M.Kumarasamy
College of Engineering
NAAC Accredited Autonomous Institution
Approved by AICTE & Affiliated to Anna University
Thalavapalayam, Karur, Tamilnadu.

B.E. MECHANICAL ENGINEERING

CURRICULUM AND SYLLABUS

R2018

CURRICULUM AND SYLLABUS

REGULATION 2018 (2018-19 Batch onwards)

Programme: B.E. – Mechanical Engineering

Vision of the Department:

To create globally recognized competent Mechanical Engineers to work in multicultural environment

Mission of the Department:

M1: To impart quality education in the field of mechanical engineering and to enhance their skills, to pursue careers or enter into higher education in their area of interest.

M2: To establish a learner-centric atmosphere along with state-of-the-art research facility.

M3: To make collaboration with industries, distinguished research institution and to become a centre of excellence

Programme Educational Objectives (PEOs):

PEO1: Graduates of the program will accommodate insightful information of engineering principles necessary for the applications of engineering.

PEO2: Graduates of the program will acquire knowledge of recent trends in technology and solve problem in industry.

PEO3: Graduates of the program will have practical experience and interpersonal skills to work both in local and international environments.

PEO4: Graduates of the program will possess creative professionalism, understand their ethical responsibility and committed towards society.

Mapping of Programme Educational Objectives with Mission of the Department:

PEOs / Department Mission Statements	M1	M2	M3
PEO1	3	3	3
PEO2	3	2	3
PEO3	3	2	3
PEO4	3	3	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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Programme Outcomes (POs):

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: 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.

PO3: 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.

PO4: 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.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: 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.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: 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.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes (PSOs):

The students will demonstrate the abilities

PSO1: Real world application: To comprehend, analyze, design and develop innovative products and provide solutions for the real-life problems.

PSO2: Multi-disciplinary areas: To work collaboratively on multi-disciplinary areas and make quality projects.

PSO3: Research oriented innovative ideas and methods: To adopt modern tools, mathematical, scientific and engineering fundamentals required to solve industrial and societal problems.

Mapping of Programme Educational Objectives with Programme Outcomes and Programme Specific Outcomes:

PEOs / POs & PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
PEO1	3	3	3	3	2	2	3	3	3	3	2	3	3	2	3
PEO2	3	3	3	3	2	2	2	2	3	3	3	3	3	2	3
PEO3	3	3	3	3	3	3	3	3	3	3	2	3	3	2	3
PEO4	3	3	3	3	2	3	3	3	3	3	3	3	3	3	3

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

Structure of Curriculum

Sl. No.	Category	Credits
1	Humanities and Social Sciences including Management courses (H)	12
2	Basic Science courses (B)	26
3	Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc. (S)	21
4	Professional core courses (C)	52
5	Professional Elective courses relevant to chosen specialization/branch (E)	18 / 24
6	Open Electives –Electives from other technical and /or emerging subjects (O)	15 / 9
7	Project work, Minor project, seminar and internship in industry or elsewhere (P)	16
8	Mandatory Courses (M) [Environmental Sciences, Induction training, Indian Constitution, Essence of Indian Traditional Knowledge]	04
	Total Credits	164

1. Humanities and Social Sciences including Management courses (H)

Course Code	Course Name	Hours / Week			C
		L	T	P	
18LEH101J	Technical English	2	0	2	3
18LEH102J	Professional English	2	0	2	3
18MBH101L	Professional Skills and Practices	0	0	2	1
18MBH102L	General Aptitude	0	0	2	1
18MBH201T	Management Principles for Engineers	2	0	0	2
18MBH202T	Social Engineering	2	0	0	2
				Total Credits	12

L-Lecture T-Tutorial P-Practical C - Credits

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2. Basic Science courses (B)

Course Code	Course Name	Hours / Week			C
		L	T	P	
18PYB101J	Physics	3	1	2	5
18CYB101J	Chemistry	3	1	2	5
18MAB101T	Calculus and Linear Algebra	3	1	0	4
18MAB102T	Advanced Calculus and Complex Analysis	3	1	0	4
18MAB201T	Transforms and Partial Differential Equations	3	1	0	4
18MAB204T	Statistics and Numerical Methods	3	1	0	4
				Total Credits	26

L-Lecture T-Tutorial P-Practical C - Credits

3. Engineering Science courses including workshop, drawing, basics of electrical / mechanical / computer etc (S)

Course Code	Course Name	Hours / Week			C
		L	T	P	
18MES101J	Engineering Graphics	1	0	4	3
18EES101J / 18EES101J(R)	Basic Electrical and Electronics Engineering	3	0	2	4
18MES102J	Basic Civil and Mechanical Engineering	3	0	2	4
18CSS101J (R)	Programming for Problem Solving	2	0	2	3
18MES201T	Engineering Mechanics	3	1	0	4
18MES202T	Mechatronics	3	0	0	3
				Total Credits	21

L-Lecture T-Tutorial P-Practical C - Credits

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2. Basic Science courses (B)

Course Code	Course Name	Hours / Week			C
		L	T	P	
18PYB101J	Physics	3	1	2	5
18CYB101J	Chemistry	3	1	2	5
18MAB101T	Calculus and Linear Algebra	3	1	0	4
18MAB102T	Advanced Calculus and Complex Analysis	3	1	0	4
18MAB201T	Transforms and Partial Differential Equations	3	1	0	4
18MAB204T	Statistics and Numerical Methods	3	1	0	4
				Total Credits	26

L-Lecture T-Tutorial P-Practical

3. Engineering Science courses including workshop, drawing, basics of electrical / mechanical / computer etc (S)

Course Code	Course Name	Hours / Week			C
		L	T	P	
18MES101J	Engineering Graphics	1	0	4	3
18EES101J	Basic Electrical and Electronics Engineering	3	0	2	4
18MES102J	Basic Civil and Mechanical Engineering	3	0	2	4
18CSS101J	Programming for Problem Solving	1	0	4	3
18MES201T	Engineering Mechanics	3	1	0	4
18MES202T	Mechatronics	3	0	0	3
				Total Credits	21

L-Lecture T-Tutorial P-Practical

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4. Professional core courses (C)

Course Code	Course Name	Hours / Week			C
		L	T	P	
18MEC201T	Engineering Thermodynamics	3	1	0	4
18MEC202T	Engineering Materials and Metallurgy	3	0	0	3
18MEC203J	Fluid Mechanics and Machinery	3	0	2	4
18MEC204J	Manufacturing Technology	3	0	2	4
18MEC205J	Strength of Materials	3	0	2	4
18MEC206J	Thermal Engineering	3	0	2	4
18MEC207T	Metrology and Measurements	3	0	0	3
18MEC208T	Theory of Machines	3	1	0	4
18MEC209L	Metrology and Dynamics Laboratory	0	0	2	1
18MEC301J	Heat and Mass Transfer	3	0	2	4
18MEC302T	Machine Design	3	1	0	4
18MEC303J	Automobile Engineering	3	0	2	4
18MEC304T	Automation and Industry 4.0	3	0	0	3
18MEC305T	Finite Element Analysis	3	1	0	4
18MEC306L	Design and Analysis laboratory	0	0	4	2
				Total Credits	52

L-Lecture T-Tutorial P-Practical C - Credits

5. Professional Elective courses relevant to chosen specialization/branch (E)

Course Code	Course Name	Hours / Week			C
		L	T	P	
18MEE001T	New Product Development	3	0	0	3
18MEE002T	Nano Technology	3	0	0	3
18MEE003T	Computer Aided Design and Manufacturing	3	0	0	3
18MEE004T	Composite Materials	3	0	0	3
18MEE005T	Design for Manufacturing and Assembly	3	0	0	3
18MEE006T	Fatigue, Fracture and Failure Analysis	3	0	0	3
18MEE007T	Design of Jigs, Fixture, Press Tools and Moulds	3	0	0	3
18MEE008T	Piping Design Engineering	3	0	0	3
18MEE009T	Operation Research and Production management	3	0	0	3
18MEE010T	Hydraulics and Pneumatics	3	0	0	3
18MEE011T	Renewable Sources of Energy	3	0	0	3
18MEE012T	Advanced Internal Combustion Engines	3	0	0	3

18MEE013T	Refrigeration and Air Conditioning System	3	0	0	3
18MEE014T	Solar Energy Engineering	3	0	0	3
18MEE015T	Design of Heat Exchanger and Pressure Vessel	3	0	0	3
18MEE016T	Waste Management and Energy Recovery	3	0	0	3
18MEE017T	Bio Mass and Bio Gas Technology	3	0	0	3
18MEE018T	Power Plant Engineering	3	0	0	3
18MEE019T	Energy Conservation and Management	3	0	0	3
18MEE020T	Computational Fluid Dynamics	3	0	0	3
18MEE021T	Advances in Casting and Welding Processes	3	0	0	3
18MEE022T	Maintenance Engineering	3	0	0	3
18MEE023T	Automation and Industrial Robotics	3	0	0	3
18MEE024T	Non Destructive Testing	3	0	0	3
18MEE025T	Additive Manufacturing	3	0	0	3
18MEE026T	Production Planning and Control	3	0	0	3
18MEE027T	Plant Layout and Materials handling	3	0	0	3
18MEE028T	Vibrations and Noise Control	3	0	0	3
18MEE029T	Process Planning and Cost Estimation	3	0	0	3
18MEE030T	Industrial Safety Engineering	3	0	0	3
18MEE031T	Engineering Economics and Cost Analysis	3	0	0	3
18MEE032T	Gas Dynamics and Jet Propulsion	3	0	0	3
18MEE033T	Total Productive Maintenance	3	0	0	3
18MEE034T	Industrial Tribology	3	0	0	3
18MEE035T	Industrial Process Engineering	3	0	0	3
18MEE036T	Supply Chain Management and Logistics	3	0	0	3
18MEE037T	Lean Manufacturing	3	0	0	3
18MEE038T	Intellectual Property Rights	3	0	0	3
18MEE039T	Industrial Internet of Things	3	0	0	3
18MEE040T	Sustainable Manufacturing Design	3	0	0	3

L-Lecture T-Tutorial P-Practical C - Credits

6. Open Electives (O)

Open elective offered by the Computer Science and Engineering Department

Course Code	Course Name	Hours / Week			C
		L	T	P	
18CSO001T	Basics of Data Structures and Algorithms	3	0	0	3
18CSO002J	Fundamentals of Python Programming	2	0	2	3
18CSO003J	Fundamentals of Java Programming	2	0	2	3
18CSO004J	Mobile Application Development	2	0	2	3
18CSO005T	Software Development using Agile	3	0	0	3

Open elective offered by the Information Technology Department

Course Code	Course Name	Hours / Week			C
		L	T	P	
18ITO001J	Problem Solving Techniques Using Python	1	0	4	3
18ITO002J	Java Programming	1	0	4	3
18ITO003J	Game Design and Development	1	0	4	3
18ITO004J	Web Design	2	0	2	3
18ITO005J	Data Structures	2	0	2	3

Open elective offered by the Electronics and Communication Engineering Department

Course Code	Course Name	Hours / Week			C
		L	T	P	
18ECO001T	Microcontrollers and Embedded systems	3	0	0	3
18ECO002T	Internet of Everything	3	0	0	3
18ECO003T	Wireless Mobile Communication	3	0	0	3
18ECO004T	Medical Engineering	3	0	0	3
18ECO005T	Signal and Image Processing	3	0	0	3

Open elective offered by the Electrical and Electronics Engineering Department

Course Code	Course Name	Hours / Week			C
		L	T	P	
18EEO001T	Basics of Internet of Things	3	0	0	3
18EEO002T	Fundamentals of Smart Grid	3	0	0	3
18EEO003T	Robotics	3	0	0	3
18EEO004T	Energy Storing Devices	3	0	0	3
18EEO005T	Fundamentals of Electric Vehicles	3	0	0	3

Open elective offered by the Electronics and Instrumentation Engineering Department

Course Code	Course Name	Hours / Week			C
		L	T	P	
18EIO001T	Basics of Automation	3	0	0	3
18EIO002T	Automotive Electronics	3	0	0	3
18EIO003T	Programmable Logic Controllers	3	0	0	3
18EIO004T	Introduction to MEMS	3	0	0	3
18EIO005T	Smart Sensor Technology	3	0	0	3

Open elective offered by the Civil Engineering Department

Course Code	Course Name	Hours / Week			C
		L	T	P	
18CEO001T	Building Services	3	0	0	3
18CEO002T	Disaster Preparedness, Planning and Management	3	0	0	3
18CEO003T	Environmental Impact Assessment	3	0	0	3
18CEO004T	Remote Sensing and GIS	3	0	0	3
18CEO005T	Metro System and Engineering	3	0	0	3

Open elective offered by the Master of Business Admistration Department

Course Code	Course Name	Hours / Week			C
		L	T	P	
18MBO001T	Business Ethics and Corporate Social Responsibility	3	0	0	3
18MBO002T	Human Capital Management	3	0	0	3
18MBO003T	Digital and Social Media Marketing	3	0	0	3
18MBO004T	Banking Principles and Practices	3	0	0	3
18MBO005T	Export Management and Documentation	3	0	0	3

Open Elective Courses Offered to other departments by Mechanical Department

Course Code	Course Name	Hours / Week			C
		L	T	P	
18MEO001T	Industrial Safety for Engineers	3	0	0	3
18MEO002T	Energy Engineering	3	0	0	3
18MEO003T	Automobile Technology	3	0	0	3
18MEO004T	Advances in Nanotechnology	3	0	0	3
18MEO005T	Product Design and Development	3	0	0	3

L-Lecture T-Tutorial P-Practical C - Credits

7. Project work, minor project, seminar and internship in industry or elsewhere (P)

Course Code	Course Name	Hours / Week			C
		L	T	P	
18MEP101N	MOOC I / Industrial Training I	0	0	2*	1
18MEP102N	MOOC II / Industrial Training II	0	0	2*	1
18MEP201L	Minor Project I	0	0	2	1
18MEP202L	Minor Project II	0	0	2	1
18MEP301L	Minor Project III	0	0	2	1
18MEP302L	Minor Project IV	0	0	2	1
18MEP401L	Project Work I	0	0	4	2
18MEP402L	Project Work II	0	0	16	8
*Non Contact Hours				Total Credits	16

L-Lecture T-Tutorial P-Practical C - Credits

8. Mandatory Courses (M)

Course Code	Course Name	Hours / Week			C
		L	T	P	
18LEM101T	Constitution of India	1	0	0	Nil
18LEM102T	Value Education	1	0	0	Nil
18GNM101L	Physical and Mental Health using Yoga	0	0	2	Nil
18GNM102L	NSS	0	0	2	Nil
18MBM201L	Competencies in Social Skills	0	0	2	1
18MBM202L	Critical and Creative Thinking Skills	0	0	2	1
18CYM201T	Environmental Science	1	0	0	Nil
18LEM103T	Indian Tradition and Heritage	1	0	0	Nil
18MBM301L	Analytical and Logical Thinking Skills	0	0	2	1
18MBM302L	Employability Skills and Practices	0	0	2	1
18LEM301T	Indian Art Forms	1	0	0	Nil
18LEM302T	Self Development and Entrepreneurship	1	0	0	Nil
				Total Credits	4

L-Lecture T-Tutorial P-Practical C - Credits

9. One Credit Courses Offered by Mechanical Department

Course Code	Course Name	Hours / Week or 15 Hours / Course			C
		L	T	P	
18MEX001J	Certification Course in Modeling	1	0	0	1
18MEX002J	Certification Course in Analysis	1	0	0	1
18MEX003J	Energy Auditing and Management	1	0	0	1
18MEX004J	Design of Experiments	1	0	0	1
18MEX005J	Tool Design and Manufacturing	1	0	0	1
18MEX006J	Vehicle Technology	1	0	0	1
18MEX007J	Automotive Exhaust System	1	0	0	1
18MEX008J	Six Sigma Certification	1	0	0	1
18MEX009J	Quality Management Systems	1	0	0	1
18MEX010J	Value analysis and value engineering	1	0	0	1
18MEOC11J / 18MEX011J	Geometrical Dimensioning and Tolerance	1	0	0	1
18MEOC12J / 18MEX012J	Manufacturing Process	1	0	0	1
18MEX013J	Design and Metrology	1	0	0	1
18MEX014J	Problem Solving Methods	1	0	0	1
18MEX015J	Productivity Improvement Techniques	1	0	0	1
18MEX016J	Energy Storage Technologies	1	0	0	1
18MEX017J	Industrial Control Valves	1	0	0	1
18MEX018J	Glass Engineering	1	0	0	1
18MEX019J	Optimization Techniques	1	0	0	1
18MEX020J	Indian Patent Laws	1	0	0	1
18MEX021J	3D Printing	1	0	0	1
18MEX022T	Indian Business Laws	1	0	0	1
18MEOC23J / 18MEX023J	Industry 4.0	1	0	0	1
18MEX024J	Online Certification Course like NPTEL etc.	1	0	0	1

L-Lecture T-Tutorial P-Practical C - Credits

50	18MEE038T Intellectual Property Rights	Same contents are suggested to follow in Intellectual Property rights course	
51	18MEE039T Industrial Internet of Things	More contents in this syllabus have been updated as per the latest requirements.	
52	18MEE040T Sustainable Manufacturing Design	Same contents has to be followed in this course and approved for this syllabus	
53	18MEO001T Industrial Safety for Engineers	Same contents has to be followed in this course and approved for this syllabus	
54	18MEO002T Energy Engineering	Suggested to follow the same contents of the syllabus of Energy Engineering course	
55	18MEO003T Automobile Technology	Same contents has to be followed in this course and approved for this syllabus	
56	18MEO004T Advances in Nanotechnology	Same contents has to be followed in this course and approved for this syllabus	
57	18MEO005T Product Design and Development	Suggested to follow the same contents in Product design and development	
58	One Credit Courses in Regulation 2018	New course code has been followed for all one credit courses. Discussed and recommended to follow the contents	
59	One Credit Courses in Regulation 2016 16MEY23 TVS Industry 4.0	Same contents have to be followed in this course and approved for this syllabus. Suggested to conduct the courses by industry experts. Ensure 15 hours duration.	
60	**BE Mechanical Engineering(R2016)** Regulation 2016	Recommended BE Mechanical Engineering Final year (2017-2021) to follow the same syllabus in Regulation 2016. No revisions have been made in the seventh and Eighth semester syllabus.	
61	**ME Manufacturing Engineering** Regulation 2019	Recommended to follow the same contents in all subjects of ME Manufacturing Engineering for the Regulation 2019 First and Second year	

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9. One Credit Courses Offered by Mechanical Department

Course Code	Course Name	Hours / Week or 15 Hours / Course			C
		L	T	P	
18MEOC01J	Certification Course in Modeling	1	0	0	1
18MEOC02J	Certification Course in Analysis	1	0	0	1
18MEOC03J	Energy Auditing and Management	1	0	0	1
18MEOC04J	Design of Experiments	1	0	0	1
18MEOC05J	Tool Design and Manufacturing	1	0	0	1
18MEOC06J	Vehicle Technology	1	0	0	1
18MEOC07J	Automotive Exhaust System	1	0	0	1
18MEOC08J	Six Sigma Certification	1	0	0	1
18MEOC09J	Quality Management Systems	1	0	0	1
18MEOC10J	Value analysis and value engineering	1	0	0	1
18MEOC11J	Geometrical Dimensioning and Tolerance	1	0	0	1
18MEOC12J	Manufacturing Process	1	0	0	1
18MEOC13J	Design and Metrology	1	0	0	1
18MEOC14J	Problem Solving Methods	1	0	0	1
18MEOC15J	Productivity Improvement Techniques	1	0	0	1
18MEOC16J	Japanese Language Course N5 Level	1	0	0	1
18MEOC17J	Japanese Language Course N4 Level	1	0	0	1
18MEOC18J	Japanese Language Course N3 Level	1	0	0	1
18MEOC19J	Optimization Techniques	1	0	0	1
18MEOC20J	Intellectual Property Rights	1	0	0	1
18MEOC21J	3D Printing	1	0	0	1
18MEOC22J	Indian Business Laws	1	0	0	1
18MEOC23J	Industry 4.0	1	0	0	1
18MEOC24J	Online Certification Course like NPTEL etc.	1	0	0	1

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Board of Mechanical Engg. On
09 MAR 2019
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M.KUMARASAMY COLLEGE OFENGINEERING

(An Autonomous Institution and Affiliated to Anna University, Chennai)

KARUR -639 113

CURRICULUM

(FIRST YEAR B.E / B.TECH – 1ST & 2ND SEMESTERS)

R 2018

B.E. MECHANICAL ENGINEERING

CURRICULUM

I YEAR

I and II Semester Curriculum

Semester I						
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
H	18LEH101J	Technical English	2	0	2	3
B	18MAB101T	Calculus and Linear Algebra	3	1	0	4
B	18PYB101J/ 18CYB101J	Physics / Chemistry	3	1	2	5
S	18CSS101J / 18CSS101J(R) / 18MES101J	Programming for Problem Solving / Engineering Graphics	2	0	2	3
			1	0	4	3
S	18MES102J / 18EES101J(R)	Basic Civil and Mechanical Engineering / Basic Electrical and Electronics Engineering	3	0	2	4
H	18MBH101L / 18MBH102L	Professional Skills and Practices / General Aptitude	0	0	2	1
M	18LEM101T	Constitution of India	1	0	0	Nil
M	18GNM101L / 18GNM102L	Physical and Mental Health using Yoga / NSS	0	0	2	Nil
Total Credits						20

Semester II						
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
H	18LEH102J	Professional English	2	0	2	3
B	18MAB102T	Advanced Calculus and Complex Analysis	3	1	0	4
B	18PYB101J/ 18CYB101J	Physics / Chemistry	3	1	2	5
S	18CSS101J / 18CSS101J(R) / 18MES101J	Programming for Problem Solving / Engineering Graphics	2	0	2	3
			1	0	4	3
S	18MES102J / 18EES101J(R)	Basic Civil and Mechanical Engineering / Basic Electrical and Electronics Engineering	3	0	2	4
H	18MBH101L / 18MBH102L	Professional Skills and Practices / General Aptitude	0	0	2	1
M	18LEM102T	Value Education	1	0	0	Nil
M	18GNM101L /	Physical and Mental Health using Yoga / NSS	0	0	2	Nil
		Total Credits				20

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DATE 15 | 10 | 2020

BOS - 9

SEU – unit 1 title may be Solar radiation and measurements

PQ – ISSS standards to be included in unit 2, 3 and 4.

OPen electives.

IoT – No change

FSM – Interchange the unit 3 & unit 4

Robotics – No change.

ESD & FC – No change.

EV – Course name may be changed as fundamentals of electric vehicles

IoT and ESD & FC subjects can be included in professional electives for EEE students with different name.

BEEE – The subject content in all the 5 units are revised based on the feedback from the stock holders

One credit course – Board is accepted to conduct three one Credit courses from 5th Semester onwards for this 2018 regulation

BTech (CSBS) – Principles of electrical engineering course content also discussed and verified.

PG 2019 Regulation.

Power System Protection course may be added as elective course in third Semester

Analog and digital electronics Subject codes are revised

15/10/2020

I to VIII Semester Curriculum

Semester I						
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
H	18LEH101J	Technical English	2	0	2	3
B	18MAB101T	Calculus and Linear Algebra	3	1	0	4
B	18PYB101J / 18CYB101J	Physics / Chemistry	3	1	2	5
S	18MES101J / 18CSS101J / 18CSS101J (R)	Engineering Graphics / Programming for Problem Solving	1	0	4	3
			2	0	2	
S	18MES102J / 18EES101J	Basic Civil and Mechanical Engineering / Basic Electrical and Electronics Engineering	3	0	2	4
H	18MBH101L / 18MBH102L	Professional Skills and Practices / General Aptitude	0	0	2	1
M	18LEM101T	Constitution of India	1	0	0	Nil
M	18GNM101L / 18GNM102L	Physical and Mental Health using Yoga / NSS	0	0	2	Nil
					Total Credits	20

Semester II						
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
H	18LEH102J	Professional English	2	0	2	3
B	18MAB102T	Advanced Calculus and Complex Analysis	3	1	0	4
B	18PYB101J / 18CYB101J	Physics / Chemistry	3	1	2	5
S	18MES101J / 18CSS101J / 18CSS101J (R)	Engineering Graphics / Programming for Problem Solving	1	0	4	3
			2	0	2	
S	18MES102J / 18EES101J	Basic Civil and Mechanical Engineering / Basic Electrical and Electronics Engineering	3	0	2	4
H	18MBH101L / 18MBH102L	Professional Skills and Practices / General Aptitude	0	0	2	1
M	18LEM102T	Value Education	1	0	0	Nil
M	18GNM101L / 18GNM102L	Physical and Mental Health using Yoga / NSS	0	0	2	Nil
					Total Credits	20

8.10 **Syllabus Revision for 18CSS101J Programming for Problem Solving**

- Faculties and Students felt that current syllabus is too heavy. Suggested for reframing the syllabus accepted for reframing as 2 0 2[Total Credits:3].
- Basics need to be concentrated much through practicals.

MEMBERS PRESENT

1. Dr.A.Kannan
2. Dr.G.Mohana Prabha
3. Dr.R.Suganya
4. Dr.T.Abirami
5. Ms.Nivetha Ravichandran
6. Mr.S.N.Gowtham
7. Dr.V.Durgadevi
8. Mr.A.Shanmugavelaytham
9. Mrs.R.Sujatha
10. Mr.M.Gunasekar
11. Mr.E.Balraj
12. Mr.S.Vinoth (15BIT2058)
13. Mr.R.Balaji (16BIT3013)
14. Ms. B. Sinthiya (PEO Coordinator)

I to VIII Semester Curriculum

Semester I						
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
H	18LEH101J	Technical English	2	0	2	3
B	18MAB101T	Calculus and Linear Algebra	3	1	0	4
B	18PYB101J / 18CYB101J	Physics / Chemistry	3	1	2	5
S	18MES101J / 18CSS101J	Engineering Graphics / Programming for Problem Solving	1	0	4	3
S	18MES102J / 18EES101J	Basic Civil and Mechanical Engineering / Basic Electrical and Electronics Engineering	3	0	2	4
H	18MBH101L / 18MBH102L	Professional Skills and Practices / General Aptitude	0	0	2	1
M	18LEM101T	Constitution of India	1	0	0	Nil
M	18GNM101L / 18GNM102L	Physical and Mental Health using Yoga / NSS	0	0	2	Nil
					Total Credits	20

Semester II						
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
H	18LEH102J	Professional English	2	0	2	3
B	18MAB102T	Advanced Calculus and Complex Analysis	3	1	0	4
B	18PYB101J / 18CYB101J	Physics / Chemistry	3	1	2	5
S	18MES101J / 18CSS101J	Engineering Graphics / Programming for Problem Solving	1	0	4	3
S	18MES102J / 18EES101J	Basic Civil and Mechanical Engineering / Basic Electrical and Electronics Engineering	3	0	2	4
H	18MBH101L / 18MBH102L	Professional Skills and Practices / General Aptitude	0	0	2	1
M	18LEM102T	Value Education	1	0	0	Nil
M	18GNM101L / 18GNM102L	Physical and Mental Health using Yoga / NSS	0	0	2	Nil
					Total Credits	20

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20 APR 2018

II YEAR

III and IV Semester Curriculum

Semester III						
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
B	18MAB201T	Transforms and Partial Differential Equations	3	1	0	4
S	18MES201T	Engineering Mechanics	3	1	0	4
C	18MEC201T	Engineering Thermodynamics	3	1	0	4
C	18MEC202T	Engineering Materials and Metallurgy	3	0	0	3
C	18MEC203J	Fluid Mechanics and Machinery	3	0	2	4
C	18MEC204J	Manufacturing Technology	3	0	2	4
P	18MEP201L	Minor Project I	0	0	2	1
M	18MBM201L	Competencies in Social Skills	0	0	2	1
M	18CYM201T/ 18LEM103T	Environmental Science / Indian Tradition and Heritage	1	0	0	Nil
					Total Credits	25

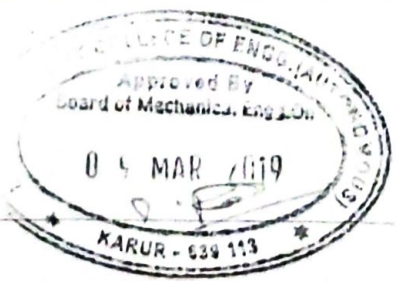
Semester IV						
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
B	18MAB204T	Statistics and Numerical Methods	3	1	0	4
S	18MES202T	Mechatronics	3	0	0	3
C	18MEC205J	Strength of Materials	3	0	2	4
C	18MEC206J	Thermal Engineering	3	0	2	4
C	18MEC207T	Metrology and Measurements	3	0	0	3
C	18MEC208T	Theory of Machines	3	1	0	4
C	18MEC209L	Metrology and Dynamics Laboratory	0	0	2	1
P	18MEP202L	Minor Project II	0	0	2	1
M	18MBM202L	Critical and Creative Thinking Skills	0	0	2	1
M	18CYM201T/ 18LEM103T	Environmental Science / Indian Tradition and Heritage	1	0	0	Nil
					Total Credits	25

III YEAR

V and VI Semester Curriculum

Semester V						
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	18MEC301J	Heat and Mass Transfer	3	0	2	4
C	18MEC302T	Machine Design	3	1	0	4
C	18MEC303J	Automobile Engineering	3	0	2	4
E	18MEE__	Professional Elective – 1	3	0	0	3
E	18MEE__	Professional Elective - 2	3	0	0	3
O	OE	Open Elective - 1	3	0	0	3
P	18MEP301L	Minor Project III	0	0	2	1
P	18MEP101N	MOOC I / Industrial Training I	0	0	0	1
M	18MBM301L	Analytical and Logical Thinking Skills	0	0	2	1
M	18LEM301T / 18LEM302T	Indian Art Forms / Self Development and Entrepreneurship	1	0	0	Nil
					Total Credits	24

Semester VI						
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
H	18MBH201T	Management Principles for Engineers	2	0	0	2
C	18MEC304T	Automation and Industry 4.0	3	0	0	3
C	18MEC305T	Finite Element Analysis	3	1	0	4
E	18MEE__	Professional Elective – 3	3	0	0	3
E / O	18MEE__	Professional Elective / Open Elective – 2	3	0	0	3
O	OE	Open Elective - 3	3	0	0	3
C	18MEC306L	Design and Analysis laboratory	0	0	4	2
P	18MEP302L	Minor Project IV	0	0	2	1
P	18MEP102N	MOOC II / Industrial Training II	0	0	0	1
M	18MBM302L	Employability Skills and Practices	0	0	2	1
M	18LEM301T / 18LEM302T	Indian Art Forms / Self Development and Entrepreneurship	1	0	0	Nil
					Total Credits	23



IV YEAR

VII and VIII Semester Curriculum

Semester VII						
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
H	18MBH202T	Social Engineering	2	0	0	2
E	18MEE__	Professional Elective – 4	3	0	0	3
E / O	18MEE__	Professional Elective / Open Elective – 4	3	0	0	3
O	OE	Open Elective - 5	3	0	0	3
P	18MEP401L	Project Work I	0	0	4	2
					Total Credits	13

Semester VIII						
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18MEE__	Professional Elective – 5	3	0	0	3
E	18MEE__	Professional Elective – 6	3	0	0	3
P	18MEP402L	Project Work II	0	0	16	8
					Total Credits	14

L-Lecture T-Tutorial P-Practical C - Credits

Total – 164 Credits

Program Articulation

Program Articulation															
Code	Course	POs											PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
18LEH101J	Technical English	√	√	√	√	√	√	√	√	√	√		√			
18MBH101L	Professional Skills and Practices						√	√	√	√	√	√	√			
18MAB101T	Calculus and Linear Algebra	√	√	√	√	√				√			√			
18PYB101J	Physics	√	√	√	√											
18CSS101J	Programming for Problem Solving	√	√							√	√		√	√	√	
18MES102J	Basic Civil and Mechanical Engineering	√		√		√	√	√		√			√			
18LEM101T	Constitution of India							√	√	√	√	√	√			
18LEH102J	Professional English	√	√	√	√	√	√	√	√	√	√		√			
18MBH102L	General Aptitude	√	√		√	√				√	√	√	√			
18MAB102T	Advanced Calculus and Complex Analysis	√	√	√	√	√				√			√			
18CYB101J	Chemistry	√	√		√											
18MES101J	Engineering Graphics	√	√	√	√	√		√	√	√	√		√	√	√	√
18EES101J	Basic Electrical and Electronics Engineering	√	√	√	√	√		√	√	√	√		√			
18LEM102T	Value Education	√	√	√		√	√	√	√	√	√		√			
18MAB201T	Transforms and Partial Differential Equations	√	√	√	√											
18MES201T	Engineering Mechanics	√	√	√								√		√		√
18MEC201T	Engineering Thermodynamics	√	√	√				√			√			√	√	√
18MEC202T	Engineering Materials and Metallurgy	√	√					√	√	√	√		√	√		√
18MEC203J	Fluid Mechanics and Machinery	√	√	√	√		√	√	√	√	√	√		√	√	√
18MEC204J	Manufacturing Technology	√	√					√	√	√	√		√	√		√
18MEP201L	Minor Project I	√	√	√	√	√		√		√	√	√	√	√	√	√
18MBM201L	Competencies in Social Skills	√								√	√					
18CYM201T	Environmental Science		√		√		√	√	√				√	√		
18MAB203T	Statistics and Numerical Methods		√	√	√									√		√

18ME202T	Mechatronics	√	√	√	√	√			√						
18ME205T	Strength of Materials	√	√	√	√		√	√	√	√	√		√	√	√	√
18ME206T	Thermal Engineering	√	√	√	√			√	√	√	√		√	√	√	√
18ME207T	Metrology and Measurements	√	√					√	√	√	√			√		√
18ME208T	Theory of Machines	√	√	√	√			√	√	√	√		√	√	√	√
18ME209L	Metrology and Dynamics Laboratory	√	√	√	√			√	√	√	√		√	√	√	√
18MEP202L	Minor Project II	√	√	√	√	√		√		√	√	√	√	√	√	√
18MBM202L	Critical and Creative Thinking Skills	√									√					
18LLM103T	Indian Tradition and Heritage	√	√	√	√	√	√	√	√	√	√		√			
18MEC301J	Heat and Mass Transfer	√	√	√	√	√	√		√	√	√		√	√		√
18ME302T	Machine Design	√	√	√	√		√		√			√	√	√		√
18MEC303J	Automobile Engineering	√	√	√	√	√	√		√	√	√		√	√		√
18MEP301L	Minor Project III	√	√	√	√	√		√		√	√	√	√	√	√	√
18MBM301L	Analytical and Logical Thinking Skills	√								√	√					
18LEM301T	Indian Art Forms						√	√	√	√	√		√			
18MBH201T	Management Principles for Engineers	√	√				√			√	√	√	√			
18MEC304T	Automation and Industry 4.0	√	√	√	√	√	√		√		√		√	√	√	√
18MEC305T	Finite Element Analysis	√	√	√	√	√	√					√	√	√		√
18MEC306L	Design and Analysis laboratory	√	√	√	√	√	√			√	√			√		√
18MEP302L	Minor Project IV	√	√	√	√	√		√		√	√	√	√	√	√	√
18MBM302L	Employability Skills and Practices	√								√	√					
18LEM302T	Self Development and Entrepreneurship	√	√				√	√	√	√	√	√	√			
18MBH202T	Social Engineering	√	√				√	√	√	√	√		√			
18MEP401L	Project Work I	√	√	√	√	√		√		√	√	√	√	√	√	√
18MEP402L	Project Work II	√	√	√	√	√		√		√	√	√	√	√	√	√
18ME001T	New Product [illegible]	√	√	√	√	√	√		√		√			√		√
18ME[illegible]	[illegible]	√	√	√		√	√	√	√				√	√		√

