1990.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Describe the manufacturing methods of Cylinder block.	K4
CO2	Describe the manufacturing methods of engine parts.	K4
CO3	Explain the mechanism, production methods employed for valves and accessories system.	K3
CO4	Explain the functioning and manufacturing methods of brakes and transmission systems.	K3
CO5	Explain the body panels manufacturing methods and suspension systems.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	2	2	2	1	-	2	1	-	-	3	-	1	3	-	-
CO2	2	2	2	1	-	2	1	-	-	3	-	1	3	-	-
CO3	2	2	2	1	-	2	1	-	-	3	-	1	3	-	-
CO4	2	2	2	1	-	2	1	-	-	3	-	1	3	-	-
CO5	2	2	2	1	-	2	1	-	-	3	-	1	3	-	-
22PPE$20	**2**	**2**	**2**	**1**	**-**	**2**	**1**	**-**	**-**	**3**	**-**	**1**	**3**	**-**	**-**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 4.1.1, 4.1.4, 6.2.1, 7.2.2, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 12.1.2
CO2	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 4.1.1, 4.1.4, 6.2.1, 7.2.2, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 12.1.2
CO3	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 4.1.1, 4.1.4, 6.2.1, 7.2.2, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 12.1.2
CO4	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 4.1.1, 4.1.4, 6.2.1, 7.2.2, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 12.1.2
CO5	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 4.1.1, 4.1.4, 6.2.1, 7.2.2, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 12.1.2

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	10	40	25	25	-	-	100
CAT2	10	40	25	25	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	10	40	25	25	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	10	40	25	25	-	-	100
ESE	10	40	25	25	-	-	100

22PPE$21	SURFACE ENGINEERING AND TRIBOLOGY	SEMESTER $

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	• To study the basics of surface features and different types of friction, wear mechanism, corrosion, different types of surface treatments and surface modification techniques, surface engineering measurements and standards.	
UNIT- I	**BASICS OF SURFACE PROPERTIES**	**(9 Periods)**
Introduction – Nature of surfaces and contact, Topography of surfaces, surface features, Surface degradation, surface interaction - Adhesive Theory of Sliding Friction, Rolling Friction, Friction properties of metallic and nonmetallic materials, Thermal considerations in sliding contact.		
UNIT- II	**WEAR AND CORROSION**	**(9 Periods)**
Wear: Introduction, Abrasive wear, Erosive, Adhesion, Fatigue wear, Fretting Wear, Laws of wear, Wear of metals and non-metals. Corrosion: Introduction, Principle of corrosion, Classification of corrosion, Types of corrosion, Factors influencing corrosion, Prevention of Corrosion.		
UNIT- III	**SURFACE CLEANING**	**(9 Periods)**
Introduction – Surface pretreatment of metallic and electronic materials, Mechanical cleaning, Polishing - Alumina and diamond polishing, Chemical cleaning – acid, alkaline, acetone and carbon tetra chloride cleaning, Degreasing, Ultrasonic cleaning.		
UNIT- IV	**SURFACE MODIFICATION TECHNIQUES**	**(9 Periods)**
Introduction – Principle, Faraday's laws of electrodeposition, Parameters of electrodeposition, Physical Vapour Deposition, Chemical Vapour Deposition, Ion implantation, Reactive ion sputtering coating, Thermal spraying, Laser surface alloying, Laser cladding, Characteristics of Wear resistant coatings, Applications of coatings and surface treatments in wear and friction control.		
UNIT- V	**LUBRICANTS AND SURFACE ENGINEERING MEASUREMENTS**	**(9 Periods)**
Lubricants and their physical properties, Viscosity and other properties of oils, Additives and selection of Lubricants, Measurement of Surface roughness, Measurement of wear and friction using Pin-on-Disc apparatus, ASTM Standards for measurement of surface treated materials – surface treatment Depth, Coating Thickness, Indentation hardness measurements.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*S. K. Basu, S. N. Sengupta & B. B. Ahuja,* ***"Fundamentals of Tribology",*** *Prentice –Hall of India Pvt. Ltd, New Delhi, 2005*
2	*Ramnarayan chattopadhyay,* ***"Advanced Thermally Assisted Surface Engineering Processes",*** *Kluwer academic publishers, 2004*

REFERENCES:

1	*G. W. Stachowiak & A. W. Batchelor,* ***"Engineering Tribology"****, Butterworth-Heinemann, UK, 2005*
2	*Adamson A W and Gast A P,* ***"Physical Chemistry of Surfaces****", Sixth Edition, John Willey & Sons, 1997.*
3	*Fontana. G.,* ***"Corrosion Engineering"****, McGraw Hill, 2008*
4	*Sudarshan T S,* ***"Surface Modification Technologies – An Engineer's Guide****", Marcel Dekkar, New York, 1989.*
5	*Kenneth G.Budinski,* ***"Surface Engineering for Wear Resistance****", Prentice hall, 1988.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the basics of surface features, laws of friction and different types of friction.	K2
CO2	Apply the knowledge of various wear mechanism and types of corrosion.	K3
CO3	Describe the various surface cleaning techniques.	K3
CO4	Elaborate the various & Advanced surface modification techniques.	K3
CO5	Explain about lubricants, measure and evaluate the surface of a material.	K3

COURSE ARTICULATION MATRIX:

	a) CO and PO Mapping														
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	1	1	1	1	-	2	1	-	1	3	-	3	-	-	-
CO2	2	2	2	1	-	2	3	-	1	3	-	3	-	-	-
CO3	2	2	2	1	-	2	3	-	1	3	1	3	-	-	-
CO4	2	2	2	1	-	2	3	-	1	3	1	3	2	-	-
CO5	2	2	2	3	-	3	3	3	2	3	1	3	1	-	-
22PPE$21	**2**	**2**	**2**	**2**	**-**	**3**	**3**	**1**	**2**	**3**	**1**	**3**	**1**	**-**	**-**
	1 – Slight, 2 – Moderate, 3 – Substantial														
	b) CO and Key Performance Indicators Mapping														
CO1	1.2.1, 2.1.1. 2.2.2, 3.1.5, 4.1.1, 6.1.1, 7.2.1, 9.2.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.2, 12.1.1, 12.2.1, 12.2.2, 12.3.1, 12.3.2														
CO2	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.2.2, 2.3.1, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.5, 3.3.2, 4.1.1, 6.1.1, 7.1.1, 7.1.2, 7.2.1, 9.2.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 12.1.1, 12.2.1, 12.2.2, 12.3.1, 12.3.2														
CO3	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.5, 3.1.6, 3.3.2, 4.1.1, 4.2.1, 6.1.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 12.1.1, 12.2.1, 12.2.2, 12.3.1, 12.3.2														
CO4	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.5, 3.1.6, 3.3.2, 4.1.1, 4.2.1, 6.1.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 12.1.1, 12.2.1, 12.2.2, 12.3.1, 12.3.2														
CO5	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.3.2, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 12.1.1, 12.2.1, 12.2.2, 12.3.1, 12.3.2														

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	15	60	25	-	-	-	100
CAT2	15	60	25	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	40	40	20	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	40	40	20	-	-	100
ESE	10	65	25	-	-	-	100

22PPE$22	PRODUCTIONMANAGEMENT	SEMESTER $

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	• To introduce various management methods in production industries.	
UNIT- I	**BASICSOFMANAGEMENT**	**(9 Periods)**
Evolutionofmanagement-Generalprinciplesofmanagement–managementfunctions–organization – types – comparison – functions of personnel management – recruitment – training –leadership-motivation– communication–conflict–Industrial relations–tradeunion.		
UNIT- II	**FORECASTING TECHNIQUES**	**(9 Periods)**
Forecasting: Methods - moving average, exponential smoothing, Regression analysis, coefficient of co-relation, Delphi, Market survey.		
UNIT- III	**OPERATIONSMANAGEMENT**	**(9 Periods)**
PlantLocation–Layout–MaterialsHandling–Methodstudy–Timestudy–Ergonomics–AggregatePlanning–Value Analysis– Forecasting.		
UNIT- IV	**MATERIALSMANAGEMENT**	**(9 Periods)**
Materials management - Purchasing – Objectives – parameters – procedure. Supplier selection – Storesmanagement–codification–Wastemanagement–Reasonsforwastegeneration–identificationandcontrolofwaste– scrap disposal.		
UNIT- V	**INVENTORYMANAGEMENT**	**(9 Periods)**
PurposeofinventoryCostrelatedtoinventoryBasicEOQmodelvariationsinEOQmodel–FiniteProduction,quantitydiscounts–ABCAnalysis–MRP-IntroductiontoMRPIIandERP.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Period**		

TEXT BOOK:

1	*R.Panneerselvam**"ProductionandOperationsManagement",**PrenticeHallofIndia,2012.*

REFERENCES:

1	*KoontzandWeihrich**"EssentialsofManagement",**McGrawHill2015*
2	*PhilipsKotler**"Marketingmanagement",**Pearson,2015*
3	*MartandT.Telesang**"ProductionManagement",**S.Chand&Co.,2007*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Illustrate the functions of management and personnel management	K4
CO2	Explain about various forecasting techniques.	K3
CO3	Identify the methods for in engineering managing materials industries	K4
CO4	Describe the importance of inventory and the ways of managing inventory	K4
CO5	Explain various ways of managing operations in engineering industries	K3

COURSE ARTICULATION MATRIX:

	a) CO and PO Mapping														
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	1	-	-	1	1	1	1	2	2	-	2	-	1	1	3
CO2	1	-	-	1	1	1	1	2	2	-	2	-	1	1	3
CO3	1	-	-	1	1	1	1	2	2	-	2	-	1	1	3
CO4	1	-	-	1	1	1	1	2	2	-	2	-	1	1	3
CO5	1	-	-	1	1	1	1	2	2	-	2	-	1	1	3
22PPE$22	**1**	**-**	**-**	**1**	**1**	**1**	**1**	**2**	**2**	**-**	**2**	**-**	**1**	**1**	**3**
	1 – Slight, 2 – Moderate, 3 – Substantial														
	b) CO and Key Performance Indicators Mapping														
CO1	1.1.1, 1.1.2, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.4, 3.1.1, 3.1.2, 3.1.6, 3.3.1, 3.4.1, 4.1.1, 4.1.2, 4.3.1, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 9.2.1, 10.1.1, 10.1.2, 10.1.3, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.2.2, 12.3.2.														
CO2	1.1.1, 1.1.2, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.4, 3.1.1, 3.1.2, 3.1.6, 3.3.1, 3.4.1, 4.1.1, 4.1.2, 4.3.1, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 9.2.1, 10.1.1, 10.1.2, 10.1.3, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 11.3.2, 12.2.2, 12.3.2														
CO3	1.1.1, 1.1.2, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.4, 3.1.1, 3.1.2, 3.1.6, 3.3.1, 3.4.1, 4.1.1, 4.1.2, 4.3.1, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 9.2.1, 10.1.1, 10.1.2, 10.1.3, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 11.3.2, 12.2.2, 12.3.2														
CO4	1.1.1, 1.1.2, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.4, 3.1.1, 3.1.2, 3.1.6, 3.3.1, 3.4.1, 4.1.1, 4.1.2, 4.3.1, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 9.2.1, 10.1.1, 10.1.2, 10.1.3, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.2.2, 12.3.2														
CO5	1.1.1, 1.1.2, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.4, 3.1.1, 3.1.2, 3.1.6, 3.3.1, 3.4.1, 4.1.1, 4.1.2, 4.3.1, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 9.2.1, 10.1.1, 10.1.2, 10.1.3, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 11.3.2, 12.2.2, 12.3.2														

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	12	57	31	-	-	-	100
CAT2	12	57	31	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	12	57	31	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	12	57	31	-	-	-	100
ESE	12	57	31	-	-	-	100

22PPE$23	SUPPLY CHAIN MANAGEMENT	SEMESTER $

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	• To understand the importance and implementation of supply chain management in organizations.	
UNIT- I	**INTRODUCTION TO SUPPLY CHAIN MANAGEMENT**	**(9 Periods)**
Definition and scope of Supply Chain Management (SCM): Key elements of SCM - Objectives of SCM - Importance and Benefits of effective Supply Chain Management - Key drivers in SCM.		
UNIT- II	**PROCUREMENT AND SUPPLIER MANAGEMENT**	**(9 Periods)**
Strategic sourcing process - Supplier selection criteria - Strategies for Supplier Relationship management - Negotiation Process - Contract Management - Supplier Performance measurement process - Strategies for Supplier Performance improvement		
UNIT- III	**LOGISTICS AND DISTRIBUTION MANAGEMENT**	**(9 Periods)**
Importance of Logistics - Functions of Logistics in SCM - Transportation modes - Factors in selection of transportation modes - Types of Warehouses (WH) - WH functions -WH Operations and Technologies - Order fulfilment process - Aspects of managing product returns - Challenges in Last Mile Delivery (LMD) - Technologies and Innovations in LMD		
UNIT- IV	**SUPPLY CHAIN DISRUPTIONS AND RISK MANAGEMENT**	**(9 Periods)**
Types of Supply Chain Disruptions - Steps in Risk Assessment Process - Risk Identification Methods - Risk Assessment Techniques - Risk Mitigation Strategies - Contingency Planning Process - Business Continuity Planning (BCP): Components - Building Supply Chain Resilience - Assessment of Supply Chain Resilience		
UNIT- V	**GLOBALIZATION**	**(9 Periods)**
Globalization: Importance, Benefits - Drivers of Globalization: Market expansion, Cost efficiencies, Technological advancements, Liberalization of Trade - Impact on Supply chains: Extended supply networks, Global sourcing and Procurement, Supply chain collaboration, Cultural and Diversity considerations - Strategies: Global network design, Information and Communication Technologies, Talent management and Cross-cultural skills.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Sunil Chopra and Peter Meindl, "**Supply Chain Management – Strategy, Planning And Operation**", PHI, 2016*

REFERENCES:

1	*Randy Subramany, "**Supply Chain Management: Origins, Evolutions, and Transformations**", Amazon Kindle, 2023*

2	*Wisner, Keong Leong and Keah-Choon Tan, "**Principles Of Supply Chain Management A Balanced Approach**", Thomson Press, 2005*
3	*Coyle, Bardi, Longley, "**The Management Of Business Logistics – A Supply Chain Perspective**", Thomson Press, 2006*
4	*Jeremy F Shapiro, "**Modeling The Supply Chain**", Thomson Duxbury, 2002*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Describe the fundamentals of supply chain management	K2
CO2	Explain the basics of procurement and supplier management	K3
CO3	Identify suitable logistics and distribution management techniques	K3
CO4	Articulate the risk management strategies for supply chain disruptions	K4
CO5	Interpret the effect of globalization on supply chain	K4

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	2	2	2	1	3	3	-	1	3	2	3	1	2	1
CO2	2	3	2	3	3	3	3	-	1	3	2	3	3	2	3
CO3	2	3	2	3	3	3	3	-	1	3	2	3	3	2	3
CO4	2	3	2	3	3	3	3	-	1	3	2	3	3	2	3
CO5	2	3	2	3	3	3	3	-	1	3	2	3	3	2	3
22PPE$23	**2**	**3**	**2**	**3**	**3**	**3**	**3**	**-**	**1**	**3**	**2**	**3**	**3**	**2**	**3**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1, 2.1.2, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.4.4, 3.1.1, 3.1.3, 3.1.5, 3.2.3, 3.3.1, 3.4.1, 4.1.1, 4.1.2, 4.3.4, 5.2.1, 5.3.1, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO2	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 3.3.2, 3.4.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.4, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO3	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 3.3.2, 3.4.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.4, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO4	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 3.3.2, 3.4.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.4, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO5	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 3.3.2, 3.4.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.4, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	15	18.3	66.7	-	-	-	100
CAT2	15	18.3	66.7	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	20	20	60	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	20	20	60	-	-	-	100
ESE	26	26	48	-	-	-	100

22PPE$24	PLANT LAYOUT AND MATERIALHANDLING	SEMESTER $

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	• To introduce the concepts of Plant Layout and Materials Handling Systems and their applications in industry.	
UNIT- I	**INTRODUCTION**	**(9 Periods)**
Factors to be considered for plant layout - physical facilities - equipments required for plant operation. Capacity, serviceability and flexibility and analysis in selection of equipments space requirements, man power requirements.		
UNIT- II	**PLANT LAYOUT**	**(9 Periods)**
Plant layout - need for layout, factors influencing product, process, fixed and combination layout - tools and techniques for developing layout, process chart, flow diagram, string diagram, template and scale models machine data. Layout planning procedure. Visualization of layout revision and improving existing layout, balancing of fabricating and assembly lines.		
UNIT- III	**MATERIAL HANDLING**	**(9 Periods)**
Principles, importance and scope of material handling. Planning, operation and costing principles types of material handling systems, factors influencing their choice.		
UNIT- IV	**UTILITIES**	**(9 Periods)**
Industrial buildings and utilities - centralized electrical pneumatic water line systems. Types of building, lighting heating, ventilation and air conditioning utilities. Planning and maintenance of waste handling statutory requirements. Packing and storage of materials - layout for packaging - packaging machinery wrapping and packing of materials, cushion materials.		
UNIT- V	**ANALYSIS OF MATERIAL HANDLING**	**(9 Periods)**
Analysis of material handling - factors involved, motion analysis, flow analysis, safety analysis, and equipment cost analysis, analysis of operation and material handling surveys.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Agarwal, G.K.* ***"Plant Layout and Material Handling"****, Jain brothers publication, 2017.*
2	*Sharma, S.C.* ***"Plant Layout and Materials Handling",*** *Khanna Publishers, 3rd edition, 2000.*

REFERENCES:

1	*James, M. Moore. "****Plant Layout and Design****", Macmillan Company, NY, 1963.*
2	*Alexandrov, M. "****Materials Handling Equipments****", MIR Publishers, 1981.*
3	*James, M. Apple* ***"Plant Layout and Material Handling"****, Kreiger Publishing Company, 1991.*

4	*Choudhary, R. B. and Tagore, G. R. N., **"Plant Layout and Materials Handling"**, Khanna Publishers, 2008.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Select appropriate location for establishing industrial plants by applying the concepts of location selection.	K2
CO2	Explain the various tools and techniques for developing plant layout.	K3
CO3	Identify and select various types of material handling equipment.	K2
CO4	Discuss about various types of industrial buildings and utilities.	K3
CO5	Perform the various analyses of material handling.	K4

COURSE ARTICULATION MATRIX:

	a) CO and PO Mapping														
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	2	1	-	-	-	-	-	-	-	-	1	2	-	-
CO2	-	2	1	-	-	-	-	-	-	-	-	1	2	-	-
CO3	-	2	1	-	-	-	-	-	-	-	-	1	2	-	-
CO4	-	2	1	-	-	3	-	-	-	-	-	1	2	-	-
CO5	-	2	1	-	-	-	-	-	-	-	-	1	2	-	-
22PPE$24	**-**	**2**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**-**	**-**
	1 – Slight, 2 – Moderate, 3 – Substantial														
	b) CO and Key Performance Indicators Mapping														
CO1	2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.4.2, 2.4.4, 3.1.5, 3.1.6, 12.2.1, 12.2.2														
CO2	2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.4, 2.3.1, 2.4.2, 2.4.4, 3.1.5, 3.1.6, 3.2.1, 3.2.3, 12.2.1, 12.2.2														
CO3	2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.4.2, 2.4.4, 3.1.5, 3.1.6, 12.2.1, 12.2.2														
CO4	2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.4.2, 2.4.4, 3.1.5, 3.1.6, 6.1.1, 6.2.1, 12.2.1, 12.2.2														
CO5	2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.4, 2.4.2, 2.4.4, 3.1.5, 3.1.6, 3.2.1, 3.2.3, 12.2.1, 12.2.2														

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	15	68.3	16.6	-	-	-	100
CAT2	15	68.3	16.6	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	50	50	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	50	50	-	-	-	100
ESE	9	59	32	-	-	-	100

22PPE$25	ENGINEERING ECONOMICS AND MANAGEMENT	SEMESTER $

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	• To provide knowledge on application of economic and organizational behavior techniques for the evaluation of real- life engineering scenarios	
UNIT- I	**INDUSTRIAL ECONOMICS**	**(9 Periods)**
Nature and scope of Economics- Importance of study of Economics for Engineers. Demand and Supply - Elasticity, cost concepts- cost and output relationship in the short and long run-Equilibrium of the firm. Pricing policies and methods		
UNIT- II	**MONEY BANKING AND TRADE**	**(9 Periods)**
Nature and functions of money- value of money- Inflation and deflation- Functions of commercial and reserve banking. Global trade- importance- foreign exchange- Balance of Payments- International Monitory institutions.		
UNIT- III	**ELEMENTS OF MANAGEMENT**	**(9 Periods)**
Evaluation of scientific management- Functions of management- planning, organizing, co-ordinating-directing and controlling-Production and productivity- Factors affecting productivity- plant location and plant layout- Work study.		
UNIT- IV	**FINANCIAL MANAGEMENT**	**(9 Periods)**
Concept and Definition- Venture capital- CRISIL rating- Purpose of investment- Types of capital - Sources of Finance-Financial statements- Stock exchange- commodity exchange- Cash flow statements- Break even analysis.		
UNIT- V	**MARKET MANAGEMENT AND PSYCHOLOGY**	**(9 Periods)**
Sales and market management- Management of sales- Advertisement- Market research- Sales Forecasting. Psychology-Definition- Industrial psychology- Individual vs group behavior- Attitude-Motives- Morale- Fatigue- Accidents.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Dwivedi D.N., "**Managerial Economics",** Vikas Publishing House Private Limited, New Delhi, 2015*

