GOVERNMENT COLLEGE OF TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University)

Coimbatore – 641 013

Curriculum and Syllabi For

B.E. PRODUCTION ENGINEERING (Full Time)

2018

Regulations

OFFICE OF THE CONTROLLER OF EXAMINATIONS

GOVERNMENT COLLEGE OF TECHNOLOGY,

THADAGAM ROAD,

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 and professional behaviors for a harmonious and prosperous society.

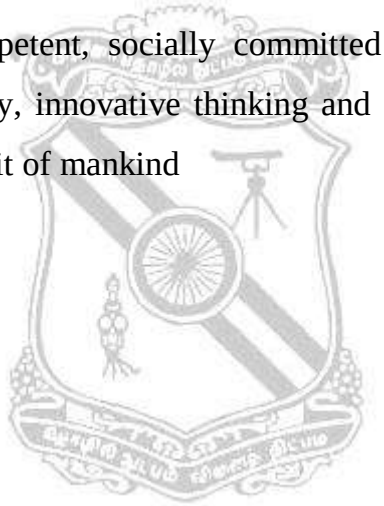
VISION AND MISSION OF THE DEPARTMENT

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 develop technically competent, socially committed and disciplined production engineers with creative ability, innovative thinking and managerial skills to produce quality products for the benefit of mankind



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.

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 needs 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.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO 1: Ability to design manufacturing processes, products, the equipment, tooling and necessary environment for the manufacture of products that meet specific material and other requirements.

PSO 2: Ability to use design, manufacturing and industrial engineering software packages to formulate and solve real time issues.

PSO 3: Ability to analyze, synthesis and control manufacturing operations using statistical methods and to create competitive advantage through the application of manufacturing planning, strategy, quality and control concepts.

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B.E.PRODUCTION ENGINEERING

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FIRST SEMESTER

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks
		Induction Programme	MC	0	0	0

Details of the Programme:

Number of Days: 21 Days

Day0: College Admission

Day1: Orientation Programme

Day2: Registration.

Day3 to Day 23 : 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.

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FIRST SEMESTER

Sl. No.	Course Code	Course title	CAT	CA Marks	End sem marks	Total marks	Hours/week			
							L	T	P	C
		THEORY								
1	18PBS101	Engineering Chemistry	BS	50	50	100	3	1	0	4
2	18PBS102	Calculus and Linear Algebra	BS	50	50	100	3	1	0	4
3	18PES103	Basics of Electrical Engineering	ES	50	50	100	3	0	0	3
		PRACTICAL								
4	18PBS104	Chemistry Laboratory	BS	50	50	100	0	0	3	1.5
5	18PES105	Basics of Electrical Engineering Laboratory	ES	50	50	100	0	0	3	1.5
6	18PES106	Engineering Graphics	ES	50	50	100	2	0	4	4
		TOTAL		**300**	**300**	**600**	**11**	**2**	**10**	**18**

SECOND SEMESTER

Sl. No.	Course Code	Course title	CAT	CA Marks	End sem marks	Total marks	Hours/week			
							L	T	P	C
		THEORY								
1	18PHS201	Communicative English	HS	50	50	100	2	1	0	3
2	18PBS202	Differential Equations and Complex Variables	BS	50	50	100	3	1	0	4
3	18PBS203	Introduction to Electromagnetism and Applied Physics	BS	50	50	100	3	1	0	4
4	18PES204	Python Programming	ES	50	50	100	3	0	0	3
		PRACTICAL								
5	18PBS205	Physics Laboratory	BS	50	50	100	0	0	3	1.5
6	18PES206	Workshop Practice	ES	50	50	100	1	0	4	3
7	18PES207	Python Programming Laboratory	ES	50	50	100	0	0	3	1.5
		TOTAL		**350**	**350**	**700**	**12**	**3**	**10**	**20**

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THIRD SEMESTER

Sl. No.	Course Code	Course title	CAT	CA Marks	End sem marks	Total marks	Hours/week			
							L	T	P	C
		THEORY								
1	18PHS301	Business Communication Skills	HS	50	50	100	3	0	0	3
2	18PBS302	Partial Differential Equations, Probability and Statistics	BS	50	50	100	3	1	0	4
3	18PES303	Engineering Mechanics	ES	50	50	100	3	1	0	4
4	18PES304	Thermal Sciences	ES	50	50	100	3	1	0	4
5	18PPC305	Engineering Metallurgy	PC	50	50	100	3	0	0	3
6	18PPC306	Manufacturing Technology	PC	50	50	100	3	0	0	3
7	18PMC3Z7	Constitution of India	MC	50	50	100	3	0	0	0
		PRACTICAL								
8	18PPC308	Metallurgy Laboratory and Thermal Science Laboratory	PC	50	50	100	0	0	3	1.5
9	18PPC309	Manufacturing Processes Laboratory	PC	50	50	100	0	0	3	1.5
		TOTAL		**450**	**450**	**900**	**21**	**3**	**6**	**24**

FOURTH SEMESTER

Sl. No.	Course Code	Course title	CAT	CA Marks	End sem marks	Total marks	Hours/week			
							L	T	P	C
		THEORY								
1	18PHS401	Total Quality Management Concepts	HS	50	50	100	3	0	0	3
2	18PBS402	Waves and Optics	BS	50	50	100	3	0	0	3
3	18PES403	Basic Electronics Engineering	ES	50	50	100	3	0	0	3
4	18PPC404	Fluid Mechanics and Machinery	PC	50	50	100	3	0	0	3
5	18PPC405	Mechanics of Materials	PC	50	50	100	3	0	0	3
6	18PPC406	Machine Tools and Processes	PC	50	50	100	3	0	0	3
7	18PMC4Z7	Environmental Sciences and Engineering	MC	50	50	100	3	0	0	0
		PRACTICAL								
8	18PPC408	Strength of Materials and Fluid Machinery Laboratory	PC	50	50	100	0	0	3	1.5
9	18PPC409	Production Drawing	PC	50	50	100	0	0	3	1.5
		TOTAL		**450**	**450**	**900**	**21**	**0**	**6**	**21**

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FIFTH SEMESTER

Sl. No.	Course Code	Course title	CAT	CA Marks	End sem marks	Total marks	Hours/week			
							L	T	P	C
		THEORY								
1	18PHS501	Operations Research Techniques	HS	50	50	100	3	1	0	4
2	18PPC502	Production Planning and Control	PC	50	50	100	3	0	0	3
3	18PPC503	Mechanics of Machines	PC	50	50	100	3	0	0	3
4	18PPC504	Metrology and Computer Aided Inspection	PC	50	50	100	3	0	0	3
5	18PPE5XX	Professional Elective I	PE	50	50	100	3	0	0	3
6	18#OE5XX	Open Elective I	OE	50	50	100	3	0	0	3
		PRACTICAL								
7	18PPC507	Metrology Laboratory	PC	50	50	100	0	0	3	1.5
8	18PEE508	Skill Development on Industrial Practices / Technical Projects	EEC	50	50	100	0	0	4	2
		TOTAL		**400**	**400**	**800**	**18**	**1**	**7**	**22.5**

SIXTH SEMESTER

Sl. No.	Course Code	Course title	CAT	CA Marks	End sem marks	Total marks	Hours/week			
							L	T	P	C
		THEORY								
1	18PPC601	Machine Elements Design	PC	50	50	100	3	1	0	4
2	18PPC602	Automation and CIM	PC	50	50	100	3	0	0	3
3	18PPC603	Fluid Power Drives and Controls	PC	50	50	100	3	0	0	3
4	18PPE6XX	Professional Elective II	PE	50	50	100	3	0	0	3
5	18#OE6XX	Open Elective II	OE	50	50	100	3	0	0	3
6	18#OE6XX	Open Elective III	OE	50	50	100	3	0	0	3
		PRACTICAL								
7	18PPC607	Modelling Laboratory	PC	50	50	100	0	0	3	1.5
8	18PEE608	Automation and Control Systems Laboratory	EEC	50	50	100	0	0	3	1.5
		TOTAL		**400**	**400**	**800**	**18**	**1**	**6**	**22**

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SEVENTH SEMESTER

Sl. No.	Course Code	Course title	CAT	CA Marks	End sem marks	Total marks	Hours/week			
							L	T	P	C
		THEORY								
1	18PPC701	Additive Manufacturing	PC	50	50	100	3	0	0	3
2	18PPC702	Production of Automotive Components	PC	50	50	100	3	0	0	3
3	18PPC703	Jigs, Fixtures and Press Tools	PC	50	50	100	3	0	0	3
4	18PPE7XX	Professional Elective III	PE	50	50	100	3	0	0	3
5	18PPE7XX	Professional Elective IV	PE	50	50	100	3	0	0	3
6	18#OE7XX	Open Elective IV	OE	50	50	100	3	0	0	3
		PRACTICAL								
7	18PPC707	Simulation Laboratory	PC	50	50	100	0	0	3	1.5
8	18PEE708	Mini Project	EEC	50	50	100	0	0	8	4
		TOTAL		**400**	**400**	**800**	**18**	**0**	**11**	**23.5**

EIGHTH SEMESTER

Sl. No.	Course Code	Course title	CAT	CA Marks	End sem marks	Total marks	Hours/week			
							L	T	P	C
		THEORY								
1	18PPE8XX	Professional Elective V	PE	50	50	100	3	0	0	3
2	18PPE8XX	Professional Elective VI	PE	50	50	100	3	0	0	3
		PRACTICAL								
3	18PEE803	Project Work	EEC	100	100	200	0	0	16	8
		TOTAL		**200**	**200**	**400**	**6**	**0**	**16**	**14**

HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT (HS)

Sl. No.	Course Code	Course title	CAT	CA Marks	End sem marks	Total marks	Hours/week			
							L	T	P	C
1	18PHS201	Communicative English	HS	50	50	100	2	1	0	3
2	18PHS301	Business Communication Skill	HS	50	50	100	3	0	0	3
3	18PHS401	Total Quality Management Concepts	HS	50	50	100	3	0	0	3
4	18PHS501	Operations Research Techniques	HS	50	50	100	3	1	0	4

BASIC SCIENCES (BS)

Sl. No.	Course Code	Course title	CAT	CA Marks	End sem marks	Total marks	Hours/week			
							L	T	P	C
1	18PBS101	Engineering Chemistry	BS	50	50	100	3	1	0	4
2	18PBS102	Calculus and Linear Algebra	BS	50	50	100	3	1	0	4
3	18PBS104	Chemistry Laboratory	BS	50	50	100	0	0	3	1.5
4	18PBS202	Differential Equations and Complex Variables	BS	50	50	100	3	1	0	4
5	18PBS203	Introduction to Electromagnetism and Applied Physics	BS	50	50	100	3	1	0	4
6	18PBS205	Physics Laboratory	BS	50	50	100	0	0	3	1.5
7	18PBS302	Partial Differential Equations, Probability and Statistics	BS	50	50	100	3	1	0	4
8	18PBS402	Waves and Optics	BS	50	50	100	3	0	0	3

ENGINEERING SCIENCES (ES)

Sl. No.	Course Code	Course title	CAT	CA Marks	End sem marks	Total marks	Hours/week			
							L	T	P	C
1	18PES103	Basics of Electrical Engineering	ES	50	50	100	3	0	0	3
2	18PES105	Basics of Electrical Engineering laboratory	ES	50	50	100	0	0	3	1.5
3	18PES106	Engineering Graphics	ES	50	50	100	2	0	4	4
4	18PES204	Python Programming	ES	50	50	100	3	0	0	3
5	18PES206	Workshop Practice	ES	50	50	100	1	0	4	3
6	18PES207	Python Programming Laboratory	ES	50	50	100	0	0	3	1.5
7	18PES303	Engineering Mechanics	ES	50	50	100	3	1	0	4
8	18PES304	Thermal Sciences	ES	50	50	100	3	1	0	4
9	18PES403	Basic Electronics Engineering	ES	50	50	100	3	0	0	3

PROFESSIONAL CORE (PC)

Sl. No.	Course Code	Course title	CAT	CA Marks	End sem marks	Total marks	Hours/week			
							L	T	P	C
1	18PPC305	Engineering Metallurgy	PC	50	50	100	3	0	0	3
2	18PPC306	Manufacturing Technology	PC	50	50	100	3	0	0	3
3	18PPC308	Metallurgy Laboratory and Thermal Science Laboratory	PC	50	50	100	0	0	3	1.5
4	18PPC309	Manufacturing Processes Laboratory	PC	50	50	100	0	0	3	1.5
5	18PPC404	Fluid Mechanics and Machinery	PC	50	50	100	3	0	0	3
6	18PPC405	Mechanics of Materials	PC	50	50	100	3	0	0	3
7	18PPC406	Machine Tools and Processes	PC	50	50	100	3	0	0	3
8	18PPC408	Strength of Materials and Fluid Machinery Laboratory	PC	50	50	100	0	0	3	1.5
9	18PPC409	Production Drawing	PC	50	50	100	0	0	3	1.5
10	18PPC502	Production Planning and Control	PC	50	50	100	3	0	0	3
11	18PPC503	Mechanics of Machines	PC	50	50	100	3	0	0	3
12	18PPC504	Metrology and Computer Aided Inspection	PC	50	50	100	3	0	0	3
13	18PPC507	Metrology Laboratory	PC	50	50	100	0	0	3	1.5
14	18PPC601	Machine Elements Design	PC	50	50	100	3	1	0	4
15	18PPC602	Automation and CIM	PC	50	50	100	3	0	0	3
16	18PPC603	Fluid Power Drives and Controls	PC	50	50	100	3	0	0	3
17	18PPC607	Modelling Laboratory	PC	50	50	100	0	0	3	1.5
18	18PPC701	Additive Manufacturing	PC	50	50	100	3	0	0	3
19	18PPC702	Production of Automotive Components	PC	50	50	100	3	0	0	3
20	18PPC703	Jigs, Fixtures and Press Tools	PC	50	50	100	3	0	0	3
21	18PPC707	Simulation Laboratory	PC	50	50	100	0	0	3	1.5

PROFESSIONAL ELECTIVES (PE)

Sl. No.	Course Code	Course title	CAT	CA Marks	End sem marks	Total marks	Hours/week			
							L	T	P	C
1	18PPE$01	Mechatronic Systems	PE	50	50	100	3	0	0	3
2	18PPE$02	Finite Element Techniques	PE	50	50	100	3	0	0	3
3	18PPE$03	Unconventional Manufacturing Processes	PE	50	50	100	3	0	0	3
4	18PPE$04	CNC Technology	PE	50	50	100	3	0	0	3
5	18PPE$05	Power Plant Engineering	PE	50	50	100	3	0	0	3
6	18PPE$06	Robust Design	PE	50	50	100	3	0	0	3
7	18PPE$07	Statistical Quality Control and Reliability Engineering	PE	50	50	100	3	0	0	3
8	18PPE$08	Advanced Welding Technology	PE	50	50	100	3	0	0	3
9	18PPE$09	Product Design and Process Engineering	PE	50	50	100	3	0	0	3
10	18PPE$10	Design for Manufacture and Assembly	PE	50	50	100	3	0	0	3
11	18PPE$11	Human Values and Professional Ethics II	PE	50	50	100	3	0	0	3
12	18PPE$12	Plant Layout and Material Handling	PE	50	50	100	3	0	0	3
13	18PPE$13	Non Destructive Testing Techniques	PE	50	50	100	3	0	0	3
14	18PPE$14	Supply Chain Management	PE	50	50	100	3	0	0	3
15	18PPE$15	Production Management	PE	50	50	100	3	0	0	3
16	18PPE$16	Lean Manufacturing	PE	50	50	100	3	0	0	3
17	18PPE$17	Micro manufacturing Processes	PE	50	50	100	3	0	0	3
18	18PPE$18	Theory of Metal Cutting	PE	50	50	100	3	0	0	3
19	18PPE$19	Advanced Casting Technology	PE	50	50	100	3	0	0	3
20	18PPE$20	Total Productive Maintenance	PE	50	50	100	3	0	0	3
21	18PPE$21	Green Manufacturing	PE	50	50	100	3	0	0	3
22	18PPE$22	Computer Aided Design	PE	50	50	100	3	0	0	3
23	18PPE$23	Robotics and Machine Vision System	PE	50	50	100	3	0	0	3
24	18PPE$24	Investment Casting	PE	50	50	100	3	0	0	3
25	18PPE$25	Electronics Manufacturing Technology	PE	50	50	100	3	0	0	3
26	18PPE$26	Smart Manufacturing	PE	50	50	100	3	0	0	3

OPEN ELECTIVES (O.E)

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem. Marks	Total Marks	Hours/Week			
							L	T	P	C
1.	18COE$01	Climate Change and Adaptation	OE	50	50	100	3	0	0	3
2.	18COE$02	Disaster Management and Mitigation	OE	50	50	100	3	0	0	3
3.	18COE$03	Energy Efficient Buildings	OE	50	50	100	3	0	0	3
4.	18MOE$04	Nanotechnology and Surface Engineering	OE	50	50	100	3	0	0	3
5.	18MOE$05	Mechatronics	OE	50	50	100	3	0	0	3
6.	18MOE$06	Renewable Energy Sources	OE	50	50	100	3	0	0	3
7.	18EOE$07	Renewable Power Generation Systems	OE	50	50	100	3	0	0	3
8.	18EOE$08	Electric Vehicles	OE	50	50	100	3	0	0	3
9.	18EOE$09	Smart Grid Systems	OE	50	50	100	3	0	0	3
10.	18LOE$10	Mobile Communication	OE	50	50	100	3	0	0	3
11.	18LOE$11	Introduction to VLSI System Design	OE	50	50	100	3	0	0	3
12.	18LOE$12	Microcontroller and Applications	OE	50	50	100	3	0	0	3
13.	18POE$13	Rapid Prototyping	OE	50	50	100	3	0	0	3
14.	18POE$14	Managerial Economics	OE	50	50	100	3	0	0	3
15.	18POE$15	Hydraulics and Pneumatics	OE	50	50	100	3	0	0	3
16.	18NOE$16	Measurement and Control	OE	50	50	100	3	0	0	3
17.	18NOE$17	Industrial Automation	OE	50	50	100	3	0	0	3
18.	18NOE$18	Virtual Instrumentation	OE	50	50	100	3	0	0	3
19.	18SOE$19	Programming in Java	OE	50	50	100	3	0	0	3
20.	18SOE$20	Cyber Security	OE	50	50	100	3	0	0	3
21.	18SOE$21	Network Essentials	OE	50	50	100	3	0	0	3
22.	18IOE$22	Programming in Python	OE	50	50	100	3	0	0	3
23.	18IOE$23	Big Data Science	OE	50	50	100	3	0	0	3
24.	18IOE$24	Object Oriented Programming Using C++	OE	50	50	100	3	0	0	3
25.	18BOE$25	Computational Biology	OE	50	50	100	3	0	0	3
26.	18BOE$26	Biology for Engineers	OE	50	50	100	3	0	0	3
27	18BOE$27	Fundamentals of Bioengineering	OE	50	50	100	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC) – PRACTICAL COURSES AND PROJECT WORK

Sl. No.	Course Code	Course title	CAT	CA Marks	End sem marks	Total marks	Hours/week			
							L	T	P	C
1	18PEE508	Skill Development on Industrial Practices / Technical Projects	EEC	50	50	100	0	0	4	2
2	18PEE608	Automation and Control Systems Laboratory	EEC	50	50	100	0	0	3	1.5
3	18PEE708	Mini Project	EEC	50	50	100	0	0	8	4
4	18PEE803	Project Work	EEC	100	100	200	0	0	16	8

MANDATORY COURSES (MC)

Sl. No.	Course Code	Course title	CAT	CA Marks	End sem marks	Total marks	Hours/week			
							L	T	P	C
1	18PMC3Z7	Constitution of India	MC	50	50	100	3	0	0	0
2	18PMC4Z7	Environmental Sciences and Engineering	MC	50	50	100	3	0	0	0

VALUE ADDED COURSES (ONE CREDIT) (VA)

Sl. No.	Course Code	Course title	CAT	CA Marks	End sem marks	Total marks	Hours/week			
							L	T	P	C
1	18PVA$01	Human Values I	VA	100	-	100	1	0	0	1
2	18PVA$02	Human Values and Professional Ethics	VA	100	-	100	1	0	0	1
3	18PVA$03	Yoga for Youth Empowerment	VA	100	-	100	1	0	0	1
4	18PVA$04	Basics of Civil Engineering	VA	100	-	100	1	0	0	1
5	18PVA$05	Metallography	VA	100	-	100	1	0	0	1
6	18PVA$06	Design of Experiments using Taguchi Concept	VA	100	-	100	1	0	0	1
7	18PVA$07	Entrepreneurship Development	VA	100	-	100	1	0	0	1
8	18PVA$08	Patents System in Engineering	VA	100	-	100	1	0	0	1
9	18PVA$09	Industrial case studies	VA	100	-	100	1	0	0	1
10	18PVA$10	Project Management	VA	100	-	100	1	0	0	1
11	18PVA$11	Industrial safety	VA	100	-	100	1	0	0	1
12	18PVA$12	Six Sigma	VA	100	-	100	1	0	0	1
13	18PVA$13	Professional Skills	VA	100	-	100	1	0	0	1
14	18PVA$14	Solar Energy Systems	VA	100	-	100	1	0	0	1
15	18PVA$15	Wind Energy Systems	VA	100	-	100	1	0	0	1
16	18PVA$16	Refrigeration Systems	VA	100	-	100	1	0	0	1
17	18PVA$17	Air Conditioning Systems	VA	100	-	100	1	0	0	1

CURRICULAM DESIGN FOR CBCS 2018 REGULATIONS

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

SUMMARY

S.No	Category	Credits Per Semester								Total Credits	% of Credits	AICTE Suggested Credits
		I	II	III	IV	V	VI	VII	VIII			
1	HS		3	3	3	4				13	7.88	12
2	BS	9.5	9.5	4	3					26	15.76	25
3	ES	8.5	7.5	8	3					27	16.36	24
4	PC			9	12	10.5	11.5	10.5		53.5	32.42	48
5	PE					3	3	6	6	18	10.91	18
6	OE					3	6	3		12	7.27	18
7	EEC					2	1.5	4	8	15.5	9.39	15
8	MC	0		0	0	0				0	0	0
Total		18	20	24	21	22.5	22	23.5	14	165	100	160

HS	Humanities and Social Sciences including Management
BS	Basic Science
ES	Engineering Science
PC	Professional Core
PE	Professional Elective
OE	Open Elective
EEC	Employability Enhancement Courses
MC	Mandatory Course

18PBS101	**ENGINEERING CHEMISTRY** *(Common to CIVIL, MECH & PRODN Branches)*	**SEMESTER I**

Category : BS

L	T	P	C
3	1	0	4

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- The course is aimed at imparting knowledge of Engineering Chemistry topics which would be useful for students to understand chemistry relevant to conventional engineering fields.

UNIT-I : WATER TECHNOLOGY	**(9+3 Periods)**
Water- sources - types of impurities, hardness - temporary and permanent – units - ppm and mg/L - estimation of hardness – EDTA method- problems- Boiler troubles- internal treatment – external treatment- lime soda process and ion exchange process- Drinking water - characteristics- colour, odour, turbidity, chloride - treatment - preliminary, primary and disinfection methods- chlorination- breakpoint chlorination, desalination – reverse osmosis.	
UNIT-II : SPECTROSCOPIC TECHNIQUES AND APPLICATIONS	**(9+3 Periods)**
Beer Lambert's law -UV visible spectroscopy and IR spectroscopy – principles – instrumentation (block diagram only)- flame photometry- principle – instrumentation (block diagram only)- estimation of sodium by flame photometry- Atomic absorption spectroscopy – principles – instrumentation(block diagram only) – estimation of nickel by atomic absorption spectroscopy.	
UNIT-III : FUELS AND COMBUSTION	**(9+3 Periods)**
Fuels- classifications - calorific value - Gross and Net calorific value - combustion –theoretical air- principle and calculations - solid fuels - Coal-proximate and ultimate analysis- significance- Coke- characteristics- manufacture by Otto Hoffman method - Liquid fuels – petroleum fractionation - petrol and diesel - knocking of ic engines and diesel engines - octane and cetane number- anti-knocking agents – Biogas – biodiesel.	
UNIT-IV : ENGINEERING MATERIALS	**(9+3 Periods)**
Refractories – classification - properties and manufacture of silica and magnesia bricks; Abrasives- Classification, properties - manufacture of SiC -; Lubricants –solid lubricants (Graphite & Molybdenum sulphide) hydrodynamic mechanism of lubrication – Cement – manufacture - setting and hardening of cement - special cements - Alumina cement and waterproof cement.	
UNIT-V : CORROSION	**(9+3 Periods)**
Corrosion – Spontaneity - Chemical corrosion- mechanism, nature of oxides – Pilling Bedworth rule - Electrochemical corrosion- mechanism – Galvanic series and importance – Prevention methods - design of materials, cathodic protection techniques (sacrificial anode and impressed current cathode), Inhibitors - Protective coatings -Inorganic coating- electroplating – surface preparation and plating method applied to Cr and Ni and galvanizing – Organic coating - paints- constituents and functions.	
Contact periods:	

Lecture: 45 Periods	**Tutorial:15 Periods**	**Practical: 0 Periods**	**Total: 60 Periods**

TEXT BOOKS:

1. *Jain. P.C. and Monica Jain,* ***"Engineering Chemistry",*** *Dhanpat Rai Publications Pvt. Ltd, New Delhi, 16th Edition, 2017.*
2. *Vairam.S, Subha Ramesh,* ***"Engineering Chemistry",*** *Wiley India, 2015.*

REFERENCE BOOKS:

1. *Dara. S.S, Umarae,* ***"TEXT BOOKS of Engineering Chemistry",*** *S. Chand Publications, 2004.*
2. *Agarwal, C.V.* ***"Chemistry of Engineering Materials",*** *9th Edition, B.S. Publications, 2006.*
3. *Kuriakose, J.C., and Rajaram J,* ***"Chemistry in Engineering and Technology",*** *vol.1 & II, Tata Mc Graw Hill Publishing company Pvt.Ltd, New Delhi, 2001*
4. *Y R Sharma ,* ***"Elementary Organic Spectroscopy",*** *S. Chand Publications, 2013.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Understand the nature of impurities and the effects of various sources of water, and apply them in treatment them usable for industrial and domestic purposes.

CO2: Know about the different types of polymeric materials, properties and fabrication which match the specific applications.

CO3: Learn the different types of fuels with their compositions, combustion characteristics In engines and apply them in design of combustion chambers.

CO4: Be familiar with the various engineering materials, refractories, abrasives, lubricants and cements with their properties and manufacturing methods which are used in engineering applications.

CO5: Gain the knowledge about corrosion of the machinery they use in their fields and, also to understand the mechanisms and to adopt the preventive measures by various techniques.

18PBS102	CALCULUS AND LINEAR ALGEBRA *(Common to CIVIL, MECH & PRODN Branches)*	SEMESTER I

Category: BS

L	T	P	C
3	1	0	4

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To be familiar with differentiation of single variable and its applications.
- To obtain the knowledge of definite and improper integration and applications.
- To acquire knowledge of differentiation for more than one variable and vector differentiation.
- To gain the knowledge of multiple integration and related applications and vector integration including theorems.
- To know about matrix theory used to solve linear system and diagonalise a matrix by transformation.

UNIT-I: DIFFERENTIAL CALCULUS	**(9+3 Periods)**
Rolle's theorem, Mean value theorems, Taylor's and Maclaurin theorems, indeterminate forms and L'Hospital's rule, Maxima and minima, Evolute of a curve.	
UNIT-II: INTEGRAL CALCULUS	**(9+3 Periods)**
Evaluation of definite and improper integrals; Beta and Gamma functions and their properties, Applications of definite integrals to evaluate surface areas and volume of revolution.	
UNIT-III: MULTIVARIABLE CALCULUS (DIFFERENTIATION)	**(9+3 Periods)**
Limit, continuity and partial derivatives, total derivative, Jacobians, Maxima, minima and saddle points, Method of Lagrange multipliers, Gradient, curl and divergence.	
UNIT-IV: MULTIVARIABLE CALCULUS (INTEGRATION)	**(9+3 Periods)**
Multiple integration - Double integrals, change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes, Triple integrals (Cartesian), Change of variables (Cartesian to spherical polar). Theorems of Green, Gauss and Stokes, Simple applications involving cubes, sphere and rectangular parallelepipeds.	
UNIT-V: MATRICES	**(9+3 Periods)**
Inverse and rank of a matrix, System of linear equations, Eigenvalues and eigenvectors, Diagonalization of matrices, Cayley-Hamilton Theorem, Orthogonal transformation and quadratic to canonical forms.	
Contact periods:	

Lecture: 45 Periods	**Tutorial: 15 Periods**	**Practical: 0 Periods**	**Total: 60 Periods**

TEXT BOOKS:

1. *Veerarajan T., **Engineering Mathematics (for first year)**, Tata McGraw-Hill, New Delhi,2008.*
2. *Srimanta Pal and suboth.C.Bhunia, **Engineering Mathematics**, Oxford university publications, New Delhi, 2015.*

REFERENCE BOOKS:

1. *B.S.Grewal,* ***Higher Engineering Mathematics****, Khanna Publishers, 43rd Edition,2015.*
2. *Erwinkreyszig,* ***Advanced Engineering Mathematics****,9th Edition, John Wiley & Sons, 2006.*
3. *Sivaramakrishnadas.P, Rukmangadachari.E,* ***Engineering Mathematics****, Pearson, Chennai & Delhi, 2nd Edition,2013.*
4. *James Stewart,* ***Essential Calculus****, Cengage Learning, Delhi, 2nd Edition, 2013.*
5. *Howard Anton, IRL Bivens, Stephen Davis,* ***Calculus,*** *Wiley, New Delhi, 10th Edition, 2013.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Understand the standard theorems and applications like maxima and minima, evolute of a curve using principles of differentiation.

CO2: Acquire fluency in integration of one variable for definite and improper integrals like beta and gamma functions and also applications of area and volumes.

CO3: Understand the techniques of partial differentiation and vector differentiation.

CO4: Understand multiple integration for finding area, surface and volume and applications to Green's, Stoke's and Gauss theorems on Vector Calculus.

CO5: Solve the linear system of equations by rank of a matrix and matrix inversion and understand the process of diagonalisation by orthogonal transformation.

18PES103	**BASICS OF ELECTRICAL ENGINEERING** *(Common to MECH & PRODN Branches)*	**SEMESTER I**

Category : ES

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To understand and analyze basic electric circuits
- To Study the working principles of Electrical Machines and Transformers
- To Study the working principles of power converters and Drives

UNIT-I : DC CIRCUITS	**(9 Periods)**
Electrical Circuit Elements – Voltage and Current Sources– Source transformation techniques – Ohms law, Kirchhoff's laws –Analysis of simple circuits with DC excitation – Superposition, Thevenin and Norton's theorem. Star and Delta transformation. Time domain analysis of first order RL and RC Circuits.	
UNIT-II : AC CIRCUITS	**(9 Periods)**
Representation of Sinusoidal waveforms, peak, rms and average value. Real power, reactive power, apparent power and power factor. Analysis of single phase AC circuits consisting of R,L, C, RL, RC, RLC combinations (Series and Parallel) – Resonance in series Circuits (Study of phenomenon). Three phase circuits – relation between voltage and current in star and delta connections – Three phase balanced circuits.	
UNIT-III : DC MACHINES AND TRANSFORMERS	**(9 Periods)**
Construction and Principle of operation and speed control of separately excited DC motor – Characteristics of motors – Applications - Magnetic materials – BH characteristics – Single phase transformer – Equivalent circuit – Types of Losses in a transformer – No Load test and Load test – Regulation and Efficiency – Auto transformer – Three phase transformer connections – Uses of transformers – Applications.	
UNIT-IV: ELECTRICAL MACHINES	**(9 Periods)**
Construction and Principle of operation of Three phase induction motor – Torque slip characteristics – Starting and speed control methods – Loss components and efficiency. Construction and working of Single phase induction motor – Construction and Working of Synchronous generators and types — Applications of all machines.	
UNIT-V : POWER CONVERTERS AND DRIVES	**(9 Periods)**
Operation of three phase Converter and Inverter circuits – Working of Chopper and duty ratio control – Chopper control of separately excited DC motor – Stator voltage control of three phase induction motor drives – Rotor resistance control of three phase induction motor – Closed loop control of slip power recovery scheme.	
Contact periods:	

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

TEXT BOOKS:

1. *D.P.Kothari, I.J.Nagrath,, **"Basic Electrical Engineering"**, Tata McGraw Hill, 2010.*
2. *P. S. Bimbhra, "**Electrical Machinery**", Khanna Publishers, 2011.*
3. *M. H. Rashid, "**Power electronics: circuits, devices, and applications**", Pearson Education India, 2009.*
4. *G. K. Dubey, "**Power Semiconductor Controlled Drives**", Prentice Hall, 1989*

REFERENCE BOOKS:

1. *Nagsarkar T K and Sukhija M S, **"Basic Electrical Engineering"**, Oxford Press (2005).*
2. *I. J. Nagrath and D. P. Kothari, "**Electric Machines**", McGraw Hill Education, 2010.*
3. *E.Hughes, **" Electrical and Electronics Technology"**, Pearson, 2010.*
4. *Mahmood Nahvi and Joseph A. Edminister, **"Electric Circuits"**, Schaum Outline Series, McGraw Hill, Sixth edition (2014).*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Verify Ohm's law and Kirchoff's laws for simple electrical circuits.
CO2: Verify Simple network theorems for electrical circuits.
CO3: Solve problems on AC circuits and analyze three phase AC circuits.
CO4: Understand the performance of DC machines and transformers.
CO5: Basic understanding of power electronic circuits and their application in speed control of AC and DC machines.

18PBS104	CHEMISTRY LABORATORY *(Common to All Branches)*	SEMESTER I

Category : BS

PRE-REQUISITES: NIL

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To inculcate practical applications of chemistry to students and make him apply in the fields of engineering and technology.

LIST OF EXPERIMENTS			
1.	Estimation of hardness by EDTA method.		
2	Estimation of chloride by Argentometric method.		
3.	Conductometric titration of mixture of strong acid and weak acid using strong base.		
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 HCl by pH titration.		
8.	Determination of the rate constant of reaction.		
9.	Estimation of Dissolved Oxygen.		
Contact periods:			
Lecture: 0Periods	**Tutorial: 0Periods**	**Practical: 45 Periods**	**Total: 45 Periods**

REFERENCE BOOKS:

1. *A.O. Thomas, "**Practical Chemistry"**, Scientific Book Centre, Cannanore, 2003.*
2. *Vogel's "**TEXT BOOKS 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

CO1: Understand the nature of hardness, chloride level, pollution level using dissolved oxygen content, iron present in water and analyse them in water.

CO2: Apply the EMF and conductometric measurements in quantitative analysis of substances.

18PES105	**BASICS OF ELECTRICAL ENGINEERING LABORATORY** *(Common to MECH & PRODN Branches)*	**SEMESTER I**

Category : ES

PRE-REQUISITES: NIL

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To familiarize with basic electrical wiring and measurements.
- To provide basic laboratory experience on electronic circuits, DC machines, AC machines and transformer.
- To demonstrate internal cut-section views of machines and other advanced measurements devices.