18MEL003T	Computer Aided Design and Manufacturing	√	√	√		√		√	√					√		√
18MEE004T	Composite Materials	√	√	√	√	√	√						√	√		√
18MEE005T	Design for Manufacturing and Assembly	√	√	√	√	√	√	√				√	√	√		
18MEE006T	Fatigue, Fracture and Failure Analysis	√	√	√	√	√		√	√				√	√		√
18MEE007T	Design of Jigs, Fixture, Press Tools and Moulds	√	√	√	√	√	√		√					√		√
18MEE008T	Piping Design Engineering	√	√	√	√	√	√		√				√	√		
18MEE009T	Operation Research & Production management	√	√	√	√	√					√	√		√		√
18MEE010T	Hydraulics and Pneumatics	√	√	√		√	√		√				√	√	√	√
18MEE011T	Renewable Sources of Energy	√	√	√			√	√	√				√	√		
18MEE012T	Advances in Internal Combustion Engines	√	√	√	√		√	√	√					√		√
18MEE013T	Refrigeration and Air Conditioning System	√	√	√	√		√	√	√			√	√	√		√
18MEE014T	Solar Energy Engineering	√	√	√	√	√	√	√	√				√	√		√
18MEE015T	Design of Heat Exchanger and Pressure Vessel	√	√	√	√	√	√		√					√		√
18MEE016T	Waste Management and Energy Recovery	√	√	√	√		√	√	√				√	√		√
18MEE017T	Bio Mass and Bio Gas Technology	√	√	√	√		√	√					√	√		
18MEE018T	Power Plant Engineering	√	√	√	√		√	√	√			√	√	√		
18MEE019T	Energy Conservation and Management	√	√	√	√		√		√			√	√	√		√
18MEE020T	Computational Fluid Dynamics	√	√	√	√	√	√							√		√
18MEE021T	Advances in Casting and Welding Processes	√	√	√	√		√	√					√	√	√	√
18MEE022T	Maintenance Engineering	√	√	√	√		√	√					√	√	√	
18MEE023T	Automation and Industrial Robotics	√	√	√	√	√	√		√					√	√	
18MEE024T	Non-Destructive Testing	√	√	√	√	√	√							√		√
18MEE025T	Additive Manufacturing	√	√	√	√		√	√	√					√		√

18MEE026T	Production Planning and Control	√	√	√	√				√		√	√		√		
18MEE027T	Plant Layout and Materials handling	√	√	√		√	√		√			√		√		
18MEE028T	Vibrations and Noise Control	√	√	√	√	√	√	√	√				√	√	√	
18MEE029T	Process Planning and Cost Estimation	√	√	√	√				√		√	√		√		
18MEE030T	Industrial Safety Engineering	√	√	√	√	√	√	√	√				√	√		
18MEE031T	Engineering Economics and Cost Analysis	√	√	√	√			√	√		√	√		√	√	
18MEE032T	Gas Dynamics and Jet Propulsion	√	√	√	√		√		√				√	√		√
18MEE033T	Total Productive Maintenance	√	√	√	√	√			√		√	√		√	√	
18MEE034T	Industrial Tribology	√	√	√	√	√		√	√					√		√
18MEE035T	Industrial Process Engineering	√	√	√	√				√		√			√	√	
18MEE036T	Supply Chain Management and Logistics	√	√	√	√				√		√	√		√	√	√
18MEE037T	Lean Manufacturing	√	√	√	√	√	√		√			√	√	√	√	√
18MEE038T	Intellectual Property Rights						√	√	√	√	√	√	√			
18MEE039T	Industrial Internet of Things	√	√	√		√	√		√			√		√	√	√
18MEE040T	Sustainable Manufacturing Design	√	√	√	√		√	√	√		√			√		√

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Board of Mechanical Engg.Co
09 MAR 2019
KARUR - 639 113

M.KUMARASAMY COLLEGE OFENGINEERING

(An Autonomous Institution and Affiliated to Anna University, Chennai)

KARUR -639 113

SYLLABUS

(FIRST YEAR B.E / B.TECH – 1ST & 2ND SEMESTERS)

R 2018

Regulation 2018		Semester I	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
H	18LEH101J	TECHNICAL ENGLISH	2	0	2	3

Prerequisite Course (s)

NIL

Course Objective (s):

The purpose of learning this course is to:

CLR-1	Analyze the importance of communication in personal, professional contexts. Identify proper English pronunciation
CLR-2	Strengthen vocabulary and grammar. Enhance listening and writing comprehension. Review films and documentaries
CLR-3	Writing brief paragraphs using appropriate techniques. Enhance their English fluency in speaking
CLR-4	Write effective essays, stories. Experience workplace communication aspects
CLR-5	Research on a topic and write a comprehensible academic project reports. Make effective presentations

Course Outcome (s) (COs):

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

CO1	Identify types, modes, channels and barriers of communication. distinguish different speech sounds, pronounce correctly
CO2	Identify, rectify the errors in the use of grammar and vocabulary. Improve listening and writing skills
CO3	Develop a topic idea into a cohesive paragraph with examples. Improve the fluency of speaking skills
CO4	Develop ideas into logical and coherent essays. Understand better the workplace culture
CO5	Identify the steps involved in writing an academic project report. List and practice skills need for making a presentation

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	3	1	3	3	3	1	3	3	3	-	3	-	-	-
CO2	1	3	1	3	3	3	1	3	3	3	-	3	-	-	-
CO3	1	3	1	3	3	2	1	3	3	3	-	3	-	-	-
CO4	1	3	1	3	3	3	1	3	3	3	-	3	-	-	-
CO5	1	3	1	3	3	3	1	3	3	3	-	3	-	-	-
CO (Avg)	1	3	1	3	3	2.8	1	3	3	3	-	3	-	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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UNIT I	COMMUNICATION	6
Definition, Process of communication - (Filling in-Class Worksheets) - Verbal and Non-Verbal Communication(Individual and Group Activities - Role play)-Other Types of Communication: General-Technical-Formal, Informal- External, Internal (Write upon a selected type of communication)- Listening, Speaking, Reading, Writing(Group activity (Newspaper) – Discussion and Feedback)- Communication and Language Barriers(Individual Activity- Sharing of Personal Experiences)-Body language(Mime).		
UNIT II	**VOCABULARY AND GRAMMAR**	7
Words with Foreign Roots, Word Formation – Inflectional, Derivational Prefixes, Suffixes(Quiz - Identifying the Borrowed roots and Their Meanings-Worksheet Exercise)-Synonyms and Antonyms and Standard Abbreviations(Context Based Activity / Learner Compiling Standard Abbreviations from Core Subject)-Homonyms and Homophones(Fun Activities – Worksheets- Cross Words)-Articles, Tenses(Exercise through Worksheets- Individual Activity -Peer Correction- Open Discussion)- Noun-Pronoun Agreement and Subject-Verb Agreement(Identifying and Learning through Error Analysis – Worksheets)-Misplaced Modifiers - Prepositions- Prepositional verbs and Phrasal verbs(Learn through Practice – Placing Same Modifier in Different Places in a Sentence)-Prepositions- Prepositional Verbs and Phrasal Verbs(Filling in-Class Worksheets)		
UNIT III	**DISCOURSE TECHNIQUES**	7
Sentence Structure, Phrases and Clauses(Exercise: Worksheet, Identifying Phrases, Clauses, Compound, Complex Sentences)-Developing Ideas into Paragraphs –Cohesion Markers(Identify Topic sentence in a Paragraph; Writing a Paragraph Based on a Topic)- -Inputs on Writing Precisely, Redundancies, Wordiness-Repetition-Clichés(Error Analysis and Editing)-Defining, Describing Technical Terms(Writing Definitions-Product and Process Description)-Inputs on Classifying/Categorising and Sequencing Ideas with Relevant Diagrams(Writing a Passage on the Given hints, Tree Diagram, Classification Table and Flow Chart)-Importance of Punctuation – Miscommunication –(Fun Activities - Worksheets for Appropriate Punctuation – Written)- Errors in Punctuation(Fun Activities - Worksheets for Appropriate Punctuation – Written)		
UNIT IV	**WORKPLACE COMMUNICATION**	6
Reading Comprehension, Guidelines questions (Referential, Critical,Interpretative)(Practice Excercise) - Précis-writing Guidelines(Practice Excercise) - Summarising(Group Activity (Oral/Written) on the Given Passages)-Essay Writing Guidelines: Introduction, Elaboration and Conclusion with Examples(Individual Activity (Written) on the Given Topic)-Organisational Report Writing - Progress Report- Guidelines(Writing a Progress Report)-Interview Skills(Mock Interview).		
UNIT V	**PROJECT WRITING**	5
Topics for Project Writing(Discussion)- Collection of Data – Avoiding Plagiarism-Authenticity and Credibility of Data(Collection of Data for Verification)- Guidelines for Writing: Outline- Objectives-Background- Methodology-Discussion-Documentation(Drafting an Outline & Preparing References)-Discussion Using Sample Project(Writing the First Draft on the Selected Topic)-Checklist for Project Format (PPT)(Self-Verification and Submission of Final Draft).		
	LIST OF EXPERIMENTS	14
1. Often Mispronounced sounds (Audio Visual Material - Listening to minimal pairs and reproducing) 2. Barriers of communication Language barriers – videos (Identifying the Language Barriers of communication –Written) 3. Short Biographical Account on Famous Personalities –Video(Oral Paraphrasing of the Content Shown) 4. Listening to Long Conversations, Daily Life (Identify Various Communication Contexts and Answering Questions – Collocation) 5. Introduction to Englishes -British and American –Videos (Discussion on Difference between British		

	and American Words) **6.** Speaking - Practice Activity – Brain Storming – Mind Mapping (Just a Minute) **7.** Describing a Scene or Event –Videos (String Narration – Describing an Event or a Scene) **8.** Technical Communication – Interpreting Data (Group Activity - Interpretation of Data - Oral Presentation) **9.** Sample Case Studies for Work Ethics – Videos (Debate on the Videos Shown) **10.** Learning Interview Techniques through Models (Mock Interview) **11.** Guidelines for Preparing a PPT; Presentation Techniques (Preparing PPT on the Topic of Learners' Choice) **12.** Formal Presentation
Text Book (s)	
1	Abirami K ,Technical English –, R.K.Publishers, Coimbatore.
Reference (s)	
1	Swan, Michael. Practical English Usage. OUP, 1995
2	Kumar Sanjay and PushpaLata. Communication Skills. OUP, 2011
3	CIEFL, Hyderabad. Exercises in Spoken English. Parts I-III. OUP
4	Anbazhagan K, Cauveri B, Devika M.P., English for Engineers. Cengage, 2016
5	www.mmm.english.com
6	www.onlinewriting.com/purdue
7	www.ieee.org/index.html

Regulation 2018		Semester I	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
B	18MAB101T	CALCULUS AND LINEAR ALGEBRA	3	1	0	4

Prerequisite Course (s)

NIL

Course Objective (s):

The purpose of learning this course is to:

1	Apply the Matrices in problems of Science and Engineering
2	Utilize Taylor series, Maxima minima and Jacobian in solving real- time application problems
3	Utilize the concepts of radius of curvature, evolute, envelope in problems of Science and Engineering
4	Apply the concept of Differential Equations in problems of Science and Engineering
5	Applications of Sequences and Series in all problems involving Science and Engineering

Course Outcome (s) (Cos):

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

CO1	Apply Matrices, Eigenvalues and Eigen Vectors and Reduction of Quadratics form in Science and Engineering problem solving
CO2	Apply Maxima and Minima, Jacobian, and Taylor series to solve problems in Science and Engineering
CO3	Identify Radius, Centre, envelope and Circle of curvature and apply them in the problem solving
CO4	Solve the different types of Differential Equations in Science and Engineering applications
CO5	Apply convergence and divergence of series using different tests and apply sequences and Series in the problem solving

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	3	-	-	-	-	-	3	-	-	3	-	-	-
CO2	3	-	-	3	3	-	-	-	-	-	-	-	-	-	-
CO3	3	3	-	3	-	-	-	-	3	-	-	3	-	-	-
CO4	-	3	-	-	-	-	-	-	3	-	-	3	-	-	-
CO5	-	3	3	-	-	-	-	-	3	-	-	3	-	-	-
CO (Avg)	3	3	3	3	3	-	-	-	3	-	-	3	-	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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UNIT I	EIGEN VALUE PROBLEMS	9 + 3
Characteristic equation- Cayley-Hamilton theorem (excluding proof)- Eigen values and Eigen vectors of a real matrix – Properties- Orthogonal transformation of a symmetric matrix to diagonal form-Quadratic form-Reduction of quadratic form to canonical form by orthogonal transformation.		
UNIT II	**FUNCTIONS OF SEVERAL VARIABLES**	**9 + 3**
Partial derivatives-Euler's theorem for homogenous functions-Total derivatives-Differentiation of implicit functions-Jacobians-Taylor's expansion-Maxima and Minima-Method of Lagrangian multipliers.		
UNIT III	**APPLICATIONS OF DIFFERENTIAL CALCULUS**	**9 + 3**
Curvature and Radius of curvature – Circle of curvature and Centre of curvature-Envelope- Evolute as Envelope of Normals.		
UNIT IV	**DIFFERENTIAL EQUATIONS OF SECOND ORDER**	**9 + 3**
Second order linear differential equations with constant coefficients- Particular Integrals for x^n, e^{ax}, cosax/sinax, e^{ax}cosbx/e^{ax}sinbx - Method of variation of parameters-Cauchy and Legendre's linear equation-Simultaneous first order linear equations with constant coefficients.		
UNIT V	**SEQUENCES AND SERIES**	**9 + 3**
Sequences: Definition and examples-Series : Types and Convergence - Series of positive terms-Test of convergence: Comparison test, D'Alembert's ratio test, Integral test, Rabee's Root test and Log test-Alternating series-Leibnitz's test-Series of positive and negative terms(Alternating series)-Absolute and Conditional convergence.		

Text Book (s)

1	B. H. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,2006.
2	B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Reference (s)

1	Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi,2008
2	N.P. Bali and Manish Goyal, A Text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008
3	G.B. Thomas and R.L. Finney, Calculus and Analytic Geometry, 9th Edition, Pearson,Reprint, 2002
4	Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010

Regulation 2018		SemesterI/Semester II	Total Hours			90
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
B	18PYB101J	PHYSICS	3	1	2	5

Prerequisite Course (s)

NIL

Course Objective (s):
The purpose of learning this course is to:

CLR-1	Identify the applications of electric field on materials
CLR-2	Identify the applications of magnetic field on materials
CLR-3	Identify the significance of quantum theory
CLR-4	Create insights to the concepts of optical effects
CLR-5	Analyze the working principle of lasers and optical fibers

Course Outcome (s) (Cos):
At the end of this course, learners will be able to:

CO1	Identify the effect of charge dynamics
CO2	Analyze electromagnetic induction
CO3	Apply quantum mechanics to basic physical problems
CO4	Apply ray propagation and optical effects
CO5	Identify the applications of lasers and optical fiber

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO (Avg)	3.00	3.00	3.00	3.00	-	-	-	-	-	-	-	-	-	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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UNIT I	ELECTROSTATICS AND DIELECTRIC MATERIALS	9+3

Del-divergence-curl and gradient operations in vector calculus-Gauss-divergence and Stoke's theorem-Electric field and electrostatic potential for a charge distribution-Gauss' law and its applications-Laplace's equations for electrostatic potential-Poisson's equations for electrostatic potential-Solving Problems-Concepts of electric current-Continuity equation-Laws of magnetism-Faraday's law-Ampere's law-Maxwell's equations-Solving Problems-Polarizations, permeability and dielectric constant -Polar and non-polar dielectrics -Types of polarization-Frequency and temperature dependence-Internal field in a field-Clausius-Mossotti equation-Solving Problems.

UNIT II	MAGNETIC AND SUPERCONDUCTING MATERIALS	9+3

Magnetization, permeability and susceptibility-Classification of magnetic materials-Ferromagnetism-Concepts of ferromagnetic domains –Hysteresis-Solving Problems -Properties and applications of ferromagnetic materials -Hard and soft magnetic materials -Ferrimagnetic materials - Magnetic bubbles – Ferrites- Solving Problems-Superconductivity -Properties of superconductivity -Type I & Type II superconductors-High Tc superconductors – SQUID – CRYOTRON-MAG LEV-Solving Problems.

UNIT III	QUANTUM PHYSICS	9+3

Introduction to Quantum mechanics-Explanation of wave nature of particles-Black body radiation-Compton effect-Solving Problems-Photoelectric effect-de Broglie hypothesis for matter waves - Physical Significance of wave function -Time independent Schrödinger's wave equation -Time dependent Schrödinger's wave equation -Solving Problems-Particle in a 1 D box -Normalization - Born interpretation of wave function -Properties of Matter waves-Verification of matter waves-G.P. Thomson Experiment-Solving Problems.

UNIT IV	WAVE OPTICS	9+3

Introduction to interference-Introduction to diffraction-Fresnel diffraction-Fraunhofer diffraction-Fraunhofer diffraction at single slit-Fraunhofer diffraction at double slit-Solving Problems-Fraunhofer diffraction at multiple slit-Diffraction grating-Characteristics of diffraction grating-Applications of diffraction grating-Polarization by reflection-Polarization by double refraction-Solving Problems -Scattering of light-Circular polarization-Elliptical polarization-Optical activity-Fresnel's relation -Brewster's angle--Solving Problems.

UNIT V	LASER AND FIBER OPTICS	9+3

Absorption and emission processes-two level-Einstein's theory of matter radiation A and B coefficients-Characteristics of laser beams-Amplification of light by population inversion-Threshold population inversion-Essential components of laser system and pumping mechanisms-Solving Problems-Nd: YAG laser-Semiconductor laser-CO_2laser Vibrational modes- CO_2 laser-energy level-Optical fiber-physical structure-Total internal reflection-Solving Problems-Numerical aperture - Acceptance angle-Losses associated with optical fibers-Classification of optical fibers-Optical fiber communications system-Optical sensors-Solving Problems.

LIST OF EXPERIMENTS	30

1. Basics of experimentation
2. Determine dielectric constant of the sample
3. Calibrate Ammeter using Potentiometer
4. Calibrate voltmeter using Potentiometer
5. Determine the energy loss of magnetic materials using B-H curve experiment
6. Determine Planck's Constant
7. Study of I-V characteristics of a light dependent resistor (LDR)
8. Determine wavelength of monochromatic light by Newton's ring
9. Determine particle size using laser
10. Determine wavelength of using diffraction grating
11. Determine wavelength for a given laser source
12. Study of numerical aperture and acceptance angle of optical fiber
13. Mini project

Text books/ References:

1	David Jeffery Griffiths, Introduction to Electrodynamics, Revised edition, Pearson, 2013
2	Ajay Ghatak, Optics, Tata McGraw Hill Education, 5th edition, 2012
3	David Halliday, Fundamentals of Physics, 7th edition, John Wiley & Sons Australia, Ltd, 2004
4	Berg and Resnick, Quantum Physics: Of Atoms, Molecules, Solids, Nuclei and Particles, 2nd Edition, 1985

Regulation 2018		Semester I / Semester II	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
S	18CSS101J(R)	PROGRAMMING FOR PROBLEM SOLVING	2	0	2	3

Prerequisite Course (s)

Nil

Course Objective (s):

The purpose of learning this course is to:

CO1	Learn programming using a structured programming language
CO2	Provide exposure on C programming.
C03	Introduce foundational concepts of computer programming to students of different branches of Engineering and Technology.

Course Outcome (s) (COs):

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

CO1	Apply the problem solving techniques for solving numeric and string problems
CO2	Solve basic numeric problems using control statements in C
CO3	Develop the C program using the concepts of array and string.
CO4	Apply the concept of function prototypes and pointers.
CO5	Compare the performance of structures and union in memory management.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PSO1	PSO1	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	2	1	-	3	-	-	1
CO2	3	-	-	-	-	-	-	-	2	1	-	3	-	-	1
CO3	3	-	-	-	-	-	-	-	2	1	-	3	-	-	1
CO4	3	-	-	-	-	-	-	-	2	1	-	3	-	-	1
CO5	3	-	-	-	-	-	-	-	2	1	-	3	-	-	1
CO (Avg)	3	-	-	-	-	-	-	-	2	1	-	3	-	-	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	INTRODUCTION	6
Basic Organization of a Computer –Number System – Binary – Decimal – Conversion – Problems– Need for logical analysis and thinking – Algorithm – Pseudo code – Flow Chart.		
UNIT II	**C PROGRAMMING BASICS**	**6**
Structure of a 'C' program – Tokens – Data Types – Operators –Input and Output operations – Decision Making and Branching – Looping statements.		
UNIT III	**ARRAYS AND STRINGS**	**6**
Arrays: Declaration – Initialization – One dimensional and Two dimensional arrays – String: String Declaration and Initialization–String Functions.		
UNIT IV	**STRUCTURES AND POINTERS**	**8**
Introduction to Structures-Need for Structure Data type – Structure: Definition, Declaration – Structure vs Union. Pointers - Definition – Initialization – Pointers arithmetic – Pointers and arrays –Null Pointer – Pointer to Structures.		
UNIT V	**FUNCTIONS**	**4**
Function – Definition of function – Declaration of function – Function Prototype – Pass by value – Pass by reference.		
LIST OF EXPERIMENTS		**15**

1. Programs on Operators
2. Programs on Control statements
3. Programs on one Dimensional Array
4. Programs on Two Dimensional Array
5. Programs on String Handling
6. Programs on Function using Call by Value
7. Programs on Function using Call by Reference
8. Programs on Pointers
9. Programs on Structures
10. Programs on Union

Text Book (s)

1	Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.
2	PradipDey, Manas Ghosh, "Fundamentals of Computing and Programming in C", First Edition, Oxford University Press, 2009

Reference (s)

1	Byron S Gottfried, "Programming with C", Schaum's Outlines, Second Edition, Tata McGraw-Hill, 2006.
2	Dromey R.G., "How to Solve it by Computer", Pearson Education, Fourth Reprint, 2007.
3	Kernighan,B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2006.
4	Yashavant P. Kanetkar. "Let Us C", BPB Publications, 2011.

Regulation 2018		Semester I / Semester II	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
S	18CSS101J	PROGRAMMING FOR PROBLEM SOLVING	1	0	4	3

Prerequisite Course (s)

Nil

Course Objective (s):

The purpose of learning this course is to:

CO1	To learn programming using a structured programming language
CO2	To provide exposure on C programming.
CO3	To introduce foundational concepts of computer programming to students of different branches of Engineering and Technology.

Course Outcome (s) (COs):

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

CO1	Apply the problem solving techniques for solving numeric and string problems
CO2	Solve basic numeric problems using control statements in C
CO3	Develop the C program using the concepts of array and string.
CO4	Apply the concept of function prototypes and pointers.
CO5	Compare the performance of structures and union in memory management.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	-	-	2	1	-	3	2	2	2
CO2	3	3	-	-	-	-	-	-	2	1	-	3	2	2	2
CO3	3	3	-	-	-	-	-	-	2	1	-	3	2	2	2
CO4	3	3	-	-	-	-	-	-	2	1	-	3	2	2	2
CO5	3	3	-	-	-	-	-	-	2	1	-	3	2	2	2
CO (Avg)	3	3	-	-	-	-	-	-	2	1	-	3	2	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	INTRODUCTION TO C	9

Evolution of Programming & Languages - Problem solving through programming - Creating algorithms - Drawing flowcharts - Writing pseudocode - Evolution of C language, its usage history - Input and output functions: Printf and scanf - Variables and identifiers - Expressions, Constants - Keyword ,Single line and multiline comments- Values, Names, Scope - Binding, Storage Classes - Input and Output Statement - Numeric Data types - Non-Numeric Data types: char string - Non-Numeric Data types: string - Increment operator - decrement operator - Comma, Arrow and Assignment operator - Sizeof operator - Bitwise operators - Relational Operators - logical Operators - Conditional Operators - Operator Precedence

UNIT II	CONTROL STATEMENT AND ARRAY	9

If statement in expression - L value and R value in expression - Control Statements – if and else – else if – nested if - switch case - Iterations – While loop - do..While loop - For loop - Goto, break, continue - Array Basic and Types - Array Initialization and Declaration - Initialization: one Dimensional Array, Accessing - Indexing one Dimensional Array Operations - Initializing and Accessing 2D Array - Initializing Multidimensional Array - Array Advantages and Limitations

UNIT III	STRINGS AND FUNCTIONS	9

String Basics - String Declaration and Initialization - String Functions: gets(), puts(), getchar() - putchar(), printf()atoi(),. strlen()strcat(), strcmp()sprint(), sscanf()strcpy(), strstr()Strrev(), strtok()Functions basics - Functions declaration and definition - Types: Call by Value - Call by Reference - Function with Arguments and no Return Values - Function without Arguments and no Return Values - Function with Arguments and Return Values - Function without Arguments and Return Values - Passing Array to Functions - Returning array from functions - Formal and Actual Parameters - Recursion Functions - Advantages of using Functions

UNIT IV	POINTERS	9

Pointers Basics - Address operator - Pointer Declaration - dereferencing pointers - Size of Pointer Variable and Pointer Operator - Void Pointers and size of Void Pointers - Arithmetic Operations - Incrementing Pointers - Constant Pointers - Null Pointers - Pointers to array elements - Pointers to strings - Function Pointers

UNIT V	STRUCTURES AND UNIONS	9

Structure basics & declaration - Initializing Structure, Accessing members - Nested structure - Array of structure - Accessing elements in a structure array - Passing Array of structure to function - Union Basic and declaration - Accessing Union Members - file: opening, defining - File closing, File Modes, File Types - Writing contents into a file - Reading file contents - Appending an existing file - File permissions and rights - Changing permissions and rights

LIST OF EXPERIMENTS	15

1. Programs on Operators
2. Programs on Control statements

3. Programs on one Dimensional Array 4. Programs on Two Dimensional Array 5. Programs on String Handling 6. Programs on Function using Call by Value 7. Programs on Function using Call by Reference 8. Programs on Function prototypes 9. Programs on Passing and returning Array to Functions 10. Programs on Recursion Functions 11. Programs on Pointers 12. Programs on Structure 13. Programs on Union 14. Programs on Files	
Text Book (s)	
1	Zed A Shaw, Learn C the Hard Way: Practical Exercises on the Computational Subjects You Keep Avoiding (Like C), Addison Wesley, 2015
2	Bharat Kinariwala, TepDobry, Programming in C, eBook
3	W. Kernighan, Dennis M. Ritchie, The C Programming Language, 2nd ed. Prentice Hall, 1996

Regulation 2018		Semester I / II	Total 3ours			75
			3ours / Week			C
Category	Course Code	Course Name	L	T	P	
S	18MES102J	BASIC CIVIL AND MECHANICAL ENGINEERING (MECH)	3	0	2	4

Prerequisite Course (s)

Nil

Course Objective (s):

- Select building materials and identify the components of a building
- Identify the various transportation systems, bridges, dams and water supply system
- Apply the concept of Harnessing energy from various energy sources
- Know the working of IC engines and identify the sub system requirements
- Apply manufacturing processes; casting, forming. List machining operations; lathe, drilling. Identify process of welding

Course Outcome (s) (COs):

CO1	Identify the building materials and its applications
CO2	Identify different transportation system, water supply system and its applications
CO3	List the basic components and analyze the working of major power plants
CO4	Identify the working of IC engines and understand the need of various auxiliary systems
CO5	Identify manufacturing processes; casting, forming. List machining operations; lathe, drilling. Identify process of welding

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	3	-	-	3	3	-	-	-	-	3	-	-	-
CO2	3	-	3	-	3	3	3	-	3	-	-	3	-	-	-
CO3	3	-	-	-	-	-	3	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	3	-	-	-	-	-	3	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO (Avg)	3		3		3	3	3		3			3	3		

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (high)

UNIT I	BUILDING MATERIALS	9

Introduction to Civil Engineering, Building Materials, History, Disciplines in Civil Engineering, Early constructions and development over time, Ancient Monuments: Peruvudaiyar or Brihadeeswarar Temple, Kallanai dam Grand Anicut, Taj Mahal, Golconda fort, Angkor Wat, Pyramids of Giza, Colosseum Development of various materials, Methods of Construction, Building Materials - Stone – Classification of Rocks, Quarrying, Dressing, Properties and Uses of Stone Mortar, Plain and Reinforced Cement, Concrete Grade and properties and uses, Necessity of Special Concrete, Self Compacting Concrete, Construction Chemicals (Plasticizers), Recycling: construction, demolition wastes, Buildings, Classification of Buildings, Selection of site for a building, Components of Buildings, Soil, General types of soil, Bearing Capacity, Factors affecting bearing capacity, Foundations: Functions, General types of, foundation, Shallow foundations

UNIT II	TRANSPORTATION AND WATER SYSTEM	9

Cement concrete flooring, Marble flooring, Granite flooring, Ceramic tile flooring, Roofs: Types of roofs, Madras terrace roof, Reinforced concrete roofs, Trussed roof, Roof Coverings: Types, Weathering course: Types, Mode of Transportation - Highways - Classification of Roads, Cross section details of flexible pavements, Railways – Zone and Headquarters, Permanent way and its requirement, Components of Permanent way, Bridges: Components of Bridge, Types, Dams: Purpose, Classification, Gravity dams - Advantages and Disadvantages, Elements of protected Water Supply system, Objective, Quantity of water, Design period, Per-capita demand, Factor affecting per capita demand, Sources of Water Supply, Standards of Drinking water, Drinking Water Treatment: Objectives, Treatment plant process, Sewage: Method of collection, Sewage treatment and disposal

UNIT III	POWER PLANTS	9

Coal based thermal Power Plant: layout, components description,working, advantages, disadvantages, Hydro Electric power plant: layout, components description, working, advantages and disadvantages, Nuclear power plant: Nuclear fission and fusion reactions, Nuclear reactor, components description, Layout, working, merits and demerits of boiling water reactor , Layout, working, merits and demerits of pressurized water reactor, Gas turbine power plants:componentsdescription,working and types gas turbines, methods to improve performance, Layout and working of open cycle plant with intercooling, reheating, regeneration, Solar Thermal power plant: layout of Flat plate collector based plant, central receiver type plant, advantages, disadvantages, Wind energy conversion system – wind turbine types, Working, advantages and disadvantages, Ocean Thermal Energy Conversion system: layout of open cycle , Layout of closed cycle, advantages, disadvantages

UNIT IV	INTERNAL COMBUSTION ENGINES	9

Engine: Classification,operations of 2 stroke & 4 stroke, Comparison of SI & CI engines, Fuel supply system and Battery ignition system, Magneto ignition system of SI engine, Working of a simple carburetor, GDI, MPFI, CRDI, Lubrication system of an engine, Functions and Working of mist and forced feed lubrication system, Cooling system of an engine – Working of air cooled (fins), Water cooled engines (forced circulation), Alternate fuels for IC Engines. Liquid fuels: methanol, ethanol, vegetable oil, Biodiesel, Gaseous fuel: Hydrogen, CNG, LPG, properties, advantages, disadvantages, Emissions from engine – Emission standards – Euro, BS, Emission control measures – Catalytic converter, Exhaust gas recirculation, Introduction to electric vehicles, Hybrid and autonomous vehicles

UNIT V	CASTING AND FORMING PROCESS	9

Casting introduction and history, Expandable mold casting process , Production steps in a typical sand-casting process, terms including patterns and core, Other expendable mold casting: shell molding, vacuum molding, expanded polystyrene process, Investment casting, Permanent mold casting: hot chamber and cold chamber

die casting & Permanent mold casting:Semi centrifugal and centrifuge casting, Metal forming introduction and its classification, metals and alloys,Bulk deformation: hot, cold forging processes, hot rolling processes,cold rolling processes, Rolling mill classification, hot and cold extrusion processes, wire and bar drawing processes, Sheet metal working, applications. Cutting operations: shearing, blanking, punching, cutoff, parting, slotting, perforating, notching, trimming, shaving, fine blanking, Bending operations: V-bending, edge bending, flanging, hemming,seaming, curling, spring back effect. Drawing operations, its defects, coining, embossing, ironing, lancing, twisting	
Text Book (s)	
1	Dr.V.Rameshbabu,"Basic Civil and Mechanical Engineering", VRB Publishers pvt ltd, 2017
Reference (s)	
1	SeropeKalpakjian, Steven Schmid," Manufacturing Processes for Engineering Materials", Pearson, 2016
2	Drbal, Larry F. Boston, Patricia G. Westra, Kayla L. Black, Veatch, "Power Plant Engineering", Kluwer Academic Pub., 1995
3	Andy Walker, "Solar Energy", John Wiley & Sons, 2013
4	John B. Heywood, "Internal Combustion Engine Fundamentals", Tata McGraw Hill Education, 2017
5	Kumar. T, LeenusJesu Martin and Murali. G, "Basic Mechanical Engineering", Suma Publications, Chennai, 2007.

LIST OF EXPERIMENTS

Total: 30hours

1.	Study of wood types, carpentry tools, operations and safety precautions.
2.	To make various carpentry joints like T-joint, lap joint, bridle joint, mortise tenon joint and etc.
3.	Study of pipeline joints, its location and functions in household fittings.
4.	Preparation of single tap, multi tap and shower connection by using GI and PVC pipes.
5.	Study about basics of fitting process, tools and method of producing models.
6.	Preparation of square, half round, step, V, T fitting of two metals by using fitting tools.
7.	Study of cutting, bending operations and tools used in sheet metal processes.
8.	To make trays, cone and funnel by using sheet metal operations.
9.	Study of welding types, tools, equipments and welded joints.
10.	Preparation of butt joints, lap joints and T-joints by shielded metal arc welding.
11.	Study about the types, properties and uses of brick, stone and cement.
12.	Study about water supply, distribution System, water treatment plant, sewage system
13.	Study about the basics of casting processes and equipments.

