GOVERNMENT COLLEGE OF TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University)

Coimbatore - 641 013

Curriculum and Syllabi For

MECHANICAL ENGINEERING

(Full Time)

2018

CBCS

Regulations

OFFICE OF CONTROLLER OF EXAMINATIONS
GOVERNMENT COLLEGE OF TECHNOLOGY
THADAGAM ROAD, COIMBATORE - 641 013
PHONE 0422 - 2433355 FAX: +91 0422 - 2433355
email: coegct@gmail.com

GOVERNMENT COLLEGE OF TECHNOLOGY,
COIMBATORE-641 013.
TAMILNADU.

VISION AND MISSION OF THE INSTITUTION

VISION

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

MISSION

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

DEPARTMENT OF MECHANICAL ENGINEERING
GOVERNMENT COLLEGE OF TECHNOLOGY
COIMBATORE-641 013.
TAMILNADU.

VISION AND MISSION OF THE DEPARTMENT

VISION

Towards a Global Knowledge Hub, striving continuously in pursuit of excellence in Mechanical Engineering Education, Entrepreneurship and Innovation.

MISSION

- To impart total quality education through effective hi-tech teaching-learning techniques and department-industries collaboration.
- To mold the young dynamic potential minds to emerge as full-fledged future professionals so as to achieve top ten ranking status in the national level.
- To achieve international standards to fulfill the Government's "Make In India" industrial policy through innovation and research.

DEPARTMENT OF MECHANICAL ENGINEERING
GOVERNMENT COLLEGE OF TECHNOLOGY
COIMBATORE – 641 013.
TAMILNADU.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

The following Programme Educational Objectives are designed based on the department mission

The PEO's are to facilitate graduating students to

PEO 1: Acquire basic knowledge and expertise necessary for professional practice in mechanical engineering for higher studies and research

PEO 2: Attain and practice technical skills to identify, analyze and solve complex problems and issues related to mechanical engineering

PEO 3: Possess a professional attitude as an individual or a team member with consideration for society, professional ethics, environmental factors and motivation for life-long learning

DEPARTMENT OF MECHANICAL ENGINEERING
GOVERNMENT COLLEGE OF TECHNOLOGY
COIMBATORE-641 013
TAMILNADU.

PROGRAMME OUTCOMES (POs)

Students pursuing in the Mechanical Engineering (Department) Programme should at the time of their graduation be in possession of the following

PO 1:	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PO 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.
PO 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
PO 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.
PO 5:	**Modern tool usage:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO 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.
PO 7:	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts and demonstrate the knowledge and need for the sustainable development
PO 8:	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9:	**Individual and team work:** Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary settings
PO 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 and make effective presentations and give and receive clear instructions.
PO 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, manage projects and in multidisciplinary environments.
PO 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.

DEPARTMENT OF MECHANICAL ENGINEERING
GOVERNMENT COLLEGE OF TECHNOLOGY
COIMBATORE – 641 013.
TAMILNADU.

PROGRAMME SPECIFIC OUTCOMES (PSO'S)

Graduates of Mechanical Engineering should be able:

PSO 1: To develop the capability for synthesizing data and technical concepts so as to emerge as a successful engineer /administrator in industry to meet the needs of society and the country.

PSO 2: To exhibit a sound foundation in mathematical, scientific and engineering areas necessary for achieving excellence in solving and analysing engineering problems to face new challenges for multi-disciplinary projects in higher /graduate studies.

PSO 3: To fulfill the ambition of life-long learning and apply professional ethics and codes of professional practices during their career.

GOVERNMENT COLLEGE OF TECHNOLOGY, COIMBATORE – 641 013

B.E.MECHANICAL ENGINEERING

CBCS 2018 REGULATIONS

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.

GOVERNMENT COLLEGE OF TECHNOLOGY, COIMBATORE – 641 013

B.E.MECHANICAL ENGINEERING

CBCS 2018 REGULATIONS

FIRST SEMESTER

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
		THEORY								
1	18MBS101	Engineering Chemistry	BS	50	50	100	3	1	0	4
2	18MBS102	Calculus and Linear Algebra	BS	50	50	100	3	1	0	4
3	18MES103	Basics of Electrical Engineering	ES	50	50	100	3	0	0	3
		PRACTICAL								
4	18MBS104	Chemistry Laboratory	BS	50	50	100	0	0	3	1.5
5	18MES105	Basics of Electrical Engineering Laboratory	ES	50	50	100	0	0	3	1.5
6	18MES106	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	18MHS201	Communicative English	HS	50	50	100	2	1	0	3
2	18MBS202	Differential Equations and Complex Variables	BS	50	50	100	3	1	0	4
3	18MBS203	Introduction to Electromagnetism and Applied Physics	BS	50	50	100	3	1	0	4
4	18MES204	Python Programming	ES	50	50	100	3	0	0	3
		PRACTICAL								
5	18MBS205	Physics Laboratory	BS	50	50	100	0	0	3	1.5
6	18MES206	Workshop Practice	ES	50	50	100	1	0	4	3
7	18MES207	Python Programming Laboratory	ES	50	50	100	0	0	3	1.5
		TOTAL		**350**	**350**	**700**	**12**	**3**	**10**	**20**

GOVERNMENT COLLEGE OF TECHNOLOGY, COIMBATORE – 641 013
B.E.MECHANICAL ENGINEERING
CBCS 2018 REGULATIONS

THIRD SEMESTER

Sl. No	Course Code	Course Title	CAT	CA Marks	End sem Marks	Total Marks	Hours/Week			
							L	T	P	C
		THEORY								
1	18MHS301	Business Communication skills	HS	50	50	100	3	0	0	3
2	18MBS302	Partial differential equations, probability and statistics	BS	50	50	100	3	1	0	4
3	18MES303	ENGINEERING MECHANICS	ES	50	50	100	3	1	0	4
4	18MPC304	Mechanics of Materials	PC	50	50	100	3	0	0	3
5	18MPC305	Fluid Mechanics and Machinery	PC	50	50	100	3	0	0	3
6	18MPC306	Manufacturing Technology I	PC	50	50	100	3	0	0	3
7	18MMC3Z7	Constitution of India	MC	50	50	100	3	0	0	0
		PRACTICAL								
8	18MPC308	Machine Drawing	PC	50	50	100	0	0	4	2
9	18MPC309	Strength of Materials Laboratory	PC	50	50	100	0	0	3	1.5
		TOTAL		**450**	**450**	**900**	**21**	**2**	**7**	**23.5**

FOURTH SEMESTER

Sl. No	Course Code	Course Title	CAT	CA Marks	End sem Marks	Total Marks	Hours/Week			
							L	T	P	C
		THEORY								
1	18MHS401	Professional Ethics	HS	50	50	100	3	0	0	3
2	18MBS402	Waves and Optics	BS	50	50	100	3	0	0	3
3	18MES403	Basic Electronics Engineering	ES	50	50	100	3	0	0	3
4	18MPC404	Kinematics of Machines	PC	50	50	100	3	0	0	3
5	18MPC405	Thermodynamics	PC	50	50	100	3	0	0	3
6	18MPC406	Manufacturing Technology II	PC	50	50	100	3	0	0	3
7	18MMC4Z7	Environmental Sciences and Engineering	MC	50	50	100	3	0	0	0
		PRACTICAL								
8	18MPC408	CAD Laboratory	PC	50	50	100	0	0	4	2
9	18MPC409	Manufacturing Process Laboratory	PC	50	50	100	0	0	3	1.5
		TOTAL		**450**	**450**	**900**	**21**	**0**	**7**	**21.5**

GOVERNMENT COLLEGE OF TECHNOLOGY, COIMBATORE – 641 013
B.E.MECHANICAL ENGINEERING
CBCS 2018 REGULATIONS

FIFTH SEMESTER

Sl. No	Course Code	Course Title	CAT	CA Marks	End sem Marks	Total Marks	Hours/Week			
							L	T	P	C
		THEORY								
1	18MHS501	Principles of Management	HS	50	50	100	3	0	0	3
2	18MES502	Biology for Mechanical Engineers	ES	50	50	100	3	0	0	3
3	18MPC503	Dynamics of Machines	PC	50	50	100	3	0	0	3
4	18MPC504	Thermal Engineering	PC	50	50	100	3	0	0	3
5	18MPE5XX	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	18MPC507	Thermal Engineering Laboratory I	PC	50	50	100	0	0	3	1.5
8	18MEE508	Skill Development Practices	EEC	50	50	100	0	0	3	1.5
		TOTAL		**400**	**400**	**800**	**18**	**0**	**6**	**21**

SIXTH SEMESTER

Sl. No	Course Code	Course Title	CAT	CA Marks	End sem Marks	Total Marks	Hours/Week			
							L	T	P	C
		THEORY								
1	18MPC601	Design of Machine Elements	PC	50	50	100	3	0	0	3
2	18MPC602	Materials Engineering	PC	50	50	100	3	0	0	3
3	18MPC603	Heat and Mass Transfer	PC	50	50	100	3	0	0	3
4	18MPE6XX	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	18MPC607	Thermal Engineering Laboratory II	PC	50	50	100	0	0	3	1.5
8	18MEE608	Skill development on Technical and Industrial practices	EEC	50	50	100	0	0	4	2
		TOTAL		**400**	**400**	**800**	**18**	**0**	**7**	**21.5**

GOVERNMENT COLLEGE OF TECHNOLOGY, COIMBATORE – 641 013
B.E.MECHANICAL ENGINEERING
CBCS 2018 REGULATIONS

SEVENTH SEMESTER

Sl. No	Course Code	Course Title	CAT	CA Marks	End sem Marks	Total Marks	Hours/Week			
							L	T	P	C
		THEORY								
1	18MPC701	Design of Transmission Systems	PC	50	50	100	3	0	0	3
2	18MPC702	Computer Aided Design	PC	50	50	100	3	0	0	3
3	18MPC703	Finite Element Analysis	PC	50	50	100	3	0	0	3
4	18MPE7XX	Professional Elective III	PE	50	50	100	3	0	0	3
5	18MPE7XX	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	18MPC707	Simulation Laboratory	PC	50	50	100	0	0	3	1.5
8	18MEE708	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	18MPE8XX	Professional Elective V	PE	50	50	100	3	0	0	3
2	18MPE8XX	Professional Elective VI	PE	50	50	100	3	0	0	3
		PRACTICAL								
3	18MEE803	Project Work	EEC	50	50	100	0	0	16	8
		TOTAL		**150**	**150**	**300**	**6**	**0**	**16**	**14**

CATEGORY-WISE CREDIT DISTRIBUTION

HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT (HS)

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem Mark	Total Marks	Hours/Week			
							L	T	P	C
1	18MHS201	Communicative English	HS	50	50	100	2	1	0	3
2	18MHS301	Business Communication skills	HS	50	50	100	3	0	0	3
3	18MHS401	Professional Ethics	HS	50	50	100	3	0	0	3
4	18MHS501	Principles of Management	HS	50	50	100	3	0	0	3

BASIC SCIENCES (BS)

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	18MBS101	Engineering Chemistry	BS	50	50	100	3	1	0	4
2	18MBS102	Calculus and Linear Algebra	BS	50	50	100	3	1	0	4
3	18MBS104	Chemistry Laboratory	BS	50	50	100	0	0	3	1.5
4	18MBS202	Differential Equations and Complex Variables	BS	50	50	100	3	1	0	4
5	18MBS203	Introduction to Electromagnetism and Applied Physics	BS	50	50	100	3	1	0	4
6	18MBS205	Physics Laboratory	BS	50	50	100	0	0	3	1.5
7	18MBS302	Partial differential equations, probability and statistics	BS	50	50	100	3	1	0	4
8	18MBS402	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	18MES103	Basics of Electrical Engineering	ES	50	50	100	3	0	0	3
2	18MES105	Basics of Electrical Engineering Laboratory	ES	50	50	100	0	0	3	1.5
3	18MES106	Engineering Graphics	ES	50	50	100	2	0	4	4
4	18MES204	Python Programming	ES	50	50	100	3	0	0	3
5	18MES206	Workshop Practice	ES	50	50	100	1	0	4	3
6	18MES207	Python Programming Laboratory	ES	50	50	100	0	0	3	1.5
7	18MES303	Engineering Mechanics	ES	50	50	100	3	1	0	4
8	18MES403	Basic Electronics Engineering	ES	50	50	100	3	0	0	3
9	18MES502	Biology for Mechanical Engineers	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.	18MPC304	Mechanics of Materials	PC	50	50	100	3	0	0	3
2.	18MPC305	Fluid Mechanics and Machinery	PC	50	50	100	3	0	0	3
3.	18MPC306	Manufacturing Technology I	PC	50	50	100	3	0	0	3
4.	18MPC308	Machine Drawing	PC	50	50	100	0	0	4	2
5.	18MPC309	Strength of Materials Laboratory	PC	50	50	100	0	0	3	1.5
6	18MPC404	Kinematics of Machines	PC	50	50	100	3	0	0	3
7	18MPC405	Thermodynamics	PC	50	50	100	3	0	0	3
8	18MPC406	Manufacturing Technology II	PC	50	50	100	3	0	0	3
9	18MPC408	CAD Laboratory	PC	50	50	100	0	0	4	2
10	18MPC409	Manufacturing Process Laboratory	PC	50	50	100	0	0	3	1.5
11	18MPC503	Dynamics of Machines	PC	50	50	100	3	0	0	3
12	18MPC504	Thermal Engineering	PC	50	50	100	3	0	0	3
13	18MPC507	Thermal Engineering Laboratory I	PC	50	50	100	0	0	3	1.5
14	18MPC601	Design of Machine Elements	PC	50	50	100	3	0	0	3
15	18MPC602	Materials Engineering	PC	50	50	100	3	0	0	3
16	18MPC603	Heat and Mass Transfer	PC	50	50	100	3	0	0	3
17	18MPC607	Thermal Engineering Laboratory II	PC	50	50	100	0	0	3	1.5
18	18MPC701	Design of Transmission Systems	PC	50	50	100	3	0	0	3
19	18MPC702	Computer Aided Design	PC	50	50	100	3	0	0	3
20	18MPC703	Finite Element Analysis	PC	50	50	100	3	0	0	3
21	18MPC707	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
	THEORY									
1	18MPE$01	Internal Combustion Engines	PE	50	50	100	3	0	0	3
2	18MPE$02	Design of Jigs, Fixtures and Press Tools	PE	50	50	100	3	0	0	3
3	18MPE$03	Hydraulics and Pneumatic controls	PE	50	50	100	3	0	0	3
4	18MPE$04	Composite Materials	PE	50	50	100	3	0	0	3
5	18MPE$05	Industrial Engineering	PE	50	50	100	3	0	0	3
6	18MPE$06	Advanced Strength of Materials	PE	50	50	100	3	0	0	3
7	18MPE$07	Theory of Metal cutting	PE	50	50	100	3	0	0	3
8	18MPE$08	Welding Technology	PE	50	50	100	3	0	0	3
9	18MPE$09	Refrigeration and Air Conditioning	PE	50	50	100	3	0	0	3
10	18MPE$10	Operations Research	PE	50	50	100	3	0	0	3
11	18MPE$11	Boiler technology	PE	50	50	100	3	0	0	3
12	18MPE$12	Gas Dynamics and Jet Propulsion	PE	50	50	100	3	0	0	3
13	18MPE$13	Process Planning and Cost Estimation	PE	50	50	100	3	0	0	3
14	18MPE$14	Lean Manufacturing	PE	50	50	100	3	0	0	3
15	18MPE$15	Power Plant Engineering	PE	50	50	100	3	0	0	3
16	18MPE$16	Mechanical Vibrations	PE	50	50	100	3	0	0	3
17	18MPE$17	Additive Manufacturing	PE	50	50	100	3	0	0	3
18	18MPE$18	Automobile Engineering	PE	50	50	100	3	0	0	3
19	18MPE$19	Entrepreneurship Development	PE	50	50	100	3	0	0	3
20	18MPE$20	Total Quality Management	PE	50	50	100	3	0	0	3
21	18MPE$21	Energy Conservation and Management	PE	50	50	100	3	0	0	3
22	18MPE$22	Industrial Robotics	PE	50	50	100	3	0	0	3
23	18MPE$23	Computational Fluid Dynamics	PE	50	50	100	3	0	0	3
24	18MPE$24	Design for Manufacture	PE	50	50	100	3	0	0	3
25	18MPE$25	Instrumentation and Control	PE	50	50	100	3	0	0	3
26	18MPE$26	Automation in Manufacturing	PE	50	50	100	3	0	0	3

OPEN ELECTIVES (OE)

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.	18EOE$07	Renewable Power Generation Systems	OE	50	50	100	3	0	0	3
7.	18EOE$08	Electric Vehicles	OE	50	50	100	3	0	0	3
8.	18EOE$09	Smart Grid Systems	OE	50	50	100	3	0	0	3
9.	18LOE$10	Mobile Communication	OE	50	50	100	3	0	0	3
10.	18LOE$11	Introduction to VLSI System Design	OE	50	50	100	3	0	0	3
11.	18LOE$12	Microcontroller and Applications	OE	50	50	100	3	0	0	3
12.	18POE$13	Rapid Prototyping	OE	50	50	100	3	0	0	3
13.	18POE$14	Managerial Economics	OE	50	50	100	3	0	0	3
14.	18POE$15	Hydraulics and Pneumatics	OE	50	50	100	3	0	0	3
15.	18NOE$16	Measurement and Control	OE	50	50	100	3	0	0	3
16.	18NOE$17	Industrial Automation	OE	50	50	100	3	0	0	3
17.	18NOE$18	Virtual Instrumentation	OE	50	50	100	3	0	0	3
18.	18SOE$19	Programming in Java	OE	50	50	100	3	0	0	3
19.	18SOE$20	Cyber Security	OE	50	50	100	3	0	0	3
20.	18SOE$21	Network Essentials	OE	50	50	100	3	0	0	3
21.	18IOE$22	Programming in Python	OE	50	50	100	3	0	0	3
22.	18IOE$23	Big Data Science	OE	50	50	100	3	0	0	3
23.	18IOE$24	Object Oriented Programming Using C++	OE	50	50	100	3	0	0	3
24.	18BOE$25	Computational Biology	OE	50	50	100	3	0	0	3
25.	18BOE$26	Fundamental concepts of Biology for Engineers	OE	50	50	100	3	0	0	3
26.	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	18MEE508	Skill Development Practices	EEC	50	50	100	0	0	3	1.5
2	18MEE608	Skill development on Technical and Industrial practices	EEC	50	50	100	0	0	4	2
3	18MEE708	Mini Project	EEC	50	50	100	0	0	8	4
4	18MEE803	Project Work	EEC	50	50	100	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	18MMC3Z7	Constitution of India	MC	50	50	100	3	0	0	0
2	18MMC4Z7	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	18MVA$01	Yoga for Youth Empowerment	VA	100	-	100	1	0	0	1
2	18MVA$02	Basics of Civil Engineering	VA	100	-	100	1	0	0	1
3	18MVA$03	Metallography	VA	100	-	100	1	0	0	1
4	18MVA$04	Micromachining	VA	100	-	100	1	0	0	1
5	18MVA$05	Wind Energy Management	VA	100	-	100	1	0	0	1
6	18MVA$06	Solar Energy Management	VA	100	-	100	1	0	0	1
7	18MVA$07	Project Management	VA	100	-	100	1	0	0	1
8	18MVA$08	Six Sigma	VA	100	-	100	1	0	0	1
9	18MVA$09	Professional Skills	VA	100	-	100	1	0	0	1
10	18MVA$10	Industry 4.0	VA	100	-	100	1	0	0	1

CURRICULAM DESIGN FOR CBCS 2018 REGULATIONS

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

SUMMARY

Sl.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	3				12	7.36	12
2	BS	9.5	9.5	4	3					26	15.95	25
3	ES	8.5	7.5	4	3	3				26	15.95	24
4	PC			12.5	12.5	7.5	10.5	10.5		53.5	32.82	48
5	PE					3	3	6	6	18	11.04	18
6	OE					3	6	3		12	7.36	18
7	EEC					1.5	2	4	8	15.5	9.51	15
8	MC	0		0	0					0	0	0
Total		18	20	23.5	21.5	21	21.5	23.5	14	163	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

18MBS101	ENGINEERING CHEMISTRY *(Common to CIVIL, MECH & PRODN Branches)*	SEMESTER I

Category: BS

PRE-REQUISITES: NIL

L	T	P	C
3	1	0	4

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 book 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 spectroscopy principle and its application to molecules

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.

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	L	L	L	--	M	--	--	L	--	--	--	L	L	--
CO2	L	M	--	L	--	--	--	--	--	--	--	--	--	L	--
CO3	H	M	--	M	--	--	--	--	--	--	--	L	--	L	--
CO4	H	L	--	--	--	--	--	--	--	--	L	--	--	L	--
CO5	M	H	L	--	--	--	--	--	L	--	--	M	--	M	--
18MBS101	H	M	L	L	--	L	--	--	L	--	L	L	L	L	--

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

18MBS102	CALCULUS AND LINEAR ALGEBRA *(Common to CIVIL, MECH, PRODN & IBT Branches)*	SEMESTER I

Category: BS

PRE-REQUISITES: NIL

L	T	P	C
3	1	0	4

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.

COURSE ARTICULATION MATRIX

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	L	L	-	-	-	-	-	-	-	-	M	L	-	-
CO2	H	L	L	-	-	-	-	-	-	-	-	M	L	-	-
CO3	H	L	L	-	-	-	-	-	-	-	-	M	L	-	-
CO4	H	L	L	-	-	-	-	-	-	-	-	M	L	-	-
CO5	H	L	L	-	-	-	-	-	-	-	-	M	L	-	-
18MBS102	H	L	L	-	-	-	-	-	-	-	-	M	L	-	-

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

18MES103	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.

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	H	M	M	-	L	-	-	-	-	-	-	L	M	-
CO2	H	H	M	M	-	L	-	-	-	-	-	-	L	M	-
CO3	H	H	M	M	-	L	-	-	-	-	-	-	L	M	-
CO4	M	M	H	H	-	M	-	-	-	-	-	-	L	M	-
CO5	H	H	L	M	-	L	-	-	-	-	-	-	L	M	-
18MES103	H	H	M	M	-	L	-	-	-	-	-	-	L	M	-

L-Low. M-Moderate, H-High

18MBS104	CHEMISTRY LABORATORY *(Common to all Branches)*	SEMESTER I

PRE-REQUISITES: NIL

Category: BS

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

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

LIST OF EXPERIMENTS			
1.	Estimation of hardness by EDTA method.		
2	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: 0 Periods	**Tutorial: 0 Periods**	**Practical: 45 Periods**	**Total: 45 Periods**

REFERENCE BOOKS:

1. *A.O. Thomas, "**Practical Chemistry"**, Scientific Book Centre, Cannanore, 2003.*
2. *Vogel's "**Text book of Quantitative Analysis"**, Jeffery G H, Basset J. Menthom J, Denney R.C., 6th Edition, EBS, 2009.*

COURSE OUTCOMES:

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

CO1: Understand the nature of hardness using EDTA Complex

CO2 Iron present in water can be estimated and chloride level, pollution level using dissolved oxygen content.

CO3: Apply the EMF and conductometric measurements in quantitative analysis of Substances.

CO4: pH of the liquid sample will be analysed and hence strength of the sample can be estimated using pH Meter

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	L	M		--	L	--	--	--	--	--	L	--	--	M
CO2	L	H	--	M	L	--	--	--	--	--	--	--	--	--	--
CO3	M	L	--	M	--	--	--	--	--	--	--	--	--	--	L
CO4	L	M	--	L	L	--	--	--	--	--	--	--	--	--	L
18MBS104	M	M	L	M	L	L	--	--	--	--	--	L	--	--	L

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

18MES105	BASICS OF ELECTRICAL ENGINEERING LABORATORY *(Common to MECH & PRODN Branches)*	SEMESTER I

PRE-REQUISITES: NIL **Category: ES**

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 Transformers.
- To demonstrate internal cut –section view of machines and other advanced measurement 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: 0 Periods	**Tutorial: 0 Periods**	**Practical: 45 Periods**	**Total: 45 Periods**

COURSE OUTCOMES:

Upon 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]

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M	H	H	-	-	-	-	-	-	M	M	L	M	M
CO2	M	M	H	H	-	L	-	-	-	-	-	-	L	M	M
CO3	H	H	H	M	-	L	-	-	-	-	-	-	L	H	-
CO4	M	M	H	H	-	L	-	-	-	-	-	-	L	M	-
CO5	M	M	H	H	-	-	-	-	-	-	-	-	L	M	-
18MES105	M	M	H	H	-	L	-	-	-	-	M	M	L	M	M

L-Low. M-Moderate, H-High

18MES106	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
- Familiarization of CAD packages.