LIST OF EXPERIMENTS			
1.	Introductions to measuring instruments – voltmeter, ammeter, wattmeter, multimeter and Digital Storage Oscilloscope.		
2.	Resonance in RLC circuits, verification of laws in electrical circuits.		
3.	Measurement of phase difference between voltage and current		
4.	No load test on single phase transformer and equivalent test		
5.	Load Test on single phase transformer		
6.	Three phase transformer connections		
7.	Voltage - Current relations in three phase circuit and three phase power measurement		
8.	Demonstration of cut out section of machines		
9.	Swinburne's Test, Speed Control and Load test on DC motor		
10.	Direction change and load test on three phase induction motor		
11.	Alternator load test and regulation test		
12.	Demonstration of LT switchgear components		
13.	Demonstration of AC and DC drives		
Contact periods:			
Lecture: 0Periods	**Tutorial: 0Periods**	**Practical: 45 Periods**	**Total: 45 Periods**

COURSE OUTCOMES:

Upon the completion of the course, the student will be able to

CO1: Making electrical connections by wires of appropriate wires **[Usage]**
CO2: Acquire exposure to common electrical components and measuring instruments. **[Familiarity]**
CO3: Verify Simple laws using electrical circuits. **[Usage]**
CO4: Do experiment to understand the characteristics of transformers and Electrical machines. **[Usage]**
CO5: Understand the working of Low Tension Switch gear components, AC and DC drives. **[Assessment]**

18PES106	ENGINEERING GRAPHICS *(Common to All Branches)*	SEMESTER I

Category : ES

PRE-REQUISITES: NIL

L	T	P	C
2	0	4	4

COURSE OBJECTIVES:

- Geometrical constructions
- Orthographic projections.
- Performing section of solids and development of the same.
- Pictorial view of solids

UNIT-I : GEOMETRICAL CONSTRUCTIONS	**(6+12 Periods)**
Dimensioning-Lettering-Types of Lines-Scaling conventions-Dividing a given straight line in to any number of equal parts- Bisecting a given angle- Drawing a regular polygon given one side-Special methods of constructing a pentagon and hexagon.	
UNIT-II : ORTHOGRAPHIC PROJECTIONS	**(6+12 Periods)**
Introduction to Orthographic Projection-Projection of points-Projection of straight lines with traces -Conversion of pictorial views to orthographic views-Projection of solids	
UNIT-III : SECTION OF SOLIDS AND DEVELOPMENT	**(6+12 Periods)**
Section of solids- Development of surfaces	
UNIT-IV : PICTORIAL VIEWS	**(6+12 Periods)**
Isometric projections - Conversion of orthographic views to pictorial views (simple objects).	
UNIT-V : COMPUTER AIDED DRAFTING	**(6+12 Periods)**
Introduction to computer aided drafting package to make 2-D Drawings. OBJECT CONSTRUCTION – page layout – Layers and Line type – 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 be included in examinations)	
Contact periods:	

Lecture: 30 Periods	**Tutorial: 0 Periods**	**Practical: 60 Periods**	**Total: 90 Periods**

TEXT BOOKS:

1. *K.Venugopal, **"Engineering Graphics"**, New Age International (P) Limited, 2015.*
2. *K.L.Narayana and P.Kannaiah, **"TEXT BOOKS on Engineering Drawing,"** 2nd Edition, SciTech Publications (India) Pvt. Ltd, Chennai, 2009.*

REFERENCE BOOKS:

1. *Dhananjay.A.Jolhe, **"Engineering Drawing"**, Tata McGraw Hill Publishing Co., 2007.*
2. *K.V.Nataraajan, **"A TEXT BOOKS of Engineering Graphics"**, Dhanalakashmi Publishers, Chennai, 2006.*
3. *M.B.Shah and B.C. Rana, **"Engineering Drawing"**, Pearson Education, 2005.*
4. *Luzadder and Duff, **"Fundamentals of Engineering Drawing"**, Prentice Hall of India Pvt Ltd, XIth Edition, 2001.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Represent solids as per international standards.

CO2: Generate and interpret multiple views through development, interpretation and sectional views.

CO3: Generate and interrupt orthographic views.

CO4: Generate and interrupt pictorial views.

18PHS201	COMMUNICATIVE ENGLISH *(Common to All Branches)*	SEMESTER II

Category : HS

L	T	P	C
2	1	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

The course is intended to

- Make learners listen to audio files and replicate in speaking contexts
- Make learners read widely and practice it in writing
- Make learners develop vocabulary and strengthen grammatical understanding

UNIT-I : LISTENING	**(6+3 Periods)**
Listening Comprehension, Pronunciation, Intonation, Stress, Pause, Rhythm, Listening to Short & Long Conversations/Monologues - Note-Taking.	
UNIT-II : SPEAKING	**(6+3 Periods)**
Self Introduction, Making Oral & Formal Presentation, Communication at Work Place, Mock Interviews, Role Play Activities, Group Discussions, Debates, Delivering Welcome Address, Proposing Vote of Thanks, Introducing the Chief Guest at a function.	
UNIT-III : READING	**(6+3 Periods)**
Reading Comprehension, Speed Reading, Interpreting Visual Materials (Signs, Post Cards Pictures, Labels Etc.), Reading for Specific Information-Reading to identify Stylistic Features (Syntax, Lexis, Sentence Structures)-Cloze Test.	
UNIT-IV : WRITING	**(6+3 Periods)**
Phrase, Clause And Sentence Structures, Punctuation, Discourse Markers, Coherence, Precision in Writing, Graph & Process Description-Definition, Writing Email-Paraphrasing, Note making, Job Application With Resume, Writing Review of a Book / Movie, Creative Writing.	
UNIT-V : GRAMMAR AND VOCABULARY	**(6+3 Periods)**
Word Formation with Prefix and Suffix, Synonyms and Antonyms, Tenses, Parts of Speech, Common Errors in English (Subject –Verb Agreement, Noun-Pronoun Agreement, Prepositions, Articles, Conditional statements, Redundancies, Clichés etc), Voices.	

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

TEXT BOOKS:

1. ***Board of Editors, Using English****, Orient Black Swan, 2015.*

REFERENCE BOOKS:

1. ***Practical English Usage****, Michael Swan. OUP 1995.*
2. ***Cambridge BEC Vantage*** *- Practice Tests, Self-study Edition, CUP, 2002*
3. ***Exercises in Spoken English****.Parts. I –III. EFLU,Hyderabad, OUP, 2014*
4. ***Indlish****. Jyothi Sanyal, Viva Books,2006*
5. ***Communicative English****. J.Anbazhagan Vijay, Global Publishers, Chennai. 2018*

WEB REFERENCES

1. *www.cambridgeenglish.org/exams/business.../business-**preliminary**/*
2. *http://www.examenglish.com/BEC/BEC_Vantage.html*
3. *www.splendid-speaking.com/exams/**bec**_speaking.htmlhtml*

COURSE OUTCOMES:

At the end of the course, the learners will be able to

CO1: Listen and speak better in formal / semi formal situations

CO2: Read and write well for a context appropriately

CO3: Strengthen Vocabulary and Grammar

18PBS202	DIFFERENTIAL EQUATIONS AND COMPLEX VARIABLES *(Common to CIVIL, MECH & PRODN Branches)*	SEMESTER II

Category: BS

PRE-REQUISITES: NIL

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

- To gain methods to solve second order differential equations with constant and variable coefficients.
- To be familiarize with formation and solutions of first order partial differential equation.
- To be understood with solutions of higher order partial differential equation and product solutions to standard PDEs.
- To be known about analytic functions with properties, construction of analytic function and the knowledge of conformal transformation.
- To obtain the knowledge of Cauchy's integral theorems, calculus of residues and complex integration around unit circle and semicircle.

UNIT-I: ORDINARY DIFFERENTIAL EQUATIONS OF HIGHER ORDER	**(9+3 Periods)**
Second order linear differential equations with constant and variable coefficients, Cauchy-Euler equation, Cauchy-Legendre equation. Method of variation of parameters, Power series solutions of Differential equations with Bessel and Legendre functions.	
UNIT-II : PARTIAL DIFFERENTIAL EQUATIONS – FIRST ORDER	**(9+3 Periods)**
Formation of partial differential equations by elimination arbitrary constants and functions. Solutions to First order partial differential equations: Standard types of first order linear and non-linear PDE, Lagrange's linear PDE.	
UNIT-III : PARTIAL DIFFERENTIAL EQUATIONS – HIGHER ORDER	**(9+3 Periods)**
Solution to homogenous and non-homogenous linear partial differential equations second and higher order by complimentary function and particular integral method. Separation of variables method: simple problems in Cartesian coordinates, Laplacian equation in plane, cylindrical and spherical polar coordinates, one dimensional diffusion equation.	
UNIT-IV : COMPLEX DIFFERENTIATION	**(9+3 Periods)**
Functions of a Complex variable - Analytic functions - Cauchy Riemann equations and sufficient conditions (excluding proof) - Harmonic and orthogonal properties of analytic functions - Construction of analytic functions – Conformal mappings: w=z+a, az, 1/z, z^2, e^z,cosz, sinz and Bilinear transformations.	
UNIT-V: COMPLEX INTEGRATION	**(9+3 Periods)**
Cauchy's integral theorem - Cauchy's integral formula - Taylor's and Laurent's theorems (Statements only) and expansions - Poles and Residues - Cauchy's Residue theorem - Contour integration: Circular and semicircle contours with no pole on real axis.	

Contact periods:			
Lecture: 45 Periods	**Tutorial: 15 Periods**	**Practical: 0 Periods**	**Total: 60 Periods**

TEXT BOOKS:

1. *Veerarajan T.,* ***Engineering Mathematics (for first year)****, Tata McGraw-Hill, New Delhi, 2008.*
2. *Srimanta Pal and suboth.C.Bhunia,* ***Engineering Mathematics****, Oxford university publications, New Delhi, 2015.*

REFERENCE BOOKS:

1. *B.S.Grewal,* ***Higher Engineering Mathematics****, Khanna Publishers,Delhi, 43rd Edition,2015.*
2. *Erwinkreyszig,* ***Advanced Engineering Mathematics****,9th Edition, John Wiley&Sons, 2006.*
3. *N.P. Bali and Manish Goyal,* ***A TEXT BOOKS of Engineering Mathematics****, Laxmi Publications, Reprint, 2008.*
4. *E. A. Coddington,* ***An Introduction to Ordinary Differential Equations****, Prentice Hall India, 1995.*
5. *G.F. Simmons and S.G. Krantz,* ***Differential Equations****, Tata McGraw Hill, 2007.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Understand the general solutions to higher order differential equations and power series solutions to second order differential equations leading to Bessel and Legendre functions.

CO2: Acquire fluency in solving first order partial differential equations.

CO3: Understand the techniques of solving second order partial differential equations and solutions by method of separation of variables.

CO4: Understand the properties of analytic function, formation of analytic function and mappings of standard functions, Mobius transformation.

CO5: Understand calculus of residues to evaluate contour integration.

18PBS203	INTRODUCTION TO ELECTROMAGNETISM AND APPLIED PHYSICS *(Common to MECH & PRODN Branches)*	SEMESTER: II

Category : BS

L	T	P	C
3	1	0	4

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

To enhance the fundamental knowledge in electromagnetism and applied physics for Mechanical and Production engineering. Upon completion of this course the students will be familiar with:

- Fundamentals of electromagnetism.
- Properties and applications of magnetic and super conducting materials.
- Elastic behavior of solids, thermal conduction and applications
- Exposed to different types of Non-destructive testing methods
- Basics of vacuum science, production and measurement

UNIT-I : ELECTROMAGNETISM	**(9+3 Periods)**
Physics of Divergence, Gradient and Curl, Qualitative understanding of surface and volume integral - Maxwell Equations (Qualitative) – Differential Form and Integral Form - Wave Equation – Derivation in Vacuum and Homogeneous Isotropic Dielectric Medium - Electromagnetic Waves - Refractive index - Phase velocity - Group velocity, Group index, Wave guide (Qualitative)	
UNIT-II : MAGNETIC MATERIALS AND SUPERCONDUCTORS	**(9+3 Periods)**
Introduction - Origin of magnetic moment - Bohr magneton - Dia, Para, and Ferro magnetic materials - Domain theory of ferromagnetism - Hysteresis - Hard and Soft magnetic materials – Superconductivity - Types of superconductors - BCS theory of superconductivity (qualitative) - properties- High Tc superconductors, Applications of superconductors- SQUID, Cryotron, Magnetic levitation.	
UNIT-III : PROPERTIES OF MATTER AND THERMAL PHYSICS	**(9+3 Periods)**
Elasticity- Hooke's law- stress-strain diagram - Factors affecting elasticity - Bending moment - Depression of a cantilever - Young's modulus by uniform bending - I shaped girders. Thermal conductivity - heat conduction in solids – Rectilinear flow of heat through along a uniform bar - Forbe's and Lee's disc method: theory and experiment.	
UNIT-IV : NON-DESTRUCTIVE TESTING	**(9+3 Periods)**
X-ray Testing – Fluorescence -Phosphorescence -Fluoroscopy –Ultrasonic Testing - Pulse echo system –LASER Testing - Liquid Penetrant Testing – Magnetic Particle Testing	
UNIT-V : VACUUM SCIENCE	**(9+3 Periods)**
Introduction - Importance of vacuum in industries - Pumping speed and throughput - Types of pumps- Rotary vane type Vacuum pump(oil sealed), Diffusion Pump and Turbo Molecular Pump - Measurement of High Vacuum-McLeod Gauge-Pirani Gauge-Penning Gauge.	

Contact periods:			
Lecture: 45 Periods	**Tutorial: 15 Periods**	**Practical: 0 Periods**	**Total: 60 Periods**

TEXT BOOKS:

1. *David Griffiths, "**Introduction to Electrodynamics"** – Unit I*
2. *P.K. Palanisamy – **Engineering Physics–II**,Scitech publications (India)pvt. Ltd , 3 rd edition 2015. – Unit II& III*

REFERENCE BOOKS:

1. *Jearl Walker, **"Fundamentals of Physics"** ,Halliday & Resnick, 10th edition,2014, WILEY- Unit-1*
2. *Baldev Raj, T. Jayakumar and M. Thavasimuthu, **"Practical Non-DestructiveTesting"**, 3rd edition,Narosa Publishing House (2007).- Unit IV*
3. *Ganesan S. Iyandurai N –**"Applied Physics"**, KKS Publishers, Chennai, 2007- Unit V*
4. *Krautkramer, Josef and Hebert Krautkramer, **"Ultrasonic Testing of Materials"**, 3rdedition, New York, Springer-Verlag (1983). – Unit IV*
5. *R. Halmshaw, **"Industrial Radiography"**, Applied Science Publishers inc.,Englewood, NJ (1982).*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Acquire knowledge in basics of Electromagnetism

CO2: Identify, analyze the properties and applications of magnetic & super conducting materials. [Familiarity]

CO3: Acquire knowledge in properties of matter and thermal physics [Application]

CO4: Familiarization of different methods of Non-destructive testing

CO5: Production & measurement of vacuum.[Familiarity]

18PES204	PYTHON PROGRAMMING *(Common to MECH & PRODN Branches)*	SEMESTER II

Category : ES

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

Upon completion of this course the students will be Familiar with:

- Data types and variables declaration
- Conditional statements, Functions and the use of basic programming.
- Iteration, Strings and List
- Dictionaries, Tuples and File handling.
- Object oriented programming development.

UNIT-I : INTRODUCTION	**(9 Periods)**
Building blocks of program – Notations, pseudo code, algorithm, flow chart, python programming language – program, debugging, Data and expression – types, variables and keywords, operators, expressions and statements, interactive mode and script mode, string operations and comments.	
UNIT-II : FUNCTIONS AND CONDITIONAL EXPRESSIONS	**(9 Periods)**
Function calls, type conversion, math, composition, adding new functions, Parameters, Stack diagram, other functions, importing with from, return values, increments, composition, Boolean function, recursion, stack diagram for recursive functions, Expressions - modulus and logical operators, Boolean expressions, conditional execution , chain and nested conditionals.	
UNIT-III : ITERATION, STRINGS, LIST	**(9 Periods)**
Multiple assignment, while statement, break, algorithms, For Loop, Strings – slices, searching, counting, methods, in operator comparison, List – traversing, operations, slices, methods, map filter and reduce, deleting elements , list and strings, objects and values, list arguments.	
UNIT-IV : DICTIONARIES, TUPLES, FILES	**(9 Periods)**
Looping and dictionaries, reverse lookup, dictionaries and lists, memos, global variables, long integers, Tuples – assignments, return values as tuples, variable length and argument, list and tuples, dictionaries and tuples, comparing, sequences, Files - reading and writing, format operator, file names and paths, catching exceptions, data bases, pickling, pipes, writing modules.	
UNIT-V : OBJECT ORIENTED PROGRAMMING	**(9 Periods)**
Classes – user defined types, attributes, rectangles, instances as return values, objects, copying, Classes and Functions – time, pure functions, modifiers, prototyping versus planning, Classes and Methods – object oriented features, printing objects, methods, operator overloading, polymorphism, interface and implementation, Inheritance – class diagrams , data encapsulation.	
Contact periods:	

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

TEXT BOOKS:

1. *Allen Downney "**Think python** – **How to think like a computer scientist**", Grean Tea press, 2015.*

REFERENCE BOOKS:

1. *Michael Dawson "**Python Programming for the Absolute Beginner**", Premier Press, 2003.*
2. *Y. Daniel Liang "**Introduction to Programming Using Python**", Pearson, 2013.*
3. *Charles Dierbach "**Introduction to Computer Science Using Python: A Computational Problem-Solving Focus**", Wiley Publications, 2012*.

COURSE OUTCOMES:

Upon completion of this course the students will be able to:

CO1: Use various data types.[**Understand**]
CO2: Analyze the use of functions and conditional structures.[**Analyze**]
CO3: Use control statements, strings and lists. [**Understand**]
CO4: Handle Dictionaries, tuples and perform file operations**. [Understand]**
CO5: Develop application using object oriented programming. [**Analyze**]

18PBS205	**PHYSICS LABORATORY** *(Common to All Branches)*	**SEMESTER II**

Category : BS

L	T	P	C
0	0	3	1.5

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

To improve the basic knowledge in Physics and its applications relevant to various streams of Engineering and Technology. Upon completion of this course the students will be familiar with:

* To have a practical knowledge about the concepts of physics and its applications in the emerging fields of engineering and technology

LABORATORY EXPERIMENTS			
1.	Spectrometer - Diffraction Grating Normal Incidence Method		
2	Air Wedge –Determination thickness of a paper		
3.	Young's Modulus – Cantilever Bending Koenig's Method		
4.	a) Laser - Particle size Determination b) Optical fiber - Determination of NA & Acceptance angle		
5.	Ammeter and Voltmeter Calibration – Low Range		
6.	Determination of Bandgap Energy of Semiconductor		
7.	Ultrasonic Interferometer - Velocity of sound & Compressibility of liquids.		
8.	Torsional pendulum –Determination of Rigidity Modulus & Moment of Inertia		
Contact periods:			
Lecture: 0Periods	**Tutorial: 0Periods**	**Practical: 45 Periods**	**Total: 45 Periods**

COURSE OUTCOMES:

Upon the completion of the course, the student will be able to

CO1: Determine all physical properties of any matter,

CO2: Calibrate electrical measuring instruments and thereby effectively using it for Particular application

CO3: Understand principle of Laser diffraction and its application in particle size determination

CO4: Understand the concept of light propagation through optical fibers and determination of its parameters

CO5: Determine the Intrinsic characteristic features of electronic devices for electrical and electronic applications.

CO6: Understand the ultrasonic wave propagation in liquids and the determination of compressibility of liquids for engineering applications.

18PES206	WORKSHOP PRACTICE *(Common to All Branches)*	SEMESTER II

Category : ES

L	T	P	C
1	0	4	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To make various basic prototypes in the carpentry trade such as Lap joint, Lap Tee joint, Dove tail joint, Mortise & Tenon joint and Cross-Lap joint.
- To make various welding joints such as Lap joint, Lap Tee joint, Edge joint, Butt joint and Corner joint.

LIST OF EXPERIMENTS			
1	Introduction to use of tools and equipments in Carpentry, Welding, Foundry and Sheet metal		
2	Safety aspects in Welding, Carpentry and Foundry		
3	Half lap Joint and Dovetail Joint in Carpentry		
4	Welding of Lap joint, 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	Electrical wiring – simple house wiring		
8	Plumbing		
9	CNC Machines demonstration and lecture on working principle.		
10	Additive manufacturing demonstration and lecture on working principle		
Contact periods:			
Lecture: 15 Periods	**Tutorial: 0 Periods**	**Practical: 60 Periods**	**Total: 75 Periods**

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO 1: Use tools and equipments used in Carpentry, Welding, Foundry and Sheet metal.
CO 2: Make half lap joint and dovetail joint in carpentry.
CO 3: Make welded lap joint, butt joint and T-joint.
CO 4: Prepare sand mould for cube, conical bush, pipes and V pulley.
CO 5: Fabricate parts like tray, frustum of cone and square box in sheet metal
CO 6: Carry out minor works/repair related to electrical wiring and plumbing.

18PES207	**PYTHON PROGRAMMING LABORATORY** *(Common to MECH & PRODN Branches)*	**SEMESTER II**

Category : ES

L	T	P	C
0	0	3	1.5

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

Upon completion of this course the students will be Familiar with:

- Data types and variables declaration
- Conditional statements, Functions and the use of basic programming.
- Iteration, Strings and List.
- Dictionaries, Tuples and File handling.
- Object oriented programming development.

LIST OF EXPERIMENTS			
1	Expressions and operators		
2	Conditional statements		
3	Functions		
4	Looping statements		
5	Strings		
6	Lists		
7	Dictionaries		
8	Tuples		
9	Files		
10	Classes – overloading, polymorphism, interfacing, encapsulation		
Contact periods:			
Lecture: 0Periods	**Tutorial: 0Periods**	**Practical: 45 Periods**	**Total: 45 Periods**

COURSE OUTCOMES:

Upon completion of this course, the students will be able to

CO1: Understand various data types.[**Understand**]
CO2: Analyze the use of functions and conditional structures.[**Analyze**]
CO3: Implement control statements, strings and lists. [**Analyze**]
CO4: Handle Dictionaries, tuples and perform file operations**.** [**Analyze**]
CO5: Develop application using object oriented programming. [**Analyze**]

18PHS301	**BUSINESS COMMUNICATION SKILLS** *(Common to MECH., EEE, PRODN & EIE Branches)*	**SEMESTER III**

Category: HS

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To impart knowledge on effective Business Communication Skills

UNIT – I: ACQUISITION OF GOOD ENGLISH	**(9 Periods)**
Parts of speech, Tenses, Vocabulary, Choice of words, Synonyms, Antonyms, Homonyms, Homophones, Prefixes, Suffixes, One word substitutes, Idioms, Phrasal verbs, Abbreviations, Acronyms.	
UNIT – II : BUSINESS WRITING	**(9 Periods)**
Sentence structure & patterns, SV Agreement, Punctuation, Email, Letter writing: Application, Interview, Appointment, Confirmation, Reference, Good will, Congratulatory, and thanking letters, Report writing, Precise writing: Summarizing matters reported in dailies & journals, decisions taken in meetings & conferences.	
UNIT – III : BUSINESS CORRESPONDENCE	**(9 Periods)**
Enquiry: Types, Purpose, Notice inviting Tenders, Placing order, Making, Handling & Rejecting complaints, Sales letters, Market surveys, Status reports, Advertisements, Classifieds, Memo reports, Office circulars, Memorandums, and Report writing.	
UNIT – IV : BUSINESS COMMUNICATION	**(9 Periods)**
Verbal & Non-Verbal communication, Body language, Soft skills, Pronunciation, Stress & Intonation, Inviting people, Accepting or Declining offers, Conveying or leaving messages over phone, Presentation, Negotiation, Speaking at a meeting.	
UNIT – V INTERPERSONAL COMMUNICATION IN ORGANIZATIONS	**(9 Periods)**
Skills needed to develop effective teams, Group Communication, Professional etiquettes, Interpersonal communication, Team roles, Effective listening and speaking, Critical thinking, Technology and communication	

Contact Periods:

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

TEXT BOOKS

1. *Bisen, Vikram & Priya.* ***"Business Communication"****, New Age International Publishers, New Delhi, 2009*
2. *Thomas.L.Means.* ***"Business Communication"****, South-Western Cengage Learning, USA, 2010.*
3. *Adhikari, Bhavana & Sethi, Anjanee.* ***"Buisness Communication"****, Tata McGraw Hill Education Private Ltd., New Delhi, 2010*

REFERENCE BOOKS:

1. *Simon Sweeney.* ***"English for Business Communication"****, Cambridge University Press, Cambridge, 2007.*
2. *Hartley, Peter & Bruckmann G. Clive.* ***"Business Communication"****, Routledge, New York, 2007.*
3. *Locker O. Kitty.* ***"Business Communication"*** *McGrill, New York, 2009*

COURSE OUTCOME:

Upon completion of the course, the student will be able to

CO1: Acquire English language skills.
CO2: Familiarize English language usage for business contexts.
CO3: Develop business correspondence.
CO4: Execute effective business communication.
CO5: Practice good interpersonal communication.

COURSE ARTICULATION MATRIX

CO/ PO	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	L									M	L	M	L		
CO2	L									M	L	M	H		
CO3	L									M	L	M		H	
CO4	L									M	L	M	H		
CO5	-									M	L	M			H
18PHS 301	L									M	L	M	L	L	L

L-Low M-Moderate (Medium), H-High

18PBS302	PARTIAL DIFFERENTIAL EQUATIONS, PROBABILITY AND STATISTICS *(Common to MECH & PRODN Branches)*	SEMESTER III

Category : BS

L	T	P	C
3	1	0	4

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To be familiarize with analytical solutions of boundary value problems as applications of partial differential equations
- To gain the concepts of probability
- To obtain the knowledge of probability distributions both discrete and continuous cases.
- To gain the knowledge of test of hypothesis applicable to small and large samples.
- To familiarize with control chart.

UNIT- I	**BOUNDARY VALUE PROBLEMS**	**(9+3 Periods)**
Half range Sine and Cosine Fourier Series –One dimensional wave equation – One dimensional heat equation (Unsteady and Steady state conditions) – Two dimensional heat equation (infinite plate only) – Fourier series solution.		
UNIT- II	**PROBABILITYAND RANDOM VARIABLES**	**(9+3 Periods)**
Sample spaces–Events – Probability Axioms–Conditional Probability – Independent Events – Baye's Theorem. Random Variables**:** Distribution Functions – Expectation - Moments - Moment Generating Functions.		
UNIT- III	**PROBABILITY DISTRIBUTIONS**	**(9+3 Periods)**
Binomial, Poisson, Geometric, Uniform, Exponential, Normal, Gamma, Weibull (Mean, Variance and Simple problems). Functions of random variables.		
UNIT- IV	**TESTING OF HYPOTHESIS**	**(9+3 Periods)**
Large samples: Tests for Mean and proportions– Small samples: Tests for Mean, Variance and Attributes using t,F, Chi–Square distribution.		
UNIT- V	**STATISTICAL QUALITY CONTROL AND CORRELATION ANALYSIS**	**(9+3 Periods)**
Statistical basis for control charts–Control limits– Control charts for variables:$\bar{X}$,R Charts – Control chart for defective:p, np Chart – Control chart for defects:c charts. Multiple and Partial Correlation - Partial Regression (Problems Only)		

Contact Periods:

Lecture: 45 Periods Tutorial: 15 Periods Practical: 0 Periods Total: 60 Periods

TEXT BOOKS:

1. *B.S.Grewal., **"Higher Engineering Mathematics",** Khanna Publishers, New Delhi, 43rd Edition, 2014.*
2. *Veerarajan T.,, **"Probability and Random Processes (with Queueing Theory and Queueing Networks)",** McGraw Hill Education (India) Pvt Ltd., New Delhi, Fourth Edition,2016.*

REFERENCE BOOKS:

1. *Veerarajan T., **"Transforms and Partial Differential Equations For semester III",** Tata Mc Graw Hill Education (India) Pvt Ltd., New Delhi, 2016.*
2. *Gupta S.C and Kapoor V.K., **"Fundamentals of Mathematical Statistics",** Sultan Chand & Sons, New Delhi, 2015.*
3. *Gupta S.P, **"Statistical Methods",** Sultan Chand & Sons, New Delhi, 2015.*
4. *Trivedi K.S, **"Probability and Statistics with Reliability, Queuing and Computer Science Applications",** Prentice Hall of India, New Delhi.*
5. *Hwei Hsu, **"Schaum's outline series of Theory and Problems of Probability and Random Process",** Tata McGraw Hill Publishing Co., New Delhi, 2015.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Solve boundary value problems as applications of partial differential equations
CO2: Acquire fluency in solving probability oriented problems
CO3: Solve problems on discrete and continuous probability distributions
CO4: Test for significance of hypothesis connected to small and large samples
CO5: Utilize the control chart technique and find partial and multiple correlations.

COURSE ARTICULATION MATRIX

PO/PSO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PSO	PSO	PSO
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	H	H	H	H	M	H	H	M	M	M	M	H	M	M	M
CO2	H	H	M	H	M	H	M	M	L	H	M	M	H	M	L
CO3	H	H	H	M	M	H	M	M	L	M	M	M	M	M	M
CO4	H	H	H	H	M	H	M	M	M	H	M	M	M	M	M
CO5	H	H	H	H	M	H	H	H	H	H	M	H	H	M	M
18PBS302	H	H	H	H	M	H	M	M	M	H	M	M	M	M	M

L- Low, M – Moderate (Medium), H – High

18PES303	**ENGINEERING MECHANICS** *(Common to MECH.,EEE, PROD., EIE & CSE Branches)*	**SEMESTER III**

Category : ES

L	T	P	C
3	1	0	4

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- To understand the force systems, geometrical properties and frictions in real life applications.
- To understand the dynamics behaviour of particles and impulse momentum principle.

UNIT – I : INTRODUCTION TO MECHANICS AND FORCE CONCEPTS	**(9+3 Periods)**
Principles and Concepts – Laws of Mechanics – system of forces – 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 into force and couple – forces in space – addition of concurrent forces in space – equilibrium of a particle in space.	
UNIT – II : FRICTION	**(9+3 Periods)**
Frictional resistance – classification of friction- laws of friction – coefficient of friction-angle of friction – angle of repose — cone of friction – free body diagram-advantages-equilibrium of a body on a rough inclined plane – non-concurrent force system - ladder friction – rope friction – wedge friction.	
UNIT – III : GEOMETRICAL PROPERTIES OF SECTION	**(9+3 Periods)**
Centroids – Determination by integration – centroid of an area – simple figures - composite sections – bodies with cut parts - moment of inertia – theorems of moment of inertia – moment of inertia of composite sections – principal moment of inertia of plane areas - radius of gyration.	
UNIT – IV : BASICS OF DYNAMICS	**(9+3 Periods)**
Kinematics and kinetics – displacements, velocity and acceleration - Equations of motion – Rectilinear motion of a particle with uniform velocity, uniform acceleration, varying acceleration – motion curves – motion under gravity – relative motion – curvilinear motion of particles – projectiles – angle of projection – range – time of flight and maximum height. Newton's second law of motion – linear momentum – D'Alembert's principle, Dynamics equilibrium — work energy equation of particles– law of conservation of energy – principle of work and energy	
UNIT – V : IMPULSE MOMENTUM AND IMPACT OF ELASTIC BODIES	**(9+3 Periods)**
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: 15 Periods** **Practical: 0 Periods** **Total: 60 Periods**

TEXT BOOKS:

1. *S.S. Bhavikatti and K.G. Rajasekarappa **"Engineering Mechanics"** New Age International (P) Ltd. 1999.*
2. *S.C. Natesan **"Engineering Mechanics"** Umesh Publications, 5-B north market, Naisarak, Delhi , 2002.*
3. *Domkundwar V.M and Anand V. Domkundwar**, "Engineering Mechanics (Statics and Dynamics)",** Dhanpat Rai and Co. Ltd, 1 st Edition, 2006.*

REFERENCE BOOKS:

1. *F.B. Beer and E.R. Johnson, **"Vector Mechanics for Engineers"**, Tata Mc.Graw Hill Pvt. Ltd, 10th Edition,2013.*
2. *S. Timoshenko and Young, **"Engineering Mechanics",** Mc.Graw Hill, 4th Edition, 1995.*
3. *Irving Shames and Krishna Mohana Rao, **"Engineering Mechanics"**, Prentice Hall of India Ltd, Delhi, 2006.*
4. *R.C. Hibbeller, **"Engineering Mechanics"**, Prentice Hall of India Ltd,13th Edition,2013.*
5. *Vela Murali, **"Engineering Mechanics",** Oxford university Press,1st Edition,2010.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Know the concept of mechanics and system of forces.
CO2: Calculate the frictional properties at different bodies.
CO3: Identify the locations of centre of gravity and moment of inertia for different sections.
CO4: Understand the basics of dynamics of particles.
CO5: Know the impulse and momentum principle and impact of elastic bodies.

COURSE ARTICULATION MATRIX

PO/PSO CO	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	M	H	M	L	L				L		L		L	L	L
CO2	L	H	L		L				L		L		L		L
CO3	L	H	L		L				L		L		L		L
CO4	M	H	L	M	L								L		L
CO5	L	H		M		L							L		L
18PES303	L	H	L	M	L	L			L		L		L	L	L

L- Low, M – Moderate (Medium), H – High

18PES304	**THERMAL SCIENCES** *(Use of Approved Steam table and Refrigeration and Air conditioning table is permitted)*	**SEMESTER III**

Category: ES

PRE-REQUISITES: NIL

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

- To understand the basic laws of Thermodynamics and Heat and mass transfer.
- To understand 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)**
Rankine cycle (without reheat and regeneration), Steam power plant, Brayton cycle, gas turbine power plant, cogeneration and combined cycle power plants. Global energy requirements – role of energy managers in industries.		
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 cycles - vapour absorption cycle, comparison between vapour compression and absorption systems. Properties of steam: P - V, T - S and H - S diagrams- Psychrometry, Psychrometric chart – processes.		
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's law.		

Contact Periods:

Lecture: 45 Periods Tutorial: 15 Periods Practical: 0 Periods Total: 60 Periods

TEXT BOOKS:

1. *Yunus A Cengel **"Introductionto Thermodynamics and Heat Transfer",** McGraw Hill Inc., New York, 2007.*
2. *Nag.P.K, **"Engineering Thermodynamics",** Tata McGraw-Hill, New Delhi, 2008.*
3. *R.K.Rajput **"Thermal Engineering",** Laxmi Publications (P) Ltd, 6th edition New Delhi, 2006.*

REFERENCE BOOKS:

1. *R.K.Rajput **"Heat and Mass Transfer",** 5th Edition,S.Chand& Company ltd,2012*
2. *Kothandaraman.C.P.,Domkundwar.S. andA.V.Domkundwar **"A course in Thermal Engineering",** Dhanpat Rai and Sons., 5th edition, 2000.*
3. *Holman.J.P **"Heat and Mass Transfer",** 3rd Edition, McGraw-Hill, 2007*
4. *Ganesan V **"Internal Combustion Engines",** Tata McGraw Hill Publishing Company, New Delhi, 2007.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: describe the thermodynamic systems and various laws of thermodynamics.

CO2: explain various thermodynamic cycles.

CO3: describe about IC engines.

CO4: describe the refrigeration and air conditioning systems.

CO5: explain about heat transfer in a thermodynamic system.

COURSE ARTICULATION MATRIX

PO/PSO CO	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	M	H	M	M		L			L	H		L	L		L
CO2	M	M	L	H		M			L	H		M	L		L
CO3	M	L	L	M		M			L	H		M	L		L
CO4	M	L	H	H		M	M		L	M		M	L		L
CO5	M	L	L	L		M	M		L	M		M	L	L	L
16PES304	M	M	M	M		M	L		L	M		M	L	L	L

L – Low, M- Moderate (Medium), H – High

18PPC305	ENGINEERING METALLURGY	SEMESTER III

Category: PC

	L	T	P	C
PRE-REQUISITES:	**3**	**0**	**0**	**3**

1. 18PBS203- Introduction to Electromagnetism and Applied Physics

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 BOOKS:

1. *Higgins R.A **"Engineering Metallurgy",** Viva books(p) ltd.,6th edition, 1998.*
2. *Dieter, G.E **"Mechanical metallurgy, SI metric edition",** McGraw-Hill, ISBN 0-07-100406-8, 1988.*
3. *Sydney H.Avner **"Introduction to Physical Metallurgy" ,** Tata McGraw Hill Book Company, 1994.*

REFERENCE BOOKS:

1. *William D Callsber **"Material Science and Engineering",** Wiley India pvt Ltd 2007.*
2. *Lakhtin Yu. **"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:

On completion of this course, students will be able to

CO1: Predict the alloy components and its composition variation with respect to temperature changes.