Regulation 2018		Semester I/Semester II	Total Hours			30
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
H	18MBH101L	PROFESSIONAL SKILLS AND PRACTICES	0	0	2	1

Prerequisite Course (s)

Nil

Course Objective (s):

The purpose of learning this course is to:

CLR-1	Equip students with different aspects of Presentation
CLR-2	Train students to use appropriate language for publics peaking.
CLR-3	Help students better understand basic leadership qualities and personality traits
CLR-4	Train the students to face interview confidently.
CLR-5	Make students understand how setting goals in life is important.

Course Outcome (s) (COs):

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

CO1	Make presentation in a formal way.
CO2	Speak with clarity and confidence, thereby enhancing their employability skills.
CO3	Enable students to understand different aspects of leadership and evaluate in their own strengths.
CO4	Clear the job interview successfully.
CO5	Realize that selecting goal is a fundamental component to long- term success of an individual.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	3	2	3	3	3	2	3	-	-	-
CO2	-	-	-	-	-	3	2	3	3	3	2	3	-	-	-
CO3	-	-	-	-	-	3	2	3	3	3	2	3	-	-	-
CO4	-	-	-	-	-	3	2	3	3	3	2	3	-	-	-
CO5	-	-	-	-	-	3	2	3	3	3	2	3	-	-	-
CO(Avg)	-	-	-	-	-	3	2	3	3	3	2	3	-	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	PRESENTATIONS	5
Tips and Techniques for an Effective Presentation - Effective presentation structure - Types of Presentation - Verbal aspect of a presentation - Non-verbal aspect of a presentation – body language - Stress management during a presentation		
UNIT II	**PUBLIC SPEAKING**	5
Importance of Public Speech - Dealing with fear and Anxiety - Tips and Techniques for Public Speaking - Informative Speech - Delivering a Persuasive Speech - Dealing with audience questions		
UNIT III	**LEADERSHIP SKILLS**	5
Communication – Motivation – Delegating – Creativity – Responsibility - Commitment		
UNIT IV	**INTERVIEW SKILLS**	5
Preparing for a Job Interview - The Interview Process - Telephone Interviews - Interview Techniques - Mock Interview - Mock Interview		
UNIT V	**GOAL SETTING**	5
Types of goals - Reasons for goal setting - Goal Setting Process - S.M.A.R.T. goals - Tips and Techniques for Goal Setting - Trouble in Setting Goals		
LIST OF EXPERIMENTS		5
1. Make a presentation on a general topic 2. Give a persuasive speech 3. Exhibit your leadership qualities 4. Mock interview 5. Share your realistic short term and long term goals and the ways to attain them.		

Text Book (s)

	NIL

Reference(s)

1	Aruna Koneru, Professional Communication, Tata McGraw-Hill Publishing Company Limited, New Delhi
2	Professional Skills and Practice, Oxford University Press
3	https://www.skillsyouneed.com
4	https://www.Business English Site.com

Regulation 2018		Semester I	Total Hours			15
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
M	18LEM101T	CONSTITUTION OF INDIA	1	0	0	-

Prerequisite Course (s)

NIL

Course Objective (s):

The purpose of learning this course is to:

CLR-1	Utilize the citizen's rights
CLR-2	Utilize the basic citizen's fundamental rights of freedom of speech, expression, equality, religion and privacy
CLR-3	Identify the Indian constitutional framework with union parliament, government and their functions and citizen's rights
CLR-4	Utilize the States functionality and provisions for the betterment of the individual and society
CLR-5	Identify the emergency provisions, the functions of election and public service commissions, identify the tax system

Course Outcome (s) (COs):

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

CO1	Identify the basic provisions in the Indian constitution
CO2	List the fundamental rights, rights to equality, freedom, religion, culture, education and the right against exploitation
CO3	Identify the fundamental duties of the Union of India, President, Vice-President, Union Ministers and Parliament functions
CO4	Identify the power of states, its legislature, Governors role and the state judiciary
CO5	List the special provisions and functionality of election commission, public service commission, individual tax and GST

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	2	3	3	3	-	3	-	-	-
CO2	-	-	-	-	-	-	2	3	3	3	-	3	-	-	-
CO3	-	-	-	-	-	-	2	3	3	3	2	3	-	-	-
CO4	-	-	-	-	-	-	2	3	3	3	2	3	-	-	-
CO5	-	-	-	-	-	-	2	3	3	3	2	3	-	-	-
CO (Avg)	-	-	-	-	-	-	2	3	3	3	2	3	-	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	INDIAN CONSTITUTION	3
Meaning of the Constitution law and Constitutionalism- Historical perspective of the Constitution of India- Salient features and characteristics of the Constitution of India Citizenship- Scheme of the fundamental rights- Scheme of the Fundamental Duties and its legal status		
UNIT II	**FUNDAMENTAL RIGHTS**	**3**
The Directive Principles of State Policy- Scheme of the Fundamental Right to Equality- Scheme of the Fundamental Right to certain Freedom under Article 19- Scope of the Right to Life and Personal Liberty under Article 21- Union Government, Union Legislature (Parliament)- LokSabha and RajyaSabha (with Powers and Functions), Union Executive		
UNIT III	**POWERS AND FUNCTIONS OF CENTRAL GOVERNMENT**	**3**
President of India (with Powers and Functions)- Prime Minister of India (with Powers and Functions) - Union Judiciary (Supreme Court)- Jurisdiction of the Supreme Court - State Government, Legislature, Legislative Assembly. Legislative Council- Powers and Functions of the State Legislature, State Executive- Governor of the State (with Powers and Functions)		
UNIT IV	**POWERS AND FUNCTIONS OF STATE GOVERNMENT**	**3**
The Chief Minister of the State (with Powers and Functions)- State Judiciary (High Courts) Union Territory, Panchayat, Municipality- Scheduled and Tribal Areas- Co-operative Societies Consumer Rights - Consumer Protection Act		
UNIT V	**POWERS AND FUNCTIONS OF ELECTION AND SERVICE COMMISSION**	**3**
Local Self Government – Constitutional Scheme in India-Emergency Provisions : National, President Rule, Financial Emergency - Election Commission of India (with Powers and Functions) - The Union Public Service Commission (with Powers and Functions) - Amendment of the Constitutional Powers and Procedure -Income Tax, Goods and Services Tax		

Text Book (s)

	NIL

Reference (s)

1	DurgadasBasu, Introduction to the Constitution of India,Lexis- Nexis, 2015
2	Subash C Kashyap, Our Parliament, National Books Trust, 2011
3	Kaushal Kumar Agarwal, India's No 1 book on Tax : Simple Language Advanced Problems: Income Tax, Kindle, 2017
4	Vivek K R Agarwal, GST Guide for students: Making GST – Good and Simple Tax, Neelam Book House, 2017

Regulation 2018		Semester I&II	Total Hours			30
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
M	18GNM101L	Physical and Mental Health using Yoga	0	0	2	0

Prerequisite Course (s) Nil

Course Objective (s):

The purpose of learning this course is to:

CLR-1	provide deeper insight into the curriculum of Yogic Sciences along with the practical applications of Yoga
CLR-2	intend that students should get familiar with the poses of Yogasanam.
CLR-3	Promote positive health in the Student through Yoga and enabling and imparting skill in them to practice and apply Yogic
CLR-4	practice for Health to general public and teach Yoga for Total personality development and spiritual evolution.

Course Outcome (s) (Cos):

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

CO1	increase the muscle strength
CO2	improve respiration, energy and vitality.
CO3	maintain a balanced metabolism and weight reduction.
CO4	maintain cardio and circulatory health.
CO5	improve athletic performance and protection from injury.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	1	-	-	-	-	-	2	-	-	-
CO2	-	-	-	-	-	1	-	-	-	-	-	2	-	-	-
CO3	-	-	-	-	-	1	-	-	-	-	-	2	-	-	-
CO4	-	-	-	-	-	1	-	-	-	-	-	2	-	-	-
CO5	-	-	-	-	-	1	-	-	-	-	-	2	-	-	-
CO (Avg)	-	-	-	-	-	1	-	-	-	-	-	2	-	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

	Introduction:	**6**
	• Human Body- Meaning and its Importance in Yoga • Definition of Anatomy and Physiology • Cell: Structure & Function	
	General information, Different parts, Structure, Function and Effect of Yogic Practices.	**24**
	• Tissues: Types, Structure & Function. • Musculo-Skeletal System • Digestive system • Excretory system • Respiratory system • Circulatory system • Nervous System • Endocrinal system	

Text / Reference (s) books:

1.	Shirley Telles - A Glimpse of the Human Body The structure anf Functions, Swami Vivekananda Yoga Prakashana, Bangalore.
2.	Makarand Madhukar Gore - Anatomy and Physiology of Yogic Practices. Motilal Banarsidass, New Delhi, 2007
3.	Anne Waugh, Allison Grant - Ross and Wilson Anatomy and Physiology in Health & Illness, Churchill Livingstone; 2010

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Regulation 2018		Semester II	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
H	18LEH102J	PROFESSIONAL ENGLISH	2	0	2	3

Prerequisite Course (s)

Nil

Course Objective (s):

The purpose of learning this course is to:

CLR-1	Develop team spirit and stress management skill
CLR-2	Demonstrate the interpersonal skills of the learners
CLR-3	Make learners perform well in interviews
CLR-4	Enable them to listen well and express their ideas, opinions effectively in official contexts
CLR-5	Sharpen their reading comprehension skill
CLR-6	Strengthen their official written communication skill.

Course Outcome (s) (COs):

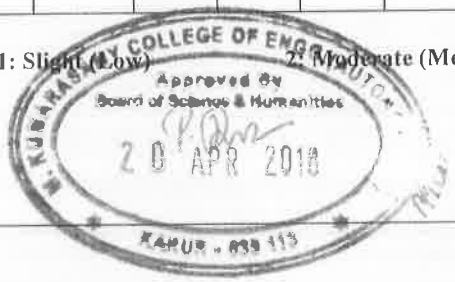
At the end of this course, learners will be able to:

CO1	Work in a team under any situation.
CO2	Practice interpersonal relationships in workplace
CO3	Face interviews confidently and successfully
CO4	Participate and excel in role plays, presentations and formal conversations.
CO5	Read and infer the meanings of technical and aesthetic passages.
CO6	Draft official letters, reports, memos, emails, etc.,

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	3	1	3	3	3	1	3	3	3	-	3	-	-	-
CO2	1	3	1	3	3	3	1	3	3	3	-	3	-	-	-
CO3	1	3	1	3	3	3	1	3	3	3	-	3	-	-	-
CO4	1	3	1	3	3	3	1	3	3	3	-	3	-	-	-
CO5	1	3	1	3	3	3	1	3	3	3	-	3	-	-	-
CO6	1	1	3	3	3	3	1	3	3	3	-	3	-	-	-
CO (Avg)	1	2.66	1.33	3	3	3	1	3	3	3	-	3	-	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)



UNIT I	SOFT SKILLS	7
Introduction to Soft Skills(MCQ on Soft Skills)-Leadership Skills(Handling a Team) -Optimism & Business Etiquettes(Presentations on How to Handle Situations Effectively)-Team Management (Motivational Videos on Positive Thinking)- Time Management(Discussion on Real Time Hardships) -StressManagement(Handling Criticism)-Organizational Communication - Channels of Communication(Case Study).		
UNIT II	**LISTENING**	**7**
Listening Skills: Active Listening, Passive Listening(Classroom Listening Activities)-Methods for improving Listening Skills, Listening and its process – Barriers to Listening(Innovative Practices and Strategies for Better Listening) – Listening to Pre-Recorded video/audio (Listening to Famous Motivational Speeches)- Listening to Reading in the Class - for Vocabulary - for Complete Understanding – for Better Pronunciation(Read aloud a Story or an Article to Listen and Complete the Task) - Listening for General Content – Listening to fill up Information(Listening –fill in the Form Activity) – Intensive Listening for Specific Purpose-Listening to Monologues(Listening to Announcements) -Extensive Listening(Listening to Business News).		
UNIT III	**SPEAKING**	**5**
Defining Presentation and its Purpose; Audience & Local: Organizing Contents; Preparing Outline(Mini presentation)- Audio-Visual Aids; Nuances of Delivery; Body Language;(PPT Presentation) - Dimensions of Speech: Syllable; Accent; Pitch; Rhythm; Intonation; Paralinguistic features of voice(Voice Modulation Practice)-Interviews &Its Types-Role Play(Mock Interview) -Group Discussion-Oral Presentations -Formal Conversations(Group Discussion Practice) .		
UNIT IV	**READING**	**5**
Reading & Its Types- Techniques for Good Comprehension, Reading Comprehension(Reading Comprehension Exercises) - Cloze Test ,Reading Newspaper- Editorials & Business Articles (Cloze Test Exercises)- Inferring Meaning- Improving Comprehension Skills(Reading for Meaning) - Skimming and Scanning– Structure of the Text – Structure of Paragraphs(Skimming and Scanning Exercises) - Interpreting Visual Communication(Graphs, Charts, Tables)(Interpreting the Graphical images).		
UNIT V	**WRITING**	**5**
Writing Official Letters(Invitation Letter (Accepting & Declining),Quotation, Ordering, Complaining, Seeking Clarification)(Business Letter Writing Exercises), Writing Official Letters(Permission – In-Plant Training)- Writing CV (Job Application)(Job Application Letter Exercise)- Essay Writing-Email Writing - Writing Reports & Proposal(Writing a Business Report)- Writing Circulars, Memos, Agenda & Minutes(Exercises on Writing Circulars, Memos, Agenda & Minutes).		
	LIST OF EXPERIMENTS	**16**

1. Videos on Stress Management (Stress Management Activities)
2. Videos on Team Spirit (Team Activities)
3. Listening to TED Talks(Listening to Business Interviews)
4. Listening to Business Presentation (Listening to Business Interviews)
5. Telephonic Conversation (Organizing a Meeting)
6. Product Launch (Persuasive Speech)
7. Business Conversations
8. Business Role Play Activities
9. Reading for Pleasure(Intensive Reading)
10. Extensive Reading(Briefing Favourite Self Help Books)

11. Reading Newspaper articles(Reading Business Reports) 12. Reading Business Legends Success Formula(Read Between the Lines) 13. Writing an Advertisement (Writing Slogans for Products) 14. Error Correction Exercises (Formal Language expressions) 15. Business Vocabulary (Writing Official E-mails) 16. Writing Business Proposals (Writing Permission Letters)	
Text Book (s)	
1	Abirami K, "Professional English", First Edition, R.K.Publishers, Coimbatore, 2019.
Reference (s)	
1	LinaMuhkopadhyay, et al., "English for Jobseekers" ,Cambridge University Press, New Delhi,2013
2	Brook Hart Guy , Business Benchmark Advanced Personal Study Book for BEC and BULATS, Cambridge
3	Mascull , Bill. Business Vocabulary in Use, Third Edition, Nov 2017
4	Emerson Paul, Business English Handbook ,Advanced, Macmillan
5	www.Business-English Site.com
6	www.businessenglishpod.com

Regulation 2018		Semester II	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
B	18MAB102T	ADVANCED CALCULUS AND COMPLEX ANALYSIS	3	1	0	4

Prerequisite Course (s)

Calculus and Linear Algebra

Course Objective (s):

The purpose of learning this course is to:

1	Evaluate Double and triple Integral and apply them in problems in Engineering Industries
2	Evaluate Surface, Volume Integral and applications of Gauss theorem, Stoke's and Green's theorem in Engineering fields
3	To know the properties of Complex functions and apply them in all the Engineering fields
4	Evaluate improper integrals involving complex functions using Residue theorem and apply them in Engineering fields
5	Transform engineering problems into ODE, PDE and Integrals and solve them using Laplace / complex analytic methods

Course Outcome (s) (Cos):

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

CO1	Evaluate multiple integrals using change of variables
CO2	Apply techniques of vector calculus in problems involving Science and Engineering.
CO3	Apply complex analytic functions and its properties in solving problems
CO4	Evaluate improper integrals using Residue theorem involving problems in Science and Engineering
CO5	Apply techniques of Laplace Transforms and inverse transform for problems in Science and Engineering and Solving Ordinary Differential Equations

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	3	-	-	-	-	-	3	-	-	3	-	-	-
CO2	3	-	-	3	3	-	-	-	-	-	-	-	-	-	-
CO3	3	3	-	3	-	-	-	-	3	-	-	3	-	-	-
CO4	-	3	3	-	-	-	-	-	3	-	-	3	-	-	-
CO5	-	3	-	-	-	-	-	-	3	-	-	3	-	-	-
CO (Avg)	3	3	3	3	3	-	-	-	3	-	-	3	-	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	MULTIPLE INTEGRALS	9 + 3

Evaluation of double integration in cartesian and polar Coordinates - Evaluation of double integral by changing of order of integration - Area as a double integral (Cartesian and Polar) - Conversion from Cartesian to Polar in double integrals - Triple integration in Cartesian Coordinates - Volume as triple integral in Cartesian, Polar and Spherical Coordinates.

UNIT II	VECTOR CALCULUS	9 + 3

Gradient,Divergence,Curl,Solenoidal,Irrotational fields - Directional derivative - Line integrals - Surface integrals - Volume Integrals - Green's theorem (excluding proof) :Applications in evaluating Line and Region - Gauss divergence theorem (excluding proof):Applications to cubes and parallelopipeds - Stoke's theorem (excluding proof):Applications to cubes and parallelopipeds.

UNIT III	ANALYTIC FUNCTION	9 + 3

Definition of Analytic function – Cauchy Riemann equations- Properties of Analytic function - Determination of Analytic function using Milne's Thomson method-Conformal mapping ($w=c+z$, $w=cz$, $w=\frac{1}{z}$) - Bilinear transformation.

UNIT IV	COMPLEX INTEGRATION	9 + 3

Cauchy's integral theorems (without proof) - Cauchy's integral formulae - Taylor's expansions with simple problems - Laurent's expansions with simple problems - Singularities - Poles and their types - Residues - Cauchy's residue theorem (without proof)- Contour integration: unit circle and semicircle.

UNIT V	LAPLACE TRANSFORMS	9 + 3

Laplace Transforms of standard functions- Transforms properties- Transform of derivatives and integrals - Initial & Final value theorems (without proof) and Verification for some problems- Inverse laplace transforms using Partial fractions and Shifting theorem- Convolution theorem- Periodic functions- Solution of linear second order ODE equations with constant coefficients.

Text Book (s)

1	B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
2	N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008

Reference (s)

1	B. H. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2	Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008
3	Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010
4	G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson,Reprint, 2002

Regulation 2018		Semester I /Semester II	Total Hours			90
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
B	18CYB101J	CHEMISTRY	3	1	2	5

Prerequisite Course (s)

NIL

Course Objective (s):

The purpose of learning this course is to:

- Apply the basic principles of chemistry at both atomic and molecular levels in understanding the concepts related to the engineering field.
- Integrate the chemical principles in their projects undertaken in their respective fields
- Enhance the quality of a materials used in the product from the technological aspects for societal applications

Course Outcome (s) (Cos):

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

CO1	Identify the suitable polymeric materials fabrication processes in various application
CO2	Apply the basic principle of inorganic chemistry at the atomic and molecular levels
CO3	Apply the various thermodynamic and kinetics concepts to real system
CO4	Assemble a battery through the understanding of electrochemical principles
CO5	Catagorize the Engineering materials for their applications

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO (Avg)	3.00	3.00	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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UNIT I	ENGINEERING ORGANIC MATERIALS	9*+3*

Polymer – Introduction- classification(based on molecular weight, structure and usage)- types of polymerization(Addition, Condensation and Copolymerisation)-crystallinity, melting point and glass transition temperature-mechnism of polymerization(free radical addition polymerization)-elastomer- structure and curing(vulcanization)- Fabrication and molding of polymers(Injection molding and blow molding)- Engineering plastics – PE, PVC, PMMA, Phenol formaldehyde resin , urea formaldehyde resin(Preparation, properties and uses)- Industrial applications of polymers.

UNIT II	COORDINATION AND ORGANOMETALLIC COMPOUNDS	9*+3*

Co-ordination compounds – Introduction- nomenclature- types of ligands (mono, di and poly dendate ligands)- isomerism(structural and stereo isomerism) – theories of bonding(Werner and Sidgwick Pouvell theory(EAN rule)) – applications – EDTA titration – Organometallic compounds - synthesis(organo zinc, organo Lithium and Organo magnesium) – Applications (18 electron rule, Ziegler Natta Catalyst and Hydroformylation)

UNIT III	THERMODYNAMICS AND KINETICS	9*+3*

Introduction- first and second law of thermodynamics – Gibbs –Helmholtz equation – Clausius clapeyron equation – Maxwell relations – Vant hoff isotherm and Isochore (problems also)- Kinetics- Introduction- types of reactions(opposing, consecutive and parallel reactions)- chain reactions (HBr and HCl formation)- Applications of kinetics and thermodynamics.

UNIT IV	ENGINEERING ELECTROCHEMISTRY	9*+3*

Introduction- Conductors and its types - cells (Electrolytic and Electrochemical cells) – Standard electrode potential- Nernst equation of an electrode- types of electrodes (SHE and Calomal electrode)- Batteries –Types (Primary, Secondary, Flow and reserve battery)- Examples (Lead acid battery, Ni-Cd battery, Lithium battery, Lithium sulphur battery and Hydrogen- Oxygen fuel cells)- Graphene.

UNIT V	INDUSTRIAL APPLICATIONS OF CHEMISTRY	9*+3*

Cement (Types, manufacture and properties) – Paints (constitutions and functions)- Lubricants- types- mechanism – properties-abrasives – types –Diamond, Corundum, emery, garnet, quartz, Silicon carbide, carborundum-boron carbide, alundum (preparation, properties and uses) –applications – Basics of biosensor and biochips.

LIST OF EXPERIMENTS	30

1. Determination of total , permanent and temporary hardness of water sample (EDTA method)
2. Determination of alkalinity in water sample- Indicator method
3. Determination of chloride content of water sample by Argentometric method(Mohr's method)
4. Determination of dissolved oxygen content of water sample by winkler's method
5. Conductometric titration of strong acid with strong base
6. Conductometric titration of mixture of acids

7. Determination of strength and amount of Hydrochloric acid- pH metry
8. Estimation of strength and amount of ferrous ion by potentiometric method
9. Determination of molecular weight of a polymer by viscometry method
10. Estimation of ferrous ion by colorimetry.
11. Cement analysis

Text / Reference (s) books:

1	B.L.Tembe, Kamaluddin and M.S.Krishnan , "Engineering chemistry"
2	S.S. Dara "A Text book of Engineering Chemistry" S.Chand & Co.Ltd, New Delhi (2009).
3	P.C.Jain and Monica Jain, "Engineering Chemistry" Dhanpat Rai Pub, Co., NewDelhi (2012).
4	Shashi Chawla, Engineering Chemistry: Dhanpat Rai &Co., 3rd Edition, 2015
5	www.nptel.ac.in

M. KUMARASAMY COLLEGE OF ENGG. (AUTONOMOUS)
Approved By
Board of Science & Humanities
20 APR 2018
KARUR - 639 113

Regulation 2018		Semester I /Semester II	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
S	18MES101J	ENGINEERING GRAPHICS (MECHANICAL)	1	0	4	3

Course Objective (s):

1. Construct ellipse, Parabola, hyperbola, cycloid and involutes.
2. Sketch the projection of points, straight lines and plane surfaces.
3. Sketch the Projection of simple solids like prisms, pyramids, cylinder and cone
4. Sketch the sectional solids and developing the lateral surfaces of simple solids
5. Understand the three dimensional drawing of simple solid by isometric projection and perspective projection, and convert isometric projection to orthographic projection.

Course Outcome (s) (COs):

CO1	Apply engineering graphic fundamentals to draw/evaluate engineering curves.
CO2	Draw the graphics of engineering parts with point, line and plane projections
CO3	Draw projection of solid objects like prisms, cylinders, pyramids and cones used in engineering objects
CO4	Develop the lateral surfaces of the sectional solids.
CO5	Create 3D part models using isometric and perspective projection.

CO-PO Mapping

COs	POs												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2	PS O3
CO1	3	2	2	2	2	-	2	3	2	2	-	3	2	2	2
CO2	3	2	3	2	2	-	1	2	3	2	-	3	3	1	2
CO3	3	2	3	2	3	-	1	2	3	2	-	2	2	1	3
CO4	3	2	3	2	3	-	1	2	3	2	-	2	2	1	3
CO5	3	2	2	2	2	-	1	2	2	2	-	3	3	1	2
CO (Avg)	3	2	2.6	2	2.4	-	1.2	2.2	2.6	2	-	2.6	2.4	1.2	2.4

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	PLANE CURVES	9
Principles of Engineering Graphics - Lettering - dimensioning - Curves used in engineering practices: Conics – Construction of ellipse, Parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes – Drawing of tangents and normal to the above curves.		
UNIT II	PROJECTION OF POINTS, LINES AND PLANE SURFACES	9
Projection of points and straight lines located in the first quadrant – Determination of true lengths and true inclinations. Projection of polygonal surface and circular lamina inclined to both reference planes.		
UNIT III	PROJECTION OF SOLIDS	9
Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method.		
UNIT IV	SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES	9
Sectioning of above solids in simple vertical position by cutting planes inclined to one reference plane and perpendicular to the other – Obtaining true shape of section. Development of lateral surfaces of simple and truncated solids – Prisms, pyramids, cylinders and cones – Development of lateral surfaces of solids with cylindrical cutouts, perpendicular to the axis.		
UNIT V	ISOMETRIC PERSPECTIVE AND ORTHOGRAPHICS PROJECTIONS	9
Principles of isometric projection – isometric scale – isometric projections of simple solids, truncated prisms, pyramids, cylinders and cones. Perspective projection of prisms, pyramids and cylinders by visual ray method. Isometric to orthographic multi-view.		

Text Book (s)	
1	K. V. Natrajan, "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai (2010).
2	K. Venugopal& V. Prabhu Raja, "Engineering Graphics", New Age International (P) Limited, 15th edition (2018).
Reference (s)	
1	1. K. R. Gopalakrishnana, "Engineering Drawing" (Vol.I&II), Subhas Publications, 2010.
2	2. R. L Jhala "Engineering Graphics", Tata McGraw Hill Publishing Company Limited, New Delhi, 2015.
3	3. DhananjayA.Jolhe, "Engineering Drawing with an introduction to AutoCAD" Tata McGraw Hill Publishing Company Limited, 2008.
4	4. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2012.
5	5. M.S. Kumar, "Engineering Graphics", D.D. Publications, 2009.

List of Expertiments.

1	Spiral and involutes using bspline or cubic spline
2	Plan of residential building
3	Simple steel truss
4	Isometric projection of simple objects
5	Creation of 3D model
6	Orthographic projection of given 3D object
7	Projection of planes with inclination to reference plane
8	Solids with inclination to one reference plane
9	Section view of simple solids
10	Development of solids

Regulation 2018		Semester - I / Semester - II	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
S	18EES101J(R)	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	3	0	2	4

Prerequisite Course (s)

NIL

Course Objective (s): The purpose of learning this course is to:

1	Gain the knowledge about D.C and A.C circuits.
2	Impart the fundamentals of electrical machines.
3	Study the fundamentals of semiconductor devices
4	Study the working concepts of measuring instruments.
5	Know about digital logic concepts and operational amplifier.

Course Outcome (s) (COs): At the end of this course, learners will be able to:

CO1	Apply the concepts of ohm's law and Kirchhoff's law in DC and AC circuits
CO2	Explain the basic concepts of DC motor, DC generator, Transformer and Induction motor.
CO3	Summarize the nature of semiconductor devices.
CO4	Interpret the concept of measuring devices like PMMC, MI, energy meter and wattmeter.
CO5	Infer the concept of electronics devices and conversion techniques

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	-	-	-	1	1	-	1	3	1	1
CO2	3	-	1	1	1	-	-	-	1	1	-	1	3	1	1
CO3	3	-	1	1	1	-	-	-	1	1	-	1	3	1	1
CO4	3	-	1	1	1	-	-	-	1	1	-	1	3	1	1
CO5	3	-	1	1	1	-	-	-	1	1	-	1	3	1	1
CO (Avg)	3	2	1	1	1	-	-	-	1	1	-	1	3	1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	ELECTRICAL CIRCUITS	9

Electrical quantities: Resistors, Inductors, Capacitors - Ohm's Law - Kirchoff's Laws -Series and Parallel circuits - Analysis of DC circuits: Mesh & Nodal analysis, Thevenin's Theorem, Norton's Theorem & Maximum Power Transfer Theorem, Star delta Transformation, RL & RC Transient Analysis. Introduction to AC Circuits: Waveforms and RMS Value – Power and Power factor- Introduction to three phase systems – Types of connections, Relationship between line and phase values.

UNIT II	ELECTRICAL MACHINES	9

Faraday's laws- Construction, Principle of Operation, Basic Equations of DC Generators, DC Motors – Two Point & Three Point Starter – Construction, Working and EMF Equation of Single Phase Transformer – Construction and Working of AC Generator – Three Phase Induction Motor: Construction and Working of Squirrel Cage and Slip Ring Induction Motor – Single Phase Induction Motor (Split Phase, Capacitor Start Induction Motor).

UNIT III	ELECTRONIC DEVICES	9

Intrinsic and Extrinsic Semiconductors – PN junction diode , Zener diode and its Characteristics – Operation of Half Wave, Full Wave and Bridge Type Rectifiers – Bipolar Junction Transistor: Configurations and Characteristics of CB, CE, CC – Construction and Operation of JFET, MOSFET.

UNIT IV	MEASUREMENTS	9

Basic Principles and Classification of Instruments – Construction and Working of PMMC, MI Instruments (Attraction & Repulsion type) – Principle of Operation of Dynamometer Type Wattmeter, Induction Type Energy Meter – Instrument transformer – CRO – Megger.

UNIT V	DIGITAL & INTEGRATED CIRCUITS	9

Number Systems – Boolean Theorems– Logic Gates – Half Adder and Full Adder Circuit – Flip-Flops: RS, JK, T and D – A/D Converter (Successive Approximation Type) – D/A Converter (Binary Weighted Type) – Op-Amp : Functional Block and Types (Inverting , Non-Inverting & Differential Amplifier).

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LIST OF EXPERIMENTS	15

1. Verification of Ohm's & Kirchoff's Laws
2. Types of Wiring (Fluorescent Lamp & Staircase)
3. Verification of Thevenin's Theorem
4. Verification of Norton's Theorem
5. Characteristics of PN Junction Diode
6. Characteristics of Common Base Configuration.
7. Characteristics of Common Emitter Configuration.
8. Measurement of Ripple Factor: Half Wave & Full Wave Rectifier.
9. Study of AC and DC Machines
10. Verification of Logic Gates
11. Study of PMMC and MI Meters

Text Book (s)

1	R. Muthusubramanian, S. Salivahanan,"Basic Electrical and Electronics Engineering," Tata McGraw-Hill, 2012
2	Sawhney, A.K., "A Course in Electrical & Electronic Measurements & Instrumentation", Dhanpat Rai and Co, 2011.

Reference (s)

1	Dash.S.S, Subramani.C, Vijayakumar.K, "Basic Electrical Engineering", Vijay Nicole, 1st Edition, 2013.
2	Jegatheesan.R, "Analysis of Electric Circuits", Tata McGraw-Hill, 2014.
3	Smarajit Ghosh, "Fundamentals of Electrical and Electronics Engineering", PHI Learning Private Ltd, 2nd Edition, 2010.

M.KUMARASAMY
COLLEGE OF ENGINEERING
NAAC Accredited Autonomous Institution
Approved by AICTE & Affiliated to Anna University
ISO 9001:2015 Certified Institution
Thalavapalayam, Karur, Tamilnadu.

Regulation 2018		Semester I/ Semester II	Total Hours			90
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
S	18EES101J	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	3	0	2	4

Prerequisite Course (s)

Nil

Course Objective (s):

The purpose of learning this course is to:

1	Analyze given electric circuits consisting of active and passive components.
2	Identify the parts, functions and working of motors, generators and transformers that function in AC and DC.
3	Utilize the basic electronic devices and circuits.
4	Utilize the working concept of measuring instruments.
5	Build simple logical circuits using Boolean expressions. Identify elements in Integrated circuit.

Course Outcome (s) (COs):

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

CO1	Discuss basic theory utilized in electrical circuits and its circuits.
CO2	Describing working principle of direct current and alternative current machines such as transformers, motors and generators.
CO3	Operate the basic electronic devices. Identify their uses and construction features.
CO4	Interpret the concept of measuring devices like PMMC,MI,energy and wattmeter.
CO5	Apply binary logic and Boolean expressions for digital circuit design, Identify elements in a Integrated circuit.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PS02	PSO3
CO1	3	2	1	1	2	-	2	2	2	2	-	2	2	1	1
CO2	3	2	1	1	2	-	2	2	2	2	-	2	2	1	1
CO3	3	-	1	1	2	-	2	2	2	2	-	2	1	1	1
CO4	3	-	1	1	1	-	2	2	2	2	-	2	1	1	1
CO5	3	2	2	2	2	-	2	2	2	2	-	2	2	1	1
CO (Avg)	3	2	1.2	1.2	1.8	-	2	2	2	2	-	2	1.6	1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	ELECTRICAL CIRCUITS	12

Introduction to DC and AC circuits, Active and Passive two terminal elements, Ohms law,Voltage-Current relation, Power, Energy, R,L,C Circuits, Voltage and Current Sources, Kirchoff's current law, Kirchoff's voltage law, Problem Solving Session, Mesh Current Analysis, Nodal Voltage Analysis, Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem, Star- Delta Transformation, Problem Solving Session, Resistive Circuit Analysis, Superposition, Convolution, RL Circuit Transient Analysis, RC & RLC Transient Analysis , Three Phase Systems, Star and delta Connections, Relation between Line and, Phase, Problem Solving Session.

UNIT II	DC MACHINES & AC MACHINES	12

Sinusoids, Generation of AC, Average, RMS values, Form and peak factors, Analysis of single phase AC circuit, Real, Reactive, Apparent power, Power factor, Magnetic materials, B-H Characteristics Simple magnetic circuits, Faraday's laws, induced emf and inductances. 1 - Phase transformers: Construction, types, ideal, practical transformer, EMF equation, Regulation, Efficiency, Problem Solving Session, Construction, working of DC Generators, Types of DC generators, Characteristics of Generators, Applications of DC generator, Working and types of DC motors, Characteristics , Two point starter and Three point starter, Problem Solving Session, AC generators (Alternators), Construction, working, Characteristics of Alternators, Losses, Single Phase motors: Split phase induction motor & Capacitor start induction motor, Working and types of single phase AC motors, Squirrel Cage and Slip ring induction motor, Types of AC starters (Autotransformer, star-delta and Rotor resistance starter), Problem Solving Session.