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 book 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 book 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.*
5. *Alan Kalameja, **"AutoCAD 2008: A tutor for Engineering Graphics",** Auto Desk Press 2007*
6. *CAD Software manuals of latest version.*

COURSE OUTCOMES:

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

CO1: Construct basic geometric shapes and dimension the drawing as per standards.

CO2: Project points, lines and solids in various positions, and convert 2D projections to pictorial projections.

CO3: Generate sectional views of solids and construct development drawings.

CO4: Generate and interrupt pictorial views.

CO5: Use AutoCAD to create simple Engineering Drawings.

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	M	L	--	M	L	--
CO2	--	--	L	--	M	L	--	--	M	M	L	--	M	L	--
CO3	--	--	L	--	H	L	--	--	M	M	L	--	M	L	--
CO4	--	--	L	--	H	L	--	--	M	M	L	--	M	L	--
CO5	--	--	L	--	H	L	--	--	M	M	L	--	M	L	--
18MES106	--	--	L	--	H	L	--	--	M	M	L	--	M	L	--

L-Low. M-Moderate, H-High

18MHS201	COMMUNICATIVE ENGLISH *(Common to All Branches)*	SEMESTER II

Category: HS

PRE-REQUISITES: NIL

L	T	P	C
2	1	0	3

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

1. CO1: Enhance their listening capacity through various accents and discourse
2. CO2: Communicate better at various public meeting and work place environments
3. CO3: Read and strengthen their interpretive and linguistic skills
4. CO4: Write appropriately on technical, business and general contexts.
5. CO5: Understand the usage of grammar and vocabulary

COURSE ARTICULATION MATRIX:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	--	--	--	M	H	L	M	--	H	H	M	H	H	--	H
CO2	--	--	--	H	H	L	M	M	H	H	M	L	H	--	H
CO3	--	--	--	H	H	L	M	M	--	H	M	H	H	--	H
CO4	--	--	--	H	H	L	M	M	--	H	M	L	H	--	H
CO5	--	--	--	L	H	L	--	--	--	H	M	H	H	--	H
18MHS201	--	--	--	H	H	L	M	M	M	H	M	H	H	--	H

L-Low. M-Moderate, H-High

18MBS202	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, 43rd Edition,2015.*
2. *Erwinkreyszig, **"Advanced Engineering Mathematics"**,9th Edition, John Wiley&Sons, 2006.*

3. *N.P. Bali and Manish Goyal, **"A text book 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.

COURSE ARTICULATION MATRIX

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	L	L	-	-	-	-	-	-	-	-	M	L	-	-
CO2	H	L	L	-	-	-	-	-	-	-	-	M	L	-	-
CO3	H	L	L	-	-	-	-	-	-	-	-	M	L	-	-
CO4	H	L	L	-	-	-	-	-	-	-	-	M	L	-	-
CO5	H	L	L	-	-	-	-	-	-	-	-	M	L	-	-
18MBS202	H	L	L	-	-	-	-	-	-	-	-	M	L	-	-

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

18MBS203	INTRODUCTION TO ELECTROMAGNETISM AND APPLIED PHYSICS *(Common to MECH & PRODN Branches)*	SEMESTER II

Category: BS

PRE-REQUISITES: NIL

L	T	P	C
3	1	0	4

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,* ***3rd edition*** *2015. – Unit II & III.*

REFERENCE BOOKS:

1. *Jearl Walker,* ***"Fundamentals of Physics"*** *, Halliday & Resnick, 10 th 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"**, 3rd edition, 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]

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	M	L	--	L	--	--	--	--	--	--	--	M	L	L
CO2	H	M	M	--	L	--	--	--	--	--	--	--	M	M	M
CO3	H	M	L	--	M	--	--	--	--	--	--	--	M	M	--
CO4	H	M	L	M	--	--	--	--	--	--	--	--	L	M	--
CO5	H	M	L	--	M	--	--	--	--	--	--	--	M	L	--
18MBS203	H	M	L	M	M	--	--	--	--	--	--	--	M	M	M

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

18MES204	PYTHON PROGRAMMING *(Common to MECH & PRODN Branches)*	SEMESTER II

Category: ES

PRE-REQUISITES: NIL

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
- 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**]

COURSE ARTICULATION MATRIX

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	M	L	--	L	L	--	L	L	--	--	L	--	M	L	L
CO2	M	L	--	L	L	--	L	L	--	--	L	--	M	L	L
CO3	M	M	L	M	L	--	L	L	--	--	L	--	M	L	L
CO4	M	M	L	M	L	--	M	M	--	--	L	--	M	M	L
CO5	M	M	L	M	L	--	M	M	--	--	M	L	M	M	L
18MES204	M	M	L	M	L	--	L	L	--	--	L	L	M	L	L

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

18MBS205	PHYSICS LABORATORY *(Common to All Branches)*	SEMESTER II

Category: BS

PRE-REQUISITES: NIL

L	T	P	C
0	0	3	1.5

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: 0 Periods	**Tutorial: 0 Periods**	**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.

COURSE ARTICULATION MATRIX

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	M	L	M	M	M	--	--	--	--	--	--	M	M	--
CO2	H	H	L	M	L	--	--	--	--	--	--	--	M	M	--
CO3	M	M	M	--	--	--	--	--	--	--	--	--	L	--	--
CO4	H	M	M	L	M	--	--	--	--	--	--	--	--	M	L
CO5	H	M	M	M	M	--	--	--	--	--	--	--	M	M	L
CO6	H	M	H	M	L	L	--	--	--	--	--	--	M	M	--
18MBS205	H	M	M	M	M	M	--	--	--	--	--	--	M	M	L

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

18MES206	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: Safely Use tools and equipment's used in Carpentry, Welding, Foundry and Sheet metal to create basic joints.

CO 2: Prepare sand mold for various basic pattern shapes.

CO 3: Fabricate parts like tray, frustum of cone and square box in sheet metal.

CO 4: Carry out minor works/repair related to electrical wiring and plumbing.

CO 5: Demonstrate the working of CNC machines and additive manufacturing.

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	--	L	--	L	--	--	--	L	--	--	--	L	M	--
CO2	H	--	L	--	L	--	--	--	L	--	--	--	L	M	--
CO3	H	--	L	--	L	--	--	--	L	--	--	--	L	M	--
CO4	H	--	L	--	M	--	--	--	L	--	--	--	M	M	--
CO5	H	--	L	--	H	--	--	--	L	--	--	--	M	M	--
18MES206	H	--	L	--	M	--	--	--	L	--	--	--	L	M	--

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

18MES207	PYTHON PROGRAMMING LABORATORY *(Common to MECH & PRODN Branches)*	SEMESTER II

Category: ES

PRE-REQUISITES: NIL

L	T	P	C
0	0	3	1.5

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: 0 Periods	**Tutorial: 0 Periods**	**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]

COURSE ARTICULATION MATRIX

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	L	L	L	--	L	L	--	--	L	L	M	L	L
CO2	M	L	L	L	L	--	L	L	--	--	L	L	M	L	L
CO3	M	M	L	M	L	--	L	L	--	--	L	L	M	L	L
CO4	M	M	L	M	L	--	M	M	--	--	L	L	M	M	L
CO5	M	M	L	M	L	--	M	M	--	--	M	L	M	M	L
18MES207	M	M	L	M	L	--	L	L	--	--	L	L	M	L	L

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

18MHS301	**BUSINESS COMMUNICATION SKILLS** *(Common to MECH, EEE, PROD & EIE Branches)*	SEMESTER III

PRE-REQUISITES: NIL **Category: HS**

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. *3Adhikari, Bhavana & Sethi, Anjanee.* ***"Business 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 OUTCOMES:

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
18MHS 301	L									M	L	M	L	L	L

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

18MBS302	PARTIAL DIFFERENTIAL EQUATIONS, PROBABILITY AND STATISTICS *(Common to MECH & PROD Branches)*	SEMESTER III

PRE-REQUISITES: NIL

Category :BS

L	T	P	C
3	1	0	4

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.

UNITI: 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.	
UNITII: PROBABILITY AND RANDOMVARIABLES	**(9+3 Periods)**
Sample spaces–Events-Probability Axioms–Conditional Probability–Independent Events–Baye's Theorem. Random Variables**:** Distribution Functions–Expectation–Moments -Moment Generating Functions.	
UNITIII:PROBABILITY DISTRIBUTIONS	**(9+3 Periods)**
Binomial, Poisson, Geometric, Uniform, Exponential, Normal, Gamma, Weibull (Mean, Variance and Simple problems). Functions of random variables.	
UNITIV: TESTING OF HYPOTHESIS	**(9+3 Periods)**
Large samples: Tests for Meanand 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:$\bar{X}$,RCharts–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.VeerarajanT., **"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, TataMcGraw 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 correlation.

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
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
18MBS 302	H	H	H	H	M	H	M	M	M	H	M	M	M	M	M

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

18MES303	**ENGINEERING MECHANICS** *(Common to MECH, EEE, PROD, EIE & CSE Branches)*	SEMESTER III

PRE-REQUISITES: NIL **Category: ES**

L	T	P	C
3	1	0	4

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, 1st 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:

On completion of this course, students will be able to

CO 1: Know the concept of mechanics and system of forces.

CO 2: 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

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	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
18MES 303	L	H	L	M	L	L			L		L		L	L	L

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

18MPC304	MECHANICS OF MATERIALS *(Common to MECH / PROD Branches)*	SEMESTER III

PRE-REQUISITES: NIL **Category: PC**

L	T	P	C
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

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	H		M		L							L	L	L
CO2	L	M	H	L	M					L			L		L
CO3		H	L	H	M					L			L		L
CO4	M	H	L	M	L								L		L
CO5	L	H		M		L							L		L
18MP C304	L	H	L	M	M	L				L			L	L	L

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

18MPC305	FLUID MECHANICS AND MACHINERY *(Common to MECH & PROD Branches)*	SEMESTER III

PRE-REQUISITES: **Category: PC**

1. 18MES303-Engineering Mechanics

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the basic principles in fluid mechanics and behaviour 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 Book 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"****, Anuradha Agencies, Vidayal Karuppur, Kumbakonaam, 1998.*

3. Kumar.K.L., ***"Engineering Fluid Mechanics"****, Eurasia Publishing House (P) Ltd., New Delhi, 2008.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO 1: Identify the importance of fluids properties and fluid principles at rest.

CO 2: Know the physical behavior of fluids system and equations under moving conditions.

CO 3: To apply the concept of dimensional analysis for model study.

CO 4: To conduct the performance test on different types of turbines

CO 5: To conduct the performance study and selection of pumps for different applications.

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	PS O1	PS O2	PS O3
CO1	M	H	L	L	M	-	-	-	-	-	-	-	-	-	M
CO2	H	M	L	M	L	-	-	-	-	-	-	-	L	-	M
CO3	L	L	M	H	L	-	-	-	-	-	-	-	L	-	M
CO4	L	M	M	H	L	-	-	-	-	L	-	-	M	-	H
CO5	L	M	M	H	L	-	-	-	-	L	-	-	H	-	M
18MPC305	M	M	M	H	L	-	-	-	-	L	-	-	L	-	M

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

18MPC306	MANUFACTURING TECHNOLOGY I	SEMESTER III

PRE-REQUISITES: NIL **Category:PC**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

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

UNIT – I METAL CASTING AND JOINING PROCESSES	**(9 Periods)**
Concepts of Manufacturing Process -Sand casting -Patterns – Moulding sand– Moulding machines-Core making-Testing- Furnaces – Casting Defects and Inspections; Physics of Welding-various Welding processes-Soldering-Brazing-Plastic welding, Welding defects-NDT Certification -Welding Codes; Adhesive Bonding-semi solid and liquid for Metals and Polymers	
UNIT – II DEFORMATION PROCESSES AND SHEET METAL FORMING	**(9 Periods)**
Plastic deformation-Yield criteria; Fundamentals of Hot and Cold working processes –Forging-Rolling- Extrusion- Drawing, Load calculations; Formability of Sheet Metal, Shearing, Deep drawing, Bending operations-Super Plastic forming; Introduction to Powder Metallurgy	
UNIT – III ADDITIVE MANUFACTURING PROCESSES	**(9 Periods)**
Fundamentals of Additive Manufacturing (AM)-Product Development-Materials for AM-Stereolithography apparatus - STL file - Fused Deposition Modeling- Laminated Object Manufacturing- Selective Laser sintering- 3D Printer – Tooling, Case studies.	
UNIT – IV CONVENTIONAL MACHINING PROCESSES	**(9 Periods)**
Orthogonal cutting, Oblique cutting, Chip formation, Mechanism of removal, Merchant and Lee Shaffer Theories, Machinability, Cutting Tools: Single, Multi-Point, Tool Signature, Inserts, Wear, Life, Materials, cutting fluids; Conventional Machining -Turning, Drilling, Milling and finishing processes, Introduction to CNC machining	
UNIT – V UNCONVENTIONAL MACHINING PROCESSES	**(9 Periods)**
Abrasive Jet Machining (AJM), Water Jet Machining (WJM), Ultrasonic Machining (UM), Electrochemical Machining (ECM). Electric Discharge Machining (EDM), Laser Beam Machining (LBM), Plasma Arc Machining (PAM), Electron Beam Machining (EBM) - principles, power sources, process parameters, MRR, Surface finish, process capabilities and tooling.	

Contact Periods:

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

TEXT BOOKS:

1. *Steven R. Schmid and Serope Kalpakjian **"Manufacturing processes for Engineering Materials"**, 5th Edition, Pearson Education India, 2009.*
2. *Sharma P.C., **"A Text book of Production Technology"**, S. Chand and Co. Ltd., 2009.*
3. *Chua C.K., Leong K.F., and Lim C.S., **"Rapid Prototyping: Principles and Applications"**, Third Edition, World Scientific Publishers, 2010.*

REFERENCE BOOKS:

1. *Mikell P. Groover,* ***"Fundamentals of Modern Manufacturing: Materials, Processes, and System"****,John Wiley and Sons Inc, 2010*
2. *Rao P.N.,* ***"Manufacturing Technology: Foundry, Forming and Welding"****, Tata McGraw Hill 3rd Edition, 2009*
3. *HMT* ***"Production Technology"****, HMT publication, 2017.*
4. *Adithan M. and Gupta A.B.* ***"Manufacturing Technology"****, New Age International Pvt Ltd, 2003.*
5. *Welding Codes and Standards from Welding Research Institute, Tiruchirappalli and through ASME/AWS websites*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Understand the basics of casting and joining technologies, inspection procedures and its relevant codes.

CO2: Evaluate the plastic deformation processes, load calculation of various deformation processes

CO3: Analyze the role of various Additive Manufacturing processes and ready to interpret with industries requirements

CO4: Know the conventional machining processes and its removal mechanism

CO5: Select the appropriate unconventional machining process for specific industrial applications.

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	L				M				M		M	L	M	M
CO2	M	M				M				M		M	M		
CO3	M				H	M		M		M		M		M	M
CO4	M	M				M				M		M	M	L	
CO5	M					M	H	M		M		M	L		M
18MPC 306	M	M			H	M	H	M		M		M	M	M	M

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

18MMC3Z7	CONSTITUTION OF INDIA *(Common to All branches)*	SEMESTER: III

PRE-REQUISITES: NIL

Category: MC

L	T	P	C
3	0	0	0

COURSE OBJECTIVES:

- 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	
18MMC3Z7						L	L					M		L	L	

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

18MPC308	MACHINE DRAWING	SEMESTER III

PRE-REQUISITES:

1. 18MES106 Engineering Graphics

Category:PC

L	T	P	C
0	0	4	2

COURSE OBJECTIVES:

- To create knowledge about standard presentation of components and symbols. It develops the knowledge to select proper tolerance and fit levels of appropriate machine components. Induces the knowledge to generate about 2-dimensional and 3-dimensional drawing with Auto CAD

UNIT – I CONVENTIONS, ABBREVIATIONS, AND SYMBOLS	**(10 Periods)**
Interrupted views, partial views of symmetrical objects, conventional representation of the continuous square and circular rod ends, adjacent parts, common machine elements, abbreviations, description of tolerances and grades, types of fits and their descriptions, selection of fits from standard tables- fits for different applications- examples- geometrical tolerances- surface finish conventions	
UNIT – II PREPARATION OF ASSEMBLY DRAWING	**(35 Periods)**
Cotter joint, knuckle joint, flange coupling, universal coupling, footstep bearing, Plummer block, connecting rod end, screw jack, lathe tailstock, stop valves – study on industrial drawings.	
UNIT – III AUTOCAD	**(15 Periods)**
Basic tools and commands of AutoCAD, line types, dimensioning, 2D drawing of machine components,3D models, importing and exporting files to other software	

Contact Periods:

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

TEXT BOOKS

1. *Gopalakrishna K.R., **"Machine Drawing"**, Subhas Publishers, Bangalore, 2003.*
2. *Bhatt.N.D, **"Machine Drawing"**, Chorotar Publishing House, 2001.*

REFERENCE BOOKS

1. *Gill.P.S., **"Text Book of Machine Drawing"**, S.K. Kataria& Sons, Publishers & Distributors, Delhi, 1998.*
2. *Narayana K.L., Kanniah.P., Venkatareddy.K.,**"Machine Drawing"**, New Age International Publishers, 2004.*
3. *James D. **"Engineering Graphics with AutoCAD 2002"**, Pearson Education, 2005.*
4. *Alan Kalameja, **"AutoCAD 2008: A tutor for Engineering Graphics"**, Auto Desk Press 2007*

COURSE OUTCOMES:

Upon completion of the course, student will be able to

CO1: Ability to select proper joint for products design

CO2: Ability to understand and initiate proper standards and codes

CO3: Ability to use proper symbols and select proper tolerance values for appropriate applications

CO4: Ability to communicate effectively in Industries (production line) through this subject knowledge

CO5: Ability to develop the better drawing using Auto CAD software (blueprint) with full technical details as required

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		L								H		H	L	
CO2	H							L			M		M		
CO3	L		H		L	M					M			M	L
CO4										H	L				L
CO5	L				H					M			M		
18MPC 308	L		L		L	L		L		L	M		L	L	L

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

18MPC309	STRENGTH OF MATERIALS LABORATORY	SEMESTER III

PRE-REQUISITES:

1. 18MPC304 Mechanics of Materials

Category: PC

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To find the strength properties of different construction materials like steel, concrete, brick and timber
- To evaluate stiffness properties of springs.
- To find the hardness properties of various metals.

LIST OF EXPERIMENTS

1. Tension test on mild steel rod.
2. Tension test on tor steel rod.
3. Torsion test on mild steel bar.
4. Tension and compression test on springs.
5. Compression test on bricks and concrete cubes.
6. Water absorption test on bricks.
7. Hardness test on different metals.(Rockwell, Brinell and Vickers)
8. Compression and bending test on wood specimens.
9. Deflection test on simply supported beams (for different metals).
10. Deflection test on cantilever beams (for different metals).
11. Bending test on rolled steel joist
12. Flexure test on tiles
13. Charpy and Izod Impact Test
14. Double shear test

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: Determine the tensile strength of materials

CO2: Obtain bending properties of structural materials.

CO3: Determine the hardness properties of the materials

CO4: Predict the compressive strength of the materials.

CO5: Obtain the impact and torsional strength of the materials.

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	L	L	L	L				M		M		H	M	L
CO2	H	L	L	M					L		L		H	L	L
CO3	H		L	H					M		M		H	L	L
CO4	M		L	M					L		M		H	M	L
CO5	H	L	L	H					L		M		H	M	L
18MPC 309	H	L	L	H	L				L		M		H	M	L

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

18MHS401	**PROFESSIONAL ETHICS** *(Common to MECH, EEE, ECE, EIE & IT Branches)*	SEMESTER IV

PRE-REQUISITES: NIL **Category: HS**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To possess knowledge on ethics, safety, rights, responsibilities and global issues on engineering and technology.

UNIT I : **ENGINEERING ETHICS**	**(9 Periods)**
Senses of 'Engineering Ethics' - Variety of moral issued - Types of inquiry - Moral dilemmas - Moral autonomy - Kohlberg's theory - Gilligan's theory - Consensus and controversy – Models of Professional Roles - Theories about right action - Self-interest - Customs and religion - Uses of ethical theories.	
UNIT II : 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 III : **SAFETY**	**(9 Periods)**
Safety and risk - Assessment of safety and risk - Risk benefit analysis and reducing risk - The three mile island and chernobyl case studies.	
UNIT IV : **RESPONSIBILITIES AND RIGHTS**	**(9 Periods)**
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, ASCE, IEEE, 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. *Charles E. Harris, Michael S. Pritchard and Michael J. Rabins,* ***"Engineering Ethics – Concepts and Cases",*** *Cengage Learning, 2009*
2. *Mike Martin and Roland Schinzinger* ***"Ethics in Engineering"*** *McGraw-Hill, New York 1996*
3. *Govindarajan M, Natarajan S, Senthil Kumar V. S "****Engineering Ethics****" Prentice Hall of India, New Delhi, 2004*

REFERENCE BOOKS

1. *Charles D. Fleddermann,* ***"Engineering Ethics",*** *Pearson Education / Prentice Hall, New Jersey, 2004 (Indian Reprint)*
2. *Charles E Harris, Michael S. Protchard and Michael J Rabins,* ***"Engineering Ethics– Concepts and Cases",*** *Wadsworth Thompson Learning, United States, 2000 (Indian Reprint now available).*
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:

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

CO1: Recognize the theories and principles of professional ethics.

CO2: Understand the basic perception of profession, professional ethics, various moral issues & uses of ethical theories..

CO3: Understand various social issues, industrial standards, code of ethics and role of professional ethics in engineering field.

CO4: Analysis of safety and risk benefit analysis.

CO5: Acquire knowledge on professional rights and responsibilities of an engineer.

CO6: Outline the global issues and codes of ethics.

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	L	H	M	M	H	M	H	H	H	L	H
CO2	H	M	M	M	L	H	M	M	H	M	H	H	L	M	H
CO3	H	M	M	M	L	H	M	M	H	M	H	H	L	M	H
CO4	H	M	M	M	L	H	M	M	H	M	H	H	H	L	H
CO5	H	M	M	M	L	H	M	M	H	M	H	H	H	L	H
CO6	H	M	M	M	L	H	M	M	H	M	H	H	L	M	H
18MHS 401	H	M	M	M	L	H	M	M	H	M	H	H	M	M	H

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

18MBS402	WAVES AND OPTICS *(Common to MECH & PROD Branches)*	SEMESTER IV

Category:BS

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 18MBS202 Differential Equations and Complex Variables,
2. 18MBS203 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 its application to quantum mechanical problems. [Familiarity & 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	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			
18MBS 402	H	M	M	M	L	M	L					M	H	H	H

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

18MES403	BASIC ELECTRONICS ENGINEERING *(Common to MECH & PROD Branches)*	SEMESTER IV

PRE-REQUISITES: NIL **Category:ES**

L	T	P	C
3	0	0	3

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

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											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
18MES403	M	M	M		M	L						M	M	L	L

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

18MPC404	KINEMATICS OF MACHINES	SEMESTER IV

PRE-REQUISITES:

1. 18MES106 Engineering Graphics
2. 18MES303 Engineering Mechanics

Category:PC

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To familiarize students with the basic of mechanisms, friction drives, to build confidence on the basics of gear theory and its nomenclature.