REFERENCES:

1	*Harold Koontz, Heinz Weihrich, "**Essentials of Management",** McGraw Hill, 2020*
2	*Sundharam K.P.M., "**Money, Banking and International Trade",** Sultan Chand Sons, New Delhi, Reprint 2005*
3	*Bhusan Y.K., "**Fundamentals of Business Organization and Management**", Sultan Chand and Sons, New Delhi, 2001.*

4	*Robbins S.P., "**Organizational Behaviour",** and Prentice Hall of India Ltd., New Delhi, 2009*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Describe the fundamental economic concepts for an industry	K2
CO2	Discuss the functions of money, banking and trade	K3
CO3	Describe the various elements of management	K3
CO4	Analyse various financial instruments available for the industry	K4
CO5	Appraise the organizational behavior and marketing management	K4

COURSE ARTICULATION MATRIX:

	a) CO and PO Mapping														
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	1	2	1	3	1	3	3	-	1	3	3	3	-	1	2
CO2	1	3	2	3	1	3	3	-	1	3	3	3	-	1	2
CO3	1	3	2	3	1	3	3	-	1	3	3	3	1	1	2
CO4	1	3	2	3	1	3	3	-	1	3	3	3	1	1	2
CO5	1	3	2	3	1	3	3	-	1	3	3	3	-	1	2
22PPE$25	**1**	**3**	**2**	**3**	**1**	**3**	**3**	**-**	**1**	**3**	**3**	**3**	-	1	2
	1 – Slight, 2 – Moderate, 3 – Substantial														
	b) CO and Key Performance Indicators Mapping														
CO1	1.2.1, 2.1.2, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.4.4, 3.1.1, 3.1.3, 3.1.5, 3.2.3, 3.3.1, 3.4.1, 4.1.1, 4.1.2, 4.3.4, 5.2.1, 5.3.1, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2														
CO2	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 3.3.2, 3.4.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.4, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2														
CO3	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 3.3.2, 3.4.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.4, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2														
CO4	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 3.3.2, 3.4.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.4, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2														
CO5	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 3.3.2, 3.4.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.4, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2														

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	50	50	-	-	-	-	100
CAT2	50	50					100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	33.33	33.33	33.33	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	33.33	33.33	33.33	-	-	-	100
ESE	42	42	16	-	-	-	100

22PPE$26	SIX SIGMA	SEMESTER $

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	• To impart knowledge to develop a product with the required quality and gain insights about the importance of six sigma practices.	
UNIT- I	**INTRODUCTION**	**(9 Periods)**
Quality Perception: Quality in Manufacturing, Quality in Service Sector; Differences between Conventional and Six Sigma concept of quality; Six Sigma success stories. Statistical foundation and methods of quality improvement. Descriptive statistics: Data Type, Mean, Median, Mode, Range, Variation, Standard Deviation, Skewness, Kurtosis.Probability Distribution:Normal, Binomial, Poisson Distribution.		
UNIT- II	**BASICS OF SIX SIGMA**	**(9 Periods)**
Concept of Six Sigma, Defects, DPMO, DPU, Attacks on X'S, Customer focus, Six Sigma for manufacturing, Six Sigma for service. Z score, Understanding Six Sigma organization, Leadership council, Project sponsors and champions, Master Black Belt, Black Belt, Green Belts.		
UNIT- III	**METHODOLOGY**	**(9 Periods)**
Methodology of Six Sigma, DMAIC, DFSS, Models of Implementation of Six Sigma, Selection of Six Sigma Projects.		
UNIT- IV	**SIX SIGMA TOOLS**	**(9 Periods)**
Project Charter, Process mapping, Measurement system analysis, Hypothesis Testing, Quality Function deployment, Failure mode effect analysis, Design of Experiments.		
UNIT- V	**SIX SIGMA RESOURCES**	**(9 Periods)**
Sustenance of Six Sigma, Communication plan, Company culture, Reinforcement and control, Introduction to softwares for Six Sigma, Understanding Minitab, Graphical analysis of Minitab plots.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Thomas Pyzdek and Paul Keller**, "The Six Sigma Handbook",** Mc Graw Hill, 3rd edition, 2018.*
2	*Craig Gygi, Neil DeCarlo, Bruce Williams, **"Six Sigma for Dummies",** John Wiley & Sons, 2012.*

REFERENCES:

1	*Geoff Tennant,**"Six Sigma: SPC and TQM in manufacturing and service" ,**Gower Publishing Co., 2017.*
2	*Greg Brue, **"Six Sigma for managers" ,**McGraw-Hill Education,2015.*

3	*Peter S. Pande, Lawrence Holpp**, "What is Six Sigma",**McGraw-Hill Education,2001.*
4	*Peter S. Pande,**"The Six Sigma Way",**McGraw-Hill Education Team Field book, 2002.*
5	*Peter S. Pande,**"The Six Sigma way",**McGraw-Hill Education, 2013.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Discuss the quality perception, descriptive statistics and mathematical distribution function related with six sigma.	K2
CO2	Explain and apply the basic concepts of six sigma.	K4
CO3	Elaborate the methodology of six sigma.	K4
CO4	Apply various six sigma tools in industrial environment.	K2
CO5	Apply the skills required to use software, tools and data to decrease expenses, reduce cycle times.	K2

COURSE ARTICULATION MATRIX:

	a) CO and PO Mapping														
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	1	1	1	1	-	-	-	1	-	-	-	-	-	1
CO2	1	1	1	1	1	-	-	-	1	-	-	-	-	-	2
CO3	2	1	2	1	1	-	-	-	1	-	-	-	-	-	2
CO4	1	2	2	2	2	-	-	-	1	-	-	-	-	-	2
CO5	2	2	2	2	2	-	-	-	1	-	-	-	-	-	2
22PPE$26	2	1	2	1	1	-	-	-	1	-	-	-	-	-	2
	1 – Slight, 2 – Moderate, 3 – Substantial														
	b) CO and Key Performance Indicators Mapping														
CO1	1.3.1, 3.1.1, 4.1.1, 5.2.1; 14.1.1														
CO2	1.3.1, 1.4.1, 3.1.1, 4.1.1, 5.2.1; 14.1.1; 14.1.2														
CO3	1.3.1, 1.4.1, 3.1.1, 4.1.1, 5.2.1 ; 14.1.1; 14.1.2														
CO4	1.3.1, 1.4.1, 3.1.1, 4.1.1, 5.2.1 ; 14.1.1; 14.1.2														
CO5	1.3.1, 1.4.1, 3.1.1, 4.1.1, 5.2.1 ; 14.1.1; 14.1.2														

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	25	25	20	10	10	10	100
CAT2	25	25	20	10	10	10	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	25	25	20	10	10	10	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	25	25	20	10	10	10	100
ESE	25	25	20	10	10	10	100

22PPE$27	NON DESTRUCTIVE TESTING TECHNIQUES	SEMESTER $

PREREQUISITES	CATEGORY	L	T	P	C
22PPC303-MANUFACTURINGTECHNOLOGY	PE	3	0	0	3

Course Objective	• To impart comprehensive knowledge about differentiate various defect types and select the appropriate NDT methods and their industrial applications.	
UNIT- I	**INTRODUCTION**	**(9 Periods)**
NDT Versus Mechanical testing, Overview of the Non-Destructive Testing Methods for the detection of manufacturing defects as well as material characterization. Relative merits and limitations, Visual methods: Optical aids, In-situ metallography, Optical holographic methods, Dynamic inspection.		
UNIT- II	**LIQUIDPENETRANT&MAGNETICINSPECTION**	**(9 Periods)**
Penetrant systems: Principles – Process - Liquid penetrant materials – Emulsifiers - cleaners developers – sensitivity - Advantages, Limitations and Applications. Magnetic methods: Advantages, Limitations - Methods of generating fields: magnetic particles and suspending liquids. Magnetography - field sensitive probes: applications. Measurement of metal properties.		
UNIT- III	**RADIOGRAPHIC METHODS**	**(9 Periods)**
Principles of radiography - sources of radiation - Ionising radiation – sources - X-rays, gamma rays Recording of radiation-Radiographic sensitivity - Fluoroscopic methods - special techniques. Radiation safety. Advantages, Limitations and Applications.		
UNIT- IV	**ULTRASONIC TESTING OF MATERIALS**	**(9 Periods)**
Ultrasonic testing: Principle - Advantages, Disadvantages, Applications - Generation of Ultrasonic waves - general characteristics of ultrasonic waves: methods and instruments for ultrasonic materials testing: special techniques.		
UNIT- V	**ELECTRICAL AND SPECIAL METHODS**	**(9 Periods)**
Electrical methods: Eddy current methods: potential - drop methods, applications - Other methods: Acoustic Emission methods, Acoustic methods: Leak detection: Thermal inspection.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Baldev Raj, T.Jayakumar, M.Thavasimuthu **"Practical Non-Destructive Testing"**,Narosa Publishing House, 2009.*
2	*RaviPrakash**"Non-DestructiveTestingTechniques"**,NewAgeInternationalPublishers,2010.*

REFERENCES:

1	*ASMMetalsHandbook**"Non-DestructiveEvaluationandQualityControl"**,AmericanSocietyofMetals,MetalsPark,Ohio,USA,2*

	00,Volume-17.
2	*PaulEMix,**"IntroductiontoNon-destructivetesting:atrainingguide"**,Wiley,2ndEditionNewJersey,2005*
3	*Charles, J. Hellier, **"Handbook of Nondestructive evaluation"**, McGraw Hill, New York 2001.*
4	*J. Krautkramer & Herbert Krautkramer, **"Ultrasonic Testing of Materials"**, Narosa Publishing House, New Delhi.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Classify various non-destructive testing and choose the right method of testing for detection of defects on various materials.	K2
CO2	Check different metals and alloys by visual inspection method.	K3
CO3	Explain and perform X-ray and Gamma ray radiography testing methods.	K3
CO4	Explain and perform Ultrasonic testing.	K3
CO5	Explain and perform non-destructive tests like: Leak Test, Eddy current test, Acoustic Emission methods and Thermal inspection.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	2	1	1	3	2	-	1	-	1	3	2	2	2	1	2
CO2	2	2	1	3	3	-	1	1	2	3	2	2	2	2	2
CO3	2	2	1	3	3	-	1	1	2	3	2	2	2	2	2
CO4	2	2	1	3	3	-	1	1	2	3	2	2	2	2	2
CO5	2	2	1	3	3	-	1	1	2	3	2	2	2	2	2
22PPE$27	**2**	**2**	**1**	**3**	**3**	**-**	**1**	**1**	**2**	**3**	**2**	**2**	**2**	**2**	**2**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1, 1.3.1, 1.4.1, 2.2.4, 2.3.1, 2.4.3, 2.4.4, 3.1.2, 3.1.3, 3.1.5, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 7.1.1, 9.1.2, 9.2.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 11.3.2, 12.1.2, 12.2.1, 12.3.2.
CO2	1.2.1, 1.3.1, 1.4.1, 2.1.3, 2.2.4, 2.3.1, 2.4.2, 2.4.3, 2.4.4, 3.1.2, 3.1.3, 3.1.5, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 7.1.1, 8.2.1, 9.1.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 11.3.2, 12.1.2, 12.2.1, 12.2.2, 12.3.2.
CO3	1.2.1, 1.3.1, 1.4.1, 2.2.4, 2.3.1, 2.4.2, 2.4.3, 2.4.4, 3.1.2, 3.1.3, 3.1.5, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 7.1.1, 8.2.1, 9.1.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 11.3.2, 12.1.2, 12.2.1, 12.2.2, 12.3.2.
CO4	1.2.1, 1.3.1, 1.4.1, 2.2.4, 2.3.1, 2.4.2, 2.4.3, 2.4.4, 3.1.2, 3.1.3, 3.1.5, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 7.1.1, 8.2.1, 9.1.1, 9.1.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 11.3.2, 12.1.2, 12.2.1, 12.2.2, 12.3.2.
CO5	1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.2.1, 2.2.4, 2.3.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.5, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 7.1.1, 8.2.1, 9.1.1, 9.1.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 11.3.2, 12.1.2, 12.2.1, 12.2.2, 12.3.2.

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	50	50					100
CAT2	50	50					100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	33.33	33.33	33.33				100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	33.33	33.33	33.33				100
ESE	42	42	16				100

22PPE$28	TOTAL PRODUCTIVE MAINTENANCE	SEMESTER $

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	• To enable the students to understand basic concepts of Total Productive Maintenance. • Expose the students to the objectives, maintenance models, group activities, logistics, condition monitoring and implementation of Total Productive Maintenance.	
UNIT-I	**MAINTENANCECONCEPTS**	**(9Periods)**
Introduction-Objectives and functions – Productivity, Quality, Reliability and Maintainability (PQRM) - Terotechnology - Reliability Centered Maintenance – Predictive Maintenance –Condition Based Maintenance – maintainability prediction – availability and system effectiveness – maintenance costs-maintenance organization.		
UNIT-II	**MAINTENANCEMODELS**	**(9Periods)**
Minimal repair-As Good as New policy-maintenance types –balancing Preventive Maintenance and breakdown maintenance – Preventive Maintenance schedules: deviations on both sides of target values-PM schedules: functional characteristics-replacement models.		
UNIT-III	**FUNDAMENTALSOFTPM**	**(9Periods)**
Zero breakdowns - Zero Defects and TPM - maximizing equipment effectiveness – Autonomous maintenance program - five pillars of TPM - TPM small group activities - TPM organization – Management Decision-Educational campaign-Creation of Organizations-Establishment of basic policies and goals-Formation of master plan-TPM implementation.		
UNIT-IV	**MAINTENANCELOGISTICS**	**(9Periods)**
Human factors in maintenance-maintenance manuals-maintenance staffing methods–queuing applications-simulation-spare parts management-maintenance planning and scheduling.		
UNIT-V	**ONLINEMONITORING**	**(9Periods)**
Condition monitoring-Infrared Thermography, Oil Analysis, acoustic emissions testing, Motor Current Analysis, Vibration Measurement and Analysis, Wear Debris Monitoring, Visual checks-corrosion control-Maintenance Management Information System-Expert system applications.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Nakajima S.* ***"Introduction to TPM"****, Productivity Press, Chennai, 1992*
2	*Srivastava S.K.* ***"Maintenance Engineering (Pri.Practices& Management)",*** *S. Chand Group, 2011*

REFERENCES:

1	*WiremanT****"TotalProductiveMaintenance",****IndustrialPressInc.,Newyork,2004*

2	*GotoF**"EquipmentplanningforTPMMaintenancePreventionDesign",**ProductivityPress,1992*
3	*ShiroseK.,**"TotalProductiveMaintenanceforWorkshopLeaders",**ProductivityPress,1992*
4	*KellyA.,**"Maintenanceplanningandcontrol",**Butterworths,London,1991*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Describe the concept of total productive maintenance used in the industries	K2
CO2	Describe how TPM improves operations by preventing equipment breakdowns and prevention of product defects and rejects.	K3
CO3	Understand the usage of tools for TPM implementation and able to identify and eliminate loss through TPM implementation.	K2
CO4	Describe the logistics involved in Total Productive Maintenance	K2
CO5	Effectively use the total productive maintenance for online monitoring of processes	K3

COURSE ARTICULATION MATRIX:

	a) CO and PO Mapping														
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	-	-	-	-	-	-	-	2	2	3	-	2	-	-	-
CO2	2	3	-	-	-	2	-	2	2	2	2	2	-	-	1
CO3	1	-	-	-	2	-	-	2	2	2	-	2	2	-	2
CO4	-	-	-	-	-	-	-	2	2	-	-	3	-	-	-
CO5	-	-	-	-	1	-	-	2	2	-	-	2	-	-	1
22PPE$28	**1**	**1**	**-**	**-**	**1**	**2**	**-**	**2**	**2**	**2**	**2**	**3**	**2**	**-**	**1**
	1 – Slight, 2 – Moderate, 3 – Substantial														
	b) CO and Key Performance Indicators Mapping														
CO1	1.1.1, 1.1.2, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.4, 3.1.1, 3.1.2, 3.1.6, 3.3.1, 3.4.1, 4.1.1, 4.1.2, 4.3.1, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 9.2.1, 10.1.1, 10.1.2, 10.1.3, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.2.2, 12.3.2.														
CO2	1.1.1, 1.1.2, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.4, 3.1.1, 3.1.2, 3.1.6, 3.3.1, 3.4.1, 4.1.1, 4.1.2, 4.3.1, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 9.2.1, 10.1.1, 10.1.2, 10.1.3, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 11.3.2, 12.2.2, 12.3.2														
CO3	1.1.1, 1.1.2, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.4, 3.1.1, 3.1.2, 3.1.6, 3.3.1, 3.4.1, 4.1.1, 4.1.2, 4.3.1, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 9.2.1, 10.1.1, 10.1.2, 10.1.3, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 11.3.2, 12.2.2, 12.3.2														
CO4	1.1.1, 1.1.2, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.4, 3.1.1, 3.1.2, 3.1.6, 3.3.1, 3.4.1, 4.1.1, 4.1.2, 4.3.1, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 9.2.1, 10.1.1, 10.1.2, 10.1.3, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.2.2, 12.3.2														
CO5	1.1.1, 1.1.2, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.4, 3.1.1, 3.1.2, 3.1.6, 3.3.1, 3.4.1, 4.1.1, 4.1.2, 4.3.1, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 9.2.1, 10.1.1, 10.1.2, 10.1.3, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 11.3.2, 12.2.2, 12.3.2														

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	15	70	15	-	-	-	100
CAT2	15	70	15	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	15	70	15	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	15	70	15	-	-	-	100
ESE	15	70	15	-	-	-	100

22PPE$29	POWERPLANTENGINEERING	SEMESTER $

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	• To learn the economics of power generation and to understand the working of power plants and its comparative analysis.	
UNIT- I	**HYDRO POWER PLANTS**	**(9Periods)**
Energy scenario – Global and National. Essential elements and classification of hydro power plants. Typical Layout and associated components. Selection of turbines. Pumped storage plants.		
UNIT- II	**THERMAL AND GAS TURBINE POWER PLANTS**	**(9Periods)**
Cycle analysis - Layout of modern coal based power plant. Super Critical Boilers - FBC Boilers. Subsystems – Water and Steam, Fuel and ash handling, Air and Gas, Draught system. Diesel and Gas Turbine power plants- Layout and Functioning. Environmental impact and Control.		
UNIT- III	**NUCLEAR POWER PLANTS**	**(9Periods)**
Layout and subsystems. Fuels and Nuclear reactions. Boiling Water Reactor, Pressurized Water Reactor, Fast Breeder Reactor, Gas Cooled and Liquid Metal Cooled Reactors – working and Comparison. Safety measures. Environmental aspects.		
UNIT- IV	**RENEWABLE ENERGY POWER PLANTS**	**(9Periods)**
Solar power plants – Photovoltaic and Thermal. Wind power plants – Vertical and Horizontal axes Wind Turbines. Biomass power plants – Gasification and combustion. Tidal and Ocean Thermal Energy plants. Geothermal plants. Fuel cell – Types. Hybrid power plants.		
UNIT- V	**ECONOMICS OF POWER GENERATION**	**(9Periods)**
Load and load duration curves. Electricity billing – costing of electrical energy – Tariff structures. Economics of power plant – Fixed and variable cost. Payback period. Net Present Value, Internal Rate of Return. Emission calculation and carbon credit.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*G.R. Nagpal,* ***"Power Plant Engineering",*** *Khanna publishers, 2012.*
2	*S.C. Arora and S. Domkundwar,* ***"A Course in Power Plant Engineering",*** *Dhanpat Rai and sons, 2014.*

REFERENCES:

1	*P.K.Nag,* ***"Power Plant Engineering****", Tata McGraw Hill, 2014.*
2	*Paul Breeze,* ***"Power Generation Technologies",*** *Elsevier Ltd., 2014.*
3	*M.M.El.Wakil,* ***"Power Plant Technology",*** *Tata McGraw Hill, 2010.*
4	*R.K. Rajput, "****A Textbook of Power Plant Engineering",*** *Laxmi Publications pvt ltd, 2016.*
5	*James Momoh,* ***"Smart Grids - Fundamentals of Design and analysis",*** *Wiley Press, 2012.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Elaborate the working of Hydro-electric power plants.	K4
CO2	Analyze the working of conventional power plants such as Thermal and Gas Turbines.	K4
CO3	Demonstrate the working of nuclear power plants and its functional components.	K3
CO4	Discuss the various types of renewable energy systems and its functional components.	K3
CO5	Calculate the cost of power generation, electricity billing and rate of return on power plant investments.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	1	2	2	3	3	-	3	3	3	2	2	-	2
CO2	2	1	2	2	3	3	3	-	3	3	1	2	1	-	2
CO3	2	1	2	2	3	3	3	-	3	3	1	2	2	-	1
CO4	2	1	2	2	3	3	3	-	3	3	1	2	2	-	2
CO5	2	1	2	2	3	3	3	-	3	3	1	2	2	-	2
22PPE$29	**2**	**2**	**2**	**2**	**3**	**3**	**3**	**-**	**3**	**3**	**2**	**2**	**2**	**-**	**2**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1, 1.3.1, 1.4.1, 2.1.3, 2.2.3, 2.2.4, 2.3.1, 3.1.1, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 4.1.1, 4.1.2, 4.3.1, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.2, 12.2.2, 12.3.1, 12.3.2.
CO2	1.2.1, 1.3.1, 1.4.1, 2.1.3, 2.2.3, 2.2.4, 2.3.1, 3.1.1, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 4.1.1, 4.1.2, 4.3.1, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.2, 12.2.2, 12.3.1, 12.3.2.
CO3	1.2.1, 1.3.1, 1.4.1, 2.1.3, 2.2.3, 2.2.4, 2.3.1, 3.1.1, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 4.1.1, 4.1.2, 4.3.1, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.2, 12.2.2, 12.3.1, 12.3.2.
CO4	1.2.1, 1.3.1, 1.4.1, 2.1.3, 2.2.3, 2.2.4, 2.3.1, 3.1.1, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 4.1.1, 4.1.2, 4.3.1, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.2, 12.2.2, 12.3.1, 12.3.2.
CO5	1.1.1, 1.2.1, 1.3.1, 2.1.3, 2.2.3, 2.2.4, 2.3.1, 2.4.1, 3.1.4, 3.1.5, 3.2.3, 4.1.1, 4.1.2, 4.3.1, 4.3.2, 4.3.3, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 11.2.1, 11.3.1, 12.1.2, 12.2.2, 12.3.1, 12.3.2.