CO2: Select suitable materials and heat treatment methods for various industrial applications.

CO3: Understand the ferrous and nonferrous materials and their application

CO4: Apply the knowledge of foundry and powder metallurgy to solve various industrial production processes.

CO5: Gain knowledge about materials testing methods and welding techniques to meet industrial requirements.

COURSE ARTICULATION MATRIX

PO/PSO / CO	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	L				M			L				L	M		
CO2	M		H		H								H	M	
CO3	H	M			M								M	H	L
CO4	L	M			M								L	M	
CO5	L					M	H				L				L
18PPC305	M	L	L		M	L	L	L			L	L	M	M	L

L- Low, M – Moderate (Medium), H – High

18PPC306	MANUFACTURING TECHNOLOGY	SEMESTER: III

Category : PC

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

* To introduce 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 – CO2 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 BOOKS:

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*

REFERENCE BOOKS:

1. *Sharma, P.C., **"A TEXT BOOKS 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*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Describe the fundamentals and different types of metal casting process.
CO2: Explain the different types and processes of metal joining process.

CO3: Explain the concepts of metal forming processes.

CO4: Describe various sheet metal forming processes.

CO5: Explain the different processes used in making plastic parts.

COURSE ARTICULATION MATRIX

PO/PSO / CO	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	M		L			L		L	L	L	L	M	H		
CO2	M		L			L		L	L	L	L	M	H		
CO3	M		L			L		L	L	L	L	M	H		
CO4	M		L			L		L	L	L	L	M	H		
CO5	M		L			L		L	L	L	L	M	H		
16PPC306	M		L			L		L	L	L	L	M	H		

L- Low, M – Moderate (Medium), H - High

18IMC3Z7	**CONSTITUTION OF INDIA** *(Common to all Branches)*	**SEMESTER: III**

PRE-REQUISITES: NIL **Category:MC**

L	T	P	C
3	0	0	0

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with,

- To know about Indian constitution
- To know about central and state government functionalities in India
- To know about Indian society

UNIT – I : INTRODUCTION	**(9 Periods)**
Historical Background – Constituent Assembly of India – Philosophical foundations of the Indian Constitution – Preamble – Fundamental Rights – Directive Principles of State Policy – Fundamental Duties – Citizenship – Role of the Election Commission.	
UNIT – II : STRUCTURE AND FUNCTION OF CENTRAL AND STATE GOVERNMENT	**(9 Periods)**
Union Government – Structures of the Union Government and Functions – President – Vice President– Prime Minister – Cabinet – Parliament – Supreme Court of India – Judicial Review. State Government – Structure and Functions – Governor – Chief Minister – Cabinet – State Legislature – Judicial System in States – High Courts and other Subordinate Courts.	
UNIT – III : CONSTITUTION FUNCTIONS OF INDIA AND INDIAN SOCIETY	**(9 Periods)**
Indian Federal System – Central – State Relations – President's Rule – Constitutional Amendments – Constitutional Functionaries - Assessment of working of the Parliamentary System in India. Society : Nature, Meaning and definition; Indian Social Structure; Caste, Religion, Language in India; Constitutional Remedies for citizens – Political Parties and Pressure Groups; Right of Women, Children and Scheduled Castes and Scheduled Tribes and other Weaker Sections.	
UNIT – IV : POLICIES AND ACTS - GENERAL	**(9 Periods)**
Insurance and Bonding – Laws Governing Sale, Purchase and use of Urban and Rural Land – Land Revenue Codes – Tax Laws – Income Tax, Sales Tax , Excise and Custom duties and their Influence on Construction Cost – Legal Requirements for Planning – Property Law– Agency Law – Local Government Laws for Approval.	
UNIT – V: POLICIES AND ACTS ON INFRASTRUCTURE DEVELOPMENT	**(9 Periods)**
A Historical Review of the Government Policies on Infrastructure – Current Public Policies on Transportations – Power and telecom Sector – Plans for Infrastructure Development – Legal framework for Regulating Private Participation in Roads and Highways – Ports and Airport and Telecom.	

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

TEXT BOOKS:

1. *Durga Das Basu, **"Introduction to the Constitution of India",** Prentice Hall of India, New Delhi,2018*
2. *R.C.Agarwal, **"Indian Political System",** S.Chand and Company, New Delhi,2004.*
3. *Maciver and Page, **" Society: An Introduction Analysis",** Mac Milan India Ltd., New Delhi,2007*
4. *K.L.Sharma,**"Social Stratification in India: Issues and Themes"**, Jawaharlal Nehru University, New Delhi,2006.*

REFERENCE BOOKS:

1. *M.Laxmikanth,* ***"Indian Polity",****Mcgraw Hill Education (India)Private limited,2016*
2. *Sharma, Brij Kishore,* ***" Introduction to the Constitution of India",*** *Prentice Hall of India, New Delhi,2018*

COURSE OUTCOMES:

On completion of the course, the students will able to

CO1: Understand and abide the rules of the Indian constitution.
CO2: Understand the functions of Central government.
CO3: Understand the function of state government.
CO4: Understand the various constitutional functions.
CO5: Understand the different culture among the people of India.

COURSE ARTICULATION MATRIX:

PO/PSO CO	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	PSO 4
CO1						M	M					M			L	
CO2						L						M		L		
CO3						L						M				
CO4						L						L		L		
CO5						L	L					L		L	L	
18PMC 3Z7						L	L					M		L	L	

L-Low, M-Moderate (Medium), H-High

18PPC308	METALLURGY LABORATORY AND THERMAL SCIENCE LABORATORY	SEMESTER: III

Category: PC

L	T	P	C
0	0	3	1.5

18PPC308 (A) METALLURGY LABORATORY

PRE-REQUISITES: NIL

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, Gun metal, aluminium, silicon alloy)
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 OUTCOME

Upon completion of the course, the student will be able to

CO1: Prepare specimen for microscopic examination

CO2: Identify the microstructures of ferrous and nonferrous engineering components.

CO3: Realize the effect of heat treatment on the properties of materials.

CO4: Select suitable non-destructive tests for finding flaws in a material.

CO5: Determine Hardenability by Jominy end quench test.

COURSE ARTICULATION MATRIX

PO/PSO CO	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
CO 1	M	H	L	L		L			L		L		M		M
CO 2	M	H	L	L		L			L		L		M		M
CO 3	M	L		L		L	L		L		L		M		M
CO4	H	M	L	L		L			L		L		M		M
CO5	H	M	L	L		L			L		L		M		M
18PPC308 (A)	M	M	L	L		L	L		L		L		M		M

L- Low, M – Moderate (Medium), H - High

18PPC308 (B) THERMAL SCIENCE LABORATORY

COURSE OBJECTIVES:

* To impart the skill of conducting tests on I.C engines, compressors and blowers for finding the performance and other related characteristic parameters.

LIST OF EXERCISES

1. Valve timing and port timing diagrams of single cylinder diesel engines.
2. Performance test on 4 stroke Diesel Engine using various loading devices.
3. Retardation test to find Frictional Power of a Diesel Engine.
4. Economical speed test on Diesel Engine.
5. Performance test on Constant speed blower.
6. Performance test on Variable speed blower.
7. Performance test on Reciprocating Air compressor.

Contact Periods:

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

COURSE OUTCOME

Upon completion of the course, the student will be able to

CO1: Find the opening / closing timings of valves or ports in engines.

CO2: Conduct performance tests on diesel engines with different types of loading devices to access the performance.

CO3: Find Frictional Power and Economical Speed of a Diesel Engine.

CO4: Conduct performance tests on blowers to access the performance.

CO5: Conduct performance tests on reciprocating compressor to access the performance.

COURSE ARTICULATION MATRIX:

PO/PSO CO	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
CO 1	M	M	L	L		M	M		L		L				M
CO 2	H	M	L	L		H	H		L		M				M
CO 3	H	M	L	L		H	H		L		M				M
CO4	H	M	L	L		H	H		L		M				M
CO5	H	M	L	L		H	H		L		M				M
18PPC308 (B)	M	M	L	L		M	M		L		L				M

L- Low, M – Moderate (Medium), H - High

18PPC309	MANUFACTURING PROCESSES LABORATORY	SEMESTER: III

Category: PC

PRE-REQUISITES:

1. 18PPC406 - Machine Tools and Processes

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To practice various machining operations in lathe.
- To practice operations in radial drilling, shaper, grinder, milling machine and gear cutting with gear hobbing, gear shaping, milling.

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 -Vee and square)
5. V-Groove cutting in shaping machine.
6. Drilling, tapping and surface grinding using surface grinder and Radial drilling machine.
7. Spur gear milling.
8. Helical gear milling.
9. Gear shaping.
10. Gear hobbing.
11. Making hexagonal hole using slotting machine.
12. Letter cutting in vertical milling machine.

Contact Periods:

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

COURSE OUTCOME

Upon completion of the course, the student will be able to

CO1: Explain the constructional details of different types of lathe.

CO2: Perform various lathe machining operations.

CO3: Set up machines like shaper, grinding and milling machine for various applications.

CO4: Prepare gears using forming and generating methods of gear manufacturing.

CO5: Operate machines tools for various assembly and fabrication tasks and expose to time management.

COURSE ARTICULATION MATRIX

PO/PSO CO	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	H					L	L	L	H	H	M	L	M		M
CO2	H	H	H				M	L	H	H	M	L	M		M
CO3	H	H	H				M	L	H	H	M	L	M		M
CO4	H	H	M		H		M	L	H	H	M	L	M		M
CO5	H	H	M		M		M	L	H	H	M	L	M		M
18PPC309	H	H	M		M	L	L	L	H	H	M	L	M		M

L- Low, M – Moderate (Medium), H - High

18PHS401	TOTAL QUALITY MANAGEMENT CONCEPTS	SEMESTER: IV

Category: HS

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- 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 BOOKS:

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

REFERENCE BOOKS:

1. *James R.Evans& William M.Lidsay* ***"The Management and Control of Quality",*** *Thomson Learning, 2002.*
2. *Feigenbaum.A.V.* ***"Total Quality Management",*** *McGraw-Hill, 1991.*
3. *Zeiri* ***"Total Quality Management for Engineers",*** *Wood Head Publishers, 1991.*
4. *John.LHradesky* ***"Total Quality Management Hand book",*** *McGraw-Hill, 1995*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Apply the principle of strategic planning, Deming philosophy and leadership concepts in industries.

CO2: Apply the principle of TQM in industries.

CO3: Select appropriate quality tools to meet industrial requirements.

CO4: Apply the six sigma concepts in industries.

CO5: Implement appropriate quality standards for industries.

COURSE ARTICULATION MATRIX

PO/PSO CO	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	L	H			M			L	L		L	L	M	L	M
CO2	L	H			M			L	L		L	L	M	L	M
CO3	L	H			M			L	L		L	L	M	L	M
CO4	L	H			M			L	L		L	L	M	L	M
CO5	L	H			M		L	L	L		L	L	M	L	M
18PHS401	L	H			M		L	L	L		L	L	L	L	M

L- Low, M – Moderate (Medium), H - High

18PBS402	WAVES AND OPTICS *(Common to MECH & PRODN)*	SEMESTER: IV

Category: BS

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 18PBS202- Differential Equations and Complex Variables
2. 18PBS203- Introduction to Electromagnetism and Applied Physics

COURSE OBJECTIVES:

To improve the basic knowledge in Physics and its applications relevant to Mechanical & Production Engineering and Technology. Upon completion of this course the students will be familiar with:

- Types of motions, oscillations and production of waves
- Wave optics phenomenon, Huygens' principle, Interference of light
- Basic principles in lasers, characteristics, types of lasers and its applications
- Fiber optic principles and its applications.
- Origin of quantum physics, Schrödinger's equation and its applications.

UNIT- I	WAVES AND OSCILLATIONS	(9 Periods)
Introduction – Vibrational or Oscillatory Motion – Simple Harmonic Motion – Differential Equation of Simple Harmonic Motion and its Solution – Total Energy of a Harmonic Oscillator – Mass-String System – Horizontal Oscillation – Vertical Oscillations – Damped Harmonic Oscillator – Theory of Forced Vibrations - Resonance		
UNIT- II	**WAVE OPTICS**	**(9 Periods)**
Huygens' Principle-superposition of waves and interference of light - Air wedge - Theory – Applications - Testing of flat surfaces – Antireflection Coatings - Thickness of a thin sheet of paper - Michelson interferometer-Theory-Applications-Determination of wavelength of monochromatic light.		
UNIT-III	**LASER OPTICS**	**(9 Periods)**
Einstein's theory of matter radiation interaction and A and B coefficients-amplification of light by population inversion - different types of lasers - gas laser - CO_2 - solid state laser - Neodymium Nd - YAG laser-dye laser-properties of laser beams – monochromaticity - coherence-directionality and brightness-Applications of lasers in cutting, welding, drilling and materials processing.		
UNIT-IV	**FIBER OPTICS**	**(9 Periods)**
Introduction – Basic Principles involved in fiber optics- Total internal reflection – Structure of optical fiber –Propagation of light through optical fiber – Derivation for Numerical Aperture and acceptance angle - fractional index change - Classification of optical fiber based on materials, refractive index profile and Modes - Fiber optical communication links - Fiber optic sensors - Temperature and displacement.		
UNIT- V	**MATTER WAVES AND APPLICATIONS**	**(9 Periods)**
Dual nature of matter and radiation - Properties of matter waves-de-Broglie wavelength in terms of voltage, energy, and temperature – Physical significance of a wave function- Schrödinger's Time independent and Time dependent wave equations – Particle in a one dimensional potential well – Applications – Scanning Electron Microscope – Transmission Electron Microscope.		

Contact Periods:

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

TEXT BOOKS:

1. *Hitendra K Malik and A K Singh **"Engineering Physics",** McGraw Hill, New Delhi, 2015.*
2. *Arumugam M **"Engineering Physics",** Anuradha Publishers, 2010.*
3. *P.K.Palanisamy **"Engineering physics-II",** Scitech publications (India) pvt. Ltd 2015 3 rd edition*

REFERENCE BOOKS:

1. *E.Hecht, **"Optics",** McGraw Hill Education, 2012.*
2. *D.J.Griffiths, **"Quantum mechanics",** Pearson Education, 2014.*
3. *H.J.Pain, **"The physics of vibrations and waves",** Wiley, 2006.*
4. *O.Svelto, **"Principles of Lasers",** Springer Science & Business Media, 2010.*

COURSE OUTCOMES:

Upon completion of this course the students will be able to

CO1: Study the oscillations and motions for the production of waves.**[Familiarity & Assessment]**

CO2: Study the waves and optics phenomena- applications [Familiarity & Assessment]

CO3: Analyze the construction and working of different types of lasers and its applications **[Familiarity & Applications]**

CO4: Understand the propagation of light waves through optical fibers,analyse the different types of fibers and its applications**[Familiarity & Application]**

CO5: Analyze the dual nature of matter using de-Broglie matter waves, Schrodinger's time independent and dependent wave equations and itsapplication to quantum mechanical problems.**[Familiarity & Application]**

COURSE ARTICULATION MATRIX

PO/PSO CO	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	H	M			M	H	M						H		
CO2	H	M	M				L					M			
CO3		H	M	M	L									H	
CO4	M	H		M	M										H
CO5		M	M		L	M						M			
18PBS402	H	M	M	M	L	M	L					M	H	H	H

L- Low, M – Moderate (Medium), H – High

18PES403	**BASIC ELECTRONICS ENGINEERING** *(Common to MECH & PRODN Branches)*	**SEMESTER: IV**

Category : ES

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

* This course enables the students to understand semiconductor devices like diodes and transistors characteristics and applications. The students also have an exposure to digital fundamentals and 8085 microprocessor.

UNIT- I	**SEMICONDUCTOR DEVICES AND APPLICATIONS**	**(9 Periods)**
Introduction to PN junction diode and VI characteristics – Half wave and Full wave rectifiers – Capacitor filters – Zener diode and its characteristics – BJT introduction – Operation and Characteristics – BJT as a single stage CE amplifier – Frequency response and Bandwidth – Positive Feedback – Barkhausen's criteria for oscillation – RC Phase shift and Wein Bridge Oscillator.		
UNIT- II	**OP-AMP AND ITS APPLICATIONS**	**(9 Periods)**
Introduction to Op-amp – Op-amp input modes and parameters – Op-amp in open loop configuration – Op-amp with negative feedback – Study of practical op-amp IC 741 – Inverting and Non-inverting amplifier applications: Summing and Difference amplifier – Unity gain buffer – Comparator – Integrator and Differentiator.		
UNIT- III	**DIGITAL ELECTRONICS FUNDAMENTALS**	**(9 Periods)**
Difference between analog and digital signals – Boolean algebra – Basic and Universal Gates – Symbols, Truth Tables, Logic expressions, Logic simplification using K-map – Logic ICs – Half and Full adder/subtractor – Multiplexers and Demultiplexers – Flipflops-RS,JK,T,D .		
UNIT- IV	**8085 MICROPROCESSOR ARCHITECTURE**	**(9 Periods)**
Block diagram of microcomputer – Architecture of 8085 – Pin configuration – Timing Diagram - Instruction formats - Instruction set – Addressing modes – Simple assembly language programs.		
UNIT- V	**INTERFACING AND APPLICATIONS**	**(9 Periods)**
Interfacing of Input and output devices using 8255 – Applications of microprocessor - Temperature control – Stepper motor control – Traffic light control.		

Contact Periods:

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

TEXT BOOKS:

1. *Robert L.Boylestad **"Electronic Devices and Circuit Theory",** 10th Edition, Pearson Education, 2009.*
2. *Ramesh S. Goankar **"Microprocessor Architecture and Programming and Applications 8085",** 6th Edition, Penram International Publishing (India) 2013*

REFERENCE BOOKS:

1. *S.Salivahanan, N.Sureshkumar and A.Vallavaraj **"Electronic Devices and Circuits", 3rd Edition",** Tata McGraw Hill, 2012.*
2. *Krishna Kant, **"Microprocessor and Microcontroller Architecture, Programming and System Design using 8085,8086, 8051 and 8096",** PHI, 2011.*
3. *Charles H.Roth, Jr, **"Fundamentals of Logic Design",** 6th Edition, Cengage Learning, 2010.*

COURSE OUTCOMES

Upon completion of the course, the student will be able to

CO1: Exposure to semiconductor devices and its applications
CO2: Knowledge on op-amp and its applications
CO3: Ability to design basic digital logic circuits
CO4: Understanding of 8085 architectures and programming
CO5: Knowledge on interfacing and applications of 8085

COURSE ARTICULATION MATRIX

PO/PSO CO	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	L											L	L		
CO2	M											L	M		
CO3	M	M	M			L						L	M	L	L
CO4	M	L										M	M		
CO5	M	M			M							M	M	L	M
18PES403	M	M	M		M	L						L	M	L	L

L- Low, M – Moderate (Medium), H – High

18PPC404	FLUID MECHANICS AND MACHINERY *(Common to MECH & PRODN)*	SEMESTER: IV

Category: PC

PRE-REQUISITES:

1. 18PES303 – Engineering mechanics

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the basic principles in fluid mechanics and behavior study of fluid particles under rest and moving conditions.
- To understand the moment principle in fluid mechanics and its application in flow through 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	**HYDRAULIC TURBINES**	**(9 Periods)**
Classification – construction, working principles and design of Pelton wheel, Francis and Kaplan Turbines - head, losses, work done and efficiency - specific speed - operating characteristics - Governing of Turbines – Problems.		
UNIT- V	**PUMPS**	**(9 Periods)**
Classification of pumps - Centrifugal pump - working principle - discharge, work done and efficiencies – Gear oil and Multistage pumps - Reciprocating pumps - work done and efficiencies - negative slip - air vessels - indicator diagram and its variation – Problems.		

Contact Periods:

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

TEXT BOOKS:

1. *Rajput.R.K.* ***"A TEXT BOOKS of Fluid Mechanics and Machinery",*** *S.Chand and Company,NewDelhi , 2010.*
2. *Ramamrutham.S and Narayanan.R.* ***"Fluid Hydraulics and Fluid Machines",*** *Dhanpat Rai Publishing House (P) Ltd , New Delhi, 2010.*
3. *Modi.P.N. and Seth.S.M.* ***"Hydraulics and Fluid Mechanics including Hydraulic Machines",*** *Standard book house,Delhi, 2015.*

REFERENCE BOOKS:

1. *Streeter, Victor L .and Wylie, E.Benjamin, **"Fluid Mechanics",** McGraw Hill Ltd., 2017.*
2. *Natarajan.M.K., **"Fluid Machines",** AnuradhaAgencies, VidayalKaruppur, Kumbakonaam, 1998.*
3. *Kumar.K.L., **"Engineering Fluid Mechanics",** Eurasia Publishing House (P) Ltd., New Delhi, 2008.*

COURSE OUTCOMES:

On completion of this course, the students will be able to

CO1: Identify the importance of fluids properties and fluid principles at rest.

CO2: Know the physical behaviour of fluids system and equations under moving conditions.

CO3: To apply the concept of dimensional analysis for model study.

CO4: To conduct the performance test on different types of turbines.

CO5: To conduct the performance study and selection of pumps for different applications

COURSE ARTICULATION MATRIX

PO/PSO CO	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
CO 1	M	H	L	L	M										M
CO 2	H	M	L	M	L								L		M
CO 3	L	L	M	H	L								L		M
CO 4	L	M	M	H	L					L			M		H
CO 5	L	M	M	H	L					L			H		M
18PPC404	M	M	M	H	L					L			L		M

L- Low, M – Moderate (Medium), H

18PPC405	MECHANICS OF MATERIALS *(Common to MECH & PRODN)*	SEMESTER: IV

Category: PC

PRE-REQUISITES: **L T P C**

1. 18PES303 - Engineering mechanics **3 0 0 3**

COURSE OBJECTIVES:

- To understand the basic concepts of stress, strain, shear force, bending moment and deflection for different types of loading conditions.
- To understand the deflection of beams, theory of columns and applications of torsion

UNIT- I	STRESS AND STRAIN	(9 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, 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 Periods)**
Beams – Types of Beams - Types of loads, supports - Shear force – Bending moment – shear forces 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 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 Periods)**
Determinations of deflection curve – Relation between slope, deflection and radius of curvature – Slope and deflection of beam at any section by 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 Periods)**
Torsion of shafts - Torsion equation - Polar modulus- Stresses in Solid and Hollow circular shafts - Torsional rigidity - Power transmitted by the shaft – Importance of 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: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Sadhu Singh **"Strength of Materials",** Khana Publishers, New Delhi, 2014.*
2. *Rajput.R. K **"Strength of Materials",** S. Chand & Company Ltd., New Delhi 2018.*
3. *James M.Gere **"Mechanics of Materials",** Thomson India, Brooks/cole, 2012.*

REFERENCE BOOKS:

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:

On completion of this course, students will be able to

CO1: Find the stress, strain and modulus for different materials.

CO2: Understand the knowledge of shear force and bending moment diagrams of beams.

CO3: Calculate the complex stresses in beams with different loading conditions.

CO4: Find the deflection behaviour of beams and slender columns.

CO5: Apply the concepts of torsion in shafts and springs.

COURSE ARTICULATION MATRIX

PO/PSO CO	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
CO 1	L	H		M		L							L	L	L
CO 2	L	M	H	L	M					L			L		L
CO 3		H	L	H	M					L			L		L
CO 4	M	H	L	M	L								L		L
CO 5	L	H		M		L							L		L
18PPC405	L	H	L	M	M	L				L			L	L	L

L- Low, M – Moderate (Medium), H – High

18PPC406	MACHINE TOOLS AND PROCESSES	SEMESTER: IV

Category: PC

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To study different machine tools and machining operations.

UNIT- I	FUNDAMENTALS OF METAL CUTTING	(9 Periods)
Concepts of orthogonal and oblique cutting - Mechanics of chip formation - Types of chips produced in cutting - Cutting forces and power-Temperature in cutting- Machinability-Tool life - Wear and failure-surface finish and integrity- Cutting Tool Materials-cutting fluids.		
UNIT- II	**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- III	**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. Shaper machine – block diagram – functions - Quick return mechanism.		
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 BOOKS:

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 BOOKS of Production Technology",*** *S.Chand and Company Ltd., New Delhi, 10th Revised edition, 2010.*

REFERENCE BOOKS:

1. *Khanna, O.P and Lal, M **"A TEXT BOOKS of 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) Pte Ltd, Delhi, 2009.*
3. *Jain R.K. and Gupta S.C **"Khanna Publisher",** New Delhi, 17th edition, 2004.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: describe about various machining processes and cutting tools.

CO2: explain the processes involved in production of round shaped components.

CO3: explain the processes involved in production of prismatic and contour shapes.

CO4: discuss about various finishing operations.

CO5: explain the machine tool structure and mechanisms of automation.

COURSE ARTICULATION MATRIX

PO/PSO / CO	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	H	L		L		L	L			L	L	M	M	L	
CO2	H		L		L	M	L	L	M		L	L	H		M
CO3	H		L		L	M	L	L	M		L	L	H		M
CO4	H		L		L	M	L	L	M		L	L	H		M
CO5	M	M	H	M	H	M	M	L	L	M	L	M	H	M	H
18PPC406	H	L	L	L	L	M	L	L	L	L	L	L	H	L	M

L – Low, M- Moderate (Medium), H - High

18PMC4Z7	ENVIRONMENTAL SCIENCES AND ENGINEERING *(Common to all Branches)*	SEMESTER: IV

Category : MC

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	0

COURSE OBJECTIVES:

- The course is aimed at creating awareness among students and also to inseminate the critical ideas of preserving environment.

UNIT I: ENVIRONMENTAL RESOURCES	**(9 Periods)**
Natural resources-Forest – benefits, over exploitation, deforestation & consequences – Water-unique features, hydrological cycle & over exploitation – Food -effect of modern agriculture, fertilizers, pesticides, eutrophication & biomagnifications- Energy resources - renewable & non-renewable resources - wind, solar and tidal-harnessing methods.	
UNIT II: ECO SYSTEM AND BIODIVERSITY	**(9 Periods)**
Ecology - ecosystem, physical and chemical components of ecosystem, biological components of ecosystem, forest ecosystem, desert ecosystem and pond ecosystem, Energy flow in ecosystem, nitrogen cycle and carbon dioxide cycle, food pyramid, Ecological succession, Biodiversity - types, values of biodiversity, hot spots of biodiversity, endangered and endemic species, conservation of biodiversity – in situ – ex situ conservation.	
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, control methods - cyclone separator and electrostatic precipitator, water pollution - classification of water pollutants, organic and inorganic pollutants, sources, effects and control of water pollutants, soil pollution- sources, effects and control, noise pollution - decibel scale , sources, effects and control.	
UNIT IV: ENVIRONMENTAL THREATS	**(9 Periods)**
Acid rain, greenhouse effect, global warming and ozone depletion, disaster management - flood, drought, earthquake and tsunami, Threats to biodiversity-destruction of habitat, habit fragmentation- hunting, over exploitation and man-wildlife conflicts, The IUCN red list categories, status of threatened species.	
UNIT V: SOCIAL ISSUES AND ENVIRONMENT	**(9 Periods)**
Sustainable development- sustainable technologies, need for energy and water conservation, rain water harvesting, water shed management, waste land reclamation, Pollution control Act, Wild life protection act, Forest conservation 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, HIV/AIDS - effects and preventive measures.	

Contact Periods:

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

TEXT BOOKS:

1. *Sharma J.P., **"Environmental Studies",** 3rd Edition, University Science Press, New Delhi 2009.*
2. *Anubha Kaushik and C.P.Kaushik, **"Environmental Science and Engineering",** 3rd Edition, New age International Publishers, New Delhi, 2008.*

REFERENCE BOOKS:

1. *R.K.Trivedi, **"Hand book of Environmental laws, Rules, Guidelines, Compliances and Standards",** Vol.I&II, Environ Media, 2006.*
2. *G.TylerMiller, JR, **"Environmental Science",** Tenth Edition, Thomson BROOKS / COLE Publishing, 2004.*
3. *Gilbert M.Masters, **"Introduction to Environmental Engineering and Science",** 2nd Edition, Pearson Education, 2004.*

COURSE OUTCOMES:

Upon the completion of the course, Students will be able to

CO1: To know about the various environmental resources, the effective utility and problems accompanied in over exploitation.

CO2: To acquire knowledge about the interaction of biosphere with environment and conservation methods of bio diversity.

CO3: To be aware of the sources of various types of pollution, their ill effects and preventive methods.

CO4: To understand the environmental threats, Acid rain, Green house effect and Ozone depletion and natural disasters.

CO5: To create an idea about sustainable development and social issues.

COURSE ARTICULATION MATRIX:

CO	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	M	L	H	L	M	M	M	M	M	M	L	L	L	L	M
CO2	M	L	L	L	L	L	L	L	L	L	L	L	M	L	L
CO3	L	L	H	L	L	L	M	M	L	M	L	L	L	L	L
CO4	L	L	H	L	L	L	L	L	L	L	L	L	L	L	L
CO5	M	L	H	L	L	L	H	H	L	M	L	L	M	L	M
18PMC4Z7	M	L	H	L	L	L	M	M	L	M	L	L	L	L	L

L - Low, M - Moderate (Medium), H - High

18PPC408	STRENGTH OF MATERIALS AND FLUID MACHINERY LABORATORY	SEMESTER:IV

Category: PC

L	T	P	C
0	0	3	1.5

PRE-REQUISITES:

1. 18PES303 – Engineering Mechanics

COURSE OBJECTIVES:

- To understand the basics of different testing methods for different materials.
- To study the behaviour of fluid system in pumpsand turbines.

18PPC408 (A) STRENGTH OF MATERIALS LABORATORY

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 aluminium beam
7. Deflection Test on Cantilever Beam
8. Hardness tests on metals like Mild Steel, Brass, Copper and Aluminium
9. Bend Test on Steel rod
10. Compression Test
11. Impact test-izod and charpy

18PPC408 (B) FLUID MACHINERY LABORATORY

LIST OF EXERCISES

1. Determination of Darcy's friction factor
2. Calibration of Flow Meters
3. Flow through Mouth Piece
4. Performance study on Centrifugal pump
5. Performance study on reciprocating pump
6. Performance study on Submersible Pump
7. Performance study on Gear oil Pump
8. Load test on Pelton Wheel Turbine
9. Load test on Kaplan Turbine

Contact Periods:

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

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Apply knowledge of compression, tension, shear and torsion testing procedures on materials.

CO2: Know the deflection and bending behaviour of different types of beams.

CO3: Find the hardness of different metals.

CO4: Find the flow properties of fluids at different places.

CO5: Conduct performance tests on pumps and turbines and draw the performance curves.

COURSE ARTICULATION MATRIX

PO/PSO CO	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
CO 1	H	M	L	L					M				L		L
CO 2	M	H	L	M	L				L				L		L
CO 3	L	H		M		L			L				L		L
CO 4	M	H	L	L	M				L				L		
CO 5	L	M	M	H	L				L	L			L		
18PPC408	M	H	L	M	L	L			L	L			L		L

L- Low, M – Moderate (Medium), H - High

18PPC409	PRODUCTION DRAWING	SEMESTER: IV

Category: PC

L	T	P	C
0	0	3	1.5

PRE-REQUISITES:

18PES106 - Engineering Graphics

COURSE OBJECTIVES:

- To provide hands on training on assembly drawing and impart knowledge on various types of machine parts & joints.
- To create knowledge about important features of assembled parts used in major engineering applications.

UNIT- I	CONVENTIONS, ABBREVIATIONS AND SYMBOLS	(4 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**	**(35 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 BOOKS:

1. *Gopalakrishna K.R **"Machine Drawing in First Angle Projection",** Subhas Stores, Bangalore, 2007,*
2. *Bhatt.N.D **"Machine Drawing",** Charotar Publishing House Pvt. Ltd., 49th edition, 2013.*

REFERENCE BOOKS:

1. *Gill.P.S., **"TEXT BOOKS of Machine Drawing",** S.K.Kataria and Sons, Publishers and Distributors, Delhi, 2013.*
2. *PSG College of Technology **"PSG College of Technology",** KalikathirAchchagam, 2012.*
3. *Narayana K.L., Kannaiah.P.,VenkataReddy.K., **"Machine Drawing",** New Age International Publishers, 2009.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Describe the conventions in assembly drawing

CO2: Describe the Fits and Tolerances

CO3: Describe the Geometric Dimensioning & Tolerancing

CO4: Incorporate the parts for to assemble

CO5: Construct an assembly drawing of various machine unit

COURSE ARTICULATION MATRIX

PO/PSO CO	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	M				M			M	L	M		M	M		
CO2	M				H			M	M	M		M	M		
CO3	M				H				M	M		M	M		
CO4					M				L	M		M	M		
CO5	H				H	M		M	M	M			M		
18PPC409	M				H	M		M	M	M		M	M		

L- Low, M – Moderate (Medium), H – High

18PHS501	**OPERATIONS RESEARCH TECHNIQUES** *(Use of Approved Statistical Table is permitted)*	**SEMESTER: V**

Category: HS

PRE-REQUISITES: NIL

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

- To provide an in-depth understanding of definition, scope, objectives, phases, models & limitations of operations research.
- 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.		
UNIT- V	**DECISION MODELS**	**(9+3 Periods)**
Game theory – Two person zero sum games – Graphical solution- Algebraic 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 BOOKS:

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.*

REFERENCE BOOKS:

1. *Taha H.A **"Operations research",** 8th Edition, Prentice – Hall of India, New Delhi, 2006.*
2. *Sharma S.D, **"OperationsResearch",** Kedarnath Ram Nath and Co.Meerut, 2009 .*
3. *Don. T. Phillips, Ravindren A and James Solberg **"Opeartions research",** John Wiley and sons, 1987.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Identify and formulate operational research models from the verbal description of a real system.

CO2: Apply operations research techniques like L.P.P, Scheduling, Sequencing, Transportation problems to Industrial optimization problems.

CO3: Use network scheduling techniques like PERT, CPM for solving project management problems.

CO4: Analyze various models and apply suitable analytical method or simulation technique to solve queuing problems.

CO5: Apply suitable decision making tools for Replacement and Game theory problems for achieving optimization.

COURSE ARTICULATION MATRIX

PO/PSO CO	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	H	M													M
CO2	M	H	M	L											M
CO3	M	H	L								H				M
CO4	M	H	M	L											M
CO5	M	H	M	L											M
18PHS501	M	H	M	L							H				M

L- Low, M – Moderate (Medium), H - High

18PPC502	PRODUCTION PLANNING AND CONTROL	SEMESTER: V

Category: PC

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To study various production planning and control activities in industries

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	**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 break even analysis. Applications - Linear, multi product break-even analysis.		
UNIT- III	**WORK STUDY**	**(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	**OPERATIONS PLANNING AND SCHEDULING**	**(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	**MATERIALS PLANNING AND CONTROL**	**(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: 45Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

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.*
3. *Anil Kumar, Suresh **"Production and Operations Management",** New Age international, 2018.*

REFERENCE BOOKS:

1. *Mart and Telsang,* ***"Industrial Engineering and Production Management",*** *S. Chand and Company, First edition, 2011.*

COURSE OUTCOMES

On completion of this course, students will be able to

CO1: Describe the various aspects of product development

CO2: Explain about the method, motion studies and work measurement

CO3: Explain about various techniques of operations planning and scheduling

CO4: Describe various aspects of materials planning and control

CO5: Explain about the theory of constraints and significance of purchasing and distribution.