UNIT - I BASICS OF MECHANISMS	**(9 Periods)**
Terminology and definition – Degree of freedom– Higher and Lower pair – Mobility – Grashoff's law – Various types of Mechanisms- Description of mechanisms-Inversions of four bar chain and slider crank chains – Mechanical advantage – Transmission angle - Springs as links- Practical considerations- pin joints vs sliders,short links, linkages vs cams	
UNIT - II KINEMATIC ANALYSIS	**(9 Periods)**
Velocity and acceleration analysis on simple mechanisms – Graphical and analytical techniques- Instantaneous center of velocity – Coriolis component – Klein's construction for slider crank chain. Synthesis of Mechanism-four bar mechanism only -Inversion method	
UNIT - III FRICTION DRIVES	**(9 Periods)**
Belt and rope drive – Open and cross belt drive – Belt materials – Creep and slip - Ratio of tensions – Effect of centrifugal force – condition for maximum power – Friction in Journal Bearing - Flat pivot bearing - Friction clutches – Single plate – Multi plate – Cone clutches-Brakes - Shoe brake and Internal Expanding brake only.	
UNIT - IV CAMS	**(9 Periods)**
Types of cams and followers – Determination of cam profiles, pressure angles for SHM, uniform acceleration and retardation with reciprocating and oscillating followers – Knife-edge, roller and flat – practical design considerations- Special cams and its applications.	
UNIT - V GEARS	**(9 Periods)**
Gear terminology- Types of gearing – Pressure angle and undercutting - Law of gearing –Interference – gear corrections - Gear trains – Simple, compound, reverted and epicyclic.	

Contact Periods:

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

TEXT BOOKS:

1. *Thomas Bevan, **"Theory of Machines"**, Pearson Education Limited, 2010*
2. *Rattan S S, **"Theory of Machines"**, Tata McGraw -Hill Publishers, New Delhi, 2009.*

REFERENCE BOOKS:

1. *Shigley J.E AndUicker J.J, **"Theory of Machines and Mechanisms"**, Mcgraw Hill Inc,2009.*
2. *V.P.Singh, **"Theory of Machines"**, Dhanapatrai & Sons, 2005*
3. *George H.Maritn, **"Kinematics and Dynamics of Machines",** Waveland PrInc, 2002.*
4. *R L Norton, **"Kinematics and Dynamics of Machinery"**, McGraw-Hill, 2009.*
5. *C. E. Wilson, P. Sadler, **"Kinematics and Dynamics of Machinery"**, 3rd edition, Pearson Education, 2014.*

COURSE OUTCOMES:

At the end of the course students will be able to

CO1: Design mechanisms for practical applications.

CO2: Synthesis of mechanisms for given conditions.

CO3: Select appropriate type of friction drives gear for a specific application.

CO4: Construct cam profile for given follower motion.

CO5: Sizing the gear or gear trains.

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	L	M	L	L	L	H	L	L	L	H	H	M
CO2	H	H	M	L	M	L	M	L	H	L	L	L	H	H	M
CO3	H	H	H	L	M	L	M	L	M	L	L	L	H	H	M
CO4	H	M	H	L	M	L	H	L	L	L	L	L	H	M	M
CO5	H	H	M	L	M	L	M	L	M	L	L	L	H	M	M
18MPC 404	H	H	H	L	M	L	M	L	M	L	L	L	H	H	M

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

18MPC405	THERMODYNAMICS	SEMESTER IV

PRE-REQUISITIES:

1. 18MBS101 Engineering chemistry
2. 18MBS203 Introduction to Electromagnetism and Applied Physics

Category:PC

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To expose thermodynamic concepts, processes and cycles for analyzing the thermodynamic systems.

UNIT - I: CONCEPT OF THERMODYNAMICS	**(9 Periods)**
Basic definitions - Microscopic and Macroscopic approach - Ideal Gas- Types of systems - State, Process, Path and Cycle - Quasi-static process - Thermodynamic Properties - Zeroth law - Thermodynamic concept of energy - Heat and work - First law of thermodynamics - PMM 1 - Thermodynamic process of closed and open systems – SFEE - Unsteady process.	
UNIT - II: SECOND LAW OF THERMODYNAMICS AND ENTROPY	**(9 Periods)**
Limitations of First law -Thermal energy reservoirs – Kelvin Plank and Clausius statements - PMM 2 -Heat engines - Refrigerators and Heat pumps - efficiency and COP - Carnot cycle - Second law efficiency -Entropy - Clausius Inequality - principle of increase in entropy - Exergy analysis of closed and open system - Thermodynamic relations.	
UNIT - III: PURE SUBSTANCE AND GAS MIXTURES	**(9 Periods)**
Pure Substances: P-T and P-V diagrams, triple point and critical points - Sub cooled liquid, saturated liquid, mixture of saturated liquid and vapor, saturated vapor and superheated vapor states of pure substance - Latent heat - Dryness fraction – use of steam tables and Mollier chart - Ideal and Real gases - Ideal gas equation -Vanderwaal's Equation - Dalton's law,Amagat's law - Mole and mass fraction – Compressibility - Generalized compressibility chart.	
UNIT - IV: COMBUSTION	**(9 Periods)**
Fuels - Combustion equations - Stoichiometric air fuel ratio - Theoretical and actual combustion process - Adiabatic Flame Temperature - Exhaust and flue gas analysis – practical analysis of combustion products – Dissociation – internal energy and enthalpy of reaction – Enthalpy of formation – Calorific value of fuels – power plant thermal efficiency – practical determination of calorific values – air fuel - vapour mixtures.	
UNIT - V: RANKINE CYCLE AND PSYCHROMETRY	**(9 Periods)**
Basic Rankine cycle – Rankine cycle with reheating, intercooling and regeneration - Application of Binary vapour cycle. Psychrometry: Moist air, Psychrometry terms-Various Psychrometric process-Adiabatic Saturation-Air Washer – Bypass factor - Applications	

Contact Periods:

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

TEXT BOOKS:

1. *Nag. P.K., **"Engineering Thermodynamics",** Tata McGraw Hill Company, 5th Edition, 2013.*
2. *YunusA Cengel, **"Thermodynamics",**Tata McGraw Hill Company, 8th Edition, 2014*

REFERENCE BOOKS:

1. *Kothandaraman C.P., **"Thermal Engineering",** Dhanpat Rai & Sons, 1998.*
2. *Holman J.P., **"Thermodynamics",** McGraw Hill Education, 9th Edition, 2010.*
3. *R.K. Rajput **"Engineering Thermodynamics"**, Laxmi Publications (P) Ltd, 5th Edition, 2016.*
4. *Arora C.P, **"Thermodynamics"**, Tata McGraw-Hill, New Delhi, 12th Edition, 2007.*
5. *Prasanna Kumar, **"Engineering Thermodynamics"**, Pearson Education, 2013.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO 1: Apply thermodynamic principles to real life thermodynamic problems.

CO 2: Analyze the principles of entropy generation.

CO 3: Identify the characteristics of gases.

CO 4: Apply the principles of combustion to thermal analysis problems.

CO 5: Appreciate and analyze the vapour power cycles.

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	M	L	L	L	L	M	L	H	M	L
CO2	H	H	H	H	M	M	M	L	L	L	L	L	H	M	L
CO3	H	M	M	H	M	L	L	L	L	L	L	L	H	H	L
CO4	H	H	M	H	M	M	L	L	L	L	M	L	H	M	L
CO5	H	H	H	H	M	M	M	L	L	L	L	L	H	M	L`
18MPC 405	H	H	M	H	M	M	L	L	L	L	L	L	H	M	L

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

18MPC406	MANUFACTURING TECHNOLOGY II	SEMESTER IV

PRE-REQUISITES: NIL

Category: PC

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To provide knowledge on machine tools for manufacturing of various components.
- To understand the relationship between process and system in manufacturing domain.
- To identify the techniques for the quality assurance of the products and the optimality of the process in terms of resources and time management.

UNIT – I: AUTOMATS, SHAPING AND PLANING MACHINES	**(9 Periods)**
Capstan and turret lathes – construction - indexing mechanism - operations - working principle of single and multi - spindle automats – shaping and planning machines – types – construction - mechanism – principle of operation – different shaping operations.	
UNIT – II: DRILLING, BROACHING AND GRINDING MACHINES	**(9 Periods)**
Drilling machines – specifications, types - feed mechanism, operations – drill tool nomenclature – broaching – specifications, types, tool nomenclature, broaching operations – grinding – types of grinding machines – grinding wheels, specifications – bonds – mounting and reconditioning of grinding wheels.	
UNIT – III: MILLING AND GEAR GENERATING MACHINES	**(9 Periods)**
Milling – specifications – types - cutter nomenclature – types of cutters – milling processes – indexing – gear forming in milling – gear generation - gear shaping and gear hobbing – specifications - cutters –coated tools & inserts- cutting spur and helical gears - bevel gear generators – gear finishing methods.	
UNIT – IV: TOOLING	**(9 Periods)**
Press tools configuration, design of die and punch; principles of forging, extrusion and drawing dies design, corrections, computer software, Holding tools: Jigs and fixtures, principles and design for lathe, drilling, milling machines, grinding machines, Tool room, cost analysis; Case study for design of fixtures for industrial applications.	
UNIT – V: ENIGNEERING METROLOGY	**(9 Periods)**
Introduction to Metrology, limits, fits, tolerances, linear and angular measurements, Surface roughness and form measurements, Gear measurements; Tool wear measurements; Advanced measuring machines, CNC systems, Laser vision, In-process gauging, 3D metrology, metrology software, Nano technology instrumentation, stage position metrology, testing and certification services.	

Contact Periods:

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

TEXT BOOKS

*1. Kalpakjian and Schmid, **"Manufacturing processes for Engineering Materials"** (5th Edition)- Pearson India, 2014*

*2. Venkataraman, K. **"Design of Jigs, Fixtures and Press Tools",** Wiley Publishers, 2015.*

3. Jain, R.K. ***"Engineering Metrology"****,20th Edition, Khanna Publishers, 2007.*

REFERENCE BOOKS

1. Cyril Donaldson, George H. Lecain and Goold, V. C. ***"Tool Design",*** *4th Edition, Tata McGraw Hill, 2012.*

2. Jain R.K. and Gupta S.C., ***"Production Technology",*** *Khanna Publishers, New Delhi, 1999*

3. HMT ***"Production Technology"****, HMT publication, 2017*

4. Rega Rajendra, ***"Principles of Engineering Metrology",*** *Jaico Publishing House, 2008*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO 1: Understand the working of basic machines tools and its uses in Industries

CO 2: Gain working exposure of hole making operations and finishing processes utilized in industries

CO 3: Study of special purpose machine tools, operations and its uses in industries

CO 4: Evaluate the importance of Tooling in Industries

CO 5: Identify the suitable measuring instruments for the specific applications and its latest developments

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	L			L	L	L	L
CO2	L	L	L			L				L	L		M	M	M
CO3	M												M	L	M
CO4	M	L	M		M	L			L	H	L	M	M	M	M
CO5	M		M	L	M		L	M		M	L	M	H	H	H
18MPC406	M	L	M	L	M	L	L	L	L	M	L	M	M	M	M

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

18MMC4Z7	ENVIRONMENTAL SCIENCES AND ENGINEERING *(Common to all branches)*	SEMESTER-IV

PRE-REQUISITES: NIL

Category : MC

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
18MMC4Z7	M	L	H	L	L	L	M	M	L	M	L	L	L	L	L

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

18MPC408	CAD LABORATORY	SEMESTER IV

PRE-REQUISITES:

1. 18MPC308 Machine Drawing

Category: PC

L	T	P	C
0	0	4	2

COURSE OBJECTIVES:

- To study the usage of CAD software packages for assembly building for various part

LIST OF EXPERIMENTS

1. Sketching - create, edit and dimension the sketch, constraints, datum planes, construction aids.
2. 3D Part modeling – protrusion, cut, sweep, draft, loft, blend, rib.
3. Editing – move, pattern, mirror, round, chamfer.
4. Assembly - creating assembly from parts - assembly constraints.
5. Conversion of 3D solid model to 2D drawing - different views, sections, isometric view and dimensioning.
6. Introduction to surface modeling.
7. Introduction to File Import, Export – DXF, IGES, STL, STEP formats.
8. 3D modeling of machine elements like flanged coupling, screw jack etc.

Any of the 3D MODELING software likes Pro/E, IDEAS, CATIA ,SOLIDWORKS and UNIGRAPHICS to be used.

Contact Periods:

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

COURSE OUTCOMES:

Upon completion of this course, students will be able to

CO 1: Develop and create models of different mechanical system using CAD packages and its tools..

CO 2: Familiarize to use different modeling tools and import export files in different formats..

CO 3: Understand the Industrial drawings and its 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	M	H	H	H	M	L						L	L	
CO2	H	H	M	H	H	H			L					L	L
CO3	H	H	H	M	M	L							L	L	
18MPC 408	H	H	H	H	H	M	L		L				L	L	L

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

18MPC409	MANUFACTURING PROCESS LABORATORY	SEMESTER IV

Category: PC

L	T	P	C
0	0	3	1.5

PRE-REQUISITES:

1. 18MPC306 Manufacturing Technology I
2. 18MPC406 Manufacturing Technology II

COURSE OBJECTIVES:

- To provide an understanding of advanced manufacturing methods.
- To get an idea of the dimensional & form accuracy of products
- To practice operations in lathe, radial drilling, shaper, grinder, milling machine and gear cutting (gear hobbing, gear shaping and milling) and CNC machines.

LIST OF EXPERIMENTS

1. Step turning, Taper turning and external thread cutting using lathe.
2. Groove cutting, knurling and chamfering.
3. Drilling and counter sinking.
4. Drilling, reaming, tapping and surface grinding using surface grinder and Radial drilling machine.
5. External cylindrical grinding of shaft.
6. V-Groove cutting in shaping machine.
7. Spur gear milling.
8. Helical gear milling.
9. Gear shaping.
10. Gear hobbing.
11. Making hexagonal hole using slotting machine.
12. CNC part programming.
13. Letter cutting in vertical milling machine.
14. Machining – turning, drilling using CNC machining centre

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

CO2: Prepare gears using forming and generating methods of gear manufacturing and CNC operation.

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

CO4: Fabricate parts for equipment's / tools used for project works.

CO5: Evaluate the accuracy & tolerance of components produced.

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				L		L			L		L		L	
CO2		L							L	M			H		L
CO3		M			M		L	L				M		M	
CO4			H				M	M		H			H		L
CO5	H	H			M			M						H	
18MPC 409	L	L	L		L		L	L	L	L		L	L	L	L

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

18MHS501	PRINCIPLES OF MANAGEMENT	SEMESTER V

Category: HS

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To understand the principles of management and their application to the functioning of an organization

UNIT – I : MANAGING SKILLS	**(9 Periods)**
Definition of management - science or art - manager vs entrepreneur; Types of managers managerial roles and skills; Evolution of management- scientific, human relations, system and contingency approaches; Types of Business Organizations - sole proprietorship - partnership – company- public and private enterprises; Organization culture and environment; Current trends and issues in management.	
UNIT – II : PLANNING	**(9 Periods)**
Nature and purpose of Planning- types of Planning- objectives, setting objectives, policies, Strategic Management, Planning Tools and Techniques, Decision making steps & processes.	
UNIT – III : ORGANIZING SKILLS	**(9 Periods)**
Nature and purpose of Organizing - formal and informal organization - organization structure, types, line and staff authority, departmentalization, delegation of authority, centralization and decentralization, job design, human resource management - HR planning, Recruitment selection, Training & Development, Performance Management, Career planning and Management.	
UNIT – IV : MOTIVATIONAL TECHNIQUES	**(9 Periods)**
Directing - individual and group behavior - motivation, motivation theories, motivational techniques, job satisfaction, job enrichment, leadership, types & theories of leadership, effective communication.	
UNIT – V : CONTROLLING TECHNIQUES	**(9 Periods)**
Controlling - system and process of controlling - budgetary and non-budgetary control techniques - use of computers and IT in management control - productivity problems and management, control and performance, direct and preventive control, reporting.	

Contact Periods:

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

TEXT BOOKS:

1. *Robbins S.P. and Coulter M., **"Management"**, Prentice Hall India, 10th ed., 2009.*
2. *James F. Stoner, R. Edward Freeman, Daniel R. Gilbert, **"Management"**, 6th ed., Pearson Education, 2004.*
3. *Tripathy PC & Reddy PN, **"Principles of Management"**, Tata McGraw Hill, 1999.*

COURSE OUTCOMES:

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

CO1: Identify the key elements of managing skills in industries.

CO2: Outline the planning and polices followed in organization.

CO 3: Develop the procedure for the recruitment, selection and training.

CO 4: Examine the needs for leadership qualities.

CO 5: Evaluate the productivity problems and management in organization.

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	M	H	H	M	H	H	H	H	H	M	M
CO2	M	L	L	M	M	H	H	M	M	H	H	H	M	M	M
CO3	M	L	L	H	H	H	L	M	H	H	H	H	H	H	M
CO4	M	H	M	L	M	H	M	H	L	H	H	H	L	L	H
CO5	M	M	M	L	H	H	L	L	M	H	H	H	H	L	M
18MHS 501	M	M	H	M	M	H	M	M	M	H	H	H	M	M	M

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

18MES502	BIOLOGY FOR MECHANICAL ENGINEERS	SEMESTER V

Category: ES

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

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:0 Periods Practical:0 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/ 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	L	L	-	-	-	-	-	-	-	-	-	-	-	-
CO2	L	M	-	L	-	-	L	M	-	-	-	-	-	-	-
CO3	L	M	L	L	-	-	-	L	M	-	-	L	-	-	-
CO4	L	L	L	L	M	-	-	-	L	-	-	-	-	L	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	M	M	L
18MES 502	L	M	L	L	M	-	L	M	M	-	-	L	M	M	L

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

18MPC503	DYNAMICS OF MACHINES	SEMESTER V

Category:PC

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 18MES303 Engineering Mechanics,
2. 18MPC404 Kinematics of Machines

COURSE OBJECTIVES:

- To expose the students to force analyses, balancing, vibration and control mechanical systems.

UNIT – I : FORCE ANALYSIS	**(9 Periods)**
Free body diagrams – static equilibrium conditions –static force analysis in simple mechanisms like Four bar mechanism, slider crank mechanism– dynamic force analysis –Inertia force and inertia torque - D‟Alemberts principle –Principle of superposition – dynamic force analysis of four bar and slider crank mechanism –graphical method– turning moment diagrams – fly wheel.	
UNIT – II : BALANCING	**(9 Periods)**
Static and dynamic balancing – balancing of rotating masses–Balancing of Reciprocating masse-Primary and secondary unbalanced forces-partial balancing of unbalanced primary force-partial balancing of Locomotives-Variation of tractive force, Swaying couple and Hammer blow.	
UNIT – III : FREE VIBRATION	**(9 Periods)**
Basic features of vibratory systems –degrees of freedom– free vibration – equations of motion – natural frequency – types of damping – damped vibration - critical speeds of simple shaft – torsional systems:single, two rotor systems.	
UNIT – IV : FORCED VIBRATION	**(9 Periods)**
Response to periodic forcing – harmonic forcing – unbalanced forcing - force transmissibility and amplitude transmissibility – vibration isolation. Selection of vibration measuring instruments – accelerometer – dynamic properties and selection of structural materials for vibration control.	
UNIT – V : MECHANISM FOR CONTROL	**(9 Periods)**
Governors – types – centrifugal governors – gravity controlled and spring controlled centrifugal governors – characteristics – effect of friction – controlling force. Gyroscopes – gyroscopic forces and torques – gyroscopic stabilization – gyroscopic effects in automobiles, ships and airplanes.	

Contact Periods:

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

TEXT BOOKS:

*1. Shigley J.E & J.J., **"Theory of Machines and Mechanisms"**, McGraw Hill Inc., 1995.*

*2. Rattan S.S. **"Theory of Machines"**, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2006.*

REFERENCE BOOKS:

*1. Thomas Bevan, **"Theory of Machines"**, Pearson Education Limited, 2010*

*2. Ghosh A. and Mallick A.K., **"Theory of Mechanisms and Machines"**, Affiliated East-West Press Pvt.Ltd, 2000.*

*3. GeorgeH.Maritn, **"Kinematics and Dynamics of Machines",** Waveland Pr Inc,2002*

*4. V.P.Singh, **"Theory of Machines"**, Dhanapatrai& Sons, 2005*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO 1: Perform the force analysis on mechanical engineering systems

CO 2: Apply balancing principles on mechanical engineering systems.

CO 3: Analyse the vibrations occurring in various mechanical systems

CO 4: Selection of vibration measuring instruments and selection of structural materials for vibration

CO 5: Analysis of gyroscopic effects in real life applications and apply the principle of governors

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	H	M	H	M	M	M	M	M	H	H	H	M
CO2	H	H	H	H	M	H	H	H	H	H	H	H	L	L	M
CO3	H	H	H	M	M	H	H	H	H	H	H	H	L	L	M
CO4	H	H	H	H	H	M	H	H	H	H	H	H	L	L	M
CO5	H	H	H	H	M	M	L	L	M	H	H	H	H	H	H
18MPC 503	H	H	H	H	M	H	M	M	H	H	H	H	M	M	M

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

18MPC504	THERMAL ENGINEERING	SEMESTER V

Category:PC

L	T	P	C
3	0	0	3

PRE-REQUISITIES:

1. 18MBS101 Engineering chemistry
2. 18MBS203 Introduction to Electromagnetism and Applied Physics

COURSE OBJECTIVES:

- This course is designed to teach the application of thermodynamic principles to the design and optimization of engineering systems. Specifically, students will have the ability to apply the first and second law of thermodynamics to internal combustion engines, compressors and refrigeration systems.

UNIT - I: GAS POWER CYCLES	**(9 Periods)**
Air standard cycles - Carnot cycle, Otto cycle, Diesel cycle, Stirling cycle, Ericsson cycle, Limited pressure cycle – Calculation of Mean Effective Pressure and Air Standard Efficiency - Comparison of Otto, Diesel, Dual and Brayton cycle. Aircraft Propulsion - Combined Brayton and Rankine cycle.	
UNIT - II: INTERNAL COMBUSTION ENGINES	**(9 Periods)**
SI and CI Engines - Classification - Components and their Function - Valve Timing Diagram and Port Timing Diagram - Actual and Theoretical P-V Diagram of Four Stroke and Two Stroke Engines - Simple and Complete Carburetor - MPFI, Diesel Pump and Injector System - Ignition Systems - Principles of Combustion and Knocking in SI and CI Engines - Lubrication and Cooling Systems - Performance Characteristics and Testing of IC Engines – Fuels - Emissions and Emission Control.	
UNIT - III: REFRIGERATION AND AIR CONDITIONING	**(9 Periods)**
Methods of Refrigeration-applications-systems. Air Refrigeration Systems-Methods-Introduction, Refrigeration load, Heating load, Concept of Heat Engine, Refrigerator and Heat Pump. Refrigerants-Introduction, designation, types, properties. Vapour Compression Refrigeration Systems - Introduction, Simple VCR system-limitations and Cascade system. Vapour Absorption Refrigeration System – Introduction, Simple VAR system, Domestic Refrigeration, Thermo-electric and Vortex tube refrigeration. Psychrometry – Chart, typical Air conditioning processes, Heating, Cooling, humidification and dehumidification, Adiabatic mixing of Air streams, Air Washer.	
UNIT - IV: BOILER AND AIR COMPRESSORS	**(9 Periods)**
Steam Generators – Classification of Boilers, Selection of a Boiler, Boiler Terms, Fire Tube Boilers – Simple Vertical Boiler, Cochran Boiler, Cornish Boiler, Lancashire Boiler, Locomotive Boiler, Scotch Boiler. Water Tube Boilers – Babcock and Wilcox, Stirling Boiler. Boiler Mountings and Accessories. Compressed air system – Introduction, Compressor types, Compressor performance, Compressed air system components, Compressor capacity assessment.	
UNIT - V: TURBO MACHINES AND ITS APPLICATIONS	**(9 Periods)**
Reciprocating and Rotary pumps, Pelton wheel, Kaplan and Francis Turbines, velocity diagrams, Impulse and Reaction principles, Steam and Gas Turbines, Theory of Jet Propulsion – Pulse jet and Ram Jet Engines, Reciprocating and Rotary Compressors – Theory and Applications.	