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	15	68	17	-	-	-	100
CAT2	15	52	33	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	50	25	25	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	50	25	25	-	-	100
ESE	9	75	16	-	-	-	100

22PPE$30	INDUSTRIAL SAFETY ENGINEERING	SEMESTER $

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	• To study the concept of industrial safety, accident investigation and reporting, and, safety education and training, and, safety management, and, safety audit and safety regulation.	
UNIT- I	**SAFETY CONCEPT**	**(9 Periods)**
Evolution of modern safety concept- History of safety movement- influence of environmental safety – Hazards –safety policy –safety survey, safety inspection safety culture and Behavioural safety.		
UNIT- II	**ACCIDENT INVESTIGATION AND REPORTING**	**(9 Periods)**
Concept of an accident, reportable and non-reportable accidents- principles of accident prevention - accident investigation and analysis- documentation of accidents- unsafe act and unsafe condition- domino sequence- role of safety committee and cost of accident.		
UNIT- III	**SAFETY EDUCATION AND TRAINING**	**(9 Periods)**
Importance of training – training methods - method of promoting safe practice-motivation-role of government agencies and private consulting agencies in safety training- Creating awareness- safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign.		
UNIT- IV	**SAFETY MANAGEMENT**	**(9 Periods)**
General concept of safety management-National Safety Council-OSHA, their roles in safety propagation - Evolution of modern safety concept-planning for safety for optimization of productivity-line and staff functions for safety-safety sampling, fault tree analysis.		
UNIT- V	**SAFETY AUDIT AND SAFETY REGULATION**	**(9 Periods)**
Components of safety audit, types of audit, audit methodology, non-conformity reporting (NCR), audit checklist and report-review of inspection, safety measures in factories act, pollution control act for water, air, land, OSHAS18001, ISO14001.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Heinrich H.W,* ***"Industrial accident Prevention",*** *McGraw-Hill company, New york,1980*
2	*Krishnan N.V,* ***"Safety management in Industry"****, Jaico Publishing House, Bombay,1997.*

REFERENCES:

1	*Dan Petersen**, "Techniques of Safety Management**", Mc Graw-Hill Company,Tokyo, 1981*
2	***"Accident Prevention Manual For Industrial Operations**", N.S.C Chicago, 13th Edition 2009.*
3	*Blake R.B., **"Industrial Safety"** Prentice Hall, Inc., New Jersey,. 3rd Edition 2000.*
4	***"Occupational safety Manual"** BHEL, Trichy, 1988.*
5	***"Safety Management",** John V. Grimaldi and Rollin H. Simonds, All India Travelers Book seller, New Delhi, 1989.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Anticipate, identify, evaluate, and control workplace hazardous conditions and practices.	K2
CO2	Develop effective safe operating procedures and comprehensive safety and health programs.	K3
CO3	Address identified hazards, conditions, and practices in a cost effective manner.	K2
CO4	Apply the general concept of safety management and planning for safety for optimization of productivity.	K3
CO5	Measure and evaluate occupational safety and health performance.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	2	1	2	1	1	3	3	-	3	3	1	3	2	1	2
CO2	2	2	2	3	1	3	3	-	3	3	1	3	2	1	1
CO3	2	1	2	2	1	3	3	1	3	3	2	3	2	2	2
CO4	2	2	2	1	2	3	3	1	3	3	2	3	2	2	2
CO5	2	2	2	3	2	3	3	2	3	3	2	3	2	2	2
22PPE$30	**2**	**2**	**2**	**2**	**2**	**3**	**3**	**1**	**3**	**3**	**2**	**3**	**2**	**2**	**2**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.5, 3.3.2, 4.1.2, 5.2.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.2, 9.1.1, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.2.
CO2	1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.3.2, 4.1.1, 4.1.2, 4.1.3, 4.3.1, 4.3.3, 4.3.4, 5.2.2, 5.3.1, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2.
CO3	1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.2.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.3.2, 4.1.2, 4.1.3, 5.2.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.2, 8.1.1, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.3.1, 12.3.2.
CO4	1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.3.2, 3.4.1, 3.4.2, 4.1.2, 4.3.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 11.3.2, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2.
CO5	1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.3.2, 4.1.1, 4.1.2, 4.2.1, 4.3.1, 4.3.3, 4.3.4, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.1, 9.1.1, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 11.3.2, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2.

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	26	74		-	-	-	100
CAT2	26	58	16		-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	26	74		-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	26	58	16	-	-	-	100
ESE	26	58	16	-	-	-	100

22COE$01	DISASTER MANAGEMENT AND MITIGATION *(Common to All Branches)*					
PREREQUISITES		**CATEGORY**	**L**	**T**	**P**	**C**
NIL		**OE**	**3**	**0**	**0**	**3**
Course Objective	To impart knowledge to create appropriate planning, preparation and response for emergency treatment in disaster situation					
UNIT – I	**INTRODUCTION TO DISASTERS**					**9 Periods**
Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Classification, Causes, Impacts - Global Trends in Disasters: Urban Disasters, Pandemics, Complex Emergencies, Climate Change- Dos and Don'ts during various types of Disasters.						
UNIT – II	**HAZARDS AND RISK VULNERABILITY**					**9 Periods**
Hazard Identification and Hazard Profiling - Hazard Analysis - Types of hazards - Natural and technological Components of Risk- likelihood and Consequence, Trends and Computation of likelihood and Consequence. Risk Evaluation – Purpose, Risk Acceptability, Alternatives, Personnel. Political/ Social, Economic. Vulnerability-Physical Profile, Social Profile, Environmental Profile, Economic Profile - Factors Influencing Vulnerability, Risk Perception.						
UNIT – III	**MITIGATION AND PREPAREDNESS**					**9 Periods**
Mitigation - Types, Obstacles, Assessment and Selection of Mitigation options, Emergency Response capacity, Incorporating Mitigation into Development and Relief Projects. Preparedness- Government Preparedness, Public Preparedness, Media as a Public educator. Obstacles to public education and preparedness.						
UNIT – IV	**RESPONSE AND RECOVERY**					**9 Periods**
Response the Emergency- Pre disaster, post disaster, Provision of Water, Food and Shelter, Volunteer Management, Command, Control and Coordination. Recovery- Short Term and Long-term Recovery- Components of Recovery- Planning, Coordination, Information, Money and Supplies, Allocation of Relief Funds, Personnel. Types of Recovery- Government, Infrastructure, Debris Removal Disposal and Processing, Environment, Housing, Economic and Livelihood, Individual, Family and Social Recovery- Special Considerations in Recovery.						
UNIT – V	**DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES**					**9 Periods**
Concept of Environmental Health and Safety Management – Elements of Environmental Health and Safety Management Policy and implementation and review – ISO 45001-Strucure and Clauses-Case Studies.						
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**						

TEXT BOOKS :

1	*Singhal J.P.* ***"Disaster Management",*** *Laxmi Publications, 2010.*
2	*Tushar Bhattacharya,* ***"Disaster Science and Management",*** *McGraw Hill India Education Pvt. Ltd., 2012.*

REFERENCES:

1	*Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005.*
2	*Government of India, National Disaster Management Policy,2009 Periods.*
3	*Gupta Anil K, Sreeja S. Nair.* ***"Environmental Knowledge for Disaster Risk Management",*** *NIDM, New Delhi, 2011*
4	*Kapur Anu Vulnerable India:* ***A Geographical Study of Disasters****, IIAS and Sage Publishers, New Delhi, 2010*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Identify the types of disasters, causes and their impact on environment and society	K2
CO2	Assess vulnerability and various methods of risk reduction measures as well as mitigation.	K2
CO3	Comprehend the mitigation and preparedness process.	K2
CO4	Describe about response and recovery process during disaster.	K2
CO5	Perform disaster damage assessment and management.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	-	1	-	2	3	3	2	2	2	-	3	2	-	2
CO2	1	-	1	-	2	3	3	2	2	2	-	3	2	-	2
CO3	1	-	1	-	2	3	3	2	2	2	-	3	2	-	2
CO4	1	-	1	-	2	3	3	2	2	2	-	3	2	-	2
CO5	1	-	1	-	2	3	3	2	2	2	-	3	2	-	2
22COE$01	1	-	1	-	2	3	3	2	2	2	-	3	2	-	2

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1, 3.1.5, 5.1.1, 5.2.1, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 8.1.1, 8.2.2, 9.1.1, 9.1.2, 9 .2.1, 10.1.1, 10.1.2, 10.1.3
CO2	1.2.1, 3.1.5, 5.1.1, 5.2.1, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, **7.2.2,** 8.1.1, 8.2.2, 9.1.1, 9.1.2, 9 .2.1, 10.1.1, 10.1.2, 10.1.3
CO3	1.2.1, 3.1.5, 5.1.1, 5.2.1, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 10.1.1, 10.1.2, 10.1.3
CO4	1.2.1, 3.1.5, 5.1.1, 5.2.1, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 10.1.1, 10.1.2, 10.1.3
CO5	1.2.1, 3.3.6, 5.1.1, 5.2.1, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.2, 9 .1.1, 9.1.2, .2.1, 10.1.1, 10.1.2, 10.1.3

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	40	40	20	-	-	-	100
CAT2	40	40	20	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	25	50	25	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	25	50	25	-	-	100
ESE	30	30	40	-	-	-	100

22COE$02	**WATER SANITATION AND HEALTH** *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	**OE**	**3**	**0**	**0**	**3**

Course Objective	To understand the overview of Environment, Health and Safety (EHS) in industries and related Indian regulations, types of Health hazards, effect, assessment and control methods and EHS Management System	
UNIT – I	**INTRODUCTION**	**9 Periods**
Need for developing Environment, Health and Safety systems in work places- International initiatives, National Policy and Legislations on EHS in India - Regulations and Codes of Practice - Role of Trade Union Safety Representatives – Ergonomics.		
UNIT – II	**OCCUPATIONAL HEALTH AND HYGIENE**	**9 Periods**
Definition of occupational health and hygiene - Categories of health hazards – Exposure pathways and human responses–Exposure Assessment-occupational exposure limits - Hierarchy of control measures - Role of personal protective equipment and the selection criteria.		
UNIT – III	**WORKPLACE SAFETY AND SAFETY SYSTEMS**	**9 Periods**
Features of Satisfactory and Safe design of work premises – good housekeeping - lighting and color, Ventilation and Heat Control, Noise, Chemical and Radiation Safety – Electrical Safety – Fire Safety – Safety at Construction sites, ETP – Machine guarding – Process Safety, Working at different levels.		
UNIT – IV	**HAZARDS AND RISK MANAGEMENT**	**9 Periods**
Safety appraisal – Job Safety Analysis-Control techniques – plant safety inspection – Accident investigation - Analysis and Reporting – Hazard and Risk Management Techniques –Onsite and Offsite emergency Plans. Employee Participation- Education and Training- Case Studies.		
UNIT – V	**ENVIRONMENTAL HEALTH AND SAFETY MANAGEMENT**	**9 Periods**
Concept of Environmental Health and Safety Management – Elements of Environmental Health and Safety Management Policy and implementation and review – ISO 45001-Strucure and Clauses-Case Studies.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	***Industrial Health and Safety Acts and Amendments**, by Ministry of Labour and Employment, Government of India.*
2	*Dr.K.U.Mistry, Siddharth Prakashan, **"Fundamentals of Industrial Safety and Health"**, 2012*

REFERENCES:

1	*Bill Taylor, **"Effective Environmental, Health, and Safety Management Using the Team Approach",** Culinary and Hospitality Industry Publications Services, 2005.*
2	*Nicholas P.Cheremisinoff and Madelyn L. Graffia, **"Environmental and Health and Safety Management"**, William Andrew Inc. NY, 1995.*
3	*Brian Gallant, **"The Facility Manager's Guide to Environmental Health and Safety"** , Government Inst Publ., 2007.*
4	*https://archive.nptel.ac.in/courses/114/106/114106017/*

COURSE OUTCOMES: UpUpon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Outline the needs for EHS in industries and related Indian regulations	K2
CO2	Assess the various types of Health hazards, effect, assessment and control methods	K2
CO3	Identity the various safety systems in working environments	K2
CO4	Select the methodology for preparation of Emergency Plans and Accident investigation	K3
CO5	Describe the EHS Management System and its elements	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	-	1	-	3	3	3	2	1	-	2	-	1	1	-
CO2	2	-	1	-	3	3	3	2	1	-	2	-	1	1	-
CO3	2	-	1	-	3	3	3	2	1	-	2	-	1	1	-
CO4	2	-	1	-	3	3	3	2	1	-	2	-	1	1	-
CO5	2	-	1	-	2	3	3	2	1	-	2	-	1	1	-
22COE$02	2	-	1	-	3	3	3	2	1	-	2	-	1	1	-

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1, 1.3.1, 3.1.4, 3.1.5, 5.1.1, 5.2.1, 5.2.2, 5.3.1, 6.1.1, 6.2.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.2, 9.1.2, 11.1.1, 11.2.1.
CO2	1.2.1, 1.3.1, 3.1.4, 3.1.5, 5.1.1, 5.2.1, 5.2.2, 5.3.1, 6.1.1, 6.2.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.2, 9.1.2, 11.1.1, 11.2.1.
CO3	1.2.1, 1.3.1, 3.1.4, 3.1.5, 5.1.1, 5.2.1, 5.2.2, 5.3.1, 6.1.1, 6.2.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.2, 9.1.2, 11.1.1, 11.2.1.
CO4	1.2.1, 1.3.1, 3.1.4, 3.1.5, 5.1.1, 5.2.1, 5.2.2, 5.3.1, 6.1.1, 6.2.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.2, 9.1.2, 11.1.1, 11.2.1.
CO5	1.2.1, 1.3.1, 3.1.4, 3.1.5, 5.1.1, 5.2.1, 5.2.2, 5.3.1, 6.1.1, 6.2.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.2, 9.1.2, 11.1.1, 11.2.1.

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	40	40	20	-	-	-	100
CAT2	40	40	20	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	25	50	25	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	25	50	25	-	-	100
ESE	30	30	40	-	-	-	100

22MOE$03	NANOTECHNOLOGY AND SURFACE ENGINEERING *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

Course Objectives	To educate the production techniques and characterization techniques of nano materials and to familiarize about the surface modification techniques using nano materials.

UNIT – I	ELEMENTS OF NANO-SCIENCE AND NANOTECHNOLOGY	9 Periods

Engineering scale of nanotechnology, different classes of nano-materials, synthesis of nano-materials, fabrication and characterization of nanostructures, Engineering applications- Cosmetics and Consumer Goods, Nano Sensor, Nano catalysts, Water Treatment and the Environment, Paints, Food and Agriculture Industry.

UNIT – II	NANOTECHNOLOGY AND CERAMICS	9 Periods

Introduction, Vapor Condensation Methods, Sputtering, Laser Method, Spray Pyrolysis, Thermo Chemical /Flame Decomposition of metal organic Precursors methods

UNIT – III	CHARACTERIZATION OF NANOMATERIALS	9 Periods

X-Ray Diffraction (XRD), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic Force Microscopy, UV / Visible Spectroscopy.

UNIT – IV	SURFACE ENGINEERING	9 Periods

Introduction to surface engineering, Scope of surface engineering for different engineering materials, Surface Preparation methods such as Chemical, Electrochemical, Mechanical: Sand Blasting, Shot peening, Shot blasting, Hydro-blasting, Vapor Phase Degreasing etc., Coatings: Classification, Properties and applications of Various Coatings.

UNIT – V	SURFACE MODIFICATION TECHNIQUES	9 Periods

Surface modification by use of directed energy beams, Plasma, Sputtering & Ion Implantation. Surface modification by Friction stir processing. Surface composites.

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1	*G. Cao, **"Nanostructures and Nanomaterials: Synthesis",** Properties and Applications by Imperial College Press, 2nd edition, 2011.*
2	*Keith Austin "**Surface Engineering Hand Book"**, London : Kogan Page, 1998*

REFERENCES:

1	*Gregory Timp, "**Nanotechnology",** Springer, 2012*
2	*Dheerendra Kumar Dwivedi, **"Surface Engineering: Enhancing Life of Tribological Components"**, Springer, 2018*
3	*D. Phil Woodruff,**"Modern Techniques of Surface Science**", Cambridge University Press, 2016*
4	*Sulabha K. Kulkarni ,**"Nanotechnology: Principles and Practices**", Springer, 2019*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Choose appropriate nano material and its manufacturing method.	K1
CO2	Select most suitable technique to deposit a layer of nano material on ceramic surface.	K2
CO3	Identify appropriate techniques to characterize nano materials.	K2
CO4	Select surface preparation, coating techniques and predict their combinational effect for engineering applications.	K2
CO5	Adopt different techniques to modify surfaces and make surface composites as per requirement.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping															
COs/POs	**PO 1**	**PO 2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	-	1	2	1	1	-	-	-	-	-	-	-	2	2	3
CO2	-	1	2	1	1	-	-	-	-	-	-	-	2	2	3
CO3	-	1	2	1	1	-	-	-	-	-	-	-	2	2	3
CO4	-	2	2	1	1	-	-	-	-	-	1	-	2	3	3
CO5	-	1	2	1	1	-	-	-	-	-	1	-	3	2	3
22MOE$03	-	1	2	1	1	-	-	-	-	-	1	-	2	2	3
1 – Slight, 2 – Moderate, 3 – Substantial															
b) CO and Key Performance Indicators Mapping															
CO1	2.2.2, 2.2.3, 2.2.4, 2.3.1, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.3.2, 4.1.1, 4.3.4, 5.1.2														
CO2	2.2.2, 2.2.3, 2.2.4, 2.3.1, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.3.2, 4.1.1, 4.3.4, 5.1.2														
CO3	2.2.2, 2.2.3, 2.2.4, 2.3.1, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.3.2, 4.1.1, 4.3.4, 5.1.2														
CO4	2.1.1, 2.1.2, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.3.2, 4.1.1, 4.3.4, 5.1.2, 5.3.1, 11.3.1														
CO5	2.2.2, 2.2.3, 2.2.4, 2.3.1, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.3.2, 4.1.1, 4.3.4, 5.1.2, 5.3.1, 11.3.1														

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	50	50	-	-	-	-	100
CAT2	30	70	-	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	50	50	-	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	30	70	-	-	-	-	100
ESE	40	60	-	-	-	-	100

22MOE$04	**INDUSTRIAL SAFETY MANAGEMENT** *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

Course Objectives	To learn the techniques of industrial safety and management to implement and solve safety problems in engineering.	
UNIT – I	**ENVIRONMENT AND SAFETY PHILOSOPHY**	**9 Periods**
Henrichs Axioms Of Industrial Safety - Concepts Of Safety – Ethics of environmental conservation – Environmental Impact Assessment – Environmental economics – Safety philosophy – Planning for safety – Organising for safety – Directing for safety - Role of Occupier and Factory Manager, Factory Safety Committee, Structure and Functions and Working Tenure Details		
UNIT – II	**SAFETY APPRAISAL AND CONTROL TECHNIQUES**	**9 Periods**
Plant and equipment safety appraisal techniques – Laws and regulation – Hazards and Risks – Major accident hazard control – Importance of Disaster management		
UNIT – III	**ACCIDENT PREVENTION AND SAFETY MANAGEMENT**	**9 Periods**
Incident - Accident - Injury - Dangerous occurrence - Unsafe Act - Unsafe Conditions - Hazards - Error, Oversight - Mistake , Near Miss - Measurement of safety performance - Key elements of Safety Management system (ISO 14001, OHSAS 18001 etc.). ILO Legislations – Convention and Recommendation concerning Safety, Health and Environment – Objectives of Health, Safety and Environment Policy, Responsibility for Implementation of HSE Policy.		
UNIT – IV	**SAFETY MANAGEMENT IN INDUSTRIES**	**9 Periods**
Safe Guarding of machines – Manual handling and storage of materials – Mechanical handling of materials – Hand tools and portable power tools – Electrical hazards – Earth , insulation and continuity tests – Industrial lighting – Safety of pressure vessels – Ventilation and heat control – Housekeeping – Special precautions - Safety in Construction Industry – Safety in Engineering Industry – Safety in Chemical Industries – Safety in Textile Industries – Safety in Dock and Port – Transportation Safety – Safety in Fire and explosive industries.		
UNIT – V	**INDUSTRIAL HYGIENE AND POLLUTION CONTROL**	**9 Periods**
Industrial Hygiene – Air sampling – Noise and vibration – Industrial physiology - Occupational health – Personal Protective Equipment's – Pollution Control strategies.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Akhil Kumar Das**, "Principles of Industrial Safety Management":Understanding the Ws of Safety at Work"** PHI Learning , 2021*
2	*Jain R K and Sunil.S.Rao**, "Industrial Safety Health and Environment Management System"**, Seventh reprint, Khanna publishers, 2023.*