UNIT III	ELECTRONIC DEVICES	12

Overview of semiconductors, Intrinsic and Extrinsic semiconductors, Operation of PN Junction diode , Characteristics of PN Diode, Operation of Zener diode, Characteristics of Zener Diode, Overview of diode circuits, Operation of Half -wave rectifier, Half wave : Ripple factor Expression, Advantages, Disadvantages, Operation of Full-wave rectifier, Full wave : Ripple factor Expression, Advantages, Disadvantages, Bridge type rectifier operation, Comparison of rectifier circuits, Overview of filters and its uses, BJT construction, operation, BJT characteristics (CB, CE and CC configurations) and uses, JFET construction, operation, JFET characteristics (Drain and Transfer characteristics), Depletion mode and Enhancement mode MOSFET construction operation, MOSFET characteristics (Transfer and output characteristics), Problem Solving Session.

UNIT IV	MEASUREMENTS	12

Methods of measurements – Overview, Types of Measurements: Primary, Secondary, Tertiary, Basic principles and Classification of Instruments- Indicating, Recording and Integrating, Construction and working of PMMC, PMMC-Torque Equation, Advantages, Disadvantages, Construction and working of MI Instruments, MI (Attraction type)-Operation, MI Attraction type-Advantages , Disadvantages, MI (Repulsion type)- Operation, Torque Equation, MI (Repulsion type)- Errors, Advantages, Disadvantages, Overview of Instrument Transformers, Current Transformer, Potential Transformer, CRO, CRT, Operation of Dynamometer type watt meter, Advantages and Disadvantages, Operation of Induction type watt meter, Advantages and Disadvantages, Megger –Construction, Working, Measurement of Earth resistance

UNIT V	DIGITAL AND INTEGRATED DEVICES	12

Number systems, binary codes, Binary arithmetic, Boolean algebra, laws and theorems, Simplification of Boolean expression, Logic Gates and Operations, Simplification of Boolean expression, Problem Solving Session, SOP and POS Expressions, Standard forms of Boolean expression, Simplify using Boolean Expressions, Minterm and Maxterm, K - Map Simple Reduction Technique, Two, Three and Four Variable K-Map, Problem Solving Session, Half adder circuit, Full adder circuit, Flip-flops : RS , JK, T and D Flip-flops, A/D Converter-Successive Approximation , D/A Converter-Binary Weighted, Overview of Op-Amp, Op-Amp : Functional block & Types (Inverting, Non-inverting & differential amplifier).

LIST OF EXPERIMENTS	30

1. Verification of Kirchoff's Law
2. Verification of all Theorems,
3. Time Domain Analysis (RL, RC).

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4. Types of wiring (Flourescent lamp,Staircase ,godown wiring),
5. Demo of DC Machine & Parts
6. Demo of AC Machine & Parts.
7. Characteristics of semiconductors
8. Measurement of Ripple factor (Half-wave and Full-wave),
9. Characteristics of CB and CE configurations
10. Demo of PMMC and MI Meters,
11. Waveform verification using CRO,
12. Measurement of Energy using Single phase Energy meter,
13. Verification of Boolean expression using logic gates,
14. Reduction using Digital Logic Gates,
15. Design and test of Inverting and Non-Inverting Amplifier using IC741

Text Book (s)

1	R. Muthusubramanian, S. Salivahanan,"Basic Electrical and Electronics Engineering, Tata McGraw-Hill, 2012

Reference (s)

1	Dash.S.S, Subramani.C, Vijayakumar.K, Basic Electrical Engineering, 1st ed.,Vijay Nicole, 2013.
2	Jegatheesan.R,Analysis of Electric Circuits, Tata McGraw-Hill, 2014.
3	P. S.Bimbhra ,Electrical Machinery,7th ed,. Khanna Publishers, 2011.
4	Moris M. Mano, Digital Design, 3rd ed.,Pearson, 2011.
5	Sawhney A.K., A Course in Electrical & Electronic measurements and Instrumentation,Dhanpat Rai and Co.2011.

M.KUMARASAMY COLLEGE OF ENGG.(AUTONOMOUS) Electrical and Electronics Engineering Approved On 14 MAR 2016 Board of Studies KARUR - 639 113

Regulation 2018		Semester I/ Semester II	Total Hours			30
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
H	18MBH102L	GENERAL APTITUDE	0	0	2	1

Prerequisite Course (s)

Nil

Course Objective (s):

The purpose of learning this course is to:

CLR1	Recapitulate fundamental mathematical concepts and skills
CLR2	Hone critical thinking skills by analyzing the arguments with explicit and implicit premises
CLR3	Sharpen logical reasoning through skillful conceptualization
CLR4	Identify the relationships between words based on their function, usage and characteristics
CLR5	Nurture passion for enriching vocabulary
CLR6	Acquire the right knowledge, skill and aptitude to face any competitive examination.

Course Outcome (s) (COs):

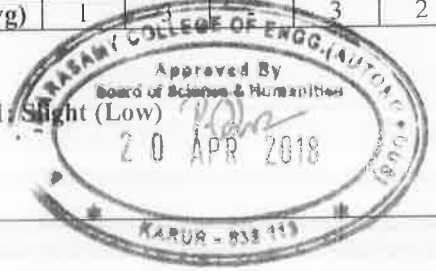
At the end of this course, learners will be able to:

CO1	Build a strong base in the fundamental mathematical concepts
CO2	Identify the approaches and strategies to solve problems with speed and accuracy
CO3	Gain appropriate skills to succeed in preliminary selection process for recruitment
CO4	Collectively solve problems in teams and groups
CO5	Build vocabulary through methodical approaches
CO6	Enhance lexical skills through systematic application of concepts and careful analysis of style, syntax, semantics and logic

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	3	-	3	2	-	-	-	3	3	1	3	-	-	-
CO2	-	3	-	3	2	-	-	-	3	3	-	3	-	-	-
CO3	-	3	-	3	2	-	-	-	3	3	1	3	-	-	-
CO4	1	3	-	3	2	-	-	-	3	3	-	3	-	-	-
CO5	-	3	-	3	2	-	-	-	3	3	1	3	-	-	-
CO6	-	3	-	3	2	-	-	-	3	3	-	3	-	-	-
CO (Avg)	1	3	-	3	2	-	-	-	3	3	1	3	-	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)



UNIT I		**6**
Types of numbers, Divisibility tests -Introduction to Significance of Verbal Aptitude in Competitive Examinations - LCM and GCD -Vocabulary enrichment techniques - Unit digit, Number of zeroes, Factorial notation - Vocabulary enrichment Techniques.		
UNIT II		**6**
Square root, Cube roots, Remainder - Identities - Contextual Vocabulary Exercise - Synonyms Fractions and Decimals, surds -Contextual Vocabulary Exercise -Antonyms		
UNIT III		**6**
Percentage Introduction - Sentence Completion Basic Level Exercises : Single Blank - Percentage Problems - Sentence Completion Basic Level Exercises : Double Blank - Profit and Loss - Cloze Test		
UNIT IV		**6**
Discount -Reading Comprehension – Introduction -Simple Interest - Reading Comprehension – Summary & Main Idea - Compound Interest, Installments - Reading Comprehension – Summary & Main Idea		
UNIT V		**6**
Logarithms Intro - Grammar Rules :A comprehensive Introduction - Logarithms Rules - Sentence Completion – Grammar - Linear Equations - Spotting Errors		
Text Book (s)		
1	Nil	
Reference (s)		
1	Charles Harrington Elstor, Verbal Advantage: Ten Easy Steps to a Powerful Vocabulary, Random House Reference, 2002	
2	Merriam Webster's Vocabulary Builder, Merriam Webster Mass Market, 2010	
3	Norman Lewis, How to Read Better and Faster, Goyal, 4th Edition	
4	Franklin GRE Word List, 3861 GRE Words, Franklin Vocab System, 2014	
5	Wiley's GMAT Reading Comprehension Grail, Wiley, 2016	
6	Manhattan Prep GRE : Reading Comprehension and Essays, 5th Edition	
7	Martin Hewings, Advanced Grammar in Use. Cambridge University Press, 2013	
8	Nishit K. Sinha, The Pearson Guide to Quantitative Aptitude and Data Interpretation for the CAT	
9	Dinesh Khattar-The Pearson Guide to QUANTITATIVE APTITUDE for competitive examinations	

Regulation 2018		Semester II	Total Hours			30
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
M	18LEM102T	VALUE EDUCATION	1	0	0	-

Prerequisite Course (s)

NIL

Course Objective (s):

The purpose of learning this course is to:

CLR-1	Connect the learners to their potential, identify their potential to create a new positive world
CLR-2	Analyze the merits and demerits of different educational systems. Identify the different systems of education
CLR-3	Draw attention towards the weaknesses they are susceptible to and inspire them through positive models
CLR-4	Instill a sense of professional ethics which help them develop a safe comfortable and prosperous society
CLR-5	Cultivate a spirit of willing accommodation in an increasingly diverse world

Course Outcome (s) (COs):

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

CO1	Equipped with an awareness of their positive energy and power
CO2	Identify the meaning of 'education'; have a clearer and better understanding in taking education to the masses
CO3	Assess their weaknesses; understand risks involved and rectify them through learning from positive and negative instances
CO4	Realize their professional responsibilities
CO5	Acquire the required values in an expanding pluralistic world not be swept off their feet due to the rapid changes

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	-	-	2	3	-	3	3	3	-	3	-	-	-
CO2	2	3	2	-	3	3	2	2	3	3	-	3	-	-	-
CO3	2	-	-	-	2	3	2	2	3	3	-	3	-	-	-
CO4	3	2	-	-	3	3	3	3	3	3	-	3	-	-	-
CO5	2	-	-	-	3	3	3	3	3	3	-	3	-	-	-
CO (Avg)	2	2.33	2	-	2.6	3	2.5	2.6	3	3	-	3	-	-	-

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

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UNIT I	VISIONS FOR YOUTH	6
Introduction (Quiz) - Two speeches by great personalities (Oral presentations) - Quotes, proverbs relating to the power and potential of youth, Excerpts: Wings of Fire (Collecting proverbs highlighting the potential of youth) - Two news articles highlighting the initiatives for social causes by youth (Role play in a similar context) - One song exhibiting the positive energy of youth (Discussion on the song)		
UNIT II	**YOUTH AND EDUCATION**	**6**
Meaning and the significance of education (Brainstorming) - Overview of different (traditional, modern) educational systems (Debate) - Role of youth in education, Urban and Rural set up, dissemination (Student presentations) - Designing and framing educational curriculum and materials (Students' Presentation based on write ups) -The pressing challenges in current educational system (Collage Design)		
UNIT III	**YOUTH AND SOCIETY**	**6**
Need for social values in the present context (Poem – "Where the mind is without fear" , Write up on various instances from real life) - Individual and group behaviour, respect for others (Case study on recent happenings) - Civic sense, bullying-substance abuse, uses of expletives (Case study on recent happenings) - Hero worship, gender insensitivity moral policing (Case study on recent happenings) - Positive contribution by youth in promoting social welfare (Short videos followed by discussions)		
UNIT IV	**YOUTH AS PROFESSIONALS**	**6**
Introduction to professional values (Brainstorming through visual cues) - Engineering societies in India (Quiz) - Challenges to be addressed by Engineers in India (Case Study) - Challenges in different sectors: agriculture (Case Study) - Challenges in different sectors: urban development, environment (Group activity (oral and written)) - Challenges in different sectors: sustainable development, cyber security (Case Study – from Newspapers)		
UNIT V	**YOUTH IN PLURALISTIC SOCIETY**	**6**
Introduction to pluralistic society, forces of globalization (Group Discussion) - Science and technology intercultural proximity (Narration of stories from various religions to illustrate the oneness of humanity) - Positive, Negative impact: religion, politics, gender, economic status, aesthetics (Discussion on "To Kill a Mocking Bird") - Values required to live in a global society (Poster presentation on festivals of various religions) - Learning the etiquettes of various societies (Poster presentation on festivals of various religions) - Success of pluralistic society, enliven the society, religious harmony through literary (Writing the aspects of pluralistic society based on the text).		

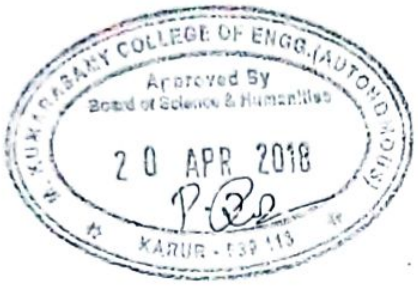
Text Book (s)

	Nil

Reference (s)

1	Kalam, APJ Abdul. Wings of Fire: AN Autobiography of APJ Abdul Kalam. Ed. Sangam Books Ltd., 1999
2	"Banaras Hindu University Speech" and "To Students". The Voice of Truth. General Editor Shriman Narayan. Navajivan Publishing House. pp. 3-13 and pp. 425-30. www.mkgandhi.org
3	Piroda, Sam. "Challenges in Science and Technology". www.nfdindia.org/loc19.htm

4	Thomas A Address to VTU Students by Narayana Murthy. https://www.karnataka.com/personalities/narayana-murthy/vtu-address-2006/
5	World Economic forum. "India's top 7 challenges from skills to water scarcity"



Regulation 2018		Semester III	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
B	18MAB201T	TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS (Common to B.E Mech, EEE, Civil & EIE)	3	1	0	4

Prerequisite Course (s)

NIL

Course Objective (s):

The purpose of learning this course is to:

1	Develop the skills of the students in the areas of Transforms and Partial differential Equations
2	Apply for the effective studies in a large number of engineering subjects like heat conduction, communication systems, electro-optics and electromagnetic theory.
3	Serve as a prerequisite for post graduate and specialized studies and research.

Course Outcome (s) (COs):

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

CO1	Expand a function in terms of Fourier Series and apply it for solving engineering problems.
CO2	Gain knowledge on Fourier Transforms
CO3	Model and solve higher order partial differential equations
CO4	Apply the methods of solving PDE in practical problems
CO5	Handle problems in Z transforms and apply it to solve difference equations

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	-	-	-	-	-	-	-	-	2	-	1
CO2	3	3	1	1	-	-	-	-	-	-	-	-	1	-	1
CO3	3	3	2	1	-	-	-	-	-	-	-	-	2	1	1
CO4	3	3	2	1	-	-	-	-	-	-	-	-	2	-	2
CO5	3	3	2	3	-	-	-	-	-	-	-	-	1	-	1
CO (Avg)	3	3	1.8	1.4	-	-	-	-	-	-	-	-	1.6	1	1.2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Approved by Board of Studies & Academic Council
29 MAR 2019
KARUR - 639 113

UNIT I	FOURIER SERIES	9+3
Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series — Parseval's identify – Harmonic Analysis.		
UNIT II	**FOURIER TRANSFORMS**	**9+3**
Fourier integral theorem (without proof) – Fourier transform pair – Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem- Parseval's identity.		
UNIT III	**PARTIAL DIFFERENTIAL EQUATIONS**	**9+3**
Formation of partial differential equations – Lagrange's linear equation – Solutions of standard types of first order partial differential equations - Linear partial differential equations of second order with constant coefficients.		
UNIT IV	**BOUNDARY VALUE PROBLEMS**	**9+3**
Classification of second order partial differential equations-Solutions of one dimensional wave equation – One dimensional equation of heat conduction –Solution of two dimensional equation of heat Equation in Cartesian coordinates.		
UNIT V	**Z - TRANSFORMS AND DIFFERENCE EQUATIONS**	**9+3**
Z-transforms - Elementary properties – Inverse Z-transform – Convolution theorem -Formation of difference equations – Solution of difference equations using Z-transform.		

Text Book (s)

1	Grewal.B.S, *'Higher Engineering Mathematics'* 40th Edition, Khanna publishers, Delhi, (2007)

Reference (s)

1	Bali.N.P and Manish Goyal *'A Textbook of Engineering Mathematics'*, Seventh Edition, Laxmi Publications(P) Ltd. (2007)
2	Ramana.B.V. *'Higher Engineering Mathematics'* Tata Mc-GrawHill Publishing Company limited, New Delhi (2007).
3	Glyn James, '*Advanced Modern Engineering Mathematics'*, Third edition-Pearson Education (2007).
4	Erwin Kreyszig *'Advanced Engineering Mathematics'*, Eighth edition-Wiley India (2007).

Regulation 2018		Semester III	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
S	18MES201T	ENGINEERING MECHANICS	3	1	0	4

Course Objective (s):

- To apply the fundamental knowledge of Mechanics concepts and force resolution.
- To gain knowledge on Equilibrium of rigid bodies in two dimensions.
- Solve the Centroid and Moments of Inertia of different objects using mathematical formula
- Impart knowledge in laws of motion, the kinematics and dynamics of particles and rigid bodies.
- Learn the concepts of static friction.

Course Outcome (s) (COs)

CO1	Illustrate the vectorial and scalar representation of forces and moments
CO2	Solve problems in engineering systems using the concept of static equilibrium
CO3	Determine the centroid of areas, and volumes and moment of inertia of composite areas
CO4	calculate the dynamic forces exerted in rigid bodies
CO5	Analyse the mechanism of friction and frictional forces involved in systems

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	-	-	-	-	-	-	-	2	-	2	-	1
CO2	3	2	1	-	-	-	-	-	-	-	2	-	2	-	1
CO3	3	2	1	-	-	-	-	-	-	-	2	-	2	-	1
CO4	3	2	1	-	-	-	-	-	-	-	2	-	2	-	1
CO5	3	2	1	-	-	-	-	-	-	-	2	-	2	-	1
CO (Avg)	2.8	1.8	1	-	-	-	-	-	-	-	2	-	2	-	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	BASICS & STATICS OF PARTICLES	12
Introduction–Units and Dimensions–Laws of Mechanics–Lami'stheorem,Parallelogram and triangular Law of forces–Vector representation of forces and moments–Vector operations: additions, subtraction, dotproduct, cross product–Coplanar Forces–Resolution and Composition of forces–Equilibrium of a particle—Equivalent systems of forces–Principle of transmissibility.		
UNIT II	**EQUILIBRIUM OF RIGID BODIES**	**12**
Free body diagram–Types of supports and their reactions–requirements of stable equilibrium–Moments and Couples–Moment of a force about a point and about an axis–Vector representation of moments and couples–Scalar components of a moment–Varignon's theorem–Equilibrium of rigid bodies in two dimensions		
UNIT III	**PROPERTIES OF SURFACES AND SOLIDS**	**12**
Determination of areas and volumes–First moment of area and the centroid of sections – Rectangle, circle, triangle from integration–T-section, I-section, -Anglesection, Hollow section by using standard formula–Rectangle, triangle, circle from integration – T section, I section, Angle section, Hollow section by using standard formula– Parallel axis theorem and Perpendicular axis -Polar moment of inertia.		
UNIT IV	**DYNAMICS OF PARTICLES**	**12**
Displacements, Velocity and acceleration, their relationship–Relative motion–Curvilinear motion– Newton's law– Work Energy Equation of particles		
UNIT V	**FRICTION AND ELEMENTS OF RIGID BODY DYNAMICS**	**12**
Frictional force–Laws of Coloumb friction–Simple contact friction–Rolling resistance– Belt friction.Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion.		

Text Book (s)

1	Beer F P and Johnson E R, "Vector Mechanics for Engineers, Statics and Dynamics", Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2010.
2	N.Kottiswaran 'Engineering Mechanics-Statics and Dynamics' Sri Balaji Publications 2014

Reference (s)

1	Meriam J.L, Kraige L.G, "Engineering Mechanics-Statics", 6th Edition, Wiley, 2010.
2	Palanichamy, M.S., Nagam, S., "EngineeringMechanics – Statics &Dynamics", Tata McGraw-Hill, 2007.
3	IrvingH.Shames,"EngineeringMechanics–StaticsandDynamics",IVEdition–Pearson Education Asia Pvt. Ltd., 2006.
4	Hibbeller, R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", 11th Edition, Pearson Education 2010.
5	Shames. I.H, 'Engineering Mechanics – Statics and Dynamics', Pearson Education, Asia, 2006.

Regulation 2018		Semester III	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	18MEC201T	ENGINEERING THERMODYNAMICS	3	1	0	4

Course Objective (s):

- Represent a thermodynamic system , identify work and/or heat interactions between the system and surroundings and apply first law of thermodynamics
- Understand implications of the second law of thermodynamics placed by the second law on the performance of thermodynamic systems
- Quantify the behavior of power plants based on the Rankine cycle and effect of enhancements by reheat and regeneration
- Understand the thermodynamic relations of ideal and real gases
- Understand the psychrometric properties and processes

Course Outcome (s) (COs):

CO1	Apply the first law of thermodynamics for simple open and closed systems under steady conditions.
CO2	Apply second law of thermodynamics to open and closed systems and evaluate entropy and availability
CO3	Apply Rankine cycle to steam power plant and compare cycle improvement methods
CO4	Interpret basic thermodynamic relations of ideal and real gases
CO5	Compute the properties of moist air and illustrate its use in psychometric processes

CO-PO Mapping

COs	POs												PSOs		
	PO 1	PO 2	PO 3	P O4	P O5	P O6	P O7	P O8	P O9	PO 10	PO1 1	PO12	PSO 1	PS O2	PSO3
CO1	3	3	3				2					1	3	-	
CO2	3	3	3				2					2	3		1
CO3	3	3	3				2					1	3	2	
CO4	3	3	3				1			1			1	-	
CO5	3	3	3				2					2	3	3	1
CO(Avg)	3	3	3				1.8			1		1.5	2.6	2.5	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	BASIC CONCEPTS AND FIRST LAW	12

Basic concepts - concept of continuum, comparison of microscopic and macroscopic approach. Path and point functions. Intensive and extensive, total and specific quantities. System and their types. Thermodynamic Equilibrium State, path and process. Quasi-static, reversible and irreversible processes. Heat and work transfer, definition and comparison, sign convention.P-V diagram. Zeroth law of thermodynamics – concept of temperature and thermal equilibrium–First law of thermodynamics –application to closed and open systems – steady flow processes.

UNIT II	SECOND LAW AND AVAILABILITY	12

Heat Reservoir, source and sink. Heat Engine, Refrigerator, Heat pump. Statements of second law and its corollaries. Carnot cycle Reversed Carnot cycle, Performance. Clausius inequality. Concept of entropy, T-s diagram, entropy change for - ideal gases - different processes, principle of increase in entropy. Applications of II Law. High and low grade energy. Availablility and irreversibility.

UNIT III	PROPERTIES OF PURE SUBSTANCE AND STEAM POWER CYCLE	12

Formation of steam and its thermodynamic properties, p-v, p-T, T-v, T-s, h-s diagrams. p-v-T surface. Use of Steam Table and Mollier Chart. Determination of dryness fraction. Application of I and II law for pure substances. Ideal and actual Rankine cycles, Cycle Improvement Methods - Reheat and Regenerative cycles.

UNIT IV	GAS MIXTURES AND THERMODYNAMIC RELATIONS	12

Gas mixtures - Properties of Ideal gas- Ideal and real gas comparison- Equations of state for ideal and real gases. Compressibility factor-Principle of Corresponding states -Generalised Compressibility Chart and its use-Dalton's and Amagat's Law - Maxwell relations, Tds Equations, Difference and ratio of heat capacities, Joule-Thomson Coefficient, Clausius Clapeyron equation.

UNIT V	PSYCHROMETRY	12

Psychrometric properties, Psychrometric charts. Property calculations of air vapour mixtures by using chart and expressions. Psychrometric process – adiabatic saturation, sensible heating and cooling, humidification, dehumidification, evaporative cooling and adiabatic mixing.

Text Book (s)

1	Rajput R.K, "A Text Book of Engineering Thermodynamics", Lakshmi Publications, New Delhi, Fifth Edition, 2017
2	Nag P K, "Engineering Thermodynamics", Tata McGraw-Hill, New Delhi, Fifth Edition, 2013

Reference (s)

1	Yunus Cengel, Michael A Boles, "Thermodynamics –An Engineering Approach" Tata McGraw-Hill, Eighth Edition, New Delhi, 2015
2	Michael J. Moran, Howard N. Shapiro, "Fundamentals of Engineering Thermodynamics", Eighth Edition, 2014
3	Chattopadhyay, P, "Engineering Thermodynamics", Oxford University Press, Second Edition, 2015.
4	Claus Borgnakke & Richard E. Sonntag, "Fundamental of Thermodynamics", Ninth Edition , 2016.
5	Mark W Zemansky and Richard H Dittman, "Heat and Thermodynamics", Eighth Edition, 2011.

Regulation 2018		Semester III	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	18MEC202T	ENGINEERING MATERIALS AND METALLURGY	3	0	0	3

Course Objective (s):

- To impart knowledge on the constitution of alloys and phase diagrams.
- To correlate the materials behaviour and heat treatment process.
- To identify and select suitable materials properties and testing
- To identify ferrous and non ferrous metals.
- To impart knowledge on non-metallic materials.

Course Outcome (s) (COs):

CO1	Describe the phase reactions, microstructures and compositions of the iron-iron carbide diagram.
CO2	Illustrate the appropriate heat treatment process in specific applications
CO3	Explain the testing procedure to evaluate material properties.
CO4	Identify the composition, properties and applications of various ferrous, non ferrous metals and their alloys
CO5	Illustrate the general concepts of Non metallic materials.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2					2	2	1	2		3	3		2
CO2	3	2					2	2	2	2		2	2		2
CO3	3	2					2	3	3	2		2	3		3
CO4	3	2					2	2	2	2		3	3		2
CO5	3	2					2	2	2	2		3	3		2
CO (Avg)	3	2					2	2.2	2	2		2.6	2.8		2.2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS	9
Constitution of alloys – Solid solutions, substitutional and interstitial – phase diagrams, Isomorphous, eutectoid, eutectic, peritectic, and peritectroid reactions, Iron – Iron carbide equilibrium diagram. Classification of steel and cast Iron, microstructure, properties and applications.		
UNIT II	**HEAT TREATMENT**	**9**
Definition–Fullannealing,stress relief,recrystallisation and spheroidizing–normalising, hardening and tempering of steel. Isothermal transformation diagrams–cooling curves superimposed on I.T. diagram, CCR - Hardenability, Jominy end quench test – Austempering, martempering – case hardening - carburising, nitriding, cyaniding, carbonitriding,flame and induction hardening.		
UNIT III	**MECHANICAL PROPERTIES AND TESTING**	**9**
Mechanism of plastic deformation,slip and twinning–Types of fracture–Testing of materials under tension,compression and shearloads–Hardness tests(Brinell,Vickers and Rockwell), Impact test - Izod and Charpy, Fatigue and creep tests, fracture toughnesstests.		
UNIT IV	**FERROUS AND NON FERROUS METALS**	**9**
Effect of alloying elements on steel(Mn,Si,Cr,Mo,V,Ti &W) – stainless and tool steels –HSLA-maraging steels–Cast Irons-Grey,White malleable,spheroidal–Graphite, Alloy cast irons,Copper and Copper alloys-Brass,Bronze and Cupronickel–Aluminum and Al-Cualloy–precipitation hardening–Bearing alloys.		
UNIT V	**NON-METALLIC MATERIALS**	**9**
Polymers–types of polymer,commodity and engineering polymers–Properties and applications of PE,PP,PS,PVC,PMMA,PET,PC,PA,ABS,PI,PAI,PPO,PPS,PEEK, PTFE Polymers – Urea and Phenol Formaldehydes – Engineering Ceramics.		

Text Book (s)

1	William D Callister —Material Science and Engineeringl, John Wiley and Sons, 2010.
2	AnupGoel, SSSabharwal, —Engineering Materials and Metallurgyl, Technical Publication, 2014.

Reference (s)

1	William D,Callister, "Material Science and Engineering",JohnWileyandSons2007.
2	Khanna O P, "A textbook of Materials Science and Metallurgy",KhannaPublishers, 2003.
3	Dieter GE, "Mechanical Metallurgy",Mc GrawHill BookCompany, 2006.
4	Winowlin Jappes J D, Alavudeen A, "A Textbook of Engineering Materials and Metallurgy", Laxmi publications, 2006.

Regulation 2018		Semester III	Total Hours			75
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	18MEC203J	FLUID MECHANICS AND MACHINERY	3	0	2	4

Course Objective (s):

- To gain knowledge in the basic concept of mechanics of fluids, properties of the fluid, conservation equations and their applications to fluid flow problems.
- To gain knowledge in the basic concept of Measurements and dimensions in fluid mechanics.
- To analyze the complexities involved in solving the solutions of practical flow problems.
- To familiarize the basic design aspects, working and operation principle of Turbines.
- To Understand the basic design aspects, working and operation principle of pumps.

Course Outcome (s) (COs):

CO1	Describe the properties of fluids and its flow characteristics.
CO2	Measure the flow and pressure of fluid and to apply dimensional parameters.
CO3	Calculate the losses during flow in a circular pipe
CO4	Explain Hydraulic turbines and its performance characteristics.
CO5	Demonstrate pumps and its performance characteristics.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3		1	2	2	2	1		2	3	2	3
CO2	3	3	3	3		1	2	2	2	1		2	3	2	3
CO3	3	3	3	3		1	2	2	2	1		2	3	2	3
CO4	3	3	3	3		1	3	2	2	1		2	3	2	3
CO5	3	3	3	3		1	3	2	2	1		2	3	2	3
CO (Avg)	3	3	3	3		1	2.4	2	2	1		2	3	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	INTRODUCTION	9
Properties of fluid: Density- Specific volume-Specific gravity- specific weight- viscosity-capillarity and surface tension- compressibility-Bulk modulus- vapor pressure – Cavitation- Types of fluids. Fluid Kinematics: Types of Fluid Flow -Concept of system, Continuum and Control Volume – Continuity Equation -Fluid Dynamics: Euler's energy equation – Bernoulli's Equation		
UNIT II	**MEASUREMENTS AND DIMENSIONAL ANALYSIS**	**9**
Measurement of Pressure : concept of fluid static pressure, absolute and gauge pressures – Pascal's law, Hydrostatic Law - pressure measurements by manometers and pressure gauges. Flow measurement: Orifice meter, Venturi meter, Pitot tube, advanced flow measurements instruments. Dimensional analysis: Dimension and units – Dimensional Homogeneity- Rayleigh's method - Buckingham's Π theorem		
UNIT III	**FLOW THROUGH CIRCULAR CONDUITS**	**9**
Viscous flow: Reynold's Experiment – Flow of Viscous Fluid in a circular pipe - Shear Stress Distribution, Velocity Distribution and Pressure Drop of a viscous fluid Flow through pipes:Friction Factor – Darcy Weisbach's Equation and Chezy's formula- Moody's Diagram- Minor Losses – HGL & TEL – Pipes in Series and parallel.		
UNIT IV	**HYDRAULIC TURBINES**	**9**
Introduction to Turbo machines and classification -Construction of velocity vector diagrams - head and specific work - components of energy transfer - degree of reaction. Pelton turbine - Francis turbine - Kaplan turbine - working principles - velocity triangles - work done – efficiencies – Performance Curves		
UNIT V	**HYDRAULIC PUMPS**	**9**
Introduction to pumps – classifications. Centrifugal Pump working principle, - velocity triangles, specific speed, efficiency and performance curves. Reciprocating pump: classification, working principle, indicator diagram- efficiency and performance curves .Rotary Pumps		

Text Book (s)

1	Bansal, R K, "Fluid Mechanics and Hydraulics Machines", Laxmi publications (P) Ltd, New Delhi, 9th Edition, 2017
2	Modi P.N. and Seth, S.M. "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi 2013.

Reference (s)

1	Kumar K. L., "Engineering Fluid Mechanics", Eurasia Publishing House(p) Ltd., New Delhi 2016
2	Graebel. W.P, "Engineering Fluid Mechanics", Taylor & Francis, Indian Reprint, 2011
3	Robert W.Fox, Alan T. McDonald, Philip J.Pritchard, "Fluid Mechanics and Machinery", 2011.
4	Streeter, V. L. and Wylie E. B., "Fluid Mechanics", McGraw Hill Publishing Co. 2010
5	Vasandani, V P, "Hydraulic Machines - Theory and Design", Khanna Publishers, 11th Edition, 2010

LIST OF EXPERIMENTS

Total:30 Hours

1.	Determination of the Coefficient of discharge of given Orificemeter.
2.	Determination of the Coefficient of discharge of given Venturi meter.
3.	Calculation of the rate of flow using Rotameter / Flow meter.
4.	Determination of friction factorfor agivenset of pipes – Major losses and minor losses
5.	Conducting experiments and drawing thecharacteristic curves of centrifugal pump
6.	Conducting experiments and drawing thecharacteristic curves of submergible pump
7.	Conducting experiments and drawing thecharacteristic curves of pumps in series and parallel operations
8.	Conducting experiments and drawing the characteristic curves of reciprocating pump.
9.	Conduction experiments and drawing the characteristic curves of Jet pump.
10.	Conducting experiments and drawing the characteristic curves of Gear pump.
11.	Conducting experiments and drawing the characteristic curves of Pelton wheel.
12.	Conducting experiments and drawing the characteristics curves of Francis turbine.
13.	Conducting experiments and drawing the characteristic curves of Kaplan turbine.

Regulation 2018		Semester III	Total Hours			75
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	18MEC204J	MANUFACTURING TECHNOLOGY	3	0	2	4

Course Objective (s):

- To acquire knowledge about the mechanism of chip formation, cutting tool materials, tool life, cutting fluids and welding processes
- To familiarize the working of machine tools such as semi-automatic, automatic lathes and CNC lathe.
- To obtain knowledge about Reciprocating machines and Gear Manufacturing
- To get wide knowledge and the concept of Additive Manufacturing
- To gain knowledge about the mechanism of unconventional machining process.

Course Outcome (s) (Cos):

CO1	Classify the various welding methods for fabrication process.
CO2	Explain concept and mechanism of center lathe and special purpose lathe.
CO3	Describe the working of milling machine, reciprocating and hole making machine.
CO4	Describe the concept of Additive Manufacturing
CO5	Illustrate the principle of unconventional machining process.

CO-PO Mapping

Cos	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2					2	2	2	1		3	1		2
CO2	3	2					2	2	2	1		3	1		2
CO3	3	2					2	2	2	1		3	1		2
CO4	3	2					2	2	2	1		3	1		2
CO5	3	2					2	2	2	1		3	1		2
CO (Avg)	3	2					2	2	2	1		3	1		2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	JOINING PROCESSES	9

Fusion welding processes – Types of Gas welding – Equipments used – Flame characteristics – Filler and Flux materials – Arc welding equipments – Electrodes – Coating and specifications – Principles of Resistance welding – Spot/butt, seam welding – Gas metal arc welding– Submerged arc welding – Tig welding –Plasma arc welding – Thermit welding – Electron beam welding – Friction welding – Weld defects – Brazing and soldering process.