Contact Periods:

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

TEXT BOOKS:

1. *Yunus A Cengel, Michael A Boles.,* ***"Thermodynamics: An Engineering Approach",*** *Mc Graw Hill Publications, 8th Edition, 2017.*
2. *A.S Sarao.,* ***"Thermal Engineering",*** *Tech India Publication Series, 2nd Edition, 2016.*

REFERENCE BOOKS:

1. *P.L. Ballaney.,* ***"Thermal Engineering",*** *Khanna Publishers, 5th Edition, 2005.*
2. *R Rudramoorthy.,* ***"Thermal Engineering",*** *McGraw Hill Education, 2nd Edition, 2017.*
3. *M. L. Mathur, F. S Mehta.,* ***"Thermal Science and Engineering",*** *Jain Book Agency, 3rdEdition, 2015*
4. *J.W Jones, W.F Stoecker.,* ***"Refrigeration and Air Conditioning",*** *Mc-Graw Hill Education, 2nd Edition, 2015.*
5. *B.U Pai.,* ***"Turbo Machines",*** *Wiley Publications, 2nd Edition, 2013.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO 1: Apply thermodynamic principles to real life thermodynamic problems.

CO 2: Analyze the principles of steam turbine and IC engines.

CO 3: Identify the characteristics of refrigerant and refrigeration cycle.

CO 4: Apply the principles of combustion in boilers and its principles

CO 5: Appreciate and analyze the vapour power cycles.

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	M	L	L	L	L	M	L	H	M	L
CO2	H	H	H	H	M	M	M	L	L	L	L	L	H	M	L
CO3	H	M	M	H	M	L	L	L	L	L	L	L	H	H	L
CO4	H	H	M	H	M	M	L	L	L	L	M	L	H	M	L
CO5	H	H	H	H	M	M	M	L	L	L	L	L	H	M	L
18MPC 504	H	H	M	H	M	M	L	L	L	L	L	L	H	M	L

L – Low M-Moderate (Medium) H-High

18MPC507	THERMAL ENGINEERING LABORATORY I	SEMESTER V

Category: PC

L	T	P	C
0	0	3	1.5

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

* To conduct performance tests on I.C engines, compressors and blowers.

LIST OF EXPERIMENTS

1. Valve timing and port timing diagrams of single cylinder diesel engines.
2. Performance test on 4 stroke Diesel Engine.
3. Heat balance test on 4 stroke Diesel Engine.
4. Retardation test to find Frictional Power of a Diesel Engine.
5. Economic speed test on Diesel Engine.
6. Performance test on Constant speed blower.
7. Performance test on Variable speed blower.
8. Performance test on Reciprocating Air compressor.
9. Performance test on four stroke computerized diesel engine.
10. Emission test on Internal Combustion engine.

Contact Periods:

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

COURSE OUTCOMES:

Upon completion of this course, students will be able to

CO 1: Select the suitable thermal devices for the specified industrial applications.

CO 2: Evaluate the performance of I.C engines.

CO 3: Conduct experiments on compressors and blowers.

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	L	L	M	H	L	M	L	L	L	L	L	M
CO2	M	H	M	H	M	L	H	L	L	L	L	L	L	M	L
CO3	L	M	M	L	L	L	L	L	M	L	L	L	L	L	L
18MPC 507	L	M	L	L	L	L	M	L	M	L	L	L	L	L	L

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

18MEE508	SKILL DEVELOPMENT PRACTICES	SEMESTER V

Category: EEC

L	T	P	C
0	0	3	1.5

PRE-REQUISITES:

1. 18MHS201 Communicative English

COURSE OBJECTIVES:

- To make students communicate effectively in different situations of professional career.

LIST OF EXPERIMENTS

1. Group discussion and debate.
2. Conducting mock meetings.
3. Negotiate with supplier or customer.
4. Listen to any audio / Read a topic and speak about it.
5. PowerPoint presentation.
6. Conduct Interviews of different kinds (one to one, many to one, telephonic interview)

Contact Periods:

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

COURSE OUTCOMES:

On completion of this course the student will be able to

CO 1: Discuss issues in a group for effective planning and execution.

CO 2: Prepare for a speech by reading or listening to audio.

CO 3: Do presentations in a group using modern aids.

CO 4: Select right personal for the concern through interviews.

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	L	M	M	H	L	L	L	L	H
CO2								L	L	H	L	L			
CO3					L		L		M	H		H	M		
CO4						L		M	M	H		H		L	
18MEE 508					L	L	L	L	M	H	L	M	L	L	L

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

18MPC601	DESIGN OF MACHINE ELEMENTS *(Use of Approved Design Data Book is permitted)*	SEMESTER VI

Category:PC

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 18MES303 Engineering Mechanics
2. 18MPC304 Mechanics of Materials
3. 18MPC308 Machine Drawing

COURSE OBJECTIVES:

- To study proper materials for different machine elements depending on their physical and mechanical properties and gain knowledge on design of various machine elements experiencing different theories of failures.

UNIT – I BASICS OF DESIGN	**(9 Periods)**
Basic procedure and requirements for designing machine elements - Stress-strain diagrams - Mechanical properties of engineering materials – preferred numbers, fits and tolerances – Modes of failure - Stresses in machine elements: Tension, Compression, Shear, bearing stress, Stress due to bending and eccentric axial loading - Principal stresses - Theories of elastic failure - Selection and use of failure theories.	
UNIT – II FLUCTUATING STRESSES AND DESIGN OF SHAFT	**(9 Periods)**
Stress concentration – Fluctuating Stresses - Fatigue failure - Endurance limit-low and high cycle fatigue – Notch Sensitivity - Reversed stresses (Design for finite and Infinite life) - Soderberg, Goodman and Gerber relations - Design of shaft under static and fatigue loading.	
UNIT – III DESIGN OF ENERGY STORING ELEMENTS	**(9 Periods)**
Design of helical,torsional and leaf springs - Design of flywheels considering stresses in rims and arms for engines and punching machines	
UNIT – IV DESIGN OF TEMPORARY AND PERMANENT JOINTS	**(9 Periods)**
Design of riveted, welded joints in plates and pressure vessels – design of eccentrically loaded riveted and welded joints – design bolted joints - design of joints with variable loading, adhesive joints.	
UNIT – V MISCELLANEOUS ELEMENTS	**(9 Periods)**
Design of rigid, flexible coupling –Design of connecting rods and crank shafts – Design and selection of rolling and sliding contact bearing.	

Contact Periods:

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

TEXT BOOKS:

*1.Shigley, J.E. and Mischke, C.R., **"Mechanical Engineering Design"**, Tenth Edition, McGraw Hill International, 2014.*

*2.T.V. Sundarajamoorthy and N. Shanmugam, **"Machine Design"**, Khanna Publishers, 1998.*

*3.V.B. Bhandari, **"Design of Machine Elements"**, McGraw Hill Publication Co., 2014.*

REFERENCE BOOKS:

*1.U.C.Jindal, **"Machine Design "**, Pearson ,2010.*

*2.Juvinal, R.C., **"Fundamentals of Machine Component Design"**, John Wiley, 2006.*

*3.Robert L Mott, **"Machine Elements in Mechanical Design"**, Pearson, 2013*

*4..Dr. S. S. Wadhwa, Er. S. S. Jolly, **"Machine Design"**, Dhanpat Rai & Co, Delhi 2012.*

*5.**"Design Data"** – P.S.G. College of Technology, Coimbatore.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Understand the different types of stresses, materials properties and their significance in machine elements design

CO2: Design the shafts by considering failure theories for reliability

CO3: Design the energy storing elements for various applications according to the prescribed standards

CO 4: Design the temporary and permanent joints for fabrication of different machine components and boilers as per the standards

CO 5: Design the connecting rod, crank shaft and selection of couplings and bearings for industrial applications

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		L						L		M	H	L
CO2		M	H	M						M			M	M	L
CO3		M	H		L								M	M	
CO4		M	H		L								M	H	
CO5		H	M							M			M	M	H
18MPC601		M	H	L	L					L	L		M	M	L

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

18MPC602	MATERIALS ENGINEERING	SEMESTER VI

Category:PC

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 18MBS203 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)**
Classes of engineering materials - Constitution of alloys - Necessity of alloying - types of solid solutions, Hume Rotherys rules - intermediate alloy phases, and electron compounds – Solid solutions, substitutional and interstitial – phase diagrams, - Iron-carbon equilibrium diagram - Experimental methods of construction of equilibrium diagrams - Isomorphous alloy systems, equilibrium cooling and heating of alloys - Isomorphous, eutectic, peritectic, eutectoid and peritectoid reactions.	
UNIT – II HEAT TREATMENT AND SURFACE TREATMENT	**(9 Periods)**
Heat treatment of alloys - Effect of alloying elements on Fe-Fe3C system - annealing process - stress relief - recrystallisation - spheroidizing – normalizing, hardening and tempering of steels - TTT diagrams – austempering, martempering - Isothermal transformation diagrams – cooling curves superimposed on I.T diagram- CCR - hardenability, Jominy-end-quench test - Case hardening, carburizing, nitriding, cyaniding, carbonitriding – Flame and Induction hardening- Applications of heat treatment.	
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- Applications in real time engineering.	

Contact Periods:

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

TEXT BOOKS:

1. *W. D. Callister, **"Materials Science and Engineering-An Introduction",** Wiley India.,2011*
2. *Dieter, G.E., **"Mechanical metallurgy",** SI metric edition,. McGraw-Hill, 2012,*
3. *Sydney H.Avner,**"Introduction to Physical Metallurgy",** Tata McGraw Hill Book Company, 2014.*

REFERENCE BOOKS:

1. *William D Callsber **"Material Science and Engineering",** Wiley India pvt Ltd 2014.*
2. *Kenneth G.Budinski and Michael K.Budinski **"Engineering Materials"** Prentice-Hall of India Private Limited, 6th Indian Reprint 2012.*
3. *O.P.Khanna,**"Material Science And Metallurgy",** Dhanpat Rai Publication ,2011*
4. *Raghavan.V, **"Materials Science and Engineering",** Prentice Hall of India Pvt. Ltd., 2015*
5. *U. C. Jindal, **"Engineering Materials and Metallurgy",** Pearson, 2011.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO 1: Predict the alloy components and its composition variation with respect to temperature changes.

CO 2: Select suitable materials and heat treatment methods for various industrial applications.

CO 3: Understand the ferrous and nonferrous materials and their application

CO 4: Apply the knowledge of foundry and powder metallurgy to solve various industrial production processes.

CO 5: Gain knowledge about materials testing methods and welding techniques to meet industrial requirements.

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				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				
18MPC 602	M	L	L		M	L	L	L			L	L	M	L	L

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

18MPC603	**HEAT AND MASS TRANSFER** *(Use of Approved Heat and Mass Transfer Data Book is permitted)*	**SEMESTER VI**

Category:PC

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 18MBS202 Differential Equations and Complex Variables
2. 18MPC405 Thermodynamics

COURSE OBJECTIVES:

- To familiarize and appreciate different modes of heat and mass transfer and its applications.

UNIT – I : CONDUCTION	**(9 Periods)**
Fundamental differential equation of heat conduction in Cartesian coordinates- representation of general heat conduction equation in cylindrical and spherical coordinates – Fourier's law of heat conduction – boundary and initial conditions – plane wall and radial systems – critical thickness of insulation – conduction with thermal energy generation – heat transfer from extended surfaces – transient heat conduction.	
UNIT – II : CONVECTION	**(9 Periods)**
Principles of convection – convection boundary layer – laminar and turbulent flow – empirical relations for external and internal forced convection flows – flat plate, cylinders, spheres – empirical relations for free convection flows – horizontal cylinders, horizontal plates, vertical planes, inclined surfaces and enclosed spaces.	
UNIT – III : RADIATION	**(9 Periods)**
Nature of thermal radiation – radiation intensity – relation to emission, irradiation and radiosity – black body radiation – loss of radiation – emissivity – surface emission – Kirchhoff's law – gray surface – view factor – radiation exchange between black surfaces – radiation exchange between gray surfaces – electrical analogy – radiation shields.	
UNIT – IV : BOILING, CONDENSATION AND HEAT EXCHANGERS	**(9 Periods)**
Boiling and Condensation – regimes of boiling – forced convection boiling – Nusselt's theory of condensation – film wise and drop wise condensation. Heat exchanger types - overall heat transfer coefficient – fouling factors – Heat exchanger analysis: LMTD method - NTU method	
UNIT – V : MASS TRANSFER	**(9 Periods)**
Basic Concepts – concentration , velocities, fluxes – diffusion mass transfer – steady state molecular diffusion – convective mass transfer – analogy between convective heat and mass transfer – convective mass transfer correlations - simultaneous heat and mass transfer.	

Contact Periods:

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

TEXT BOOKS:

1. *Sachdeva R.C., **"Fundamentals of Engineering Heat and Mass Transfer"**, New Age International Publishers, New Delhi, 2010.*
2. *Kothandaraman C.P., **"Fundamentals of Heat and Mass Transfer"**, New Age International Publishers, New Delhi, 2010.*

REFERENCE BOOKS:

1. *Frank P Incropera and David P. Dewitt,* ***"Fundamentals of Engineering Heat and Mass Transfer",*** *John Wiley and Sons, 2010.*
2. *Holman J.P.,* ***"Heat and Mass Transfer"****, Tata McGrawHill, 2010.*
3. *Yadav R.,* ***"Heat and Mass Transfer"****, Central Publishing House, Allahabad, 2010.*
4. *Ozisik M.N.,* ***"Heat Transfer",*** *McGraw Hill Book Co., 2005.*
5. *Yunus Cengel,* ***"Heat Transfer"****, McGraw Hill Company, 2008.*

COURSE OUTCOMES:

Upon completion of this course, students will be able to

CO 1: Apply the concepts of heat transfer in conduction mode to real problems.

CO 2: Apply the concepts of heat transfer in convection mode to engineering applications.

CO 3: Apply the concepts of radiation heat transfer in practical problems.

CO 4: Analyze the phase change heat transfer and heat exchangers.

CO 5: Apply the mass transfer in real life problems.

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	H	M	M	L	L	L	L	L	L	L	L	H	L
CO2	L	M	H	M	M	L	L	L	L	L	L	L	L	H	L
CO3	L	M	H	M	M	L	L	L	L	L	L	L	L	H	L
CO4	L	M	H	M	M	L	L	L	L	L	L	L	L	H	L
CO5	L	M	H	M	M	L	L	L	L	L	L	L	L	H	L
18MPC 603	L	M	H	M	M	L	L	L	L	L	L	L	L	H	L

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

18MPC607	THERMAL ENGINEERING LABORATORY II	SEMESTER VI

Category: PC

L	T	P	C
0	0	3	1.5

PRE-REQUISITES:

18MPC504 Thermal Engineering

COURSE OBJECTIVES:

* To provide exposure to the students on studying the performance of heat transfer equipments.

LIST OF EXPERIMENTS
1. Test on pin fin apparatus.
2. Test on counter flow heat-exchanger.
3. Determination of convection heat transfer coefficient.
4. Determination of thermal resistance and conductivity.
5. Determination of emissivity of non-black surfaces.
6. Determination of transient temperature distribution.
7. Performance test on cooling tower.
8. Determination of COP of a heat pump.
9. Determination of COP of a refrigeration system.
10. Determination of COP of an air-conditioning system.
11. Study of Boiler, steam turbine and Steam Engines

Contact Periods:

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

COURSE OUTCOMES:

Upon completion of this course, students will be able to

CO 1: Conduct of experiments on heat transfer

CO 2: Estimate COP of refrigerator, heat pump and air-conditioning system.

CO 3: Illustrate the working of boiler, steam turbines and steam engines.

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	L	L	M	L	H	H	L	H	L	L	M
CO2	M	M	L	L	L	L	H	L	H	H	L	M	L	L	M
CO3	H	L	L	M	L	L	M	L	M	M	L	M	L	L	L
18MPC 607	M	M	L	L	L	L	M	L	H	H	L	M	L	L	M

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

18MEE608	SKILL DEVELOPMENT ON TECHNICAL AND INDUSTRIAL PRACTICES	SEMESTER VI

Category: EEC

L	T	P	C
0	0	4	2

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To make students get ready to become an entrepreneur or an effective administrator.

LIST OF EXPERIMENTS

1. Conduct literature survey on selected technical domain. (Minimum 20 literatures to be reviewed) and prepare a survey report.
2. Visit any two industry and prepare a technical report about the visit
3. Conduct market survey and prepare report on any selected product by meeting the customers / retailersusing any methods. (Questionnaire, Audio / Video recording etc.)
4. Assess the risk involved in any industries. (Existing risk, or upcoming risk in the market).
5. Perform process planning and estimate the cost of production for a product.
6. Design an alternate mechanism for an existing product to perform the same function or a function in addition to the existing function.
7. Perform tolerance analysis in production and assembly drawings.

Contact Periods:

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

COURSE OUTCOMES:

On completion of this course the student will be able to

CO 1: Identify gaps in published literatures and find scope of improvement.

CO 2: Write technical report about any industrial activity.

CO 3: Perform market survey and risk assessment to find an area of scope in the market.

CO 4: Innovate new mechanism design and estimate cost for a product or process.

CO 5: Read Engineering drawings and analyse tolerances.

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	L	L	L	H	H	H		H		H	M	M
CO2							H		M	H	M		M	M	M
CO3			L			L	H		M	M	M	H	H	M	H
CO4	H	H	H			H	H	L	H		H	H	H	H	H
CO5		L	L			L	H		M			L	M	L	L
18MEE 608	L	L	L	L	L	L	H	L	M	L	M	L	H	M	M

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

18MPC701	DESIGN OF TRANSMISSION SYSTEMS *(Use of Approved Design Data Book is permitted)*	SEMESTER VII

Category: PC

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 18MES303Engineering Mechanics
2. 18MPC404 Kinematics of Machines

COURSE OBJECTIVES:

- To study power transmitting and power controlling elements

UNIT – I: DESIGN OF POWER TRANSMISSION ELEMENTS	**(9 Periods)**
Selection of ropes, Flat belt – V belt – ribbed V belt – selection of chains and sprockets – Ratchet and pawl mechanism.	
UNIT – II: SPUR AND HELICAL GEARS	**(9 Periods)**
Kinematics – force analysis in gears – stress analysis – dynamic effects – gear blank design - estimating gear size, module and face width - power rating calculations based on strength and wear considerations, crossed helical gear terminology - estimating the size of the pair of crossed-helical gears.	
UNIT – III: BEVEL AND WORM GEAR	**(9 Periods)**
Straight bevel gear: Tooth terminology, tooth forces and stresses, equivalent number of teeth, estimating the dimensions of pair of straight bevel gears. Worm Gear: Merits and demerits – Terminology. Thermal Capacity, Materials-forces and stresses, efficiency, estimating the size of the worm gear pair.	
UNIT – IV: DESIGN OF GEAR BOX	**(9 Periods)**
Geometric progression - standard step ratio - ray diagram, kinematic layout - design of sliding mesh and constant mesh gear box - introduction to planetary gear box.	
UNIT – V: CAMS, CLUTCHES AND BRAKES	**(9 Periods)**
Cam Design: Types-pressure angle and under cutting base circle determination-forces and surface stresses.Design of plate clutches-axial clutches-cone clutches- introduction to Hydraulic clutche. Band and block brakes-external shoe brakes-Internal expanding shoe brake.	

Contact Periods:

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

TEXT BOOKS:

1. *V.B. Bhandari, **"Design of Machine Elements"**, McGraw Hill Publication Co., 2014.*
2. *T.V. Sundarajamoorthy and N. Shanmugam, **"Machine Design"**, Khanna Publishers, 1998.*

*3. "**Design Data"** – P.S.G. College of Technology, Coimbatore.*

REFERENCE BOOKS:

1. *Gitin M. Maitra and L.V. Prasad, **"Hand Book of Mechanical Design"**, II Edition, Tata McGraw Hill, 1995.*
2. *Juvinal R.C. **"Fundamentals of Machine Components Design"**John Wiely and Sons. 2011*
3. *Merhyle F.Spotts,Terry E.Shoup and Lee E.Hornberger **"Design of Machine elements"**, Prentice Hall, India International ed,2003.*
4. *Robert L Mott, **"Machine Elements in Mechanical Design"**, Pearson, 2013*
5. *Joseph Edward Shigley and Charles, R. Mischke, **"Mechanical Engineering Design"**, McGraw Hill International ,2014.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO 1: Select flexible transmission elements for machinery and equipments.

CO 2: Understand kinematics of gears and can design spur and helical gears for engineering use.

CO 3: Understand kinematics of gears and can design bevel and worm gears for engineering use.

CO 4: Design and develop gear box for various machinery and equipments.

CO 5: Design Cams, friction clutches and brake components.

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	L	L								H	M	
CO2	L	H		L	M						L		M	H	L
CO3	L	H		L	M						L		M	H	L
CO4		M	H	L	L								M	H	
CO5		M	H	L	L								M	H	
16MPC 701	L	H	M	L	L						L		M	H	L

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

18MPC702	COMPUTER AIDED DESIGN *(Common to MECH & PROD Branches)*	SEMESTER VII

Category : PC

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 18MES106 Engineering Graphics
2. 18MPC308 Machine 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 McMohan and Jimmie Browne **"CAD/CAM Principles", "Practice and Manufacturing management** " Second Edition, Pearson Education, 1999.*
2. *Radhakrishnan P, SubramanyanS. and Raju V., **"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

CO1: 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

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		H							M					
CO2		L			M									M	
CO3		L			H			L		L				M	
CO4		L		L					L	L			M	M	
CO5					H						M		L	M	
18MPC 702	L	L	H	L	M			L	L	L	M		L	M	

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

18MPC703	FINITE ELEMENT ANALYSIS	SEMESTER VII

Category: PC

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 18MBS102 Calculus and Linear Algebra

COURSE OBJECTIVES:

- To acquire knowledge of computational techniques of solving problems in Multiphysics.
- To develop the skill of solving problems with complex boundaries.

UNIT – I: RELEVANCE OF FEM	**(9 Periods)**
Historical background-basic concept of FEM – discretization of 1D, 2D and 3D Domains, mesh refinement, convergence requirements - gradient and divergence theorems - boundary and initial value problems.	
UNIT – II: CHARACTERISTIC MATRICES AND LOAD VECTORS	**(9 Periods)**
One dimensional governing equation - structural and heat transfer problems - variational method-variation calculus – weighted residual methods – Galerkinmethod - Ritz method - generalized coordinate's approach - principle of minimization of potential energy.	
UNIT – III: ONE DIMENSIONAL PROBLEMS	**(9 Periods)**
Derivation of shape functions, Stiffness matrices and force vectors -Assembly of Matrices - shape function characteristics - problems in axial load members, trusses, heat transfer through composite walls and fins –Buckling of columns.	
UNIT – IV: TWO DIMENSIONAL PROBLEMS	**(9 Periods)**
Derivation of shape functions for CST and LST triangular and rectangular elements, Stiffness matrices and force vectors -Pascal's triangle- concept of plane stress and plain strain and axi-symmetry - Structural and heat transfer application - introduction to coupled field analysis.	
UNIT – V: HIGHER ORDER ELEMENTS	**(9 Periods)**
Natural co-ordinate systems – Isoparametric elements – Shape functions for isoparametric elements – One and two dimensions – Jacobian transformation - Serendipity and Lagrangian elements – Numerical integration - Matrix solution techniques.	

Contact Periods:

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

TEXT BOOKS:

1. *Larry J. Segerlind**, "Applied Finite element Analysis"**, John Wiley & Sons , 1987*

*2. Logan D L**, "A First Course in the Finite Element Method"**, Third Edition, Thomson Learning, 2002.*

REFERENCE BOOKS:

1. Singiresu.S.Rao, ***"The Finite Element Method in Engineering"****, ButterWorth Heinemann, 2001.*

2. J.N Reddy, ***"An Introduction to Finite Element Method"****, McGraw Hill, Intl, Student Edition 2003.*

*3. Tirupathi R. Chandrupatla and Ashok D. Belegundu****,"Introduction to Finite Element in Engineering"****, Pearson Education ,2003*

*4. David V.Hutton,****"Fundamentals of finite element Analysis",*** *McGraw Hill Inc, Newyork, 2004.*

*5. J Seshu. P,****"Textbook of Finite Element Analysis",*** *Prentice Hall of India, 2003.*

COURSE OUTCOMES:

Upon completion of the course, student will be able to

CO1: Understand the applications of numerical methods and their advantages.