REFERENCES:

1	*Prathibha Bansal and Anupama Prashar, **"Industrial safety and Environment"**, S.K.Kattaria Sons, 2005.*
2	*A.K.Gupta, **"Industrial safety and Environment"**, Laxmi Publication Pvt Limited, 2008.*
3	***"Accident Prevention Manual For Industrial Operations"**, N.S.C Chicago, 13th Edition 2009.*
4	*Dan Petersen**, "Techniques of Safety Management"**, Americal Society of Safety Emgineers, 4th edition, 2003.*

B.E.PRODUCTION ENGINEERING

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand Environment and safety philosophy.	K1
CO2	Frame Safety appraisal and control technique to create safety management.	K2
CO3	Follow accident prevention procedure to solve safety problem.	K2
CO4	Implement safety management for Industries.	K3
CO5	Follow Industrial Hygiene and Pollution control	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	-	1	3	-	-	-	-	-	-	-	3	1	2
CO2	3	3	-	1	2	-	-	-	-	-	-	-	3	2	2
CO3	3	3	-	-	3	-	-	-	-	-	-	-	3	1	2
CO4	3	3	-	1	2	-	-	-	-	-	-	-	3	2	2
CO5	3	3	-	-	3	-	-	-	-	-	-	-	3	1	2
22MOE$04	3	3	-	1	3	-	-	-	-	-	-	-	3	1	2
1 – Slight, 2 – Moderate, 3 – Substantial															

b) CO and Key Performance Indicators Mapping	
CO1	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.3, 2.2.1, 2.2.3, 2.2.4, 2.4.4, 4.3.4, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2
CO2	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.4.3, 2.4.4, 4.1.4, 5.1.2, 5.2.1, 5.3.1, 5.3.2
CO3	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.4.3, 2.4.4, 5.1.1, 5.1.2, 5.2.1, 5.3.1, 5.3.2
CO4	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.4.3, 2.4.4, 4.1.4, 5.1.2, 5.2.1, 5.3.1, 5.3.2
CO5	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.4.3, 2.4.4, 5.1.1, 5.1.2, 5.2.1, 5.3.1, 5.3.2

ASSESSMENT PATTERN							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	70	20	10	-	-	-	100
CAT2	50	30	20	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	60	40	-	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	50	30	20	-	-	-	100
ESE	50	30	20	-	-	-	100

22EOE$05	RENEWABLE POWER GENERATION SYSTEMS *(Common to All Branches)*					
PREREQUISITES		**CATEGORY**	**L**	**T**	**P**	**C**
NIL		OE	3	0	0	3
Course Objectives	To understand energy scenarios, energy sources and their utilization, society's present needs and future energy demands, the principles of renewable energy conversion systems					
UNIT – I	**ENERGY SCENARIO**					**9 Periods**
Principles of renewable energy; energy and sustainable development, fundamentals and social implications. worldwide renewable energy availability, renewable energy availability in India, brief descriptions on solar energy, wind energy, tidal energy, wave energy, ocean thermal energy, biomass energy, geothermal energy, oil shale. Introduction to Internet of energy (IOE).						
UNIT – II	**SOLAR ENERGY**					**9 Periods**
Solar Energy: Fundamentals; Solar Radiation; Estimation of solar radiation on horizontal and inclined surfaces; Solar radiation Measurements- Pyrheliometers, Pyrometer, Sunshine Recorder. Solar Thermal systems: Flat plate collector; Solar distillation; Solar pond electric power plant. Solar electric power generation- Principle of Solar cell, Photovoltaic system for electric power generation, advantages, Disadvantages and applications of solar photovoltaic system.						
UNIT – III	**WIND AND BIOMASS ENERGY**					**9 Periods**
Wind Energy: Properties of wind, availability of wind energy in India, wind velocity and power from wind; major problems associated with wind power, Basic components of wind energy conversion system (WECS); Classification of WECS- Horizontal axis- single, double and multi blade system. Vertical axis- Savonius and Darrieus types. Biomass Energy: Introduction; Photosynthesis Process; Biofuels; Biomass Resources; Biomass conversion technologies -fixed dome; Urban waste to energy conversion; Biomass gasification (Downdraft).						
UNIT – IV	**TIDAL AND OCEAN THERMAL ENERGY**					**9 Periods**
Tidal Power: Tides and waves as energy suppliers and their mechanics; fundamental characteristics of tidal power, harnessing tidal energy, advantages and limitations. Ocean Thermal Energy Conversion: Principle of working, OTEC power stations in the world, problems associated with OTEC.						
UNIT – V	**GREEN ENERGY**					**9 Periods**
Introduction, Fuel cells: Classification of fuel cells – H_2; Operating principles, Zero energy Concepts. Benefits of hydrogen energy, hydrogen production technologies (electrolysis method only), hydrogen energy storage, applications of hydrogen energy, problem associated with hydrogen energy.						
Contact Periods: (Times New Roman, Size 11, BOLD, Sentence case) **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**						

TEXT BOOK

1	G D Rai, Non Conventional Energy sources, Khanna Publication, Fourth Edition, 2009
2	Boyle, "Renewable Energy – Power For A Sustainable Future", Oxford, 2012

REFERENCES

1	S Rao,B.B.Parulekhar, "Energy Technology 3/e: Nonconventional, Renewable and Conventional", Khanna Publishers, 1994
2	G. N. Tiwari,"Solar Energy - Fundamentals, Design, Modelling and Applications", 2002
3	Gilbert M. Masters, "Renewable and Efficient Electric Power Systems" Wiley,2005
4	Shobh Nath Singh, "Non-Convention Energy Resources", Pearson, 2018

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Describe the environmental aspects of renewable energy resources in comparison with various conventional energy systems, their prospects and limitations.	K2
CO2	Summarize the use of solar energy and the various components used in the energy production with respect to applications like - heating, cooling, desalination, electric power generation.	K2
CO3	Apply the conversion principles of wind and tidal energy for the production of electric power generation	K3
CO4	Apply the concept of biomass energy resources and green energy for developing sustainable electric power generation set-up	K3
CO5	Analyze the basic knowledge of ocean thermal energy conversion and hydrogen energy and hence design & evaluate the power generation system	K4

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	3	3	3	3	3	3	-	-	-	-	3	3	3	2
CO2	3	3	3	3	3	3	3	-	-	-	-	3	3	3	2
CO3	3	3	3	3	3	3	3	-	-	-	-	3	3	3	2
CO4	3	3	3	3	3	3	3	-	-	-	-	3	3	3	2
CO5	3	3	3	3	3	3	3	-	-	-	-	3	3	3	2
22EOE $05	3	3	3	3	3	3	3	-	-	-	-	3	3	3	2
1 – Slight, 2 – Moderate, 3 – Substantial															

b) CO and Key Performance Indicators Mapping	
CO1	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.1,3.1.2,3.1.3,3.1.4,3.1.5,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,3.3.2,3.4.1,3.4.2,4.1.1,4.1.2,4.1.3,4.1.4,4.2.1,4.2.2,4.3.1,4.3.2,4.3.3,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,6.1.1,6.2.1,7.1.1,7.1.2,7.2.1,7.2.2,12.1.1,12.1.2,12.2.1,12.2.2,12.3.2.
CO2	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.1,3.1.2,3.1.3,3.1.4,3.1.5,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,3.3.2,3.4.1,3.4.2,4.1.1,4.1.2,4.1.3,4.1.4,4.2.1,4.2.2,4.3.1,4.3.2,4.3.3,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,6.1.1,6.2.1,7.1.1,7.1.2,7.2.1,7.2.2,12.1.1,12.1.2,12.2.1,12.2.2,12.3.2.
CO3	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.1,3.1.2,3.1.3,3.1.4,3.1.5,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,3.3.2,3.4.1,3.4.2,4.1.1,4.1.2,4.1.3,4.1.4,4.2.1,4.2.2,4.3.1,4.3.2,4.3.3,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,6.1.1,6.2.1,7.1.1,7.1.2,7.2.1,7.2.2,12.1.1,12.1.2,12.2.1,12.2.2,12.3.2.
CO4	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.1,3.1.2,3.1.3,3.1.4,3.1.5,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,3.3.2,3.4.1,3.4.2,4.1.1,4.1.2,4.1.3,4.1.4,4.2.1,4.2.2,4.3.1,4.3.2,4.3.3,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,6.1.1,6.2.1,7.1.1,7.1.2,7.2.1,7.2.2,12.1.1,12.1.2,12.2.1,12.2.2,12.3.2.
CO5	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.1,3.1.2,3.1.3,3.1.4,3.1.5,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,3.3.2,3.4.1,3.4.2,4.1.1,4.1.2,4.1.3,4.1.4,4.2.1,4.2.2,4.3.1,4.3.2,4.3.3,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,6.1.1,6.2.1,7.1.1,7.1.2,7.2.1,7.2.2,12.1.1,12.1.2,12.2.1,12.2.2,12.3.2.

B.E.PRODUCTION ENGINEERING

ASSESSMENT PATTERN – THEORY (Times New Roman, Size 11)							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	20	30	30	-	-	100
CAT2	20	20	30	30	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	20	20	30	30	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	20	20	30	30	-	-	100
ESE	20	20	30	30	-	-	100

B.E.PRODUCTION ENGINEERING

22EOE$06	SMART GRID TECHNOLOGY *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

Course Objectives	To provide a comprehensive understanding of Smart Grid Technology, including its components, functions, applications and implications for Energy Management and Distribution.	
UNIT – I	**BASICS OF POWER SYSTEMS**	**9 Periods**
Basics of Power Systems: Load and Generation - Power Flow Analysis- Economic Dispatch and Unit Commitment Problems. Smart Grid: Definition – Applications- Government and Industry- Standardization		
UNIT – II	**SMART GRID COMMUNICATIONS**	**9 Periods**
Two-way Digital Communications Paradigm - Network Architectures - IP-based Systems - Power Line Communications - Advanced Metering Infrastructure		
UNIT – III	**WIDE AREA MEASUREMENT**	**9 Periods**
Sensor Networks - Phasor Measurement Units- Communications Infrastructure- Fault Detection and Self-Healing Systems -Applications and Challenges		
UNIT – IV	**SECURITY AND PRIVACY**	**9 Periods**
Cyber Security Challenges in Smart Grid - Load Altering Attacks- False Data Injection Attacks- Defense Mechanisms - Privacy Challenges- Cyber Security Standards		
UNIT – V	**ECONOMICS AND MARKET OPERATIONS**	**9 Periods**
Introduction, Reasons for restructuring / deregulation of power industry, Understanding the restructuring process - Entities involved. The market place mechanisms-Energy and Reserve Markets- Market Power - Generation Firms- Locational Marginal Prices- Financial Transmission Rights		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	*Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage "***Smart Grid Technologies and applications"** *John Wiley Publishers Ltd., 2012.*
2	*P. Venkatesh, B.V. Manikandan, S. Charles Raja, A. Srinivasan "***Electrical Power Systems- Analysis, Security and Deregulation"** *PHI Learning Private Limited, New Delhi, 2012.*

REFERENCES

1	*Lars T. Berger, Krzysztof Iniewski "***Smart Grid applications, Communications and Security***" John Wiley Publishers Ltd., 2012***.***
2	*Yang Xiao,* **"Communication and Networking in Smart Grids",** *CRC Press Taylor and Francis Group, 2012.*
3	*Caitlin G. Elsworth,* **"The Smart Grid and Electric Power Transmission"***, Nova Science Publishers Inc, August 2010*
4	*Lars T. Berger, Krzysztof Iniewski "***Smart Grid applications, Communications and Security***" John Wiley Publishers Ltd., 2012***.***

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Recollect the fundamentals of conventional power systems and learn the concept of smart grid	K1
CO2	Interpret the role of communication Technologies in a smart grid	K2
CO3	Apply the state-of-the-art measurement and protection techniques for reliable grid	K3
CO4	Utilize the techniques for ensuring safety and security of the smart grid	K3
CO5	Analyze the economical aspects of the smart grids	K4

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping															
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	2	2	2	2	2	2	2	-	-	1	1	-	3	2	1
CO2	3	3	1	2	2	-	-	-	-	2	3	2	3	2	1
CO3	3	3	1	2	2	-	-	-	-	2	3	2	3	3	2
CO4	3	3	1	2	2	3	2	2	1	-	-	3	3	3	2
CO5	3	2	2	2	2	-	2	2	-	1	3	3	3	3	2
22EOE $06	3	3	1	2	2	3	2	2	1	2	3	3	3	3	2
1 – Slight, 2 – Moderate, 3 – Substantial															

b) CO and Key Performance Indicators Mapping	
CO1	1.2.1,1.3.1,1.4.1,2.3.1,2.3.2,2.4.4,3.1.3,3.1.6,3.2.1,4.1.4,4.2.1,4.3.4,5.1.1,5.3.1,6.1.1,7.1.1,7.2.2,10.1.1,10.3.1,11.1.1
CO2	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.2,2.1.3,2.2.1,2.2.3,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.6,3.2.13.2.2,3.2.3,4.1.1,4.1.3,4.1.4,5.1.1,5.2.1,5.3.1,12.1.2,12.2.2,12.3.2,10.1.1,10.2.2,10.3.1,11.1.1,11.2.1,11.3.1,11.3.2,12.3.1,12.3.2
CO3	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.2,2.1.3,2.2.1,2.2.3,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.6,3.2.13.2.2,3.2.3,4.1.1,4.1.3,4.1.4,5.1.1,5.2.1,5.3.1,12.1.2,12.2.2,12.3.2,10.1.1,10.2.2,10.3.1,11.1.1,11.2.1,11.3.1,11.3.2,12.3.1,12.3.2
CO4	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.2,2.1.3,2.2.1,2.2.3,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.6,3.2.13.2.2,3.2.3,4.1.1,4.1.3,4.1.4,5.1.1,5.2.1,5.3.1,8.2.2,9.1.2,7.2.1,7.2.2,6.2.1,6.1.1,5.3.2,5.3.1,5.3.212.1.2,12.2.2,12.3.2,
CO5	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.2,2.1.3,2.2.1,2.2.3,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.6,3.2.13.2.2,3.2.3,4.1.1,4.1.3,4.1.4,5.1.1,5.2.1,5.3.1,12.1.2,12.2.2,12.3.2

B.E.PRODUCTION ENGINEERING

ASSESSMENT PATTERN							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	10	30	40	20	-	-	100
CAT2	10	30	40	20	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	30	30	20	20	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	30	30	20	20	-	100
ESE	10	30	40	20	-	-	100

22LOE$07	**CMOS VLSIDESIGN** *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

Course Objective	To introduce various aspects of CMOS logic design in combinational and sequential circuit to design CMOS VLSI system components	
UNIT – I	**CMOSLOGICDESIGN**	**9 Periods**
Inverter- CMOS Logic Gates: Compound Gates – Pass Transistors and Transmission Gates –Tristated – Multiplexers –CMOS Fabrication and Layout: Fabrication Process – Layout Designrule–GateLayouts– StickDiagrams–DesignPartitioning.		
UNIT – II	**MOSTRANSISTORTHEORY**	**9 Periods**
Introduction – Long Channel I-V Characteristics – C-V Characteristics – Non-ideal I-V Effects –DC Transfer Characteristics – CMOS Technologies – Sources of Power Dissipation - DynamicPower–Static Power.		
UNIT – III	**COMBINATIONALCIRCUITDESIGN**	**9 Periods**
CircuitFamilies:StaticCMOS–RatioedCircuits–CascodeVoltageSwitchLogic–Dynamic Circuits–PassTransistorCircuits.Silicon-on-InsulatorCircuitDesign–SubthresholdCirucitDesign.		
UNIT – IV	**SEQUENTIALCIRCUITDESIGN**	**9 Periods**
Sequentialstaticcircuits–Circuitdesignoflatchedandflip-flops–Sequencingdynamiccircuits –Synchronizers–Wavepipelining -VLSIclocking:CMOS clockingstyles-Pipelinedsystems-Clockgenerationanddistribution.		
UNIT – V	**DESIGNOFVLSISYSTEMS**	**9 Periods**
System Specifications – Structural Gate Level Modeling – Switch Level Modeling – BehavioralandRTL Modeling-Addition/subtraction–Comparators–counters—Multiplexers-BinaryDecoders – Comparators – Priority Encoders – Latches - Flip-Flops and Registers – SRAM –DRAM–ROM.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*N. Weste and David Money Harris, "**CMOS VLSI Design**", Fourth Edition, PearsonEducation,2011*
2	*Uyemura, John P, "**Introduction to VLSI Circuits and Systems**", Wiley & Sons, 8th Reprint 2009*

REFERENCES:

1	*JanM.Rabaey,"**DigitalIntegratedCircuits:ADesignPerspective**",PHI,SecondEdition,2012.*
2	*R.JacobBaker,"**CMOS:CircuitDesign,Layout,andSimulation**",Wiley-IEEE,RevisedSecondEdition,2008.*
3	*Pucknell,"**BasicVLSIDesign**",PrenticeHall,2006.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Realize the CMOS logic design	K2
CO2	Explain the basic MOS transistor theory and power dissipation in CMOS logic.	K2
CO3	Develop combinational circuit design of CMOS logic	K3
CO4	Interpret sequential circuit design of CMOS logic	K2
CO5	Model the digital system using Hardware Description Language	K2

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	3	2	-	-	2	-	-	-	2	-	3	3	1	3
CO2	3	2	1	-	-	2	-	-	-	2	-	3	2	1	2
CO3	3	3	2	-	-	2	-	-	-	2	-	3	3	1	3
CO4	3	3	2	-	-	2	-	-	-	2	-	3	3	1	3
CO5	3	3	2	-	-	2	-	-	-	2	-	3	3	1	3
22LOE$07	**3**	**3**	**2**	-	-	**2**	-	-	-	**2**	-	**3**	**3**	**1**	**3**
1 – Slight, 2 – Moderate, 3 – Substantial															

b) CO and Key Performance Indicators Mapping

CO1	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 3.1.4, 3.1.5, 3.1.6, 3.3.2, 3.4.1, 3.4.2, 6.1.1, 10.1.1, 10.1.2, 10.1.3, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO2	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 3.1.4, 3.3.2, 3.4.1, 3.4.2, 6.1.1, 10.1.1, 10.1.2, 10.1.3, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO3	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 3.1.4, 3.1.5, 3.1.6, 3.3.2, 3.4.1, 6.1.1, 10.1.1, 10.1.2, 10.1.3, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO4	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 3.1.4, 3.1.5, 3.1.6, 3.3.2, 3.4.1, 3.4.2, 6.1.1, 10.1.1, 10.1.2, 10.1.3, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO5	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 3.1.4, 3.1.5, 3.1.6, 3.3.2, 3.4.1, 3.4.2, 6.1.1, 10.1.1, 10.1.2, 10.1.3, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	40	40	20	-	-	-	100
CAT2	40	40	20	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	50	50	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	50	50	-	-	-	100
ESE	40	40	20	-	-	-	100

B.E.PRODUCTION ENGINEERING

22LOE$08	**MOBILE COMMUNICATION** *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

Course Objective	To understand and recall the mobile radio propagation, cellular architectures, equalization and diversity techniques, digital modulation techniques and various wireless network standards.	
UNIT – I	**MOBILE RADIO PROPAGATION**	**9 Periods**
Review of free-space propagation - Radio Wave Propagation in wireless environment - Free Space Propagation Model - Ground Reflection Model, Diffraction, Scattering - Practical link budget design - Small scale fading - Time dispersion parameters - Coherence bandwidth - Doppler spread & Coherence time, Fading due to Multipath time delay spread - Fading due to Doppler spread.		
UNIT – II	**CELLULAR CONCEPT**	**9 Periods**
Hexagonal cell-Cell clustering-Frequency Reuse-Static and dynamic channel assignment strategies - Handoff Strategies - Interference and System Capacity - Trunking - Capacity in Cellular Systems. Multiple Access Techniques: FDMA, TDMA, CDMA, OFDMA.		
UNIT – III	**MULTIPATH MITIGATION TECHNIQUES**	**9 Periods**
Equalization – Adaptive equalization: Linear and Non-Linear equalization, - Diversity – Micro and Macro diversity - Diversity combining techniques - Rake receiver- MIMO Coding: Alamouti Scheme (Qualitative)		
UNIT – IV	**MODULATION TECHNIQUES**	**9 Periods**
Modulation in cellular wireless systems: Binary Phase Shift Keying (BPSK) – QPSK –Orthogonal QPSK-Minimum Shift Keying-Gaussian Minimum Shift Keying - Multicarrier modulation: Orthogonal Frequency Division Multiplexing (OFDM) -PAPR reduction –Windowed OFDM - Filtered OFDM		
UNIT – V	**WIRELESS NETWORKS**	**9 Periods**
Second Generation Cellular Standard: GSM - Third Generation Cellular standards: CDMA -WCDMA-Fourth Generation Cellular Standards: 4G LTE – LTE Advanced – 5G Network – Near Field Communication (NFC) systems – Wireless LAN technology – Hyper LAN – Bluetooth technology – Ultra Wideband (UWB) communication - Introduction to 60 GHz mmWave.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Theodore S. Rappaport, "Wireless communications", 2nd Edition, Pearson Education, 2010*
2	*Mischa Schwartz, "Mobile Wireless Communications", 1st Edition, Cambridge University Press, 2010*