UNIT II	CENTRE LATHE AND SPECIAL PURPOSE LATHES	9

Centre lathe, constructional features, cutting tool geometry, various operations, taper turning methods, thread cutting methods, special attachments, machining time and power estimation. Capstan and turret lathes – automats – single spindle, Swiss type, automatic screw type, multi spindle –Introduction to CNC-Working principle-types of codes

UNIT III	RECIPROCATING MACHINE TOOLS AND GEAR MANUFACTURING	9

Reciprocating machine tools: shaper, planer, slotter – Milling : types, milling cutters, operations – Grinding Machines – Grinding wheel Specifications – Honing – Tapping – Burnishing – Super Finishing – Surface Integrity concepts – Gear Manufacturing Processes – Gear Hobbing – Gear Shaping Machines – Manufacture of Spur – Helical – Bevel – Worm and Worm Wheel – Gear Finishing.

UNIT IV	ADDITIVE MANUFACTURING	9

Overview – History – Need-Classification -Additive Manufacturing Technology in product development- Materials for Additive Manufacturing Technology – Tooling – Applications - Liquid based system – Stereo lithography Apparatus (SLA)- Principle, process, advantages and applications – Solid based system –Fused Deposition Modeling – Principle, process, advantages and applications, Laminated Object Manufacturing

UNIT V	UNCONVENTIONAL MACHINING PROCESSES	9

Principle of operations – Advantages and disadvantages – applications: Abrasive Jet machining process (AJM), Water Jet Machining process (WJM), Ultrasonic Machining process (USM), Electric Discharge machining process (EDM), Laser Beam Machining process (LBM) Chemical Machining process (CHM) and Electro Chemical Machining process (ECM)

Text Book (s)

1	S K Hajra Choudhury, Elements of Workshop Technology - Vol. I, Media Promoters & Publishers Private Limited, Mumbai,2013
2	Kaushish J P, "Manufacturing Processes", PHI Learning Pvt. Ltd., New Delhi, 2010
3	S. K. Hajra Choudhury, Elements of Workshop Technology. Vol. II, Media Promoters & Publishers Private Limited., Mumbai, 2013.
4	P.C. Sharma, Manufacturing Technology - I, S Chand and Company Private Limited,New Delhi,2010
5	P.C Sharma, Manufacturing Technology - II, S.Chand & Company Limited. New Delhi, 2012.

Reference (s)

1	P. N. Rao, Manufacturing Technology vol. I, Tata McGraw-Hill Publishing Company Private Limited, New Delhi, 2010
2	Serope Kalpakjian, Steven R. Schmid, Manufacturing Engineering and Technology,Pearson Education Limited,New Delhi, 2013.

3	J. P. Kaushish, Manufacturing Processes, Prentice Hall of India Learning Private Limited, New Delhi, 2013.
4	P. N. Rao, Manufacturing Technology- Metal Cutting and Machine Tools, Tata McGraw Hill Publishing Company Private Limited., New Delhi, 2013
5	http://nptel.ac.in/courses/112107144/1

LIST OF EXPERIMENTS (Total:30 Hours)	
I LATHE	
1.1	Facing, plain turning, step turning and Taper turning
1.2	Single start V thread, cutting and knurling operations
1.3	Assembly of Machined Components for different fits
1.4	Tool wear, Cutting force measurements.
II RECIPROCATING MACHINE	
2.1	Round to square in Shaper
2.2	Keyway cutting in slotter
III GEAR MANUFACTURING, DRILLING MACHINE	
3.1	Gear Making, Hexagonal Milling in Milling Machine
3.2	Drilling, reaming, tapping in Drilling Machine
IV GRINDING MACHINE	
4.1	Prepare good surface finish on flat metal
4.2	Prepare good surface finish on circular metal
V FOUNDRY	
5.1	Mould with solid and split patterns
5.2	Mould with loose-piece pattern
5.3	Mould with Core
VI WELDING	
6.1	TIG welding of metal plate
6.2	MIG Welding of different types of joints

Regulation 2018		Semester III	Total Hours			30
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
M	18MBM201L	COMPETENCIES IN SOCIAL SKILLS	0	0	2	1

Course Objective (s):

The purpose of learning this course is to:

1	To sharpen problem solving skill and to improve thinking capability of the students
2	To hone soft skill and analytical ability of students
3	To engage learners in using language purposefully and cooperatively
4	To expertise the writing and presentation skill to fulfill the corporate expectations

Course Outcome (s) (Cos):

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

CO1	Students should be able to solve both analytical and logical problems in an effective manner
CO2	Students can design and deliver information in a proper manner
CO3	Presentation skills of students will be improved individually as well as a team member

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	1	-	1
CO2	-	-	-	-	-	-	-	-	-	2	-	-	-	1	-
CO3	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO (Avg)	3.00	-	-	-	-	-	-	-	2.00	2.00	-	-	1.00	1.00	1.00

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	Module - 1	6
Aptitude: Coding & Decoding - Direction Sense Test. **Communication:** Self-Introduction and SWOT analysis - Letter writing - types.		
UNIT II	**Module - 2**	6
Aptitude: Venn Diagrams - Data Interpretation. **Communication:** Phrasal verbs - Voice of Valluvar.		
UNIT III	**Module - 3**	6
Aptitude: Averages. **Communication:** Idioms and Phrases - Skits.		
UNIT IV	**Module - 4**	6
Aptitude: Time and Distance - Problems on Trains. **Communication:** Prefix/Suffix - Root words - Adjectives - JAM (Extempore Speech).		
UNIT V	**Module - 5**	6
Aptitude: Clocks & Calendars. **Communication:** Homophones - Frame Tales.		

Text Book (s)

1	Dr.R.S.Aggarwal, "Quantitative Aptitude", S. Chand & Company Limited, 2015
2	Dr.R.S.Aggarwal, "A Modern Approach to Verbal & Non - Verbal Reasoning", S. Chand & Company Limited, 2015

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Regulation 2018		Semester III / Semester IV	Total Hours			60
			Hours / Week			C
Category	Course Code	Course Name	L	T	P	
M	18CYM201T	Environmental Science	1	0	0	-

Prerequisite Course (s)

NIL

Course Objective (s):

The purpose of learning this course is to:

- To demonstrate in-depth knowledge within environmental engineering and an awareness of social, economic, political, and environmental impacts of engineering practices.
- To have competence for working with multi-disciplinary teams to arrive at solutions to environmental engineering problems.
- To get solutions which will minimize the negative impact of human activities on the environment and to protect human health

Course Outcome (s) (Cos):

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

CO1	Improve fundamental knowledge of the inter-relationships between the built environment and natural systems
CO2	Characterize and mitigate man-made hazards like nuclear hazards. Understand the principles involved in the generation of different forms of energy
CO3	Improve the reliability, performance, disaster-management of natural calamities and solid waste and water supplies and treatment processes.
CO4	Understand the source, effects and control measure of various environmental pollution
CO5	Apply information technology in the control of human population and women and child welfare

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	2	-	-	-	-	3	-	-	-	-	-	-	-	-
CO2	-	2	-	-	-	3	3	-	-	-	-	-	1	-	1
CO3	-	2	-	2	-	3	3	-	-	-	-	-	1	-	1
CO4	-	2	-	-	-	3	3	2	-	-	-	-	1	-	1
CO5	-	2	-	2	-	3	3	-	-	-	-	-	-	-	-
CO (Avg)	-	2.00	-	2.00	-	3.00	3.00	2.00	-	-	-	-	1.00		1.00

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	ENVIRONMENT& BIODIVERSITY	3
Definition-types of environment, components of environment, scope-importance of environmental studies- Bio diversity-definition-value of biodiversity-Threats to biodiversity - India a mega diversity nation-endangered and endemic species of India-conservation of biodiversity.		
UNIT II	ENERGY SOURCES	3
Energy resources- Growing energy needs- Renewable and Nonrenewable energy sources- Use of alternate energy sources - Nuclear Energy- Alternative energy fuels-power alcohol-Bio diesel (preparation, properties &uses)		
UNIT III	SOCIAL ISSUES AND ENVIRONMENT	3
Environment ethics – Climate change – Global warming – Acid rain – Ozone layer depletion –Nuclear accidents-holocaust. Solid waste management - Rain water Harvesting-watershed management-		
UNIT IV	ENVIRONMENTAL POLLUTION & ACTs	3
Source, types, effects & control- Air pollution -Water pollution – Soil pollution – Marine pollution and Plastic Pollution -The Environment (Protection) Act - Air (Prevention and control of pollution) Act - Water (Prevention and control of pollution) Act- Role of individual in prevention of pollution.		
UNIT V	HUMAN POPULATION AND ENVIRONMENT	3
Sustainable development – Urban Population growth and distribution – Population explosion – Family Welfare Program –Women and child welfare- Role of information technology in environment and human health- case studies		

Text / Reference (s) books:

1	Dr.J.P.Sharma, " Environmental studies" , Laxmi Publications(p) Ltd, New Delhi.
2	Miller "Environmental Science" 11th Edition, Cengage Learning India Private Limited, New Delhi, (2006).
3	Master. G.M., "Introduction to Environmental Engineering and Science", Pearson Education Pvt Ltd., (2004)
4	Dr.A.Ravikrishnan " Environmental Science and Engineering " Sri Krishna publications, Chennai(2015)
5	P.Anandan, R.Kumaravelan "Environmental Science and Engineering" Scitech Publication (India) Pvt. Ltd, Chennai, Reprint 2009.

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Regulation 2018		Semester IV	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
B	18MAB204T	STATISTICS AND NUMERICAL METHODS (Common to B.E Mech, EEE, Civil & EIE)	3	1	0	4

Prerequisite Course (s)

NIL

Course Objective (s):

The purpose of learning this course is to:

1	Know the various methods of solving algebraic and transcendental equations numerically where analytical methods fail to give solution
2	Understand the concept of interpolation
3	Understand the concept of numerical differentiation and integration which is widely applicable when the function in the analytic form is too complicated or the huge amount of data are given such as series of measurements, observation or some other empirical information

Course Outcome (s) (COs):

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

CO1	Analyze and evaluate the accuracy of common numerical methods.
CO2	Apply numerical methods to obtain approximate solutions to mathematical problems.
CO3	Predict the solution of a given problem and confirm it with its corrector value and if it deviates to apply the corrector again.
CO4	Understand the problems of Students t-test for single mean and difference of means.
CO5	Identify the applications, various design and concepts of experiments.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	-	-	-	-	-	-	-	-	1	-	3
CO2	3	3	2	1	-	-	-	-	-	-	-	-	-	-	3
CO3	3	3	2	3	-	-	-	-	-	-	-	-	1	-	3
CO4	3	3	2	1	-	-	-	-	-	-	-	-	1	-	3
CO5	3	3	1	1	-	-	-	-	-	-	-	-	1	2	1
CO (Avg)	3	3	2	1	-	-	-	-	-	-	-	-	1	2	2.6

2: Moderate (Medium) 3: Substantial (High)

UNIT I	SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS	9+3
Newton-Raphson method- Gauss Elimination method – Pivoting - Gauss-Jordan method – Iterative methods of Gauss-Jacobi and Gauss-Seidel - Matrix Inversion by Gauss-Jordan method - Eigenvalues of a matrix by Power method .		
UNIT II	**INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION**	**9+3**
Lagrange's and Newton's divided difference interpolation –Newton's forward and backward difference interpolation - Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal rule, Simpson's 1/3 rule and Simpson's 3/8 rule (Single Integral)		
UNIT III	**NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS**	**9+3**
Taylor's series method – Euler's method - Modified Euler's method - Fourth order Runge- Kutta method for solving first and second order differential equations – Milne's predictor-corrector methods and Adam Bash Forth predictor-corrector method for solving first order equations - Finite difference methods for solving second order equation.		
UNIT IV	**TESTING OF HYPOTHESIS**	**9+3**
Sampling distributions - Tests for Single mean, proportion, Difference of means (large and small samples) – Tests for single variance and equality of variances – Chi-square test for goodness of fit – Independence of attributes.		
UNIT V	**DESIGN OF EXPERIMENTS**	**9+3**
Completely randomized design – Randomized block design – Latin square design - 2^2 - factorial design.		

Text Book (s)

1	R.A. Johnson and C.B. Gupta, "Miller and Freund"s Probability and Statistics for Engineers", Pearson Education, Asia, 7th edition, 2007.
2	Grewal, B.S. and Grewal,J.S., " Numerical methods in Engineering and Science", Khanna Publishers, New Delhi, 2004.

Reference (s)

1	R.E. Walpole, R.H. Myers, S.L. Myers, and K Ye, "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia , 8th edition, 2007.
2	M.R. Spiegel, J. Schiller and R.A. Srinivasan, "Schaum"s Outlines Probability and Statistics", Tata McGraw Hill edition, 2004.
3	Chapra, S. C and Canale, R. P. "Numerical Methods for Engineers", 5th Edition, Tata McGraw-Hill, New Delhi, 2007.

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Regulation 2018		Semester IV	Total Hours			45
			Hours / Week			C
Category	Course Code	Course Name	L	T	P	
S	18MES202T	MECHATRONICS	3	0	0	3

Course Objective (s):

- To impart knowledge about the sensors and transducer involved in Mechatronics systems which are very much essential to understand the emerging field of automation.
- To know about the working principle of various Electrical actuating Systems
- To analyze the various Hydraulic & pneumatic components used in Mechatronics system
- To obtain knowledge in PLC components and its functions, basics of CNC & CIM
- To gain knowledge in basic Mechatronics system design and smart system

Course Outcome (s) (COs):

CO1	Outline appropriate sensors and actuators for an engineering application
CO2	Understand the various electrical actuating sytem used for automation
CO3	Describe the various Hydraulic & pneumatic systems components
CO4	Identify programme logic controller and its components , functions
CO5	Evaluate Mechatronics system design and smart systems

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	1	-	-	2	-	-	-	2	1	-	-
CO2	3	2	2	2	1	-	-	2	-	-	-	2	1	-	-
CO3	3	2	2	2	1	-	-	2	-	-	-	2	1	-	-
CO4	3	2	2	2	1	-	-	2	-	-	-	2	1	-	-
CO5	3	2	2	2	1	-	-	2	-	-	-	2	1	-	-
CO (Avg)	3	2	2	2	1	-	-	2	-	-	-	2	1	-	-

UNIT I	SENSORS AND TRANSDUCERS	9
Introduction to Mechatronics Systems – Measurement Systems – Control Systems – Microprocessor based Controllers. Sensors and Transducers – Performance Terminology – Sensors for Displacement, Position and Proximity; Velocity, Motion , Fluid Pressure, Liquid Flow, Liquid Level, Temperature, Light Sensors – Selection of Sensors.		
UNIT II	**ELECTRICAL ACTUATION SYSTEMS**	**9**
Electrical Actuation Systems – Mechanical Switches – Solid State Switches – Solenoids – Construction and working principle of D.C and A.C Motors – Speed control of AC and DC drives, Stepper Motors - Switching circuitries for Stepper motor – Servo motors.		
UNIT III	**HYDRAULIC & PNEUMATIC SYSTEMS**	**9**
Construction of Control Components : Directional control valve – 3/2 way valve – 4/2 way valve – Shuttle valve – check valve – pressure control valve – pressure reducing valve, sequence valve, Flow control valve – Fixed and adjustable, electrical control solenoid valves, Relays, ladder diagram. Pneumatic Components: Properties of air – Compressors – Filter, Regulator, and Lubricator Unit – Air control valves, Quick exhaust valves, and pneumatic actuators.		
UNIT IV	**PROGRAMMABLE LOGIC CONTROLLERS**	**9**
Programmable Logic Controllers – Basic Structure – Input / Output Processing – Programming – Mnemonics – Timers, Internal relays and counters – Shift Registers – Master and Jump Controls – Data Handling – Analogs Input / Output – Selection of a PLC. Introduction to CNC systems and Computer Intergrated Manufacturing		
UNIT V	**DESIGN OF MECHATRONICS SYSTEMS**	**9**
Stages in designing Mechatronics Systems – Traditional and Mechatronics Design - Possible Design Solutions – Case Studies of Mechatronics Systems: Pick and place robot, Wireless surveillance ballon, Automatic tool and pallet changers – Autonomous mobile robot – Engine Management System - Automatic Car Park barrier, Introduction to smart systems.		

Text Book (s)

1	W. Bolton, "Mechatronics', Pearson Education Limited, 5th Edition, 2013
2	R. Srinivasan, "Hydraulics and Pneumatic Controls", McGraw Hill Education, 2nd Edition, 2008

Reference (s)

1.	Ogata k., "Modern Control Engineering" , Prentice Hall, 5th Edition, 2010
2.	David. W. Pessen, "Industrial Automation", John Wiley & Sons, 4th Edition, 2012
3.	S. Brain Morass, "Automated Manufacturing Systems: Sensors, Actuators", TATA McGraw Hill, 4th Edition, 1995.
4	Singh M.D. and Joshi J.G., Mechatronics, PHI Learning Private Limited, 3rd Edition, 2014.
5	Dan Necsulescu, "Mechatronics", Pearson Education, 4th Edition 2009

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Regulation 2018		Semester IV	Total Hours			75
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	18MEC205J	STRENGTH OF MATERIALS	3	0	2	4

Course Objective (s):

- To gain knowledge in stresses, strains and deformation in components due to external loads.
- To gain knowledge on shear force and bending stress distribution in different beams under various loads.
- To learn the deformation of shaft under torsion and deflection of closed helical springs.
- To impart knowledge on finding slope and deflection of beams and buckling of columns for various boundary conditions.
- To learn two dimensional stress systems and stresses in thin cylinders and spherical shells.

Course Outcome (s) (COs):

CO1	Explain the fundamental concepts of stress and strain in simple and compound bar.
CO2	Construct shear force and bending moment diagram for mechanism in beams in various loading conditions.
CO3	Illustrate the basic equation of simple torsion in designing of shafts and helical spring
CO4	Calculate the slope and deflection in beams using different methods and Familiarize the behavior of column under axial and eccentric loads.
CO5	Examine the stresses related to thin and thick cylinders subjected to fluid pressure.

CO-PO Mapping

Cos	POs												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3		1	1	2	2	2		2	2	2	1
CO2	3	3	3	3		2	2	2	2	2		2	2	2	1
CO3	3	3	3	3		2	2	2	2	2		2	2	2	1
CO4	3	3	3	3		2	2	2	2	2		2	2	2	1
CO5	3	3	3	3		1	1	2	2	2		2	2	2	1
CO (Avg)	3	3	3	3		1.6	1.6	2	2	2		2	2	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	STRESS STRAIN AND DEFORMATION OF SOLIDS	9
Rigid and Deformable bodies – Strength, Stiffness and Stability – Stresses; Tensile, Compressive and Shear – Deformation of simple and compound bars under axial load – Thermal stress – Elastic constants.		
UNIT II	**BEAMS - LOADS AND STRESSES**	**9**
Types of beams: Supports and Loads – Shear force and Bending Moment in beams – Cantilever, Simply supported and Overhanging beams – Stresses in beams – Theory of simple bending – Stress variation along the length and in the beam section.		
UNIT III	**TORSION**	**9**
Analysis of torsion of circular bars – Shear stress distribution – Bars of Solid and hollow circular section – Stepped shaft – Twist and torsion stiffness – Compound shafts – Fixed and simply supported shafts – Application to close-coiled helical springs – Maximum shear stress in spring section including Wahl Factor – Deflection of helical coil springs under axial loads.		
UNIT IV	**BEAM DEFLECTION**	**9**
Elastic curve of Neutral axis of the beam under normal loads – Evaluation of beam deflection and slope: Double integration method, Macaulay Method, and Moment-area Method –Columns – End conditions – Equivalent length of a column – Euler equation – Slenderness ratio – Rankine formula for columns.		
UNIT V	**ANALYSIS OF STRESSES IN TWO DIMENSIONS**	**9**
Biaxial state of stresses – Thin cylindrical and spherical shells – Deformation in thin cylindrical and spherical shells – Biaxial stresses at a point – Stresses on inclined plane– Principal planes and stresses – Mohr's circle for biaxial stresses – Maximum shear stress		

Text Book (s)	
1	Rajput, R K, "Strength of Materials", S.Chand & Co, New Delhi, 2014.
2	Beer F P and Johnston R," Mechanics of Materials", McGraw-Hill Book Co, Seven Edition, 2016
Reference (s)	
1	Bansal R.K, "Strength of Materials", Laxmi Publications, New Delhi, 2017.
2	Rattan S.S, "Strength of Materials", Tata McGraw-Hill Education, 2011
3	R S Khurmi & N. Khurmi, "Strength of Materials", S.Chand & Co, New Delhi, 2015
4	Jindal U.C., "Strength of Materials", Pearson Education India, 2012
5	Russell C Hibbler, "Mechanics of Materials", 2014

LIST OF EXPERIMENTS

Total:30 Hours

1	Tension test on a mild steel rod, Aluminum & Cast Iron
2	Double shear test on Mild steel and Aluminum rods
3	Torsion test on mild steel rod
4	Impact tests on metal specimen
5	Hardness test on metals - Brinnell and Rockwell Hardness Number
6	Deflection test on beams (Aluminium, Steel, Wood)
7	Compression test on helical springs.
8	Microscopic examination of ferrous alloys (plain carbon steels, stainless steels, tool steels etc.)
9	Microscopic examination of non ferrous alloys (Magnesium alloys, Aluminium alloys, Titanium alloys).
10	Microscopic examination of welded samples (ferrous and or non ferrous alloys).
11	Quantitative metallography of specimen by measure the volume fraction of a phase in a polycrystalline material (image analysis).
12	Hardness measurement on heat treated samples (unhardened specimen, quenched, quenched and tempered specimen.

Regulation 2018		Semester IV	Total Hours			75
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	18MEC206J	THERMAL ENGINEERING	3	0	2	4

Course Objective (s):

- Integrate concepts, laws and methodologies from the first course in thermodynamics and cyclic processes
- Apply thermodynamic concepts in IC engines
- Understand the principles of nozzles and steam turbines
- Describe the principles of air compressors
- Explain the working of refrigeration ,air conditioning and cooling tower.

Course Outcome (s) (COs):

CO1	Analyze thermodynamic cycles.
CO2	Summarize the construction, operation and performance of IC engines.
CO3	Understand the working of Steam Nozzles and & Steam Turbines and their performance.
CO4	Calculate the performance of reciprocating air compressor.
CO5	Describe the working of refrigeration and Air conditioning system.

CO-PO Mapping

Cos	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3			2	1	1	1		2	3	2	3
CO2	3	3	3	3			2	1	1	2		2	3	2	3
CO3	3	3	3	3			2	1	1	2		2	3	2	3
CO4	3	3	3	3			2	1	1	1		2	3	2	3
CO5	3	3	3	3			3	1	1	2		2	3	2	3
CO (Avg)	3	3	3	3			2.2	1	1	1.6		2	3	2	3

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

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UNIT I	GAS POWER CYCLES	9
Otto, Diesel, Dual, Brayton, with PV and TS diagrams-heat supply methods .Calculation of mean effective pressure, and air standard efficiency - Actual and theoretical PV diagram of four stroke and two stroke engines.		
UNIT II	**PERFORMANCE OF IC ENGINES**	**9**
Introduction to basic Construction-Performance test- Measurement of brake power – Indicated power – Fuel consumption – Air consumption; Heat balance test – heat carried away by exhaust gases and Morse test on IC engines – Standard testing procedure of IC engines – Performance curves and effect of various parameters on the performance of the engines-Knocking and Detonation.		
UNIT III	**STEAM NOZZLES AND TURBINES**	**9**
Flow of steam through nozzles, shapes of nozzles, effect of friction, critical pressure ratio, supersaturated flow, Impulse and Reaction principles, compounding of Turbines, velocity diagram for single-stage turbine, speed regulations –Governors.		
UNIT IV	**AIR COMPRESSOR**	**9**
Classification of Air compressors - working principle, work of compression - with and without clearance, Volumetric efficiency, Isothermal efficiency and Isentropic efficiency. Multistage air compressor with Intercooling. Working principle and comparison of Rotary compressors with reciprocating air compressors.		
UNIT V	**REFRIGERATION AND AIR CONDITIONING**	**9**
Vapour compression refrigeration cycle, Effect of Superheat and Sub-cooling, Performance calculations, Working principle of air cycle, vapour absorption system, and Thermoelectric refrigeration. Air conditioning systems, concept of RSHF, GSHF and ESHF, Cooling load calculations. Cooling towers – concept and types.		

List of Practical Experiments (Practical-30 Hours)

1. Draw the Valve timing diagram and Port timing diagram for IC Engine
2. Determine Flash and Fire point of sample of oil by open cup and Closed Cup apparatus
3. Determine absolute viscosity by Saybolt viscometer / Redwood viscometer
4. Determine COP of Refrigeration test rig
5. Determine COP of Air Conditioning test rig
6. Determine Performance characteristics of Air Blower test rig
7. Determine Performance characteristics of Reciprocating Air Compressor
8. Determine Performance characteristics of four stroke diesel engine by load test
9. Draw the heat balance sheet of four stroke diesel engine
10. Determine performance characteristics of four stroke diesel engine by speed test

Text Book (s)

1.	Rajput. R K , "Thermal Engineering", S.Chand Publishers, 2017
2.	Mahesh M Rathore,"Thermal Engineering", McGraw Hill Education (India) Pvt. Ltd.,2015

Reference (s)

1.	Sarkar, B K, "Thermal Engineering" ,Tata McGraw-Hill Publishers, 2016,
2.	Arora.C P,"Refrigeration and Air Conditioning," Tata McGraw-Hill Publishers 2015
3.	Ganesan V " Internal Combustion Engines", Third Edition, Tata McGraw-Hill 2016
4.	Rudramoorthy, R, "Thermal Engineering", Tata McGraw-Hill, New Delhi, 2010.
5.	Kothandaraman C P, Domkundwar S, Domkundwar A V, "A course in thermal engineering," Dhanpat Rai and sons, 2015

Regulation 2018		Semester IV	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	18MEC207T	METROLOGY AND MEASUREMENTS	3	0	0	3

Prerequisite Course (s)

Engineering Materials and Metallurgy

Course Objective (s):

- Learn the linear and angular measuring equipments with their principle of operation and application.
- Gain knowledge about laser principles and advances in metrology.
- Learn about various methods of measurements of mechanical parameters
- Demonstrate modern measuring equipments using Laser
- Measure mechanical parameters

Course Outcome (s) (COs):

CO1	Explain the measurement methods, instruments and errors in measurements.
CO2	Describe the techniques of comparators, linear and the angular measuring instruments.
CO3	Illustrate form measurement of surface roughness and surface finish measurements.
CO4	Describe the coordinate measuring machine and the applications of Laser in Metrology.
CO5	Calculate the force, torque, power, flow and temperature in the system.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2					2	3	2	2		3	2		2
CO2	3	2					1	2	3	2		3	3		2
CO3	3	2					1	2	3	2		2	2		3
CO4	3	2					1	2	3	2		2	2		3
CO5	3	2					1	2	2	2		3	3		2
CO (Avg)	3	2					1.2	2.2	2.6	2		2.6	2.4		2.4

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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UNIT I	CONCEPT OF MEASUREMENT	9
Definition of metrology -General concept– Generalized measurement system-Units and standards-measuring instruments: sensitivity, stability, range, accuracy and precision-static and dynamic response -repeatability-systematic and random errors-correction, calibration, Introduction to Dimensional and Geometric Toleranceing- interchangeability.		
UNIT II	**LINEAR, ANGULAR MEASUREMENT**	**9**
-Linear measuring instruments: Vernier, micrometer, Slip gauges and classification, Tool Makers Microscope interferometery, optical flats, Comparators limit gauges Mechanical, pneumatic and electrical comparators, applications. Angular measurements:- Sine bar, Sine center, bevel protractor and angle Decker.		
UNIT III	**FORM AND SURFACE FINISH MEASUREMENT**	**9**
Measurement of screw threads-Thread gauges, floating carriage micrometer-measurement of gears-tooth thickness-constant chord and base tangent method-Gleason gear testing machine – radius measurements-surface finish, straightness, flatness and roundness measurements. Surface roughness/surface finish measurement and optical flat in measurement.		
UNIT IV	**LASER AND ADVANCES IN METROLOGY**	**9**
Precision instruments based on laser-Principles- laser interferometer-application in linear, angular measurements and machine tool metrology Coordinate Measuring Machine (CMM)- Constructional features – types, applications – digital devices- computer aided inspection. Demonstration of modern measurement in Industrial applications		
UNIT V	**MEASUREMENTS OF MECHANICAL PARAMETERS**	**9**
Force, torque, power - mechanical, pneumatic, hydraulic and electrical type. Temperature: bimetallic strip, thermocouples, pyrometer, electrical resistance thermistor.		

Text Book (s)

1	Jain R K ,"Engineering Metrology", Khanna Publishers, 21st Revised Edition, 2015
2	Beckwith T G, Lewis Buck N, "Mechanical Measurements", Addison Wesley, New Delhi, 2008

Reference (s)

1	Raghavendran N V & Krishnamurthy L, "Engineering Metrology and Measurements", Oxford, 2013
2	Jay L Bucher, "The Metrology Hand Book -Second Edition", ASQ Quality Press, 2012.
3	Ammar Grous, "Applied Metrology for Manufacturing Engineering", Wiley 2011.
4	Hadiya P, Katariya H G, "Mechanical Measurement and Metrology", Books India, 2010.
5	Anand K Bewoor, "Metrology and Measurements" , Tata Mcgraw,2009

Regulation 2018		Semester IV	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	18MEC208T	THEORY OF MACHINES	3	1	0	4

Course Objective (s):

- Describe link ,mechanism ,kinematic pair and degree of freedom.
- Explain the working of Governors ad Gyroscopes
- Demonstrate the static and dynamic balancing of Rotary and reciprocating masses
- Demonstrate the gear tooth and gear train
- Describe the free,forced and damped vibration

Course Outcome (s) (COs):

CO1	Define Link,Kinematic pair,and inversion of four bar chain.
CO2	Describe the basics of governors and its effects in ship and automobiles.
CO3	Calculate unbalanced force of rotating and reciprocating masses.
CO4	Explain gear tooth terminology and gear trains .
CO5	Illustrate the frequency of free ,forced and damped vibration.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3			1	2	1	1		3	3	2	3
CO2	3	3	3	3			1	2	1	1		3	3	2	3
CO3	3	3	3	3			1	2	1	1		3	3	2	3
CO4	3	3	3	3			1	2	1	1		3	3	2	3
CO5	3	3	3	3			1	2	1	1		3	3	2	3
CO (Avg)	3.00	3.00	3.00	3.00			1.00	2.00	1.00	1.00		3.00	3.00	2.00	3.00

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

UNIT I	BASICS OF MECHANISMS	9
Definitions – Link, Kinematic pair, Kinematic chain, Mechanism, and Machine. -Degree of Freedom – Mobility - Kutzbach criterion (Gruebler's equation) - Grashoff's law- Kinematic Inversions of four-bar chain and slider crank chain - Mechanical Advantage- Transmission angle. Description of common Mechanisms - Offset slider mechanism as quick return mechanisms, Pantograph, Straight line generators (Peaucellier and Watt mechanisms), Steering gear for automobile, Hooke's joint, Toggle mechanism		
UNIT II	**MECHANISMS FOR CONTROL**	**9**
Governors - Types - Centrifugal governors - Gravity controlled and spring controlled centrifugal governors –Characteristics - Effect of friction.Gyroscopes - Gyroscopic couple - Gyroscopic stabilization - Gyroscopic effects in Aeroplane and ships		
UNIT III	**BALANCING**	**9**
Static and dynamic balancing - Balancing of rotating masses - Balancing a single cylinder Engine – Primary and secondary unbalanced forces - Balancing Multi-cylinder Engines – Firing order – Pivoted cradle balancing machines		
UNIT IV	**GEARS AND GEAR TRAINS**	**9**
Classification of gears – Gear tooth terminology - Fundamental Law of toothed gearing and involute gearing – Length of path of contact and contact ratio -Gear trains – Simple, compound and Epicyclic gear trains.		
UNIT V	**FREE AND FORCED VIBRATION**	**9**
Basic features of vibratory systems - Free vibration -natural frequency - Types of Damping - Damped free vibration – Whirling of shafts and critical speed– Forced vibration caused by unbalance - Support motion - Vibration isolation		

Text Book (s)

1	Khurmi R S "Theory of Machines", S.CHAND Publishers and Distributors, 2017
2	Rattan S S, "Theory of Machines",Tata McGraw-Hill Publishing Company, New Delhi, 2017

Reference (s)

1	Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, 2005.
2	Ramamurti V, "Mechanism and Machine Theory", Second Edition, Narosa Publishing House, 2010.
3	Ghosh A and A K Mallick, "Theory of Mechanisms and Machines", Affiliated East- West Pvt. Ltd., New Delhi, 2010.
4	Ambekar A G, Mechanism and Machine Theory, Prentice Hall of India, New Delhi, 2007.
5	Bansal R.K , "A Text Book of Theory of Machines" Laxmi Publications, New Delhi, 2017.

Regulation 2018		Semester IV	Total Hours			30
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	18MEC209L	METROLOGY AND DYNAMICS LABORATORY	0	0	2	1

Course Objective (s):

- Supplement the principles learnt in kinematics and Dynamics of Machinery.
- Understand measuring devices used for testing various components

Course Outcomes:

CO1 Construct the characteristic curves for various governors
CO2 Calculate the frequency of beam and spring mass systems
CO3 Perform the static and dynamic balancing of rotating and reciprocating masses
CO4 Illustrate the errors in measuring instruments
CO5 Measure the parameters in gear tooth and threads

LIST OF EXPERIMENTS - METROLOGY LAB

1.Calibration of Vernier / Micrometer / Dial Gauge
2.Checking Dimensions of part using slip gauges
3.Measurements of Gear Tooth Dimensions
4.Measurement of Angle using sine bar / sine center / tool makers microscope
5.Measurement of straightness and flatness
6.Measurement of thread parameters using profile projector / floating carriage
7.Measurement of Temperature using Thermocouple / Pyrometer
8.Measurement of Displacement / force / Torque
9.Measurement of Vibration / Shock

LIST OF EXPERIMENTS - DYNAMICS LAB

1. a) Determination of Mass moment of inertia of Fly wheel and Axle system.
   b) Determination of Mass Moment of Inertia of axisymmetric bodies using Turn Table apparatus.
   c) Determination of Mass Moment of Inertia using bifilar suspension and compound pendulum.
2. Motorized gyroscope – Study of gyroscopic effect and couple.
3. Governor - Determination of range sensitivity, effort etc., for Watts, Porter, Proell, and Hartnell Governors.
4. Cams – Cam profile drawing, Motion curves
5. a) Single degree of freedom Spring Mass System – Determination of natural Frequency and verification of Laws of springs – Damping coefficient determination.
   b) Multi degree freedom suspension system – Determination of influence coefficient.
6. Determination of Torsional natural frequency of single and Double Rotor systems - Undamped and Damped Natural frequencies.
7. Vibration of Equivalent Spring mass system – Undamped and damped vibration.
8. Transverse vibration of Free-Free beam – with and without concentrated masses.