CO2: Evaluate complexities in solving boundary value problems and effective solving methods.

CO3: Apply numerical techniques to solve structural and heat transfer problems.

CO4: Analyse two dimensional problems in mechanical engineering.

CO5: Use higher order elements to obtain more accurate solutions.

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	L	M	M	L					L		L	M	M	L
CO2	H	L	M	H	L					L	L	L	M	M	L
CO3	H	M	M	H	H		L			L	L	L	M	M	L
CO4	M	H	M	M	L		L			L	M	L	M	M	L
CO5	M	M	M	M	L					L		L	M	M	L
18MPC 703	H	M	M	M	L		L			L	L	L	M	M	L

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

18MPC707	SIMULATION LABORATORY	SEMESTER VII

Category: PC

L	T	P	C
0	0	3	1.5

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

* To learn to develop geometric models and to use finite element modeling for simulating various engineering applications.

LIST OF EXPERIMENTS

1. Modeling and Meshing.
2. Solution and Post processing.
3. Various types of Analysis: Structural, Thermal and coupled field analysis
    - Stress analysis of an axisymmetric component
    - Stress analysis of a beams
    - Stress analysis of plane strain problems
    - Stress analysis of three dimensional components
    - Thermal analysis of fins, composite walls, chimneys and weld assembly
    - Modal analysis of Beams

Introduction to ANSYS Parametric Design Language

Contact Periods:

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

COURSE OUTCOMES:

Upon completion of this course, students will be able to

CO 1: Understand the use of simulation software to solve problems in mechanical engineering

CO 2: Interpret complex engineering structures or machine parts by finite element simulation..

CO 3: Simulate multi-physics problems.

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	L										M	H	L
CO2	M	H	L										M	H	L
CO3	M	H			M								M		L
18MPC 707	M	H	L		M								M	H	L

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

18MEE708	MINI PROJECT	SEMESTER VII

Category: EEC

L	T	P	C
0	0	8	4

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- Opportunity to design and develop small working models.
- Develop experimental or simulation solutions to small industrial problems.
- Facilitate problem identification, formulation and solution.
- Work collaboratively in small groups.

The students may be grouped into groups of about four members per group and work under a project supervisor. The device / system / component(s) to be designed/ fabricated / investigated / analyzed may be decided in consultation with the supervisor. An industrial expert may be included as an external supervisor. A project report to be submitted by the group and the fabricated model / investigation / analysis to be reviewed and evaluated continuously by a committee constituted by the head of the department / program coordinator.

Contact Periods:

Lecture: 0 Periods Tutorial:0 Periods Practical:120 Periods Total:120 Periods

COURSE OUTCOMES:

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

CO1: Model or simulate solutions to small engineering problems considering environmental issues

CO2: Apply the principles of mechanical engineering to solve engineering problems

CO3: Perform feasibility study and manage activities to complete task in specified duration.

CO4: Assign and undertake tasks in a team as per team discussion.

CO5: Do presentation and write technical reports for effective communication within and outside the team.

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	H	M	H	H	L	H	-	M	-	H	H	H
CO2	H	H	H	H	M	H	H	-	H	-	L	-	H	H	-
CO3	M	M	M	M	M	L	L	L	H	L	M	H	H	H	-
CO4	H	M	M	L	L	L	M	H	H	H	-	H	H	H	-
CO5	-	-	-	-	M	M	-	L	H	H	-	M	H	-	H
18MEE 708	M	M	M	M	M	M	M	M	H	L	L	M	H	M	M

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

18MEE803	PROJECT WORK	SEMESTER VIII

Category: EEC

L	T	P	C
0	0	16	8

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- Opportunity to apply the knowledge learned throughout the program.
- Undertake problem identification, formulation and solution.
- Facilitate technical, project management and presentation spheres.
- Work cooperatively in small team environment.

The students may be grouped into groups of about four members per group and work under a project supervisor. The device / system / component(s) to be fabricated / investigated / analyzed may be decided in consultation with the supervisor. An industrial expert may be included as an external supervisor. A project report to be submitted by the group and the fabricated model / investigation / analysis to be reviewed and evaluated continuously by a committee constituted by the head of the department / program coordinator.

Contact Periods:

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

COURSE OUTCOMES:

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

CO1: Model or simulate solutions to small engineering problems considering environmental issues

CO2: Apply the principles of mechanical engineering to solve engineering problems

CO3: Perform feasibility study and manage activities to complete task in specified duration.

CO4: Assign and undertake tasks in a team as per team discussion.

CO5: Do presentation and write technical reports for effective communication within and outside the team.

.

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	H	M	H	H	L	H	-	M	-	H	H	H
CO2	H	H	H	H	M	H	H	-	H	-	L	-	H	H	-
CO3	M	M	M	M	M	L	L	L	H	L	M	H	H	H	-
CO4	H	M	M	L	L	L	M	H	H	H	-	H	H	H	-
CO5	-	-	-	-	M	M	-	L	H	H	-	M	H	-	H
18MEE 803	M	M	M	M	M	M	M	L	H	L	L	M	H	M	L

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

18MPE$01	INTERNAL COMBUSTION ENGINES

Category: PE

L	T	P	C
3	0	0	3

PREREQUISITES:

1. 18MPC405 Thermodynamics
2. 18MPC504 Thermal Engineering

COURSE OBJECTIVES:

- To impart knowledge on basics and subsystems of internal combustion engines and their applications.

UNIT – I :FUNDAMENTALS OF ENGINE SYSTEMS	**(9 Periods)**
Fuel air cycle and Actual cycle analysis, Engine Classification, Different parts of I.C. Engines, Four Stroke Cycle Engines, Two Stroke Cycle Engines, Laboratory tests for fuel – Cetane and Octane number. Performance Parameters, Basic Measurements, Engine Performance Curves – Bharat Stage emission norms	
UNIT – II : SI ENGINES: CARBURETION AND IGNITION SYSTEMS	**(9 Periods)**
Carburetion and Carburetors - factors influencing carburetion, - Types of Carburetors- Description of Some Important Makes of Carburetors, Introduction to Fuel Injection- Direct Injection- Indirect Injection- Injection Considerations- Comparison of Petrol Injection and Carburetted Fuel Supply Systems - Electronic Fuel Injection. Ignition System - requirements of an Ignition System - Basic Ignition System- Magneto Ignition- Firing Order - Electronic Ignition Systems, Lubrication Systems.	
UNIT – III : CI ENGINES: INJECTION AND LUBRICATION SYSTEMS	**(9 Periods)**
Functional Requirements of an Injection System - Fuel Injection System- Air Injection- Solid or Airless Injection, Fuel Pump, Fuel Atomizer, Types of Nozzles and Fuel Spray Patterns - Main Requirements of an Injector Nozzle, Lubrication Systems- Wet Sump Lubrication System- Dry Sump Lubrication System- Mist Lubrication System- Lubrication of Different Engine Parts- Lubrication of Ball and Roller Bearings- Oil Filters, Crankcase Ventilation.	
UNIT – IV : COMBUSTION IN S.I. ENGINES	**(9 Periods)**
Definition of Combustion- Ignition Limits, Combustion Phenomenon- Normal Combustion- Abnormal Combustion, Effect of Engine Variables on Ignition Lag, Factors Affecting Ignition Timing, Pre Ignition. Detonation - Effects of Detonation- Factors Affecting Detonation, Performance Number, Combustion Chamber Design- Swirl- Squish and Tumble- Flame Propagation - Surface to Volume Ratio- Stroke to Bore Ratio- Compression Ratio, Some Types Of Combustion Chambers- Divided Combustion Chambers.	
UNIT – V : COMBUSTION IN C.I. ENGINES	**(9 Periods)**
Combustion Phenomenon in C.I. Engines, Fundamentals of the Combustion Process, Delay Period- Factors Affecting Delay Period, Diesel Knock, Combustion Chambers – Primary Design Consideration – Types - Basic Methods of Generating Air Swirl, Cold Starting. Combustion chambers for Homogeneous charge compression ignition systems – Dual and alternate fueled engine systems.	

Contact Periods:

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

TEXT BOOKS:

*1. Ganesan .V , **"IC Engines"** , Tata McGraw-Hill, 2003.*

*2. John B. Haywood, **"Internal Combustion Engine Fundamentals",** McGraw-Hill Automotive Technology Series, 1988*

REFERENCE BOOKS:

*1. Richard Stone, **"Introduction to IC Engines",** Macmilan,– 1992.*

*2. K. K. Ramalingm, **"Internal Combustion Engines",** Scitech publications, 2003.*

*3. Heldt,P.M., **"High Speed Combustion Engines",** Oxford IBH Publishing Co., 1985.*

*4. Obert,E.F., **"Internal Combustion Engine analysis and Practice",** International TextBook Co., Scranton, 1988.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO 1: Appreciate and check the working of IC engines taking environmental issue and performance into consideration

CO 2: Analyze combustion in CI and SI engines for and modify the design of combustion chamber

CO 3: Understand the functioning of fuel supply system and lubrication system

CO 4: Analyze the performance and emission characteristics

CO 5: Understand various modern engine methodologies like GDI, HCCI and alternate fuelled engines.

.

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	L	H	M	H	L	M	L	L	L	M	H	M	H	M
CO2	L	M	M	L	M	L	H	M	M	L	H	L	L	H	H
CO3	M	M	M	M	M	H	M	L	L	H	M	M	H	H	L
CO4	H	M	L	M	H	M	L	M	L	H	H	M	M	H	H
CO5	M	L	L	H	M	M	L	H	H	M	H	H	M	H	M
18MPE$01	M	M	M	M	M	M	M	M	M	M	H	M	M	H	M

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

18MPE$02	DESIGN OF JIGS, FIXTURES AND PRESS TOOLS *(Use of Approved Data book is permitted)*

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 18MPC306 Manufacturing Technology I
2. 18MPC406 Manufacturing Technology II

COURSE OBJECTIVES:

- To understand the concepts of press tool design and fixture design for machining and forming systems.

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 and external diameter - external profile - ejectors - 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)**
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 – Common defects in jig design-design and development of jigs for simple components.	
UNIT - III DESIGN OF FIXTURES	**(9 Periods)**
principles of milling boring, lathe and broaching fixtures - Grinding, planning and shaping fixtures, assembly, Inspection and welding fixtures- modular fixtures - Common defects in fixture design - design and development of fixtures for simple component – quick change fixtures.	
UNIT - IV PRESS ELEMENTS AND CUTTING DIE DESIGN	**(9 Periods)**
Press working terminology – types - presses and accessories - tonnage requirements - strip lay out calculations - shearing action - die and punch elements - strippers, knockouts, stops, pilots, selection of standard die sets - design and development of progressive and compound dies for blanking and piercing operations.	
UNIT - V DESIGN OF FORMING AND MISCELLANEOUS DIES	**(9 Periods)**
Design and development of forming - bending and drawing dies - types - design considerations in forging - extrusion –recent trends in tool design – introduction to computer aids for sheet metal forming analysis.	

Contact Periods:

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

TEXT BOOKS:

1. *Kempster, **"Jigs and Fixtures Design",** The English Language Book Society, 1998.*
2. *Joshi P.H, **"Jigs and Fixtures",** Tata McGraw-Hill Publishing Company Limited, New Delhi 2004.*

REFERENCE BOOKS:

1. *Donaldson C, **"Tool Design",** Tata McGraw-Hill, New Delhi, 2003.*
2. *K.Venkataraman, **"Design of Jigs, Fixtures & Press tools",** Tata McGraw-Hill Publishing Company Limited, New Delhi 2005.*
3. *Edward G Hoffman, **"Jigs and Fixture Design",** Thomson – Delmar Learning, Singapore, 2004.*

4. *Hiram E Grant,* ***"Jigs and Fixture"*** *Tata McGraw Hill, New Delhi, 2003.*
5. ***"Fundamentals of Tool Design",*** *CEEE Edition, ASTME, 1983.*

COURSE OUTCOMES

On completion of this course, students will be able to

CO 1: Design appropriate clamping and locating systems for specific operations.

CO 2: Apply the concepts of jigs design for simple components.

CO 3: Apply the concepts of fixture design for simple components.

CO 4: Apply the concepts of die design for shearing operations.

CO 5: Apply the concepts of die design for forming operations

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	H		L				L		L		L	L	L
CO2	L	M	H		L				L		L		L	L	L
CO3	L	M	H		L				L		L		L	L	L
CO4	L	M	H		L				L		L		L	L	L
CO5	L	M	H		L				L		L		L	L	L
18MPE$02	L	M	H		L				L		L		L	L	L

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

18MPE$03	HYDRAULICS AND PNEUMATIC CONTROLS

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 18MPC305Fluid Mechanics and Machinery

COURSE OBJECTIVES:

- To provide exposure to the basics of hydraulic and pneumatic principles and development of circuits for various engineering applications

UNIT – I FLUID POWER SYSTEMS AND FUNDAMENTALS	**(9 Periods)**
Introduction to fluid power- Advantages of fluid power- Application of fluid power system- Types of fluid power systems-Properties of hydraulic fluids – types of fluids – Fluid power symbols-Basics of hydraulics – Applications of Pascal's Law-Losses in pipe, valves and fittings - Pumping theory – Pump classification – Gear, Vane and piston pumps- construction and working of pumps – pump Selection.	
UNIT – II CONTROL COMPONENTS, ACTUATORS	**(9 Periods)**
Pressure, Flow and Directional control valves - Fluid Power Actuators: Linear hydraulic actuators – Types of hydraulic cylinders – Single acting, double acting special cylinders like tandem, Rod less, Telescopic - Cushioning mechanism - Construction of double acting cylinder - Rotary actuators - Gear, Vane and Piston motors.	
UNIT – III DESIGN OF HYDRAULIC CIRCUITS	**(9 Periods)**
Reciprocating- sequencing – synchronizing – regenerative – pump unloading – double pump circuits –Counterbalance valve application circuit - Accumulators circuits - Intensifier circuits - Fail-safe circuits.	
UNIT – IV PNEUMATIC SYSTEMS AND COMPONENTS	**(9 Periods)**
Properties of air – Compressors – Filter, Regulator, and Lubricator Unit – Air control valves, Quick exhaust valves, and pneumatic actuators- Control elements – position- pressure sensing – switching- Speed control circuits – Pneumo - hydraulic circuit - Sequential circuit design for simple applications using cascade method, step counter method- Selection of components for pneumatic systems.	
UNIT – V SERVO SYSTEMS AND MAINTENANCE	**(9 Periods)**
Servo systems – Hydro Mechanical servo systems - Electro hydraulic servo systems and proportional valves - Introduction to Electro Hydraulic/Pneumatic logic circuits, ladder diagrams- PLC applications in fluid power control - Fluid power circuits -installation and maintenance - failure and trouble shooting.	

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 Inc. 2011*

*2. Majumdar S.R., **"Pneumatic systems – Principles and maintenance"**, Tata McGraw-Hill, 2006*

REFERENCE BOOKS:

*1. Michael J., Pinches and John G.Ashby, **"Power Hydraulics"**, Prentice Hall, 1989.*

*2. Lal, **"Oil hydraulics in the service of industry"**, Allied publishers, 1982.*

*3. James L. Johnson, **"Introduction to Fluid Power"**, Delmar/Thomson Learning,2003.*

*4. John J. Pippenger and Tyler G Hicks, **"Industrial Hydraulics"**, McGraw Hill Book Co., 1979.*

*5.**"Industrial Hydraulics Manual"** 5 th Edition, Eaton Hydraulics Training Services, 2008.*

COURSE OUTCOMES:

At the end of the course students will be able to

CO1: Identify fluid power systems and select the appropriate pumps for industrial applications.

CO2: Demonstrate the applicability of hydraulic power systems for engineering applications.

CO 3: Design customized circuits in hydraulics for various industrial needs.

CO4: Choose pneumatic systems and demonstrate the applicability of pneumatic power systems on real life applications.

CO 5: Analyze failure of fluid power systems and to solve them.

COURSEARTICULATION 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	H	M	M	M		L					L		M		L
CO 2	M	M	M	M	L	M					L		L	L	L
CO 3	H	H	H	H	H	H	M				L	M	H	H	L
CO 4	H	H	M	M	L	M					L		L	L	L
CO 5	H	H	H	H	M	H	M				L		M	H	L
18MPE$03	H	H	M	M	L	M	L				L	L	M	M	L

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

18MPE$04	COMPOSITE MATERIALS

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

* To impart the fundamentals of composite materials with different reinforcement, matrix materials and comprehend the types of manufacturing methods for advance composite materials to meet various engineering requirements.

UNIT – I: BASICS OF COMPOSITE MATERIALS	**(9 Periods)**
Classification and characteristics of composite materials - Mechanical behavior – Polymer matrix composites – Metal matrix composites – Ceramic matrix composites - Basic terminology and Manufacture of laminated fiber - Reinforced composite materials - Current and potential advantages – Structural and Multifunctional - Applications of composite materials.	
UNIT – II: REINFORCEMENT AND MATRICES	**(9 Periods)**
Different types of fibers and resins – Glass – Boron – carbon – organic – ceramic – whiskers and other Nonoxide Reinforcements - Properties and applications of fibers - Roll of matrix - Matrix materials, Selection of matrix -Thermoset matrix -Thermoplastic matrix, Fiber architecture – Natural Fibers.	
UNIT – III: DESIGN OF COMPOSITE STRUCTURES	**(9 Periods)**
Elements of Design - Steps in design process – Static, dynamic and stability analysis – Laminated composites plates - inter laminar stresses – stress distribution in fiber and the matrix - Design analysis stages - Material selection - Configuration selection - Laminate joints - Design requirements and design failure criteria.	
UNIT – IV: MANUFACTURING OF COMPOSITES	**(9 Periods)**
Fundamentals terms – requirement and selection of constituents - Bagging films - Molding process - Compression molding - Pltrusion – pre-peg layer - Filament winding - Liquid composite molding processes - Resin film infusion -Elastic reservoir molding -Tube rolling - Forming methods for thermoplastic matrix composites.	
UNIT – V: METAL, CERAMIC AND CARBON MATRIX COMPOSITES	**(9 Periods)**
Metal matrix composites (MMC) - Characteristics of MMC – Types – reinforcement effects – volume fraction – rule of mixtures – processing of MMC - Ceramic matrix composites (CMC) – types and properties – sintering – cold and hot isostatic pressing - processing of CMC - Carbon matrix composites – Characteristics and constituents - Fabrication methods - Applications.	

Contact Periods:

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

TEXT BOOKS:

1. *Krishnan K., Chawla **"Composite Materials Science and Engineering"**, Springer (India) Private Limited, 2016*
2. *P.K. Mallick , **"Fiber Reinforced Composite materials, Manufacturing and Design"**, CRC Press,*

Taylor and Francis Group, Boca Raton, London, Newyork, 2014

*3. Ronald F.Gibson **"Principles of Composites Materials Mechanics"** CRC Press Taylor and Francis Group, Boca Raton, London, Newyork, 2012*

REFERENCE BOOKS:

*1. A.K.Bhargava, **"Engineering Materials: Polymers, ceramics and composites"**, Pentice Hall of India Limited, 2012.*

*2. Hyer M., Stress Analysis of Fiber – **"Reinforced Composite Materials"**, Tata McGraw Hill, 2010.*

*3. Madhujit Mukhopadhyay , **"Mechanics of Composite Materials and Structures"**, Universities Press (India) Private Limited, 2009.*

*4. Robert M.Jones, **"Mechanics of Composite Materials"**, Taylor & Francis Group, 2012.*

5. Web Portal: Composite Materials {NPTEL .Mechanical Engineering}

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Understand the mechanics and behavior of reinforced composite materials for specific applications and developing composite materials for sustainability

CO2: Formulate different types of reinforcement and matrices to develop new composite material for the various application

CO3: Design and manufacture post processing methods of composite structures and capable to perform various analysis

CO4: Execute different methods of manufacturing advanced composites to meet the innovate demand in engineering.

CO5: Fabricate metal matrix, ceramic matrix and carbon matrix composite for various engineering application to meet the societal demand.

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	H			M	M				L		H		L
CO2	H	M	M	M	M		L				M		M	M	
CO3	M	M	M	M		L	M				L		L	M	
CO4	M	M	M	L		H	L		L		M		M	L	
CO5	L	L		L		M	L					L	M	M	
16MPE$04	M	M	M	L	L	M	L		L		L	L	M	L	L

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

18MPE$05	INDUSTRIAL ENGINEERING

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- Assume Technical and Managerial roles in the Industries.
- Apply Engineering Principles to the working environment.
- Use quality tools to foresee and solve issues in the industrial situations.
- Work collaboratively.

UNIT – I : FORECASTING	**(9 Periods)**
Characteristics and Principles - Qualitative Methods, Delphi Technique, Market Research-Time Series Methods- Moving Average, Exponential Smoothing,- Box Jenkins Method –autoregressive moving average (ARMA) or autoregressive integrated moving average (ARIMA) models - Fitting Regression Models - Measurement of Forecast Errors, Coefficient of Correlation- Problem solving.	
UNIT – II : FACILITIES PLANNING AND WORK STUDY	**(9 Periods)**
Factors affecting Site Location Decisions - Principles and Types of Layout - Layout Planning - Layout Tools and Computerised Layout Techniques - Design of Group Technology Layout - Line Balancing - Line Balancing Methods- Objectives of Work Study -Method Study Procedure, Recording Techniques - Motion Study - Principles of Motion Economy - Techniques of Work-measurement - Time Study - Synthesis Method - Analytical Estimating - Predetermined Motion Time System (PMTS) - Work Sampling Techniques.	
UNIT – III : LEAN MANUFACTURING	**(9 Periods)**
Elements of Just In Time (JIT) - Pull and Push System, Kanban System- Optimized Production Technology and Synchronous Manufacturing – Implementation of Six Sigma - Single Minute Exchange of Die (SMED) 5S concept - Concurrent Engineering- Cellular Manufacturing - Enablers of Agile Manufacturing – Rapid Manufacturing - Business process reengineering (BPR) - Basics of Supply Chain Management, Supply chain and "Keiretsu" – Enterprises Resources Planning (ERP) - Role of KAIZEN, Quality Circles and POKA YOKE in Modern Manufacturing – Seven wastes in Lean Manufacturing.	
UNIT – IV :AGGREGATE PRODUCTION PLANNING	**(9 Periods)**
Objectives of Aggregate Planning - Capacity Requirement Planning (CRP) Process - Types of Capacity Planning - Strategies for Aggregate Capacity Planning - Master Production Scheduling - Procedure for Developing MPS – Materials Requirements Planning (MRP-I), Issues in MRP, Designing and Managing the MRP System, Evaluation of MRP - Manufacturing Resources Planning (MRP-II).	
UNIT – V : SCHEDULING OF OPERATIONS	**(9 Periods)**
Operations Planning and Scheduling - Scheduling Techniques - Stages in Scheduling – Loading, Dispatching, Expediting - Finite Loading and Infinite Loading - Load Charts and Machine Loading	

Charts - Priority Sequencing -Dynamic Sequencing Rules - Batch Scheduling – Economic Batch Quantity (EBQ) or Economic Run Length (ERL) – Scheduling in Repetitive, Batch and Job Shop Manufacturing – Allocation of units for a single resource, allocation of multiple resources - Resource balancing - Flexible manufacturing system.

Contact Periods:

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

TEXT BOOKS:

1. *R.Panneerselvam,* ***"Production & Operations Management"****, 3rd Edition, PHI Learning Private Limited, New Delhi, 2012.*
2. *Elwood S.Buffa, and Rakesh K.Sarin,* ***"Modern Production/Operation Management"****, 8th Edition, John Wiley & Sons, 2000.*

REFERENCE BOOKS:

1. *Dilworth B.James,* ***"Operations Management Design, Planning and Control for Manufacturing and Services",*** *Mcgraw Hill Inc., New York, 1992*
2. *Vollman T.E,* ***"Manufacturing Planning and Control Systems"****, Galgotia Publications, 2002.*

COURSE OUTCOMES:

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

CO1: Apply the knowledge of Engineering and Sciences to improve the productivity of Industries.

CO2: Design a system to meet the desired needs within realistic constraints.