REFERENCES:

1	*Suvra Sekhar Das and Ramjee Prasad, "Evolution of air interface towards 5G Radio Access Technology and Performance Analysis", River Publishers,2018*
2	*David Tse, Pramod Viswanath, "Fundamentals of Wireless Communication", 1st Edition, Cambridge University Press, 2006.*
3	*Andreas.F. Molisch, "Wireless Communications", 2nd Edition, Wiley, 2011.*
4	*Aditya K Jagannatham, "Principles of Modern Wireless Communication Systems Theory and Practice", 1st Edition, McGraw Hill Education (India) Private Limited, 2017*
5	*William Stallings, "Wireless Communications and networks", 2nd Edition, Pearson, 2009.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Interpret the concepts of radio propagation and fading channel models in wireless communication	K3
CO2	Interpret the functionalities of various cellular concepts and multiple access techniques and solve problems in channel assignment and traffic intensity in cellular system	K4
CO3	Explain various equalization and diversity combining techniques used in multipath propagation	K2
CO4	Discuss the need for digital and multicarrier modulation techniques used in modern cellular system	K2
CO5	Recall the functionalities of various wireless networks used in day-today life.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping															
COs/ POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	3	2	1	1	-	-	-	-	-	-	-	1	3	-	1
CO2	3	2	1	1	-	-	-	-	-	-	-	1	3	-	1
CO3	3	2	1	1	-	-	-	-	-	-	-	1	3	-	1
CO4	3	2	1	1	-	-	-	-	-	-	-	1	3	-	1
CO5	3	2	1	1	-	-	-	-	-	-	-	1	3	-	1
22LOE$08	3	2	1	1	-	-	-	-	-	-	-	1	3	-	1
1 – Slight, 2 – Moderate, 3 – Substantial															
b) CO and Key Performance Indicators Mapping															
CO1	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.2,2.2.3,2.3.1,2.3.2,2.4.1,2.4.4,3.1.1,3.1.2,3.3.1,4.1.1,4.2.1,4.3.3, 12.1.1,12.2.2														
CO2	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.2,2.2.3,2.3.1,2.3.2,2.4.1,2.4.4,3.1.1,3.1.2,3.3.1,4.1.1,4.2.1,4.3.3, 12.1.1,12.2.2														
CO3	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.2,2.2.3,2.3.1,2.3.2,2.4.1,2.4.4,3.1.1,3.1.2,3.3.1,4.1.1,4.2.1,4.3.3, 12.1.1,12.2.2														
CO4	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.2,2.2.3,2.3.1,2.3.2,2.4.1,2.4.4,3.1.1,3.1.2,3.3.1,4.1.1,4.2.1,4.3.3,12.1.1,12.2.2														
CO5	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.2,2.2.3,2.3.1,2.3.2,2.4.1,2.4.4,3.1.1,3.1.2,3.3.1,4.1.1,4.2.1,4.3.3,12.1.1,12.2.2														

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	40	20	20	-	-	100
CAT2	50	50			-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	20	40	20	20	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	50	50	-	-	-	-	100
ESE	20	40	20	20	-	-	100

B.E.PRODUCTION ENGINEERING

22POE$09	**RAPIDPROTOTYPING** *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

Course Objectives	To educate the students with fundamental and advanced knowledge in the field of Rapid Prototyping technology and associated Aerospace, Architecture, Art, Medical and Industrial applications.	
UNIT- I	**INTRODUCTION**	**9 Periods**
Overview - Need - Development of Rapid Prototyping (RP) Technology: Rapid Prototyping -Rapid Tooling - Rapid Manufacturing - Additive Manufacturing. RP Process Chain, Benefits, Applications: Building Printing, Bio Printing, Food Printing, Electronics Printing, Automobile, Aerospace, Healthcare.		
UNIT- II	**VAT POLYMERIZATION AND MATERIAL EXTRUSION**	**9 Periods**
Photo polymerization: Stereo lithography Apparatus (SLA) - Materials -Process - top down and bottom up approach - Advantages - Limitations - Applications. Digital Light Processing (DLP) - Process - Advantages - Applications. Material Extrusion: Fused Deposition Modelling (FDM) - Process-Materials -Applications and Limitations.		
UNIT- III	**POWDER BED FUSION AND BINDER JETTING**	**9 Periods**
Powder Bed Fusion: Selective Laser Sintering (SLS): Process - Powder Fusion Mechanism - Materials and Application. Selective Laser Melting (SLM), Electron Beam Melting (EBM): Materials - Process - Advantages and Applications. Binder Jetting: Three-Dimensional Printing - Materials - Process - Benefits - Limitations - Applications.		
UNIT- IV	**MATERIAL JETTING AND DIRECTED ENERGY DEPOSITION**	**9 Periods**
Material Jetting: Multi jet Modelling- Materials - Process - Benefits - Applications. Directed Energy Deposition: Laser Engineered Net Shaping (LENS) - Process - Material Delivery -Materials –Benefits - Applications.		
UNIT- V	**SHEET LAMINATION AND DIRECT WRITE TECHNOLOGY**	**9 Periods**
Sheet Lamination: Laminated Object Manufacturing (LOM)- Basic Principle- Mechanism: Gluing or Adhesive Bonding - Thermal Bonding - Materials - Application and Limitation. Ink-Based Direct Writing (DW): Nozzle Dispensing Processes, Inkjet Printing Processes, Aerosol DW - Applications of DW.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Ian Gibson, David Rosen, Brent Stucker, Mahyar Khorasani "**Additive manufacturing technologies".** 3rd edition Springer Cham, Switzerland, 2021.*
2	*Andreas Gebhardt and Jan-Steffen Hötter "**Additive Manufacturing: 3D Printing for Prototyping and Manufacturing**", Hanser publications, United States, 2015.*

REFERENCES:

1	*Andreas Gebhardt, **"Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing"**, Hanser Gardner Publication, Cincinnati., Ohio, 2011.*

2	*Milan Brandt,* ***"Laser Additive Manufacturing: Materials, Design, Technologies, and Applications"****, Woodhead Publishing., United Kingdom, 2016.*
3	*Amit Bandyopadhyay and Susmita Bose,* ***"Additive Manufacturing",*** *1st Edition, CRC Press., United States, 2015.*
4	*Kamrani A.K. and Nasr E.A.,* ***"Rapid Prototyping: Theory and practice",*** *Springer., United States ,2006.*
5	*Liou, L.W. and Liou, F.W.,* ***"Rapid Prototyping and Engineering applications: A tool box for prototype development"****, CRC Press., United States, 2011.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Discuss the development of RP technology and how RP technology propagated into various businesses and developing opportunities.	K3
CO2	Demonstrate the Vat polymerization and material extrusion processes and its applications.	K3
CO3	Elaborate the process and applications of powder bed fusion and binder jetting.	K3
CO4	Evaluate the advantages, limitations, applications of material jetting and directed energy deposition processes.	K3
CO5	Describe the sheet lamination and direct write technology.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	2	-	2	-	3	-	3	3	3	3	-	-	-
CO2	2	2	3	2	3	-	3	-	3	3	1	2	-	-	-
CO3	2	2	3	2	3	-	3	-	3	3	1	2	-	-	-
CO4	2	2	3	2	3	-	3	-	3	3	1	2	-	-	-
CO5	2	2	3	2	3	3	3	-	3	3	1	3	-	-	-
22POE$09	**2**	**2**	**3**	**2**	**3**	**1**	**3**	-	**3**	**3**	**2**	**3**	-	-	-

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping	
CO1	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 5.2.2, 5.3.1, 5.3.2, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 11.2.1, 11.3.1, 11.3.2, 12.1.1, 12.1.2, 12.2.2, 12.3.1, 12.3.2.
CO2	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.3.1, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.2, 12.2.2, 12.3.1, 12.3.2.
CO3	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.3.1, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.2, 12.2.2, 12.3.1, 12.3.2.
CO4	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.3.1, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.2, 12.2.2, 12.3.1, 12.3.2.

CO5	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.3.1, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.1, 12.1.2, 12.2.2, 12.3.1, 12.3.2.

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	15	52	33	-	-	-	100
CAT2	15	68	17	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	50	50	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	-	100	-	-	-	100
ESE	9	75	16	-	-	-	100

22POE$10	**MANAGERIALECONOMICS** *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

Course Objectives	*To introduce the fundamental economic principles necessary for production managers	
UNIT- I	**FUNDAMENTALS OF MANAGERIAL ECONOMICS**	**9 Periods**
Introduction to Economics - Scope of Managerial Economics - General Foundations of Managerial Economics: Economic Approach, Working of Economic System and Circular Flow of Activities - Economics and Business Decisions: Relationship between Economic Theory and Managerial Economics - Role of managerial Economics in Decision making - Concept of Economic Rationality - Opportunity Cost - Marginal and Incremental approach.		
UNIT- II	**DEMAND ANALYSIS**	**9 Periods**
Demand and Supply - Determinants of Demand - Demand Estimation and Forecasting - Price Elasticity of Demand - Price Elasticity- Factors Affecting Price Elasticity - Cross Price Elasticity - Income Elasticity of Demand - Advertisement or Promotional Elasticity - Elasticity of Supply.		
UNIT- III	**DEMAND THEORY**	**9 Periods**
Utility Analysis - Total and Marginal Utility - Law of Diminishing marginal utility - Indifference curve analysis - Consumer Equilibrium - Consumer Surplus - Price effect, Substitution Effect and Income Effect.		
UNIT- IV	**THEORY OF PRODUCTION AND COST**	**9 Periods**
The Production Function - Profit-Maximizing Input Usage - Isoquants and Isocosts – CostMinimization and Optimal Input Substitution - The Cost Function - Breakeven analysis,Contribution analysis - Long-run Costs and Economies of Scale - Multiple Cost Functions andEconomies of Scope - Learning curve.		
UNIT- V	**THEORY OF MARKET AND PRICING**	**9 Periods**
Forms of Markets: Meaning and Characteristics - Market Equilibrium: Practical Importance, Market Equilibrium and Changes in Market Equilibrium. Pricing Functions: Market Structures - Pricing and output decisions under different competitive conditions: Monopoly Monopolistic completion and Oligopoly.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Maheshwari.Y* ***"Managerial Economics",*** *Prentice Hall of India, 2012*
2	*Thomas and Maurice* ***"Managerial Economics: Concept and Applications",*** *McGrawHill, 2005*

REFERENCES:

1	*D.N. Dwivedi,* ***"Managerial Economics",*** *Vikas Publishing house, 2015*
2	*Christopher R Thomas, S Charles Maurice,* ***"Managerial economics",*** *Mcgraw Hill, 2014*
3	*M. A. Beg, "****Managerial Economics****",Global Professional Publishing Ltd, 2010*
4	*K.C. Sankaranarayanan, "****Managerial Economics****", CBS, 2015*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain fundamentals of managerial economics	K2
CO2	Discuss the dynamics of Demand	K3
CO3	Explain about various theories of demand	K3
CO4	Discuss about the factors influencing production	K4
CO5	Describe about the theory of market and pricing method	K4

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	2	1	3	1	3	3	-	1	3	3	3	-	1	2
CO2	1	3	2	3	1	3	3	-	1	3	3	3	-	1	2
CO3	1	3	2	3	1	3	3	-	1	3	3	3	-	1	2
CO4	1	3	2	3	1	3	3	-	1	3	3	3	1	1	2
CO5	1	3	2	3	1	3	3	-	1	3	3	3	-	1	2
22POE$10	**1**	**3**	**2**	**3**	**1**	**3**	**3**	**-**	**1**	**3**	**3**	**3**	**-**	**1**	**2**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1, 2.1.2, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.4.4, 3.1.1, 3.1.3, 3.1.5, 3.2.3, 3.3.1, 3.4.1, 4.1.1, 4.1.2, 4.3.4, 5.2.1, 5.3.1, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO2	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 3.3.2, 3.4.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.4, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO3	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 3.3.2, 3.4.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.4, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO4	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 3.3.2, 3.4.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.4, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO5	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 3.3.2, 3.4.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.4, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2

B.E.PRODUCTION ENGINEERING

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Rememberin g (K1) %**	**Understandi ng (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	50	50	-	-	-	-	100
CAT2	50	50	-	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	33.33	33.33	33.33	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	33.33	33.33	33.33	-	-	-	100
ESE	42	42	16	-	-	-	100

22NOE$11	MEASUREMENT AND CONTROL *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

COURSE OBJECTIVE	To teach about the concepts of variable sensors for industrial parameter measurement and to impart knowledge on automatic control system	
UNIT - I	**INTRODUCTION TO MEASUREMENTS**	**9 Periods**
Elements of measurement system - Classification of Instruments – Static and dynamic characteristics of a measurement system - Errors in measurement - Calibration of instruments.		
UNIT - II	**STRAIN AND DISPLACEMENT MEASUREMENT**	**9 Periods**
Strain: Types of strain gauges, theory of operation, strain gauge materials, strain gauge circuits and applications. Displacement: Resistive potentiometer: Linear, circular and helical – LVDT - RVDT - Capacitance transducers – Piezoelectric transducers – Hall Effect devices - Proximity sensors.		
UNIT - III	**PRESSURE AND TEMPERATURE MEASUREMENT**	**9 Periods**
Pressure: Mechanical devices: Diaphragm, bellows, and bourdon tube - Electrical devices: Variable resistance, inductance and capacitance transducers. Temperature: Resistance type temperature sensors: RTD , Thermocouples, Thermopiles and Thermistor - Laws of thermocouple – Radiation methods for temperature measurement.		
UNIT - IV	**FLOW AND LEVEL MEASUREMENT**	**9 Periods**
Flow: Variable head type flow meters: Orifice plate, Venturi tube, Flow nozzle, Pitot tube - Variable area type: Rotameter - Turbine flow meter - Electromagnetic flow meter - Ultrasonic flow meter. Level: Resistive, inductive and capacitive techniques – Ultrasonic methods – Air purge system .		
UNIT - V	**AUTOMATIC CONTROL SYSTEM**	**9 Periods**
Elements of control system – Concept of open loop and closed loop systems – Mathematical modelling - Controllers – Brief idea of Proportional, Derivative and Integral Modes – Pneumatic Controller – Hydraulic Controller.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*A.K. Sawhney, Puneet Sawhney**, "A Course in Mechanical Measurements and Instrumentation & Control"** Dhanpat Rai & Co, 2012.*
2	*S. K. Singh, "**Industrial Instrumentation and Control**", McGraw Hill Publication, 3rd Edition, 2016.*

REFERENCES:

1	*William Bolton, "**Instrumentation and Control Systems**," Newnes, Publication, 3rd Edition, 2021.*
2	*E. D. Doeblin, **"Measurement Systems: Application and Design",** McGraw Hill Publication, 6th Edition, 2017.*
3	*E.W. Golding and F.C. Widdis, **"Electrical Measurements and Measuring Instruments"** A.H.Wheeler and Co., 5th Edition, 2011.*
4	*Alan S. Morris, **"Measurement and Instrumentation Principles",** Butterworth-Heinemann Publications, 3rd Edition**,** 2011.*

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
CO1	Describe the methods of measurement and classification of measuring instruments.	K2
CO2	Suggest suitable sensor for the measurement of strain and displacement.	K2
CO3	Explain the construction and working of transducers for pressure and temperature measurement.	K2
CO4	Elucidate the characteristics of flow and level measuring instruments.	K2
CO5	Elaborate the concept of automatic control system.	K2

COURSE ARTICULATION MATRIX

a) CO/PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	-	-	-	-	-	-	-	-	-	3	2
CO2	3	2	2	2	-	-	-	-	-	-	-	-	-	3	2
CO3	3	2	2	2	-	-	-	-	-	-	-	-	-	3	2
CO4	3	2	2	2	-	-	-	-	-	-	-	-	-	3	2
CO5	3	3	3	2	-	-	-	-	-	-	-	-	-	3	3
22NOE$11	**3**	**3**	**3**	**2**	-	-	-	-	-	-	-	-	-	**3**	**2**

b) CO and Key Performance Indicators mapping

CO1	1.1.1, 1.1.2, 1.2.1,1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 3.2.1, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.2, 4.1.3, 4.1.4
CO2	1.1.1, 1.1.2, 1.2.1,1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2,2.2.3, 2.3.1, 2.3.2, 3.1.6, 3.3.2, 3.4.1, 3.4.2, 4.1.2, 4.1.3, 4.1.4
CO3	1.1.1, 1.1.2, 1.2.1,1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 3.1.5, 3.1.6, 3.3.2, 3.4.1, 3.4.2, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2
CO4	1.1.1, 1.1.2, 1.2.1,1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2,2.2.3, 2.2.4, 2.3.1, 2.3.2, 3.1.5, 3.1.6, 3.3.2, 3.4.1, 3.4.2, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2
CO5	1.1.1, 1.1.2, 1.2.1,1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 3.1.5, 3.1.6, 3.2.1, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2

ASSESSMENT PATTERN - THEORY

Test/Bloom's Category	Remembering (K1)%	Understanding (K2) %	Applying (K3)%	Analyzing(K4)%	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	60	-	-	-	-	100
CAT2	40	60	-	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	30	70	-	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	30	70	-	-	-	-	100
ESE	40	60	-	-	-	-	100

B.E.PRODUCTION ENGINEERING

22NOE$12	**INDUSTRIAL AUTOMATION** *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

COURSE OBJECTIVE	To elaborate on the basic concept of automation, including the necessary components and various automation controllers utilized in industrial automation.	
UNIT - I	**INTRODUCTION TO AUTOMATION**	**9 Periods**
Automation overview – Requirement of automation systems – Architecture of industrial automation system –Industrial bus systems: Modbus and Profibus.Introduction to Industry 4.0 and its evolution.		
UNIT - II	**AUTOMATION COMPONENTS**	**9 Periods**
Sensors for temperature – Pressure – Force – Displacement - Speed – Flow- level – Humidity and pH measurement. Actuators – Process control valves –Power electronic drives: DIAC- TRIAC –power MOSFET – IGBT. Introduction to DC and AC servo drives for motion control.		
UNIT - III	**PROGRAMMABLE LOGIC CONTROLLERS**	**9 Periods**
PLC Hardware – power supplies and isolators –Relays – Switches -Seal-in circuits – PLC programming – ladder diagram – sequential flow chart – PLC communication and networking – PLC selection – PLC installation – Advantages – Application of PLC to process control industries and Robotics.		
UNIT - IV	**DISTRIBUTED CONTROL SYSTEM**	**9 Periods**
Overview of DCS – DCS hardware – DCS software configuration – DCS communication – DCS supervisory computer tasks – DCS integration with PLC and Computers.		
UNIT - V	**SUPERVISORY CONTROL AND DATA ACQUISITION SYSTEMS**	**9 Periods**
Introduction - Supervisory Control and Data Acquisition Systems – SCADA HMI Essentials – SCADA Components – SCADA Configuration and Software – HMI hardware and software.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Frank D. Petruzella, "**Programmable Logic Controllers**", 5th Edition, McGraw Hill, 2016.*
2	*S.K. Singh "**Industrial Instrumentation and Control**", 3rd Edition, McGraw Hill Companies, 2004.*

REFERENCES:

1	*Sudip Misra, Chandana Roy, Anandarup Mukherjee, **"Introduction to Industrial Internet of Things and Industry 4.0**", CRC Press, 1st edition, 2021*
2	*Bela G Liptak, "**Process software and digital networks – Volume 3**", 4th Edition, CRC press, 2012.*
3	*Romily Bowden, "**HART application guide and the OSI communication foundation**",1999.*
4	*John.W. Webb Ronald A Reis, "**Programmable Logic Controllers - Principles and Applications**", Prentice Hall Inc., 5th Edition, 2003.*
5	*M. P. Lukcas, "**Distributed Control Systems"**, Van Nostrand Reinhold Co., 1986.*

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
CO1	Elaborate the basic architecture of automation systems and Industry 4.0.	K2
CO2	Describe the various automation components and industrial bus system involved in industrial automation	K2
CO3	Construct ladder logic diagram using PLC basic functions, timer and counter functions for simple applications	K3
CO4	Illustrate the functionary components and supervisory control of DCS with relevant diagrams	K2
CO5	Describe the basics of SCADA technology.	K2

COURSE ARTICULATION MATRIX

a) CO/PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	-	-	-	1	3	3
CO2	3	2	1	-	-	-	-	-	-	-	-	-	1	3	3
CO3	3	3	2	2	-	-	-	-	1	-	-	2	1	3	3
CO4	3	2	2	-	-	-	-	-	-	-	-	-	1	3	3
CO5	3	2	`1	-	-	-	-	-	-	-	-	-	1	3	3
22NOE$12	3	3	2	1	-	-	-	-	1	-	-	1	1	3	3

b) CO and Key Performance Indicators mapping

CO1	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.3.1, 2.4.3,3.1.1, 3.1.2, 3.1.3, 3.3.1,3.3.2.
CO2	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.3.1, 2.4.3,3.1.1, 3.1.2, 3.1.3, 3.3.1,3.3.2.
CO3	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.3.1, 2.4.3,3.1.1, 3.1.2, 3.1.3, 3.3.1,3.3.2, 4.1.1, 4.1.2, 4.2.1, 4.2.2, 9.1.1, 9.1.2, 10.1.1, 10.1.2, 10.1.3, 12.1.1, 12.1.2.
CO4	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.3.1, 2.4.3,3.1.1, 3.1.2, 3.1.3, 3.3.1,3.3.2.
CO5	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.3.1, 2.4.3,3.1.1, 3.1.2, 3.1.3, 3.3.1,3.3.2.