COURSE ARTICULATION MATRIX

PO/PSO CO	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	M	L	L							L	M	L			M
CO2	M	M		M	L					L	H	L			M
CO3	L	M	L	L	L					L	M	L			M
CO4	M	L	L	L	L					M	H	L			M
CO5	M	M	M	L	L					L	M	L			M
18PPC502	M	M	L	L	L					L	H	L			M

L- Low, M – Moderate (Medium), H – High

18PPC503	MECHANICS OF MACHINES	SEMESTER: V

Category: PC

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 18PES303 – Engineering mechanics
2. 18PPC405 – Mechanics of Materials

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 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 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 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 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 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: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Rattan, S.S.* ***"Theory of Machines",*** *Mc Graw-Hill Education (I) Private Ltd., New Delhi, 2015.*
2. *Bansal Dr.R.K. and BrarDr.J.S.* ***"Theory of Machines",*** *Laxmi Publications (P) Ltd., New Delhi, 2016.*

REFERENCE BOOKS:

1. *Uicker, J.J., Pennock G.R and Shigley, J.E* ***"Theory of Machines and Mechanisms",*** *3rd Edition, Oxford University Press, 2009.*
2. *Thomas Bevan,* ***"Theory of Machines",*** *3rd Edition, CBS Publishers and Distributors, 2005.*
3. *Robert L. Norton* ***"Kinematics and Dynamics of Machinery",*** *Tata McGraw-Hill, 2009.*
4. *Rao,J.S. and Dukkipati R.V.* ***"Mechanism and Machine Theory",*** *Second Edition, Willey Eastern Ltd., 1992.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Explain the basics concepts of various mechanisms and to do velocity and acceleration analysis of simple mechanisms.

CO2: Describe the effect of friction on power transmission.

CO3: Discuss the basic principles of gears and cams.

CO4: Perform static and dynamic balancing of high speed rotary and reciprocating machines.

CO5: Analyze free and forced vibrations of machines, engines and structures.

COURSE ARTICULATION MATRIX

PO/PSO CO	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	M	H											M		
CO2	M	H											M		
CO3	M	H										L	M		
CO4	M	H										L	M		
CO5	M	H										L	M		
18PPC503	M	H										L	M		

L- Low, M – Moderate (Medium), H – High

18PPC504	METROLOGY AND COMPUTER AIDED INSPECTION	SEMESTER: V

Category: PC

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- 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 – standards of measurement – accuracy and precision – errors in measurement –limits, fits and tolerances – interchangeability and selective assembly – calibration of instruments. Principles of light interference – measurements and calibration – 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 – co ordinate 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 BOOKS:

1. *Gupta. I.C **"A TEXT BOOKSof Engineering Metrology",** Dhanpat Rai and Sons, Delhi, 2012.*
2. *Groover M.P **"Automation, Production systems and Computer Integrated Manufacturing",** Prentice Hall India Ltd.,*

REFERENCE BOOKS:

1. *Jain.R.K., **"Engineering Metrology",** Khanna Publishers, Delhi, 2015.*
2. *Gayler G.N., and Shotbolt C.R **"Metrology for Engineers",** ELBS Edn.*
3. *ASTE **"Hand book of industrial metrology",** CRC Press.*
4. *Marvin J.Weber, **"Hand book of LASERS",** CRC Press.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: understand the general concepts of linear and angular measurements.

CO2: describe various geometric and form measurements.

CO3: explain about recent measuring machines and advances in metrology.

CO4: describe various measurement concepts involved in laser metrology.

CO5: explain the basic concepts of computer aided inspection

COURSE ARTICULATION MATRIX

PO/PSO CO	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	H			L								M	L		M
CO2	M	L		M								L	L		M
CO3	M			H								M	L		M
CO4	M		L	M								M	L		M
CO5	M		L	H								M	L		M
18PPC504	H	L	L									M	L		M

L- Low, M – Moderate (Medium), H - High

18PPC507	METROLOGY LABORATORY	SEMESTER: V

Category: PC

	L	T	P	C
PRE-REQUISITES: NIL	**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 verniercaliper.
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:

On completion of this course, students will be able to

CO1: Explain the general concepts of measurements.

CO2: Apply and Identify correct symbols, abbreviations and units for all measurements.

CO3: Perform some linear, angular and form measurements, and record observations.

CO4: Calibrate the measuring instruments.

CO5: Explain about various methods of traditional and modern measurements that are used in the industry to measure product dimensions.

COURSE ARTICULATION MATRIX

PO/PSO CO	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	L	L							M	L			L		M
CO2	L				L	L			M	L			L		M
CO3	L	H							M	L			L		M
CO4	L	H							M	L			L		M
CO5	L	H			M				M	L			L	M	M
18PPC507	L	H			L	L			M	L			L	L	M

L- Low, M – Moderate (Medium), H - High

18PEE508	SKILL DEVELOPMENT ON INDUSTRIAL PRACTICES / TECHNICAL PROJECTS	SEMESTER: V

PRE-REQUISITES: NIL

Category: EEC

L	T	P	C
0	0	4	2

COURSE OBJECTIVES:

- To provide an opportunity to the student to get an industrial exposure and training in the field of one or more relevant courses of a specific programme or inter disciplinary engineering streams.
- To provide an opportunity to the student to get hands on training in the fabrication of one or more components of a complete working model, which is designed by them.

The students may undergo Industrial training / Internship at Research organization / Reputed firms satisfying prescribed qualifications set by the department (after due approval from the HOD) for a period of not less than two week during summer vacation. In this case, the training has to be undergone continuously from one organization only. At the end of Industrial training / Internship, the student shall submit a detailed report on the training under gone and a certificate from the organization concerned.If the student does not have the offer for Industrial training / Internship, the student may instead do a project on a topic of interest related to area of study.

The progress of the Industrial training / Internship / 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 Industrial training / Internship / 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: 60 Periods Total: 60 Periods

COURSE OUTCOMES

On completion of this course, students will be able to

CO1: Practice acquired knowledge within the chosen area of technology for project development.

CO2: Identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach.

CO3: Reproduce, improve and refine technical aspects for engineering projects.

CO4: Follow and value health, safety and ethical practices during project.

CO5: Work as an individual or in a team in development of technical projects.

CO6: Communicate and report effectively project related activities and findings.

COURSE ARTICULATION MATRIX

PO/PSO CO	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	L	M		M		L			L		L	M	M	L	
CO2	M	H	H	M	H	M	L		H	L	H	M	H	H	H
CO3	H	H	H	M	H	M	L		H	L	H	H	H	H	H
CO4						M	L	H	L		H	L			
CO5									H	L	H	H	H	H	H
CO6									M	H	M	M			
18PEE508	H	H	H	M	H	M	L	H	H	H	H	H	H	H	H

L- Low, M – Moderate (Medium), H - High

18PPC601	**MACHINE ELEMENTS DESIGN** *(Use of Approved Data Book is permitted)*	**SEMESTER: VI**

Category: PC

L	T	P	C
3	1	0	4

PRE-REQUISITES:

1.18PES303 - Engineering Mechanics
2.18PPC405 - Mechanics of Materials
3.18PPC503 - Mechanics of Machines

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 BOOKS:

1. *Bhandari V **"Design of Machine Elements",** Tata McGraw-Hill Book Co,3rd Edition, 2010.*
2. *Sharma, P.C., Aggarwal, D.K **"A TEXT BOOKS of Machine Design",** Kataria and sons., 2012.*

REFERENCE BOOKS:

1. *Shigley, J.E., and Mischke, C.R **"Mechanical Engg. Design",** McGraw-Hill Book Co., 8th edition, 2008.*
2. *Dobrovolsky, V., **"Machine Elements",** A TEXT BOOKS, MIR Publishers.*
3. *Spotts, M.F **"Design of Machine Elements (6th ed.)",** Prentice Hall of India Pvt.Ltd.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Estimate safety factors of simple structures exposed to static and repeated loads.

CO2: Design the shafts and bearings.

CO3: Design the welded joints, bolted joints, couplings and springs.

CO4: Design the drives - chain drives and belt drives.

CO5: Design the spur gears, helical gears and gear boxes

COURSE ARTICULATION MATRIX

PO/PSO CO	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	M	H	L									L	M	M	H
CO2	M	H	L									L	H	M	H
CO3	M	H	L									L	H	M	H
CO4	M	H	L									L	H	M	H
CO5	M	H	L									L	H	M	H
18PPC601	M	H	L									L	H	M	H

L- Low, M – Moderate (Medium), H - High

18PPC602	AUTOMATION AND CIM	SEMESTER: VI

Category: PC

L	T	P	C
3	0	0	3

PRE-REQUISITES:

18PPC406 – Machine Tools and Processes

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 BOOKS:

1. *Mikell P Groover, **"Automation, Production Systems and Computer Integrated Manufacturing",** Pearson education (Singapore) Pvt. Ltd., New Delhi, 4th edition 2008.*
2. *Radhakrishnan P and Subramaniyan S **"CAD/CAM/CIM",** New Age International (P) Ltd., 3rd edition, 2008.*

REFERENCE BOOKS:

1. *James A Rehg and Henry W Kraebber **"Computer Integrated Manufacturing",** 3rd edition Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2005.*
2. *Chris McMahon, and Jimmie Browne, **"CAD/CAM Principles, Practice and manufacturing Management",** Addison Wesley Longman Ltd, England, 2nd edition, 1998.*
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:

On completion of this course, students will be able to

CO1: Explain the fundamentals of automation and CIM.

CO2: Describe the automation in manufacturing.

CO3: Describe the material handling and storage systems.

CO4: Explain the concept of group technology and flexible manufacturing system.

CO5: Describe the fundamentals of Control systems.

COURSE ARTICULATION MATRIX

PO/PSO CO	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	M	M	M	L	M	L			L			L	H	M	M
CO2	L	M	M	M	H	L			L		M	L	H	H	L
CO3	L	M	M	M	M	L			L		M	L	H	M	L
CO4	L	M	M	M	M	M			M		M	L	H	M	L
CO5	L	M	L	M	M	L			M	M	L		H	M	L
18PPC602	L	M	M	M	M	L			L	L	M	L	H	M	L

L – Low, M- Moderate (Medium), H – High

18PPC603	FLUID POWER DRIVES AND CONTROLS	SEMESTER: VI

Category: PC

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 18PPC404 – Fluid Mechanics and Machinery
2. 18PPC406 – Machine Tools and Processes

COURSE OBJECTIVES:

- To make the students to design the hydraulic and pneumatic circuits for different applications.

UNIT- I	BASIC PRINCIPLES	(9 Periods)
Hydraulic Principles; Hydraulic Fluids; Hydraulic pumps – Classification, Characteristics, Pump Selection, Pumping Circuits; Hydraulic actuators – Classification, Cylinder Mounting, Selection, Characteristics; Hydraulic valves – Pressure, Flow, Direction Controls, Applications, Symbols		
UNIT- II	**HYDRAULIC CIRCUITS**	**(9 Periods)**
Hydraulic circuits – Reciprocating, Quick Return, Sequencing, Synchronizing, Regenerative circuit, Double pump hydraulic system; Application circuits – Press, Milling Machine, Planner, Fork Lift, etc.		
UNIT- III	**POWER GADGETS IN HYDRAULICS**	**(9 Periods)**
Accumulators – Classification, Circuits; Pressure Intensifier and Circuit; Safety Circuits; Mechanical hydraulic servo system; Selection of components. Installation and Maintenance of Hydraulic power pack; Troubleshooting of fluid power circuits.		
UNIT- IV	**PNEUMATIC SYSTEMS**	**(9 Periods)**
Pneumatic Fundamentals; Control Elements; Logic Circuits; Position sensing, Pressure sensing; Electrical controls:Various switches; Electro Pneumatic and Electro Hydraulic Circuits.		
UNIT- V	**DESIGN AND SELECTION OF PNEUMATIC CIRCUITS**	**(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 BOOKS:

1. *Anthony Esposito,* ***"Fluid Power with Applications",*** *Pearson Education India, 7th edition, 2013.*
2. *Andrew Parr,* ***"Hydraulics and Pneumatics: A Technician's and Engineer's Guide",*** *Butterworth – Heinemann 3rd edition, 2011.*

REFERENCE BOOKS:

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:

On completion of this course, students will be able to

CO1: Describe the principle of fluid power
CO2: Describe the components of hydraulics
CO3: Design the hydraulic circuits for automation
CO4: Describe the components of pneumatics
CO5: Design the pneumatic circuits for automation

COURSE ARTICULATION MATRIX

PO/PSO CO	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	M												M		
CO2	M												M		
CO3	M	H											M		
CO4	M												M		
CO5	M	H											M		
18PPC603	M	H											M		

L- Low, M – Moderate (Medium), H - High

18PPC607	MODELLING LABORATORY	SEMESTER: VI

Category: PC

L	T	P	C
0	0	3	1.5

PRE-REQUISITES:

1. 18PES106- Engineering Graphics
2. 18PPC409-Production Drawing

COURSE OBJECTIVES:

* To design the solid models by creating parts and assemble them with the aid of computers.

LIST OF EXERCISES

Exercises on modelling of mechanical components using packages like AutoCAD / Mechanical Desktop/Inventor/IDEAS/ Pro Engineer/CATIA/Unigraphicsetc…

1. Simple two dimensional geometry creations and modification using drafting module.
2. Detailing and documentation of a typical production drawing
3. Attributes and data extraction from a drawing
4. Creation of simple solid models using CSG and B-rep Approach
5. Surface Modeling
6. External database connection
7. Generation of working drawings of components and preparation of assembly models of Tail stock, Crane hook, Flanged coupling ,Screw jack, Clapper box, Universal coupling, Machine vice Drill jig assembly by using the following techniques…
8. Generation of surfaces of revolution
9. Generation of surfaces of extrusion
10. Generation of surfaces by skinning operation
11. Generation of solid models using constructive solid geometry, method shading and rendering.

Contact Periods:

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

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Explain the basics of graphics generation, 2-Dimensional and 3-Dimensionalconcepts involved in Computer Aided Design.

CO2: Use the commands to create, edit and dimension the 2D model in detail.

CO3: Use the commands to create, edit and dimension the 3D surface model.

CO4: Use the commands to create, edit and dimension the 3D solid model.

CO5: Do the assembly of various solid models and create 3D assembly model.

COURSE ARTICULATION MATRIX

PO/PSO CO	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	H	M	M	M	M							L	L	L	
CO2	M	M	L	L	L								L	L	
CO3	M	M	L	L	L								L	L	
CO4	M	M	M	L	L								L	L	
CO5	H	M	M	L	L								L	L	
18PPC607	M	M	M	L	L							L	L	L	

L- Low, M – Moderate (Medium), H - High

18PEE608	AUTOMATION AND CONTROL SYSTEMS LABORATORY	SEMESTER: VI

Category: EEC

PRE-REQUISITES: NIL

L	T	P	C
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.

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:

On completion of this course, students will be able to

CO1: design and develop the simple industrial application pneumatic circuits.
CO2: design and develop the simple industrial application hydraulic circuits.
CO3: explain PID controller with temperature control system.
CO4: control the speed of electrical drives.
CO5: activate the stepper motor interfacing with 8051 micro-controller.

COURSE ARTICULATION MATRIX

PO/PSO CO	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	M	H	M	M		M			L	L		L	H	M	L
CO2	M	H	M	M		L			L	L		L	H	M	L
CO3	L	M	H	M		L			L	L		L	H	M	L
CO4	L	M	L	M		L			L	L		L	H	M	L
CO5	L	M	M	M		L			L	L		L	H	M	L
18PEE608	L	M	M	M		L			L	L		L	H	M	L

L – Low, M- Moderate (Medium), H - High

18PPC701	**ADDITIVE MANUFACTURING** *(Common to MECH & PRODN)*	**SEMESTER: VII**

Category: PC

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To educate students with fundamental and advanced knowledge in the field of Additive Manufacturing technology and the 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. Software for AM- 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 formats - Data 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 3DP 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 BOOKS:

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*

REFERENCE BOOKS:

1. *Gibson, I., Rosen, D.W. and Stucker, B **"Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing",** Springer, 2010.*
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:

On completion of this course, students will be able to

CO1: Appreciate the importance of computers and modern tools in manufacturing to reduce cost and matching the societal needs.

CO2: Create and analyze 2D and 3D models using CAD modeling software and integrating with manufacturing systems.

CO3: Understand the variety of Additive Manufacturing (AM) technologies apply to their potential to support design and manufacturing, case studies relevant to mass customized manufacturing.

CO4: Apply knowledge on latest techniques of manufacturing in their field of career

CO5: To monitor and control shop floor with the aid of computers

COURSE ARTICULATION MATRIX

PO/PSO CO	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			L				M						L	L	
CO2			M											M	L
CO3			L										M	L	
CO4			M		H	M	L						M	H	L
CO5		M				L					M		L	H	
18PPC701		M	M		M	L	L				L		M	M	L

L- Low, M – Moderate (Medium), H - High

18PPC702	PRODUCTION OF AUTOMOTIVE COMPONENTS	SEMESTER: VII

Category: PC

PRE-REQUISITES:

L	T	P	C
3	0	0	3

1. 18PPC305 – Engineering Metallurgy
2. 18PPC306 – Manufacturing Technology
3. 18PPC406 - Machine Tools and Processes

COURSE OBJECTIVES:

* 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 of crankshaft, connecting rod and gudge on 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 hydroforming - 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 BOOKS:

1. *Kirpal Singh **"Automobile Engineering, Vol I and II",** Standard Publishers., 12th edition, 2011.*
2. *William H.Crouse and Anglin **"Automotive Mechanics",** McGraw Hill Book Co., 10th edition, 2008.*
3. *Helt P.M. **"High speed combustion engines",** Oxford and IBM Publishers Co. 1990.*

REFERENCE BOOKS:

1. *Newton and Steels **"The motor vehicle",** 12th edition, 1998.*
2. *Narang G.B.S, **"Automobile Engineering",** Khanna Publishers, 1991.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Describe the major casting methods of cast iron and aluminium cylinder block.

CO2: Describe the manufacturing methods of engine parts.

CO3: Select the suitable material with respect to the functional requirement.

CO4: Explain the fuel and transmission system.

CO5: Explain the brakes, suspension and engine management systems.

CO6: Identify suitable processes for the automobile parts according to the functional requirement.

COURSE ARTICULATION MATRIX

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	P0 12	PSO 1	PSO 2	PSO 3
CO1	H	H	H	H	M	H	H			M	M	H	H	H	L
CO2	H	H	H	H	M	H	H			M	M	H	H	H	L
CO3	H	H	H	H	M	H	H			M	M	H	H	H	L
CO4	H	H	H	H	M	H	H			M	M	H	H	H	L
CO5	H	H	H	H	M	H	H			M	M	H	H	H	L
18PPC702	H	H	H	H	M	H	H			M	M	H	H	H	L

L- Low, M – Moderate (Medium), H - High

18PPC703	JIGS, FIXTURES AND PRESS TOOLS *(Use of approved data book is permitted)*	SEMESTER: VII

PRE-REQUISITES:

1.18PPC306– Manufacturing Technology

Category: PC

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce the fundamental concepts of various types of jigs, fixtures and dies
- To design a simple jig/ fixture / die for a given component

UNIT- I	LOCATING AND CLAMPING PRINCIPLES	(9 Periods)
Tool design objectives - tool design in manufacturing - planning the design - principles of supporting and locating elements- referencing, basic rules of locating - planes of movement - locating from a flat surface - locating from internal andexternal diameter - external profile - principles of clamping and work holding – types - non mechanical clamping- clamping accessories - materials used in jigs and fixtures		
UNIT- II	**DESIGN OF 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	**DESIGN OF FIXTURES**	**(9 Periods)**
General principles of milling boring, lathe and broaching fixtures - Grinding, planning and shaping fixtures, assembly, Inspection and welding fixtures- modular fixtures - design and development of fixtures for simple component.		
UNIT- IV	**PRESS ELEMENTS AND CUTTING DIE DESIGN**	**(9 Periods)**
Press working terminology – types - Punch and die elements - Types of Sheet metal shearing operations - 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	**DESIGN OF 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 BOOKS:

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

REFERENCE BOOKS:

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.*

. **COURSE OUTCOMES:**

On completion of this course, students will be able to

CO1: Explain the fundamentals of work holding devices, locators and clamps.

CO2: Discuss about various types of jigs and design simple jigs.

CO3: Discuss about various types of fixtures and design simple fixtures

CO4: Discuss about the various elements of die and design simple dies for sheet metal shearing operation.

CO5: Discuss about various sheet metal forming operations and recent trends.

COURSE ARTICULATION MATRIX

PO/PSO CO	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	L	M	M	M						L	M	L	M	L	M
CO2	M	H	M	L						L	M	L	M		M
CO3	M	M	L	L						L	M	L	M		M
CO4	M	M	M	L						L	L	L	L		M
CO5	M	H	H	M						L	L	L	M		H
18PPC703	M	H	M	L						L	M	L	M	L	M

L- Low, M – Moderate (Medium), H - High

18PPC707	SIMULATION LABORATORY	SEMESTER: VII

Category: PC

L	T	P	C
0	0	3	1.5

PRE-REQUISITES:

1. 18PPC405- Mechanics of Materials

COURSE OBJECTIVES:

- To gain practical experience in handling 3D modeling and analysis software.

Finite Element Modeling and Analysis
1. Exercises on Modeling and Meshing on 1D, 2D and 3D models. 2. Exercises on Solution and Post processing of 1D, 2D and 3D models. 3. Structural analysis of a fixed beam 4. Structural analysis of a cantilever beam 5. Structural analysis of a link element 6. Structural analysis of aluminium bracket 7. Modeling using axisymmetry 8. Plane stress analysis 9. Modeling of a spindle base 10. Modal analysis of cantilever beam 11. Modeling of allen key 12. Heat distribution in rectangular slab 13. Thermal analysis of 2D heat sink 14. 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
CASTING simulation software
- Study of casting simulation

Contact Periods:

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

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Explain the basics used to create and manipulate geometric models in computer using ANSYS.

CO2: Create 1D, 2D and 3D models using ANSYS and Master CAM.

CO3: Do structural and thermal analysis of various models.

CO4: Describe about the failure criteria and vonmises stress for various models.

CO5: Explain the importance of casting simulation in foundry industries.

COURSE ARTICULATION MATRIX

PO/PSO CO	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	M	M	M	M	M								L	M	
CO2	M	M	H	M	M								L	M	
CO3	M	M	H	M	M								L	M	
CO4	M	M	H	M	M								L	M	
CO5	H	H	H	M	M								L	M	
18PPC707	M	M	H	M	M								L	M	

L- Low, M – Moderate (Medium), H - High

18PEE708	MINI PROJECT	SEMESTER: VII

Category: EEC

PRE-REQUISITES:	L	T	P	C
1. 18PEE508 Skill Development on Industrial Practices/Technical Projects	0	0	8	4

COURSE OBJECTIVES:

* To provide an opportunity to the student to get hands on training in the fabrication of one or more components of a complete working model, which is designed by them.

The students may be grouped into 2 to 4 and work under a project supervisor. The device/ system/component(s) to be fabricated may be decided in consultation with the supervisor and if possible with an industry. A project report to be submitted by the group and the fabricated model, which will be reviewed and evaluated continuously by a Committee constituted by the Head of the Department.

The progress of fabrication 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 fabricated model 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: 120 Periods** **Total: 120 Periods**

COURSE OUTCOMES

On completion of this course, students will be able to

CO1: Practice acquired knowledge within the chosen area of technology for project development.

CO2: Identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach.

CO3: Reproduce, improve and refine technical aspects for engineering projects.

CO4: Follow and value health, safety and ethical practices during project.

CO5: Work as an individual or in a team in development of technical projects.

CO6: Communicate and report effectively project related activities and findings.

COURSE ARTICULATION MATRIX

PO/PSO CO	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	L	M		M		L			L		L	M	M	L	
CO2	M	H	H	M	H	M	L		H	L	H	M	H	H	H
CO3	H	H	H	M	H	M	L		H	L	H	H	H	H	H
CO4						M	L	H	L		H	L			
CO5									H	L	H	H	H	H	H
CO6									M	H	M	M			
18PEE708	M	H	H	M	H	M	L	H	H	H	H	H	H	H	H

L- Low, M – Moderate (Medium), H - High

18PEE803	PROJECT WORK	SEMESTER: VIII

Category: EEC

PRE-REQUISITES:

	L	T	P	C
1. 18PEE508 Skill Development on Industrial Practices/Technical Projects	**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.

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

On completion of this course, students will be able to

CO1: identify problem specification or need for development.

CO2: analyse and develop conceptual design and methodology of solution for the problem.

CO3: devise solution and build physical model /test if required, as per industry / research / societal need, with due consideration of environmental aspects.

CO4: follow and value health, safety and ethical practices during project.

CO5: contribute as an individual or in a team in development of technical projects.

CO6: express technical ideas, strategies and methodologies in written form.

CO7: develop effective communication skills for presentation of project related activities.

COURSE ARTICULATION MATRIX

PO/PSO / CO	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	L	M		M		L			L		L	M	M	L	
CO2	M	H	H	H	H	M	L		H	L	H	M	H	H	H
CO3	H	H	H	H	H	M	H		H	L	H	H	H	H	H
CO4						H	L	H	L		H	L			
CO5									H	L	H	H	H	H	H
CO6									M	H	M	M			
CO7									M	H	L	M			
18PEE803	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H

L- Low, M – Moderate (Medium), H - High

18PPE$01	MECHATRONIC SYSTEMS

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1.18PES103-Basics of Electrical Engineering

2. 18PES403- Basic Electronics Engineering

COURSE OBJECTIVES:

- Introducing the key elements of mechatronics system and understanding the concepts of integration and design of mechatronics system.

UNIT- I	MECHATRONICS SYSTEMS	(9 Periods)
Introduction to Mechatronics- Basics of actuating systems. Mechanical, pneumatic, hydraulics, electrical systems- control systems- measurements systems- Mechatronics approach.		
UNIT- II	**SENSORS AND TRANSDUCERS**	**(9 Periods)**
Introduction - performance terminology- displacement, position and proximity- velocity and motion- fluid pressure-temperature sensors- light sensors- selection of sensors- signal processing.		
UNIT- III	**8085 MICROPROCESSOR**	**(9 Periods)**
Introduction- architecture- pin configuration- instruction set- programming of microprocessors using 8085 instructions-interfacing input and output devices- interfacing D/A converters and A/D converters- applications- temperature controls-stepper motor control- traffic light controller.		
UNIT- IV	**PROGRAMMABLE LOGIC CONTROLLERS**	**(9 Periods)**
Introduction - basic structure - input/output processing – programming – Mnemonics - timers, internal relays And counters - data handling - analog input/output - selection of a PLC.		
UNIT- V	**DESIGN OF MECHATRONIC SYSTEMS**	**(9 Periods)**
Stages in designing Mechatronics systems - Traditional and Mechatronics design - Possible design – solutions - case studies of Mechatronics systems - pick and place robots - automatic car park systems - engine management systems.		

Contact Periods:

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

TEXT BOOKS:

1. *W.Bolton **"Mechatronics",** Pearson education., Second Edition, 2007.*
2. *Ramesh S. Gaonkar **"Microprocessor Architecture Programming and Applications",** Wiley Eastern, 1991.*

REFERENCE BOOKS:

1. *Michel B. Histand and David G. Alciatore, **"Introduction to Mechatronics and measurement systems",** McGraw Hill International Editions.*
2. *HMT Ltd, **"Mechatronics",** Tata McGraw Hill publishing Co. Ltd.*
3. *D.A.Bradley, D. Dawson, N.C. Buru and A.J. Loader **"Mechatronics",** Chapman and Hall.*
4. *K. Ram,.**"Fundamantals of Microprocessors and Microcomputers",** Dhampat rai publications.*
5. *Dan Necsulescu **"Mechatronics",** Pearson Education Asia. (Indian reprint).*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Build the basic block diagram of mechatronics system (sensing, measuring controlsand actuation, hardware and software).

CO2: Describe the mechatronic system approach.

CO3: Explain the concepts of transducers, sensors, microprocessor and programmable logic controllers in mechatronics systems.

CO4: Identify critical problems/ design issues and suggest feasible solutions in mechatronics systems.

CO5: Design mechatronic components and systems.

COURSE ARTICULATION MATRIX

PO/PSO CO	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	H	H	M	M	M	L						L	L	M	
CO2	M	M	M	M	M	L						L	L	M	
CO3	M	M	M	M	M	L						L	L	M	
CO4	M	M	H	H	M	L						L	L	M	
CO5	H	H	H	H	M	L						L	L	M	
18PPE$01	H	H	H	H	M	L						L	L	M	

L- Low, M – Moderate (Medium), H – High

18PPE$02	FINITE ELEMENT TECHNIQUES

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 18PPC405 – Mechanics of Materials

COURSE OBJECTIVES:

- 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 equations - 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 BOOKS:

1. *J.N.Reddy **"Introduction to Finite Element Method",** McGraw Hill, Intl, 3rd edition, 2006.*
2. *Larry J. Segerlind **"Applied Finite Element Analysis",** John Wiley and Sons., 2nd edition, 1985.*
3. *SingiresuS.Rao **"The Finite Element Method in Engineering",** Butterworth Heinemann., 5thedition, 2011.*

REFERENCE BOOKS:

1. *Tirupathi R. Chandrupatala and Ashok D. Belegundu **"Introduction to Finite Elements in Engineering",** Pearson Education, 4th edition, 2011.*
2. *David V. Hutton, **"Fundamentals of Finite Element Analysis",** Tata McGraw Hill, 3rd edition, 2005.*
3. *ChandrakantS.Desai, **"Elementary Finite Element Method",** Prentice Hall Inc., 1979.*
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:

On completion of this course, students will be able to

CO1: Describe the fundamentals of finite element technique
CO2: Formulate the structural and heat transfer problems
CO3: Solve the simple structural and heat transfer problems
CO4: Describe the shape function and element characteristics
CO5: Describe the higher order elements

COURSE ARTICULATION MATRIX

PO/PSO CO	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
CO 1	M	H	M				M					M		M	
CO 2	M	M	L	M			L			M		L		M	
CO 3	M		M	M			M			M		L		H	
CO 4	M	M		M						H		M		H	
CO 5	M	M	L							L		L		M	
18PPE$02	M	M	L	M			M			M		L		M	

L- Low, M – Moderate (Medium), H - High

18PPE\$03	UNCONVENTIONAL MANUFACTURING PROCESSES

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To understand the working principles of various non-traditional machining processes, applications, advantages and limitations.

UNIT- I	MECHANICAL ENERGYMETAL REMOVAL PROCESSES	(9 Periods)
Need of modern machining processes – classification and selection of technology. Mechanical processes - 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	**THERMAL METAL REMOVAL PROCESSES**	**(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	**FORMING PROCESSES AND FOUNDRY TECHNIQUES**	**(9 Periods)**
Explosive forming, Electro – hydraulic forming, electro – magnetic forming. Dynapak machine - high pressure moulding, squeeze casting, vacuum castings.		
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 BOOKS:

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.*

REFERENCE BOOKS:

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:

On completion of this course, students will be able to

CO1: describe the mechanical energy based newer production processes.

CO2: describe the electrochemical energy based newer production processes.

CO3: describe the thermal energy based newer production processes.

CO4: explain the explosive forming and high pressure casting processes.

CO5: describe various Rapid Prototyping techniques

COURSE ARTICULATION MATRIX

PO/PSO / CO	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	M	H		M	M				M	L	L	L	H		L
CO2	M	H		M	M				M	L	L	M	H		L
CO3	M	H		M	L				M	L	L	M	H		L
CO4	M	H		M	L				M	L	L	M	H		L
CO5	L	H		M	L				L	L	L	M	H		L
18PPE$03	M	H		M	L				M	L	L	M	H		L

L – Low, M- Moderate (Medium), H – High

18PPE\$04	CNC TECHNOLOGY

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

18PPC406 – Machine Tools and Processes

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, inductosysn, 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 BOOKS:

1. *HMT Limited **"Mechatronics",** Tata McGraw-Hill Publishing Company Limited, New Delhi, 2005*
2. *Mike Mattson **"CNC Programming Principles and Applications",** Delmar Cengage learning, 2010*

REFERENCE BOOKS:

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*
4. *Third Edition 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:

On completion of this course, students will be able to

CO1: Describe the evolution and principle of CNC machine tools and types of control systems.

CO2: Apply knowledge in current terminology to describe the CNC machines and its types.

CO3: Describe constructional features of CNC machine tools, drives and positional transducers used in CNC machine tools.

CO4: Generate CNC programs for popular CNC controllers.

CO5: Describe tooling and work holding devices for CNC machine tools.

COURSE ARTICULATION MATRIX

PO/PSO CO	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	L				H								L		
CO2	L				H								L		
CO3	L				M								M		
CO4	L				H							M		H	
CO5	L				M								M		
18PPE$04	L				H							M	M	M	

L- Low, M – Moderate (Medium), H – High

18PPE\$05	**POWER PLANT ENGINEERING** *(Common to MECH & PRODN)*

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 18PPC304 -Thermal Sciences

COURSE OBJECTIVES:

- To learn the economics of power generation.
- To understand the working of power plants components.

UNIT- I	ECONOMICS OF POWER GENERATION	(9 Periods)
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.		
UNIT- II	**HYDRO POWER PLANTS**	**(9 Periods)**
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- III	**THERMAL AND GAS TURBINE POWER PLANTS**	**(9 Periods)**
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- IV	**NUCLEAR POWER PLANTS**	**(9 Periods)**
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- V	**RENEWABLE ENERGY POWER PLANTS**	**(9 Periods)**
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.		

Contact Periods:

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

TEXT BOOKS:

1. M.*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.*

REFERENCE BOOKS:

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*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Arrive at cost of power generation, electricity billing and rate of return on power plant investments.

CO2: Understand the working of Hydro-electric power plants.

CO3: Analyze the working of Conventional power plants such as Thermal and Gas Turbines.

CO4: Understand the working of nuclear power plants and its functional components.

CO5: Understand the different types of renewable energy systems and its functional components.

COURSE ARTICULATION MATRIX

PO/PSO / CO	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
CO 1	M	L	H	M	H	L	M	L	L	L	M	H	M		M
CO 2	L	M	H	L	M	L	H	M	M	L	H	L	L		M
CO 3	M	M	H	M	M	H	M	L	L	H	M	M	M		L
CO 4	H	M	L	M	H	M	L	M	L	H	H	M	M		M
CO 5	M	L	L	H	M	M	L	H	H	M	H	H	M		M
18PPE$05	M	M	M	M	M	M	M	M	M	M	H	M	M		M

L- Low, M – Moderate (Medium), H - High

16PPE$06	ROBUST DESIGN

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 18PES303 -Engineering Mechanics

COURSE OBJECTIVES:

* 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, ANOVA, 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 - Statistical analysis, 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 BOOKS:

1. *A. Mitra **"Fundamentals of Quality Control and Improvement",** Pearson Publication, 1998*
2. *Phillip J.Rose **"Taguchi techniques for quality engineering",** McGraw Hill, 1996*

REFERENCE BOOKS:

1. *Montgomery, D.C.,* ***"Designand 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. *NicoloBelavendram* ***"Quality by Design; Taguchi techniques for industrial experimentation",*** *Prentice Hall, 1995.*
4. *J. Krottmaier* ***"Optimizing Engineering Design",*** *McGraw Hill Ltd, 1993*
5. *MadhavShridharPhadke,* ***"Quality Engineering Using Robust Design",*** *Prentice Hall, 1985*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Select appropriate tools for robust design.

CO2: Identify and implement single factor experiments

CO3: Identify and implement multi factor experiments

CO4: Apply the concepts of .special experiment designs

CO5: Apply the concepts of Taguchi experiment design for practical problems.

COURSE ARTICULATION MATRIX

PO/PSO CO	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
CO 1	L	M	H		L				L		L		L	L	L
CO 2	L	M	H		L				L		L		L	L	L
CO 3	L	M	H		L				L		L		L	L	L
CO 4	L	M	H		L				L		L		L	L	L
CO 5	L	M	H		L				L		L		L	L	L
16PPE$06	L	M	H		L				L		L		L	L	L

L- Low, M – Moderate (Medium), H - High

18PPE\$07	STATISTICAL QUALITY CONTROL AND RELIABILITY ENGINEERING

Category: PE

PRE-REQUISITES:

L	T	P	C
3	0	0	3

1. 18PPC502- Production Planning and Control

COURSE OBJECTIVES:

- 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 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 – process capability – process capability studies and simple problems – 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 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.		
UNIT- III	**ACCEPTANCE SAMPLING**	**(9 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 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 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: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Grant, Eugene.L **"Statistical Quality Control",** McGraw-Hill, 7th edition, 2008.*
2. *L.S.Srinath **"Reliability Engineering",** Affiliated East west press, 1991.*

REFERENCE BOOKS:

1. *Monohar Mahajan, **"Statistical Quality Control",** Dhanpat Rai and Sons, 2001.*
2. *R.C.Gupta, **"Statistical Quality control",** Khanna Publishers, 1997*
3. *Besterfield D.H **"Quality Control",** Prentice Hall, 1993.*
4. *Sharma S.C., **"Inspection Quality Control and Reliability",** Khanna Publishers, 1998*
5. *Connor, P.D.T.O **"Practical Reliability Engineering",** John Wiley, 1993.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: describe the basic concepts involved in manufacturing process control for variables.
CO2: describe various process control charts for attributes.
CO3: explain the concepts of acceptance sampling.
CO4: explain the life testing techniques, failure data analysis and mean failure rate.
CO5: describe Pareto analysis and product design, development and life cycle concepts.