CO3: Function in multidisciplinary teams.

CO4: Use the techniques, skills, and modern Engineering tools in manufacturing practice.

CO5: Perform as an effective Industrial Engineer integrating high and low levels of management.

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									H	
CO2			H											M	
CO3						H	M		H	M	H	M	H		M
CO4	H	H		M	H	H						M		H	
CO5						H	M	H					H		H
18MPE$05	L	L	L	L	L	M	L	L	L	L	L	L	L	M	L

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

18MPE$06	ADVANCED STRENGTH OF MATERIALS

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 18MES303 Engineering Mechanics,
2. 18MPC304Mechanics of Materials

COURSE OBJECTIVES:

- To know the fundamentals of mechanics of materials under various loading conditions.
- To understand the elastic theories in determining the stresses relating to contact bodies, non circular shafts and rotary sections.

UNIT – I : ELASTICITY	**(9 Periods)**
Stress-Strain relations and general equations of elasticity in Cartesian, Polar and spherical coordinates differential equations of equilibrium-compatibility-boundary conditions-representation of three-dimensional stress of a tension generalized hook's law - St. Venant's principle - plane stress-Airy's stress function.	
UNIT – II : SHEAR CENTRE AND UNSYMMETRICAL BENDING	**(9 Periods)**
Location of shear centre for various sections - shear flows. Stresses and deflections in beams subjected to unsymmetrical loading-kern of a section.	
UNIT – III : CURVED FLEXIBLE MEMBERS AND STRESSES IN FLAT PLATES	**(9 Periods)**
Circumference and radial stresses - deflections-curved beam with restrained ends-closed ring subjected to concentrated load and uniform load-chain links and crane hooks. Stresses in circular and rectangular plates due to various types of loading and end conditions, buckling of plates	
UNIT – IV : TORSION OF NON-CIRCULAR SECTIONS	**(9 Periods)**
Torsion of rectangular cross section - S.Venants theory - elastic membrane analogy Prandtl's stress function torsional stress in hollow thin walled tubes.	
UNIT – V : STRESSES DUE TO ROTARY SECTIONS AND CONTACT STRESSES	**(9 Periods)**
Radial and tangential stresses in solid disc and ring of uniform thickness and varying thickness. Methods of computing contact stress-deflection of bodies in point and line contact applications	

Contact Periods:

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

TEXT BOOKS:

1. *Y.C.Fung,* ***"Foundations of Solid mechanics",*** *Prentice Hall International,1965*
2. *Sadhu Singh,* ***"Strength of Materials",*** *Khanna publishers, New Delhi, 2013.*
3. *L. S. Negi,* ***"Strength of Materials",*** *Tata Mc Graw Hill Education Pvt. Ltd, 2010*

REFERENCE BOOKS:

1. *Sadhusingh,* ***"Theory of Elasticity",*** *Hanna Publishers, 2003.*
2. *Timoshenko and Goodier,* ***"Theory of Elasticity",*** *McGraw Hill, 2010*
3. *Robert D. Cook, Warren C. Young, "****Advanced Mechanics of Materials****", Mc-millan pub. Co., 1985.*
4. *Seely and Smith, "****Advanced Mechanics of Materials****", John Wiley International Edn, 1952.*
5. *https://nptel.ac.in/courses/105105108/5*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Appreciate the governing differential equations describing the elastic behavior of three dimensional systems

CO2: Determine the stresses in cases of unsymmetrical bending and curved flexible members (or) Formulate analytical techniques in determining the stresses in cases of unsymmetrical bending and curved flexible members

CO3: Comprehend the elastic theories in determining the stresses relating to contact bodies, non circular shafts and rotary sections.

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	M	L	L	L	L	M	L	L	H	H	M
CO2	H	H	H	H	M	L	L	L	L	H	M	M	H	H	M
CO3	H	H	H	M	M	L	L	L	L	M	M	M	H	H	M
18MPE$06	H	H	M	M	M	L	L	L	L	M	L	L	H	H	M

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

18MPE$07	**THEORY OF METAL CUTTING** *(Use of approved data book is permitted)* *(Common to MECH & PRODUCTION Branches)*

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 18MES303 Engineering Mechanics
2. 18MPC504 Thermal Engineering

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 versus 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 BOOK:

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 the student 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

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	M	L								M		M	L		M
CO 2	M	L	L							M		M	M	M	
CO 3	M		L									M			
CO 4	M		M									M	L	L	
CO 5	M				M			M		M	M	M	M	H	M
18MPE$07	M	L	L		M			M		M	M	M	M	M	M

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

18MPE$08	WELDING TECHNOLOGY

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 18MPC306 Manufacturing Technology I

COURSE OBJECTIVES:

- To study the welding processes, understanding of inspection methods of welded products and also helps to know the material considerations of this operation.

UNIT – I : GAS, ARC AND RESISTANCE WELDING PROCESSES	**(9 Periods)**
Classification and characteristics - Welding processes and Methods - Gas Welding - Gas welding equipments, flame characteristics - Arc welding processes -SMAW - Electrodes - Gas metal arc welding – Flux cored arc welding – Submerged arc welding – GTAW – Principles of Resistance welding – Spot Welding - Seam welding, Seamless welding – Percussion welding.	
UNIT – II : SPECIAL WELDING PROCESSES	**(9 Periods)**
Ultrasonic welding - Explosive welding- diffusion welding - Friction welding - Plasma - Transferred welding - Electron beam welding - Laser beam welding - Friction stir welding - Allied welding processes - Brazing and Soldering .	
UNIT – III :WELDING METALLURGY	**(9 Periods)**
Weld thermal cycles – Heat Affected Zone (HAZ) – Weldability of carbon steels, Cast Iron, Stainless steel, aluminum and its alloys, Copper, Titanium alloys, low alloy steels and Magnesium - Hydrogen embrittlement – Pro and post weld heat Treatments.	
UNIT – IV : WELDING OF SIMILAR AND DISSIMILAR METALS	**(9 Periods)**
Welding similar and dissimilar metals - welding of ceramics, composites, micro welding of thin components - Defects in weldments, mechanism - reasons and remedies of cold cracking - hot cracking- reheated cracking and lamellar tearing.	
UNIT – V : DESIGN OF WELD JOINTS, WELDABILITY, INSPECTION AND TESTING OF WELDMENTS	**(9 Periods)**
Design of weld joints and problems – welding symbols - Testing of welds – quality in weldment – weldability assessment and weldability tests - destructive and NDT evaluation of weldments - procedure for destructive testing - tensile, bending and toughness tests - magnetic particle test - X Ray, gamma, ultrasonic and acoustic tests.	

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, 1997.*
2. *Howard B. Cary, Scott C. Helaer., **"Modern Welding Technology"**, Pearson Education. Ltd, 2011.*

REFERENCE BOOKS:

1. *Nadkarni S.V., **"Modern Arc Welding Technology",** South Asia Books, 1988.*
2. *Little R.L., **"Welding and welding Technology",** Tata McRaw Hill Publishing Co.,Ltd. , New Delhi, 1989.*
3. *A.Elango, K.Kalaiselvan, **"Laser Welding Technology",** Anuradha Publications, Chennai,2016.*
4. *O.P.Khanna**, "Welding Technology",** DhanpatRai and sons, 2008.*
5. *Baldev Raj, V. Shankar, A.K.Bhaduri, **"Welding Technology for Engineers**", Alpha Science International, 2006.*

COURSE OUTCOMES:

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

CO 1: Provide the principle of the welding process for joints production to the machine products

CO 2: Operate the latest and special welding process for uncommon new and specialized components

CO 3: Evaluate the physical and chemical properties change due to the welding

CO 4: Join the different dissimilar materials as per requirement

CO 5: Inspect its quality of welded portion of machine component.

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	L	L										L		
CO2				L							M		M	L	L
CO3	M	M									L		M	L	
CO4	L	L					M						L		
CO5	L					L			L		M		M	L	M
18MPE$08	L	L	L	L		L	L		L		L		M	L	L

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

18MPE$09	**REFRIGERATION AND AIR CONDITIONING** *(Use of Approved Refrigeration and Air conditioning Tables and Charts are Permitted)*

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 18MPC405 Thermodynamics
2. 18MPC504 Thermal Engineering

COURSE OBJECTIVES:

- To study different refrigeration systems used in households, industries and development of air conditioning systems based on cooling load.

UNIT – I : REFRIGERATION CYCLES AND REFRIGERANTS	**(9 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	**(9 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	
UNIT – III : SYSTEM COMPONENTS	**(9 Periods)**
compressors – reciprocating, rotary and centrifugal compressors, evaporators- flooded, dry expansion, shell and tube and double pipe evaporators, condensers – air cooled, water cooled and evaporative condensers, expansion devices – automatic, capillary tube and thermostatic expansion valve.	
UNIT – IV : DUCT DESIGN AND DISTRIBUTION	**(9 Periods)**
Air distribution systems – study of different types of duct systems, methods of duct design, duct insulation, air purity – air cleaning methods.	
UNIT – V : AIR CONDITIONING AND COOLING LOAD	**(9 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: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Arora S C and Domkundwar S., **"Refrigeration and Airconditioning"**, DhanpatRai& Sons 8th Edition,, New Delhi, 1997.*
2. *Roy J Dossat, **"Principle of Refrigeration"**, Wiley Eastern Limited, Fifth Edition 2001.*

REFERENCE BOOKS:

1. *Stocker, **"Refrigeration and Air Conditioning"**, Tata McGraw Hill Publishing Company Limited, New Delhi, 1982.*
2. *Manohar Prasad, **"Refrigeration and Air Conditioning",** Wiley Eastern Limited, 2004.*
3. *Jordan and Prister, **"Refrigeration and Air Conditioning",** Prentice Hall of India Limited, NewDelhi, 1985.*
4. *Arora C.P, **"Refrigeration and Air Conditioning"**, Tata McGraw Hill Publishing Company Limited, 3rd Edition, NewDelhi, 2009.*
5. *P.N. Ananthanarayanan **" Basic Refrigeration and Air Conditioning"**, Tata McGraw Hill Publishing Company Limited, 4th Edition, 2013.*

COURSE OUTCOMES

On completion of this course, students will be able to

CO1: Work on various refrigeration cycles

CO2: Work on various refrigeration systems operated using heat energy

CO 3: Design refrigeration components.

CO 4: Design air distribution systems.

CO 5: Estimate cooling load for air conditioning.

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		L			L	M				L		L	L	L
CO2	M		L			L	M				L		L	L	L
CO3	M	M	L			L	M				L		L	L	L
CO4	M	M	L			L	M				L		L	L	L
CO5	M		L			L	M				L		L	L	L
18MPE$09	M	L	L			L	M				L		L	L	L

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

18MPE$10	**OPERATIONS RESEARCH** *(Use of Approved Statistical Tables Permitted)* *(Common to MECH, ECE Branches)*

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 18MBS102 Calculus and Linear Algebra
2. 18MBS302 Partial Differential Equations, Probability and Statistics

COURSE OBJECTIVES:

- To acquire knowledge of linear programming and network problems and their solving techniques.
- To develop the skill of resolving queing situations and comprehend decision strategies.

UNIT – I: LINEAR MODELS	**(9 Periods)**
Development - Characteristics and Phases of operation research - Types of models – graphical method – simplex algorithm – duality formulation – dual simplex method. Linear Programming Problem - Formulation – Graphical solution – Simplex method - Solution by Excel solver.	
UNIT – II: NETWORK AND SEQUENCING MODELS	**(9 Periods)**
Network models – shortest route – minimal spanning tree – maximum flow models – project network – PERT and CPM networks – critical path scheduling – sequencing models - Flow –Shop sequencing – 'n' jobs through two machines – n jobs through three machines – Job shop sequencing – two jobs through 'm' machines	
UNIT – III: INVENTORY, TRANSPORTATION AND ASSIGNMENT MODELS	**(9 Periods)**
Inventory models – economic order quantity models – safety stock – reorder point – lead time – quantity discount models – transportation problems – Formulation – Optimal solution, unbalanced transportation problem – Degeneracy. Assignment problems - Formulation – Optimal solution - Variants of Assignment Problem.	
UNIT – IV: QUEUING THEORY	**(9 Periods)**
Queuing models – queuing systems and structures – notation parameter – single server and multi server models – poisson arrival – exponential service – simulation – Monte Carlo technique – use of random numbers – Exercise problems.	
UNIT –V: DECISION MODELS	**(9 Periods)**
Decision models – game theory – two person zero sum games – graphic solution – replacement models – replacement policies - models based on service life – economic life. Dynamic Programming: Introduction – Terminology - Bellman's Principle of Optimality – Applications of dynamic programming- shortest path problem.	

Contact Periods:

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

TEXT BOOKS:

1. A.M.Natarajan, P.Balasubramaniam, A. Tamilarasi ***"Operations Research",*** *Pearson Education, 2011.*

2. P.K. Gupta & D.S. Hira, ***"Problems in Operations Research (Principles & Solutions)",*** *S.Chand & Co. Ltd., 2013.*

3. Taha Hamdy A, ***"Operations Research"****, Prentice Hall of India Pvt. Ltd., 2010.*

REFERENCE BOOKS:

1. Dharani Venkatakrishnan. S, ***"Operations Research"*** *(Principles & Problems), Keerthi Publishing House Pvt. Ltd., 2006.*

*2. Don. T. Phillips, Ravindren, A and James Solberg****, "Operations Research"****, John Wiley & Sons, 2009.*

3. Fourer, D.Gay and B. Kernighan, AMPL, ***"A Modeling Language for Mathematical Programme"****, Brooks/Cole-Thomson, 2007.*

4.J.K.Sharma ***"Operation Research"*** *MacMilan., 2009*

COURSE OUTCOMES:

Upon completion of the course, student will be able to

CO 1: Understand the use of linear programming problems and methods of solving

CO 2: Evaluate optimal routes with minimum distance and maximal flow capacity so as to reduce cost.

CO 3: Apply economic order quantity concept to minimize inventory carrying charges.

CO 4: Analyse queing situations thereby reduce waiting time of costumers and make effective System utilization.

CO 5: Make strategic decisions.

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	L	H					L	L	L	L	L	M
CO2	H	M	M	L	L					L	L	M	L	L	M
CO3	H	H	H	M	L					L	M	L	L	L	M
CO4	H	L	M	M	L					L	L	M	L	L	M
CO5	H	M	M	M	L				H	L	L	H	L	L	M
18MPE$10	H	M	M	M	L				L	L	L	M	L	L	M

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

18MPE$11	BOILER TECHNOLOGY

PRE-REQUISITIES: NIL

COURSE OBJECTIVES:

- To make the students to learn various power generation units, steam generators and safety standards of various steam generating units.

UNIT –I: INTRODUCTION	**(9 Periods)**
Function of boilers, Classification of boilers,Parameter of a steam Generator – Thermal calculations of Modern steam Generator – Tube Metal Temperature Calculationand choice of Materials – Steam purity Calculations and Water treatment.	
UNIT-II BOILER DESIGN	**(9 Periods)**
Design of Boiler Drum – Steam Generator Configurations for Industrial Power and Recovery Boiler – Pressure Loss and circulation in Boilers.	
UNIT-III DESIGN OF ACCESSORIES	**(9 Periods)**
Design of Air Preheaters – Economizers and Super heater for high pressure steam Generators – Design Features of Fuel Firing Systems and Ash Removing Systems.	
UNIT –IV: BOILER CODE	**(9 Periods)**
IBR and International Regulations – ISI Code's Testing and Inspection of Steam Generator – Safety Methods in Boilers – Factor of safety in the Design of Boiler Drum and Pressure Parts-Safety of Fuel Storage and Handling– Safety Methods of Automatic Operation of Steam boilers.	
UNIT –V: STEAM POWERPLANTS	**(9 Periods)**
Combined cycle power generation– Heat Recovery Steam Generators (HRSG) fired and unfired, co-generation plants- Rankine cycle with internal and external irreversibility– reheat factor, reheating and regeneration	

Contact Periods:

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

TEXT BOOKS:

1. *Kumar Rayaprolu **"Boilers for Power and Process",** April 23, 2009 by CRC Press.*
2. *David Gunn, Robert Horton, **"Industrial Boilers",** Longman Scientific & Technical Publication**, 2000.***

REFERENCE BOOKS:

1. ***"Carl schields",** Boilers–Type Characteristics and function**, McGraw Hull Publishers, 2002.***
2. *Large Boiler Furnaces**, "Richard Dolezal Elsevier Company", 2008.***
3. *Boilers: A Practical Reference **"Kumar Rayaprolu",** CRC Press, 2012*
4. *P. Chatopadhyay; **"Boiler Operation Engineering**": Questions and Answers; Tata McGrawHill Education Pvt Ltd, New Delhi.*
5. *V.Ganapathy,**" Industrial Boilers and Heat Recovery Steam Generators: Design, Applications and Calculations"*** Marcel Dekker,2013.

Web References:

1. *http://www.volund.uk*
2. *http://www.aee.vatech.co.at*
3. *http://www.thermomax.com*
4. *http://www.pages.hotbot.com*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO 1: Gain knowledge in different types of boilers used in different industries and problems raised in boiler maintenance and solve them.

CO 2: Economically utilize the heat in industries within the knowledge of Indian boiler regulation act.

CO 3: Know about the kind of boilers being used in various industries and their applicability.

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	H	L	L	H	H	M	H	M	H	M	L
CO2	H	H	M	H	M	H	M	M	H	L	L	L	H	H	M
CO3	H	H	H	M	L	H	M	M	L	H	M	H	M	M	M
18MPE$11	H	H	H	M	M	M	M	M	M	M	M	M	H	M	M

L – Low M-Moderate (Medium) H-High

18MPE$12	GAS DYNAMICS AND JET PROPULSION *(Use of Standard Gas Tables permitted)*

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 18MPC405 Thermodynamics
2. 18MPC305 Fluid Mechanics and Machinery

COURSE OBJECTIVES:

- To impart knowledge on behaviour of compressible flow and propulsion systems

UNIT – I: BASIC CONCEPTS AND ISENTROPIC FLOWS	**(9 Periods)**
Energy and momentum equations of compressible fluid flows - Stagnation states, Mach waves and Mach cone – Effect of Mach number on compressibility – Isentropic flow through variable ducts – Nozzle and Diffusers	
UNIT – II: FLOW THROUGH DUCTS	**(9 Periods)**
Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) – Friction Choking and Its Consequences, variation of flow properties.	
UNIT – III: NORMAL AND OBLIQUE SHOCKS	**(9 Periods)**
Governing equations – Variation of flow parameters across the normal and oblique shocks – Prandtl Meyer Flow around Concave and Convex Corners, Prandtl – Meyer relations – Applications.	
UNIT – IV: JET PROPULSION	**(9 Periods)**
Theory of jet propulsion – Thrust equation – Thrust power and propulsive efficiency – Operating principle, cycle analysis and use of stagnation state performance of ram jet, turbojet, and turbofan and turbo prop engines.	
UNIT – V: SPACE PROPULSION	**(9 Periods)**
Types of rocket engines: Solid, Liquid and Hybrid Propellant Rockets – Propellants-feeding systems – Ignition and combustion – Theory of rocket propulsion – Performance study – Staging – Terminal and characteristic velocity - Applications – space flights.	

Contact Periods:

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

TEXT BOOKS:

1. *E.Rathakrishnan., **"Gas Dynamics"** Prentice Hall of India private limited, 2012.*
2. *Yahya, S.M. **"Fundamentals of Compressible Flow with aircraft and rocket propulsion",** New Age International (P) Limited, New Delhi, 2016.*
3. *G.P.Sutton, **"Rocket Propulsion Elements",** 7th Edition, A wiley interscience publication, US 2001.*

REFERENCE BOOKS:

1. *Hill. P. and C. Peterson,* ***"Mechanics and Thermodynamics of Propulsion",*** *Addison – Wesley Publishing company, 1992.*
2. *Zucrow. N.J.,* ***"Aircraft and Missile Propulsion"****, Vol.1 & II, John Wiley, 1975.*
3. *Zucrow. N.J.,* ***"Principles of Jet Propulsion and Gas Turbines",*** *John Wiley, New York, 1970.*
4. *Anderson, J.D.,* ***"Modern Compressible flow"****, 3rd Edition, McGraw Hill,2003.*
5. *V.Babu.,* ***"Fundamentals of Gas Dynamics",*** *Athena Academic Ltd, UK, 2015.*

COURSE OUTCOMES

On completion of the course students will be able to

CO1: Apply the concepts of isentropic flow in practical applications.

CO2: Analyze the flow phenomena in ducts.

CO3: Identify and analyze the normal and oblique shocks.

CO4: Design the jet propulsion engine systems.

CO5: Select and design space propulsion 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	L	L	M	H	M	L		L			L		M	H	L
CO2	L	L	M	H	M	L		L			L		M	H	L
CO3	L	L	L	H	M	L		L			L		M	H	L
CO4	L	L	M	H	M	L		L			L		M	H	L
CO5	L	L	M	H	M	L		L			L		M	H	L
18MPE$12	L	L	M	H	M	L		L			L		M	H	L

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

18MPE$13	PROCESS PLANNING AND COST ESTIMATION

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 18MPC306 Manufacturing Technology I
2. 18MPC406 Manufacturing Technology II

COURSE OBJECTIVES:

- To give an understanding of the fundamentals of Process Planning and estimation of appropriate costs of processes and products and applying these to manage competitive manufacturing systems and organizations

UNIT – I: PROCESS PLANNING	**(9 Periods)**
Introduction of Process Planning- Aims and Objectives- material evaluation methods of process planning, steps in process selection, production equipment and tooling selection Place of process planning in Manufacturing cycle, Drawing interpretation, Dimensional tolerance vs Production processes	
UNIT – II : PROCESS PLANNING STEPS	**(9 Periods)**
Design of a process plan – Selection of production processes, tools and process parameters- Positioning and work holding devices, selection of jigs and fixtures, selection of quality assurance methods, Selection of inspection devices and tools, Documenting the process plan, Simple Case studies. Computer-Aided Process Planning (CAPP) – Benefits, Architecture and approaches.	
UNIT – III : COST ESTIMATION	**(9 Periods)**
Importance, Types, Purpose, Components, Procedure, Classification of costs, Cost elements, Overhead expenses, Break-even analysis, types of estimates, estimating procedure, estimation of labor cost, material cost, allocation of overhead charges, calculation of depreciation cost.	
UNIT – IV : PRODUCTION COST ESTIMATION	**(9 Periods)**
Estimation of production cost for - Casting processes, Welding processes, and Forging processes, different production processes for different jobs, estimation of forging cost, estimation of welding cost, estimation of foundry cost, estimation of machining cost.	
UNIT – V : ESTIMATION OF MACHINING TIME AND COST	**(9 Periods)**
Importance of machine time calculation, machining time for different lathe operations, drilling and boring time calculations, Machining time calculation for Milling, Shaping, Planing and Grinding, Cost estimation for machining processes.	

Contact Periods:

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

TEXT BOOKS:

1. *Gideon Halevi,* ***"Process and Operation Planning",*** *Kluwer academic publishers (Printed ebook), 2003*
2. *M. Adithan,* ***"Process Planning and Cost Estimation",*** *New Age International Publishers, 2007*
3. *T.R.Banga and S.C.Sharma,* ***"Estimations and Costing",*** *Khanna Publishers,1988*

REFERENCE BOOKS:

1. *Peter Scalon,* ***"Process Planning, Design/ Manufacture Interface"****, Elsevier Sci.&Tech. 2002.*
2. *Ostwaal P.F. and Munez J.,* ***"Manufacturing Processes and Systems"****, 9th ed., John Wiley*
3. *Chitale A.V. and Gupta R.C.,* ***"Product Design and Manufacturing"****, 2nd ed., Prentice Hall*
4. *Robert Creese, M. Adithan, B.S Pabla,* ***"Estimating and Costing for the Metal Manufacturing Industries",*** *Marcel Dekker, 1992.*
5. *G.B.S. Narang, V. Kumar,* ***"Production and Costing",*** *Khanna Publishers, 2000*

COURSE OUTCOMES:

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

CO1: Select logical, rational and economical process plans, equipment and tools.