ASSESSMENT PATTERN - THEORY

Test/Bloom's Category	Remembering (K1)%	Understanding (K2) %	Applying (K3)%	Analyzing(K4)%	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	60	20	-	-	-	100
CAT2	20	60	20	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	20	60	20	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	20	60	20	-	-	-	100
ESE	20	60	20	-	-	-	100

22SOE$13	**PROGRAMMING IN JAVA** *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

Course Objectives	The objective of this course is to provide students with the essential Java constructs necessary for developing an object-oriented program.	
UNIT – I	**FUNDAMENTALS OF JAVA PROGRAMMING**	**9 Periods**
History and Evolution of Java- Overview of java– Operators- Control Structures– Methods- Classes and Objects– Inheritance- Packages and Interfaces- Exception Handling.		
UNIT – II	**THREADS , I/O AND STRING HANDLING**	**9 Periods**
Multi threaded Programming– Enumeration- Auto boxing– Annotations- String Handling-Input/Output: Exploring java.io		
UNIT – III	**EVENT HANDLING**	**9 Periods**
Introducing the AWT: working with windows- graphics and text- Using AWT controls- Layout Manager - Menus - Introducing Swing		
UNIT – IV	**IMAGING AND DATABASE CONNECTIVITY**	**9 Periods**
Imaging: Creating- loading and displaying- Image observer- Double buffering- Media tracker- Image producer– consumer– filters– animation- Java Database Connectivity		
UNIT – V	**NETWORKING**	**9 Periods**
Networking – Remote Method Invocation – Java Beans –Java servlets		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS

1	*Herbert Schildt, "Java**, The Complete Reference** ", Tata McGrawHill, 12th Edition, 2022*

REFERENCES

1	*Deitel .H.M and Deitel.P.J, " **Java: How to Program** ", Pearson Education Asia, 9th Edition 2011*
2	*Lay.S&Horstmann Gary Cornell, " **Core Java Vol I** ", The Sun Microsystems & press Java Series, 9th Edition, 2012*
3	*NPTEL Course : "**PROGRAMMING IN JAVA" https://archive.nptel.ac.in/courses/106/105/106105191/***

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Write simple java programs using fundamental concepts of java like control structures, inheritance, packages, interfaces and exception handling	K4
CO2	Write java program using multithreading and string handling	K3
CO3	Write java programs for managing events and to access database	K4
CO4	Write java programs to display and manipulation of graphical images	K3
CO5	Develop client server programs using RMI and servlets	K3

B.E.PRODUCTION ENGINEERING

COURSE ARTICULATION MATRIX:

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	2	2	1	-	-	-	-	2	-	-	1	2	2
CO2	2	1	2	2	1	-	-	-	-	2	-	-	-	2	3
CO3	2	1	2	2	1	-	-	-	-	2	-	-	1	2	3
CO4	2	1	2	2	1	-	-	-	-	2	-	-	1	2	3
CO5	2	1	2	2	1	-	-	-	-	2	-	2	1	2	3
22SOE$13	2	2	2	2	1	-	-	-	-	2	-	1	1	2	3

b) CO and Key Performance Indicators Mapping	
CO1	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.2.1, 2.2.3, 2.2.4, 2.4.3, 3.1.5, 3.1.6, 3.2.2, 3.3.1, 3.3.2, 4.1.1, 4.1.2, 4.1.3, 4.2.1, 4.3.1, 4.3.2, 5.2.2,10.1.1,10.1.2,10.1.3
CO2	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.4.3, 3.1.5, 3.1.6, 3.2.2, 3.3.2, 4.1.1, 4.1.2, 4.1.3, 4.2.1, 4.3.1, 4.3.2, 5.2.2,10.1.1,10.1.2,10.1.3
CO3	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.4.3, 3.1.5, 3.1.6, 3.2.2, 3.3.2, 4.1.1, 4.1.2, 4.1.3, 4.2.1, 4.3.1, 4.3.2, 5.2.2,10.1.1,10.1.2,10.1.3
CO4	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.4.3, 3.1.5, 3.1.6, 3.2.2, 3.3.2, 4.1.1, 4.1.2, 4.1.3, 4.2.1, 4.3.1, 4.3.2, 5.2.2,10.1.1,10.1.2,10.1.3
CO5	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.4.3, 3.1.5, 3.1.6, 3.2.2, 3.3.2, 4.1.1, 4.1.2, 4.1.3, 4.2.1, 4.3.1, 4.3.2, 5.1.1, 5.2.2,10.1.1,10.1.2,10.1.3,12.1.1,12.2.1,12.2.2

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	-	30	40	30	-	-	100
CAT2	10	30	40	20	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	-	70	30	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	-	50	50	-	-	100
ESE	-	30	40	30	-	-	100

22SOE$14	NETWORK ESSENTIALS *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

Course Objectives	The objective of the course is to understand the basics of networking and able to configure and troubleshoot switches and routers.	
UNIT – I	**INTRODUCTION**	**9 Periods**
Introduction to Computer Networks - Goals and advantages of Computer Networks - Network Topologies – Basic networking devices – Protocols – the need for a layered architecture - The OSI Model and the TCP/IP reference model – the Ethernet LAN – Home Networking – Assembling an office LAN – Testing and Troubleshooting a LAN – Physical layer cabling: Twisted pair and Fiber optics		
UNIT – II	**WIRELESS NETWORKING**	**9 Periods**
Importance of Wireless Networking – IEEE 802.11 Wireless LANs – Bluetooth- WIMAX – RFIDs – Securing the Wireless LANs – Configuring a Point to Multipoint Wireless LAN – Interconnecting network LANs – Switch, Bridges and Routers. Interconnecting LANs with the router, Configuring the network interface-Auto negotiation		
UNIT – III	**ADDRESSING AND ROUTING FUNDAMENTALS**	**9 Periods**
IPv4 and IPv6 addressing – Subnet masks – CIDR blocks – configuration of a router – Console port connection - user EXEC mode – Privileged EXEC mode - Configuration of a switch – Static VLAN configuration - Spanning Tree protocol – Network Management – Power over Ethernet		
UNIT – IV	**ROUTING PROTOCOLS**	**9 Periods**
Static Vs Dynamic Routing Protocols – Distance vector Routing – Link State Routing – Hybrid Routing – Configuring RIP - Network Services – DHCP, DNS - Analyzing Internet Traffic.		
UNIT – V	**TROUBLESHOOTING AND NETWORK SECURITY**	**9 Periods**
Analyzing Computer Networks – FTP data packets – Analyzing Campus Network data traffic – Troubleshooting the router and switch interface, Troubleshooting fiber optics – Intrusion – DOS – Security software and hardware.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

	*Jeffrey S.Beasley Piyasat Nilkaew "**Network Essentials**" 3 rd Edition, Pearson, 2018*
	*Larry L. Peterson and Bruce S. Davie "**Computer Networks, A Systems Approach**" 5 th edition, Morgan Kaufmann Publishers Inc, 2014.*

REFERENCES :

1	*Behrouz A. Forouzan, "**Data Communications and Networking with TCP/IP Protocol Suite**", Sixth Edition TMH, 2022.*
2	*James F. Kurose, Keith W. Ross, "**Computer Networking, A Top-Down Approach Featuring the Internet**", Eighth Edition, Pearson Education, 2021.*
3	*Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, "**Computer Networks: An Open Source Approach**", McGraw Hill, 2012.*
4	*Nader F. Mir, "**Computer and Communication Networks",** Second Edition, Prentice Hall, 2014.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Identify topologies and types of Computer Networks and enumerate the layers of the OSI model and TCP/IP	K2
CO2	Explain the significance of wireless networks and configure a Wireless LAN	K3
CO3	Configure a switcher and a router	K3
CO4	Describe basic routing algorithms and network services	K3
CO5	Troubleshoot the router and switch interface	K3

a) CO and PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	-	-	1	-	-	-	-	-	-	1	2	-
CO2	2	3	-	-	-	1	-	-	-	-	-	-	1	2	-
CO3	2	3	-	2	2	1	-	-	-	-	-	-	1	2	-
CO4	2	3	-	2	2	1	-	-	-	-	-	-	1	2	-
CO5	2	3	-	2	2	1	-	-	-	-	-	-	1	2	-
22SOE$14	2	3	-	2	2	1	-	-	-	-	-	-	1	2	-

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.3.1, 1.4.1, 2.1.2, 2.2.2, 2.4.4, , 4.1.2, 5.1.1, 5.1.2,5.2.1, 5.2.2, 5.3.2, 6.1.1, 6.1.2
CO2	1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3,2.2.4, 4.1.2, 5.1.1, 5.1.2,5.2.1, 5.2.2, 5.3.2, 6.1.1, 6.1.2
CO3	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3,2.2.4, 4.1.1, 4.1.2, 5.1.1, 5.1.2,5.2.1, 5.2.2, 5.3.2, 6.1.1, 6.1.2
CO4	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3,2.2.4, 4.1.1, 4.1.2, 5.1.1, 5.1.2,5.2.1, 5.2.2, 5.3.2, 6.1.1, 6.1.2
CO5	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3,2.2.4, 4.1.1, 4.1.2, 5.1.1, 5.1.2,5.2.1, 5.2.2, 5.3.2, 6.1.1, 6.1.2

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	35	35	-	-	-	100
CAT2	10	45	45	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	50	50	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	50	50	-	-	-	100
ESE	10	40	50	-	-	-	100

22I0E$15	**VIDEO CREATION AND EDITING** *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

Course Objective	Upon completion of the course the students will be familiar with the principles and techniques of video creation and editing, video production equipment and software, visual storytelling and video production, planning, executing, and editing video projects. also able to foster critical thinking and creativity in developing and executing video projects.	
UNIT – I	**INTRODUCTION TO VIDEO CREATION AND EDITING**	**9 Periods**
Overview of video creation and editing -Brief history of video and film production -Understanding visual storytelling: developing documentary and dramatic projects- introduction to digital and film systems		
UNIT – II	**PRE-PRODUCTION**	**9 Periods**
Developing a concept and idea - Scriptwriting and storytelling -The Digital image - Film systems and cameras -The film image - Case Study : Non linear editing system		
UNIT – III	**PRODUCTION**	**9 Periods**
Camera operation and techniques: The video camcorder- The Lens - Lighting and sound recording techniques - Directing actors and crew -Conducting interviews -Shooting the movie - Case Study : Professional video zoom lenses		
UNIT – IV	**POST-PRODUCTION**	**9 Periods**
Picture and Dialogue editing - Editing digital video -sound editing and mixing -Color grading and correction-Sound editing and mixing – working with film in post production Case Study : Digital Audio Recording		
UNIT – V	**DISTRIBUTION AND PROMOTION**	**9 Periods**
Presenting the project - funding sources - budgets- business arrangements- legal and copyright issues-distribution and marketing - publicity and the marketing campaigns-building and sustaining a career - Case Study : Creating a short movie.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	Steven Ascher and Edward Pincus,The Filmmaker's Handbook: A Comprehensive Guide for the Digital Age,Fifth edition Penguin Publishing Group, 2012

REFERENCES :

1	Walter Murch,In the Blink of an Eye: A Perspective on Film Editing", Silman-James Press,2001
2	Karel Reisz and Gavin Millar,The Technique of Film Editing",second edition ,Taylor and Francis Group 2017
3	Ken Dancyger, The technique of film and video editing , fifth edition , Elsevier 2011.
4	Chris Kenworthy,Digital video production cookbook, OReillyMedia ,2006
5	Mark Brindle, The Digital Filmmaking Handbook ,Quercus Publishing, 2014

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Demonstrate an understanding of the history and evolution of video production and editing.	K2
CO2	Develop and execute a concept, script, and storyboard for a video project	K3
CO3	Plan and prepare for a video shoot, including casting, location scouting, and budgeting.	K3
CO4	Edit and assemble video footage using basic and advanced editing techniques.	K2
CO5	Promote and distribute the final video on various platforms.	K1

Course Articulation Matrix (Times New Roman, Size 11)														
COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	1	1	1	-	-	-	-	-	-	-	-	1	1
CO2	1	2	3	2	3	-	-	-	-	-	-	-	1	1
CO3	1	2	1	3	3	-	1	-	3	1	2	-	1	1
CO4	1	2	2	2	3	3	-	-	3	1	2	-	1	1
CO5	1	2	2	2	3	3	1	3	3	3	2	-	1	1
22IOE$15	1	2	2	2	2	1	1	1	2	1	1	-	1	1
1– Slight, 2 – Moderate, 3 – Substantial														
b) CO and Key Performance Indicators Mapping														
CO	Key Performance Indicators													
CO1	1.1.1,1.2.1,1.31,2.1.1,2.1.2,2.2.4,2.4.1,3.1.4,3.4.1,4.1.3,													
CO2	1.1.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.4.3,3.1.1,3.1.2,3.1.3,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,3.4.1,3.4.2,4.1.1, 4.1.3,4.2.1,4.3.1,4.3.2,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,													
CO3	1.1.1,2.1.1,2.1.3,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.2,2.4.3,3.2.1,3.2.2,3.3.1,3.4.2,4.1.1,4.1.3,4.1.4,4.2.2, 4.3.1,4.3.2,4.3.3,,5.1.1,5.1.2,5.2.1,5.2.2,5.3.2,7.1.1,9.1.1,9.1.2,9.2.1,9.2.2,9.2.3,10.1.1,11.2.1,11.3.1,1 1.3.2													
CO4	1.1.1,2.1.1,2.1.3,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.2,2.4.3,3.2.1,3.2.2,3.3.1,,3.3.2,3.4.2,4.1.1,4.1.3,4.2.1 , ,4.3.1,4.3.2,5.1.1,5.1.2,5.2.1,5.2.2,5.3.2,6.1.1,6.1.2,,9.1.1,9.1.2,9.2.1,9.2.2,9.2.3,10.1.1,11.3.1,11.3.2													
CO5	1.1.1 , 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4 2.3.2, 2.4.3, 3.2.1, 3.2.3, 3.3.1, 3.3.2, 3.4.2, 4.1.1, 4.1.3, 4.3.1, 4.3.2, 4.3.3, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.12, 8.1.1, 8.2.1,8.2.2, , 9.1.1, 9.1.2, 9.2.1,9.2.2, 9.2.3,9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3,10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 11.2.1													

ASSESSMENT PATTERN – THEORY (Times New Roman, Size 11)							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	30	40	-	-	-	100
CAT2	30	30	40	-	-	-	100
Assignment 1	30	30	40	-	-	-	100
Assignment 2	30	30	40	-	-	-	100
Other mode of internal assessments, if any	-	-	-	-	-	-	-
ESE	30	30	40	-	-	-	100

B.E.PRODUCTION ENGINEERING

22IOE$16	**DIGITAL MARKETING** *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

Course Objectives	To give insight on the framework to analyze, strategies and plan digital marketing and communication activities for typical marketing situations. Familiarize with the key tools and techniques of digital marketing that are popularly used by professionals in the real world of digital marketing and help them develop the ability to formulate and analyze key metrics to evaluate the performance of typical digital marketing efforts.	
UNIT – I	**INTRODUCTION TO DIGITAL MARKETING**	**9 Periods**
Basics of Digital Marketing - online marketplace analysis: digital marketing environment - consumer choice and digital influence online consumer behavior-competitors -suppliers- new channel structures - rate of environment change - economic force-political force -legal force - social force- cultural force.		
UNIT – II	**DIGITAL MARKETING STRATEGY DEVELOPMENT**	**9 Periods**
Digital marketing strategy - The impact of digital media and technology on the marketing mix: product-price-place-promotion -people, process and physical evidence - relationship marketing using digital platforms: the challenge of customer engagement - customer lifecycle management		
UNIT – III	**DIGITAL MARKETING IMPLEMENTATION AND PRACTICE**	**9 Periods**
Delivering the online customer experience: planning website design and redesign projects - initiation of the website project - defining site or app requirement - designing the user experience - development and testing of content - site promotion or traffic building - campaign planning for digital media		
UNIT – IV	**MARKETING COMMUNICATIONS USING DIGITAL MEDIA CHANNELS**	**9 Periods**
Search engine marketing - online public relations - affiliated marketing - interactive display advertising - email marketing and mobile text messaging- social media and viral marketing - offline promotion techniques		
UNIT – V	**EVALUATION OF DIGITAL CHANNEL PERFORMANCE**	**9 Periods**
Create a performance management system - performance metric framework - tools and techniques for collecting metrics -customer experience and content management - online consumer behavior- online retailing - customer acquisition in B2B marketing -online inter- organizational trading		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	Dave Chaffey Fiona Ellis-Chadwick, Digital Marketing,sixth edition, 2016

REFERENCES :

1	Puneet singh Bhatia, Fundamentals of Digital Marketing , Pearson India Education services,2017
2	Mathur, Vibha, Arora, Saloni,"DigitalMarketing",PHI Learning Pvt. Ltd.,2020
3	Ian Dodson, The Art of Digital Marketing: The Definitive Guide to Creating Strategic, Targeted, and Measurable Online Compaigns, Wiley 2016
4	Dr.Shakti Kundu, Digital Marketing Trends and Prospects:Develop an effective Digital Marketing strategy with SEO, SEM, PPC, Digital Display Ads & Email Marketing techniques,BPB PUBN,2021
5	Seema Gupta , Digital Marketing,Third Edition, McGraw Hill 2022
6.	Simon Kingsnorth, Digital Marketing Strategy : An Integrated Approach to Online Marketing, Kogan page,2022

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the role and importance of digital marketing in a rapidly changing business landscape	K1
CO2	Discuss the key elements of a digital marketing strategy	K2
CO3	Demonstrate advanced practical skills in common digital marketing tools such as Social media and Blogs	K2
CO4	Demonstrate advanced practical skills in common digital marketing tools such as SEM	K2
CO5	understand online consumer behavior and influence the extent to which individuals are likely to engage with the digital marketplace	K2

Course Articulation Matrix (Times New Roman, Size 11)

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1	1	2	2	-	-	-	-	-	-	-	-	2	2
CO2	1	1	2	2	-	-	-	-	-	-	-	-	2	2
CO3	1	1	2	2	3	-	-	-	-	-	-	-	2	2
CO4	1	1	2	2	3	2	3	3	3	3	3	3	2	2
CO5	1	1	2	2	1	-	3	3	3	3	3	3	2	2
22IOE$16	1	1	2	2	1	1	1	1	1	1	1	1	2	2

1– Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO	Key Performance Indicators
CO1	1.1.1,2.1.1,2.1.2,3.1.1,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,4.1.1,4.1.3,4.2.1,4.3.3,
CO2	1.1.1,2.1.1,2.1.2,3.1.1,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,4.1.1,4.1.3,4.2.1,4.3.3,
CO3	1.1.1,2.1.1,2.1.2,3.1.1,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,4.1.1,4.1.3,4.2.1,4.3.3,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2
CO4	1.1.1,2.1.1,2.1.2,3.1.1,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,4.1.1,4.1.3,4.2.1,4.3.3, 5.1.1,5.1.2,5.2.1, 5.2.2,5.3.1,5.3.2,6.1.1,7.1.1,7.1.2,7.2.1,7.2.2,8.1.1,8.2.1,8.2.2,9.1.1,9.1.2,9.2.1,9.2.2,9.2.3,9.2.4,9.3.1,10.1.1, 10.1.2,10.1.3,10.2.1,10.2.2,10.3.1,10.3.2,11.1.1,11.1.2,11.2.1,11.3.1,11.3.2,12.1.1,12.1.2,12.2.1,12.2.2,12.3.1 ,12.3.2
CO5	1.1.1,2.1.1,2.1.2,3.1.1,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,4.1.1,4.1.3,4.2.1,4.3.3, 5.1.1,5.1.2,5.2.1, 7.1.1,7.1.2,7.2.1,7.2.2,8.1.1,8.2.1,8.2.2,9.1.1,9.1.2,9.2.1,9.2.2,9.2.3,9.2.4,9.3.1, 10.1.1,10.1.2,10.1.3,10.2.1,10.2.2,10.3.1,10.3.2,11.1.1,11.1.2,11.2.1,11.3.1,11.3.2,12.1.1,12.1.2,12.2.1,12.2.2 ,12.3.1,12.3.2

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	30	40	-	-	-	100
CAT2	30	30	40	-	-	-	100
Assignment 1	30	30	40	-	-	-	100
Assignment 2	30	30	40	-	-	-	100
Other mode of internal assessments, if any	-	-	-	-	-	-	-
ESE	30	30	40	-	-	-	100

B.E.PRODUCTION ENGINEERING

22BOE$17	PRINCIPLES OF FOOD TECHNOLOGY *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

Course Objective	To learn about the various food constituents and its additives. To learn about various microbes associated with food. To learn about different food processing and preservation techniques.	
UNIT – I	**FOOD AND ENERGY**	**9 Periods**
Constituents of food – carbohydrates, lipids, proteins, water, vitamins and minerals, dietary sources, role and functional properties in food, contribution to organoleptic and textural characteristics.		
UNIT – II	**FOOD BORNE DISEASES**	**9 Periods**
Classification – food infections – bacterial and other types; food intoxications and poisonings– bacterial and non-bacterial; food spoilage – factors responsible for spoilage, spoilage of vegetable, fruit, meat, poultry, beverage and other food products.		
UNIT – III	**FOOD ADDITIVES**	**9 Periods**
Classification, intentional and non-intentional additives, functional role in food processing and preservation; food colourants – natural and artificial; food flavours; enzymes as food processing aids.		
UNIT – IV	**FOOD PRESERVATION**	**9 Periods**
Principles involved in the use of sterilization, pasteurization and blanching, thermal death curves of microorganisms, canning; frozen storage-freezing characteristics of foods, microbial activity at low temperatures, factors affecting quality of foods in frozen storage; irradiation preservation of foods.		
UNIT – V	**FOOD PACKAGING**	**9 Periods**
Types of packaging material and containers; Interactions between packaging and foods; Packing - meat, dairy, fresh fruits and vegetables, beverages and confectionaries; Food packaging closure and sealing system; Nutrition labelling and legislative requirements.		
Contact Periods: **Lecture: 45 Periods** **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**		