COURSE ARTICULATION MATRIX

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M	L	L									M		M
CO2	M	M	L	L									M		M
CO3	M	L	L	L									M		M
CO4	M	L	M	M									M		M
CO5	M	M	M	M									M		M
18PPE$07	M	M	M	M									M		M

L- Low, M – Moderate (Medium), H – High

18PPE$08	ADVANCED WELDING TECHNOLOGY

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 18PPC305 – Engineering Metallurgy
2. 18PPC306 – Manufacturing Technology

COURSE OBJECTIVES:

- 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 BOOKS:

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*
3. *Little R.L **"Welding and welding Technology",** Tata McGraw Hill Publishing Co., Ltd., New Delhi, 34th reprint, 2008.*

REFERENCE BOOKS:

1. *Schwartz M.M **"Metals Joining Manual",** McGraw Hill Books, 1979.*
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, 10th edition 1993.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Describe the solid state welding processes

CO2: Describe the high energy beam welding processes

CO3: Describe the Elctro-slag and Elctro-gas welding processes

CO4: Describe the plasma arc welding processes

CO5: Describe the special welding techniques for plastics and underwater welding processes

COURSE ARTICULATION MATRIX

PO/PSO CO	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	M				M		H		L			M	M		
CO2	H		H		L		M		L	M	L		M		M
CO3	M	L	M		M		M				M	M	L		
CO4	M				L		M		L	M					
CO5	M	L	M		L		L					L			M
18PPE $08	M	L	M		L		M		L	M	L	M	M		M

L- Low, M – Moderate (Medium), H - High

18PPE$09	PRODUCT DESIGN AND PROCESS ENGINEERING

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 18PPC305 – Engineering Metallurgy
2. 18PPC306 – Manufacturing Technology
3. 18PPC406 – Machine Tools and Processes
4. 18PPC504 – Metrology and Computer Aided Inspection

COURSE OBJECTIVES:

* 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)**
Modeling and simulation; the role of models in product design mathematical modeling 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 BOOKS:

1. *George E.DieterandLinda C. Schmidt **"Engineering design",** McGraw HillEducation, 5th edition, 2012*
2. *Robert Matousek **"Engineering Design",** Blacke and Sons Ltd, 1972*

REFERENCE BOOKS:

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.*
6. *Oliver R. Wade, **"Tolerance Control in Design and Manufacturing",**Industrial Press, New York publications, 1967.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1*:* Describe the product innovation

CO2: Describe the analytical evaluation of the products

CO3: Select the appropriate material for the product

CO4: Develop the appropriate processing technique for the product

CO5: Incorporate the aesthetic and ergonomic values

COURSE ARTICULATION MATRIX

PO/PSO CO	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	M	M	H			H	L		H	L		M	H		
CO2	M	H	M			M	M		M				M		
CO3	L	M	M	M		M	M		M			M	M		
CO4	M		L	M		H	L		H				M		
CO5		L	L			L	M		M				L		
18PPE$09	M	M	M	M		M	M		M	L		M	M		

L- Low, M – Moderate (Medium), H – High

18PPE$10	DESIGN FOR MANUFACTURE AND ASSEMBLY

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

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)
Economics of process selection – general design principles of manufacturability – proper material selections – strength and mechanical factors – Geometric tolerances – Design for serviceability – Tolerance Charting Techniques. General aspects of the designers work - design factors – systematic working plan – basic design.		
UNIT- II	**FORM DESIGN**	**(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 BOOKS:

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.*

REFERENCE BOOKS:

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:

On completion of this course, students will be able to

CO1: Explain the basic design principles and use of tolerances in manufacturing.

CO2: Describe the concepts of form design for various metals and alloys involving in casting process.

CO3: Describe the design concepts of formed metals and plastic components.

CO4: Explain the concepts of various machined parts design for manufacturing.

CO5: Explain the assembly concepts for manufacturing and its technology requirements.

COURSE ARTICULATION MATRIX

PO/PSO CO	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	H	M	M	L									L		
CO2	M	L	M	L									L		
CO3	M	L	M	L									L		
CO4	M	L	M	L									L		
CO5	M	L	M	L									L		
18PPE $10	M	L	M	L									L		

L- Low, M – Moderate (Medium), H – High

18PPE$11	HUMAN VALUES AND PROFESSIONAL ETHICS II

Category: PE

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To develop the capacity of making value judgments in real life situations and to overcome the crisis of values encountered in professional life.

UNIT - I	HUMAN VALUES AND INTRODUCTION TO ETHICS	(9 Periods)
Morals, Values and Ethics – Integrity – Work Ethic – Respect for Others – Living Peacefully – caring – Sharing – Honesty – Courage – Valuing Time – Co-operation – Commitment – Empathy – Self-Confidence – Character – Spirituality - Senses of 'Engineering Ethics' - variety of moral issues - types of inquiry.		
UNIT - II	**ETHICAL THEORIES AND PROFESSIONALISM**	**(9 Periods)**
Moral dilemmas - moral autonomy - Kohlberg's theory - consensus and controversy – Models of Professional Roles - theories about right action - Self-interest - customs and religion - uses of ethical theories.		
UNIT - III	**ENGINEERING AS SOCIAL EXPERIMENTATION**	**(9 Periods)**
Engineering as experimentation - engineers as responsible experimenters - codes of ethics - a balanced outlook on law - the challenger case study.		
UNIT - IV	**SAFETY,RESPONSIBILITY AND RIGHTS**	**(9 Periods)**
Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - three mile island and chernobyl case studies. Collegiality and loyalty - respect for authority - collective bargaining - confidentiality - conflicts of interest - occupational crime - professional rights - employee rights - Intellectual Property Rights (IPR) - discrimination.		
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 -moral leadership-sample code of Ethics like ASME, SAE India, Institution of Engineers (India), Indian Institute of Materials Management, Institution of electronics and telecommunication engineers (IETE),India.		

Contact Periods:

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

TEXT BOOKS:

1. *Mike Martin and Roland Schinzinger **"Ethics in Engineering",** McGraw-Hill, New York, 3rd edition, reprint 2007*
2. *Govindarajan M, Natarajan S, Senthil Kumar V. S **"Engineering Ethics",** Prentice Hall of India, New Delhi, 2004*
3. *Tripathi A N **"Human values",** New Age international Pvt. Ltd., New Delhi, 2002*

REFERENCE BOOKS:

1. *Charles D. Fleddermann **"Engineering Ethics",** Pearson Education / Prentice Hall, New Jersey, 2004*
2. *Charles E Harris, Michael S. Protchard and Michael J Rabins **"Engineering Ethics – Concepts and Cases",*** Wadsworth Thompson Learning, United States, 2000 .
3. *John R Boatright **"Ethics and the Conduct of Business",**Pearson Education, New Delhi, 2003.*
4. *Edmund G Seebauer and Robert L Barry **"Fundamentals of Ethics for Scientists and Engineers",** Oxford University Press, Oxford, 2001.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: recognize the basic concepts of Human values and ethics.

CO2: express the ethical theories.

CO3: identify the concept of professionalism

CO4: identify and implement the safety aspects in social experimentation

CO5: understand the impact of technical development in environmental and societal context.

COURSE ARTICULATION MATRIX

PO/PSO CO	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	L	L	H			H	H	H	H			M	H		
CO2	L	L	H			H	H	H	H			M	H		
CO3	L	L	H			H	H	H	H	H	H	M	H		
CO4	L	L	H			H	H	H	H	H		M	H	H	
CO5	L	L	H			H	H	H	H	H		M	H	H	
18PPE $11	L	L	H			H	H	H	H			M	H		

L- Low, M – Moderate (Medium), H - High

18PPE$12	PLANT LAYOUT AND MATERIAL HANDLING

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

* To understand basic layout and the usage of material handling equipments for industries and gain knowledge on industrial buildings and utilities.

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 BOOKS:

1. *James, M. Apple **"Plant Layout and Material Handling",** Kreiger Publishing Company, 1991*
2. *Rudenko. N **"Materials handling equipment",** Mir Publishers, 1969*

REFERENCE BOOKS:

1. *James, M. Moore **"Plant Layout and Design",** Macmillan Company, NY, 1963*
2. *Muther, R.**"Practical Plant Layout",** McGraw Hill Book Company, NY, 1955*
3. *Colin Hardie **"Material Handling in Machine Shops",** Machinery Publication Co. Ltd., London, 1970*
4. *Alexandrov, M **"Materials Handling Equipments",** MIR Publishers, 1981.*
5. *Boltzharol, A. **"Materials Handling Handbook",** The Ronald Press Company, 1958*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Design plant layout for any type of industries.

CO2: Perform effective selection and utilization of buildings and utilities.

CO3: Select and utilize suitable material handling equipment.

CO4: Plan appropriate HVAC system for industrial buildings.

CO5: Analyze the usage of material handling equipments.

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COURSE ARTICULATION MATRIX

PO/PSO CO	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	M	L	M		L	L		L	L		L		L	L	L
CO2	M	L	M			L		L	L		L		L	M	L
CO3	M	L	M			L		L	L		L		L	L	L
CO4	H	L	M			L		L	L		L		L	L	L
CO5	M	L	M		M	L		L	L		L		L	L	L
18PPE$12	M	L	M		L	L		L	L		L		L	L	L

L- Low, M – Moderate (Medium), H - High

18PPE\$13	NON DESTRUCTIVE TESTING TECHNIQUES

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 18PPC306 - Manufacturing Technology

COURSE OBJECTIVES:

- To understand principle behind various NDT techniques.
- To study about NDT equipments and accessories.
- To learn working procedures of various NDT techniques.

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	**LIQUID PENETRANT & MAGNETIC INSPECTION**	**(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 BOOKS:

1. *Baldev Raj, T.Jayakumar, M.Thavasimuthu **"Practical Non-Destructive Testing",** Narosa Publishing House, 2009.*
2. *Ravi Prakash **"Non-Destructive Testing Techniques",** New Age International Publishers, 2010*

REFERENCE BOOKS:

1. *ASM Metals Handbook **"Non-Destructive Evaluation and Quality Control",** American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17.*
2. *Paul E Mix, **"Introduction to Non-destructive testing: a training guide",** Wiley, 2nd Edition New Jersey, 2005*
3. *Charles, J. Hellier, **"Handbook of Nondestructive evaluation",** McGraw Hill, New York 2001.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Classify various non-destructive testing and choose the right method of testing for detection of defects on various materials.

CO2: Check different metals and alloys by visual inspection method.

CO3: Explain and perform non-destructive tests like: Liquid penetrant test, Magnetic particle test, Ultrasonic test, X-ray and Gamma ray radiography, Leak Test, Eddy current test.

CO4: Describe the safety procedures of operating the NDT equipments and follow them.

CO5: Detect the flow and other defects using NDT procedure for industrial component.

COURSE ARTICULATION MATRIX

PO/PSO CO	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		M											L		M
CO2		M													M
CO3		M	M	H	M							M			
CO4						M									H
CO5			M			L									M
18PPE$13		M	M	H	M	M						M	L		M

L- Low, M – Moderate (Medium), H – High

18PPE$14	SUPPLY CHAIN MANAGEMENT

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To develop the students in the dynamics of inter-organizational collaboration and coordination towards building supply chains.

UNIT- I	INTRODUCTION TO SUPPLY CHAIN MANAGEMENT	(9 Periods)
Meaning and definition of supply chain management, Difficulties of managing supply chains, the development chain, global optimization, Key issues in of supply chain management.		
UNIT- II	**INVENTORY MANAGEMENT AND RISK POOLING**	**(9 Periods)**
Introduction, single stage Inventory control, The economic lot size model, effect of demand uncertainty. Risk pooling, centralized and decentralized system, managing inventory in the supply chain, forecasting.		
UNIT- III	**VALUE OF INFORMATION**	**(9 Periods)**
Introduction, Bullwhip effect-Quantifying the bullwhip effect-impact of centralized information on the bullwhip effect-supply chain with centralized demand information and decentralized demand information=managerial insights in the value of centralized information. Methods for coping with the bullwhip effect. Supply chain integration - push, pull and push-pull system. Demand driven strategies.		
UNIT- IV	**GLOBALISATION OF SCM**	**(9 Periods)**
Introduction,-Global market forces, Technological forces, global cost forces, political and economic forces. Managing global risks-speculative strategies, hedge strategies, flexible strategies- requirements for global strategy implementation. Issues in international supply chain management- International versus regional products, region-specific products, true global products. Supplies integration into to new product development- spectrum of supplier integration, keys to effective supplier integration, bookshelf of technologies and suppliers. Mass customization-Meaning, making mass customization work, mass customization and supply chain management.		
UNIT- V	**INFORMATION TECHNOLOGY FOR SCM**	**(9 Periods)**
Goals of supply chain IT, IT standards, It infrastructure, IT for supply chain excellence.		

Contact Periods:

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

TEXT BOOKS:

1. *Simchi-Levi David, Kaminsky Philip, Simchi-Levi Edith and Ravi Shankar.* ***"Designing and Managing the Supply Chain: Concepts, Strategies and Case Studies",*** *Third Edition, Tata McGraw Hill Education Private Limited, New Delhi, Tenth reprint, 2012.*
2. *Chopra S and Meindl P* ***"Supply Chain Management: Strategy, Planning and Operation",*** *Second Edition, Prentice Hall India Private Limited, 2005.*

REFERENCE BOOKS:

1. *Robert Jacobs F, William Berry and Clay Whybark D* ***"Manufacturing Planning and Control for Supply Chain Management",*** *Tata McGraw Hill, New Delhi, 2011.*
2. *Christopher* ***"Logistics and Supply Chain Management",*** *Pearson Education Asia, New Delhi*
3. *Taylor and Brunt,* ***"Manufacturing Operations and Supply Chain Management (The Lean Approach)",*** *Business Press Thomson Learning, NY*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Describe the objectives of supply chain management.

CO2: Describe the inventory management and risk pooling.

CO3: Describe about value of information.

CO4: Describe about globalization of SCM.

CO5: Describe about information technology for SCM.

COURSE ARTICULATION MATRIX

PO/PSO CO	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	M					M						L		L	
CO2	H	L			L	M			L				M	M	
CO3									L	M		M			M
CO4	H	L				L		L					L		
CO5		H			L				L			M		M	
18PPE$14	M	M			L	M		L	L	L		M	L	M	L

L- Low, M – Moderate (Medium), H - High

18PPE$15	PRODUCTION MANAGEMENT

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

* To introduce various management methods in production industries.

UNIT- I	BASICS OF MANAGEMENT	(9 Periods)
Evolution of management - General principles of management – management functions – organization –types – comparison – functions of personnel management – recruitment – training – leadership - motivation – communication – conflict – Industrial relations – trade union.		
UNIT- II	**OPERATIONS MANAGEMENT**	**(9 Periods)**
Plant Location – Layout – Materials Handling – Method study – Time study – Ergonomics – Aggregate Planning – Value Analysis.		
UNIT- III	**MATERIALS MANAGEMENT**	**(9 Periods)**
Materials management - Purchasing – Objectives – parameters – procedure. Supplier selection – Stores management – codification – Waste management – Reasons for waste generation – identification and control of waste – scrap disposal.		
UNIT- IV	**INVENTORY MANAGEMENT**	**(9 Periods)**
Purpose of inventory – Cost related to inventory – Basic EOQ model – variations in EOQ model – Finite Production, quantity discounts – ABC Analysis – MRP - Introduction to MRP II and ERP.		
UNIT- V	**MARKETING MANAGEMENT**	**(9 Periods)**
Functions of marketing – Sales promotion methods – advertising – product packaging – marketing variables – distribution channels – organization – market research – market research techniques.		

Contact Periods:

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

TEXT BOOKS:

1. *R. Panneerselvam **"Production and Operations Management",** Prentice Hall of India, 2012.*

REFERENCE BOOKS:

1. *Koontz and Weihrich **"Essentials of Management",** McGraw Hill 2015*
2. *Philips Kotler **"Marketing management",** Pearson, 2015*
3. *Martand T. Telesang **"Production Management",** S.Chand& Co., 2007*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Illustrate the functions of management and personnel management.

CO2: Explain various ways of managing operations in engineering industries.

CO3: Identify the methods for managing materials in engineering industries.

CO4: Describe the importance of inventory and the ways of managing inventory.

CO5: Explain the various processes involved in marketing.

COURSE ARTICULATION MATRIX

PO/PSO CO	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	L								M	M	H	M			
CO2	M	M		M	L					L	H	L	L		H
CO3	L	M	L	L	L					L	M	L			L
CO4	M	L	L	L	L					L	H	L			M
CO5		L								H	M	L			
18PPE$15	L	M	L	L	L				L	L	H	L	L		M

L- Low, M – Moderate (Medium), H - High

18PPE$16	**LEAN MANUFACTURING** *(Common to MECH & PRODN)*

Category: PE

PRE-REQUISITES:

1. 18PPC306 -Manufacturing Technology
2. 18PPC406 - Machine Tools and Processes

L	**T**	**P**	**C**
3	**0**	**0**	**3**

COURSE OBJECTIVES:

* 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 BOOKS:

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*
3. *N.Gopalakrishnan, **"Simplifed Lean Manufacture",** PHI, 2010*

REFERENCE BOOKS:

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:

On completion of this course, students will be able to

CO1: Describe about the origin and foundation of lean production.
CO2: Describe about stability and standards in lean system.
CO3: Describe about Just In Time (JIT) and its application in lean.
CO4: Describe about Jidoka and Poke Yoke.
CO5: Describe about lean involvement and culture.

COURSE ARTICULATION MATRIX

PO/PSO CO	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
CO 1	L		M		L	H	M				L	L		L	
CO 2	M	L		M	L	M	L		L			M	M	M	
CO 3			H	L					L	M				L	M
CO 4	H	L		M		M		L				M	L	H	
CO 5		M	H		L		L		L						
18PPE$16	M	L	M	M	L	M	L	L	L	M	L	M	L	M	L

L- Low, M – Moderate (Medium), H - High

18PPE$17	MICRO MANUFACTURING PROCESSES

Category: PE

PRE-REQUISITES:

1. 18PPC306 – Manufacturing Technology
2. 18PPC406 - Machine Tools and Processes

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- 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 BOOKS:

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

REFERENCE BOOKS:

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.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Describe various mechanical micro machining processes

CO2: Describe various beam energy based micro machining processes.

CO3: Explain various methods of nano polishing techniques.

CO4: Understand and explain the micro forming and welding processes.

CO5: Use the knowledge of micro manufacturing processes into engineering applications.

COURSE ARTICULATION MATRIX

PO/PSO / CO	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	M				H			M	L	M		M	M		
CO2	M				H			M	M	M		M	M		
CO3	M				H				M	M		M	M		
CO4					M				L	M		M	M		
CO5	H				H	M		M	M	M			M		
18PPE$17	M				H	M		M	M	M		M	M		

L- Low, M – Moderate (Medium), H - High

18PPE$18	**THEORY OF METAL CUTTING** *(Use of approved data book is permitted)* *(Common to MECH & PRODN Branches)*

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 18PES303 -Engineering Mechanics
2. 18PPC304 -Thermal Sciences

COURSE OBJECTIVES:

* To familiarize students about the basic mechanics, thermal, wear and chatter mechanisms in metal cutting processes.

UNIT- I	ORTHOGONAL CUTTING	(9 Periods)
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	**OBLIQUE CUTTING**	**(9 Periods)**
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 ratios in oblique cutting, Shear angle and Velocity relationship, Stabler's rule, Oblique cutting applications.		
UNIT- III	**THERMAL ASPECTS OF MACHINING**	**(9 Periods)**
Heat distributions in machining, Experimental determination and analytical calculation of cutting tool 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	**CUTTING TOOL MATERIALS, TOOL LIFE AND TOOL WEAR**	**(9 Periods)**
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 of machining, Reasons for failure of cutting tools and mechanisms and measurements of wear in single and multi-point cutting tools		
UNIT- V	**DESIGN OF CUTTING TOOLS**	**(9 Periods)**
Nomenclature of Single point and Multi point cutting tools - Design of Turning tool, Drills, Milling cutters and tool holders.		

Contact Periods:

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

TEXT BOOKS:

1. *Shaw.M.C.* ***"Metal cutting principles",*** *oxford Clare don press, 2005.*
2. *Bhattacharya.A.* ***"Metal Cutting Theory and practice",****Central Book Publishers, India, 2012.*

REFERENCE BOOKS:

1. *Boothroid D.G. & Knight W.A.,* ***"Fundamentals of machining and machine tools",*** *Marcel Dekker, Newyork, 1989.*
2. *HMT* ***"Production Technology",*** *HMT publication, 2017*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Elaborate the mechanisms of chip formation in different metal cutting processes

CO2: Understand the difference between Orthogonal and Oblique cutting and its uses

CO3: Realize the thermal effects of cutting process and its removal methods

CO4: Predict the effects of cutting parameters on Tool life

CO5: Design a cutting tool for various cutting process

COURSE ARTICULATION MATRIX

PO/PSO CO	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	M	L								M		M	L		M
CO2	M	L	L							M		M	M	M	
CO3	M		L									M			
CO4	M		M									M	L	L	
CO5	M				M			M		M	M	M	M	H	M
18PPE$18	M	L	L		M			M		M	M	M	M	M	M

L- Low, M – Moderate (Medium), H - High

18PPE$19	ADVANCED CASTING TECHNOLOGY

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

* To impart knowledge on various advanced casting techniques.

UNIT- I	CASTING OF METALS	(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.		
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 BOOKS:

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.*

REFERENCE BOOKS:

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:

On completion of this course, students will be able to

CO1: Explain the factors influencing casting of metals.

CO2: Explain the robots in metal casting.

CO3: Explain various advanced casting processes.

CO 4: Describe the thermal, metallurgical aspects during solidification in casting.

CO 5: Explain the applications of computer in metal casting.

COURSE ARTICULATION MATRIX

PO/PSO CO	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	M	M		L		L	L	L	L	L		L	H		L
CO2	L	M	H			M	M	L	L	L		L	H		L
CO3	M	M	L	L	L	M	L	L	L	L		L	H		L
CO4	L	H	M	L	L	M	L			L		L	H		L
CO5	L	M	M	M	M	L	L	L	L	L		L	H		L
18PPE$19	L	M	M	L	L	M	L	L	L	L		L	H		L

L – Low, M- Moderate (Medium), H - High

18PPE$20	TOTAL PRODUCTIVE MAINTENANCE

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

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	MAINTENANCE CONCEPTS	(9 Periods)
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	**MAINTENANCE MODELS**	**(9 Periods)**
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	**FUNDAMENTALS OF TPM**	**(9 Periods)**
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	**MAINTENANCE LOGISTICS**	**(9 Periods)**
Human factors in maintenance - maintenance manuals - maintenance staffing methods - queuing applications - simulation - spare parts management - maintenance planning and scheduling.		
UNIT- V	**ONLINE MONITORING**	**(9 Periods)**
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 BOOKS:

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

REFERENCE BOOKS:

1. *Wireman T **"Total Productive Maintenance",** Industrial Press Inc., New york, 2004*
2. *Goto F **"Equipment planning for TPM Maintenance Prevention Design",** Productivity Press,1992*
3. *Shirose K., **"Total Productive Maintenance for Workshop Leaders",** Productivity Press, 1992*
4. *Kelly A., **"Maintenance planning and control",** Butterworths, London, 1991*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Describe the concept of total productive maintenance used in the industries.

CO2: Describe how TPM improves operations by preventing equipment breakdowns and prevention of product defects and rejects.

CO3: Understand the usage of tools for TPM implementation and able to identify and eliminate loss through TPM implementation.

CO4: Describe the logistics involved in Total productive Maintenance.

CO5: Effectively use the total productive maintenance for online monitoring of processes.

COURSE ARTICULATION MATRIX

PO/PSO / CO	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								M	M	H		M			
CO2	M	H				M		M	M	M	M	M			L
CO3	L				M			M	M	M		M	M		M
CO4								M	M			H			
CO5					L			M	M			M			L
18PPE$20	L	L			L	M		M	M	M	M	M	M		L

L- Low, M – Moderate (Medium), H – High

18PPE$21	GREEN MANUFACTURING

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To introduce the basic concepts needed to proceed green 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)**
Levels of manufacturing systems, environmentally conscious manufacturing- components, system effects and 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 BOOKS:

1. *Daniel B Botkin and Edward A Keller **"Environmental Science",** John Wiley & Sons, Chichester, 2010*
2. *Madu. C.N **"Handbook of Environmentally Conscious Manufacturing",**N Kluwer Academic Publisher, 2001.*

REFERENCE BOOKS:

1. *Swamidass, P.M., **"Encyclopedia of Production and Manufacturing Management",** Kluwer Academic Publisher, 2000.*
2. *Kutz, M **"Environmentally Conscious Mechanical Design** John Wiley & Sons, 2007*
3. *Davim, J.P **Sustainable Manufacturing",** John Wiley & Sons, 2010.Koontz and Odonnel-Essentials of Management, McGraw Hill 1992*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Explain about the effect of humans on ecosystems and various phenomenon of Eco systems

CO2: Explain about the environmentally conscious manufacturing systems.

CO3: Evaluate the effects of water pollution by manufacturing systems and their prevention

CO4: Discuss the effects of air and solid pollution in manufacturing systems

CO5: Explain about environmental management systems

COURSE ARTICULATION MATRIX

PO/PSO CO	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	L					H	H	M	L	M	L	H			L
CO2	L	L	M	L		H	H	M	L	M	L	H			L
CO3	L	L	L	L		H	H	M	L	M	L	H			L
CO4	L	L	M	L		H	H	M	L	M	L	H			L
CO5	L	M	M	L		H	H	M	L	M	L	H			L
18PPE$21	L	L	M	L		H	H	M	L	M	L	H			L

L- Low, M – Moderate (Medium), H - High

18PPE$22	**COMPUTER AIDED DESIGN** *(Common to MECH & PRODN Branches)*

Category : PE

L	T	P	C
3	0	0	3

PRE-REQUISITES :

1. 18PES106 - Engineering Graphics
2. 18PPC409 – Production Drawing

COURSE OBJECTIVES:

* 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-spline surfaces. 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 BOOKS:

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*
3. *C.McMohan and J.Browne, **"CAD/CAM Principles",**II edition, Pearson Education,1999*

REFERENCE BOOKS:

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, students will be able to

CO 1: Understand the fundamental of computer graphics and 2D and 3D transformation

CO2: Familiar about the geometric, surface and solid modeling technique

CO3: Develop the line , surface and solid removal algorithm and creation of computer animation

CO4: Identify the importance of tolerance during assembly of components

CO5: Summarize the various standards used in CAD

.

COURSE ARTICULATION MATRIX

PO/PSO CO	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	L		H							M				M	M
CO2		L			M									M	M
CO3		L			H			L		L				M	M
CO4		L		L					L	L				M	M
CO5					H						M			L	M
18PPE$22	L	L	H	L	M			L	L	L	M			M	M

L- Low, M – Moderate (Medium), H – High

18PPE$23	ROBOTICS AND MACHINE VISION SYSTEM

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- 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 BOOKS:

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*

REFERENCE BOOKS:

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. *Ramesh Jam, RangachariKasturi, Brain G.Schunck **"Machine Vision",** Tata McGraw Hill.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Explain the basic concepts like various configurations, classification and parts of robots.

CO2: Explain the concept of kinematics, degeneracy, dexterity and trajectory planning.

CO3: Describe various end effectors (grippers and tools) and sensors used in robots.

CO4: Explain the concept of Artificial Intelligence in robots, various types of robot programming and its applications.

CO5: Demonstrate the image processing and image analysis techniques by machine vision system.

COURSE ARTICULATION MATRIX

PO/PSO CO	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	M	L	L									L	M		
CO2	M	M	M	M								L	M		
CO3	M	L	L									L	M		
CO4	M	M	H		M							L	M	M	
CO5	H	M	M	L								L	M	M	
18PPE$23	M	M	M	L	L							L	M	M	

L- Low, M – Moderate (Medium), H - High

18PPE$24	INVESTMENT CASTING

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 18PPC306 – Manufacturing Technology

COURSEOBJECTIVES:

* To enable the students to understand the difference between investment casting and other casting processes and familiarize them in design and product development, casting process, wax materials and destructive and non destructive testing used in industries.

UNIT- I	INTRODUCTION	(9 Periods)
Overview of investment casting and comparison with other casting processes, Advantages, Disadvantages, Limitations and Applications.		
UNIT- II	**DESIGN AND PRODUCT DEVELOPMENT**	**(9 Periods)**
Product design- Tool design, Feeder design, Gate Design – spruing techniques – wax tree assembly- Cost estimation of product - Estimation of alloy constituents, wax to metal conversion ratios – Selection of equipments for moulding process- simulation software for metal pouring (Precast, Magma)		
UNIT- III	**CASTING PROCESS**	**(9 Periods)**
Preparation of wax pattern- inversion, wax injection, wax pattern assembly; Shelling – Ceramic coating, Dewaxing; Shell firing – Metal melting, Spectrometer analysis - Pouring; Fettling – Knockout, Cutoff, Grinding, Heat treatment, Shot blasting – Process control		
UNIT- IV	**MATERIALS AND INSPECTION**	**(9 Periods)**
Types of wax, properties, specification and testing for wax materials – Binders and refractory filler materials – testing of binders, slurry and refractory materials – Material standards- ASTM, BIS, JIS, DIN - Destructive and Non-Destructive testing of castings		
UNIT- V	**INDUSTRIAL PRACTICES**	**(9 Periods)**
Quotation – Follow-up – Costing – Receipt of Purchase order – MRP - PPC – Quality system standards and product certification standards – ISO 9001:2008, Pressure Equipment Directive (Valves) – API(American Petroleum Institute), CE(European Standards), AS(Aerospace).		

Contact Periods:

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

TEXT BOOKS:

1. *Investment Casting Institute staff **"Investment casting Handbook",** 1997*
2. *P.R. Beeley, R.F. Smart **"Investment Casting",** 1995*

REFERENCE BOOKS:

1. *James E. Sopcak,* ***"Handbook of Lost Wax Or Investment Casting",*** *Gembooks, 1968*
2. *C. W. Ammen* ***"Lost Wax Investment Casting",*** *Tab Books 1977*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Compare investment casting process with other casting processes.
CO2: Explain the investment casting process.
CO3: Write types of wax, properties and specifications.
CO4: Explain various destructive and non-destructive testing of investment castings.

COURSE ARTICULATION MATRIX

PO/PSO / CO	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	H	M	H		L						H	M	H	L	L
CO2	H	M	H	H	L	M	M	M	M		M	M	M	L	L
CO3	H	H	H	L		L	M	L		L	L		M	L	
CO4	M	M	L	L		L	M	L	M	L	L	M	H	L	
18PPE$24	H	M	H	L		L	M	L	M	L	L	M	H	L	

L- Low, M – Moderate (Medium), H - High

18PPE$25	ELECTRONICS MANUFACTURING TECHNOLOGY

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 18PES403 – Basic Electronics Engineering

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 and encapsulation 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 thermal management, Reliability fundamentals, reliability testing, failure analysis, design for manufacturability, assembly, reworkability, testing, reliability and environment.		

Contact Periods:

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

TEXT BOOKS:

1. *Prasad R.* ***"Surface Mount Technology –Principles and practice",*** *Second Edition, Chapman and Hall, 1997, New York*
2. *Tummala R.R.* ***"Fundamentals of microsystem packaging",*** *Mc -Graw Hill, 2001*

REFERENCE BOOKS:

1. *PuligandlaViswanadham and Pratap Singh* ***"Failure Modes and Mechanisms in Electronic Packages",*** *New York, 1997, N.Y. ISBN 0-412-105591-8.*
2. *Totta P., Puttlitz K. and Stalter K.,* ***"Area Array Interconnection Handbook",*** *Kluwer Academic Publishers, Norwell, MA, USA, 2001. ISBN 0-7923-7919-5.*
3. *Lee N.C.,* ***"Reflow Soldering Process and Trouble Shooting SMT,BGA,CSP and Flip Chip Technologies",*** *2001, Elsevier Science*
4. *Zarrow P. and Kopp D.* ***"Surface Mount Technology Terms and Concepts",*** *1997, Elsevier Science and Technology,.ISBN 0750698756.*
5. *Harper C.A.,* ***"Electronic Packaging and Interconnection Handbook",*** *McGraw Hill Inc., New York, N.Y., 1997, ISBN 0-07-026694-8.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Describe wafer preparation and PCB fabrication process.
CO2: Use different types of mounting technologies for electronic assemblies.
CO3: Perform quality inspection on the PCBs
CO4: Repair and rework of Electronics assemblies
CO5: Describe the quality and reliability aspects of Electronics assemblies

COURSE ARTICULATION MATRIX

PO/PSO CO	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	L					L	L					M	H		
CO2	L				L							L	L		
CO3	H	M		M	L			L				L			H
CO4	H	M		M	L			L				L			L
CO5	L			L								L			M
18PPE$25	M	L		M	L	L	L	L				L	M		M

L- Low, M – Moderate (Medium), H – High

18PPE$26	SMART MANUFACTURING

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSEOBJECTIVES:

- 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 BOOKS:

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

REFERENCE BOOKS:

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:

On completion of this course, students will be able to

CO1: Identify various components of expert systems

CO2: Describe the Architecture and components of intelligent manufacturing systems

CO3: Explain the process of designing mechanisms and Process planning with Knowledge based systems

CO4: Discuss the Applications of knowledge based systems in Group Technology

CO5: Discuss the various recent advances and industrial applications of Artificial intelligence an Expert systems

COURSE ARTICULATION MATRIX

PO/PSO CO	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	H	L	M	L	M			M	L	L	M	M	L	H	
CO2	H	L	H	L	M			M	L	L	M	M	L	H	
CO3	H	L	H	L	M			M	L	L	M	M	L	H	
CO4	H	L	H	L	M			M	L	L	M	M	L	H	
CO5	H	L	H	L	M			M	L	L	M	M	L	H	
18PPE$26	H	L	H	L	M			M	L	L	M	M	L	H	

L- Low, M – Moderate (Medium), H - High

18COE$01	**CLIMATE CHANGE AND ADAPTATION** *(Common to All Branches)*

Category : OE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- Able get knowledge about Climate system and its changes and causes
- Able to learn about impacts, adaptation and mitigation of climate change
- Able to learn about clean technology and clean energy

UNIT – I : EARTH'S CLIMATE SYSTEM	**(9 Periods)**
Introduction-Climate in the spotlight - The Earth's Climate Machine – Climate Classification - Global Wind Systems – Trade Winds and the Hadley Cell – The Westerlies - Cloud Formation and Monsoon Rains – Storms and Hurricanes - The Hydrological Cycle – Global Ocean Circulation – El Nino and its Effect - Solar Radiation – The Earth's Natural Green House Effect – Green House Gases and Global Warming – Carbon Cycle.	
UNIT – II : OBSERVED CHANGES AND ITS CAUSES	**(9 Periods)**
Observation of Climate Change – Changes in patterns of temperature, precipitation and sea level rise – Observed effects of Climate Changes – Patterns of Large Scale Variability – Drivers of Climate Change – Climate Sensitivity and Feedbacks – The Montreal Protocol – UNFCCC – IPCC – Evidences of Changes in Climate and Environment – on a Global Scale and in India – climate change modeling.	
UNIT – III : IMPACTS OF CLIMATE CHANGE	**(9 Periods)**
Impacts of Climate Change on various sectors – Agriculture, Forestry and Ecosystem – Water Resources – Human Health – Industry, Settlement and Society – Methods and Scenarios – Projected Impacts for Different Regions – Uncertainties in the Projected Impacts of Climate Change – Risk of Irreversible Changes.	
UNIT – IV : CLIMATE CHANGE ADAPTATION AND MITIGATION MEASURES	**(9 Periods)**
Adaptation Strategy/Options in various sectors – Water – Agriculture –- Infrastructure and Settlement including coastal zones – Human Health – Tourism – Transport – Energy – Key Mitigation Technologies and Practices – Energy Supply – Transport – Buildings – Industry – Agriculture – Forestry - Carbon sequestration – Carbon capture and storage (CCS) - Waste (MSW & Bio waste, Biomedical, Industrial waste – International and Regional cooperation.	
UNIT – V : CLEAN TECHNOLOGY AND ENERGY	**(9 Periods)**
Clean Development Mechanism – Carbon Trading - examples of future Clean Technology – Biodiesel – Natural Compost – Eco- Friendly Plastic – Alternate Energy – Hydrogen – Bio-fuels – Solar Energy – Wind – Hydroelectric Power – Mitigation Efforts in India and Adaptation funding.	