CO2: Estimate process planning steps and select work holding devices

CO3: Estimate cost of Components and Products**.**

CO4: Estimate production cost of various manufacturing processes

CO5: Estimate Machining time and cost of various machining processes

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	H	H	L	M	M	M	H	H	M	M	M
CO2	H	H	M	H	H	L	L	M	M	M	L	H	M	H	M
CO3	H	H	M	H	M	H	M	M	M	M	M	M	M	H	M
CO4	H	H	M	H	M	M	M	L	M	M	M	M	M	H	M
CO5	H	M	M	M	M	M	M	M	M	L	M	M	M	H	M
18MPE$13	H	H	L	M	H	M	H	H	M	H	M	M	M	M	M

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

18MPE$14	**LEAN MANUFACTURING** *(Common to MECH & PROD Branches)*

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 18MPC306 Manufacturing Technology I
2. 18MPC406 Manufacturing Technology II

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, 2012.*
2. *Gopalakrishnan N,* ***"Simplified Lean Manufacture: Elements, Rules, Tools and Implementation"****, Prentice Hall of India Learning Private Limited, 2010.*
3. *Bill Carreira,* ***"Lean Manufacturing that Works: Powerful Tools for Dramatically Reducing Wastes and Maximizing Profits"****, Prentice Hall of India Learning Private Limited, 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:

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		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	
CO5		M	H		L		L		L						
18MPE$14	M	L	M	M	L	M	L	L	L	M	L	M	L	M	L

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

18MPE$15	POWER PLANT ENGINEERING *(Common to MECH & PROD Branches)*

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 18MPC504 Thermal Engineering

COURSE OBJECTIVES:

- To learn the economics of power generation.
- To understand the working of power plant 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. *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, Learners will be able to

CO 1: Arrive at cost of power generation, electricity billing and rate of return on power plant investments

CO 2: Understand the working of Hydro-electric power plants.

CO 3: Analyze the working of Conventional power plants such as Thermal and Gas Turbines.

CO 4: Understand the working of nuclear power plants and its functional components.

CO 5: Understand the different types of renewable energy systems and its functional components.

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	L	H	M	H	L	M	L	L	L	M	H	M	H	M
CO2	L	M	H	L	M	L	H	M	M	L	H	L	L	H	H
CO3	M	M	H	M	M	H	M	L	L	H	M	M	H	H	L
CO4	H	M	L	M	H	M	L	M	L	H	H	M	M	H	H
CO5	M	L	L	H	M	M	L	H	H	M	H	H	M	H	M
18MPE$15	M	M	M	M	M	M	M	M	M	M	H	M	M	H	M

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

18MPE$16	MECHANICAL VIBRATIONS

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 18MES303 Engineering Mechanics,
2. 18MPC503 Dynamics of Machines

COURSE OBJECTIVES:

- To introduce the fundamentals in Vibration, Vibration analysis of systems. To develop a working knowledge required to understand the physical significance and design, analyze the vibration systems with desired conditions.

UNIT – I: FUNDAMENTALS OF VIBRATIONS	**(9 Periods)**
Kinematics of simple vibrating motion - Simple harmonic motions - Vectorial representation of harmonic motion - Degree of freedom - Equations of motions - general solution of free vibration - fourier series and harmonic analysis –Workdone by harmonic force	
UNIT – II: FREE VIBRATIONS	**(9 Periods)**
Undamped free vibration-differential equations – torsional vibrations - eqivalent stiffness of spring combinations - Transverse vibrations of beams – beams with several masses - Bifilar suspension - free damped vibration – types - differential equations of free damped vibration – Critical damping - applications of critical damping.	
UNIT – III: FORCED VIBRATIONS	**(9 Periods)**
Sources of excitation - Equations of motion with harmonic force - response of rotating and reciprocating unbalance system - vibration isolation – transmissibility - forced vibrations with coulomb damping ,viscous damping- Introduction to chatter - vibration measuring instruments	
UNIT – IV: MULTI DEGREES FREEDOM SYSTEM	**(9 Periods)**
Vibrations of undamped two degrees of freedom systems – Forced vibrations - damped free vibrations - forced harmonic vibrations - coordinate coupling - Several degrees of freedom system - influence coefficient - generalized coordinates - matrix method - orthogonality principle - eigen values and eigenvectors	
UNIT – V: CONTINUOUS SYSTEMS	**(9 Periods)**
Transverse vibration of strings - Longitudinal vibrations of bars - Lateral vibration of beams - Torsional vibration of circular shafts - Whirling of shafts. Introduction - Method of Laplace transformation and response to an impulsive output - response to step-input, pulse-input, and phase plane method.	

Contact Periods:

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

TEXT BOOKS:

1. *V.P.Singh, **"Mechanical Vibrations",** Dhanapatrai & Sons, 2005*
2. *Thomson.,**"Mechanical Vibration",** Prentice Hall, 1998.*

REFERENCE BOOKS:

1. G.K. Grover, ***"Mechanical vibration",*** *Nemchand Chand and Sons, 2010*

2. Den Hartog, ***"Mechanical Vibration",*** *Waveland PrInc,2002*

3. Singiresu S. Rao , ***"Mechanical Vibrations",*** *4Th Edition ,Printice hall,2010*

COURSE OUTCOMES:

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

CO 1: Study the basics of vibration.

CO 2: Formulate mathematical models of problems in free vibrations

CO 3: Determine a complete solution to forced vibration problems using mathematical or numerical techniques

CO 4: Able to identify multi degrees of freedom system and solving problems using mathematical and numerical technique.

CO 5: Apply the knowledge to design the continuous vibration system for the requirement of industry

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	L	L	L	L	L	L	L	L	L	L	M	M	L
CO2	H	H	M	L	M	L	L	L	L	L	L	M	M	H	L
CO3	H	M	M	L	L	L	M	M	L	L	L	M	H	H	L
CO4	H	H	M	L	L	L	L	M	L	L	L	H	M	H	L
CO5	H	H	H	L	L	L	L	M	M	L	L	L	H	H	M
18MPE$16	H	H	M	L	L	L	L	M	L	L	L	M	M	H	L

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

18MPE$17	**ADDITIVE MANUFACTURING** *(Common to MECH & PROD Branches)*

Category: PE

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 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

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	L	
CO2			M											M	L
CO3			L										M	L	
CO4			M		H	M	L						M	H	L
CO5		M				L					M		L	H	
18MPE$17		M	M		M	L	L				L		M	M	L

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

18MPE$18	AUTOMOBILE ENGINEERING

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 18MPC504 Thermal Engineering

COURSE OBJECTIVES:

- The learners are able to visualize the scope of Automobile Engineering.

UNIT – I :INTRODUCTON TO AUTOMOTIVES	**(9 Periods)**
An overview of different types of automobiles and their power sources. Specifications, Performance Parameters, Quality standards, Trends in automobile design	
UNIT – II : POWER SOURCE FEATURES	**(9 Periods)**
Reciprocating Engine systems, Rotary Engine systems, Gas Turbine systems, Hybrid systems - Pollutant emissions and their control; Catalytic converter systems, Electronic Engine management systems	
UNIT – III : TRANSMISSION, SUSPENSION AND BRAKING SYSTEMS	**(9 Periods)**
Clutch system, Gear box system, propeller shafting, differential, axles, wheels and tyres and Preliminaries of suspension systems	
UNIT – IV : AUXILIARY SYSTEMS	**(9 Periods)**
Electrical and electronic systems, safety systems, Heating, Ventilation, and Air Conditioning (HVAC) systems, Vehicle Thermal Management System and vehicle body design features.	
UNIT – V : TESTS, SERVICE AND MAINTENANCE	**(9 Periods)**
Engine Tuning, vehicle maintenance, engine and Chassis Dynamometry Pollutants and emissions Check, Wind Tunnel Tests, preliminaries of engine and vehicle testing.	

Contact Periods:

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

TEXT BOOKS:

*1. Dr. Kirpal Singh, **"Automobile Engineering Vol. I & II"**, Standard Distributors Publishers, 2012.*

*2. R.B.Gupta, **"Automobile Engineering"** Sathya Prakashan, New Delhi, 2006.*

REFERENCE BOOKS:

*1. William H.Crouse, **"Automotive Mechanics"**, McGraw Hill Book Co. 2004.*

*2. K.K. Ramalingam, **"Automobile Engineering – theory and Practice"** SciTech Publications, 2001.*

*3. Joseph Heinter **"Automobile Mechanics Principles and Practice"** Affiliated East West Press, 1997.*

*4. Jain K.K. and Asthana. R.B, **"Automobile Engineering"** Tata McGraw Hill Publishers, New Delhi, 2002.*

5. Heinz Heisler, ***"Advanced Engine Technology"*** *SAE International Publications USA, 1998.*

COURSE OUTCOMES:

On completion of this course, learners will be able to:

CO1: Identify the different components in an automobile.

CO2: Clearly understand different auxiliary and transmission systems.

CO3: Explain the working of various parts like engine, transmission, clutch, brakes

CO4: Understand the environmental implications of automobile emissions

CO5: Develop a strong base for understanding future developments in the automobile industry

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	M	L	H	M	M	M	L	L	L	H	M	M	H
CO2	H	M	H	H	M	H	L	L	L	M	M	L	H	M	H
CO3	M	M	M	L	M	H	M	L	L	M	H	L	H	H	M
CO4	H	M	H	M	H	M	H	H	M	M	H	L	L	L	H
CO5	M	L	L	L	M	H	M		L	H	H	H	H	M	H
18MPE$18	M	M	M	M	M	H	M	L	L	M	H	M	M	M	H

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

18MPE$19	ENTREPRENEURSHIP DEVELOPMENT

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVE:

- To identify and apply the concepts of entrepreneurship and to behave responsibly and ethically in their role of entrepreneurs in selection of the opportunity and management of resources and utilization of the support from Government and monetary institutions.

UNIT – I: INTRODUCTION TO ENTREPRENEURSHIP	**(9 Periods)**
Evolution of the concept of entrepreneurship, Characteristics of entrepreneurs, Functions of entrepreneurs, Types of Entrepreneurs, Differences with managers, Growth of entrepreneurship in India, Role of entrepreneurship in economic development, Factors affecting growth of entrepreneurship, Entrepreneurial competencies – Business model canvas.	
UNIT – II: START-UP OF ENTREPRENEURIAL VENTURES	**(9 Periods)**
Opportunity identification and selection, Establishment of incubation centres, Formulation of business plans, Project appraisal-Methods, Financing of ventures- Sources of finance-Internal and external sources, Forms of ownership, Legal issues of setting of ventures- Patents, Copyrights, trademarks	
UNIT – III: SUPPORT SYSTEM FOR ENTREPRENEURS	**(9 Periods)**
Institutional support for entrepreneurs- Commercial banks, Other financial institutions, Taxation benefits- Tax holiday, Investment allowance, Rehabilitation allowance, Amortization of certain preliminary expenses, Important provisions of the Industrial Policy Resolution – Government policies- Introduction to proposal writing.	
UNIT – IV: MANAGEMENT OF THE VENTURES	**(9 Periods)**
People Management- Leadership, Motivation, Communication, challenges caused by workforce diversity, Working Capital Management- Assessment of working capital, Factors determining working capital requirement, Working capital cycle, Inventory Management- Motives for holding inventories, Methods of inventory management.	
UNIT– V: STRATEGIES FOR GROWTH, SUCCESSION PLANNING, ENDING THE VENTURE	**(9 Periods)**
Growth strategies- Penetration of market, Product development, Market development, Diversification, External sources for growth- Joint ventures, Acquisitions, Mergers and Franchising, Succession planning- Transfer to family members, Selling the business, bankruptcy laws in India.	

Contact Periods:

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

TEXT BOOKS:

*1. Khanka,S.S., **"Entrepreneurial Development"** S.Chand & Company Private Limited, New Delhi,*

2015

2. *Hisrich, Manimala, Peters, Shepherd,* ***"Entrepreneurship"*** *McGraw Hill Education Private Limited, New Delhi, 2014*

REFERENCE BOOKS:

1. *Bruee R Barringer and Duane Ireland,* ***"Entrepreneurship – Successfully Launching New Ventures"****, Pearson – Prentice Hall, 2006.*
2. *Marc J Dollinger,* ***"Entrepreneurship – Strategies and Resources"****, Pearson Education, 2003.*
3. *Mary Coulter,* ***"Entrepreneurship in Action"****, Prentice Hall of India, 2006.*
4. *Robert D Hisrich, Michael P Peters and Dean Shepherd,* ***"Entrepreneurship"****, Tata McGraw Hill, 2007.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Provide an accurate self-analysis for an entrepreneurial career.

CO2: Find an attractive market and decide on the most suitable source of finance for the same.

CO3: Design and develop a entrepreneurial venture that would enjoy the maximum support from financial institutions and the Government.

CO4: Successfully meet the challenges of motivating and communicating with a diverse workforce.

CO5: Find alternative strategies to save a venture that is unable to sustain on its own.

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
CO2					M						M		L		
CO3								L	L			L			L
CO4								M	M	H					H
CO5				L				M					H		L
18MPE$19				L	L			L	L	L	L	L	L		L

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

18MPE$20	TOTAL QUALITY MANAGEMENT

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To facilitate the understanding of total quality management principle, processes and to develop a product with the required quality at affordable price with the satisfaction of customer

UNIT – I: QUALITY CONCEPTS	**(9 Periods)**
Introduction, need for quality, evolution of quality, definitions of quality, product quality and service quality; Basic concepts of TQM, TQM framework, contributions of Deming, Juran and Crosby. Barriers to TQM; Quality statements, customer focus, customer orientation & satisfaction, customer complaints, customer retention; costs to quality, case studies.	
UNIT – II: TQM PRINCIPLES	**(9 Periods)**
TQM principles; leadership, strategic quality planning; Quality councils, employee involvement, motivation; Empowerment; Team and Teamwork; Quality circles, recognition and reward, performance appraisal; Continuous process improvement; PDCA cycle, 5S, Kaizen,e-Kanban; Supplier partnership, Partnering, Supplier rating & selection, Quality Awards.	
UNIT – III: STATISTICAL PROCESS CONTROL	**(9 Periods)**
The seven traditional tools of quality; New management tools; Statistical fundamentals, population and sample, normal curve, control charts for variables, attributes and its applications, process capability; Six sigma, concepts, methodology, certification, applications to manufacturing, service sector including IT.	
UNIT – IV: TOOLS AND TECHNIQUES	**(9 Periods)**
Benchmarking needs and benefits, 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, Case studies.	
UNIT – V: QUALITY SYSTEMS	**(9 Periods)**
Introduction to 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, ISO45000, IATF16949; Implementation of TQM in manufacturing industry.	

Contact Periods:

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

TEXT BOOKS:

*1. Dale H.Besterfield, et al., **"Total Quality Management",** Pearson Education, 2008.*

*2. Subburaj Ramasamy, **"Total Quality Management",** Tata McGraw Hill, 2008.*

*3. Janakiraman B. and Gopal R.K., **"Total Quality Management"**, Prentice Hall India, 2006.*

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. *Mukherjee P.N.* ***"Total Quality Management",****PHI Publishers,2006*
5. *John.L Hradesky* ***"Total Quality Management Hand book"*** *McGraw-Hill, 1995.*

COURSE OUTCOMES

On completion of this course, students will be able to

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

CO2: Apply the principle of TQM in industries.

CO3: Evaluate statistical process control in industries.

CO4: Select appropriate quality tools to meet industrial requirements.

CO5: Implement appropriate quality standards for industries.

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	H			M		L		M			M	L	M	L
CO2	L	H							M			M			
CO3	L	H	M		L			L				M	L		L
CO4	L	H			M	H		M		H		M	M	M	L
CO5	L	H			M	M	L	M	H	H		M	M	M	L
18MPE$20	L	H	M		M	M	L	M	M	H		M	L	M	L

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

18MPE$21	ENERGY CONSERVATION AND MANAGEMENT

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 18MPC405Thermodynamics
2. 18MPC504 Thermal Engineering

COURSE OBJECTIVES:

- To acquire knowledge on energy auditing and management
- To aware about energy policies of various agencies

UNIT – I :BASICS OF ENERGY MANAGEMENT	**(9 Periods)**
Energy - Power – Past & Present scenario of World; National Energy consumption Data – Environmental aspects associated with energy utilization –Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers. Instruments for energy auditing.	
UNIT – II : FINANCIAL MANAGEMENT, ENERGY MONITORING AND TARGETING	**(9 Periods)**
Investment-need, appraisal and criteria, financial analysis techniques simple payback period, return on investment, net present value, internal rate of return, cash flows, risk and sensitivity analysis; financing options, energy performance contracts and role of Energy Service Companies (ESCOs) Energy Monitoring and Targeting: Defining monitoring & targeting, elements of monitoring and targeting, data and information-analysis, techniques – energy consumption, production, cumulative sum of differences (CUSUM). Energy Management Information Systems (EMIS).	
UNIT – III : ENERGY MANAGEMENT AND AUDIT	**(9 Periods)**
Definition, energy audit, need, types of energy audit. Energy management (audit) approach-understanding energy costs, Bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel and energy substitution, energy audit instruments and metering.	
UNIT – IV : THERMAL SYSTEMS	**(9 Periods)**
Stoichiometry, Boilers, Furnaces and Thermic Fluid Heaters – Efficiency computation and encon measures. Steam: Distribution and Usage: Steam Traps, Condensate Recovery, Flash Steam Utilization, Insulators and Refractories , Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems – Cooling Towers – D.G. sets	
UNIT – V : ENERGY, ENVIRONMENT, AIR POLLUTION AND CLIMATE CHANGE	**(9 Periods)**
United Nations Framework Convention on Climate Change (UNFCC), sustainable development, Kyoto Protocol, Conference of Parties (COP), Clean Development Mechanism (CDM), CDM Procedures case of CDM – Bachat Lamp Yojna and industry; Prototype Carbon Fund (PCF).	

Contact Periods:

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

TEXT BOOKS:

1. ***Energy Manager Training Manual*** *(4 Volumes) available at www.energymanager training.com, a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India, 2004.*
2. *Frank Kreith, D.Yogi Goswami* ***"Energy Management and Conservation Handbook"*** *Tailor and Franciss, 1st Edition, 2007.*

REFERENCE BOOKS:

1. *Witte. L.C., P.S. Schmidt, D.R. Brown,* ***"Industrial Energy Management and Utilisation"*** *Hemisphere Publ, Washington, 1988.*
2. *Callaghn, P.W. "****Design and Management for Energy Conservation****", Pergamon Press, Oxford, 1981*
3. *Dryden. I.G.C.,* ***"The Efficient Use of Energy"*** *Butterworths, London, 1982*
4. *Turner. W.C.,* ***"Energy Management Hand book"****, Wiley, New York, 1982.*
5. *Murphy. W.R. and G. Mc KAY,* ***"Energy Management"****, Butterworths, London 1987.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Understand and analyse the energy data of industries

CO2: Carryout energy accounting and balancing

CO3: Conduct energy audit and suggest methodologies for energy savings and

CO4: Utilise the available resources in optimal ways

CO5: Aware about energy policies

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	L	H	H	L	M	H	L	M	L	L	L	L	L
CO2	M		L			L	M	H	H		L	L	L	L	L
CO3	M	M	L			L	M	L		M	L	L	L	L	L
CO4	M	M	L	L	L	L	M		L		L	L	L	L	L
CO5	M		L			L	M				L	L	L	L	L
18MPE$21	M	L	L	L	L	L	M	L	L	L	L	L	L	L	L

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

18MPE$22	INDUSTRIAL ROBOTICS

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 18MES403 Basic Electronics Engineering
2. 18MPC404 Kinematics of Machines

COURSE OBJECTIVES:

* To familiarize students with the concepts and techniques of robot manipulator, its kinematics, programming and build confidence to choose, evaluate and incorporate robots in engineering systems.

UNIT – I: FUNDAMENTALS OF ROBOT	**(9 Periods)**
Robot; definition, robot anatomy, work envelope, types and classification, joint notations, types of joints, robot parts and their functions, specifications, speed of motion, pay load, precision of movement; Need for robots in Indian scenario, A view on Global and Indian manufacturers of Robots.	
UNIT – II: ROBOT DRIVE SYSTEMS AND END EFFECTORS	**(9 Periods)**
Drives; hydraulic, pneumatic, mechanical, electrical, Servo motors, Stepper motors, salient features, application, End effectors; types, Grippers; mechanical, pneumatic, hydraulic, magnetic, vacuum and limitations, Multiple grippers.	
UNIT – III: SENSORS AND MACHINE VISION	**(9 Periods)**
Requirements of sensors, principles, types and applications of: Proximity (Inductive, Hall effect, Capacitive, Ultrasonic and Optical) – Range (Triangulation, Structured light approach) – Speed, Position (resolvers, optical encoders) – Force – Torque – Touch sensors (binary, analog sensor), Introduction to Machine Vision; functions, image processing and analysis, training the vision system.	
UNIT – IV: ROBOT KINEMATICS AND ROBOT PROGRAMMING	**(9 Periods)**
Forward kinematics and Reverse kinematics of manipulators; two, three degrees of freedom, homogeneous transformation matrix, simple problems (2D), Lead through programming, Robot programming languages; VAL programming, motion commands, sensor commands, end effecter commands, simple programs for loading, unloading and palletizing operations, Advances in Robot Programming.	
UNIT – V: APPLICATIONS, IMPLEMENTATION AND ROBOT ECONOMICS	**(9 Periods)**
Robot cell design; types, application of robots in processing, assembly, inspection, material handling in Automobile, Medical Nuclear Industries, Implementation of robots in industries; safety considerations for robot operations, safety codes, Economic analysis of robots; pay back and rate of return method.	

Contact Periods:

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

TEXT BOOKS:

1. *Groover, M.P. **"Industrial Robotics – Technology, Programming and Applications"**, McGraw-Hill, 2012.*
2. *Yoram Koren, **"Robotics for Engineers"**, McGraw-Hill, 1992.*

REFERENCE BOOKS:

1. *Groover, M.P. **"Automation, Production Systems, Computer Integrated Manufacturing"**, Pearson Education, 2016.*
2. ***"Handbook of Industrial Robotics"**, Second Edition, John Wiley & Sons, Inc., 2007*
3. *Cameron Hughes, Trarey Hughes, **"Robot Programming"**, Pearson, 5th Edition., 2016.*
4. *Richard D.Klafter, Thomas A.Chmielewski and Micheal Negin, **"Robotic engineering –An Integrated Approach"**, Prentice Hall Inc, Englewoods Cliffs, 2005.*

COURSE OUTCOMES:

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

CO1: Understand the fundamental concept of robot for the selection of various applications
CO2: Control the robot actuation by selecting appropriate drives
CO3: Analyse the role of the sensors, machine vision and manipulators in Manufacturing System
CO4: Evaluate the Robot Kinematics and gain knowledge to write Robot Programs
CO5: Employ the robots in industries and identify the social and economic challenges

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	
CO2	M									M		M	L		
CO3	L				H					M		M		L	
CO4	L	M			M					M		M	M	M	M
CO5	L					M	M	M		M	L	M	M	M	M
18MPE$22	L	M			M	M	M	M		M	L	M	M	M	M

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

18MPE$23	COMPUTATIONAL FLUID DYNAMICS

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITIES:

1. 18MPC305 Fluid Mechanics and Machinery.

COURSE OBJECTIVES:

- To make the students to learn finite difference and finite volume discretized forms of CFD equations and their solutions.
- Provide the essential numerical background for solving the partial differential equations governing the fluid flow.

UNIT –I: FUNDAMENTALS OF CFD	**(9 Periods)**
Basics of CFD, Governing equations of Fluid Dynamics – Continuity, Momentum and Energy Equations, Physical Boundary and initial conditions, overview of numerical methods - Mathematical behavior of PDEs on CFD – Elliptic, Parabolic and Hyperbolic equations.	
UNIT–II: DISCRETISATION TECHNIQUES AND SOLUTION METHODOLOGIES	**(9 Periods)**
Methods of deriving discretization equations – Finite difference and Finite volume methods, Finite difference discretization of wave equation, Laplace equation, Burger's equation, numerical error and stability analysis. Time dependent methods – Explicit, Implicit – Crank – Nicolson methods, time split methods.	
UNIT –III: CFD TECHNIQUES	**(9 Periods)**
Finite volume formulation of steady one-dimensional convection and Diffusion problems, Central, upwind, hybrid and power-law schemes – Discretization equations for two dimensional convection and diffusion. Representation of the pressure – Gradient term and continuity equation – Staggered grid – Momentum equations – Pressure and velocity corrections – Pressure – Correction equation. SIMPLE algorithm and its variants.	
UNIT –IV: TURBULENCE MODELING	**(9 Periods)**
Time – averaged equation for turbulent flow, Turbulence models – Zero equation model, one equation model, two equation K-I models, and advanced models.	
UNIT –V: GRID GENERATION	**(9 Periods)**
Choice of grid, grid oriented velocity components, Cartesian velocity components, staggered and collocated grid arrangements, Algebraic Methods – Methods – Differential Equation methods – Adaptive grids.	