Regulation 2018		Semester IV	Total Hours			30
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
M	18MBM202L	CRITICAL AND CREATIVE THINKING SKILLS	0	0	2	1

Course Objective (s):

The purpose of learning this course is to:

1	To focus on listening, speaking, & writing skills through audio & video sessions
2	To hone soft skill and analytical ability of students
3	To overcome the fear in group communication and to provide the effective communication
4	To expertise intelligible pronunciation, stress and intonation patterns

Course Outcome (s) (Cos):

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

CO1	Students can be able to solve both analytical and logical problems in an effective manner
CO2	Students can demonstrate an ability to design and deliver messages
CO3	The quality of student's communication with practical experience is improved

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	1	-	1
CO2	-	-	-	-	-	-	-	-	-	2	-	-	-	1	-
CO3	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO (Avg)	3.00	-	-	-	-	-	-	-	-	2.00	-	-	1.00	1.00	1.00

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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UNIT I	Module - 1	6
Aptitude: Time and Work - Pipes and Cisterns. **Communication:** Sentence Pattern - Debate.		
UNIT II	**Module - 2**	**6**
Aptitude: Boats and Streams. **Communication:** Tenses and voices - Tech Talk.		
UNIT III	**Module - 3**	**6**
Aptitude: Problems on Ages - Probability **Communication:** Analogies - Biography.		
UNIT IV	**Module - 4**	**6**
Aptitude: Data sufficiency - Logical Puzzles. **Communication:** Punctuation - Connection.		
UNIT V	**Module - 5**	**6**
Aptitude: Mensuration. **Communication:** Preposition - News of the Week.		

Text Book (s)

1	Dr.R.S.Aggarwal, "Quantitative Aptitude", S. Chand & Company Limited, 2015
2	Dr.R.S.Aggarwal, "A Modern Approach to Verbal & Non - Verbal Reasoning", S. Chand & Company Limited, 2015

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Regulation 2018		Semester III/ Semester IV	Total Hours			15
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
M	18LEM103T	INDIAN TRADITION AND HERITAGE	1	0	0	-

Prerequisite Course (s)

Nil

Course Objective (s):

The purpose of learning this course is to:

1	Make students understand the role and impact of culture in human life.
2	Draw attention towards languages and literatures of ancient period.
3	Cultivate secularism in students
4	Equip students with the knowledge of Indian art and architectural evolution over years.
5	Make students identify Indian culture in abroad.

Course Outcome (s) (Cos):

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

CO1	Understand the meaning of culture, trace the influence and significance of geographical features on Indian culture.
CO2	Develop an awareness of the variety of languages and literatures in India.
CO3	Recognise the characteristics of various religious movements in ancient India.
CO4	Identify the characteristics and various styles of Indian architecture and sculpture at different times.
CO5	Examine various modes through which Indian culture spread abroad.

CO-PO Mapping

COs	POs												PSOs		
	PO 1	PO 2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	-	-	-	-	-	2	2	2	2	2	-	2	-	-	-
CO2	-	-	-	-	-	2	2	1	2	2	1	2	-	-	-
CO3	-	-	-	-	-	1	1	1	1	1	1	1	-	-	-
CO4	2	2	2	2	2	2	2	2	2	2	1	2	-	-	-
CO5	-	-	-	-	-	2	2	2	2	2	-	2	-	-	-
CO (Avg)	2	2	2	2	2	1.8	1.8	1.6	1.8	1.8	1	1.8	-	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

M. KUMARASAMY COLLEGE OF ENGINEERING (AUTONOMOUS) Approved By Board of Science & Humanities 29 MAR 2019 KARUR - 639 113

UNIT I	HISTORY OF INDIAN CULTURE	2
Characteristics of Indian Culture - Significance of Geography on Indian Culture -Society in India through ages- Ancient Period - Varna and Jati, family and marriage in India - Position of women in ancient India- Contemporary period; Caste system and communalism.		
UNIT II	LITERATURE AND EDUCATION	4
Evolution of script and languages in India : Harappan Script and Brahmi Script, Short History of the Sanskrit Literature: The Vedas, The Brahmanas and Upanishads and Sutras, Epics: Ramayana and Mahabharata&Puranas - History of Buddhist and Jain Literature in Pali, Prakrit and Sanskrit, Sangam Literature and Odia Literature.		
UNIT III	RELIGION AND PHILOSOPHY	4
Religion and Philosophy in India: Ancient Period: Pre-Vedic and Vedic Religion, Buddhism and Jainisim, Indian Philosophy - Vedanta and Mimansa school of Philosophy.		
UNIT IV	ART AND ARCHITECTURE	2
Indian Art & Architecture: Gandhara School and Mathura School of Art; Hindu Temple Architecture, Budhhist Architecture, Medieval Architecture and Colonial Architecture, Indian Painting Tradition, Performing Arts: Divisions of Indian classical music: Hindustani and Carnatic, Dances of India, Rise of modern theatre and Indian cinema.		
UNIT V	SPREAD OF INDIAN CULTURE ABROAD	3
Causes, Significance and Modes of Cultural Exchange - Through Traders, Teachers, Emissaries, Missionaries and Gypsies, Indian Culture in South East Asia, India, Central Asia and Western World through ages.		
Text Book (s)		
Nil		
Reference (s)		
Chakravarti, Ranabir: Merchants, Merchandise & Merchantmen, in: Prakash, Om (ed.): *The Trading World of the Indian Ocean, 1500-1800* (*History of Science, Philosophy and Culturein Indian Civilization,* ed. by D.P. Chattopadhyaya, vol. III, 7), Pearson, Delhi, 2012.		

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Regulation 2018		Semester V	Total Hours			75
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	18MEC301J	HEAT AND MASS TRANSFER	3	0	2	4

Prerequisite Course (s)

Fluid Mechanics and Machinery, Engineering Thermodynamics

Course Objective (s):

- To impart the knowledge of conduction heat transfer mechanisms
- To provide the knowledge on the principles of free and forced convection.
- To study the performance of various types of heat exchanger.
- To impart the knowledge on black body radiation and grey body radiation
- To learn about diffusion and convective mass transfer.

Course Outcome (s) (COs):

CO1	Apply the principle mechanism of heat transfer under steady state and transient conditions.
CO2	Apply the fundamental concept and principles in convective heat transfer
CO3	Apply the theory of phase change heat transfer and design of heat exchangers.
CO4	Apply the fundamental concept and principles in radiation heat transfer.
CO5	Analyze the relation between heat and mass transfer and to solve simple mass transfer problems.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	-	-	-	-	2	2	-	1	3	-	1
CO2	3	3	3	3	-	-	-	-	2	2	-	1	3	-	1
CO3	3	3	3	2	-	-	-	-	1	1	-	1	3	-	1
CO4	3	3	3	2	2	1	-	1	2	2	-	1	3	-	1
CO5	3	3	3	2	-	-	-	-	-	-	-	1	3	-	1
CO (Avg)	3	3	3	2.2	2	1	-	1	1.75	1.75	-	1	3	-	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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UNIT I	**CONDUCTION**	**9**
General Differential equation – Cartesian, Cylindrical and Spherical Coordinates – One Dimensional Steady State Heat Conduction — plane and Composite Systems – Conduction with Internal Heat Generation – Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis,Semi Infinite and Infinite Solids –Use of Heisler's charts.		
UNIT II	**CONVECTION**	**9**
Conservation Equations, Boundary Layer Concept – Forced Convection: External Flow – Flow over Plates, Cylinders Spheres and Bank of tubes. Internal Flow – Entrance effects. Free Convection – Flow over Vertical Plate, Horizontal Plate, Inclined Plate, Cylinders and Spheres.		
UNIT III	**PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS**	**9**
Nusselt's theory of condensation- Regimes of Pool boiling and Flow boiling, correlations in boiling and condensation. Heat Exchanger Types - Overall Heat Transfer Coefficient – Fouling Factors. LMTD and NTU methods		
UNIT IV	**RADIATION**	**9**
Radiation laws, Black Body and Gray body Radiation. Shape Factor. Electrical Analogy. Radiation Shields.		
UNIT V	**MASS TRANSFER**	**9**
Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state Molecular Diffusion. Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations		

Text Book (s)

1	R.C. Sachdeva, "Fundamentals of Engineering Heat & Mass transfer", New Age International Publishers, 2010
2	Yunus A. Cengel, "Heat Transfer A Practical Approach" – Tata McGraw Hill, 5 thEdition – 2013

Reference (s)

1	Frank P. Incropera and David P. Dewitt, "Fundamentals of Heat and Mass Transfer", John Wiley & Sons, 7th Edition, 2014.
2	Holman, J.P., "Heat and Mass Transfer", Tata McGraw Hill, 2010
3	Kothandaraman, C.P., "Fundamentals of Heat and Mass Transfer", New Age International, New Delhi, 2014
4	Ozisik, M.N., "Heat Transfer", McGraw Hill Book Co., 1994
5	S.P. Venkateshan, "Heat Transfer", Ane Books, New Delhi, 2014

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LISTOFEXPERIMENTS

Total:30 Hours

1.	Determination of thermal conductivity of Composite wall
2.	Determination of thermal conductivity of Insulating material
3.	Determination of heat transfer coefficient for forced convection through horizontal pipe
4.	Determination of heat transfer coefficient for natural convection on vertical cylinder
5.	Determination of heat transfer coefficient for forced convection on Pin fin
6.	Determination of heat transfer coefficient for natural convection on Pin fin
7.	Determination of emmissivity of grey surface
8.	Verification of Stefan Boltzman Constant
9.	Compare the performance of parallel flow and counter flow heat exchanger
10.	Determination of performance of cooling tower
11.	Study of Critical Heat Flux in Pool boiling

Regulation 2018		Semester V	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	18MEC302T	MACHINE DESIGN	3	1	0	4

Prerequisite Course (s)

Strength of Materials, Engineering Mechanics

Course Objective (s):

- To familiarize the various steps involved in the Design Process
- To understand the principles involved in evaluating the shape and dimensions of a component to satisfy functional and strength requirements.
- To gain knowledge on the principles and procedure for the design of power Transmission components.
- To understand the standard procedure available for Design of Transmission sip terms
- To learn to use standard data and catalogues

Course Outcome (s) (COs):

CO1	Design machine elements subjected to simple and variable loads.
CO2	Design shaft and welded joints for various engineering applications.
CO3	Identify the appropriate Flexible elements for Industrial Applications and Understand the design procedure involved in Brake and clutc design.
CO4	Design of spur and helical gear drives
CO5	Design and select the suitable spiring and bearing for the industrial applications

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	-	-	2	-	1	-	-		1	1	-	-
CO2	3	3	2	1	-	2	-	1	-	-	1	1	1	-	1
CO3	3	3	3	2	-	2	-		-	-	1	2	2	-	1
CO4	3	3	2	1	-	2	-	1	-	-	1	1	1	-	-
CO5	3	3	2	1	-	2	-	1	-	-	1	1	1	-	1
CO (Avg)	3	3	2.4	1.2	-	2	-	1	-	-	1	1.2	1.2	-	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	STEADY STRESSES AND VARIABLE STRESSES IN MACHINE II MEMBERS	12

Introduction to the design process - factor influencing machine design, selection of materials based on mechanical properties - Direct, Bending and torsional stress equations – Impact and shock loading – calculation of principle stresses for various load combinations, eccentric loading – Design of curved beams - Factor of safety - theories of failure – stress concentration – Design for variable loading – Soderberg, Goodman and Gerber relations.

UNIT II	DESIGN OF SHAFTS AND WELDED JOINTS	12

Introduction to shafts – Materials used for shafts – Types of shafts – standard sizes of shafts - Design of shafts – Shatfs subjected to twisting moment, bending moment, both twisting and bending moment – Design of shafts based on Rigidity – Introduction to welded joints – welding process – Types of welded joints – Elements of a weld symbol – Strength of Transverse Fillet welded joints - Strength of Parallel Fillet Welded Joints - Special Cases of Fillet Welded Joints

UNIT III	DESIGN FOR TRANSMISSION SYSTEMS	12

Belt Drive – Introduction, classification – Types of belts, Factors influencing the selection of belt drive- Flat belt – outline – Design consideration of flat belt – flat belt pulley – materials for pulleys - Design of flat belt drive – Introduction to V-Belt drive – types of V belt drive – Design of V belts – Types of Brakes –Heat Generation and heat dissipation in brakes - Design of Brake – Block Brake – Band Brake – Types of clutch - Design of Single and Multi plate clutches

UNIT IV	DESIGN OF SPUR GEARS AND HELICAL GEARS	12

Gear Terminology-Speed ratios and number of teeth-Force analysis -Tooth stresses – Dynamic effects - Fatigue strength - Factor of safety - Gear materials – Module and Face width-power rating calculations based on strength and wear considerations - Parallel axis Helical Gears – Pressure angle in the normal and transverse plane- Equivalent number of teeth-forces and stresses. Estimating the size of the helical gears

UNIT V	DESIGN OF SPRINGS	12

Intoduction - Types of Springs - Standard Size of Spring Wire - Material for Helical Springs - Terms used in Compression Springs - optimization of helical springs – Stresses in Helical Springs of Circular Wire - Deflection of Helical Springs of Circular Wire - Buckling of Compression Springs- Leaf springs – Construction of leaf springs - Equalised Stress in Spring Leaves - Length of Leaf Spring Leaves - Materials for Leaf Springs – Disc Springs

Text Book (s)

1	J. E. Shigley and C. R. Mischke, Mechanical Engineering Design, 10th Edition, Tata McGraw-Hill Publishing Company Pvt. Ltd., New Delhi, 2014.
2	S.MdJalaludeen, "Machine Design", Anuradha Publications, Chennai, 2014

Reference (s)

1	Bhandari V.B, "Design of Machine Elements", 4th Edition, McGraw-Hill Book Co, 2016.
2	S. G. Kulkarni, Machine Design, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2010.
3	B. J. Hamrock, B. Jacobson and S. R. Schmid, Fundamentals of Machine Elements, Third Edition, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2014
4	U.C.Jindal : Machine Design, "Design of Transmission System", Dorling Kindersley, 2010
5	R. L. Norton, Design of Machinery, Fifth Edition, Tata McGraw Hill Publishing Company [illegible] Delhi, 2011

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Regulation 2018		Semester V	Total Hours			75
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	18MEC303J	AUTOMOBILE ENGINEERING	3	0	2	4

Prerequisite Course (s)

Engineering Thermodynamics , Fluid Mechanics and Machinery

Course Objective (s):

- To impart knowledge on the principles of operation and constructional details of various automobile engine power source.
- To impart knowledge on the working of fuel supply system and combustion technique in various automobiles.
- To provide knowledge on the requirement and function of various components in power transmission and suspension system in vehicle.
- To impart knowledge on the emission in automobile.
- To provide advance automotive driving control.

Course Outcome (s) (COs):

CO1	Explain the operating principles and constructional details of various automobile engine power source.
CO2	Identify the appropriate Fuel supply system for a particular automobile vehicle based on the requirements.
CO3	Analyze the function of various components in transmission and safety driving line of a vehicle.
CO4	Explain the emission control technique and its importance.
CO5	Analyze the advance automotive driving methods.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	3	-	1	-	3	2	2	-	3	3	-	2
CO2	3	2	2	2	-	2	-	2	2	2	-	3	3	-	2
CO3	3	2	3	2	-	1	-	2	2	2	-	3	3	-	-
CO4	3	2	3	2	-	3	3	2	2	2	-	3	3	-	1
CO5	3	3	2	2	-	1	2	2	2	2	-	3	3	-	1
CO (Avg)	3	2.2	2.2	2.2	-	1.6	2.5	2.2	2	2	-	3	3	-	1.5

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	**VEHICLESTRUCTUREAND ENGINES**	**9**
Types ofautomobiles, Automotive components, sub systems and their positions, vehicleconstruction and differentlayouts, chassis,frame and body,resistancestovehiclemotion and aerodynamics of vehicles. Introduction to automobile engine power source.		
UNIT II	**ENGINEAUXILIARYSYSTEMS**	**9**
Carburetor-basic type and working principles- Electronic fuel injection system for petrol and diesel engine- supercharging and turbo charging. Review of cooling and lubrication system. Electrical sytem (General electrical circuits. Battery, Starting motor, DC generator, Alternator, Ignition circuit, Dash board instrumentation, Lighting system) and electronics system - Ignition system (Magneto coil and Electronic type). Electronic engine management system.		
UNIT III	**TRANSMISSIONSYSYTEMS**	**9**
Clutch-typesandconstruction, gearboxes- manualandautomatic, Wheel drive components, Wheel and tyres - Steeringgeometry ,PowerSteering, Front and Rear Axle-Suspension Systems.BrakingSystems- ABS and electronic brake force distribution (EBD).Stabilizer, Air Bags		
UNIT IV	**EMISSION CONTROL AND ALTERNATIVEENERGYSOURCES**	**9**
Emission Norms and Bharat standard – Non exhaust and exhaust emission (SCR).Useofalternative fuels in Automobiles -Enginemodificationsrequired–Performance and Combustion CharacteristicsofSIandCIengineswiththesealternatefuels.		
UNIT V	**ADVANCES IN AUTOMOTIVE TECHNOLOGY**	**9**
Electric andHybridVehicles,Fuel Cell. Advanced driving controls – Electronic Stability Program (ESP), Traction control system (TCS), Hill hold control, automatic climate control. Fuel smart engines. Autonomous driving – Google car-GPS Technology.		

Text Book (s)

1	Kirpal Singh, "Automobile Engineering Vol. 1& 2" , Standard Publishers, 7th Edition 2012
2	William. H. Crouse, Donald L Anglin, Automotive Mechanics, 10th Edition, McGraw-Hill, 2017.

Reference (s)

1	Ganesan V.." Internal Combustion Engines" , Third Edition, Tata Mcgraw-Hill ,2007
2	Jain,K.K.,and Asthana .R.B, "Automobile Engineering" Tata McGraw Hill Publishers,New Delhi,2002
3	Julian Happian-Smith "Introduction to Modern Vehicle Design", Publisher: Society of Automotive Engineers Inc.2012.
4	Bosch Automotive Hand Book, 8th Edition, Bentley Publishers, 2011.
5	Hand Book - Automotive Research Association of India (ARAI- Pune)

Total:30 Hours

SL.NO	LIST OF EXPERIMENTS
1	STUDY OF TYPES OF CLUTCHES
2	DISMANTLING AND ASSEMBLING OF SINGLE PLATE CLUTCH
3	DISMANTLING AND ASSEMBLING OF SINGLE CYLINDER I.C ENGINE
4	STUDY OF MULTI CYLINDER ENGINES
5	STUDY OF GEAR BOX
6	DISMANTLING AND ASSEMBLING OF FRONT AXLE AND REAR AXLE
7	DISMANTLING AND ASSEMBLING OF DIFFERENTIAL UNIT
8	TESTING OF THE BATTERY
9	TESTING OF THE WHEEL BALANCING
10	TESTING OF THE VALVE CLEARENCE ADJUSTMENT IN ENGINE
11	STUDY OF FUEL SUPPLY SYSTEM IN I.C ENGINE
12	STUDY AND DEMONSTRATION OF AUTOMOBILE CHASSIS
13	MOTORING TEST ON SINGLE CYLINDER FOUR STROKE DIESEL ENGINE
14	RETARDATION TEST ON SINGLE CYLINDER FOUR STROKE DIESEL ENGINE
15	MORSE TEST ON MULTI CYLINDER PETROL ENGINE

Regulation 2018		Semester V	Total Hours			30
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
M	18MBM301L	ANALYTICAL AND LOGICAL THINKING SKILLS	0	0	2	1

Course Objective (s):

The purpose of learning this course is to:

1	To sharpen problem solving skills and to improve thinking capability of the students
2	To drive the students to use language with great commitment and cooperation
3	To expertise the creative thinking and presentation skills to meet the company needs

Course Outcome (s) (Cos):

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

CO1	Students will be able to solve both analytical and logical problems in a fruitful manner
CO2	Students will organize and convey the information in such an incomparable way
CO3	Presentation skills will be imparted to students

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	1	-	1
CO2	-	-	-	-	-	-	-	-	2	-	-	-	-	1	-
CO3	-	-	-	-	-	-	-	-	-	2	-	-	-	1	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO (Avg)	3.00	-	-	-	-	-	-	-	2.00	2.00	-	-	1	1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	Module - 1	6
Aptitude: Alligations or Mixtures - Blood Relations. **Communication:** How to set Goals - Interpersonal Relationships - JOHARI Window - Work & Business Etiquette		
UNIT II	**Module - 2**	**6**
Aptitude: Partnership - Statement and Assumptions. **Communication:** Transition to Corporate World - Career opportunities in Various Sectors and know your industry.		
UNIT III	**Module - 3**	**6**
Aptitude: Arithmetic and Geometric Progressions - Syllogisms. **Communication:** Time Management - Anger and Stress Management - Conflict Management.		
UNIT IV	**Module - 4**	**6**
Aptitude: Permutations and Combinations - Statements & Conclusions. **Communication:** Launch a Product - Telephonic Etiquette.		
UNIT V	**Module - 5**	**6**
Aptitude: Geometric Problems. **Communication:** Presentation Skills - Oral presentation and public speaking skills, Business presentations.		

Text Book (s)

1	Dr.R.S.Aggarwal, "Quantitative Aptitude", S. Chand & Company Limited, 2015
2	Dr.R.S.Aggarwal, "A Modern Approach to Verbal & Non - Verbal Reasoning", S. Chand & Company Limited, 2015

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Regulation 2018		Semester V	Total Hours			15
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
M	18LEM301L	INDIAN ART FORMS (Common to all UG Programmes)	1	0	0	-

Prerequisite Course (s)

NIL

Course Objective (s):
The purpose of learning this course is to:

CLR-1	Introduce the learners to various art forms and whet their aesthetics sense.
CLR-2	Improve learners' knowledge on history of theatre and drama and draw connections between theatrical practices and social contexts in both modern and pre modern periods..
CLR-3	Enable the learners to identify and understanding various types of dance and music concepts
CLR-4	Make learners explore the diversity of Architecture, Sculpture, Painting and its intersection with community, culture and society.
CLR-5	Make students to get familiarized with the formal, historical, and theoretical aspects of literary arts.

Course Outcome (s) (COs):
At the end of this course, learners will be able to:

CO1	Identify aesthetics traits found throughout Indian art.
CO2	Demonstrate understanding of the social and artistic movements that have shaped theatre and dance.
CO3	Recognize different concepts involved in music and dance.
CO4	Identify and appreciate the salient features and various styles of Indian Architecture, Sculpture and Painting at different times.
CO5	Demonstrate a broad understanding of Indian literary arts and appreciate the role that historical context plays in the creation and interpretation of literary works

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	1	1	2	2	2	-	2	-	-	-
CO2	-	-	-	-	-	1	1	2	2	1	-	2	-	-	-
CO3	-	-	-	-	-	1	1	2	2	1	-	2	-	-	-
CO4	-	-	-	-	-	1	1	2	2	2	-	2	-	-	-
CO5	-	-	-	-	-	1	1	2	2	2	-	2	-	-	-
CO (Avg)	-	-	-	-	-	1	1	2	2	1.6	-	2	-	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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UNIT I	INDIAN ARTS	3
Introduction to art (aesthetics, taste)- fine arts - applied arts –Terminology - Subject matter -Art as propaganda - Purposes/uses of art.		
UNIT II	THEATRE & DRAMA	3
History of Theatre and Drama- Traditional Theatre forms- Modern Theatre and its characteristics- Puppetry –different forms and elements of drama.		
UNIT III	MUSIC AND DANCES	3
Origin of Music and Dance- Classical music and Carnatic Music- Regional Music -Musical Instruments-Regional Classical Dances.		
UNIT IV	ARCHITECTURE, SCULPTURE, PAINTING	3
History of architecture, sculpture, painting -Indo-Islamic Architecture- Temple Architecture– different types of Sculptures and its characteristics-Painting and its different styles.		
UNIT V	LITERARY ARTS	3
Ancient Indian Literature- Early Dravidian Literature- Medieval Literature- Modern Indian Literature-Contemporary Literature.		

Text Book (s)

	NIL

Reference (s)

1	Dhar, Parul Pandya, ed., 2011, Indian Art History Changing Perspectives, New Delhi: D.K. Print world and National Museum Institute (Introduction).
2	Guha-Thakurta, Tapati, The making of a new modern Indian art: Aesthetics and nationalism in Bengal, 1850-1920, Cambridge University Press, 1992
3	Huntington, Susan, The Art of Ancient India: Hindu, Buddhist, Jain, Weatherhill, 1985
4	Mitter, Partha, Indian Art, Oxford History of Art series, Oxford University Press, 2001

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Regulation 2018		Semester VI	Total Hours			30
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
H	18MBH201T	MANAGEMENT PRINCIPLES FOR ENGINEERS	2	0	0	2

Prerequisite Course (s)

Nil

Course Objective (s): The purpose of learning this course is to:

1	Enable the students to study the evolution of management.
2	Study about planning tools and techniques in management for engineers.
3	Learn about career planning for engineers.
4	Enable the effective and barriers communication in the organization.
5	Study the system and process of effective controlling in the organization.

Course Outcome (s) (COs): At the end of this course, learners will be able to:

CO1	Acquired the knowledge on fundamental concept of management and its various functions.
CO2	Gained knowledge on planning and decision making process.
CO3	Attained the knowledge of organization structure and career planning.
CO4	Demonstrate the ability to directing, leadership and communicate effectively.
CO5	Analysis isolates issues and formulates best control methods.

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	1	-	-	1	-	1	2	-	-
CO2	2	2	-	-	-	1	-	-	1	1	1	1	-	-
CO3	2	-	-	-	-	1	-	-	-	-	1	2	-	-
CO4	1	-	-	-	-	1	-	-	1	1	1	-	-	-
CO5	2	-	-	-	-	1	-	-	-	1	1	3	-	-
CO (Avg)	1.80	2.00	-	-	-	1.00	-	-	1.00	1.00	1.00	2.00	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	INTRODUCTION TO MANAGEMENT PRINCIPLES	6
Meaning, Definition of Management – Managerial Role - POSDCORB -Management vs. Administration- Evolution of Management Thoughts- Henry Fayol's 14 Principles- Opportunities and Challenges in Management.		
UNIT II	**PLANNING**	**6**
Nature and purpose of planning – Planning process – Types of planning – Objectives – Setting - Objectives – policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.		
UNIT III	**ORGANIZING**	**6**
Nature and purpose – Formal and informal organization – organization chart – Organization Structure– Types – Line and staff authority – Departmentalization – Delegation of Authority – Centralization and Decentralization – Job Design.		
UNIT IV	**DIRECTING**	**6**
Foundations of individual and group behavior – Motivation – Motivation Theories – Motivational - Techniques –Leadership – Types and Theories of Leadership – Communication – Process of Communication – Barrier in Communication – Effective Communication.		
UNIT V	**CONTROLLING**	**6**
System and Process of Controlling – budgetary and Non-Budgetary Control Techniques – Use of Computers and IT in Management control – Control and performance – Direct and Preventive control – Reporting.		

Reference (s)

1	P.C.Tripathi., P.N Reddy, Principles of Management, McGraw Hill, 5th Edition 2012.
2	Harold Koontz, Heinz Weihrich, A RamachandraAryasri, Tata McGraw Hill, Principles of Management, 2016
3	Charles W Hill, Stephen L Mcshane, Principles of Management, McGraw Hill, Special Indian Edition 2007.
4	1.Stephen A. Robbins & David A. Decenzo& Mary Coulter, "Fundamentals of Management" 7th Edition, Pearson Education, 2011.
5	Harold Koontz & Heinz Weihrich "Essentials of management" Tata McGraw Hill, 1998.

Regulation 2018		Semester VI	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	18MEC304T	AUTOMATION AND INDUSTRY 4.0	3	0	0	3

Prerequisite Course (s)

Nil

Course Objective (s):

- To understand the components that constitute Industry 4.0.
- To understand the various technologies and function aspect of Industry 4.0
- To introduce the importance of automation techniques in manufacturing industries.
- To provide a good understanding of Internet of Things (IoT) and its envisioned deployment domains
- To understand the functioning Numerical Control Production System

Course Outcome (s) (COs):

CO1	Implement Industry 4.0 concepts on any existing systems:
CO2	Make the use of Industry 4.0 technologies
CO3	Familiar with various automation technologies in manufacturing industries
CO4	Understand the design architecture of IoT
CO5	Familiar with the Numerical Control Production System

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	1	-	1	-	1	-	1	-	1	-	2	-
CO2	2	2	2	1	-	1	-	1	-	1	-	-	1	2	-
CO3	2	2	2	1	1	-	-	2	-	1	-	-	2	2	2
CO4	2	2	2	-	1	-	-	-	-	-	-	1	-	3	2
CO5	2	2	2	1	2	-	-	-	-	-	-	-	3	3	2
CO (Avg)	2	2	2	1	1.33	1	-	1.33	-	1	-	1	2	2.4	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	INTRODUCTION TO INDUSTRY 4.0	9
Introduction to Industry 4.0- Components of Industry 4.0 - Need for industry 4.0 – Industrial Revolutions - Drivers of Industry 4.0 - Support System for Industry 4.0 - Internet of Services (IoS) - Smart Manufacturing - Smart Devices and Products - Predictive Analytics		
UNIT II	**TECHNOLOGIES AND FUNCTION CONCEPT INDUSTRY 4.0**	**9**
Digital manufacturing, augmented reality, Big data analytics, cyber physical systems, cloud computing, artificial intelligence, cognitive computing, machine learning, cyber security, Mobile Computing, 3D Printing - Function aspect of technologies - Technology classification of I4.0 - Closed Loop Economy - Concept of Knowledge Economy - Sustainability and circular economy		
UNIT III	**AUTOMATION IN MANUFACTURING INDUSTRIES**	**9**
Introduction-Automation in production system, Principles and strategies of automation, Basic elements of an automated system,Levels of automations, Material handling and identification technologies-Overview of material handling systems, Types of material handling equipment, Conveyor system, Automated guided vehicle system, Automated Manufacturing Systems-Components, Classification and overview of manufacturing systems, Cellular manufacturing, Flexible manufacturing system(FMS), FMS and its planning and implementation		
UNIT IV	**INDUSTRIAL INTERNET OF THINGS**	**9**
Introduction to Internet of Things-Overview of Internet of Things-the Edge, Cloud and the Application Development, Anatomy of the Thing, Industrial Internet of Things (IIoT -Industry 4.0), Quality Assurance, Predictive Maintenance, Real Time Diagnostics, Design and Development for IoT, Understanding System Design for IoT, Design Model for IoT, Challenges -future and potential of IoT -application in manufacturing industry		
UNIT V	**NUMERICAL CONTROL PRODUCTION SYSTEMS**	**9**
Numerical Control Production Systems: Basic concepts, coordinate system and machine motion-Types of NC systems- Point to point, straight cut and continuous path. Machine control unit and other components, Tape and tape readers.NC part programming:Punched tape and tape formats, NC words, methods of part programming, manual part programming: APT programming, Direct numerical control. Computer numerical control. Adaptive control. Applications and economics of NC.		

Text Book (s)

1	Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", Apress 1st ed. Edition, 2017.
2	M.P.Groover,"Automation, Production Systems and Computer Integrated Manufacturing", 5 th Edition, Pearson Education, 2009

Reference (s)

1	Mohammad Dastbaz , Peter Cochrane "Industry 4.0 and Engineering for a Sustainable Future" Springer ISBN 978-3-030-12953-8- 2019.
2	Elena G. Popkova · Yulia V. RagulinaAleksei V. Bogoviz "Industry 4.0: Industrial Revolution of the 21stCentury" ISBN 978-3-319-94310-7 – 2019.
3	N. Viswanandham, Y. Narahari, "Performance Modeling of Automated Manufacturing Systems", 1st Edition, 2009.
4	Olivier Hersent, "The Internet of Things: Key Applications and Protocols", Wiley 2nd Edition, 2012
	Jonathan Follett, Foundational Elements of an IoT Solution–The Edge, The Cloud and Application Development, Oreilly,1stEdition, 2016

Regulation 2018		Semester VI	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	18MEC305T	FINITE ELEMENT ANALYSIS	3	1	0	4

Prerequisite Course (s)

Basic knowledge on Numericals and Calculas

Course Objective (s):

- To enable the students to understand the applications of Finite element analysis in engineering applications by the concepts of virtual work/ equilibrium approach, variational and weighted residual methods for solving engineering problems.
- To appreciate the use of FEM to a range of Engineering Problems.
- To provide knowledge on the fundamental concepts of finite element analysis in two dimensional solid mechanics.
- To impart knowledge on basic concepts of thermal distributions in various engineering components through finite element methods.
- To provide knowledge on higher order elements in complex problems.

Course Outcome (s) (COs):

CO1	Apply mathematical formulation of finite element method to basic (linear) ordinary and partial differential equations in mechanical systems.
CO2	Solve the one dimensional structural problems
CO3	Solve the vector variable problems using 2D element
CO4	Determine thermal distribution in one and two dimensional engineering applications.
CO5	Implement finite element method to solve complex equations.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO 3
CO1	3	2	2	2	-	1	-	-	-	-	1	1	2	-	1
CO2	3	2	3	1	1	-	-	-	-	-	-	1	2	-	-
CO3	3	2	3	2	1	-	-	-	-	-	-	1	2	-	1
CO4	3	2	3	3	2	1	-	-	-	-	2	2	2	-	2
CO5	3	2	3	3	-	1	-	-	-	-	2	1	2	-	2
CO (Avg)	3	2	2.8	2.2	1.33	1	-	-	-	-	1.66	1.2	2	-	1.5

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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UNIT I	INTRODUCTION	9
Historical Background – Mathematical Modeling of field problems in Engineering – Governing Equations – Discrete and continuous models – Boundary, Initial and Eigen Value problems– Weighted Residual Methods – Variational Formulation of Boundary Value Problems – RitzTechnique – Basic concepts of the Finite Element Method.		
UNIT II	**ONE-DIMENSIONAL PROBLEMS**	**9**
Finite element modeling – Natural Coordinates and shape functions - linear bar element, - total potential energy approach - element stiffness matrix and force vector – global stiffness matrix and force vector - boundary condition – problems- quadratic element, Plane Trusses - development of shape function - element equations , element stiffness matrix and force vector – global stiffness matrix and force vector – boundary condition- problems, beam element –finite element formulation – Load vector –boundary condition-problems.		
UNIT III	**TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS**	**9**
Finite element modeling – constant strain triangular element – Iso-parametric representation – Potential Energy approach - Element stiffness matrix and force vector – global stiffness matrix and force vector – Boundary condition – Problems, Axisymmetric solids subjected to Axisymmetric loading - axis symmetric formulation - Element stiffness matrix and force vector – global stiffness matrix and force vector –Boundary condition – Problems.		
UNIT IV	**HEAT TRANSFER / SCALAR VARIABLE PROBLEM 1 D & 2D**	**9**
Scalar variable problems- steady state heat transfer- 1D,2Dconduction& convection – Global stiffness matrix and global thermal load vector - Boundary condition – Problems.		
UNIT V	**TWO DIMENSIONAL VECTOR VARIABLE PROBLEM USING QUADRILATERAL ELEMENTS**	**9**
Selection of order of polynomial-linear, simplex, complex and multiplex elements, errors in FEA, mesh refinement methods and convergence requirements. Iso, Sub and Super parametric element, shape functions for a 2-D four nodded and eight nodded Isoparametric rectangular element using natural coordinate system - problems. Gaussian quadrature method-problems.		