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

TEXT BOOKS:

1 *Jan C. van Dam,* ***"Impacts of Climate Change and Climate Variability on Hydrological Regimes"****, Cambridge University Press, 2009.*
2 *Bates, B.C., Z.W. Kundzewicz, S. Wu and J.P. Palutikof, Eds.,* ***"Climate Change and Water"****. Technical Paper of the Intergovernmental Panel on Climate Change, IPCC Secretariat, Geneva, 2008.*
3 *Dash Sushil Kumar,* ***"Climate Change – An Indian Perspective"****, Cambridge University Press India Pvt. Ltd, 2007.*
4 *IPCC Report Technical paper VI – Climate change and Water, 2008.*

REFERENCE BOOKS:

1 *IPCC fourth assessment report - The AR4 synthesis report, 2007*
2 *IPCC fourth assessment report –Working Group I Report, " The physical Science Basis",2007*
3 *IPCC fourth assessment report - Working Group II Report,* ***"Impacts, Adaptation and Vulnerability"****, 2007*
4 *Climate change 2014: Impacts, Adaptation and Vulnerability, IPCC*
5 *Climate change 2013: The Physical Science basis, IPCC.*
6 *www.environment.gov.au/climate-change/adaptation.*
7 *www.environment.org/explore-topics/climate-change/what.we.do/climate-adaptation.*

COURSE OUTCOMES:

On completion of the course, the students will be able to
CO1: Understand the climatic system and the factors influencing the climatic changes
CO2: Assess the uncertainty and impact of climatic changes
CO3: Understand the impacts of climate change in various sectors.
CO4: Develop strategies for adaptation and mitigation of climatic changes
CO5: Identify clean technologies for sustainable growth

COURSE ARTICULATION MATRIX:

PO / CO	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	PSO 4
CO1			M			L	L					L	L	L	L	L
CO2	L					L	L					L	M	M	M	L
CO3						L	L					L		H	H	
CO4	M	M	L	M		L	M					L	L	M	M	M
CO5	L	M	M	M		L	H					L	L	M	L	M
18COE $01	L	M	M	M		L	M					L	L	M	M	M

L-Low, M-Moderate (Medium), H-High

18COE$02	DISASTER MANAGEMENT AND MITIGATION *(Common to All Branches)*

Category : OE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To give knowledge about basics of Disaster Management.
- To impart knowledge about Hazards and Vulnerability.
- To give knowledge about mitigation and preparedness.
- To teach about Response and Recovery.
- To impart knowledge about the participants involved in the disaster management activity.

UNIT - I : INTRODUCTION	**(9 Periods)**
Disaster throughout history, History of disaster management, Capacity by demand, UN International strategy for disaster reduction, the Hyogo framework for action, Post 2015 framework, Disaster trends.	
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 Acceptibility, Alternatives, Personnel. Political/ social, Economic. vulnerability-Physical Profile, Social Profile, Environmental Profile, Economic Profile. Factors Influncing Vulnerability, risk Perception.	
UNIT - III : MITIGATION AND PREPAREDNESS	**(9 Periods)**
Mitigation - types of mitigation ,Ostacles in mitigation, Assement and selection of Mitigation options, Emergency response capacity as , Incorporating Mitigation into development and relief projects. Prepareness- 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 : PARTICIPANTS	**(9 Periods)**
Governmental Disaster management agencies- Fire, law, emergency management, Emergency medical service, Millitary and other resources. Structures- local, regional, national. Bilateral assistance and its types. Types of national agencies involved in international disaster management. Political implications of bilateral assistance. Non GovernmentalOrganaisations – operations, NGO/ Millitary coordination, standard of conduct. The role of Private sector and academia. Multilateral organaisations - UN agencies and progammes, Regional &Inernationalorganaisations. International Financial Institutions- the world bank, IMF, ADB, IADB. Special considerations.	

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

TEXT BOOKS:

*1. Damon P. Coppola, **"Introduction to International Disaster management"**, Elsevier publication, 2015*

REFERENCE BOOKS:

*1. Brassard, Caroline, Giles, David W., Howitt, Arnold M., **"Natural Disaster Management in the Asia-Pacific"**, Policy and Governance.*
*2. **"Disaster Management",** Global Challenges and Local Solutions, Universities Press, 2009.*
*3. Jack Pinkowski, **"Disaster Management Handbook"**, CRC Press , January 22, 2008.*
4. Disaster Management Guidelines, GOI-UNDP Disaster Risk Reduction Programme (2009-2012).

COURSE OUTCOME:

On completion of the course, the students will be able to

CO1: Able to get knowledge about basics of Disaster management.
CO2: Able to impact knowledge about Hazards and vulnerability
CO3: Able to know about Mitigation and preparedness.
CO4: Able to attain knowledge about response and recovery.
CO5: Able to learn about the participants involved in the disaster management activity.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS01	PS02	PS03	PS04
CO1		L			L	L		L								L
CO2	L	H		M	L	M						L	L			L
CO3	L	L			H	M						L	L			L
CO4	L	M		L	L	M	M									L
CO5		M		L	L	M										L
18COE $02	L	M		L	L	M	M					L	L			L

L-Low, M-Moderate (Medium), H-High

18COE$03	**ENERGY EFFICIENT BUILDINGS** *(Common to All Branches)*

Category : OE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To understand the Concepts of Sustainable Environment, basics of energy analysis, simulation and management.
- To understand the concept of managing air quality.
- To understand the Green building concepts.

UNIT – I : INTRODUCTION	**(9 Periods)**
Life cycle impacts of materials and products – sustainable design concepts – strategies of design for the environment -the sun-earth relationship and the energy balance on the earth's surface, climate, wind – solar radiation and solar temperature – sun shading and solar radiation on surfaces – energy impact on the shape and orientation of buildings – thermal properties of building materials.	
UNIT – II : ENERGY EFFICIENT TECHNIQUES	**(9 Periods)**
Passive Cooling And Day Lighting – Active Solar And Photovoltaic- Building Energy Analysis Methods- Building Energy Simulation- Building Energy Efficiency Standards- Lighting System Design- Lighting Economics and Aesthetics- Impacts of Lighting Efficiency – Energy Audit and Energy Targeting- Technological Options For Energy Management.	
UNIT – III : INDOOR ENVIRONMENTAL QUALITY MANAGEMENT	**(9 Periods)**
Psychrometry- Comfort Conditions- Thermal Comfort- Ventilation And Air Quality Air Conditioning Requirement- Visual Perception- Illumination Requirement- Auditory Requirement-Energy Management Options- Air Conditioning Systems- Energy Conservation In Pumps- Fans And Blowers-Refrigerating Machines- Heat Rejection Equipment- Energy Efficient Motors- Insulation.	
UNIT – IV : GREEN BUILDING CONCEPTS	**(9 Periods)**
Green Building Concept- Green Building Rating Tools- Leeds And IGBC Codes. – Material Selection Embodied Energy- Operating Energy- Façade Systems- Ventilation Systems- Transportation- Water Treatment Systems- Water Efficiency- Building Economics.	
UNIT – V : GREEN BUILDING DESIGN CASE STUDY	**(9 Periods)**
Students To Work Through A Controlled Process of Analysis And Design To Produce Drawings and Models Of Their Own Personal Green Building Project. Topics Include Building Form, Orientation and Site Considerations; Conservation Measures; Energy Modeling; Heating System And Fuel Choices; Renewable Energy Systems; Material Choices; and Construction Budget-Students Will Research Green Construction and Design in A Particular -Construction Context and Report Their Results to the Class.	

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

TEXT BOOKS:

1 *Kibert, C.* ***"Sustainable Construction: Green Building Design and Delivery"****, John Wiley & Sons, 4th Edition, 2016.*

2 *Edward G Pita,* ***"An Energy Approach- Air-Conditioning Principles and Systems"****, Pearson Education, 2003.*

3 *Satyajit Ghosh, Abhinav Dhaka,* ***"Green structures: Energy efficient buildings"****, 2015.*

REFERENCE BOOKS:

1 *Colin Porteous,* ***"The New Eco-Architecture"****, Spon Press, 2002.*

2 *Ganesan T P,* ***"Energy Conservation in Buildings"****, ISTE Professional Center, Chennai, 1999.*

3 *NPTEL* ***"Energy Efficiency and Simulation"****, Prof.E.Rajsekar., IIT Roorkee.*

4 *Energy Conservation Building Codes: www.bee-india.nic.in*

5 *Lever More G J,* ***"Building Energy Management Systems"****, E And FN Spon, London, 2000.*

6 *NPTEL* ***"Energy efficiency acoustics and day lighting in building"****, Prof.B.Bhattacharjee., IIT Delhi.*

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1: Understand the Concepts of Sustainable Environment.

CO2: Understand the basics of energy analysis, simulation and management.

CO3: Understand the concept of managing air quality.

CO4: Understand the Green building concepts.

CO5: Create drawings and models of their own personal green building project

COURSE ARTICULATION MATRIX:

PO / CO	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	PSO 4
CO1	L	M	L			M	M	L	L	L		L	L	M	L	L
CO2			L	L		L	L					L		L		
CO3		L				L	M	L				L		L		
CO4	L	M					H					M		M		
CO5	M	M	H	L			H	L	M		M	M		H	L	M
18COE $03	L	M	H	L		M	H	L	L	L	M	M	L	H	L	M

L-Low, M-Moderate (Medium), H-High

18MOE\$04	**NANOTECHNOLOGY AND SURFACE ENGINEERING** *(Common to All Branches)*

Category : OE

L	**T**	**P**	**C**
3	**0**	**0**	**3**

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To Understand and analyze the concepts of Quantum confinement, Dimensional structures and Properties of Nanosystems
- To be familiar with various methods of synthesis of Nanomaterials
- To analyze and understand the mechanical and electrical properties of Nanomaterial and its applications

UNIT – I: PROPERTIES OF NANOMATERIALS	**(9 Periods)**
Size effect and properties of nanoparticles - particle size - particle shape - particle density - melting point, surface tension, wettability - specific surface area and pore size – Properties of Individual nanoparticles. Quantum confinement in 3D, 2D, 1D and zero dimensional structures -Size effect and properties of nanostructures- Top down and Bottom up approach.	
UNIT – II : SYNTHESIS OF NANOMATERIALS	**(9 Periods)**
Sol-Gel Process - Self-assembly – Electrodeposition - Spray Pyrolysis - Flame Pyrolysis – Metal nano-crystals by Reduction – Solvo-thermal Synthesis - Chemical Vapor Deposition (CVD) – Metal Orgonic Chemical Vapor Deposition (MOCVD).Ball Milling - Inert Gas Condensation Technique (IGCT) – Thermal evaporation – Pulsed Laser Deposition (PLD) – DC/RF Magnetron Sputtering - Molecular Beam Epitaxy (MBE) – Melt Spinning process – Applications	
UNIT – III : MECHANICAL AND ELECTRICAL PROPERTIES	**(9 Periods)**
Nanoscale Mechanics - Introduction – Mechanical properties – The Elasticity of Nanomaterials – Elasticity of Bulk Nanomaterials –Plastic Deformation of Nanomaterials – Crystals and Crystal Plasticity – From Crystal Plasticity to Polycrystal Plasticity. Introduction - Energy Storage Basics - Electrical Energy Storage Devices and Impact of Nanomaterials - Electrochemical Properties of Nanoscale Materials - Aerogels and Structure-Directed Mesoporous and Macroporous Solids - Nanoparticles - Nanotubes, Nanowires, and Nanorolls	
UNIT – IV : FUNDAMENTALS OF SURFACE ENGINEERING	**(9 Periods)**
Surface engineering - classification, definition, scope and general principles, Conventional surface engineering - Surface engineering by material removal: Cleaning, pickling, etching, grinding, polishing, buffing / puffing, Surface engineering by material addition - From liquid bath, hot dipping, Electro-deposition / plating.	
UNIT – V : SURFACE MODIFICATION	**(9 Periods)**
Surface modification of steel and ferrous components - Pack carburizing, Aluminizing, calorizing, diffusional coatings (principle and scope of application), Surface modification using liquid/molten bath: Cyaniding, liquid carburizing (diffusion from liquid state), Surface modification using gaseous medium: Nitriding, Carbo-nitriding (diffusion from gaseous state).	

Contact Periods:

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

TEXT BOOKS:

1. *Kelsall Robert W, Ian Hamley and Mark Geoghegan, —**"Nanoscale Science and Technology"**‖, Wiley Eastern, 2004.*
2. *N John Dinardo, **"Nanoscale Charecterisation of Surfaces & Interfaces**", 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000*
3. *ASM Metals Hand Book –Vol. 5, **"Surface Engineering"**, 1996*

REFERENCE BOOKS:

1. *G. Timp. Editor, **"Nanotechnology"** AIP press, Springer-Verlag, New York, 1999*
2. *Hari Singh Nalwa, Editor, **"Nanostructured materials and Nanotechnology''**, Concise Edition, Academic Press, USA (2002).*
3. *GuozhongGao,**"Nanostructures & Nanomaterials: Synthesis, Properties & Applications**", Imperial College Press (2004).*
4. *K.G. Budinski, **"Surface Engineering for Wear Resistances",** Prentice Hall, Englewood Cliffs, 1988.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Analyze the particle size, particle shape, particle density, Size effect and properties of Nanostructures.

CO2: Acquire knowledge in various methods of synthesis of Nanomaterials.

CO3: Analyze the Elasticity of Nanomaterials, Electrical Energy Storage Devices and Aerogels.

CO4: Apply various Nanomaterials to the LED, Transistor Applications.

CO5: Apply various surface engineering techniques

COURSE ARTICULATION MATRIX

CO/ PO	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	M	M	L	L	M	L	M	M	M	L	M	M	M	M	M
CO2	H	H	M	H	H	L	L	M	M	M	L	H	M	H	M
CO3	H	H	L	H	M	M	L	L	M	M	M	M	M	H	M
CO4	L	H	M	H	M	M	L	L	M	M	M	M	M	H	M
CO5	M	M	L	M	M	L	M	M	M	L	M	M	M	H	M
18MOE$04	H	H	L	M	H	M	H	H	M	H	M	M	M	M	M

L-Low, M-Moderate(Medium), H-High

18MOE$05	**MECHATRONICS** *(Common to All Branches)*

Category : OE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

* To study the mechatronics system and understanding the concepts of integration and design of mechatronics system.

UNIT – I : SYSTEM MODELS	**(9 Periods)**
Introduction - Definition of Mechanical Systems, Philosophy and approach. Systems and Design - Mechatronic approach, Integrated Product Design - Modeling- Analysis and Simulation, Man-Machine Interface.	
UNIT – II : SENSORS AND TRANSDUCERS	**(9 Periods)**
Sensors and transducers - classification, Development in Transducer technology, Optoelectronics - Shaft encoders, CD Sensors, Vision System.	
UNIT – III : DRIVES AND ACTUATORS	**(9 Periods)**
Drives and Actuators - Hydraulic and Pneumatic drives - Electrical Actuators - servo motor and Stepper motor, Drive circuits, open and closed loop control - Embedded Systems - Hardware Structure, Software Design and Communication, Programmable Logic Devices, Automatic Control and Real Time Control Systems.	
UNIT – IV : SMART MATERIALS	**(9 Periods)**
Smart materials - Shape Memory Alloy, Piezoelectric and Magnetostrictive Actuators - Materials, Static and dynamic characteristics, illustrative examples for positioning, vibration isolation.	
UNIT – V : MICROMECHATRONIC SYSTEMS	**(9 Periods)**
Micromechatronic systems - Microsensors, Microactuators - Micro-fabrication techniques - LIGA Process- Lithography, etching, Micro-joining. Application examples - Case studies Examples of Mechatronic Systems from Robotics Manufacturing, Machine Diagnostics, Road vehicles and Medical Technology.	

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

TEXT BOOKS:

*1. W.Bolton, **"Mechatronics"**, Longman,2nd Edition,1999*

REFERENCE BOOKS:

*1. Michael B. Histand and David G.Alciatore, **"Introduction to Mechatronics and Measurement Systems"**, Tata McGraw Hill, 2nd Edition,2003*

*2. D.A.Bradley, D.Dawson, N.C.Buru and A.J.Loader**, "Mechatronics"** Chapman and Hall,1993*

*3. Dan S Necsulescu, **"Mechatronics"**, Pearson Education Asia,2005*

*4. Devdas Shetty, Richard A. Kolk, **"Mechatronics System Design"**, Thomson, PWS publishing, 2007.*

*5. Smaili.A and Mrad.F, **"Mechatronics: Integrated Technologies for Intelligent Machines"**, Oxford university press, 2008*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Identify the key elements of mechatronics system and models.

CO2: Select appropriate sensors and transducers for industrial application.

CO 3: Integrate mechanical, electrical, electronics, control systems in the mechatronics system design

CO 4: Select the proper smart material for mechatronics system.

CO 5: Apply the principles of mechatronics in industrial needs.

COURSE ARTICULATION MATRIX

CO/ PO	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	H	H	H	M	L	H	L	L	H	L	M	L	M	H	L
CO2	H	H	H	L	L	H	L	L	M	L	M	L	M	H	L
CO3	H	H	H	L	L	H	L	L	M	L	M	L	M	H	L
CO4	H	H	H	M	H	H	L	L	M	M	L	L	H	H	L
CO5	H	H	H	M	L	H	L	L	H	M	M	M	H	H	L
18MOE$05	H	H	H	H	L	H	L	L	M	L	M	L	M	H	L

L-Low, M-Moderate (Medium), H-High

18MOE$06	**RENEWABLE ENERGY SOURCES** *(Common to All Branches)*

Category : OE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To elucidate the technologies used for generation and utilization of power from renewable energy resources.

UNIT – I: SOLAR ENERGY	**(9 Periods)**
Solar radiation, solar spectra-latitude and longitude, Declination angle, solar window, cosine law, seasonal variations, hour angle, calculation of angle of incidence, angstroms equation and constants, Photo voltaic: p-n junctions. Solar cells, PV systems, Standalone, Grid connected solar power - Types of solar thermal collectors – Flat and concentrating collectors, solar thermal applications -water heaters, dryers, stills, refrigeration, air-conditioning, solar pond, central receiver power generation.	
UNIT – II: WIND ENERGY	**(9 Periods)**
Wind energy - Basic principle of wind energy conversion system, wind data and energy estimation, site selection, components of wind energy conversion systems, design consideration of horizontal axis wind mill- merits and limitations- application.	
UNIT – III: BIOMASS ENERGY	**(9 Periods)**
Biomass, sources of biomass, thermo-chemical and bio-chemical conversion of biomass - Pyrolysis, gasification, combustion and fermentation. Gasifiers – Up draft, downdraft and fluidized bed gasifier. Digesters- Fixed and floating digester biogas plants, economics of biomass power generation.	
UNIT – IV: OCEAN AND GEOTHERMAL ENERGY	**(9 Periods)**
Ocean energy resources - Principles of ocean thermal energy conversion systems - ocean thermal power plants - Principles of ocean wave energy conversion and tidal energy conversion - Difference between tidal and wave power generation, Economics of OTEC. Definition and classification of Geothermal resources, Utilization for electricity generation and direct heating, Wellhead power generating units. Overview of micro and mini hydel power generation.	
UNIT – V: RENEWABLE ENERGY POLICIES	**(9 Periods)**
Renewable energy policies - Feed-in tariffs, portfolio standards, policy targets, tax incentives, and biofuels mandates. International policies for climate change and energy security. Economic analysis and comparisons, Life cycle analysis, financial analysis, cost of conserved energy, and externalities. Cost assessment of supply technologies versus energy- Efficiency.	

Contact Periods:

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

TEXT BOOKS:

*1. Sunil S. Rao and Dr. B.B. Parulekar, **"Energy Technology",** Khanna Publishers, Second Ed. 1997*
*2. Pai and Ramaprasad,**"Power Generation through Renewal sources",** Tata McGraw Hill – 1991*

REFERENCE BOOKS:

*1. Rai , G.D., **"NonConventional sources of Energy"**, Khanna Publishers , IV Ed.,2009*
*2. Bansal NK, Kleeman and Meliss, M **"Renewable Energy Sources and Conversion Techniques"**, Tata McGraw Hill, 1996*
*3. Roland Wengenmayr, Thomas Buhrke, **"Renewable energy: Sustainable energy concepts for the future"**, Wiley-VCH, 1st edition, 2008.*

COURSE OUTCOMES:

On completion of the course students will be able to

CO1: Realize the need for utilizing the energy from clean and Sustainable energy resources.
CO2: Describe the principles of operation of the broad spectrum of renewable energy Technologies
CO3: Analyze energy technologies from a systems perspective.
CO4: Articulate the technical challenges for each of the renewable sources
CO5: Create solutions for alternate energy issues
CO6: Discuss economic, technical and sustainability issues involved in the integration of renewable energy systems

COURSE ARTICULATION MATRIX

CO/ PO	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	H	M	M	M	M	M	M			L	L	L	H	M	M
CO2	H	H	M	M	M	M	M	L		L	L	L	H	H	H
CO3	H	M	M	M	M	M	M	M			L	L	M	H	H
CO4	M	H	M	L	M	H	M	M		L	L	L	H	H	H
CO5	M	H	H	H	M	M	M	M		L	L	L	M	H	M
CO6	H	M	M	M	M	M	M		H	H	L	L	M	H	M
18MOE$06	H	H	M	M	M	M	M	L	L	L	L	L	H	H	H

L-Low, M-Moderate(Medium), H-High

18EOE$07	**RENEWABLE POWER GENERATION SYSTEMS** *(Common to All Branches)*

PRE-REQUISITES: NIL

Category : OE

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

* To elucidate the technologies used for generation and utilization of power from renewable energy resources.

UNIT-I : SOLAR ENERGY	**(9 Periods)**
Solar radiation, solar spectra-latitude and longitude, Declination angle, solar window, cosine law, seasonal variations, hour angle, calculation of angle of incidence, angstroms equation and constants, Photo voltaic: p-n junctions. Solar cells, PV systems, Standalone, Grid connected solar power - Types of solar thermal collectors – Flat and concentrating collectors, solar thermal applications -water heaters, dryers, stills, refrigeration, air-conditioning, solar pond, central receiver power generation.	
UNIT-II : WIND ENERGY	**(9 Periods)**
Wind energy - Basic principle of wind energy conversion system, wind data and energy estimation, site selection, components of wind energy conversion systems, design consideration of horizontal axis wind mill- merits and limitations- application.	
UNIT-III : BIOMASS ENERGY	**(9 Periods)**
Biomass, sources of biomass, thermo-chemical and bio-chemical conversion of biomass - Pyrolysis, gasification, combustion and fermentation. Gasifiers – Up draft, downdraft and fluidized bed gasifier. Digesters - Fixed and floating digester biogas plants, economics of biomass power generation.	
UNIT-IV : OCEAN AND GEOTHERMAL ENERGY	**(9 Periods)**
Ocean energy resources - Principles of ocean thermal energy conversion systems - ocean thermal power plants - Principles of ocean wave energy conversion and tidal energy conversion - Difference between tidal and wave power generation, Economics of OTEC. Definition and classification of Geothermal resources, Utilization for electricity generation and direct heating, Wellhead power generating units. Overview of micro and mini hydel power generation.	
UNIT-V : RENEWABLE ENERGY POLICIES	**(9 Periods)**
Renewable energy policies - Feed-in tariffs, portfolio standards, policy targets, tax incentives, and biofuels mandates. International policies for climate change and energy security. Economic analysis and comparisons, Life cycle analysis, financial analysis, cost of conserved energy, and externalities. Cost assessment of supply technologies versus energy - Efficiency.	

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

TEXT BOOKS:

1. *Rao. S. and Dr. Pamlekar B.B "**Energy Technology**" Khanna Publishers, Second Ed. 2016*
2. *Rai , G.D., "**Non-Conventional sources of Energy**", Khanna Publishers , V Ed.,2016*

REFERENCE BOOKS:

1. *Khan. B.H, "Non-Conventional Energy Resources", The McGraw Hills, Second edition, 2016.*
2. *Bansal NK, Kleeman and Meliss, M "**Renewable Energy Sources and Conversion Techniques**", Tata McGraw Hill, 1996*
3. *Roland Wengenmayr, Thomas Buhrke," Renewable energy: Sustainable energy concepts for the future", Wiley-VCH, 1st edition, 2008.*

COURSE OUTCOMES:

On completion of the course students will be able to

CO1: Understand the concept of various Non-Conventional energy resources
CO2: Familiarize the principles of operation of renewable energy technologies
CO3: Realize the need for utilizing the energy from clean and Sustainable energy resources.
CO4: Interpret advantages and disadvantages of different renewable sources of energy
CO5: Comprehend the environmental aspects and the correlation between different operational parameters
CO6: Evaluate the options and estimate the energy generation through renewable sources

COURSE ARTICULATION MATRIX:

CO	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	H	M	M	M	-	M	H	-	-	-	-	-	H	M	M
CO2	H	H	M	L	M	M	M	L	-	-	-	-	H	H	H
CO3	H	M	M	M	M	M	M	-	-	-	-	-	M	H	H
CO4	M	H	M	L	M	H	M	-	-	-	-	-	H	H	H
CO5	M	H	L	H	M	M	M	-	-	-	L	-	M	H	M
CO6	H	M	M	L	M	M	M	-	L	-	L	-	M	H	M
18EOE $07	H	H	M	M	-	M	M	L	L	-	L	-	H	H	H

L - Low, M - Moderate (Medium), H – High

18EOE$08	**ELECTRIC VEHICLES** *(Common to All Branches)*

Category : OE

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

* To understand the technology of Electric and Hybrid Electric Vehicles and their business perspective

UNIT-I : INTRODUCTION	**(9 Periods)**
Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical models to describe vehicle performance. Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.	
UNIT-II : ELECTRIC TRAINS	**(9 Periods)**
Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Induction Motor drives, Permanent Magnet Motor drives, Switch Reluctance Motor drives- drive system efficiency.	
UNIT-III : ANALYSIS OF ENERGY STORAGE	**(9 Periods)**
Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems.	
UNIT-IV : ENERGY MANAGEMENT STRATEGIES	**(9 Periods)**
Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.	
UNIT-V : BUSINESS PERSPECTIVE OF ELECTRIC VEHICLE	**(9 Periods)**
Design of a Hybrid Electric Vehicle (HEV) - Design of a Battery Electric Vehicle (BEV) Hybrid Electric Heavy Duty Vehicles, Fuel Cell Heavy Duty Vehicles. Business: E-mobility business, electrification challenges, Connected mobility and Autonomous mobility- case study: E-mobility Indian Roadmap Perspective. Policy: EVs in infrastructure system, integration of EVs in smart grid, social dimensions of EVs.	

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

TEXT BOOKS:

1. *Mehrdad Ehsani, Yimin Gao, Sebatien Gay and Ali Emadi, "**Modern Electric, Hybrid Electric and Fuel cell vehicles: Fundamentals, Theory and Design**", CRC press, 2004.*
2. *C. Mi, M. A. Masrur and D. W. Gao, "**Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives**", John Wiley & Sons, 2011.*
3. *S. Onori, L. Serrao and G. Rizzoni, "**Hybrid Electric Vehicles: Energy Management Strategies**", Springer, 2015.*

REFERENCE BOOKS:

1. *James Larminie and John Loury, "**Electric Vehicle Technology – Explained**", John Wiley & Sons Ltd, 2003.*
2. *Sandeep Dhameja, "**Electric Vehicle Battery Systems**", Butterworth – Heinemann, 2002.*
3. *Ronald K Jurgen, "**Electric and Hybrid – Electric Vehicles**", SAE, 2002.*
4. *Ron Hodkinson and John Fenton, "**Light Weight Electric/ Hybrid Vehicle Design**", Butterworth – Heinemann, 2001.*
5. *T. Denton, **"Electric and Hybrid Vehicles"**, Routledge, 2016.*

COURSE OUTCOMES:

On completion of the course students will be able to

CO1: Understand the basics of electric vehicle components and configuration.
CO2: Analyze suitable drive scheme for developing an electric vehicle.
CO3: Able to opt a proper energy management system.
CO4: Analyze the performance of practical HEV and EV.
CO5: Understand the infrastructure for Electric Vehicles and business potential.

COURSE ARTICULATION MATRIX:

CO	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	-	M	M	M	-	M	M	-	-	-	-	L	M	M	-
CO2	-	M	M	M	-	M	M	-	-	-	-	L	M	M	-
CO3	-	M	M	M	-	M	M	-	-	-	-	L	M	M	-
CO4	-	M	M	M	-	M	M	-	-	-	-	L	M	M	-
CO5	-	M	M	M	-	M	M	-	-	-	-	L	M	M	-
18EOE $08	-	M	M	M	-	M	M	-	-	-	-	L	M	M	-

L - Low, M - Moderate (Medium), H – High

18EOE$09	**SMART GRID SYSTEMS** *(Common to All Branches)*

Category : OE

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

***** To comprehend the underlying techniques applied to Smart Grid

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 BOOKS:

1. *Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage "**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.*

REFERENCE BOOKS:

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.*

COURSE OUTCOMES:

On completion of the course students will be able to

CO1: Demonstrate the various aspects of the smart grid, including Technologies, Components, Architectures and applications

CO2: Creating a framework to operate the grid more effectively.

CO3: Evaluate the existing grid with respect to smart grid

CO4: Upgrade the existing grid to smart grid environment

COURSE ARTICULATION MATRIX:

CO	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	-	-	-	L	L	M	H	L	M	M	M	H	M	H	M
CO2	L	L	M	M	M	M	M	L	M	M	M	M	M	M	H
CO3	-	-	-	M	M	M	M	M	M	M	M	H	M	M	M
CO4	L	-	-	M	M	M	H	-	M	M	M	H	M	H	H
18EOE $09	L	L	M	M	M	M	H	L	M	M	M	H	M	H	H

L - Low, M - Moderate (Medium), H - High

18LOE$10	**MOBILE COMMUNICATION** *(Common to All Branches)*

PRE-REQUISITES: NIL **Category: OE**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study the concept of Mobile radio propagation, cellular system design
- To understand mobile technologies like GSM and CDMA.
- To know the mobile communication evolution of 2G, 3G and 3 GPP in detail.
- To have overview of immerging technologies application.

UNIT I WIRELESS COMMUNICATION	**(9 periods)**
Cellular systems- Frequency Management and Channel Assignment- types of handoff and their characteristics, dropped call rates & their evaluation -MAC – SDMA – FDMA – TDMA – CDMA – Cellular Wireless Networks.	
UNIT II WIRELESS NETWORKS	**(9 periods)**
Wireless LAN – IEEE 802.11 Standards – Architecture – Services – Mobile Ad hoc Networks- WiFi and WiMAX - Wireless Local Loop.	
UNIT III MOBILE COMMUNICATION SYSTEMS	**(9 periods)**
GSM-architecture-Location tracking and call setup- Mobility management- Handover-Security-GSM SMS – International roaming for GSM- call recording functions-subscriber and service data mgt – Mobile Number portability -VoIP service for Mobile Networks – GPRS – Architecture-GPRS procedures-attach and detach procedures-PDP context procedure-combined RA/LA update procedures-Billing	
UNIT IV MOBILE NETWORK AND TRANSPORT LAYERS	**(9 periods)**
Mobile IP – Dynamic Host Configuration Protocol-Mobile Ad Hoc Routing Protocols– Multicast routing-TCP over Wireless Networks – Indirect TCP – Snooping TCP – Mobile TCP – Fast Retransmit / Fast Recovery – Transmission/Timeout Freezing-Selective Retransmission – Transaction Oriented TCP- TCP over 2.5 / 3G wireless Networks.	
UNIT V APPLICATION LAYER	**(9 periods)**
WAP Model- Mobile Location based services -WAP Gateway –WAP protocols – WAP user agent profile- caching model-wireless bearers for WAP - WML – WMLScripts - WTA - iMode - SyncML.	

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

TEXT BOOKS:

*1. John Schiller, "**Mobile Communications**", Second Edition, Pearson Education, 2003.*
*2. William Stallings, "**Wireless Communications and Networks**", Pearson Education, 2002.*

REFERENCES BOOKS:

*1. Kaveh Pahlavan, Prasanth Krishnamoorthy, "**Principles of Wireless Networks**", First Edition, Pearson Education, 2003.*

*2. Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, "**Principles of Mobile Computing**", Springer, 2003.*

*3. C.K.Toh, "**AdHoc Mobile Wireless Networks**", First Edition, Pearson Education, 2002.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Understand GSM, CDMA concepts and architecture, frame structure, system capacity, services provided.

CO2: Study of evolution of mobile communication generations 2G, 2.5G, 3G with their characteristics and limitations.

COURSE ARTICULATION MATRIX:

CO	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	M	M	M	-	-	-	-	-	-	-	-	L	M	L	-
CO2	M	M	M	-	-	-	-	-	-	-	-	L	M	L	-
18LOE $10	M	M	M	-	-	-	-	-	-	-	-	L	M	L	-

L - Low, M - Moderate (Medium), H - High

18LOE$11	**INTRODUCTION TO VLSI SYSTEM DESIGN** *(Common to All Branches)*

Category: OE

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce various aspects of CMOS logic design in combinational and sequential circuit to design CMOS VLSI system components

UNIT I: CMOS LOGIC DESIGN	**(9 Periods)**
Inverter- CMOS Logic Gates: Compound Gates – Pass Transistors and Transmission Gates – Tristated – Multiplexers –CMOS Fabrication and Layout: Fabrication Process – Layout Design rule – Gate Layouts – Stick Diagrams – Design Partitioning	
UNIT II: MOS TRANSISTOR THEORY	**(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 - Dynamic Power – Static Power.	
UNIT III: COMBINATIONAL CIRCUIT DESIGN	**(9 Periods)**
Circuit Families: Static CMOS – Ratioed Circuits – Cascode Voltage Switch Logic – Dynamic Circuits – Pass Transistor Circuits. Silicon-on-Insulator Circuit Design – Subthreshold Cirucit Design	
UNIT IV: SEQUENTIAL CIRCUIT DESIGN	**(9 Periods)**
Sequential static circuits – Circuit design of latched and flip-flops – Sequencing dynamic circuits – Synchronizers – Wave pipelining - VLSI clocking: CMOS clocking styles - Pipelined systems - Clock generation and distribution.	
UNIT V: DESIGN OF VLSI SYSTEMS	**(9 Periods)**
System Specifications – Structural Gate Level Modeling – Switch Level Modeling – Behavioral and RTL Modeling - Addition/subtraction – Comparators –counters —Multiplexers - Binary Decoders – 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, Pearson Education,2011.*
2. *Uyemura, John P, "**Introduction to VLSI Circuits and Systems**", Wiley & Sons, 8th Reprint 2009*

REFERENCE BOOKS:

1. *Jan M. Rabaey, "**Digital Integrated Circuits: A Design Perspective**", PHI, Second Edition, 2012.*
2. *R. Jacob Baker, "**CMOS: Circuit Design, Layout, and Simulation**", Wiley-IEEE, Revised Second Edition, 2008.*
3. *Pucknell, "**Basic VLSI Design**", Prentice Hall, 2006.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Realize the CMOS logic design

CO2: Acquire knowledge on combinational and sequential circuit design of CMOS logic

CO3: Use VLSI clocking styles and realize CMOS VLSI system components

COURSE ARTICULATION MATRIX:

CO	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	M	M	M	-	-	-	-	-	-	-	-	L	H	L	L
CO2	M	M	M	-	-	-	-	-	-	-	-	L	M	L	L
CO3	M	M	M	-	-	-	-	-	-	-	-	L	H	L	L
18LOE $11	M	M	M	-	-	-	-	-	-	-	-	L	H	L	L

L - Low, M - Moderate (Medium), H - High

18LOE$12	**MICROCONTROLLER AND APPLICATIONS** *(Common to All Branches)*

Category: OE

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- Describe the architecture of 8051 microcontroller.
- Develop assembly program for 8051.
- Apply the instruction set of 8051 to get effective programs.
- Design system in block level using microcontroller, memory devices, buses and other peripheral devices.
- Solve real life problem using microcontroller based systems.