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

TEXT BOOKS:

1. *John D. Anderson, Jr., **"Computational Fluid Dynamics: The Basics with Applications",** McGraw Higher Ed Publication, 1st Edition, 2012.*
2. *Suhas V. Patankar, **"Numerical Heat Transfer and Fluid Flow",** Hemisphere Publishing Corporation, 1st Edition, 2017.*

REFERENCES BOOKS:

1. *Versteeg H.K, and MalasekeraW.,* ***"An Introduction to Computational Fluid Dynamics: The Finite Volume Method",*** *Pearson Publication, 2nd Edition, 2008.*
2. *D. A, Anderson, John C. Tannehill, Richard H. Pletcher,* ***"Computational Fluid Mechanics and Head Transfer",*** *CRC Press, 3rd Edition, 2012.*
3. *Muralidhar K, and Sundararajan T.,* ***"Computational Fluid Flow and Heat Transfer",*** *Narosa Publishing House, New Delhi, 2nd Edition, 2014.*
4. *TaylorC, and T.G Hughes.,* ***"Finite Element Programming of the Navier-Stokes Equation",*** *PineridgePress Limited, U.K., 1981.*
5. *Fletcher, Professor Clive A.J.,* ***"Computational Techniques for Fluid Dynamics",*** *Fundamental and GeneralTechniques, Springer – Verlag, 1996.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO 1: Appreciate different types of PDEs that arise in fluid flow and heat transfer problems.

CO 2: Design of Numerical Schemes for 1D model equations of flow fluid and implement large scale linear System solvers (iterative and direct)

CO 3: Propose the concepts of numerical schemes for unsteady viscous flows.

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	M	L	L	L	L	L	L	L	H	H	L
CO2	M	M	H	H	M	L	L	L	L	L	L	L	H	H	L
CO3	H	H	M	M	M	L	L	L	L	L	L	L	M	H	L
18MPE$23	H	H	H	M	M	L	L	L	L	L	L	L	H	H	L

L – Low M-Moderate (Medium) H-High

18MPE$24	DESIGN FOR MANUFACTURE

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 18MPC306 Manufacturing Technology I
2. 18MPC406 Manufacturing Technology II

COURSE OBJECTIVES:

- To create knowledge about the design factors which are influencing the manufacturing process
- To select proper manufacturing process with the environment concerns.

UNIT – I : DESIGN PRINCIPLESFOR MANUFACTURABILITY	**(9 Periods)**
General design principles for manufacturability – Mechanical properties of material: Tensile properties, Engineering stress-strain, True stress strain, Compression properties, Shear properties, mechanisms selection, evaluation method, process capability – feature tolerances –geometric tolerances – assembly limits –datum features – tolerance stacks.	
UNIT – II : FACTORS INFLUENCING FORM DESIGN	**(9 Periods)**
Working principle, material, manufacture, design- possible solutions - materials choice - influence of materials on form design - form design of welded members, forgings and castings.	
UNIT – III : MACHINING COMPONENT DESIGN	**(9 Periods)**
Design features to facilitate machining - drills - milling cutters - keyways - reduction of machined area- simplification by separation - simplification by amalgamation - design for machinability - design for economy - design for clampability - design for accessibility - design for assembly. Recommended materials for machinability, Design recommendations - Design for machining round holes: Introduction, Suitable materials, Design recommendations, Recommended tolerances.	
UNIT – IV : CASTING COMPONENT DESIGN	**(9 Periods)**
Redesign of castings based on parting line considerations - minimizing core requirements, machined holes, redesign of cast members to obviate cores. Identification of uneconomical design - modifying the design - group technology. Die casting: Introduction to die casting, Applications, Suitable material consideration, General design consideration, Specific design recommendation, Design for powder metal processing: Introduction to powder metal processing, Typical characteristics and applications, Design recommendations.	
UNIT – V : DESIGN FOR ENVIRONMENT	**(9 Periods)**
Introduction – environmental objectives – global issues – regional and local issues – basic DFE methods – design guidelines – lifecycle assessment method – techniques to reduce environmental impact –design for energy efficiency – design to regulations and standards.	

Contact Periods:

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

TEXT BOOKS:

*1. Robert Matousek, **"Engineering Design- A systematic approach"**, Blackie &sons ltd., 1963*
*2. Harry Peck, **"Design for Manufacture"**, Pitman Publishers, 1983.*

REFERENCE BOOKS:

*1. Boothroyd, G, **"Design for Assembly Automation and Product Design"**, New York, Marcel Dekker. 1980*

*2. Bralla, **"Design for Manufacture handbook"**, McGraw hill, 1999.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO 1: Analyse the design principles for manufacturiability

CO 2: Selection of methods for productivity with considerations of factors

CO 3: Analyse the design considerations for machining the components

CO 4: Selection of component design for casting

CO 5: Selection of materials for the design of experiments

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	H	M	H	M	M	M	M	M	H	H	H	M
CO2	H	H	H	H	M	H	H	H	H	H	H	H	L	L	M
CO3	H	H	H	M	M	H	H	H	H	H	H	H	L	L	M
CO4	H	H	H	H	H	M	H	H	H	H	H	H	L	L	M
CO5	H	H	H	H	M	M	L	L	M	H	H	H	H	H	H
18MPE$24	H	H	H	H	M	H	M	M	H	H	H	H	M	M	M

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

18MPE$25	INSTRUMENTATION AND CONTROL

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

* To provide a basic knowledge about measurement systems and their components, learn about various sensors used for measurement of mechanical quantities and to integrate the measurement systems with the process for process monitoring and control.

UNIT-I: BASIC ELECTRICAL MEASUREMENTS AND SENSING DEVICES	**(9 Periods)**
Introduction- Forces of Electromagnetic Origin- Waveform Measures - Basic Analog Meters - Basic Digital Meters - The Oscilloscope -Oscilloscope Selection -Output Recorders-Counters—Time and Frequency Measurements -Transducers- The Variable-Resistance Transducer- The Differential Transformer (LVDT) - Capacitive Transducers -Piezoelectric Transducers- Photoelectric Effects - Photoconductive Transducers -Photovoltaic Cells - Ionization Transducers - Magnetometer Search Coil -Hall-Effect Transducers - Digital Displacement Transducers -Comparison of Analog and Digital Instruments.	
UNIT-II: FLOW MEASUREMENTS	**(9 Periods)**
Introduction-Positive - Displacement Methods – Flow - Obstruction Methods - Practical Considerations for Obstruction Meters - The Sonic Nozzle - Flow Measurement by Drag Effects - Hot-Wire and Hot-Film Anemometers -Magnetic Flowmeters – Flow -Visualization Methods -The Shadowgraph - The Schlieren - The Interferometer -The Laser Doppler Anemometer (LDA) - Smoke Methods -Pressure Probes - Impact Pressure in Supersonic Flow.	
UNIT-III: FORCE, TORQUE, AND STRAIN MEASUREMENTS	**(9 Periods)**
Introduction - Mass Balance Measurements - Elastic Elements for Force Measurements - Torque Measurements - Stress and Strain - Strain Measurements - Electrical-Resistance Strain Gages - Measurement of Resistance Strain-Gage Outputs - Temperature Compensation - Strain-Gage Rosettes - The Unbonded Resistance Strain Gage.	
UNIT-IV: SYSTEM MODELS	**(9 Periods)**
Introduction - static response and dynamic response – Gain –Gain of systems in series, Feedback loops, Dynamic response – Mechanical systems, Rotational systems, Electrical systems, Thermal systems, Hydraulic systems, transfer function and system transfer functions, Block manipulation, Multiple inputs.	
UNIT- V: CONTROLLERS	**(9 Periods)**
P, PI, PID Controllers, tuning of controllers, Proportional steady-state offset, Disturbance rejection, Integral wind-up - Frequency response,Nyquist diagrams and their use, Systems with dead time - Cascade control, Feedforward control.	

Contact Periods:

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

TEXT BOOKS:

1. *J. P. Holman, **"Experimental methods for engineers"**,8th edition, Tata McGraw-Hill, 2015*

2. *W. Bolton, **"Instrumentation and control systems"** ,2nd edition, Newnes, 2015.*

REFERENCE BOOKS:

*1. Thomas G. Beckwith, Roy D. Marangoni, John H. LienhardV, **"Mechanical Measurements"** (6th Edition), Pearson Education India, 2007.*

*2. Gregory K. McMillan, **Process/Industrial Instruments and Controls Handbook**, Fifth Edition,McGraw-Hill: New York,1999.*

3. *Harold L. Wade, **Basic and advanced regulatory control: system design and application**, ISA-The Instrumentation, Systems, and Automation Society , 2004.*

COURSE OUTCOMES

On completion of the course students will be able to

CO1: Understand the electrical measurements and sensing devices.
CO2: Identify the flow measurements instrumentation system requirements.
CO3: Select and use force, torque, and strain measurement instrument.
CO4: Identify the mechanical system model equivalent to instrumentation.
CO5: Identify the controller requirements and its stability.

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	L	M	M	H						L		L	M	L
CO2	L	L	M	M	H						L		L	M	L
CO3	L	L	M	M	H						L		L	M	L
CO4	L	L	M	M	H						L		L	M	L
CO5	L	L	M	M	H						L		L	M	L
18MPE$25	L	L	M	M	H						L		L	M	L

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

18MPE$26	AUTOMATION IN MANUFACTURING

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 18MPC306 Manufacturing Technology I
2. 18MPC406 Manufacturing Technology II

COURSE OBJECTIVES:

- To understand the importance of automation in the of field machine tool based Manufacturing.
- To get the knowledge of various elements of manufacturing automation – CAD/CAM, Sensors, pneumatics, hydraulics and CNC.
- To understand the basics of Automated guided vehicle systems and Industrial Robotics.

UNIT – I : AUTOMATION IN PRODUCTION SYSTEMS	**(9 Periods)**
Introduction: Current trends, CAD, CAM, CIM; Rigid automation: Part handling, Machine tools and Automated Material handling. Assembly, Flexible fixturing Basic Elements of an automated system – Levels of Automation – Lean Production and Just-In-Time Production.	
UNIT – II : CONTROL TECHNOLOGIES	**(9 Periods)**
Basic Elements of an Automated System-Levels of Automation, industrial control systems, sensors, actuators, and other control system components- Mechanical & Electro mechanical Systems, Pneumatics and Hydraulics, NC and NC part programming, CNC-Adaptive Control , DNC, Engineering analyses of NC Positioning Systems.	
UNIT – III : CELLULAR MANUFACTURING	**(9 Periods)**
Group Technology(GT), Part Families – Parts Classification and coding – Simple Problems in OPITZ Part Coding system – Production flow Analysis – Cellular Manufacturing – Composite part concept – Machine cell design and layout – Quantitative analysis in Cellular Manufacturing –Rank Order Clustering Method - Arranging Machines in a GT cell – Hollier Method – Simple Problems.	
UNIT – IV : FLEXIBLE MANUFACTURING SYSTEM	**(9 Periods)**
Types of Flexibility - FMS – FMS Components – FMS Application & Benefits – FMS Planning and Implementation Issues – Quantitative analysis of Bottleneck Model on simple problems in FMS. Automated Guided Vehicle System (AGVS) – AGVS Application – Vehicle Guidance technology – Vehicle Management & Safety	
UNIT – V : BASICS OF INDUSTRIAL ROBOTICS	**(9 Periods)**
Robot Anatomy and Related Attributes – Classification - Control systems – End Effectors – Sensors – Applications – Basics of Robot Part Programming – Robot Accuracy and Repeatability– Simple Problems- Introduction to Internet of Things.	

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",*** *prentice Hall*
2. *SeropeKalpakjian and Steven R. Schmid,* ***"Manufacturing – Engineering and Technology"****, 7th edition,Pearson*
3. *YoramKoren,* ***"Computer Control of Manufacturing System"****, 1st edition*

REFERENCE BOOKS:

1. *Kant Vajpayee S,* ***"Principles of Computer Integrated Manufacturing",*** *Prentice Hall India, 2003.*
2. *Radhakrishnan P, Subramanyan S.and Raju V.,* ***"CAD/CAM/CIM",*** *2nd Edition, New Age International (P) Ltd, New Delhi, 2000.*
3. *Gideon Halevi and Roland Weill,* ***"Principles of Process Planning – A Logical Approach"*** *Chapman & Hall, London, 1995.*
4. *Geoffrey Boothroyd,* ***"Assembly Automation and Product Design",*** *Second Edition, Taylor and Francis Group.*
5. *P Rao, N Tewari and T.K. Kundra,* ***"Computer Aided Manufacturing",*** *Tata McGraw Hill, 2000.*

COURSE OUTCOMES:

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

CO1: Get a comprehensive picture of computer based automation of manufacturing operations

CO2: Analyze mechanical, electromechanical, Pneumatic hydraulic and NC systems

CO3: Analyze Cellular manufacturing system

CO4: Analyze Flexible Manufacturing System and Automated Guided Vehicle System

CO5: Know basic controlling of Industrial Robotics

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
18MPE$26	H	H	L	M	H	M	H	H	M	H	M	M	M	M	M

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:

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

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

Category : OE

PRE-REQUISITES: NIL

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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 proframming 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)*

Category: OE

PRE-REQUISITES: NIL

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	FUNDAMENTAL CONCEPTS OF BIOLOGY FOR ENGINEERS *(Common to All Branches)*

Category: OE

PRE-REQUISITES: NIL

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)*

Category: OE

PRE-REQUISITES: NIL

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: 00 Periods** **Practical: 00 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

18MVA$01	YOGA FOR YOUTH EMPOWERMENT *(Common to CIVIL, MECH, EEE & PROD Branches)*

Category: VA

L	T	P	C
1	0	0	1

PRE-REQUISITES: NIL

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. *Yoga for Modern Age – Vethathiri Maharashi*
2. *Mind – Vethathiri Maharashi*

COURSE OUTCOMES:

Upon 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						
18MVA$01						L	L		M		L		L	L	L

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

18MVA$02	BASICS OF CIVIL ENGINEERING *(Common to MECH & PROD Branches)*

Category: VA

L	T	P	C
1	0	0	1

PRE-REQUISITES: NIL

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

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	L		L						L					
CO2						L		L	M	M	H	L			
18MVA$02	H	L		L		L		L	L	M	M	L			

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

18MVA$03	METALLOGRAPHY *(Common to MECH& PROD Branches)*

Category:VA

L	T	P	C
1	0	0	1

PRE-REQUISITES: NIL

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

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												L		
CO2	H	H			H	M				M			H	M	
CO3	H	H			H	M				M			H	M	
18MVA$03	H	H			H	L				L			M	L	

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

18MVA$04	MICROMACHINING

Category:VA

L	T	P	C
1	0	0	1

PRE-REQUISITES: NIL

COURSE OBJECTIVES:.

- To be familiar with the principles, basic machine tools, and developments in the micro machining processes.

UNIT – I: INTRODUCTION TO MICROMACHINING	**(5 Periods)**
Introduction to Micromachining- Traditional Micromachining Processes - Diamond Turning – Micromilling – Microgrinding - Metrology for micro machined components - Applications.	
UNIT-II: ADVANCED MICROMACHINING AND NANOFINISHING PROCESSES	**(5 Periods)**
Water Jet Micro Machining - Abrasive Jet Micromachining - Ultrasonic Micromachining - Electrochemical Micromachining - Electrochemical Micro Grinding - Electrostream Microdrilling - Electrochemical Microdeburring - Shaped Tube Electrolytic Micromachining- Chemical Micromachining (ChMM).	
UNIT – III: NANO POLISHING	**(5 Periods)**
Abrasive Flow Nanofinishing - Magnetic Abrasive Nanofinishing- Magneto rheological finishing – Magneto Rheological abrasive flow finishing - Magnetic Float polishing – Elastic Emission Machining – chemo-mechanical Polishing.	

Contact Periods:

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

REFERENCE BOOKS:

1. *M.J.Jackson,* **"Microfabrication and Nanomanufacturing"**, *Taylor & Francis, CRC Press,2005.*
2. *Jain V. K.,* **"Micro Manufacturing Processes"** *CRC Press, Taylor & Francis Group, 2012.*
3. *Mcgeough. J.A.,* ***"Micromachining of Engineering Materials"****, CRC press 2001.*
4. *http://www.cmxr.com/Education/Introduction.html*

COURSE OUTCOMES:

At the end of the course students will be able to

CO 1: Apply various traditional micro machining processes in industrial needs.

CO 2: Identify various mechanical and electrical energy based micro machining processes in engineering applications.

CO 3: Apply the knowledge of nano polishing techniques in engineering applications.

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	M										M		
CO2	M	M	M										M		
CO3	H	M	M										M		
18MVA$04	M	M	M										M		

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

18MVA$05	WIND ENERGY MANAGEMENT

Category:VA

L	T	P	C
1	0	0	1

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To study the concept of wind energy generation
- To understand the fundamentals of wind energy and its conversion system
- To learn wind turbine control & monitoring

UNIT – I: WIND ENERGY	**(5 Periods)**
Nature of the wind - power in the wind - factors influencing wind - wind data and energy estimation - wind speed monitoring - wind resource assessment - Betz limit - site selection - wind energy conversion devices - classification, characteristics, applications – offshore wind energy – Hybrid systems - safety and environmental aspects – wind energy potential and installation in India - Repowering concept.	
UNIT – II: AERODYNAMICS THEORY & WIND TURBINE TYPES	**(5 Periods)**
Airfoil terminology, Blade element theory, Blade design, Rotor performance and dynamics, Balancing technique (Rotor & Blade), Types of loads; Sources of loads Vertical Axis Type, Horizontal Axis, Constant Speed Constant Frequency, Variable speed Variable Frequency, Up Wind, Down Wind, Stall Control , Pitch Control, Gear Coupled Generator type.	
UNIT – III: MODERN WIND TURBINE CONTROL & MONITORING SYSTEM	**(5 Periods)**
Details of Pitch System & Control Algorithms, Protections used & Safety Consideration in Wind turbines, Wind Turbine Monitoring with Error codes, SCADA & Databases: Remote Monitoring and Generation Reports, Operation & Maintenance for Product Life Cycle, Balancing technique (Rotor &Blade), FACTS control & LVRT & New trends for new Grid Codes.	

Contact Periods:

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

REFERENCE BOOKS:

1. *Freris, L.L., **"Wind Energy Conversion Systems"**, Prentice Hall, 1990.*
2. *Mario Garcia –Sanz, Constantine H. Houpis, **"Wind Energy Systems"**, CRC Press 2012.*
3. *Spera, D.A., **"Wind Turbine Technology: Fundamental concepts of Wind Turbine Engineering"**, ASME Press, 1994.*
4. *Twidell, J.W. and Weir, A., **"Renewable Energy Sources"**, EFN Spon Ltd., 1983.*
5. *John D Sorensen and Jens N Sorensen, **"Wind Energy Systems"**, Woodhead Publishing Ltd, 2011.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO 1: Knowledge in conversion techniques of wind energy

CO 2: Learning of wind turbine components and their construction

CO 3: Understating of wind turbine control & monitoring

CO 4: Knowledge in working principle of Wind energy system

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	H	L	M				M				L		L	M	
CO 2	L		H									L	L	M	
CO 3					H	L					M			L	
CO 4	M		M								H		M		M
18MVA$05	M	L	M		L	L	L				M	L	L	L	L

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

18MVA$06	SOLAR ENERGY MANAGEMENT

Category:VA

L	T	P	C
1	0	0	1

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To understand and appreciate the solar energy crisis and environmental concerns associated with the energy management, and the importance of solar energy conservation in society and legal acts.

UNIT – I: SOLAR RADIATION AND AVAILABILITY	**(5 Periods)**
Source of radiation – solar constant– solar charts – Measurement of diffuse, global and direct solar radiation: pyrheliometer, pyranometer, pyregeometer, net pyradiometer-sunshine recorder	
UNIT – II: SOLAR ENERGY COLLECTORS	**(5 Periods)**
Solar Non-Concentrating Collectors – Design considerations – Classification air, liquid heating collectors –Derivation of efficiency and testing of flat plate collectors –Analysis of concentric tube collector – Solar green house.	
UNIT – III: ENERGY MANAGEMENT	**(5 Periods)**
Supply side and demand side management – Energy conservation methods – Energy management systems – Energy monitoring – Energy review and energy bench marking – Energy action planning – Energy auditing. Energy policy – Energy conservation act 2001 – Energy labeling and energy standards.	

Contact Periods:

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

REFERENCE BOOKS:

1. *D. Yogi Goswami, Frank Kreith, Jan. F. Kreider, **"Principles of Solar Engineering"**, 2nd Edition, Taylor & Francis, 2000, Indian reprint, 2003*
2. *Sukhatme SP, **"Solar Energy: Principles of Thermal collection and Storage"**, Tata McGraw-Hill, 1996.*
3. *W. Shepherd and D. W. Shepherd**, "Energy Studies",** Second Edition Imperial College Press, London, 2004*

COURSE OUTCOMES

CO1: Gaining awareness on working, construction and performance evaluation of solar photovoltaic and solar thermal devices

CO2: Describe the challenges and problems associated with the use of solar energy and its impacts on environment

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	M	M	L	L	M	H	H	M	M	L	H	H
CO 2	M	M	H	M	L	M	M	L	H	M	M	L	H	M	H
18MVA$06	M	H	H	M	M	M	M	M	H	H	M	M	M	H	H

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

18MVA$07	**PROJECT MANAGEMENT** *(Common to MECH & PROD Branches)*

Category:VA

L	T	P	C
1	0	0	1

PRE-REQUISITES: NIL

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
18MVA$07	L				L	L		L	H	M	L	H	L	L	L

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

18MVA$08	SIX SIGMA *(Common to MECH & PRODN Branches)*

Category: VA

L	T	P	C
1	0	0	1

PRE-REQUISITES: NIL

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 Bearnard Juran Institute **"Six Sigma Break Through and Beyond",** 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 Simga: 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**

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	H	H	M	H	M	L			L	M	M	L	M	M	M
CO 2	H	M	M	H	M	L			L	M	M	M	M	M	M
CO 3	H	H	M	H	M	L			L	M	M	L	M	M	M
18MVA$08	H	H	M	H	M	L			L	M	M	L	M	M	M

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

18MVA$09	**PROFESSIONAL SKILLS** *(Common to MECH & PROD Branches)*

Category: VA

L	T	P	C
1	0	0	1

PRE-REQUISITES: NIL

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
18MVA$09				L		L		H	M		L	M	L		H

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

18MVA$10	INDUSTRY 4.0

Category: VA

L	T	P	C
1	0	0	1

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

* To know about latest technologies implemented in the industry.

UNIT – I	**(5 Periods)**
Definition, Environment for Industry 4, Characteristics, Technologies of Industry 4.0, Current Scenario	
UNIT – II	**(5 Periods)**
Industry 4.0 Solutions – Vertical networking, Horizontal integration, Exponential Technologies through Engineering.	
UNIT – III	**(5 Periods)**
Future Potential of Industry 4.0, Case studies	

Contact Periods:

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

REFERENCES:

www.bcg.com

www2.deloitte.com

www.mdpi.com

COURSE OUTCOMES:

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

CO1: Able to identify the basics of industry

CO2: Able to understand and identify the various solutions of industry

CO3: Able to apply the techniques in industrial automation.

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	M	M	H		L				M		H	H	M	H	L
CO 2		H		M					M		H	H	M	H	L
CO 3				M	H	L			M		H	H	H	H	L
18MVA$10	L	M	L	L	L	L			M		H	H	M	H	L

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