TEXT BOOK

1	*T.P. Coultate ,* ***Food – The Chemistry Of Its Components****, 6th Edn. Royal Society,London, 2015.*
2	*W.C. Frazier And D.C. Westhoff ,* ***Food Microbiology****, 4th Ed., Mcgraw-Hill Book Co., NewYork 2013.*

REFERENCES

1	*Srinivasan Damodaran and Kirk L. Parkin., "Fennema's Food Chemistry", CRC Press, 5 thedition. 2017.*
2	*Fellows P.J, "Food Processing Technology: Principles and Practices", Woodhead Publishing 4 th edition,2016.*
3	*B. Sivasanker , Food Processing And Preservation, Prentice-Hall Of India Pvt. Ltd. New Delhi 2002.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Learn different constituents present in food and microorganism involved in processing of food.	K1
CO2	Learn principles and different preservations techniques of food can also be known.	K1
CO3	Learn techniques involved in modern food processing and impact of the process on food quality.	K2
CO4	Explain various preservation and packaging techniques for food product	K2
CO5	Describe the relationship between food and microorganism that basis for fermentation and preservation	K2

a) Course Articulation Matrix

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	-	-	1	-	-	-	-	2	3	-	-	1	3
CO2	1	-	-	-	-	-	-	-	-	3	-	-	1	3
CO3	1	-	-	2	-	2	-	-	-	3	-	-	1	3
CO4	1	-	1	-	-	-	-	-	-	3	-	-	1	3
CO5	1	-	2	-	-	-	-	-	-	3	-	-	1	3
22BOE$17	1	-	1	1	-	2	-	-	2	3	-	-	1	3
1 – Slight, 2 – Moderate, 3 – Substantial														

b) CO and Key Performance Indicators Mapping

CO1	1.4.2, 2.1.3
CO2	1.4.1, 3.1.3
CO3	1.4.4, 2.1.4
CO4	1.4.1, 2.1.3,3.4.2
CO5	1.4.1,2.2.1

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	50	50	-	-	-	-	100
CAT2	60	40	-	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	50	50	-	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	50	50	-	-	-	-	100
ESE	50	50	-	-	-	-	100

B.E.PRODUCTION ENGINEERING

22PVA$06	YOGA FOR YOUTH EMPOWERMENT	SEMESTER $

PREREQUISITES	CATEGORY	L	T	P	C
NIL	EEC	1	0	0	1

Course Objectives	*To create awareness and the benefits of yoga and meditation. *To study and analyze the influential factors, which affect the engineering students' healthy life.	
UNIT- I	**PHYSICAL STRUCTURE AND ITS FUNCTIONS**	**(05)**
Yoga - Purpose of life, philosophy of life, Physical structure, Importance of physical exercise, Rules and regulation of simplified physical exercises, hand exercise, leg exercise, breathing exercise, eye exercise, kapalapathy, Mahar asana, body massage, acupressure, body relaxation.		
UNIT- II	**YOGASANAS**	**(05)**
Rules & Regulations – asana, pranayama, mudra, bandha		
UNIT- III	**MIND**	**(05)**
Bio magnetism& mind - imprinting & magnifying – eight essential factors of living beings, Mental frequency and ten stages of mind, benefits of meditation, such as perspicacity, magnanimity, receptivity, adaptability, creativity, Simplified Kundalini yoga: Agna, Santhi, thuriam, thuriyatheetham.		
Contact Periods: **Lecture: 15 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 15 Periods**		

TEXT BOOK:

1	*VethathiriMaharashi* ***"Yoga for Modern Age"***
2	*VethathiriMaharashi* ***"Mind"***

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	YOGA which gives healthy & better living, Physical, Mental mood, Intellectual & spiritual.	K1
CO2	Work skilfully and perfectly towards the excellence.	K3
CO3	Achieve meditation practices, which strengthen the mind and increases the will power	K3
CO4	Concentration, creativity and ultimately to transform the mind to achieve self-realization	K2

B.E.PRODUCTION ENGINEERING

COURSE ARTICULATION MATRIX:

	a) CO and PO Mapping														
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	-	-	-	-	-	2	-	-	-	-	-	-	1	-	-
CO2	-	-	-	-	-	-	-	-	1	-	-	-	-	1	-
CO3	-	-	-	-	-	-	1	-	-	-	-	-	1	-	1
CO4	-	-	-	-	-	-	1	-	2	-	-	-	-	-	-
22PVA$06	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**-**	**-**	**-**	**1**	**1**	**1**
	1 – Slight, 2 – Moderate, 3 – Substantial														

	b) CO and Key Performance Indicators Mapping
CO1	6.2.1
CO2	9.1.1, 9.1.2, 9.2.2
CO3	7.1.1
CO4	7.1.1, 9.2.1, 9.2.2, 9.2.3

B.E.PRODUCTION ENGINEERING

22PVA$07	BASICS OF CIVIL ENGINEERING	SEMESTER $

PREREQUISITES	CATEGORY	L	T	P	C
NIL	EEC	1	0	0	1

Course Objectives	*To make the students aware of basic concepts of Civil Engineering by exposing the students about the building materials and construction methods followed.	
UNIT- I	**BUILDING MATERIALS**	**(7 Periods)**
Qualities of good building stone - Qualities of good brick - Cement composition, types and uses - Properties and uses of tor steel, structural steel sections, timber - Concrete - Grade of concrete - Properties of reinforced concrete.		
UNIT- II	**BUILDING CONSTRUCTION**	**(8 Periods)**
Foundation functions – Failures - Bearing capacity of soil - Different types of foundation. Masonry - Points to be observed in construction - Brick masonry – Types of bond - Stone masonry - Random rubble and Ashlar masonry. Flooring - Various types of floor finishing for Residential, Industrial buildings.		
Contact Periods: **Lecture: 15 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 15 Periods**		

TEXT BOOK:

1	*Punmia B.C **"Basic Civil Engineering",** Lakshmi Publications, 2003*
2	*Bhavikatti S. S "**Basic Civil Engineering",** New Age International Publishers, 2010*

REFERENCES:

1	*Rangwala S.C **"Engineering Materials",** Charotar Publishing House, 2014*
2	*Punmia B.C **"Building Construction",** Lakshmi Publications, 2008.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the qualities and properties for building materials used in the field	K2
CO2	Apply the knowledge of construction practices in real life situation in the societal	K4

B.E.PRODUCTION ENGINEERING

COURSE ARTICULATION MATRIX:

	a) CO and PO Mapping														
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	2	1	-	1	-	-	-	-	-	1	-	-	1	-	1
CO2	-	-	-	-	-	2	-	1	2	2	3	1	1	-	1
22PVA$07	**2**	**2**	**-**	**1**	**-**	**2**	**-**	**1**	**2**	**2**	**3**	**1**	**1**	**-**	**1**
	1 – Slight, 2 – Moderate, 3 – Substantial														
	b) CO and Key Performance Indicators Mapping														
CO1	1.1.1, 1.2.1, 1.3.1, 2.1.1, 2.2.2, 2.2.4, 2.4.4, 4.2.1, 4.2.2, 10.2.1, 10.2.2														
CO2	6.1.1, 8.1.1, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 10.2.1, 10.2.2, 10.3.1, 11.1.1, 11.1.2, 11.2.1, 11.3.1, 11.3.2, 12.3.1														

B.E.PRODUCTION ENGINEERING

22PVA$08	METALLOGRAPHY	SEMESTER $

PREREQUISITES	CATEGORY	L	T	P	C
22PPC302 – ENGINEERING METALLURGY	EEC	1	0	0	1

Course Objectives	*To understand the preparation of metallographic specimens for micro examination and analyze the microstructures of metals and metallic alloys.	
UNIT – I	**PREPARATION OF METALLOGRAPHIC SPECIMENS**	**(5 Periods)**
Microscopic and macroscopic examination, Polishing techniques for different metals and alloys, Sectioning- Fracturing, Shearing, Sawing, Abrasive cutting, Electric discharge machining, Mounting- Adhesive mounting, Plastic mounting, Grinding and Etching techniques - Electrolytic etching, Potentiostat etching, Chemical etching.		
UNIT – II	**MICROSTRUCTURES OF FERROUS AND NON FERROUS METALS**	**(5 Periods)**
Crystalline structure of metals, Phase changes of metals and alloys, Crystal defects in metals, Microstructures of plain carbon steel, tool steel, grey C.I, SG iron, Brass, Bronze and composites.		
UNIT – III	**IMAGE ANALYSING TECHNIQUES**	**(5 Periods)**
Light microscopy, SEM, TEM, XRD, Quantitative microscopy-Grain size measurement, Inclusion rating methods, Measurements of structural gradients - Decarburization, Case depth, Coating thickness, Quantitative fractography, Image analysis.		
Contact Periods: **Lecture: 15Periods Tutorial: 0 Periods Practical: 0 Periods Total: 15 Periods**		

TEXT BOOK:

1	*O.P. Khanna **"Material Science & Metallurgy",** Dhanpat Rai Publication ,2011*
2	*Sydney H. Avner **"Introduction to Physical Metallurgy",**Tata McGraw Hill Book Company, 1994.*

REFERENCES:

1	*R.C. Gifkins, **"Optical Microscopy of Metals",** American Elsevier Pub. Co., 1970.*
2	*S.Telansky, **"Multiple beam interference Microscopy of Metals",** Academic Press, New York, 1970.*
3	*Kay Geels, **"Metallographic and Materialographic Specimen Preparation, Light Microscopy, Image Analysis and Hardness Testing",** ASTM International, U.S.A. ASTM Stock No. MNL46.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Apply the specimen preparation methods in metallographic inspection.	K3
CO2	Identify the phase changes of microstructures and defects in metals and metallic alloys.	K2
CO3	Analyze the microstructures and defects in metals and metallic alloys.	K4

COURSE ARTICULATION MATRIX:

	a) CO and PO Mapping														
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	-	-	-	2	-	-	-	-	-	-	-	-	-
CO3	3	3	-	-	-	2	-	-	-	-	-	-	-	-	-
22PVA$08	**3**	**3**	-	-	-	**2**	-	-	-	-	-	-	-	-	-
	1 – Slight, 2 – Moderate, 3 – Substantial														
	b) CO and Key Performance Indicators Mapping														
CO1	1.2.1, 1.3.1														
CO2	1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 6.1.1														
CO3	1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 6.1.1														

22PVA$09	DESIGN OF EXPERIMENTS USING TAGUCHI CONCEPT	SEMESTER $

PREREQUISITES	CATEGORY	L	T	P	C
22PBS205 - DIFFERENTIAL EQUATIONS AND NUMERICAL METHODS 22PPC514 - METROLOGY AND COMPUTER AIDED INSPECTION	EEC	1	0	0	1

Course Objectives	*To achieve optimized results by approaching various special Experimental Techniques for various design problems.	
UNIT – I	INTRODUCTION TO QUALITY BY DESIGN	(3 Periods)
Introduction - goal post philosophy – Taguchi's definition of quality - Taguchi loss function - quality characteristics.		
UNIT – II	DESIGN PROCESS	(3 Periods)
Objective of engineering design - variability due to noise factors - prediction of the process average under optimum condition.		
UNIT – III	ORTHOGONAL ARRAYS AND MATRIX EXPERIMENTS	(3 Periods)
Matrix experiments - orthogonal arrays – degrees of freedom of orthogonal arrays – interaction effects - prediction of the process.		
UNIT – IV	SIGNAL-TO-NOISE RATIO	(3 Periods)
Signal-to-noise (SN) ratio for static problems - Relationship between SN ratio and quality loss, and its applications.		
UNIT – V	CONDUCTING AN EXPERIMENT	(3 Periods)
Randomized block design – completely randomized design – two level factorial experiments - analysis of experiments.		
Contact Periods: **Lecture: 15 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 15 Periods**		

TEXT BOOK:

1	*Philip J Rose* ***"Taguchi techniques for quality Engineering",*** *Prentice Hall, 2005.*
2	*NicoloBelavendram* ***"Quality by Design, Taguchi techniques for Industrial experimentation",*** *Prentice Hall, 1995.*

REFERENCES:

1	*Montgomery D.C* ***"Design and Analysis of Experiments",*** *5th Edition, John Wiley and Sons, NewYork., 2001.*

2	*Sung H Park,* ***"Robust Design and Analysis for Quality Engineering",*** *Chapman and Hall, London, 1996.*
3	*Giani Taguchi, Elssayed A. Elsayed, Thomas C.* ***"Quality Engineering in Production Systems",*** *Mc Graw Hill Book Company, 1989.*
4	*Genichi Taguchi, Subir Chowdhury and Shin Taguchi* ***"Robust Engineering",*** *McGraw Hill, New York, 2000.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the quality concepts in engineering.	K2
CO2	Describe the influences of design process related with quality.	K2
CO3	Explain the concept of orthogonal array and its interaction effects.	K3
CO4	Explain about signal to noise ratio and quality loss function.	K3
CO5	Conduct experiments on randomized block and completely randomized block for optimization	K4

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2	2	1	0	0	0	0	0	0	0	1	2	2
CO2	2	2	2	2	1	0	0	0	0	0	0	0	1	2	2
CO3	2	2	2	2	1	0	0	0	0	0	0	0	1	2	2
CO4	2	2	2	2	1	0	0	0	0	0	0	0	1	2	2
CO5	2	2	2	2	1	0	0	0	0	0	0	0	1	2	2
22PVA$09	**3**	**2**	**2**	**2**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**2**	**2**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.2.2, 2.2.3, 2.2.4, 2.4.2, 2.4.4, 3.1.1, 3.1.2, 3.1.5, 3.1.6, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.2.1, 4.2.2, 5.1.1
CO2	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.2.2, 2.2.3, 2.2.4, 2.4.2, 2.4.4, 3.1.1, 3.1.2, 3.1.5, 3.1.6, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.2.1, 4.2.2, 5.1.1
CO3	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.2.2, 2.2.3, 2.2.4, 2.4.2, 2.4.4, 3.1.1, 3.1.2, 3.1.5, 3.1.6, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.2.1, 4.2.2, 5.1.1
CO4	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.2.2, 2.2.3, 2.2.4, 2.4.2, 2.4.4, 3.1.1, 3.1.2, 3.1.5, 3.1.6, 3.3.1, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.2.1, 4.3.1, 5.1.1
CO5	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.2.1, 2.2.2, 2.2.3, 2.4.2, 2.4.4, 3.1.1, 3.1.2, 3.1.5, 3.1.6, 3.3.1, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.2.1, 4.3.1, 5.1.1

B.E.PRODUCTION ENGINEERING

22PVA$10	ENTREPRENEURSHIP DEVELOPMENT	SEMESTER $

PREREQUISITES	CATEGORY	L	T	P	C
NIL	EEC	1	0	0	1

Course Objectives	*To familiarise the students in entrepreneurship concepts and processes.	
UNIT – I	**CONCEPT OF ENTREPRENEURSHIP**	**(5Periods)**
Definition and concept of enterprising –Types and of entrepreneur –Factors Affecting Entrepreneurial Growth. Project Identification-Methodology of project identification - short listing and zeroing on product/service - problems in project evaluation		
UNIT – II	**FINANCE AND MARKETING**	**(5Periods)**
Need, Sources, Capital Structure, and Term Loans. Accounting principles - conventions and concepts - balance sheet - profit and loss account - accounting rate of return, payback period, Small Scale Industry duty practice. Marketing - Sales strategies.		
UNIT – III	**ASSISTANCE TO ENTREPRENEUR**	**(5Periods)**
Small industries development in India and its concept - ancillary industries - starting a small-scale industry, Taxation Benefits to Small Scale Industry: Need, Depreciation, Rehabilitation and Investment.		
Contact Periods: **Lecture: 15 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 15 Periods**		

TEXT BOOK:

1	*Robert D Hisrich, Michael P Peters & Dean Shepherd "Entrepreneurship", Tata McGraw Hill, 2007*
2	*Donald F Kuratko and Richard M Hodgetts "**Entrepreneurship**", South-Western.*

REFERENCES:

1	*Vasant Desai "**The Dynamics of Entrepreneurial Development and Management**", Himalaya Publishing House, 2010.*
2	*Sudha G S "**Managementand Entrepreneurship Development**", Indus Valley Publication, 2009*
3	*Thomas W Zimmerer and Norman M Scarborough "**Essential of Entrepreneurship and Small Business Management**", Prentice Hall of India, 2009*
4	*Marc J Dollinger, "**Entrepreneurship-Strategies and Resources**", Pearson Education, 2003*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Describe the basic concept of entrepreneurship	K2
CO2	Describe the financial concepts and marketing	K4
CO3	Describe the assistance to entrepreneur	K2

COURSE ARTICULATION MATRIX:

	a) CO and PO Mapping														
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	1	1	1	2	3	2	3	3	3	3	0	1	1
CO2	2	2	1	1	1	2	3	2	1	3	3	2	0	1	0
CO3	2	2	1	1	1	2	3	2	2	3	3	2	0	1	1
22PVA$10	**2**	**2**	**1**	**1**	**1**	**2**	**3**	**2**	**2**	**3**	**3**	**3**	**0**	**1**	**1**
	1 – Slight, 2 – Moderate, 3 – Substantial														
	b) CO and Key Performance Indicators Mapping														
CO1	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.2.2, 2.2.3, 2.2.4, 3.1.1, 3.1.2, 3.1.3, 3.1.5, 4.1.1, 4.3.4, 5.1.2, 6.1.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.2, 9.1.1, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.2, 11.1.1, 11.1.2, 11.2.1, 11.3.1, 11.3.2, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2.														
CO2	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.3.2, 3.1.1, 3.1.2, 3.1.3, 3.1.5, 4.1.1, 4.3.4, 5.1.2, 6.1.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.2, 9.2.1, 9.2.4, 10.1.1, 10.1.2, 10.1.3, 10.2.2, 10.3.2, 11.1.1, 11.1.2, 11.2.1, 11.3.1, 11.3.2, 12.2.2, 12.3.1, 12.3.2.														
CO3	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.2.2, 2.2.3, 2.2.4, 3.1.1, 3.1.2, 3.1.3, 3.1.5, 4.1.1, 4.3.4, 5.1.2, 6.1.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.2, 9.1.1, 9.2.1, 9.2.4, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.2, 11.1.1, 11.1.2, 11.2.1, 11.3.1, 11.3.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2.														

B.E.PRODUCTION ENGINEERING

22PVA$11	PATENTS SYSTEM IN ENGINEERING	SEMESTER $

PREREQUISITES	CATEGORY	L	T	P	C
NIL	EEC	1	0	0	1

Course Objectives	*To familiarise the students in patent systems and processes.	
UNIT – I	INTRODUCTION TO IPR & PATENTS	(5 Periods)
Understanding of Intellectual Property Rights - IPR Regime - Legislations and Salient Features of Patent Act - Content of Indian Patent System.		
UNIT – II	PATENT SEARCH, DRAFTING & FILING PROCEDURE IN INDIA	(5 Periods)
Patent Search - Patent Drafting - Patent Filing Procedure in India - Patent Prosecution in India.		
UNIT – III	PATENT ENFORCEMENT IN INDIA AND INTERNATIONAL PATENT SYSTEMS	(5 Periods)
Enforcement of Patents - Infringement of Patents - International Patent Systems – International Treaties for Patent - Multilateral Agreements.		
Contact Periods: **Lecture: 15 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 15 Periods**		

TEXT BOOK:

1	*Neeraj Pandey, KhushdeepDharni "**Intellectual Property Rights**", PHI Learning pvt. Ltd - New Delhi*
2	*S.R.A. Rosedar "**Intellectual Property Rights**", LexisNexis, 1st edition, 2014.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Describe the basic concept of Intellectual Property Rights.	K2
CO2	Describe the IPR filing procedure in India.	K3
CO3	Describe the patent enforcement and international patent systems.	K2

COURSE ARTICULATION MATRIX:

	a) CO and PO Mapping														
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	2	3	3	2	2	2	2	2	3	3	2	1	0	2
CO2	1	1	3	3	3	3	2	2	2	3	3	2	1	0	1
CO3	1	1	3	3	3	3	1	2	2	3	3	2	1	0	1
22PVA$11	**1**	**2**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**3**	**3**	**2**	**1**	**0**	**2**
	1 – Slight, 2 – Moderate, 3 – Substantial														
	b) CO and Key Performance Indicators Mapping														
CO1	1.2.1, 2.1.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.2.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 6.1.1, 7.1.1, 7.1.2, 8.1.1, 8.2.2, 9.1.2, 9.2.1, 9.3.1, 10.1.1, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 11.2.1, 11.3.1, 11.3.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2.														
CO2	1.2.1, 2.1.1, 2.2.2, 2.2.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.2.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.2, 6.1.1, 6.2.1, 7.1.2, 7.2.2, 8.1.1, 8.2.2, 9.1.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 11.2.1, 11.3.1, 11.3.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2.														
CO3	1.2.1, 2.1.1, 2.2.2, 2.2.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.2.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.2, 6.1.1, 6.2.1, 7.1.2, 8.1.1, 8.2.2, 9.1.2, 9.2.1, 9.3.1, 10.1.1, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 11.2.1, 11.3.1, 11.3.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2.														