UNIT I: MICROCONTROLLER	**(9 Periods)**
Microcontroller Features – On chip oscillator, List of Special Function Registers (SFRs), On chip program memory, on chip data memory, I/O Ports, Watch Dog Timer, Architecture of 8051, Instruction set - Addressing modes.	
UNIT II: ASSEMBLY LANGUAGE PROGRAMMING	**(9 Periods)**
8051 Assembly Language Programming, Branch Instruction Programming -I/O Port Programming – Arithmetic and Logic Instruction Programming-code conversion programming	
UNIT III: PROGRAMMING IN C AND INTERFACING-I	**(9 Periods)**
Timers & Counters programming - Serial Port Programming - Interrupts Programming .8255 Interfacing and Programming- External Memory Interfacing - LCD interfacing, LED Interfacing	
UNIT IV: INTERFACING-II	**(9 Periods)**
Keyboard Interfacing - ADC, DAC interfacing –Temperature Transducer-Pressure and Displacement Transducer-Light Sensor - Optocoupler - Relays.	
UNIT V: APPLICATIONS OF MICROCONTROLLERS	**(9 Periods)**
Stepper Motor interface-Temperature Monitoring and Control System-Speed Control of a DC Motor - Digital Thermometer-Digital Frequency Meter.	

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

TEXT BOOKS:

1. *Mohammad Ali Mazidi, Janice Gillispie Mazidi* ***"The 8051 Microcontroller and Embedded Systems (Using assembly and C)"*** *Pearson education/ Prentice Hall of India Pvt. Ltd., 2007.*
2. ***Ajit Pal,*** *"Microcontrollers : Principles and Applications"****, Prentice-Hall of India Pvt.Ltd; 1 edition (August 2011).***

REFERENCE BOOKS:

1. *Krishna Kanth, **"Microprocessor and Microcontroller Archotecture,Programming and System Design using 8085, 8086, 8051"**, Prentice Hall of India, 2011.*
2. *Kenneth J.Ayala, **"The 8051 Microcontroller"** 3rd edition,Thompson Delmar Learning,2007, New Delhi.*
3. *Jacob Fraden, **"Handbook of Modern Sensors: Physics, Design and Applications"**, 3rd ed, Springer, 2010.*
4. *Michael J. Pont, **"Embedded C"** Pearson Education India, 1st edition (*2007*);*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Describe the architectures of controller

CO2: Develop Assembly program applying Digital logic and mathematics using 8051 instruction set

CO3: Design microcontroller based system within realistic constraint like user specification, availability of components etc

CO4: Interface real world sensors

CO5: Solve real life problem and construct a complete system as a solution

COURSE ARTICULATION MATRIX:

CO	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	M	M	M	-	-	-	-	-	-	-	-	L	H	L	L
CO2	M	M	M	-	-	-	-	-	-	-	-	L	M	L	L
CO3	M	M	M	-	-	-	-	-	-	-	-	L	H	L	L
CO4	M	M	M	-	-	-	-	-	-	-	-	L	H	L	L
CO5	M	M	M	-	-	-	-	-	-	-	-	L	M	L	L
18LOE $12	M	M	M	-	-	-	-	-	-	-	-	L	H	L	L

L - Low, M - Moderate (Medium), H - High

18POE$13	**RAPID PROTOTYPING** *(Common to All Branches)*

Category: OE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

* To educate students with fundamental and advanced knowledge in the field of Rapid Prototyping technology and the associated Aerospace, Architecture, Art, Medical and Industrial applications.

UNIT- I	**INTRODUCTION**	**(9 Periods)**
Need - Development of RP systems – Applications in Product Development - Virtual Prototyping- Rapid Tooling – Rapid Manufacturing - Classification of RP processes – Benefits - Applications		
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 formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing, Tool path generation-Software for RP- Case studies.		
UNIT- III	**LIQUID BASED AND SOLID BASED RAPID PROTOTYPING SYSTEMS**	**(9 Periods)**
Classification – Liquid based systems - 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 - Case studies.		
UNIT- IV	**POWDER BASED RAPID PROTOTYPING 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 RAPID PROTOTYPING 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 3DP 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 BOOKS:

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*

REFERENCE BOOKS:

1. *Gibson, I., Rosen, D.W. and Stucker, B **"Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing",** Springer, 2010.*
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 Tooling: Technologies and Industrial Applications",** CRC press, 2005*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Appreciate the importance of computers and modern tools in manufacturing to reduce cost and matching the societal needs.

CO2: Create and analyze 2D and 3D models using CAD modeling software and integrating with manufacturing systems.

CO3: Understand the variety of Additive Manufacturing (AM) technologies apply to their potential to support design and manufacturing, case studies relevant to mass customized manufacturing.

CO4: Apply knowledge on latest techniques of manufacturing in their field of career

CO5: To monitor and control shop floor with the aid of computers

COURSE ARTICULATION MATRIX

PO/PSO / CO	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			L				M						L	L	
CO2			M											M	L
CO3			L										M	L	
CO4			M		H	M	L						M	H	L
CO5		M				L					M		L	H	
18POE$13		M	M		M	L	L				L		M	M	L

L- Low, M – Moderate (Medium), H – High

18POE$14	**MANAGERIAL ECONOMICS** *(Common to All Branches)*

Category: OE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To introduce the fundamental economic principles necessary for production managers.

UNIT- I	**FUNDAMENTALS OF MANAGERIAL ECONOMICS**	**(9 Periods)**
Goals and Constraints - The Nature and Importance of Profits - Understanding Incentives - Economic rationality, Scarcity and opportunity cost -Marginal and Incremental Analysis.		
UNIT- II	**DEMAND ANALYSIS**	**(9 Periods)**
Demand and Supply -Market Equilibrium - Price Elasticity of Demand - Price Elasticity, Total Revenue, and Marginal Revenue - Factors Affecting Price Elasticity - Cross Price Elasticity - Income Elasticity of Demand - Other Elasticities, Elasticities for Nonlinear Demand Functions - Elasticity of Supply.		
UNIT- III	**DEMAND THEORIES**	**(9 Periods)**
Choice and Utility Theory - Law of Diminishing marginal utility - 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 - Cost Minimization and Optimal Input Substitution - The Cost Function - Breakeven analysis, Contribution analysis - Long-run Costs and Economies of Scale - Multiple Cost Functions and Economies of Scope - Learning curve.		
UNIT- V	**THEORY OF MARKET AND PRICING**	**(9 Periods)**
The Nature of Industry - Perfect Competition – Monopoly - Monopolistic Competition – Oligopoly - Product pricing.		

Contact Periods:

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

TEXT BOOKS:

1. *Thomas and Maurice **"Managerial Economics: Concept and Applications",** McGraw-Hill, 2005*
2. *Maheshwari.Y **"Managerial Economics",** Prentice Hall of India, 2012*

REFERENCE BOOKS:

1. *D.N. Dwivedi, **"Managerial Economics",** Vikas Publishing house, 2015*
2. *Christopher R Thomas, S Charles Maurice, **"Managerial economics",** Mcgraw Hill, 2014*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Explain fundamentals of managerial economics.
CO2: Discuss the dynamics of market forces.
CO3: Explain about various theories of demand.
CO4: Discuss about the cost concepts related to production.
CO5: Describe about the theory of market and pricing method.

COURSE ARTICULATION MATRIX

PO/PSO / CO	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	L	L							L	M	M	L			L
CO2	L	L	L							M	M	L			L
CO3	L									L	M	L			L
CO4	L									L	L	L			L
CO5	L	M	M	L						L	M	L			L
18POE$14	L	L	L	L						L	M	L			L

L- Low, M – Moderate (Medium), H - High

18POE$15	**HYDRAULICS AND PNEUMATICS** *(Common to All Branches)*

PRE-REQUISITES: NIL **Category: OE**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

* To make the students to design the hydraulic and pneumatic circuits for different applications.

UNIT- I	**BASIC PRINCIPLES**	**(9 Periods)**
Hydraulic Principles; Hydraulic Fluids; Hydraulic pumps – Classification, Characteristics, Pump Selection; Hydraulic actuators; Hydraulic valves – Pressure, Flow, Direction Controls, Applications, Symbols.		
UNIT- II	**HYDRAULIC CIRCUITS**	**(9 Periods)**
Hydraulic circuits – Reciprocating, Quick Return, Sequencing, Synchronizing, Regenerative circuit, Double pump hydraulic system; Safety Circuits.		
UNIT- III	**POWER GADGETS IN HYDRAULICS**	**(9 Periods)**
Accumulators – Classification, Circuits; Pressure Intensifier and Circuit; Mechanical-hydraulic servo system; Selection of components. Installation and Maintenance of Hydraulic power pack; Troubleshooting of fluid power circuits.		
UNIT- IV	**PNEUMATIC SYSTEMS**	**(9 Periods)**
Pneumatic Fundamentals; Control Elements; Logic Circuits; Position sensing, Pressure sensing; Electrical controls: Various switches; Electro Pneumatic and Electro Hydraulic Circuits.		
UNIT- V	**DESIGN AND SELECTION OF PNEUMATIC CIRCUITS**	**(9 Periods)**
Design of Pneumatic circuits – Classic, Cascade, Step counter; 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 BOOKS:

1. *Anthony Esposito, **"Fluid Power with Applications",** Pearson Education India, 7th edition, 2013.*
2. *Andrew Parr, **"Hydraulics and Pneumatics:A Technician's and Engineer's Guide",** Butterworth-Heinemann, 3rd edition, 2011.*

REFERENCE BOOKS:

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:

On completion of this course, students will be able to

CO1: Describe the principle of fluid power
CO2: Describe the components of hydraulics
CO3: Design the hydraulic circuits for automation
CO4: Describe the components of pneumatics
CO5: Design the pneumatic circuits for automation

COURSE ARTICULATION MATRIX

PO/PSO CO	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	M	H										M			
CO2	M											M			
CO3	M	H										M			
CO4	M											M			
CO5	M											M			
18POE$15	M	H										M			

L- Low, M – Moderate (Medium), H - High

18NOE$16	**MEASUREMENT AND CONTROL** *(Common to All Branches)*

PRE-REQUISITES: NIL **Category: OE**

L	T	P	C
3	0	0	3

COURSE OBJECTIVE

- To learn about the working of different analog and digital instruments.

UNIT I – INTRODUCTION TO MEASUREMENTS	**(9 Periods)**
Significance of measurements – Methods of measurements – Classification of Instruments – Functions of Instruments and Measurement System – Elements of measurement system – Errors in measurement — Calibration of instruments: Methods & analysis – Introduction to Transducer & types.	
UNIT II – STRAIN AND DISPLACEMENT MEASUREMENT	**(9 Periods)**
Factors affecting strain measurements – Types of strain gauges – theory of operation – strain gauge materials – strain gauge circuits and applications of strain gauges. Resistive potentiometer (Linear, circular and helical) – L.V.D.T., R.V.D.T. and their characteristics – variable inductance and capacitance transducers – Piezo electrical transducers – Hall Effect devices and Proximity sensors.	
UNIT III – PRESSURE AND TEMPERATURE MEASUREMENT	**(9 Periods)**
Mechanical devices like Diaphragm, Bellows, and Bourdon tube for pressure measurement – Variable inductance and capacitance transducers – Piezo electric transducers – L.V.D.T. for measurement of pressure. Resistance type temperature sensors – RTD & Thermistor – Thermocouples & Thermopiles, Laws of thermocouple – Radiation methods of temperature measurement.	
UNIT IV – FLOW AND LEVEL MEASUREMENT	**(9 Periods)**
Differential pressure meters like Orifice plate, Venturi tube, flow nozzle, Pitot tube, Rotameter, Turbine flow meter, Electromagnetic flow meter and Ultrasonic flow meter. Resistive, inductive and capacitive techniques for level measurement – Ultrasonic methods – Air purge system (Bubbler method).	
UNIT V – AUTOMATIC CONTROL SYSTEM	**(9 Periods)**
Elements of control systems – concept of open loop and closed loop systems – Controllers – Brief idea of proportional, derivative and integral – 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 Electronic and Electrical Measurements and Instrumentation"** S.K.Kataria & Sons, Delhi, 2014.*
2. *E. D. Doeblin, **"Measurement Systems: Application and Design",** McGraw – Hill Publication, 6th Edition 2017.*

REFERENCE BOOKS

1. *S. K. Singh, **"Industrial Instrumentation & Control"**, 3rd Edition, McGraw Hill, 2016.*
2. *A.K. Sawhney, Puneet Sawhney **"A Course in mechanical measurements and Instrumentation & Control"**, Dhanapat Rai & Co, 2012.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO 1: Explain the construction and working of instruments used for various measurements.

CO 2: Describe the methods of measurement, classification of transducers and to analyze error.

CO 3: Elaborate the basic concept of control system.

CO 4: Analyze the characteristics of various measuring instruments

CO 5: Suggest suitable instruments for a particular application

COURSE ARTICULATION MATRIX:

CO/ PO	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	H	H	M	H	M	H	M	L	H	M	H	H	H	M	H
CO2	H	M	M	M	H	H	H	M	H	L	H	H	H	H	M
CO3	H	H	M	H	M	H	M	L	H	M	H	H	H	H	H
CO4	H	H	M	H	M	H	M	L	H	M	H	H	H	M	H
CO5	H	H	M	H	M	H	M	L	H	M	H	H	H	M	M
18NOE$16	H	H	M	H	M	H	M	L	H	M	H	H	M	H	M

L-Low, M-Moderate (medium), H-High

18NOE$17	**INDUSTRIAL AUTOMATION** *(Common to All Branches)*

PRE-REQUISITES: NIL **Category: OE**

L	T	P	C
3	0	0	3

COURSE OBJECTIVE

- To elaborate the basic concept of automation and the components required for automation

UNIT I – INTRODUCTION TO AUTOMATION	**(9 Periods)**
Automation overview – requirement of automation systems – architecture of industrial automation system – power supplies and isolators –relays – switches –transducers – sensors –seal-in circuits – industrial bus systems : modbus and profibus.	
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 – 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 (DCS)	**(9 Periods)**
Overview of DCS – DCS hardware – DCS software configuration – DCS communication – DCS supervisory computer tasks – DCS integration with PLC and Computers	
UNIT V – SCADA	**(9 Periods)**
Introduction - Supervisory Control and Data Acquisition Systems (SCADA) – 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. *John.W. Webb Ronald A Reis, **"Programmable Logic Controllers - Principles and Applications",** Prentice Hall Inc., 5th Edition, 2003.*
2. *M. P. Lukcas, **"Distributed Control Systems",** Van Nostrand Reinhold Co., 1986.*

REFERENCE BOOKS :

1. *Bela G Liptak, **"Process software and digital networks – Volume 3",** 4th Edition, CRC press, 2012.*
2. *Romily Bowden, **"HART application guide and the OSI communication foundation",** 1999*
3. *Frank D. Petruzella, **"Programmable Logic Controllers",** 5th Edition, McGraw Hill, 2016.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO 1: Elaborate the basic architecture of automation systems

CO 2 : Describe the various sensors and actuators involved in industrial automation

CO 3: Construct ladder logic diagram using PLC basic functions, timer and counter functions for simple applications

CO 4: Illustrate the functionary components and supervisory control of DCS with relevant diagrams

CO 5: Describe the basics of SCADA technology

COURSE ARTICULATION MATRIX:

CO/ PO	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	H	H	M	M	L	L	L	H	L	M	L	L	H	L	L
CO2	H	H	H	H	L	L	L	H	L	M	L	L	H	L	L
CO3	H	H	M	M	L	L	M	H	L	M	L	L	H	L	L
CO4	H	H	H	H	L	L	L	H	L	M	L	L	H	L	L
CO5	H	H	M	M	M	L	L	H	L	M	L	L	H	L	L
18NOE$17	H	H	M	M	L	L	L	H	L	M	L	L	H	L	L

L-Low, M-Moderate (medium), H-High

18NOE$18	**VIRTUAL INSTRUMENTATION** *(Common to All Branches)*

PRE-REQUISITES: NIL **Category: OE**

L	T	P	C
3	0	0	3

COURSE OBJECTIVE

- To confer applications of virtual instrumentation in various fields.

UNIT I – INTRODUCTION	**(9 Periods)**
Virtual Instrumentation and LabVIEW - Evolution of LabVIEW - Difference between LabView and conventional languages - Sequencing and data flow - Graphical programming.	
UNIT II – LabVIEW ENVIRONMENT	**(9 Periods)**
Front panel - Block diagram - Icon and Connector - Control Palette - Function Palette-Tools Palette - Creating, editing, wiring, debugging and saving VIs - sub-VIs - creating sub-VIs - simple examples-Looping: For loop, while loop-Shift registers - case and sequence; structures, formula nodes.	
UNIT III – PROGRAMMING TECHNIQUES	**(9 Periods)**
Arrays - clusters, charts and graphs, - local and global variables - property node, string and file I/O.	
UNIT IV – DATA ACQUISITION AND INSTRUMENT CONTROL	**(9 Periods)**
DAQ – Components - Buffers: Buffered and non buffered I/O - Triggering - Analog I/O-Digital I/O - Counters and timers-Instrument control: VISA, GPIB, VXI and PXI	
UNIT V – ADVANCED Lab VIEW AND APPLICATIONS	**(9 Periods)**
Connectivity in LabVIEW: an introduction - IVI - Labwindows/CVI. Applications of Lab VIEW: process control, physical, biomedical, Image acquisition and processing.	

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

TEXT BOOKS

1. *Sanjay Gupta and Joseph John, **"Virtual Instrumentation using LabVIEW"** Tata McGraw-Hill, Second edition 2010*
2. *Gary Johnson, Richard Jennings **"Lab view graphical programming",** Tata McGraw Hill, 2011.*

REFERENCE BOOKS

1. *Lisa K Wells and Jeffrey Travels, **"Labview for everyone",** Prentice Hall, 3rd Edition 2009.*
2. *S. Gupta, J.P. Gupta, **"PC interfacing for data acquisition and process control",** 2nd Ed., Instrument Society of America, 2011*
3. *Jovitha Jerome, **"Virtual Instrumentation Using LabVIEW"** PHI Learning Pvt. Ltd 1st Edition, 2010*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO 1: Recognize the importance and applications of virtual instrumentation.

CO 2: Develop ability for programming in LabVIEW using various data structures, program structures, plotting the graphs and charts for system monitoring, processing and controlling.

CO 3: Realize the basics of interfacing and programming using related hardware.

CO 4: condition the acquired signal from the transducer to standard data formats

CO 5: Develop real time applications using LabVIEW

COURSE ARTICULATION MATRIX:

CO/ PO	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	M	H	M	M	L	L	L	H	L	M	M	M	H	M	M
CO2		H	H	H	L	L	L	H	L	M	M	M	H	M	M
CO3		H	M	M	L	L	M	H	L	M	M	M	H	M	M
CO4		H	H	H	L	L	L	H	L	M	M	M	H	M	M
CO5		H	M	M	M	L	L	H	L	M	M	M	H	M	M
18NOE$18	M	H	M	M	L	L	L	H	L	M	M	M	H	M	M

L-Low, M-Moderate(medium), H-High

18SOE$19	**PROGRAMMING IN JAVA** *(Common to All Branches)*

PRE-REQUISITES: NIL **Category: OE**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course the students will be familiar with:

- Basic programming constructs in java to develop simple object oriented programs.
- Exception handling, multi-threading and I/O programming
- Development of GUI applications
- Manipulation of images.
- Network Programming

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 : APPLETS AND EVENT HANDLING	**(9 Periods)**
Applet class- Event Handling. Introducing the AWT: working with windows- graphics and text- Using AWT controls- Layout Manager - menus.	
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, Eighth Edition, 2011.*

REFERENCE BOOKS:

1. *Deitel .H.M and Deitel.P.J, **"Java: How to Program",** Pearson Education Asia, Eighth Edition 2010.*
2. *Lay.S&Horstmann Gary Cornell, **"Core Java Vol I",** Seventh Edition, The Sun Microsystems & press Java Series, 2005.*
3. *Lay.S&Horstmann Gary Cornell, **"Core Java Vol II",** Eighth Edition, The Sun Microsystems & press Java Series, 2008.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Write simple java programs using fundamental concepts of java like control structures, inheritance, packages, interfaces and exception handling. [**Usage]**

CO2: Write java program using multithreading and string handling. [**Usage]**

CO3: Develop GUI based applications using Applets. [**Usage]**

CO4: Write java programs to display and manipulation of graphical images. [**Usage]**

CO5: Establish database connectivity.[**Familiarity]**

CO6: Develop client server programs using RMI and servlets. [**Usage]**

COURSE ARTICULATION MATRIX:

CO	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	PSO 4
CO1	M	M	H		H	M	M				H	M	M	H	H	H
CO2	M	M	H		H	M	M				H	M	M	H	H	H
CO3	M	M	H		H	M	M				H	M	M	H	H	H
CO4	M	M	H		H	M	M				H	M	M	H	H	H
CO5	M	M	H		H	M	M				H	M	M	H	H	H
CO6	M	M	H		H	M	M				H	M	M	H	H	H
18SOE$19	M	M	H		H	M	M				H	M	M	H	H	H

L - Low, M - Moderate (Medium), H - High

18SOE$20	**CYBER SECURITY** *(Common to All Branches)*

PRE-REQUISITES: NIL **Category: OE**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- Cybercrime and cyber offenses
- Cybercrime using mobile devices.
- Tools and methods used in cybercrime.
- Legal perspectives of cybercrime.
- Fundamentals of computer forensics.

UNIT – I : INTRODUCTION TO CYBERCRIME AND CYBEROFFENSES	**(9 Periods)**
Cybercrime and Information Security - Classifications of Cybercrimes - The Legal Perspectives - Cybercrime and the Indian ITA 2000 - A Global Perspective on Cybercrimes - Plan of Attacks - Social Engineering – Cyberstalking - Cybercafe and Cybercrimes – Botnets - Attack Vector.	
UNIT – II : CYBERCRIME: MOBILE AND WIRELESS DEVICES	**(9 Periods)**
Proliferation of Mobile and Wireless Devices - Trends in Mobility - Credit Card Frauds in Mobile and Wireless Computing Era – Security challenges posed by mobile devices – registry setting for mobile devices – authentication service security – attacks on mobile/cell phones – Organizational measures for handling mobiles.	
UNIT – III : TOOLS AND METHODS USED IN CYBERCRIME	**(9 Periods)**
Proxy Servers and Anonymizers – Phishing - Password Cracking – Keyloggers – Spywares -Virus and Worms - Trojan Horses and Backdoors – Steganography - DoS and DDoS Attacks - SQL Injection - Attacks on Wireless Networks.	
UNIT – IV : CYBERCRIMES AND CYBERSECURITY: THE LEGAL PERSPECTIVES	**(9 Periods)**
Cyberlaws- The Indian Context - The Indian IT Act - Challenges to Indian Law and Cybercrime Scenario in India - Consequences of Not Addressing the Weakness in Information Technology Act - Digital Signatures and the Indian IT Act - Amendments to the Indian IT Act - Cybercrime and Punishment.	
UNIT – V : UNDERSTANDING COMPUTER FORENSICS	**(9 Periods)**
Digital Forensics - Forensics Analysis of E-Mail - Network Forensics - Forensics and Steganography - Forensics and Social Networking Sites - Challenges in Computer Forensics - Data Privacy Issues – Forensics Auditing – Antiforensics.	

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

TEXT BOOKS:

1. *Nina Godbole and Sunit Belapur,* ***"Cyber Security Understanding Cyber Crimes, Compute Forensics and Legal Perspectives"****, Wiley India Publications, April, 2011.*

REFERENCE BOOKS:

1. *Robert Jones,* ***"Internet Forensics: Using Digital Evidence to Solve Computer Crime",*** *O"Reilly Media, October, 2005.*
2. *Chad Steel, "****Windows Forensics: The field guide for conducting corporate computer investigations****", Wiley India Publications, December, 2006.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Explain the fundamental concepts of cybercrime and cyberoffenses. **[Familiarity]**
CO2: Describe the cybercrimes occurred in mobile and wireless devices. **[Familiarity]**
CO3: Elaborate the methods used in cybercrime. **[Familiarity]**
CO4: Explain the laws for cybercrime and its respective punishments. **[Familiarity]**
CO5: Explain the forensics Analysis of E-Mail, Network and Social Networking Sites **[Familiarity]**

COURSE ARTICULATION MATRIX:

CO	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	PSO 4
CO1	M	M	M	M	L	H	L	M				H	H	L	M	M
CO2	M	M	M	M	M	H	M	M				M	H	H	M	M
CO3	H	L	L	L	L	H	H	L				H	H	H	L	L
CO4	H	M	M	M	M	H	H	H				M	H	H	L	L
CO5	H	M	M	M	M	L	H	L				H	H	H	M	M
18SOE$20	H	M	M	M	M	H	H	M				H	H	H	M	M

L - Low, M - Moderate (Medium), H - High

18SOE$21	**NETWORK ESSENTIALS** *(Common to All Branches)*

PRE-REQUISITES: NIL **Category: OE**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with,

- Basic taxonomy and terminology of the computer networking
- Wireless networking
- Addressing and Routing
- Routing protocols
- Troubleshooting and security issues.

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 BOOKS:

1. *Jeffrey S.Beasley Piyasat Nilkaew **"Network Essentials"** 3rd Edition, Pearson, 2012*
2. *Larry L. Peterson and Bruce S. Davie **"Computer Networks, A Systems Approach"** 5th edition, Morgan Kaufmann Publishers Inc, 2011.*

REFERENCE BOOKS:

1. *Behrouz A.Ferouzan, **"Data Communications and Networking"**, 5th edition, Tata McGraw-Hill, 2012.*
2. *Andrew S. Tanenbaum, **"Computer networks"**, PHI, 5th edition 2011.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Identify topologies and types of Computer Networks and enumerate the layers of the OSI model and TCP/IP and Explain the functions of each layer **[Familiarity]**

CO2: Explain the significance of wireless networks and configure a Wireless LAN **[Assessment]**

CO3: Describe basic routing algorithms and network services. **[Familiarity]**

CO4: Troubleshoot the router and switch interface **[Usage]**

CO5: Analyze Campus Network data traffic **[Usage]**

COURSE ARTICULATION MATRIX:

CO	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	PSO 4
CO1	M	M	H	H	H	L	L	H	H	H	H	H	M	H	H	M
CO2	L	L	L	L	H	L	L	H	L	L	L	H	M	H	H	M
CO3	L	H	M	M	H	L	L	H	H	M	L	H	L	H	H	L
CO4	H	H	H	M	H	L	L	H	H	H	M	H	M	H	H	M
CO5	H	H	H	M	H	L	L	H	H	M	L	H	M	H	H	M
18SOE$21	M	H	H	M	H	L	L	H	H	L	M	H	M	H	H	M

L - Low, M - Moderate (Medium), H - High

18IOE$22	**PROGRAMMING IN PYTHON** *(Common to All Branches)*

PRE-REQUISITES: NIL **Category: OE**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with,

- Data types and variables declaration.
- Control statements, Functions and the use of basic programming.
- List, dictionary and operations used in python.
- File and Exception handling.
- Object oriented programming and GUI development.

UNIT – I : INTRODUCTION	**(9 Periods)**
Introduction to Python - Setting up Python in OS – Python IDLE(write- edit- run- and save programs) – Strings - Numbers – Variables – simple I/O - Getting user input– Using String method–Converting values.	
UNIT – II : CONTROL STATEMENTS AND FUNCTIONS	**(9 Periods)**
Control statements – Random number generator- Branching and loops – Range functions- Functions –User defined functions- passing parameters- return function- working with global variables and constants.	
UNIT – III : LISTS AND DICTIONARIES	**(9 Periods)**
Lists – create- index- slice a list- Add and delete elements from a list- Append- Sort and reverse a list- nested sequences- Dictionaries – Create- add- delete from a Dictionary- Operations associated with pairs of data.	
UNIT – IV : FILES AND EXCEPTIONS	**(9 Periods)**
Files – Read from text files- Write to text files- Read and write more complex data- Exceptions – Intercept and handle errors during program's execution.	
UNIT – V : OBJECT ORIENTED PROGRAMMING AND GUI	**(9 Periods)**
Object oriented programming – Create objects of different classes in the same program- objects communication- complex object creation- derive new classes- existing class extension- override method- GUI – GUI toolkit- create and fill frames- create buttons- text entries and text boxes- create check buttons and radio buttons - case study – create a web page using GUI functionality.	

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

TEXT BOOKS:

1. *Y. Daniel Liang,* ***"Introduction to Programming Using Python",*** *Pearson, 2013.*
2. *David I.Schneider,* ***"Introduction to programming using python",*** *person, 2015.*

REFERENCE BOOKS:

1. *Michael Dawson,* ***"Python Programming for the Absolute Beginner",*** *Premier Press, 2003.*
2. *Charles Dierbach,* ***"Introduction to Computer Science Using Python: A Computational Problem-Solving Focus",*** *Wiley Publications, 2012.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to,

CO1: Use various data types. **[Understand]**
CO2: Use control statements and functions. **[Understand]**
CO3: Analyze the arrangement of data elements in Lists and Dictionary structures. **[Analyze]**
CO4: Handle exceptions and perform file operations**. [Understand]**
CO5: Develop application using object oriented programming and GUI. **[Analyze]**

COURSE ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	L		L	L		L	L			L		L	L
CO2	M	L		L	L		L	L			L		L	L
CO3	M	M	L	M	L		L	L			L		M	L
CO4	M	M	L	M	L		M	M			L		M	L
CO5	M	M	L	M	L		M	M			M	L	M	L
18IOE $22	M	M	L	M	L		M	M			L	L	M	L

L - Low, M - Moderate (Medium), H – High

18IOE$23	**BIG DATA SCIENCE** *(Common to All Branches)*

PRE-REQUISITES: NIL **Category: OE**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with,

- Big Data and its characteristics.
- Technologies used for Big Data Storage and Analysis.
- Mining larger data streams.
- Concepts related to Link analysis and handle frequent data sets.

UNIT – I : THE FUNDAMENTALS OF BIG DATA	**(9 Periods)**
Understanding Big Data-Concepts and Technology-Big Data Characteristics-Types of data-Case Study-Business Motivation and Drivers for Big Data Adoption- Planning Considerations-Enterprise Technologies and Big Data Business Intelligence- OLTP-OLAP-Extract Transform Load-Data Warehouses-Data Mart-Traditional and Big Data BI-Case Study.	
UNIT – II : BIG DATA STORAGE AND PROCESSING	**(9 Periods)**
Big Data Storage Concepts- Clusters-File systems and Distributed File Systems-NoSQL- Sharding -Replication -Sharding and Replication-CAP Theorem-ACID-BASE-Case Study- Big Data Processing Concepts- Parallel Data Processing-Distributed Data Processing-Hadoop-Processing Workloads-Cluster-Processing in Batch mode-Processing in RealTime mode-Case study	
UNIT – III : BIG DATA STORAGE AND ANALYSIS TECHNOLOGY	**(9 Periods)**
Big Data Storage Technology: On-Disk Storage devices-NoSQL Databases-In-Memory Storage Devices-Case study, Big Data Analysis Techniques: Quantitative Analysis-Qualitative Analysis-Data Mining-Statistical Analysis-Machine Learning-Semantic Analysis-Visual Analysis-Case Study.	
UNIT – IV : MINING DATA STREAMS	**(9 Periods)**
The stream data model – Sampling data streams – counting distinct elements in a stream – Estimating moments. Finding similar items – Applications of nearest neighbor search – shingling of documents - similarity preservation – locality sensitive hashing- distance measures – methods for high degree similarity.	
UNIT – V : LINK ANALYSIS AND FREQUENT ITEMSETS	**(9 Periods)**
Link analysis – Page rank – Efficient computation of a page rank – topic sensitive page rank – link spam –Frequent datasets – the market basket model – Apriori algorithm – handling larger datasets in main memory –limited pass algorithm – counting frequent items in a stream.	

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

TEXT BOOKS:

1. *Thomas Erl, WajidKhattak, and Paul Buhler,* ***"Big Data Fundamentals Concepts, Drivers & Techniques",*** *Prentice Hall,2015.*
2. *AnandRajaraman and Jeffrey David Ullman,* ***"Mining of Massive Datasets",*** *Cambridge University Press, 2012.*

REFERENCE BOOKS:

1. *Paul Zikopoulos, Chris Eaton, Paul Zikopoulos,* ***"Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data",*** *McGraw Hill, 2011.*
2. *Frank J Ohlhorst,* ***"Big Data Analytics: Turning Big Data into Big Money",*** *Wiley and SAS Business Series, 2012.*
3. *Bill Franks,* ***"Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics",*** *Wiley and SAS Business Series, 2012.*
4. *Paul Zikopoulos, Dirk deRoos, Krishnan Parasuraman, Thomas Deutsch , James Giles, David Corrigan,* ***"Harness the Power of Big data – The big data platform",*** *McGraw Hill, 2012.*
5. *Colleen Mccue,* ***"Data Mining and Predictive Analysis: Intelligence Gathering and Crime Analysis",*** *Elsevier, 2007*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to,

CO1: Understand the Big Data and usage in Enterprise Technologies. **[Understand]**
CO2: Store and Process Big Data using suitable Processing Methods. **[Understand]**
CO3: Handle Big Data using appropriate analysis Techniques. **[Analyze]**
CO4: Mine larger data streams using suitable algorithms. **[Understand]**
CO5: Rank pages and handle large data sets efficiently. **[Analyze]**

COURSE ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	L	M	L	H	L							M	L
CO2	M				H			L				L	M	L
CO3		H			H							L	M	L
CO4	M	H	M		M							L	M	L
CO5	L	M	H									L	M	L
18IOE $23	M	H	M	L	H	L		L				L	M	L

L - Low, M - Moderate (Medium), H - High

18IOE$24	**OBJECT ORIENTED PROGRAMMING USING C++** *(Common to All Branches)*

PRE-REQUISITES: NIL **Category: OE**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with,

- Fundamentals of object oriented programming
- Classes and objects
- Concepts of overloading and type conversions
- Inheritance and Polymorphisms
- Files, templates and exception handling

UNIT – I : PRINCIPLES OF OBJECT ORIENTED PROGRAMMING	**(9 Periods)**
Basic concepts- benefits – applications of object oriented programming – beginning with C++ - tokens – expressions and control structures – C++ stream classes – Formatted and Unformatted I/O operations. Managing output with manipulators.	
UNIT – II : CLASSES AND OBJECTS	**(9 Periods)**
Introduction – specifying class – defining member functions – memory allocation constructors and destructors - parameterized, copy, default, dynamic and multiple constructors – destructors.	
UNIT – III : FUNCTIONS AND TYPE CONVERSIONS	**(9 Periods)**
Introduction – function prototyping call by reference – return by reference – inline function – recursion – friend function – function overloading – operator overloading – manipulation of strings using operators – type conversions.	
UNIT – IV : INHERITANCE AND POLYMORPHISM	**(9 Periods)**
Defining derived classes – single, multiple, multilevel, hierarchical and hybrid inheritance – virtual base classes – abstract base classes – nesting of classes - pointers – pointers to objects – this pointer – pointers to derived classes – virtual functions – pure virtual functions virtual constructors and destructors.	
UNIT – V : FILES AND TEMPLATES	**(9 Periods)**
Classes for file stream operations – opening and closing a file – detecting EOF – open file modes – file pointers and their manipulations – sequential I/O operations – updating and error handling of file. Class and function template – template with multiple parameters – overloading, member function and non-type template arguments-Exception handling.	