Text Book (s)

1	Tirupathi R. Chandrupatla, Ashok D. Belegundu, "Introduction to Finite Elements in Engineering: International Edition", 4th Edition,Pearson Education Limited, 2014
2	Daryl L. Logan., —A first course in Finite Element Method, Cengage Learning., 2016.

Reference (s)

1	JunuthulaNarasimha Reddy., An Introduction to the Finite Element Method, 3rd Ed., McGraw-Hill, 2006.
2	Fish J., and Belytschko T., A First course in Finite elements, 1st Ed., John Wiley and Sons, 2007.
3	David V.Hutton, —Fundamentals of Finite Element Analysisl, Tata McGraw-Hill Edition, 2005.
4	Robert D. Cook, S. David, Malkucs Michael E. Plesha, Concepts and Applications of Finite Element Analysis, John Wiley, New Delhi,2007

Regulation 2018		Semester VI	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	18MEC306L	DESIGN AND ANALYSIS LABORATORY	0	0	4	2

Prerequisite Course (s)

Nil

Course Objective (s):

- To provide knowledge on creating model for a given component using software
- To give exposure to software tools needed to analyze engineering problems.
- To expose the students to different applications of simulation and analysis tools.

Course Outcome (s) (COs):

CO1	Analyze the behavior of a component subjected to structural, dynamic and thermal loading conditions by using Finite Element Method based package.
CO2	Find deformations and stresses in components subjected to combined structural and thermal loads.
CO3	Validate the design of the product by analyzing and comparing the stresses induced with analytical /experimental results.
CO4	CFD analysis to validate simple 2D flow problem
CO5	Develop MAT Lab program to simulate Mechanical system.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	-	-	2	2	-	-	2	-	2
CO2	3	3	3	2	2	2	-	-	2	2	-	-	2	-	2
CO3	3	3	3	2	2	1	-	-	2	2	-	-	1	-	1
CO4	3	3	3	2	2	-	-	-	2	2	-	-	2	-	3
CO5	3	3	3	2	2	-	-	-	2	2	-	-	2	-	2
CO (Avg)	3	3	3	2	2	1.6	-	-	2	2	-	-	1.8	-	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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LIST OF EXPERIMENTS –

A. **CAD PRACTICE AND ASSEMBLY DRAWING**

Drawing, Editing, Dimensioning, Plotting Commands, Layering Concepts, Hatching, Detailing, Assembly, basic principles of GD&T (geometric dimensioning &tolerancing).

Shaft couplings – Plummer block – Screw jack- Lathe Tailstock – Universal Joint – Knuckle joint – Pipe vice - Machine Vice – Stuffing box– Connecting rod - Simple Eccentric Preparation of Bill of materials and tolerance data sheet

B. **ANALYSIS**

1. Force and Stress analysis using link elements in Trusses, cables etc.
2. Stress and deflection analysis in beams with different support conditions.
3. Stress analysis of flat plates and simple shells.
4. Stress analysis of axi – symmetric components.
5. Thermal stress and heat transfer analysis of plates.
6. Thermal stress analysis of cylindrical shells.
7. Vibration analysis of spring-mass systems.
8. Model analysis of Beams.

Regulation 2018		Semester VI	Total Hours			30
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
M	18MBM302L	EMPLOYABILITY SKILLS AND PRACTICES	0	0	2	1

Course Objective (s):

The purpose of learning this course is to:

1	Learn the application of mathematical or statistical models to different real-world contexts
2	Focus on writing & speaking skills through vigorous practices.
3	Enhance soft skills and analytical ability of students
4	Defeat the fear while communicating in group and to master the effective communication

Course Outcome (s) (Cos):

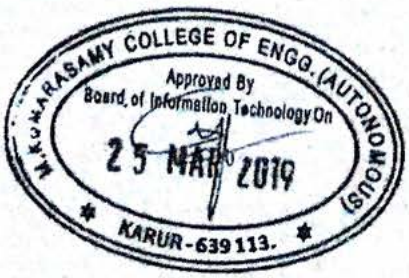
At the end of this course, learners will be able to:

CO1	Solve both analytical and logical problems in a productive manner
CO2	Launch their ability of comprising and delivering the information
CO3	Upgrade their communication quality in near future

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-			
CO2	-	-	-	-	-	-	-	-	3	-	-	-			
CO3	-	-	-	-	-	-	-	-	-	3	-	-			
CO4	-	-	-	-	-	-	-	-	-	-	-	-			
CO5	-	-	-	-	-	-	-	-	-	-	-	-			
CO (Avg)	3.00	-	-	-	-	-	-	-	3.00	3.00	-	-			

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)



UNIT I	Module - 1	6
Aptitude: Time and Distance (Speed, Streams) - Problems on Trains - Arrangements and BloodRelations. **Communication:** Job Application - Cover letter,Bio-data,Resume& CV building.		
UNIT II	Module - 2	6
Aptitude: Time and Work - Pipes & Cisterns - Situation Reaction Test & Data Interpretations. **Communication:** Writing practices on circulars, notices, memos, Agenda preparation and Minutes of meeting.		
UNIT III	Module - 3	6
Aptitude: Ages - Averages - Probability - Profit and Loss. **Communication:** Email Etiquette - Essay writing.		
UNIT IV	Module - 4	6
Aptitude: Mensuration - SI & CI - Cause and Effect Analysis - Statement, Assumptions & Conclusions. **Communication:** Group Discussion and guidelines.		
UNIT V	Module - 5	6
Aptitude: Permutation and Combinations - Partnership - Alligations or Mixtures. **Communication:** Interview skills - General instructions, Review of interview questions, Mock Interviews.		

Text Book (s)

1	Dr.R.S.Aggarwal, "Quantitative Aptitude", S. Chand & Company Limited, 2015
2	Dr.R.S.Aggarwal, "A Modern Approach to Verbal & Non - Verbal Reasoning", S. Chand & Company Limited, 2015

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Regulation 2018		Semester V/VI	Total Hours			15
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
M	18LEM302T	SELF DEVELOPMENT AND ENTREPRENEURSHIP	1	0	0	Nil

Prerequisite Course (s)

Nil

Course Objective (s): The purpose of learning this course is to:

1	Develop entrepreneurship and self-employment abilities to start any venture plan, use, and monitor and control resources optimally and economically.
2	Know the Micro, small and medium industries Registration Process.
3	Study about product selection and development.
4	Learn about the Project report preparation.
5	Analysis the Enterprise risk management.

Course Outcome (s) (COs): At the end of this course, learners will be able to:

CO1	Identify entrepreneurial quality.
CO2	Know the entrepreneurial support agencies.
CO3	Prepare project setup planning and project report
CO4	Select appropriate agencies for technical and financial support.
CO5	Explain SWOT analysis and strategies to achieve goals.

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	1	-	-	1	1	1	1	-	-
CO2	-	1	-	-	-	2	1	1	1	2	2	1	-	-
CO3	1	3	-	-	-	-	2	1	1	1	2	1	-	-
CO4	-	1	-	-	-	1	2	1	1	1	2	1	-	-
CO5	2	1	-	-	-	-	1	-	1	1	1	1	-	-
CO (Avg)	1.50	1.50	-	-	-	1.33	1.50	1.00	1.00	1.20	1.60	1.00		

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	INTRODUCTION TO SELF-EMPLOYMENT AND ENTREPRENEURSHIP DEVELOPMENT	6

Introduction of self-employment – Characteristics- Creativity. Entrepreneurship development-Qualities of entrepreneur and Characteristics of Diploma holder as a self-employer like developing networking and personal contacts, importance of productivity, quality, cost consciousness and customers' satisfaction. Types of enterprise-Sole partnership -Partnership firm- Joint stock company- Co-operative society.

UNIT II	ENTREPRENEURIAL SUPPORT AGENCIES	6

Definition – Micro, small and medium industries- Registration process of an enterprise with Government agencies-Name, type and role of state and national level support agencies. Current state & National Level Promotional Schemes for establishmen of new.

UNIT III	PROJECT SET UP PLANNING	6

Product Selection: importance- Product development stages. Process Selection: Factors affecting process selection - Technology lifecycle. Process Conversion-Capacity Planning: Basic method to assess / estimate capacity. Selection of location and layouts: Factors affecting selection of location - Objectives and types of plant layout.

UNIT IV	PROJECT PROPOSAL PLANNING	6

7-M resources- Marketing- definition, need for enterprise, 4Ps channels- Market survey. Methods - Project report preparation for mechanical feature based product: Meaning of project planning and report: Feasibility study. Details required for preparing project plan. Project cost estimation.

UNIT V	ENTERPRISE AND RISK MANAGEMENT	6

Concept of risk in the context of enterprise/ project-Uncertainty and certainty of project elements-Decision making under risk-Methods of risk management-Strength, Weakness, Opportunity and Threat (SWOT) analysis.

Reference (s)

1	Entrepreneurship & Venture Management, Clifford and Bombak, JosephR.Momanso.
2	Small Industries management – Karmakar.M.B.
3	Creativity –Pradeep Khandwala
4	Entrepreneurship development and Management, R.K.Singal, S.K.Kataria Sons.

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Regulation 2018		Semester VII	Total Hours			30
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
H	18MBH202T	SOCIAL ENGINEERING	2	0	0	2

Prerequisite Course (s)

Nil

Course Objective (s): The purpose of learning this course is to:

1	Learn about fundamental concept of social engineering
2	Know the different elements of ethical hacking and social engineering.
3	Understand the concepts of threats and attack vectors
4	Understand the ethical hacking
5	Learn about the attacks against individuals and organizations

Course Outcome (s) (COs): At the end of this course, learners will be able to:

CO1	Understand the concept of social engineering and types of attacks.
CO2	Identify the key security concepts, CIA and IT governance and best practices
CO3	Understand principles of social engineering.
CO4	Exhibit the ethical hacking concepts and scopes, threats and attack vectors and common areas of vulnerability.
CO5	Gain knowledge of attacks against individuals and organizations.

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	-	-	-	1	1	1	1	1	-	1	-	-
CO2	1	1	-	-	-	2	-	2	1	-	-	1	-	-
CO3	-	1	-	-	-	-	1	2	1	-	-	1	-	-
CO4	-	-	-	-	-	-	-	3	-	-	-	1	-	-
CO5	1	1	-	-	-	-	-	-	1	1	-	1	-	-
CO (Avg)	1.33	1.25	-	-	-	1.50	1.00	2.00	1.00	1.00	-	1.00	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	INTRODUCTION TO SOCIAL ENGINEERING	6
Social Engineering Defined - Why Does Social Engineering Work - Identify Communication Style - key aspects of social engineering - Categories of Social Engineering Attacks – human – based attacks and technology - based attacks		
UNIT II	**KEY SECURITY**	**6**
Key security - concepts - Types of key security concepts – Cyber security position. The CIA Triad - the significance of incident response and frameworks around cyber security. IT Governance - Best practices - compliance.		
UNIT III	**PSYCHOLOGY OF SOCIAL ENGINEERING**	**6**
Mind Tricks: Psychological Principle - Four fundamental aspects of human nature that social engineers - the desire to be helpful - the tendency to be trusting - the fear of offending others - the tendency to cut corners		
UNIT IV	**ETHICAL HACKING AND SOCIAL ENGINEERING**	**6**
Ethical Hacking Concepts and Scopes - Threats and Attack Vectors - Information Assurance - Threat Modelling - Enterprise Information Security Architecture - Vulnerability Assessment and Penetration Testing - Types of Social Engineering - Insider Attack - Preventing Insider Threats - Social Engineering Targets and Defence Strategies. Common Areas of Vulnerability - Appropriate access - Assessed resistance - Information availability		
UNIT V	**CASES OF SOCIAL ENGINEERING**	**6**
Notable Cases of Social Engineering - Attacks against Individuals - Attacks against Organizations - Preventing Social Engineering Attacks - Mitigating the Damage of Social Engineering Attacks - Segregation of Access - Maintain Access Logs - Ensure That Backups Occur Regularly - Automatically Revoke User Privileges If Suspicious Activity Is Detected		

Reference (s)

1	Kevin D. Mitnick, William L. Simon, Steve Wozniak, The Art of Deception: Controlling the Human Element of Security, Wiley, October 17th 2003
2	Christopher Hadnagy, Social Engineering: The Science of Human Hacking Paperback- Wiley Publishing Inc.,Edition 2018
3	Lester Evans, Cybersecurity: An Essential Guide to Computer and Cyber Security for Beginners, Including Ethical Hacking, Risk Assessment, Social Engineering, Attack and Defense Strategies, and Cyberwarfare Paperback –2018
4	Dr. Erdal Ozkaya, Learn Social Engineering: Learn the art of human hacking with an internationally renowned expert-2018

Regulation 2018		Semester V / VI / VII / VIII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18MEE001T	NEW PRODUCT DEVELOPMENT	3	0	0	3

Prerequisite Course (s)

Nil

Course Objective (s):

- To enable the students to gain knowledge on the process of product development based on customer needs
- To enable the students to understand the standard procedure available for concept development
- To facilitate the students to use design process and system level design issues
- To make the students to familiarize with the Intellectual property rights
- To develop the students creative and Innovative skills

Course Outcome (s) (COs):

CO1	Understand the process to plan and develop products
CO2	List the process of collecting information and develop product specifications
CO3	Discuss the concept generation, selection and testing processes.
CO4	Explain the concepts of industrial design and design for manufacture
CO5	Explain about Intellectual property rights and how to write claims

CO-PO Mapping

COs	POs												PSOs		
	PO 1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	-	-	2	-	-	-	-	-	1	2	-	-
CO2	3	3	3	3	3	-	-	-	-	-	-	2	2	-	1
CO3	3	3	3	3	3	2	-	-	-	-	-	2	2	-	1
CO4	3	3	2	2	2	1	-	-	-	-	-	2	2	-	1
CO5	2	2	-	-	2	1	-	2	-	2	-	2	-	-	-
CO (A				2.6	2.5	1.5	-	2	-	2	-	1.8	2	-	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	CREATIVITY	9

Concept and history of creativity, need for creativity, creative environment, stages of creativity process, creativity and intelligence, creativity in various contexts, economic view of creativity, measuring creativity, fostering creativity, creative problem solving – brain storming and various techniques, lateral thinking. Role of creativity in entrepreneurship – Research and development (R&D). Case studies on creative solutions to contemporary issues.

UNIT II	INNOVATION	9

Definition, creativity vis-à-vis innovation, conceptualizing innovation, types of innovation, sources of innovation, goals of innovation, process of technological innovation, diffusion of innovation, factors contributing to successful technological innovation, failure of innovations, innovation management, measures of innovation. Case studies - Innovations in health sector, Agriculture, Education, Entrepreneurship and Corporate R & D.

UNIT III	PROJECT PLANNING AND EVALUATION	9

Definition and purpose of project, collection of ideas, screening ideas, selection criteria for new projects, development of project plan, project evaluation – purpose, kinds of evaluation, stages of evaluation process, techniques of project evaluation, project analysis, benefits and risks of new projects.

UNIT IV	PRODUCT DEVELOPMENT AND EVALUATION	9

Research and new product development – process and types of new products, creative design, design of prototype – purpose, process, and types, model preparation, testing and quality evaluation; marketing research – purpose and process, types and methods; introducing new products, cost evaluation, Product deployment and commercialization - Case Studies.

UNIT V	PROTECTION OF INNOVATION	9

Intellectual property (IP), classes of IP – industrial property and copyrights; Intellectual Property Rights(IPR); Patents, patentability, patent acts, governing laws, history of patent laws and acts, patent administration; patenting process – patent application, patent search, prosecution, publication, examination, opposition, grant, renewal, patent rights; international code for patents. Intellectual Property Rights, Write the description of the invention, Refine Claims, Pursue application. Economics and Management Accelerating Projects, Project Execution

Text Book (s)

1	Frederick Betz, Managing Technological innovation, John Wiley & Sons, Inc., Third Edition, 2015
2	Product design and development "Karl T Ulrich; Steven D Eppinger" New York, NYMcGraw-Hill Education,2016

Reference (s)

1	Product Design Kavin N Aotto, Kritine I Wood, Prentice Hall Publications 2015
2	Dieter G.E. —Engineering Design, McGraw Hill Company International Edition 2017
3	Paul Windrum and Per Koch, Innovation in Public Sector Services: Entrepreneurship, Creativity and Management, Edward Elgar Publishing Limited, 2012.

Regulation 2018		Semester V / VI / VII / VIII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18MEE002T	NANO TECHNOLOGY	3	0	0	3

Prerequisite Course (s)

Engineering materials and metallurgy

Course Objective (s):

- To foundational knowledge of the Nanoscience, nano technology and related fields.
- Educate various concepts of methods of preparation nano materials and synthesis.
- Make them to understand the various types nano materials
- Outlinc thc various characterization techniques of nano materials
- Enable them to apply the various applications of nano materials

Course Outcome (s) (COs):

CO1	Describe the basic conceps of nano science and nanotechnology
CO2	Understand the general methods and preparation Nano technology process
CO3	Describe the various types of nanomatcrials.
CO4	Understand the various characterization techniques of nano materials
CO5	Identify various principles and their industrial applications of Nanotechnology.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PS O3
CO1	3	-	-	-	-	-	2	2	-	-	-	-	3	-	-
CO2	3	3	-	-	2	3	-	-	-	-	-	-	3	-	2
CO3	3	3	-	-	-	3	-	3	-	-	-	-	3	-	-
CO4	3	3	2	-	2	-	3	-	-	-	-	1	2	-	2
CO5	3	3	-	-	-	3	3	-	-	-	-	1	3	-	3
CO (Avg)	3	3	2	-	2	3	2.6	2.5	-	-	-	1	2.8	-	2.3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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UNIT I	INTRODUCTION	9
Basic concepts of Nanoscience and technology- Classifications of nanostructured materials- nano particles- quantum dots - quantum wires-ultra-thinfilms- multilayered materials. Effect on properties of Mechanical, Electronic, Optical, Magnetic and Thermal properties.		
UNIT II	**GENERAL METHODS OF PREPARATION**	**9**
Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE		
UNIT III	**NANO MATERIALS**	**9**
Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), Nanometal oxides-ZnO, TiO2,MgO, ZrO2, NiO, nanoalumina, CaO, AgTiO2, Ferrites, Nanoclays- preparation of Quantum wires, Quantum dots.		
UNIT IV	**CHARACTERIZATION TECHNIQUES**	**9**
X-ray diffraction technique, Scanning Electron Microscopy (SEM) - Transmission Electron Microscopy (TEM) - Surface Analysis techniques of AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation		
UNIT V	**APPLICATIONS**	**9**
NanoInfoTech: - nanocomputer, molecular switch, super chip, nanocrystal, Nano fludics- Building blocks-Biogical applications- Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, Nanoparticles for sunbarrier products - printing, solar cell, battery.		

Text Book (s)

1	Nano Technology an Introduction, Second Edition, Jeremy J.Ramsden, Elsevier Science,2016
2	Charles P. Poole, Frank J. Owens, Introduction to Nanotechnology, John Wiley & Sons. (2009)

Reference (s)

1	Introduction to Nano: Basics to Nanoscience and Nanotechnology (Engineering Materials), Springer ,2017.
2	Nano physics and Nano technology, Edward L. Wolf, Wiley-VCH, 3rd Edition, 2015
3	Introduction to Nanoscience and Nanotechnology, Gabor L. Hornyak, Taylor & Francis, 2008
4	T. Pradeep, Nano: The Essentials Understanding Nanoscience and Nanotechnology, New Delhi.(2007)
5	Nanomaterials:Synthesis, properties and applications C.N.R:Rao, P.J.Thomas and U.Kulkarni, Springer-Verlag (2007).

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Regulation 2018		Semester V / VI / VII / VIII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18MEE003T	COMPUTER AIDED DESIGN AND MANUFACTURING	3	0	0	3

Prerequisite Course (s)

Manufacturing Technology

Course Objective (s):

- To develop an understanding about the role of computer in manufacturing.
- To provide an in-depth understanding of shop floor control and virtual organization and control of Manufacturing processes.
- To introduce group technology and concurrent engineering and develop skill in the developing.
- Improve communications through documentation and to create a database for manufacturing.
- To take up case studies on FMS and CIM systems.

Course Outcome (s) (COs):

CO1	Explain NC, DNC and CNC used in CIM
CO2	Apply the features of CAD System in design and modeling
CO3	Explain the role of AGVs, AS/RS and Robots in material handling and Storage System.
CO4	Describe Group Technology and Classification of Coding system.
CO5	Explain Artificial Intelligent system, Expert system and FMS.

CO-PO Mapping

Cos	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	2	-	2	-	1	1	-	-	-	-	1	-	2
CO3	3	2	-	-	-	-	-	-	-	-	-	-	1	-	-
CO4	3	2	-	-	-	-	1	-	-	-	-	-	1	-	-
CO5	3	2	1	-	2	-	1	1	-	-	-	-	1	-	2
CO (Avg)	3	2	1.5	-	2	-	1	1	-	-	-	-	1	-	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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UNIT I	INTRODUCTION	9
Introduction - computer aided design and manufacturing Hardware –Types of systems – Evaluation criteria – Input Devices – Output devices – Hardware integration and networking – Hardware trends. Software – Graphics standards – User Interface –Modules – Modeling and Viewing – Documentation and Development. Introduction to CAD/CAM – CAD/CAM concepts –Types of production.		
UNIT II	**PRINCIPLES OF COMPUTER GRAPHICS**	**9**
Geometric Modeling – Wireframe, Surface and Solid – Parametric representation of curves & surfaces - CSG and B-Rep- World/device coordinate representations, 2D and 3D geometric transformations, Matrix representation, translation, scaling, shearing, rotation and reflection, composite transformations, concatenation.		
UNIT III	**CNC MACHINE TOOLS**	**9**
Introduction to NC, CNC, DNC- Manual part Programming – Computer Assisted Part Programming – Examples using NC codes- Adaptive Control – Canned cycles and subroutines – CAD / CAM approach to NC part programming – APT language, machining from 3D models. Data exchange standards – IGES, STEP, CALS etc. – communication standards		
UNIT IV	**GROUP TECHNOLOGY, CAPP AND FMS**	**9**
Introduction to part families-parts classification and cooling – group technology machine cells-benefits of group technology – Process Planning – CAPP & types of CAPP – Flexible manufacturing systems (FMS) – the FMS concept-transfer systems – head changing FMS – Introduction to Rapid prototyping, Knowledge Based Engineering.		
UNIT V	**CAD-CAM INTEGRATION**	**9**
Introduction – Part production cycle – Manufacturing Systems – Manufacturing Processes – Integration Requirements – Part programming – Tool path generation and Verification – Design and Engineering Applications.		

Text Book (s)

1	Mikell. P. Groover —Automation, Production Systems and Computer Integrated Manufacturing, Pearson Education 2015.
2	Ibrahim Zeid "Mastering CAD CAM" Tata McGraw-Hill PublishingCo.2007.

Reference (s)

1	R Ibrahim Zeid, Sivasubramanian, "CAD/CAM theory and Practice", Tata McGraw Hill,2014.
2	Kevin Otto and Kristin Wood, "Product Design", Pearson Education, 2014.
3	Ibrahim Zeid, "Mastering CAD/CAM", Tata McGraw Hill, 2011.
4	Rao, P.N., "CAD/CAM Principles and Applications", 3rd Edition, Tata McGraw Hill, 2012

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Regulation 2018		Semester V / VI / VII / VIII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18MEE004T	COMPOSITE MATERIALS	3	0	0	3

Prerequisite Course (s)

Engineering Materials and Metallurgy, Strength of materials

Course Objective (s):

- To understand the basic properties of fibers and reinforcements is composite materials
- To apply the method of manufacturing of polymer matrix composites
- To apply the procedures involved in manufacturing of metal matrix composites
- To apply the method of manufacturing of ceramic matrix composites and carbon-carbon composites
- To analyse the mechanical behaviour of laminated composites

Course Outcome (s) (COs):

CO1	Interpret the types of fybers and reinforcements used for the production of composites
CO2	Develop a procedure to produce different polymer matrix composites.
CO3	Experiment with different metal matrix composites to find its applicability
CO4	Identify a suitable method for manufacturing of ceramic matrix composites and carbon-carbon composites
CO5	Aanalyse the macro micro mechanics of laminated composites

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	-	-	-	-	-	-	-	1	1	-	1
CO2	3	3	3	3	2	1	-	-	-	-	-	2	2	-	3
CO3	3	3	3	3	2	1	-	-	-	-	-	1	2	-	3
CO4	3	3	3	3	2	1	-	-	-	-	-	1	2	-	3
CO5	3	3	3	3	2	1	-	-	-	-	-	-	2	-	3
CO (Avg)	3	2.8	2.6	2.6	2	1	-	-	-	-	-	1.2	1.8	-	2.6

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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UNIT I	INTRODUCTION TO COMPOSITE MATERIALS	9
Definition-Matrix materials-polymers-metals-ceramics, Natural composites - Resins: polyester, epoxy, Reinforcements: Particles, whiskers, inorganic fibers, metal filaments- ceramic fibers- fiber fabrication-natural composite wood, Jute, sisal and other vegetable fibers- Advantages and drawbacks of composites over monolithic materials. Mechanical properties and applications of composites, Particulate-Reinforced composite Materials, Dispersion-Strengthened composite, Fiberreinforced composites Rule of mixtures-Characteristics of fiber-Reinforced composites, Manufacturing of fiber and reinforcemnts		
UNIT II	**PROCESSING OF POLYMER MATRIX COMPOSITES**	**9**
Thermo set matrix composites: hand layup, spray, filament winding, Pultrusion, resin transfer molding, autoclave molding - bag molding, compression molding with Bulk Molding Compound and sheet Molding Compound – thermoplastic matrix composites – film stacking, diaphragm forming, thermoplastic tape laying, injection molding – interfaces in PMCs - structure, properties and application of PMCs –recycling of PMCs.		
UNIT III	**PROCESSING OF METAL MATRIX COMPOSITES**	**9**
Metallic matrices: aluminium, titanium, magnesium, copper alloys – processing of MMCs: liquid state, Solid state, in situ fabrication techniques – diffusion bonding – powder metallurgy techniques interfaces in MMCs – mechanical properties – machining of MMCs – Applications.		
UNIT IV	**PROCESSING OF CERAMIC MATRIX COMPOSITES AND CARBON-CARBON COMPOSITES**	**9**
Processing of CMCs: cold pressing, sintering, reaction bonding, liquid infiltration, lanxide process – in situ chemical reaction techniques: chemical vapour deposition, chemical vapour impregnation, solgel–interfaces in CMCs – mechanical properties and applications of CMCs – Carbon carbon Composites – applications.		
UNIT V	**INTRODUCTION TO COMPOSITE LAMINATES AND STRENGTH ANALYSIS**	**9**
Basic Assumptions of Laminated anisotropic plates. Laminate Constitutive Equations – Coupling Interactions, Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates. Laminate Structural Moduli. Evaluation of Lamina Properties from Laminate Tests. Quasi-Isotropic Laminates. Determination of Lamina stresses within Laminate- fatigue of laminate composites		

Text Book (s)

1	Krishnan K Chawla, Composite Materials: Science and Engineering, International Edition, Springer, 2019, Fourth Edition, ISBN: 978-3-030-28982-9,978-3-030-28983-6.

Reference (s)

1	P. K. Mallick, William E. Stirton, Processing of Polymer Matrix Composites, CRC Press Taylor & Francis Group, 2018, ISBN:13: 978-1-4665-7822-7
2	Davim, J. Paulo, Metal matrix composites : materials, manufacturing and engineering, De Gruyter, 2014, ISBN: 9781680157680,168015768X
3	C. T. Lynch, J. P. Kershaw, Metal Matrix Composites, CRC Press, Taylor & Francis Group, 2018, ISBN 13: 978-1-315-89534-5
4	ASM Handbook – Composites, Vol-21, 2017, ISBN -13: 978-0-87170-703-1.
5	R.M. Jones, "Mechanics of composite Materials", second edition, Republished by Taylor &. Francis, 2014

Regulation 2018		Semester V / VI / VII / VIII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18MEE005T	DESIGN FOR MANUFACTURING AND ASSEMBLY	3	0	0	3

Prerequisite Course (s)

Nil

Course Objective (s):

- To study the various factors influencing the manufacturability of components and the use of tolerances in manufacturing
- To design a product that is easily and economically manufactured by using standard components
- To apply of this study to various forging, casting, welding and machining processes.
- To study about the various assembly methods, processes and design for assembly guidelines.
- To impart knowledge about the product life cycle assessments and environmental impact of materials,manufacturing methods and the way to minimize it

Course Outcome (s) (COs):

CO1	Describe the role of manufacture and assembly within the overall design process.
CO2	Evaluate and select the manufacturing and assembly processes relevant to the casting and welding industry.
CO3	Use the design for manufacturing concept to reduce machining time and manufacturing cost
CO4	Review and select suitable manufacturing and assembly processes for a complex, and welldefined component.
CO5	Design a complex, well-defined component accounting for manufacture and assembly

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	1	-	-	-	-	-	-	1	1	-	-
CO2	3	2	1	2	-	-	-	-	-	-	-	1	2	-	-
CO3	3	2	1	-	-	-	-	-	-	-	2	1	1	-	-
CO4	3	2	1	-	-	1	-	-	-	-	1	1	1	-	-
CO5	3	2	2	2	1	1	2	-	-	-	-	1	1	-	-
CO (Avg)	3	2	1.2	2	1	1	2	-	-	-	1.5	1	1.2	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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UNIT I	INTRODUCTION TO DFM	9
Qualities of a designer - Systematic working plan - Factors influencing choice of materials –Manufacturing methods. Process capability. Tolerances – Relevant to manufacturing, assembly. Tolerance stack – effects on assembly – Methods of eliminating tolerance stack. International Tolerance Grades, Surface finish, Attainable tolerance grades and different machining processes.		
UNIT II	**FORM DESIGN – CASTING AND WELDING**	**9**
Influence of loading, materials, production methods on form design. Casting considerations –Requirements and rules. Welding considerations – Requirements and rules. Redesign of components for castings. Redesign of components for welding. Case studies.		
UNIT III	**FORM DESIGN – FORGING AND MACHINING**	**9**
Forging considerations – Requirements and rules. Choice between casting, forging and welding. Machining considerations – Requirements and rules. Redesign of components for forging. Redesign of components formachining. Case studies.		
UNIT IV	**INTRODUCTION TO DFA**	**9**
Distinction between assembly methods and processes. Factors determining assembly methods and processes. Design factors independent of methods and processes. Design factors dependent on methods. Design factors dependent on processes.		
UNIT V	**DESIGN FOR ASSEMBLY**	**9**
Approaches to design for assembly – Approaches based on design principles and rules – Qualitative evaluation procedures, knowledge based approach, Computer aided DFA methods. Assemblability measures. Boothroyd –Dewhurst DFA method – Redesign of a simple product. Case studies.		

Text Book (s)

1	Harry Peck, "Design for Manufacture", Pittman Publication, 1983.
2	Alan Redford and Chal, "Design for Assembly - Principles and Procedures",McGraw Hill International Europe, London, 1994.
3	O.Molloy, S.Tilley and E.A.Warman. "Design for Manufacturing and Assembly", Springer US 2012.
4	Erik Tempelman, Hugh.S, Bruno Ninaber V.E "Manufacturingand Design", Elsevier 2014.

Reference (s)

1	Boothroyd, G., "Design for Assembly Automation and Product Design". CRC press,MarcelDekker, 2005.
2	Mohd Izwan Zaini, "Design for Manufacturing and Assembly of industry product"Universiti Teknikal Malaysia Melaka 2007.
3	Boothroyd, G, Heartz and Nike, "Product Design for Manufacture, Marcel Dekker", CRCpress, 2010.
4	Grigore Gogu, DanielCoutellier, Patrick Chedmail, Pascal Ray, "Recent Advances in Integrated Design and Manufacturing in Mechanical Engineering"Springer Science 2013.
5	Laroux K.G , "Design for Advanced Manufacturing: Technologies and Processes" McGraw Hill Education ,2017
6	Fit Tolerance ISO anroid mobile applications: Fit Tolerance ISO 1.2, International Tolerances1.33

Regulation 2018		Semester V / VI / VII / VIII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18MEE006T	FATIGUE, FRACTURE AND FAILURE ANALYSIS	3	0	0	3

Prerequisite Course (s)

Engineering Materials and Metallurgy

Course Objective (s):

- To understand the various modes of mechanical failure of materials
- To analyse the materials behaviour under dynamic loading conditions
- To Evaluate the procedures involved in asses remaining life of engineering components
- To understand the principles and practices for static loading, fracture and failure analysis of non metallic materials
- To analyse the fracture surface of static, cyclic, and corrosion failures of materials

Course Outcome (s) (COs):

CO1	Interpret the static, dynamic, corrosion wear types of mechanical fracture of materials
CO2	Analyse the dynamic behaviour of materails to design of components under fatigue load condition.
CO3	Design components that contain crack and its growth under fatigue load condition.
CO4	Relate the cause of a failure for determining corrective actions or mitigation
CO5	Aanalyse the potential causes and modes of failure of materials

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO 3
CO1	2	2	2	2	1	-	2	-	-	-	-	1	1	-	2
CO2	3	3	3	3	2	-	1	-	-	-	-	2	3	-	3
CO3	3	3	3	3	3	-	2	-	-	-	-	2	3	-	3
CO4	2	2	2	2	1	-	1	3	-	-	-	1	3	-	2
CO5	3	3	2	3	3	-	-	3	-	-	-	1	3	-	3
CO (Avg)	2.6	2.6	2.4	2.6	2	-	1.5	3	-	-	-	1.4	2.6	-	2.6

2: Moderate (Medium) 3: Substantial (High)

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UNIT I	MECHANICAL FAILURE OF MATERIALS	9
Failure Due to Fracture- Ductile Fracture- Brittle Fracture- Ductile-to-Brittle Transition- Stress Concentration- Speed of Loading- Griffith Crack Theory and Fracture Toughness- Factors for Fracture Toughness- Prevention of Fatigue Failure- Failure Due to Corrosion- Failure Due to Wear- Scope of Analysis.		
UNIT II	**BEHAVIOUR UNDER DYNAMIC LOADS AND DESIGN APPROACHES**	**9**
Fatigue, The S-N Curve, low and high cycle fatigue test, Structural Features of Fatigue-crack initiation and propagation mechanisms and Paris law.- Safe life, Stress-life, strain-life and fail - safe design approaches -Effect of surface and metallurgical parameters on fatigue – Fracture of non metallic materials – Failure analysis, sources of failure, procedure of failure analysis.		
UNIT III	**FATIGUE CRACK GROWTH CURVE**	**9**
Empirical relation describing crack growth law – life calculations for a given load amplitude – effects of changing the load spectrum - rain flow method– external factors affecting the K1c values.- leak before break analysis. Crack Initiation under large scale yielding – thickness as design parameter – mixed mode fractures		
UNIT IV	**STATIONARY CRACK UNDER STATIC LOADING**	**9**
Two dimensional elastic fields – Analytical solutions yielding near a crack front – Irwin's approximation - plastic zone size – Dugdaale model – determination of J integral and its relation to crack opening displacement. Fracture of non metallic materials – Failure analysis, sources of failure, procedure of failure analysis.		
UNIT V	**FRACTOGRAPHIC ANALYSIS**	**9**
General practice in failure analysis- Ductile and brittle failure mechanisms- Stress corrosion cracking and hydrogen assisted failure mechanisms- Plastic Analysis Hydrostatic stress, deviatoric stress, yield criteria. Elastic-Plastic -Cyclic fatigue failure mechanism- Effect of defects on failure- Linear Elastic Analysis Airy stress function, crack tip stresses, finite size effects, crack opening displacement.		