B.E.PRODUCTION ENGINEERING

22PVA$12	INDUSTRIAL CASE STUDIES	SEMESTER $

PREREQUISITES	CATEGORY	L	T	P	C
NIL	EEC	1	0	0	1

Course Objectives	*The main objective of the Industrial Training is to experience and understand real life situations in industrial organizations and their related environments and accelerating the learning process of how student's knowledge could be used in a realistic way.

The students have to undergo practical industrial training for four weeks (During Sixth Semester holidays) in recognized industrial establishments.

At the end of the training they have to submit a report with following information:

1. Profile of the Industry,
2. Product range,
3. Organization structure,
4. Plant layout,
5. Processes/Machines/Equipment/devices,
6. Personnel welfare schemes,
7. Details of the training undergone,
8. Projects undertaken during the training, if any
9. Learning points.

End Semester examination will be a Viva-Voce Examination during Seventh Semester. The assessments will be based equally on the report in the prescribed format and viva- voce Examination by a committee nominated by the Head of the Department.

Contact Periods:
Lecture: 0 Periods Tutorial: 0 Periods Practical: 30 Periods Total: 15 Periods

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Discuss the different forms of organization, functions of management, organizational behavior, group dynamics and modern concepts in industrial management	K5

COURSE ARTICULATION MATRIX:

	a) CO and PO Mapping														
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	1	2	2	2	3	2	2	3	2	2	2	2	3
22PVA$12	**3**	**3**	**1**	**2**	**2**	**2**	**3**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**3**
	1 – Slight, 2 – Moderate, 3 – Substantial														
	b) CO and Key Performance Indicators Mapping														
CO1	1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.4, 3.1.1, 3.1.5, 3.3.1, 4.1.1, 4.1.2, 4.1.4, 5.1.1, 5.1.2, 5.2.2, 5.3.1, 6.1.1, 7.1.1, 7.1.2, 7.2.1, 8.1.1, 8.2.2, 9.2.1, 9.2.2, 9.3.1, 10.1.1, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 12.1.2, 12.2.2, 12.3.2.														

B.E.PRODUCTION ENGINEERING

22PVA$13	PROJECT MANAGEMENT	SEMESTER $

PREREQUISITES	CATEGORY	L	T	P	C
NIL	EEC	1	0	0	1

Course Objectives	*To prepare the students to identify, plan, develop, manage, successfully implement, execute and finish the projects within stipulated time in their chosen area.	
UNIT – I	**BASICS OF PROJECT MANAGEMENT**	**(5 Periods)**
Introduction, definition of project and project management, project objectives, classification of projects, need for project management, project management knowledge areas and processes, project life cycle, project management principles.		
UNIT – II	**PROJECT IDENTIFICATION AND PLANNING**	**(5 Periods)**
Project identification process - project initiation, pre-feasibility study, feasibility studies, project break-even point, Project planning -need of project planning, project life cycle, roles, responsibility and team work, project planning process.		
UNIT – III	**PROJECT IMPLEMENTATION AND EXECUTION**	**(5 Periods)**
Organizational structure influences on projects, project risk management- role of risk management in overall project management, steps in risk management, project execution -project control process and case studies in project management.		
Contact Periods: **Lecture: 15 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 15 Periods**		

REFERENCES:

1	*Clifford F. Gray, Erik W. Larson.,* ***"Project Management: The Managerial Process",*** *McGraw Hill, 6th Edition, 2014.*
2	*Gary R.Heerkens.,* ***"Project Management"*** *McGraw Hill, 2002.*
3	*Nick Jenkins.,* ***"A Project Management Primer",*** *2006.*
4	*Robert K. Wysocki* ***"Effective Project Management"*** *Wiley Publishers, 2013.*
5	*Jack R. Meredith and Samuel J. Mantel., "****Project Management, A Managerial Approach****" John Wil & Sons, 2015.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Apply the concepts of project management in engineering.	K3
CO2	Identify and plan new projects.	K2
CO3	Implement and execute new projects.	K3

COURSE ARTICULATION MATRIX:

	a) CO and PO Mapping														
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	1	1	1	1	2	3	2	3	3	3	3	0	0	2
CO2	2	1	1	1	1	2	3	2	3	3	3	3	1	1	2
CO3	2	1	1	1	1	2	3	2	3	3	3	3	1	2	3
22PVA$13	**2**	**1**	**1**	**1**	**1**	**2**	**3**	**2**	**3**	**3**	**3**	**3**	**1**	**1**	**3**
	1 – Slight, 2 – Moderate, 3 – Substantial														
	b) CO and Key Performance Indicators Mapping														
CO1	1.2.1, 1.3.1, 1.4.1, 2.2.2, 2.2.4, 2.4.4, 3.1.1, 3.1.3, 3.1.5, 4.1.1, 4.3.4, 5.1.2, 5.2.2, 6.1.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 1.2.1, 11.3.1, 11.3.2, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2.														
CO2	1.2.1, 1.3.1, 1.4.1, 2.2.2, 2.2.4, 2.4.4, 3.1.1, 3.1.3, 3.1.5, 4.1.1, 4.3.4, 5.1.2, 5.2.2, 6.1.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 1.2.1, 11.3.1, 11.3.2, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2.														
CO3	1.2.1, 1.3.1, 1.4.1, 2.2.2, 2.2.4, 2.4.4, 3.1.1, 3.1.3, 3.1.5, 4.1.1, 4.3.4, 5.1.2, 5.2.2, 6.1.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 1.2.1, 11.3.1, 11.3.2, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2.														

B.E.PRODUCTION ENGINEERING

22PVA$14	PROFESSIONAL SKILLS	SEMESTER $

PREREQUISITES	CATEGORY	L	T	P	C
NIL	EEC	1	0	0	1

Course Objectives	*To inculcate administrative skills in students minds to make them able to administrate effectively for project implementation.	
UNIT – I	SELF ANALYSIS AND CREATIVITY	(05)
SWOT Analysis, Who am I, Attributes, Importance of Self Confidence, Self Esteem. Out of box Thinking, Lateral Thinking.		
UNIT – II	LEADERSHIP	(05)
Skills for a good Leader, Assessment of Leadership Skills, Conflicts in Human Relations – Reasons Case Studies, Approaches to conflict resolution.		
UNIT – III	DECISION MAKING	(05)
Importance and necessity of Decision Making, Process and practical way of Decision Making, Weighing Positives & Negatives.		
Contact Periods: **Lecture: 15 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 15 Periods**		

TEXT BOOK:

1	*Robert D Hisrich, Michael P Peters & Dean Shepherd "**Entrepreneurship**", Tata McGraw Hill, 2007.*
2	*Donald F Kuratko and Richard M Hodgetts "**Entrepreneurship**", South-Western.*

REFERENCES:

1	*Covey Sean, "**Seven Habits of Highly Effective Teens**", New York, Fireside Publishers, 1998.*
2	*Carnegie Dale, "**How to win Friends and Influence People**", New York: Simon & Schuster, 1998.*
3	*Thomas A Harris, "**I am ok, You are ok**", New York-Harper and Row, 1972*
4	*Daniel Coleman, "**Emotional Intelligence**", Bantam Book, 200*
5	*Soft Skills, 2015, "**Career Development Centre**", Green Pearl Publications.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Do self analysis and posses a positive approach	K2
CO2	Develop leadership qualities to solve conflicts and maintain good relationship with personals.	K3
CO3	Make decision for effective project implementation.	K2

B.E.PRODUCTION ENGINEERING

COURSE ARTICULATION MATRIX:

	a) CO and PO Mapping														
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	1	2	1	2	2	2	3	2	2	3	2	1	1	1	2
CO2	1	1	1	1	1	2	3	2	3	3	2	1	0	3	1
CO3	1	1	1	1	1	2	3	2	2	3	3	1	0	3	2
22PVA$14	**1**	**2**	**1**	**2**	**2**	**2**	**3**	**2**	**3**	**3**	**3**	**1**	**1**	**3**	**2**
	1 – Slight, 2 – Moderate, 3 – Substantial														
	b) CO and Key Performance Indicators Mapping														
CO1	1.2.1, 2.1.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 3.1.1, 3.1.2, 3.1.3, 3.1.5, 4.1.1, 4.3.1, 4.3.4, 5.1.2, 5.2.2, 5.3.1, 6.1.1, 7.1.1, 7.1.2, 7.2.1, 8.1.1, 8.2.2, 9.1.2, 9.2.1, 9.2.2, 9.2.4, 10.1.1, 10.1.3, 10.2.1, 10.2.2, 10.3.2, 11.1.1, 11.3.1, 11.3.2, 12.1.1, 12.1.2.														
CO2	1.2.1, 2.1.1, 2.2.2, 2.2.3, 3.1.1, 3.1.3, 3.1.5, 4.1.1, 4.3.4, 5.1.2, 5.2.2, 6.1.1, 7.1.1, 7.1.2, 7.2.1, 8.1.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.3, 10.2.1, 10.2.2, 10.3.2, 11.1.1, 11.3.1, 11.3.2, 12.1.1, 12.2.1.														
CO3	1.2.1, 2.1.1, 2.2.2, 2.2.3, 2.2.4, 3.1.1, 3.1.3, 3.1.5, 4.1.1, 4.3.4, 5.1.2, 5.2.2, 6.1.1, 7.1.1, 7.1.2, 7.2.1, 8.1.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.4, 10.1.1, 10.1.3, 10.2.1, 10.2.2, 10.3.2, 11.1.1, 11.1.2, 11.2.1, 11.3.1, 11.3.2, 12.1.1, 12.2.1.														

B.E.PRODUCTION ENGINEERING

22PVA$15	SOLAR ENERGY SYSTEMS	SEMESTER $

PREREQUISITES	CATEGORY	L	T	P	C
NIL	EEC	1	0	0	1

Course Objectives	*To familiarize the importance of solar energy and methods of harnessing solar energy.	
UNIT- I	**SOLAR THERMAL ENERGY COLLECTORS AND STORAGEDEVICES**	**(5 Periods)**
A review of energy related environmental problems, introduction to solar energy, Devices for thermal collections - Liquid flat plate collector – Solar Air heater – Parabolic concentrating collector – Fresnel reflector - Power tower system – Thermal Storage devices – Latent heat and sensible heat storage.		
UNIT- II	**THERMAL APPLICATIONS**	**(5 Periods)**
Water heating – Space heating – Space cooling and refrigeration – Distillation Drying – Cooking - Solar thermal power plant-Low temperature – medium temperature and high temperature power plant.		
UNIT- III	**SOLAR PHOTO VOLTAIC SYSTEM**	**(5 Periods)**
Solar cell – basic principle - Solar Photo voltaic system for power generation – off – grid and grid connected system – other PV application.		
Contact Periods: **Lecture: 15 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 15 Periods**		

TEXT BOOK:

1	*S.P. Sukhatme., "**Solar Energy: Principles of Thermal Collection and Storage**", Tata McGraw Hill Publishing Company Ltd., New Delhi, 2006.*

REFERENCES:

1	*G.D. Rai., "**Non Conventional Energy Sources**", Khanna Publishers, New Delhi, 1999*
2	*G.N. Tiwari., "**Solar Energy – Fundamentals Design, Modelling and applications**", Narosa Publishing House, New Delhi, 2002.*
3	*D. Yogi Goswami, Frank Kreith, Jan. F. Kreider, **"Principles of Solar Engineering",** 2nd Edition, Taylor & Francis, 2000, Indian reprint, 2003*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the acquired knowledge of various solar thermal energy collectors and thermal storage devices	K3
CO2	Explain the various thermal applications	K3
CO3	Describe the power generation of solar photovoltaic system	K3

B.E.PRODUCTION ENGINEERING

COURSE ARTICULATION MATRIX:

	a) CO and PO Mapping														
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	2	3	3	3	3	3	2	-	1	3	3	3	2	-	1
CO2	2	3	3	3	3	3	2	-	1	3	3	3	2	-	1
CO3	**2**	**3**	**2**	**3**	**3**	**3**	**2**	**-**	**1**	**3**	**3**	**3**	**2**	**-**	**1**
22PVA$15	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**-**	**1**	**2**	**2**	**2**	**2**	**-**	**1**
	1 – Slight, 2 – Moderate, 3 – Substantial														
	b) CO and Key Performance Indicators Mapping														
CO1	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 2.4.4, 3.1.1, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.2, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.2, 7.2.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2														
CO2	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 2.4.4, 3.1.1, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.2, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.2, 7.2.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2														
CO3	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 2.4.4, 3.1.1, 3.1.3, 3.1.4, 3.1.6, 3.2.2, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.2, 7.2.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2														

B.E.PRODUCTION ENGINEERING

22PVA$16	WIND ENERGY SYSTEMS	SEMESTER $

PREREQUISITES	CATEGORY	L	T	P	C
NIL	EEC	1	0	0	1

Course Objectives	*To develop adequate knowledge about wind energy conversion systems.	
UNIT- I	**WIND ENERGY PRINCIPLES**	**(5 Periods)**
Principles of wind Energy Conversion- Nature of wind – Power in the wind – Forces on the wind – wind energy conversion – wind data and wind energy estimation - Site Selection Considerations.		
UNIT- II	**WIND ENERGY CONVERSION SYSTEM**	**(5 Periods)**
Wind Energy Conversion system- Basic components of WECS – Classification - Advantages and Disadvantages of WECS - Types of wind energy collectors – horizontal axis machines – design considerations – vertical axis machines – performance of wind machines.		
UNIT- III	**WIND ENERGY APPLICATIONS**	**(5 Periods)**
Applications of WECS – Pumping – wind assisted gas turbine generators – direct heat applications – Electricity generation -Interconnected System-Environmental Aspects.		
Contact Periods: **Lecture: 15 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 15 Periods**		

TEXT BOOK:

1	*G.D.Rai.,**"NonConventionalEnergySources",**KhannaPublishers,NewDelhi,1999.*

REFERENCES:

1	*GodfreyBoyle,**"RenewableEnergy,PowerforaSustainableFuture".,**OxfordUniversityPress,U.K., 1996*
2	*L.L.Freris.,**WindEnergyConversionsystems",**PrenticeHall,UK,1990*
3	*John D Sorensen and Jens N Sorensen, **"Wind Energy Systems"**, Woodhead Publishing Ltd, 2011.*
4	*Mario Garcia –Sanz, Constantine H. Houpis, **"Wind Energy Systems"**, CRC Press 2012.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the acquired knowledge of Wind Energy principles (WECS) and select suitable site for erecting Wind Energy Conversion System	K3
CO2	Describe the various types of Wind Energy Conversion System (WECS) and its components.	K3
CO3	Explain various applications of wind energy conversion system.	K2

B.E.PRODUCTION ENGINEERING

COURSE ARTICULATION MATRIX:

	a) CO and PO Mapping														
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	2	3	2	3	-	3	2	-	1	3	3	2	2	2	1
CO2	2	3	2	3	3	3	2	-	1	3	2	2	2	3	2
CO3	2	-	1	-	-	3	2	-	1	-	-	2	-	-	-
22PVA$16	**2**	**2**	**1**	**2**	**1**	**2**	**2**	**-**	**1**	**2**	**1**	**2**	**1**	**1**	**1**
	1 – Slight, 2 – Moderate, 3 – Substantial														
	b) CO and Key Performance Indicators Mapping														
CO1	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 2.4.4, 3.1.1, 3.1.3, 3.1.5, 3.3.1, 3.3.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.3, 4.3.4, 6.1.1, 6.2.1, 7.1.2, 7.2.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 11.2.1, 11.3.1, 12.2.1, 12.2.2, 12.3.2														
CO2	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.2, 2.4.1, 2.4.3, 2.4.4, 3.1.1, 3.1.3, 3.1.5, 3.1.6, 3.2.2, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.3, 4.3.4, 5.1.1, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.2, 7.2.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.3.1, 12.2.1, 12.2.2, 12.3.2														
CO3	1.2.1, 1.3.1, 1.4.1, 3.1.5, 6.1.1, 6.2.1, 7.1.2, 7.2.2, 9.2.1, 12.2.1, 12.2.2, 12.3.2														

B.E.PRODUCTION ENGINEERING

22PVA$17	REFRIGERATION SYSTEMS	SEMESTER $

PREREQUISITES	CATEGORY	L	T	P	C
NIL	EEC	1	0	0	1

Course Objectives	*To develop adequate knowledge about refrigeration systems.	
UNIT- I	REFRIGERATION CYCLES	(08)
Air refrigeration cycles – Reversed Carnot cycle, Bell Coleman cycle, simple vapour compression refrigeration cycle, compound compression refrigeration cycles and cascade refrigeration cycles.		
UNIT- II	ABSORPTION SYSTEMS AND REFRIGERANTS	(07)
Ammonia – water system, Lithium Bromide – water system - Electrolux refrigeration system, Steam jet refrigeration and solar refrigeration systems. Refrigerants – properties and classification– eco friendly refrigerants.		
Contact Periods: **Lecture: 15 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 15 Periods**		

TEXT BOOK:

1	*Arora C.P., **"Refrigeration and Air Conditioning"**, Tata McGraw Hill Publishing Company Limited, 3rd Edition, New Delhi, 2009.*

REFERENCES:

1	*RoyJDossat.,**"PrincipleofRefrigeration",**WileyEasternLimited,FifthEdition2001.*
2	*P.N. Ananthanarayanan **" Basic Refrigeration and Air Conditioning"**, Tata McGraw Hill Publishing Company Limited, 4th Edition, 2013.*
3	*Manohar Prasad, **"Refrigeration and Air Conditioning"**, Wiley Eastern Limited, 2004.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Describe various refrigeration cycles.	K3
CO2	Explain various refrigeration systems and refrigerants operated using heat energy.	K3

B.E.PRODUCTION ENGINEERING

COURSE ARTICULATION MATRIX:

	a) CO and PO Mapping														
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	3	2	2	-	-	1	-	1	3	-	2	2	1	-
CO2	2	-	1	-	-	-	1	-	1	3	-	2	1	1	-
CO3	1	1	1	1	-	-	1	-	1	2	-	1	1	1	-
22PVA$17	**3**	**2**	**2**	**1**	**-**	**-**	**1**	**-**	**1**	**3**	**-**	**2**	**2**	**1**	**-**
	1 – Slight, 2 – Moderate, 3 – Substantial														
	b) CO and Key Performance Indicators Mapping														
CO1	1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 2.4.4, 3.1.1, 3.1.3, 3.1.4, 3.1.5, 3.4.1, 4.1.1, 4.1.4, 4.3.3, 4.3.4, 7.1.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 12.2.1, 12.2.2, 12.2.3														
CO2	1.2.1, 1.3.1, 1.4.1, 3.1.5, 7.1.2, 9.2.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 12.1.1, 12.2.1, 12.2.2, 12.3.2														

B.E.PRODUCTION ENGINEERING

22PVA$18	AIR CONDITIONING SYSTEMS	SEMESTER $

PREREQUISITES	CATEGORY	L	T	P	C
NIL	EEC	1	0	0	1

Course Objectives	*To develop adequate knowledge about air conditioning systems.	
UNIT- I	AIR DISTRIBUTION SYSTEMS	(07)
Air distribution systems – study of different types of duct systems, duct insulation, air purity – air cleaning methods.		
UNIT- II	PSYCHROMETRY AND COOLING LOAD	(08)
Psychrometry, psychrometer, psychometric processes, moist air behaviour, effective temperatures, sensible heat factor ratio and cooling load estimation for an air conditioned space.		
Contact Periods: **Lecture: 15 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 15 Periods**		

TEXT BOOK:

1	*Arora C.P., **"Refrigeration and Air Conditioning"**, Tata McGraw Hill Publishing Company Limited, 3rd Edition, New Delhi, 2009.*

REFERENCES:

1	*ManoharPrasad.,**"RefrigerationandAirConditioning",**WileyEasternLimited,2004*
2	*Arora S C and Domkundwar S., **"Refrigeration and Airconditioning"**, Dhanpat Rai& Sons 8th Edition, New Delhi, 1997.*
3	*Jordan and Prister, **"Refrigeration and Air Conditioning"**, Prentice Hall of India Limited, NewDelhi, 1985.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the air distribution systems and components.	K3
CO2	Acquire knowledge about psychrometry and estimate cooling load for air conditioning.	K3

B.E.PRODUCTION ENGINEERING

COURSE ARTICULATION MATRIX:

	a) CO and PO Mapping														
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	2	-	1	-	-	-	1	-	1	3	-	2	1	-	-
CO2	3	3	1	2	-	-	1	-	1	3	-	3	2	1	-
CO3	1	1	1	1	-	-	1	-	1	2	-	1	1	1	-
22PVA$18	**2**	**1**	**1**	**1**	**-**	**-**	**1**	**-**	**1**	**3**	**-**	**2**	**1**	**1**	**-**
	1 – Slight, 2 – Moderate, 3 – Substantial														
	b) CO and Key Performance Indicators Mapping														
CO1	1.2.1, 1.3.1, 1.4.1, 3.1.5, 7.1.2, 9.2.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2														
CO2	1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 2.4.4, 3.1.1, 3.1.3, 3.1.4, 3.1.5, 4.1.1, 4.1.4, 4.3.3, 4.3.4, 7.1.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 12.1.1, 12.2.1, 12.2.2, 12.3.1, 12.3.2														