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

TEXT BOOKS:

1. *Lafort Robert,* ***"Object oriented profframming in C++",*** *4th Edition.*
2. *E.Balagurusamy,* ***"Object oriented Programming with C++",*** *McGraw Hill Education Ltd, 7th Edition 2017.*

REFERENCE BOOKS:

1. *R.Rajaram,* ***"Object Oriented Programming and C++",*** *New Age International 2nd edition, 2013.*
2. *K.R. Venugopal, Rajkumar, T. Ravishankar,* ***"Mastering C++",*** *Tata McGraw Hill Education, 2nd edition, 2013.*
3. *Yashavant P. Kanetkar,* ***"Let us C++",*** *BPB Publications, 2nd edition 2003.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to,

CO1: Understand the principles of object oriented programming. **[Understand]**
CO2: Develop programs using classes and objects. **[Analyze]**
CO3: Use functions and type conversions in programs. **[Understand]**
CO4: Apply inheritance and polymorphism to develop applications. **[Analyze]**
CO5: Use files, templates and handle exceptions. **[Understand]**

COURSE ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	H	H	M			M						M	L
CO2	M	H	H	H			M						H	L
CO3	M	H	H	H			M						H	L
CO4	M	H	H	H			M						H	L
CO5	M	H	H	H			M						H	L
18IOE $24	M	H	H	H			M						H	L

L - Low, M - Moderate (Medium), H - High

18BOE$25	**COMPUTATIONAL BIOLOGY** *(Common to All Branches)*

PRE-REQUISITES: NIL **Category: OE**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- Understand the basic concepts and role of computation in biological analysis
- Familiarize with sequence alignment methods
- Understand the machine learning tools used for biological analysis

UNIT – I : BASICS OF BIOLOGY	**(9 Periods)**
Biomolecules of life: Structure and Composition of DNA, RNA & Protein. Protein Structure basics-Primary, Secondary and tertiary Structure of protein.	
UNIT – II : BIOLOGICAL DATABASES	**(9 Periods)**
Concept of Relational database, Data archiving, Data mining, Primary databases-NCBI, EMBL, DDBJ; Structure databases-PDB	
UNIT – III : SEQUENCE ANALYSIS	**(9 Periods)**
Pairwise alignment tools-Dot matrix analysis, Dynamic programming-Smith Waterman and Needleman Wunsch algorithm ,Heuristic methods- BLAST,FASTA; Multiple sequence alignment methods-Progressive alignment (Clustal)	
UNIT – IV : STRUCTURE ANALYSIS AND DRUG DESIGN	**(9 Periods)**
Protein secondary prediction-Chou fasman method, GOR method; Tertiary structure prediction-Homology modelling, Introduction to Computer aided drug design.	
UNIT – V : MACHINE LEARNING	**(9 Periods)**
Genetic Algorithm, Neural networks, Artificial Intelligence, Hidden markov model -application in bioinformatics	

Contact Periods:
Lecture: 45 Periods **Tutorial: 00 Periods** **Practical: 00 Periods** **Total: 45 Periods**

TEXT BOOKS:

*1.David W. Mount , **"Bioinformatics: Sequence and Genome Analysis"** , Cold Spring Harbor Laboratory Press, Second Edition, 2004*
*2. Arthur M. Lesk, **"Introduction to Bioinformatics"**, Oxford University Press, 2008.*
*3.Pierre Baldi, Soren Brunak. , **"Bioinformatics: The machine learning approach"**, MIT Press, 2001*

REFERENCE BOOKS:

*1. Andreas D. Baxevanis, **"Bioinformatics, A Practical Guide to the Analysis of Genes and Proteins"**, Third edition; Wiley-Interscience, 2004.*
*2. Baxevanis A.D. and Oullette, B.F., **"A Practical Guide to the Analysis of Genes and Proteins"**, 2nd ed., John Wiley, 2002*
*3. David L. Nelson, Michael M. Cox., **"Lehninger: Principles of Biochemistry"**, Sixth edition, Freeman, W. H. & Co. Publisher, 2012.*

COURSE OUTCOMES:

Upon completion of the course the students will be able to

CO1: Understand the basic structure of Biological macromolecules
CO2: Acquire the knowledge of biological databases and its importance.
CO3: Perform pair wise and multiple sequence alignment
CO4: Predict the secondary and tertiary structure of proteins.
CO5: Understand the machine learning approaches in computational biology

COURSE ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	M	L	L		L			M				L	
CO2	M	L	L	L					L			L	L	L
CO3	L		L			M			L			L	L	
CO4	M	M	L	M	M								M	
CO5		M		H	H	M	L		M				H	H
18BOE $25	M	M	L	M	M	M	L		M			L	M	H

L - Low, M-Moderate (Medium), H- High

18BOE$26	**BIOLOGY FOR ENGINEERS** *(Common to All Branches)*

PRE-REQUISITES: NIL **Category: OE**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the basic functions of the cell and their mechanisms in transport process.
- To get familiarize human anatomy and physiology.
- To learn about microbes, immune system and biomolecules.
- To know the concepts of applied biology.

UNIT – I : BASICS OF CELL BIOLOGY	**(9 Periods)**
An overview of cells – origin and evolution of cells-cell theory-classification of cells – prokaryotic cells and eukaryotic cells; Structure of prokaryotic and eukaryotic cells and their organelles-comparison of prokaryotic and eukaryotic cells; Transport across membranes – diffusion - active and passive diffusion.	
UNIT – II : BASICS OF MICROBIOLOGY	**(9 Periods)**
Classification of microorganism-microscopic examination of microorganisms; Structural organization and multiplication of bacteria-viruses-algae and fungi; Microorganism used for the production of penicillin-alcohol and vitamin B-12.	
UNIT – III : HUMAN ANATOMY AND PHYSIOLOGY	**(9 Periods)**
Basics of human anatomy-tissues of the human body-epithelial-connective-nervous and muscular; Nervous system-Respiratory System-Circulatory system and Digestive system.	
UNIT – IV : BIO MOLECULES AND IMMUNE SYSTEM	**(9 Periods)**
Introduction to Biochemistry-classification-structure and properties of carbohydrates-proteins- lipids and nucleic acids; Innate and acquired immunity; Types of immune responses.	
UNIT – V : APPLIED BIOLOGY FOR ENGINEERS	**(9 Periods)**
Overview of biosensors - glucometer applications-medicine; Microarray analysis to diagnose the cancer; Microbial production of biofuels; Applications of stem cells.	

Contact Periods:
Lecture: 45 Periods **Tutorial: 00 Periods** **Practical: 00 Periods** **Total: 45 Periods**

TEXT BOOKS:

1. *Darnell J, Lodish H, Baltimore D.* ***"Molecular Cell Biology"****, W.H.Freeman; 8th Edition, 2016.*
2. *Pelczar MJ, Chan ECS and Krein NR,* ***"Microbiology"****, Tata McGraw Hill, 5thEdition, New Delhi.2001.*
3. *Wulf Cruger and Anneliese Cruger,* ***"A Textbook of Industrial Microbiology"****, Panima Publishing Corporation, 2nd Edition, 2000.*

REFERENCE BOOKS:

1. *David L. Nelson and Michael M Cox, **"Lehninger's Principles of Biochemistry"**, Macmillan Worth Publisher, 4th edition, 2004.*
2. *Brain R.Eggins , **"Chemical Sensors and Biosensors"**, John Wiley & Sons, 2002.*
3. *Anton Moser, **"Bioprocess Technology, Kinetics and Reactors"**, Springer, Berlin (Verlag),1st edition, 1998*
4. *Kuby J, **"Immunology"**, WH Freeman & Co., 7th edition, 2013.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Understand the functions of cell and their structural organization
CO2: Describe the mechanisms and role of cell in immune system
CO3: Get familiarized biomolecules and human anatomy system
CO4: Illustrate the applications of microbes in industrial process
CO5: Apply the engineering concepts in biology

COURSE ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L	L	L	-	-	-	-	-	-	-	-	-	H	M
CO2	L	M	-	L	-	-	L	M	-	-	-	-	M	M
CO3	L	M	L	L	-	-	-	L	M	-	-	L	H	H
CO4	L	L	L	L	M	-	-	-	L	-	-	-	M	H
CO5	-	-	-	-	-	-	-	-	-	-	-	-	H	H
18BOE $26	L	M	L	L	M	-	L	M	M	-	-	L	H	H

L - Low, M-Moderate (Medium), H- High

18BOE$27	**FUNDAMENTALS OF BIOENGINEERING** *(Common to All Branches)*

PRE-REQUISITES: NIL **Category: OE**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To make the students aware of the overall industrial bioprocess.
- To understand the basic configuration and parts of a fermentor.
- To study the production of primary and secondary metabolites.
- To understand the production of modern biotechnology products.

UNIT I: INTRODUCTION TO INDUSTRIAL BIOPROCESS	**(9 Periods)**
Fermentation - Bacterial, Fungal and Yeast, Biochemistry of fermentation. Traditional and Modern Biotechnology - A brief survey of organisms, processes, products. Basic concepts of Upstream and Downstream processing in Bioprocess.	
UNIT II : FERMENTATION INDUSTRY	**(9 Periods)**
Overview of fermentation industry, Basic configuration of Fermentor and ancillaries, main parameters to be monitored and controlled in fermentation processes. Types of fermentation – Solid state, submerged, batch, continuous, fed batch fermentation methods.	
UNIT III : PRODUCTION OF PRIMARY METABOLITES	**(9 Periods)**
A brief outline of processes for the production of some commercially important organic acids - Citric acid, lactic acid ,acetic acid; amino acids - glutamic acid, phenylalanine; ethanol.	
UNIT IV: PRODUCTION OF SECONDARY METABOLITES	**(9 Periods)**
Study of production processes for various classes of secondary metabolites: Antibiotics: beta lactams – penicillin and cephalosporin; aminoglycosides – streptomycin; macrolides - erythromycin, vitamin - B9, B12.	
UNIT V: PRODUCTS THROUGH MODERN BIOTECHNIQUES	**(9 Periods)**
Production of industrial enzymes - proteases, amylases, lipases; Production of single cell protein from wastes; biopreservatives – Bacterosin; biopolymers - xanthan gum and PHA. Industrial uses of enzymes in detergents, beverage and food.	

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

TEXT BOOKS

1. *Peter F. Stanbur., Stephen J. Hall., A. Whitake., **"Principles of Fermentation Technology"**, Science & Technology Books. 2007.*
2. *Presscott, S.C., Cecil G., Dun, **"Industrial Microbiology"**, Agrobios (India), 2005.*
3. *Casida, L.E., **"Industrial Microbiology"**, New Age International (P) Ltd, 1968.*

REFERENCE BOOK

1. *Crueger, W., Anneliese Cruege.,**"Biotechnology: A Textbook of Industrial Microbiology"**, Panima Publishing Corporation, Edition 2, 2003.*
2. *Sathyanarayana, U., **"Biotechnology"**, Books and Allied (P) Ltd. Kolkata, 2005.*
3. *Ratledge C., Kristiansen B., **"Basic Biotechnology"**, Cambridge University Press, second Edition, 2001.*
4. *Michael J. Waites., **"Industrial Microbiology: An Introduction"**, Blackwell Publishing,2001.*

COURSE OUTCOMES:

Upon completion of the course in Bioprocess Principles graduates will be able to

CO1: Understand the basics of industrial bioprocess.

CO2: Explain the principle of a fermentation process and the chronological development of fermentation industry.

CO3: Understand the basic configuration of a fermentor and its ancillaries.

CO4: Learn the production of various primary and secondary metabolites.

CO5: Understand the production of biotechnological products.

COURSE ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	H	H	-	-	-	-	-	-	-	-	-	M	-
CO2	H	M	-	-	-	-	-	-	-	-	-	-	-	-
CO3	H	H	H	M	M	M	-	L	H	-	-	-	-	H
CO4	H	L	L	-	-	L	-	L	-	-	-	-	-	H
CO5	H	M	H	L	M	-	-	L	-	-	-	-	-	H
18BOE $27	H	M	H	M	M	M	-	L	H	-	-	-	M	H

L- Low , M-Moderate(Medium), H- High

18PVA$01	HUMAN VALUES I

PRE-REQUISITES: NIL **Category: VA**

L	T	P	C
1	0	0	1

COURSE OBJECTIVES:

- Essential complementarily between 'values' and 'skills' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
- The development of a Holistic perspective among students towards life, profession and happiness based on a correct understanding of the Human reality and the rest of existence, which forms the basis of Value based living in a natural way.
- The plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually satisfying human behaviour and mutually enriching interaction with nature.

UNIT- I	INTRODUCTION TO VALUE EDUCATION	(5 Periods)
Introduction- Need, Basic Guidance, Content and Process for Value Education- Basic human Aspirations – Prosperity and happiness – Methods to fullfill human aspirations - Understanding and living in harmony at various levels.		
UNIT- II	**HARMONY IN THE HUMAN BEING**	**(5 Periods)**
Coexistence – Happiness and convenience – Appraisal of Physical needs – Mental and Physical health – Human relationship – Mutual Trust and Respect.		
UNIT- III	**ETHICS**	**(5 Periods)**
Morals, Values and Ethics - Integrity - Work Ethics - Service Learning - Civic Virtue – Caring – Sharing - honesty- Courage – Empathy – Self Confidence -Ethical Human Conduct- Basis for humanistic Education, Constitution and universal order – Competence in professional ethics – Strategy for transition from the present state to Universal human order.		

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

TEXT BOOKS:

1. *R.R. Gaur, R. Singal, G.P. Bangaria* ***"Foundation Course in Human Values and Professional Ethics", 2009",*** *Excel Book Private Ltd., New Delhi.*

REFERENCE BOOKS:

1. *S. K. Chakraborty and Dabangshu Chakraborty* ***"Human Values and Ethics: Achieving Holistic Excellence",*** *ICFAI University Press, 2006.*
2. *A.N. Tripathy* ***"Human Values",*** *New Age International publishers, 2003.*
3. *M. Govindarajan, S. Natarajan and V.S. Senthil kumar* ***"Engineering Ethics(including human values)",*** *Eastern Economy Edition, Printice Hall of India Ltd., 2004.*
4. *E.G. Seebauer and Rober. L. Berry* ***"Fundamentals of Ethics for Scientists and Engineers",*** *Oxford University Press, 2000.*

COURSE OUTCOMES:

Upon completion of this course the students will be able to

CO1: Start exploring themselves, get comfortable to each other and to the teacher and start finding the need and relevance for the course.

CO2: See that their practice in living is not in harmony with their natural acceptance most of the time and able to refer to their natural acceptance to remove this disharmony.

CO3: Aware of their activities like understanding, desire,thought and selection and start finding their focus of attention at different moments.

CO4: Able to see that respect is right evaluation and only right evaluation leads to fulfillment in relationship.

CO5: Develop an understanding of the whole existence and interconnectedness in nature.

COURSE ARTICULATION MATRIX

PO/PSO CO	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			M			H	H	H	L				L	L	L
CO2			M			H	H	H	L				L	L	L
CO3			M			H	H	H	L				L	L	L
CO4			M			H	H	H	L				L	L	L
CO5			M			H	H	H	L				L	L	L
18PVA$01			M			H	H	H	L				L	L	L

L- Low, M – Moderate (Medium), H – High

18PVA$02	HUMAN VALUES AND PROFESSIONAL ETHICS

PRE-REQUISITES: NIL **Category: VA**

L	T	P	C
1	0	0	1

COURSE OBJECTIVES:

- Engineering Ethics and Human Values
- Social responsibility of an Engineer
- Ethical dilemma while discharging duties in Professional life.

UNIT- I	ENGINEERING ETHICS	(5 Periods)
Senses of Engineering Ethics -variety of moral issues – types of inquiry – moral dilemmas – moral autonomy – Kohlberg's Theory – Gilligen's Theory – Consensus and contraversy – Models of Professional roles – theories about right actions – Self interest – customs and religion – uses of ethical theories – Valuing time-cooperation-commitment.		
UNIT- II	**ENGINEERING AS SOCIAL EXPERIMENTATION**	**(5 Periods)**
Engineering as experimentation – engineers as responsible experimenters – codes of ethics – a balanced outlook on law – the challenger case study - engineers as managers – consulting engineers - Moral leadership		
UNIT- III	**SAFTY, RESPONSIBLITIES, RIGHTS AND GLOBAL ISSUES**	**(5 Periods)**
Safty and risk – assessment of safty and risk – risk benefit analysisand reducing risk – the three mile island and chernobyl case studies.– Environmental ethics – computer ethics – weapons development- Multinational corporations - engineers as expert witnesses and advisors.		

Contact Periods:

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

TEXT BOOKS:

1. *Mike Martin and Roland Schinzinger **"Ethics in Engineering",** McGraw Hill, New York,1996.*
2. *M. Govindarajan,S. Natarajan and V.S. Senthil kumar **"Engineering Ethics (including human values)",** Eastern Economy Edition, Printice Hall of India Ltd., 2004.*

REFERENCE BOOKS:

1. *Charles D.Fleddermann **"Engineering Ethics",** Pearson Education, 2004.*
2. *Edmund G Seebauer and Robert L. Berry **"Fundamentals of Ethics for Scientists and Engineers, 2001",** Oxford University Press*
3. *Charles E. Harris, Michael S. Protchard and Michael J. Rabins **"Engineering Ethics – Concepts and Cases",** Thomson Learning, 2000.*
4. *John R. Boatright **"Ethics and Conduct of Business",** Pearson Education,2003.*

COURSE OUTCOMES:

Upon completion of this course the students will be able to

CO1: Understand and appreciate Human values, exhibit self confidence and develop good character

CO2: Sense engineering ethics, professional roles and valuing time, co-operation and commitment

CO3: Uunderstand and practise code of ethics.

CO4: Assess safty and risk and capabile of doing risk benefit analysis.

CO5: Develop and exhibit moral leadership qualities in exercising Engineering Consultations without compromising envionmental, legal and ethical issues

COURSE ARTICULATION MATRIX

PO/PSO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PSO	PSO	PSO
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1			M			H	H	H	L				L	L	L
CO2			M			H	H	H	L				L	L	L
CO3			M			H	H	H	L				L	L	L
CO4			M			H	H	H	L				L	L	L
CO5			M			H	H	H	L				L	L	L
18PVA$02			M			H	H	H	L				L	L	L

L- Low, M – Moderate (Medium), H. – High

18PVA$03	YOGA FOR YOUTH EMPOWERMENT *(Common to CIVIL, MECH, EEE & PRODN Branches)*

PRE-REQUISITES: NIL **Category: VA**

L	T	P	C
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	(5 Periods)
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, maharasana, body massage, acupressure, body relaxation		
UNIT- II	**YOGASANAS**	**(5 Periods)**
Rules & Regulations – asana, pranayama, mudra, bandha		
UNIT- III	**MIND**	**(5 Periods)**
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 BOOKS:

1. *VethathiriMaharashi **"Yoga for Modern Age"***
2. *VethathiriMaharashi **"Mind"***

COURSE OUTCOMES:

On completion of the course, student will be able to

CO1: YOGA which gives healthy & better living, Physical, Mental mood, Intellectual & spiritual.

CO2: Work skillfully and perfectly towards the excellence.

CO3: Achieve meditation practices, which strengthen the mind and increases the will power

CO4: Concentration, creativity and ultimately to transform the mind to achieve self-realization

COURSE ARTICULATION MATRIX

PO/PSO CO	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						H							L		
CO2									M					L	
CO3							L				L		L		L
CO4							L		M						
18PVA$03						L	L		M		L		L	L	L

L- Low, M – Moderate (Medium), H - High

18PVA$04	**BASICS OF CIVIL ENGINEERING** *(Common to MECH & PROD Branches)*

PRE-REQUISITES: NIL **Category: VA**

L	T	P	C
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 BOOKS:

1. *Punmia B.C **"Basic Civil Engineering",** Lakshmi Publications, 2003*
2. *Bhavikatti S. S **"Basic Civil Engineering",** New Age International Publishers, 2010*

REFERENCE BOOKS:

1. *Rangwala S.C **"Engineering Materials",** Charotar Publishing House, 2014*
2. *Punmia B.C **"Building Construction",** Lakshmi Publications, 2008.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Know the qualities and properties for building materials used in the field

CO2: Apply the knowledge of construction practices in real life situation in the societal context.

COURSE ARTICULATION MATRIX

PO/PSO CO	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	H	L		L						L					
CO2						L		L	M	M	H	L	L		L
18PVA$04	H	L		L		L		L	M	M	H	L	L		L

L- Low, M – Moderate (Medium), H – High

18PVA$05	**METALLOGRAPHY** *(Common to MECH & PROD Branches)*

Category: VA

L T P C
1 0 0 1

PRE-REQUISITES:

1. 18PPC305 – Engineering metallurgy

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: 15 Periods Tutorial:0 Periods Practical:0 Periods Total: 15 Periods

REFERENCE BOOKS:

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.*
3. *R.C. Gifkins, **"Optical Microscopy of Metals",** American Elsevier Pub. Co., 1970*
4. *S.Telansky, **"Multiple beam interference Microscopy of Metals",** Academic Press, New York, 1970.*
5. *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:

At the end of the course students will be able to

CO1: Apply the specimen preparation methods in metallographic inspection.
CO2: Identify the phase changes of microstructures and defects in metals and metallic alloys.
CO3: Analyze the microstructures and defects in metals and metallic alloys.

COURSE ARTICULATION MATRIX

PO/PSO CO	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	M												L		
CO2	H	H			H	M				M			H	M	
CO3	H	H			H	M				M			H	M	
18PVA$05	H	H			H	L				L			M	L	

L- Low, M – Moderate (Medium), H – High

18PVA$06	DESIGN OF EXPERIMENTS USING TAGUCHI CONCEPT

Category: VA

L	T	P	C
1	0	0	1

PRE-REQUISITES:

1. 18PBS302 - Partial Differential Equations, Probability and Statistics
2. 18PPC504- Metrology and Computer Aided Inspection

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 BOOKS:

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.*
3. *Montgomery D.C **"Design and Analysis of Experiments",** 5th Edition, John Wiley and Sons, NewYork., 2001*

REFERENCE BOOKS:

1. *Sung H Park,* ***"Robust Design and Analysis for Quality Engineering",*** *Chapman and Hall, London, 1996.*
2. *Giani Taguchi, Elssayed A. Elsayed, Thomas C.* ***"Quality Engineering in Production Systems",*** *Mc Graw Hill Book Company, 1989.*
3. *Genichi Taguchi, Subir Chowdhury and Shin Taguchi* ***"Robust Engineering",*** *McGraw Hill, New York, 2000.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Understand the quality concepts in engineering.

CO2: Describe the influences of design process related with quality.

CO3: Explain the concept of orthogonal array and its interaction effects.

CO4: Explain about signal to noise ratio and quality loss function.

CO5: Conduct experiments on randomized block and completely randomized block for optimization

COURSE ARTICULATION MATRIX

PO/PSO CO	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	H	M	M	M	L								L	M	M
CO2	M	M	M	M	L								L	M	M
CO3	M	M	M	M	L								L	M	M
CO4	M	M	M	M	L								L	M	M
CO5	M	M	M	M	L								L	M	M
18PVA $06	M	M	M	M	L								L	M	M

L- Low, M – Moderate (Medium), H – High

18PVA$07	ENTREPRENEURSHIP DEVELOPMENT

PRE-REQUISITES: NIL **Category: VA**

L	T	P	C
1	0	0	1

COURSE OBJECTIVES:

- To familiarise the students in entrepreneurship concepts and processes.

UNIT- I	CONCEPT OF ENTREPRENEURSHIP	(5 Periods)
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**	**(5 Periods)**
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**	**(5 Periods)**
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 BOOKS:

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.*

REFERENCE BOOKS:

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:

On completion of this course, students will be able to

CO1: Describe the basic concept of entrepreneurship.

CO2: Describe the financial concepts and marketing.

CO3: Describe the assistance to entrepreneur.

COURSE ARTICULATION MATRIX

PO/PSO / CO	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	M					M		M	L		L	M			L
CO2	M		M						M	H	H				
CO3	M	M	L			L		M	M	M		M			
18PVA$07	M	M	L			L		M	M	M	M	M			L

L- Low, M – Moderate (Medium), H - High

18PVA$08	PATENTS SYSTEMS IN ENGINEERING

PRE-REQUISITES: NIL **Category: VA**

L	T	P	C
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 BOOKS

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

On completion of this course, students will be able to

CO1: Describe the basic concept of Intellectual Property Rights.
CO2: Describe the IPR filing procedure in india.
CO3: Describe the patent enforcement and international patent systems.

COURSE ARTICULATION MATRIX

PO/PSO / CO	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	M					M		M	L		L	M			L
CO2	M		M						M	H	H				
CO3	M	M	L			L		M	M	M		M			
18PVA$08	M	M	L			L		M	M	M	M	M			L

L- Low, M – Moderate (Medium), H – High

18PVA$09	INDUSTRIAL CASE STUDIES

PRE-REQUISITES: NIL **Category: VA**

L	T	P	C
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: 30 Periods

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Understand the different forms of organization, functions of management, organizational behaviour, group dynamics and modern concepts in industrial management.

COURSE ARTICULATION MATRIX

PO/PSO / CO	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	M	M	H	L	M	L		L	M	L	M	L	M	M	M
18PVA$09	M	M	H	L	M	L		L	M	L	M	L	M	M	M

L- Low, M – Moderate (Medium), H – High

18PVA$10	**PROJECT MANAGEMENT** *(Common to MECH & PROD Branches)*

PRE-REQUISITES: NIL **Category: VA**

L	T	P	C
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

REFERENCE BOOKS:

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 Wiley & Sons, 2015.*

COURSE OUTCOMES

On completion of this course, students will be able to

CO1: Apply the concepts of project management in engineering.

CO2: Identify and plan new projects.

CO3: Implement and execute new projects.

COURSE ARTICULATION MATRIX

CO/PO	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
CO 1	L				L	L		L	H	M	L	H	L	L	L
CO 2	L				L	L		L	H	M	L	H	L	L	L
CO 3	L				L	L		L	H	M	L	H	L	L	L
18PVA$10	L				L	L		L	H	M	L	H	L	L	L

L-Low, M-Moderate(Medium), H-High

18PVA$11	INDUSTRIAL SAFETY

PRE-REQUISITES: NIL **Category: VA**

L	T	P	C
1	0	0	1

COURSE OBJECTIVES:

* To introduce the safety awareness among the students.

UNIT- I	INTRODUCTION	(5 Periods)
The importance of safety and health for engineers – Safety and Health professions – Fundamental concepts and terms.		
UNIT- II	**HAZARDS AND CONTROL**	**(5 Periods)**
General principles – Structural failures, Slipping, Electrical hazards, Tools, transportation – Modes, causes and Prevention.		
UNIT- III	**SAFETY MANAGEMENT**	**(5 Periods)**
Fundamentals – Risk management and Assessment – safety plans and programs.		

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

TEXT BOOKS:

1. *Roger.L. Brauer **"Safety And Health For Engineers",** Wiley Interscience, 2006*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: explain about the importance of safety.
CO2: describe the types of hazards and their prevention methods
CO3: explain about the guidelines for safety management

COURSE ARTICULATION MATRIX

PO/PSO / CO	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						H	H	H	M		L		L	L	L
CO2						H	H	H	M		L		L	L	L
CO3						H	H	H	M		L		L	L	L
18PVA$11						H	H	H	M		L		L	L	L

L- Low, M – Moderate (Medium), H – High

18PVA$12	**SIX SIGMA** *(Common to MECH & PRODN Branches)*

PRE-REQUISITES: NIL **Category: VA**

L	T	P	C
1	0	0	1

COURSE OBJECTIVES:

* To impart knowledge on six sigma tools on projects and successful completion of projects that drive meaningful business results.

UNIT - I	**SIX SIGMA QUALITY AND STANDARDS**	**(5 Periods)**
Meaning and use of the Six Sigma approach- the underlying concept of variation- the relationships to related Quality Management approaches – Basic six sigma tools – Nature of six sigma improvements projects.		
UNIT – II	**DEFINING THE PROJECT MISSION**	**(5 Periods)**
Focus on creativity and creativity tools used in coming up with creative formulations and solutions in Six Sigma improvement projects.-Review and management of Six Sigma projects		
UNIT – III	**INTRODUCTION TO STATISTICS AND EXCEL**	**(5 Periods)**
Statistical techniques for summarizing data and extensive use of Microsoft Excel-Statistical Process control.		

Contact Periods:

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

TEXT BOOKS:

1. *Joseph A De Feo, William W BearnardJuran Institute **"Six Sigma Break Through and Beyond",**M Tata McGraw Hill, New Delhi, 2004*
2. *Richard B Chase F Robert Jacobs and Nicholas J Aquilano **"Operations Management for Competitive Advantage",** McGraw Hill Inc., New York, Tenth Edition, 2003*
3. *Poka – Yoke **"Improving Product Quality by Preventing Defects",** Productivity Press, Portland, Oregon, 1993*

REFERENCE BOOKS:

1. *George Eckes **"Six Sigma for Everyone",** John Wiley & Sons", 2003*
2. *J M Juran ,F.M.Gyna & R.S.Bingham **"Quality control Hand book",** McGraw Hill book co,1979*
3. *Rath, Strong Staff **"Six Sigma Leadership Handbook",** John Wiley & sons" 2003.*
4. *Mikel J Harry **"Six Sigma: The Break through Management Strategy Revolutionizing the World's top Corporations",** 2003.*
5. *Robert O Slater **"Management Insights and Leadership Secrets of the Legendary CEO",** 1998*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Describe the six sigma approach and basic six sigma tools.

CO2: Use the creativity tools.

CO3: Employ the statistical techniques for summarizing datas.

COURSE ARTICULATION MATRIX

PO/PSO CO	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	H	H	M	H	M	L			L	M	M	L	M	M	M
CO2	H	M	M	H	M	L			L	M	M	M	M	M	M
CO3	H	H	M	H	M	L			L	M	M	L	M	M	M
18PVA$12	H	H	M	H	M	L			L	M	M	L	M	M	M

L- Low, M – Moderate (Medium), H - High

18PVA$13	**PROFESSIONAL SKILLS** *(Common to MECH & PROD Branches)*

PRE-REQUISITES: NIL **Category: VA**

L	T	P	C
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	**(5 Periods)**
SWOT Analysis, Who am I, Attributes, Importance of Self Confidence, Self Esteem. Out of box thinking, Lateral Thinking.	
UNIT – II: LEADERSHIP	**(5 Periods)**
Skills for a good Leader, Assessment of Leadership Skills, Conflicts in Human Relations – Reasons Case Studies, Approaches to conflict resolution	
UNIT – III: DECISION MAKING	**(5 Periods)**
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

REFERENCE BOOKS:

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, 2006*
5. *Soft Skills, 2015,* ***"Career Development Centre"****, Green Pearl Publications.*

COURSE OUTCOMES

On completion of this course the student will be able to

- **CO 1:** Do self analysis and pocess a positive approach.
- **CO 2:** Develop leadership qualities to solve conflicts and maintain good relationship with personals.
- **CO 3:** Make decision for effective project implementation.

COURSE ARTICULATION MATRIX

CO/PO	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
CO 1						L		H	M		L	M	L		H
CO 2								H	M			M	L		H
CO 3				L		L		M	M			M	L		M
18PVA$13				L		L		H	M		L	M	L		H

L-Low, M-Moderate(Medium), H-High

18PVA$14	SOLAR ENERGY SYSTEMS

PRE-REQUISITES: NIL **Category: VA**

L	T	P	C
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 STORAGE DEVICES	(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 BOOKS:

*1. S.P. Sukhatme., **"Solar Energy: Principles of Thermal Collection and Storage",** Tata McGraw Hill Publishing Company Ltd., New Delhi, 2006.*

REFERENCE BOOKS:

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.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Describe the characteristics of Solar thermal and Solar Photovoltaic Systems.
CO2: Explain various solar thermal and Photo voltaic applications.

COURSE ARTICULATION MATRIX

PO/PSO CO	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	L	L					H					M	M		
CO2	L	L					H					M	M		
18PVA$14	L	L					H					M	M		

L- Low, M – Moderate (Medium), H – High

18PVA$15	WIND ENERGY SYSTEMS

PRE-REQUISITES: NIL **Category: VA**

L	T	P	C
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 BOOKS:

*1. G.D. Rai., **"Non Conventional Energy Sources",** Khanna Publishers, New Delhi, 1999.*

REFERENCE BOOKS:

1. *Godfrey Boyle, **"Renewable Energy, Power for a Sustainable Future".,** Oxford University Press, U.K., 1996*
2. *L.L. Freris., **Wind Energy Conversion systems",** Prentice Hall, UK, 1990*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Describe the various types of Wind Energy Conversion System (WECS) and its components.

CO2: Select suitable site for erecting Wind Energy Conversion System considering environmental aspects.

CO3: Explain various applications of wind energy conversion system.

COURSE ARTICULATION MATRIX

PO/PSO CO	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	M												M		
CO2	L	H	M	M		M	H								H
CO3	M						M								M
18PVA$15	M	H	M	M		M	M						M		M

L- Low, M – Moderate (Medium), H – High

18PVA$16	REFRIGERATION SYSTEMS

PRE-REQUISITES: NIL **Category: VA**

L	T	P	C
1	0	0	1

COURSE OBJECTIVES:

- To develop adequate knowledge about refrigeration systems.

UNIT- I	REFRIGERATION CYCLES AND REFRIGERANTS	(8 Periods)
Air refrigeration cycles – reversed Carnot cycle, Bell Coleman cycle, simple vapour compression refrigeration cycle, compound compression refrigeration cycles, and cascade refrigeration cycles.		
UNIT- II	**VAPOUR ABSORPTION AND OTHER SYSTEMS**	**(7 Periods)**
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 BOOKS:

*1. Arora C.P., **"Refrigeration and Air Conditioning",** Tata McGraw Hill Publishing Company Limited, 3rd Edition, NewDelhi, 2009*

REFERENCE BOOKS:

*1. Roy J Dossat., **"Principle of Refrigeration",** Wiley Eastern Limited, Fifth Edition 2001.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Describe various refrigeration cycles.

CO2: Explain various refrigeration systems operated using heat energy.

COURSE ARTICULATION MATRIX

PO/PSO / CO	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	M		L									L	M		
CO2	L		L										M		
18PVA$16	M		L									L	M		

L- Low, M – Moderate (Medium), H - High

18PVA$17	AIR CONDITIONING SYSTEMS

PRE-REQUISITES: NIL **Category: VA**

L	T	P	C
1	0	0	1

COURSE OBJECTIVES:

- To develop adequate knowledge about air conditioning systems.

UNIT- I	AIR DISTRIBUTION SYSTEMS	(7 Periods)
Air distribution systems – study of different types of duct systems, duct insulation, air purity – air cleaning methods.		
UNIT- II	**CONDITIONING AND COOLING LOAD**	**(8 Periods)**
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 BOOKS:

1. *Arora C.P., **"Refrigeration and Air Conditioning",** Tata McGraw Hill Publishing Company Limited, 3rd Edition, NewDelhi, 2009*

REFERENCE BOOKS:

1. *Manohar Prasad., **"Refrigeration and Air Conditioning",** Wiley Eastern Limited, 2004*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Explain the air distribution systems and components.

CO2: Estimate cooling load for air conditioning

COURSE ARTICULATION MATRIX

PO/PSO CO	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	M											L	M		
CO2	L		L			L									
18PVA$17	M		L			L						L	M		

L- Low, M – Moderate (Medium), H – High