Text Book (s)

1	A.J. McEvily, J. Kasivitamnuay, Metal Failures: Mechanisms, Analysis, Prevention, Wiley-Interscience, 2013.
2	W.D. Callister, Jr., D.G. Rethwisch, Materials Science and Engineering: An Introduction, John Wiley & Sons, 10th Edition, 2018

Reference (s)

1	Tribikram Kundu, "Fundamentals of Fracture Mechanics", Ane Books Pvt. Ltd. New Delhi/ CRC, Press, 1st Indian Reprint, 2012
2	I. Milne, R.O. Ritchie, B.L. Karihaloo (Eds.), Comprehensive Structural Integrity, Elsevier, 2006.
3	Shin-Ichi Nishida, Failure Analysis in Engineering Applications,2014, ISBN: 9781483193779
4	George E. Dieter , Mechanical Metallurgy, 3Rd Edition, 2013,Tata McGraw-Hill Education
5	George E. Totten, David K.Wills, Dierk G. Hydraulic Failure Analysis: Fluids, Components, and System Effects, Feldmann - 2001

Regulation 2018		Semester V / VI / VII / VIII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18MEE007T	DESIGN OF JIGS, FIXTURE, PRESS TOOLS AND MOULDS	3	0	0	3

Prerequisite Course (s)

Nil

Course Objective (s):

- To understand the functions and design principles of Jigs, fixtures, press tools and moulds.
- To gain proficiency in the development of required views of the final design.
- To understand the functions and design principles of Press work and Moulds.
- To introduce about press working terminologies and press accessories
- To introduce the different types of jigs for producing the part.

Course Outcome (s) (COs):

CO1	Explore the various locating and clamping methods
CO2	Illustrate the design and development of jigs and fixtures and their types.
CO3	Explain the design principles of Press Work, cutting dies and their functions.
CO4	Describe the function and design principles of bend forming and drawing dies.
CO5	Illustrate the types & methods of moulds along with their design and applications.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	-	-	-	-	-	-	-	-	1	-	-
CO2	3	3	3	2	2	1	-	1	-	-	-	-	2	-	1
CO3	3	3	3	2	2	1	-	1	-	-	-	-	2	-	1
CO4	3	3	3	2	2	1	-	1	-	-	-	-	2	-	-
CO5	3	3	3	2	2	1	-	1	-	-	-	-	2	-	1
CO (Avg)	3	3	2.8	1.8	2	1	-	1	-	-	-	-	1.8	-	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	LOCATING AND CLAMPING PRINCIPLES	9
Tool design objectives – Functions and Advantages of Jigs and fixtures – Basic elements – principles of location – Locating methods and devices – Redundant Location –Principles of clamping – Clamping elements with mechanical,magnetic,vaccum,electrostatic clamping , pneumatic and hydraulic actuation. Standard parts – Drill bushes– Tolerances and error analysis -Factors considered for Design of Jigs and Fixtures.		
UNIT II	**JIGS AND FIXTURES**	**9**
Design and development of jigs and fixtures for given component-Types of Jigs – post, turnover, channel, latch, box, pot, angular post jigs-Rack and pinion operated-Air operated Jig - Indexing jigs components – General principles of milling, Lathe, boring, broaching and grinding fixtures – Assembly, Inspection and Welding fixtures – Modular fixturing systems- Quick change fixtures.		
UNIT III	**PRESS WORKING TERMINOLOGIES AND ELEMENTS OF CUTTING DIES**	**9**
Press Working Terminologies - operations – Types of presses – press accessories – Computation of press capacity – Strip layout – Material Utilization – Shearing action – Clearances – Press Work Materials – Center of pressure- Design of various elements of dies – Die Block – Punch holder, Die set, guide plates – Stops – Strippers – Pilots – Selection of Standard parts – Design and preparation of four standard views of simple blanking, piercing, compound and progressive dies.		
UNIT IV	**BENDING FORMING AND DRAWING DIES**	**9**
Difference between bending, forming and drawing – Blank development for above operations – Types of Bending dies – Press capacity – Spring back – knockouts – direct and indirect – pressure pads – Ejectors – Variables affecting Metal flow in drawing operations – draw die inserts – draw beadsironing – Design and development of bending, forming, drawing reverse re-drawing and combinationdies – Blank development for axi- symmetric, rectangular and elliptic parts – Single and double action dies.		
UNIT V	**DESIGN OF MOULDS**	**9**
Types of moulds and dies for various processing methods - Mould and Die Design Concept and Materials. Injection Mould Design - Basics of mould construction - Methodical Mould Design - Design of Feed System, Ejection System Venting - Design of Cooling system – Mould alignment concepts and De-moulding Techniques. Moulds with a slide core - Split cavity moulds. (Use of Approved Design Data Book is permitted).		

Text Book (s)

1	Joshi P.H, "Jigs and Fixtures", Third Edition, Tata McGraw Hill, New Delhi, 2010.
2	Donaldson, Lecain and Goold. "Tool Design", Tata McGraw Hill, Fourth edition, 2012.

Reference (s)

1	K. Venkataraman, "Design of Jigs Fixtures & Press Tools", Tata McGraw Hill, New Delhi, 2005.
2	R.G.W.Pye, Injection Mould Design, SPE Publication, 2000.
3	Hoffman "Jigs and Fixture Design" – Thomson Delmar Learning, Singapore, 2004
4	Kempster, "Jigs and Fixture Design", Hoddes and Stoughton – Third Edition.
5	Design Data Hand Book, PSG College of Technology, Coimbatore, 2011.

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Regulation 2018		Semester V / VI / VII / VIII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18MEE008T	PIPING DESIGN ENGINEERING	3	0	0	3

Prerequisite Course (s)

Fluid mechanics and machinery

Course Objective (s):

- To impart knowledge on piping processes.
- To understand the piping layout and the stresses acting on it.
- To evaluate the geometry and dimensions of pressure vessels and piping design.
- To identify and correct the design errors and create the safe working environment.
- To learn the concept of piping layout and the stresses acting on it.

Course Outcome (s) (COs):

CO1	Understand the process diagrams
CO2	Understand the process layouts and piping drawings
CO3	Design of piping for various conditions of fluid flow and transmission
CO4	Analyze columns and piping drawings under various loadings
CO5	Expose to the concept of piping layout and the stresses acting on it.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	-	-	-	-	-	-	-	-	1	2	-	-
CO2	3	2	1	-	-	-	-	1	-	-	-	1	2	-	-
CO3	3	2	2	-	1	1	-	2	-	-	-	1	2	-	-
CO4	3	3	3	2	2	1	-	1	-	-	-	1	2	-	-
CO5	3	3	3	2	1	1	-	1	-	-	-	1	2	-	-
CO (Avg)	2.8	2.4	2	2	1.3	1	-	1.2	-	-	-	1	2	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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UNIT I	INTRODUCTION TO PIPING	9
Process Diagrams (PFD, UFD, P&ID, Line List etc) Pipe Fittings- Pipe Flanges, Valves and Piping Special Items -Various codes and standards used in power and process industries- Overview of Technical Queries and Technical Bid Evaluations.		
UNIT II	**DESIGN OF LAYOUT**	**9**
Preparation of Plot Plan Preparation of Equipment Layouts-Preparation of Piping General Arrangement Drawings- Preparation of Cross Sectional Drawings- Piping Isometric Drawings-Material Take off-Preparation of Piping Material Specification- Valve Material Specification- Pipe Wall thickness Calculations Branch reinforcement calculations, Influence of corrosion in piping design, introdcution to piping software tools.		
UNIT III	**JUNCTION STRESSES, OPENING AND REINFORCEMENTS**	**9**
Stresses in piping systems - discontinuity stresses- thermal stresses - methods for determining stresses - stress concentration in plate having circular hole due to bi-axial loading - Theory of reinforced opening and reinforcement limits.		
UNIT IV	**INTRODUCTION TO STRESS ANALYSIS**	**9**
Types of stresses- Significance of forces and moments in piping system- Expansion Loop and Bellows- Pipe Supports- Support Types-Support Selection- Support Location- Support Span Calculation.		
UNIT V	**PIPING STRESS ANALYSIS**	**9**
Flow diagram - piping layout and piping stress analysis - Flexibility factor and stress intensification factor - Design of piping system as per B31.1 piping code - Piping components - bends, tees, bellows and valves - Types of piping supports and their behavior - Piping codes.		

Text Book (s)

1	Roy A., Parisher, Robert A. Rhea, "Pipe Drafting and Design", Gulf Professional Publishing,2012.
2	Geoff.B, Barker IEng, MEI, "The Engineer's Guide to Plant Layout and Piping Design for the Oil and Gas Industries", Gulf Publishing Company, 2017.

Reference (s)

1	SamKannappan, "Introduction to Pipe Stress Analysis", Abi Enterprises Inc., 2008.
2	Peter Smith, "Fundamentals of Piping Design", Gulf Publishing Company, 2007.
3	Mohinder L. Nayyar, "Piping Engineering Hand book", McGraw Hill, 2000.
4	Baldev Raj, B.K.Choudhary, Anish Kumar, "Pressure Vessels and Piping: Codes, Standards, Design and Analysis", Narosa Publishing House, 2009.
5	M. W. Kellogg Company, "Design of Piping Systems" - John Wiley & Sons, 2006.

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Regulation 2018		Semester V / VI / VII / VIII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18MEE009T	OPERATIONS RESEARCH AND PRODUCTION MANAGEMENT	3	0	0	3

Prerequisite Course (s)

Nil

Course Objective (s):

- To impart knowledge on the basics of linear programming techniques
- To understand the transportation and assignment models.
- To provide knowledge on network models and project management
- To learn the concept of inventroy control and problems associated in it
- To provide knowledge Production Management and business problems

Course Outcome (s) (COs):

CO1	Construct the mathematical model of real time problems into linear programming model.
CO2	Develop the optimum solution for transportation model and assignment model.
CO3	Construct the networking model for evaluation of project management
CO4	Describe the inventory model and nontraditional optimization techniques.
CO5	Explain the production management technique and its classifications.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	-	1	-	-	-	-	-	-	-	3	-	1
CO2	3	3	3	2	2	-	-	-	-	-	-	-	3	-	2
CO3	3	3	3	2	2	-	-	-	-	-	3	-	2	-	2
CO4	3	3	2	2	2	-	-	-	-	2	2	-	2	-	-
CO5	3	2	2	-	2	-	-	-	-	2	3	-	1	-	-
CO (Avg)	3	2.8	2.4	2	1.8	-	-	-	-	2	2.6	-	2.2	-	1.6

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	LINEAR MODELS	9
Introduction to Operation Research – Phases of Operation Research – Scope - Application –Productivity Improvement - Linear programming – Formation of an L.P. Model – Graphical method– Simplex algorithm – Artificial Variable - Big M method – Two phase method.		
UNIT II	**TRANSPORTATION MODELS AND ASSIGNMENT MODELS**	9
Transportation Models – North West corner cell method – Least cell method – Vogel's approximation method – Optimization using UV method – Assignment problems – Balanced and Unbalanced assignment models - Hungerian method.		
UNIT III	**NETWORK AND PROJECT MANAGEMENT**	9
Project management – Construction of Project network - CPM and PERT models – Critical path scheduling - Crashing of project networks – Sequencing models (theory only) - Network models – Shortest path method – Djiktra's method.		
UNIT IV	**INVENTORY MODELS AND NON TRADITIONAL OPTIMIZATION**	9
Inventory – Types – Benefits – Inventory models – Economic order quantity – Operation of Inventory system – Safety Stock –Purchase model with or without shortages – Manufacturing model with or without shortages - Quantity discount model. Genetic algorithms – simulated annealing - Particle swarm optimization – Ant colony (Introduction to above Optimization Techniques - theory only).		
UNIT V	**PRODUCTION MANAGEMENT**	9
Production system - identification of technical, economic, social, human components and characteristics in the system – Classification of production System – New Product Design – Product Life Cycle – Demand Forecasting – Need and classification of forecasting – Production Planning and control– Capacity Planning – Aggregate Planning - Materials Requirement Planning (MRP) – Process Planning.		

Text Book (s)

1	Khanna O.P., Industrial Engineering and management, Dhanpat Rai Publications.,2010.
2	R.Pannerselvam,"Operational Research", PHI Learning pvt ltd., New Delhi, second Edition, 2010.

Reference (s)

1	Philips, Ravindran and Solberg, "Operations Research", John Wiley,2002
2	Frederick S.Hiller and GeraldJ.Lieberman, "Introduction to Operations Research", TMH (SIE) 8th Edition, 2005.
3	J.K.Sharma, "Operations Research Theory and Applications", Macmillan India, 3rd Edition, 2009.
4	Taha H.A., "Operations Research", Prentice Hall of India, Eighth Edition, 2012.

Regulation 2018		Semester V / VI / VII / VIII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18MEE010T	HYDRAULICS AND PNEUMATICS	3	0	0	3

Prerequisite Course (s)

Fluid Mechanics and Machinery

Course Objective (s):

- To learn about fluid power systems and its fundamentals.
- To impart knowledge on various types of hydraulic pumps and actuators.
- To learn about various fluid power control components and its functions.
- To study about various types of pneumatic components.
- To learn fluid power circuit design methods, failure and troubleshooting.

Course Outcome (s) (COs):

CO1	Explain the fluid power system and its fundamentals
CO2	Identify suitable hydraulic pumps and actuators for different applications.
CO3	Choose the suitable fluid power control components for various applications.
CO4	Choose the suitable pneumatic components for different applications.
CO5	Design fluid power circuit for given applications and understand troubleshootings

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	-	-	-	-	-	-	3	-	-	-
CO2	3	2	2	-	-	1	-	2	-	-	-	3	1	1	-
CO3	3	3	2	-	-	1	-	2	-	-	-	3	1	1	-
CO4	3	3	2	-	-	1	-	2	-	-	-	3	1	1	-
CO5	3	3	3	-	2	1	-	2	-	-	-	3	2	2	1
CO (Avg)	3	2.4	2.2	-	2	1	-	2	-	-	-	3	1.2	1.2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	INTRODUCTION TO FLUID POWER	9
Definition – Hydraulics Vs Pneumatics – Standards – Application – Basic Principle of Hydraulics – Pascal's Law – Transmission and multiplication of force – Basic properties of hydraulic fluids – liquid flow-static head pressure – pressure loss – work – power – energy – Basic principle of pneumatics: absolute pressure and Temperature – gas laws – vacumm – Fluid power symbols		
UNIT II	**HYDRAULIC SYSTEM AND COMPONENTS**	**9**
Sources of Hydraulic Power: Pumping theory – Pump classification – Gear pump, Vane Pump, piston pump, construction and working of pumps – pump performance and characteristics – Variable displacement pumps. Fluid Power Actuators: Linear hydraulic actuators – Types of hydraulic cylinders – Single acting, Double acting special cylinders like tanden, Rodless, Telescopic, Cushioning mechanism, Construction of double acting cylinder, Rotary actuators – Fluid motors, Gear, Vane and Piston motors.		
UNIT III	**DESIGN OF HYDRAULIC CIRCUITS**	**9**
Construction of Control Components : Directional control valve – 3/2 way valve – 4/2 way valve – Shuttle valve – check valve – pressure control valve – pressure reducing valve, sequence valve, Flow control valve – Fixed and adjustable, electrical control solenoid valves, Relays, ladder diagram. Accumulators and Intensifiers: Types of accumulators – Accumulators circuits, sizing of accumulators, intensifier – Applications of Intensifier – Intensifier circuit – Air-over-oil Intensifier circuit.		
UNIT IV	**PNEUMATIC SYSTEMS AND COMPONENTS**	**9**
Pneumatic Components: Properties of air – Compressors – Filter, Regulator, Lubricator Unit – Air control valves, Quick exhaust valves, pneumatic actuators. Fluid Power Circuit Design, Speed control circuits, synchronizing circuit, Penumo hydraulic circuit, Sequential circuit design for simple applications using cascade method - Advantages.		
UNIT V	**DESIGN OF PNEUMATIC CIRCUITS**	**9**
Servo systems – Hydro Mechanical servo systems, Electro hydraulic servo systems and proportional valves. Fluidics – Introduction to fluidic devices, simple circuits, Introduction to Electro Hydraulic Pneumatic logic circuits, ladder diagrams, PLC applications in fluid power control. Fluid power circuits; failure and troubleshooting.		

Text Book (s)

1	Anthony Esposito, Fluid Power with Applications, Pearson Education New Delhi, 2011
2	S. R. Majumdar, Oil Hydraulics, Tata McGraw Hill Publishing Company Pvt Ltd. New Delhi,2004.

Reference (s)

1	Srinivasan.R, "Hydraulic and Pneumatic controls", Vijay Nicole, 2006.
2	James L. Johnson, Introduction to Fluid Power, Delmar Thomson Learning, 2003.
3	S. R. Majumdar, Pneumatic systems Principles and maintenance, Tata McGraw Hill Publishing Company Pvt Ltd. New Delhi, 2008
4	S.Illango,V. Soundarrajan, Introduction to Hydraulics and Pneumatics, Prentice hall of India, New Delhi, 2007.
5	Online Courses : https://nptel.ac.in/courses/112/105/112105046/
6	Mobile Application : https://play.google.com/store/apps/details?id=unlimited.lifehacks&hl=en_US&gl=US&showAllReviews=true

Regulation 2018		Semester V / VI / VII / VIII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18MEE011T	RENEWABLE SOURCES OF ENERGY	3	0	0	3

Prerequisite Course (s)

Nil

Course Objective (s):

- To understand the solar energy resourse and application
- To identify with Wind energy conversion in to power
- To analyze the Bio energy generation and utilization
- To discover the utilization and environmental merits pattern of renewable energy resources
- To new development of new sustainable energy methodologies / technologies for its utilization

Course Outcome (s) (COs):

CO1	Explain solar radiation, components and applications of PV systems
CO2	Illustrate the wind energy conversion systems, storage systems and applications
CO3	Classify the Bio energy technology and its utilization
CO4	Explain the principle and components of OTEC, Tidal, Geothermal and Hydel Energy sources and environmental issues
CO5	Illustrate the Hydrogen generation, Storage, Transport and applications and Fuel cell technologies

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	-	-	2	3	1	-	-	-	1	1	-	-
CO2	3	2	1	-	-	2	3	1	-	-	-	1	1	-	-
CO3	3	2	-	-	-	2	3	1	-	-	-	1	1	-	-
CO4	3	2	-	-	-	2	3	1	-	-	-	1	1	-	-
CO5	3	3	1	-	-	2	3	1	-	-	-	1	1	-	-
CO (Av				-	-	2	3	1	-	-	-	1	1	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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UNIT I	**SOLAR ENERGY**	**9**
Solar Radiation – Measurements of solar Radiation and sunshine – Solar Thermal Collectors – Flat Plate and Concentrating Collectors – Solar Applications – fundamentals of photo Voltaic Conversion – solar Cells – PV Systems – PV Applications		
UNIT II	**WIND ENERGY**	**9**
Wind Data and Energy Estimation – wind Energy Conversion Systems – Wind Energy generators and its performance – Wind Energy Storage – Applications – Hybrid systems.		
UNIT III	**BIO ENERGY**	**9**
Biomass, Biogas, Source, Composition, Technology for utilization – Biomass direct combustion – Biomass gasifier – Biogas plant – Digesters – Ethanol production – Bio diesel production and Economics. Case studies for rural bio gas plant		
UNIT IV	**OTEC, TIDAL, GEOTHERMAL AND HYDEL ENERGY**	**9**
Tidal energy – Wave energy – Data, Technology options – Open and closed OTEC Cycles – Small hydro, turbines – Geothermal energy sources, power plant and environmental issues.		
UNIT V	**NEW ENERGY SOURCES**	**9**
Hydrogen, generation, storage, transport and utilization, Applications : power generation, transport – Fuel cells – technologies, types – economics and the power generation		

Text Book (s)

1	G.D. Rai, Non Conventional Energy Sources, Khanna Publishers, New Delhi, 5th Edition, 2010.
2	D. P. Kothari, K. C. Singal and Rakesh Ranjan, Renewable Energy Sources and Emerging Technologies, Prentice Hall of India, New Delhi, 2nd Edition ,2009.

Reference (s)

1	Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press, U.K., 3rd Edition, 2012.
2	John Twidell, Tony Weir , Renewable Energy Sources, EFN Spon Ltd., UK, 3rd Edition 2015
3	G.N. Tiwari, solar Energy – Fundamentals Design, Modelingand applications, Narosa Publishing House, New Delhi, Revised Edition 2012.
4	S.P. Sukhatme, Solar Energy-Principles of thermal Collection and storage, Tata McGraw Hill Publishing Company Ltd., New Delhi, 3rd Edition 2009.
5	Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press, U.K., 3rd Edition, 2012.

Regulation 2018		Semester V / VI / VII / VIII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18MEE012T	ADVANCES IN INTERNAL COMBUSTION ENGINES	3	0	0	3

Prerequisite Course (s)

Engineering Thermodynamics, Thermal Engineering

Course Objective (s):

- To understand the underlying principles of operation of different SI Engines and components.
- To identify the detailed principles of CI engines
- To provide knowledge on pollutant formation, control, alternate fuel etc.
- To classfy the different types of alternative fuels.
- To enable the students to understand the recent developments in Engines

Course Outcome (s) (COs):

CO1	Describe fuel air Mixture requirements to spark ignition engine combustion and various supply methods and factors affecting the combustion
CO2	Explain the diesel Fuel Injection for combustion in the combustion chamber and governing the combustion factors
CO3	Illustrate formation of emission and controlling methods in the engine exhaust
CO4	Compare the liquid and gaseous fuels combustion parameters and its properties for good performances
CO5	Describe the new concepts of fuel supply systems and engine diagnostics

CO-PO Mapping

COs	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	-	-	2	2	1	-	-	-	2	1	-	1
CO2	3	3	2	1	-	2	2	1	-	-	-	2	2	-	2
CO3	3	3	3	2	-	2	3	1	-	-	-	2	3	-	2
CO4	3	3	3	-	-	2	3	1	-	-	-	2	3	-	2
CO5	3	3	2	1	-	2	3	1	-	-	-	2	2	-	-
CO (Avg)	3	3	2.4	1.3	-	2	2.6	1	-	-	-	2	2.2	-	1.7

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	SPARK IGNITION ENGINES	9
Mixture requirements – Fuel injection systems – Monopoint, Multipoint & Direct injection - Stages of combustion – Normal and Abnormal combustion – Knock – Factors affecting knock – Combustion chambers. Cylinder deactivation and variable valve timings		
UNIT II	**COMPRESSION IGNITION ENGINES**	**9**
Diesel Fuel Injection Systems - Stages of combustion – Knocking – Factors affecting knock – Direct and Indirect injection systems – Combustion chambers – Fuel Spray behaviour – Spray structure and spray penetration – Air motion and combustion chamber design- Introduction to Turbo charging.		
UNIT III	**POLLUTANT FORMATION AND CONTROL**	**9**
Pollutant – Sources – Formation of Carbon Monoxide, Unburnt hydrocarbon, Oxides of Nitrogen, Smoke and Particulate matter – Methods of controlling Emissions – Pre Combustion: Compression ratio, Injection pressure and air fuel ratio. Post combustion: Catalytic converters, Selective Catalytic Reduction and Particulate Traps – Methods of measurement – Emission norms and Driving cycles.		
UNIT IV	**ALTERNATIVE FUELS**	**9**
Alcohol, Hydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel and bio fuels- Properties, Suitability, Merits and Demerits - Engine Modifications.		
UNIT V	**RECENT TRENDS**	**9**
Air assisted Combustion, Homogeneous charge compression ignition engines – Variable Geometry turbochargers – Common Rail Direct Injection Systems – Hybrid Electric Vehicles – NOx Adsorbers - Onboard Diagnostics- Cruise control.		

Text Book (s)

1	Mathur. R.B. and R.P. Sharma, "Internal Combustion Engines"., Dhanpat Rai & Sons 2010.
2	Ramalingam. K.K., "Internal Combustion Engine Fundamentals", Scitech Publications, 2011.

Reference (s)

1	John B.Heywood., " Internal Combustion Engine Fundamentals" TMH, 2010
2	Mishra D P "Fundamentals of Combustion" Prentice Hall India Learning Private Limited;2010
3	Eric Chowenitz, "Automobile Electronics", SAE Publications, 2005
4	V.Ganesan, "Internal Combustion Engines", III Edition, TMH, 2016
5	B.P. Pundir, Internal combustion Engines Combustion and Emissions, Narosa Publishing House Private limited, New Delhi, 2010.

Regulation 2018		Semester V / VI / VII / VIII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18MEE013T	REFRIGERATION AND AIR CONDITIONING SYSTEM	3	0	0	3

Prerequisite Course (s)

Thermal Engineering

Course Objective (s):

- To explain the working various types basic refrigeration systems
- To calculate the performance of vapour compression refrigeration system
- To explain the working principle of different vapour absorption refrigeration system
- To classify the air conditioning system and explain the various air conditioning system components
- To determine the cooling load for various conditions considering the different heat sources.

Course Outcome (s) (COs):

CO1	Demonstrate the working of various refrigeration systems and System components.
CO2	Analyse the performance of VCR system and illustrate the working of different VCR systems.
CO3	Explain the working principle of different VAR systems and estimate the performance of the systems and Non conventional refrigeration
CO4	Illustrate the various air conditioning system components and classify the air conditioning system.
CO5	Estimate the cooling load for various conditions considering the different heat sources.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	-	-	1	1	-	-	-	-	1	1	-	-
CO2	3	3	2	1	-	-	1	-	-	-	-	1	1	-	2
CO3	3	3	2	-	-	-	1	-	-	-	-	1	2	-	1
CO4	3	1	1	-	-	-	-	-	-	-	-	2	1	-	-
CO5	3	2	2	1	-	1	-	2	-	-	1	2	3	-	2
CO (Avg)	3	2	1.6	1	-	1	1	2	-	-	1	1.4	1.6	-	1.6

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	INTRODUCTION TO REFRIGERATION	9
Refrigeration and second law of thermodynamics-Engine, refrigerator and heat pump- Methods of Refrigeration- Evaporative refrigeration, Refrigeration by expansion of air, Refrigeration by throttling of gas, Ice refrigeration, Steam jet refrigeration, Dry ice refrigeration, Refrigeration by using liquid gases- Refrigerants- Properties & selection- Environmental impact of refrigerants- System components- Compressors Evaporators- Condensers- Thermostatic Expansion devices- Cooling towers.		
UNIT II	**VAPOUR COMPRESSOR REFRIGERATION SYSTEM**	**9**
Simple vapour compression refrigeration cycle- T-S, and p-h charts for VCR system- presentation of different process on p-h chart- COP from T-S chart- Advantages and Disadvantages of VCR over air compression refrigeration- Methods for improving COP – Single load and multi load systems. Methods for Defrosting- air refrigeration- Bell Coleman Air refrigerator- Simple cooling and simple evaporative type- Boot strap and boot strap evaporative type.		
UNIT III	**ABSORPTION REFRIGERATION SYSTEM**	**9**
Introduction- Basic absorption system- Actual ammonia absorption system- Lithium Bromide absorption refrigeration system- Electrolux refrigerator – Actual Electrolux refrigerator- COP of absorption refrigeration system. Non-conventional refrigeration – Vortex tube – Thermo Electric refrigeration- Pulse tube refrigeration- Cooling by adiabatic demagnetization.		
UNIT IV	**AIR CONDITIONING SYSTEM**	**9**
Methods of air conditioning – Direct expansion- All water systems- All air systems- Combined systems- Heat pump systems- Air conditioning equipments – Air filters – Humidifiers- Dehumidifiers- fans and blowers- cooling towers and spray ponds- Air distribution system. Types of air conditioners- Window, split type and central air conditioning – Applications- Automotive air conditioning.Advanced A/C systems – Intelligent air conditioning.		
UNIT V	**COOLING LOAD CALCULATIONS**	**9**
Different heat sources- Types of load- Conduction heat load, radiation heat load, radiation load of sun, Occupants load, Equipment load, Infiltration load, Fresh air load- By pass factor- Effective room sensible heat factor- Design of space cooling load- Basics of Air duct design.		

Text Book (s)

1	Manohar Prasad, "Refrigeration and Air Conditioning", New Age International (P) Ltd, 2015.
2	Arora. C.P., "Refrigeration and Air Conditioning", Tata McGraw-Hill New Delhi,2007.

Reference (s)

1	Roy.JDossat, "Principles of Refrigeration", Prentice Hall, 2001
2	Stoecker N.F and Jones, "Refrigeration and Air Conditioning", MCG raw Hill Education, Asia,2001.
3	Langley, Billy C., 'Solid state electronic controls for HVACR' Prentice-Hall 1986.
4	Rex Miller, Mark R.Miller., Air conditioning and Refrigeration, McGraw Hill, 2006.
	Ibrahim Dincer, Refrigeration Systems and Applications, John Wiley & Sons, 2017.

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Regulation 2018		Semester V / VI / VII / VIII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18MEE014T	SOLAR ENERGY ENGINEERING	3	0	0	3

Prerequisite Course (s)

Nil

Course Objective (s):

- To learn abour Solar energy and techniques to utilize it efficiently and cost effectively.
- To learn about Conversion of sunlight to heat for either direct usage or further conversion to other energy carriers
- To provide Design a solar thermal system for a given criteria.
- To impart the knowledge on Solar energy storage and process to implement.
- To learn about Applications of solar energy

Course Outcome (s) (COs):

CO1	Understand the available solar energy and the current solar energy conversion and utilization processes
CO2	Analyze performance of flat plate collector and develop skills to design, model, analyze and evaluate solar thermal systems.
CO3	Understand the photovoltaic cells operation.
CO4	Estimate the PV array requirement for small residential and industrial applications.
CO5	Solve simple to complex problems of solar thermal energy conversion and storage.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	-	2	1	-	-	-	-	2	-	-	-
CO2	3	3	2	2	2	2	1	1	-	-	-	1	2	-	2
CO3	3	2	1	1	-	2	1	-	-	-	-	2	-	-	-
CO4	3	3	2	2	2	2	1	1	-	-	-	2	2	-	1
CO5	3	3	2	3	2	2	1	1	-	-	-	1	2	-	2
CO (Avg)	3	2.8	1.6	1.8	2	2	1	1	-	-	-	1.6	2	-	1.6

2: Moderate (Medium) 3: Substantial (High)

UNIT I	INTRODUCTION	9
Energy alternatives – New energy technologies – Solar thermal process Solar Radiation – Solar constant – extra terrestrial radiation – clear sky irradiation – solar radiation measurement – estimation of average solar radiation – solar radiation on tilted surface.		
UNIT II	**FLAT PLATE COLLECTORS**	9
Energy balances equation and collectors efficiency – collector performance – collector improvements, effect of incident angle, dust and shading – thermal analysis of flat plate collector and useful heat gained by the fluid - collector design – heat transfer factors.		
UNIT III	**CONCENTRATION COLLECTORS AND REFLECTORS**	9
Parabolic concentrators, non-imaging concentrators, other forms of concentrating collectors. Tracking –receiver shape and orientation – performance analysis – reflectors – reflectors orientation –performance analysis.		
UNIT IV	**SOLAR ENERGY STORAGE**	9
Stratified storage – well mixed storage – comparison – Hot water system – practical consideration –solar ponds – principle of operation and description of Non-convective solar pond – extraction of thermal energy application of solar ponds.		
UNIT V	**APPLICATIONS OF SOLAR ENERGY**	9
Solar electric power generation, photo voltaic cells. Solar furnace, Solar Chimney, heaters – power generation system. Tower concept – solar refrigeration system, thermo electric refrigeration system.		

Text Book (s)

1	Sukhatme.K, Suhas P. Sukhatme, "Solar energy: Principles of thermal collection and storage", Tata McGraw Hill publishing Co. Ltd, 8th Edition, 2011.
2	Goswami D.Y., Kreith F., Kreider J.F.,"Principles of Solar Engineering", Taylor and Francis,2nd Edition,Indian reprint, 2015.

Reference (s)

1	G.D. Rai, "Solar Energy Utilization", Khanna Publishers, 5th Edition, 2014.
2	Kriender, J.M., 'Principles of Solar Engineering', McGraw Hill, 2000.
3	Mangal, V.S., 'Solar Engineering', Tata McGraw Hill, 2014.
4	Bansal, N.K., 'Renewable Energy Source and Conversion Technology', Tata McGraw Hill, 2011.
5	John.A. Duffie and Willam A.Beckman., 'Solar Engineering of Thermal Processes', Wiley, 2006.

Regulation 2018		Semester V / VI / VII / VIII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18MEE015T	DESIGN OF HEAT EXCHANGER AND PRESSURE VESSEL	3	0	0	3

Prerequisite Course (s)

HEAT AND MASS TRANSFER

Course Objective (s):

- To know the classisification of heat exchanger and its working principle
- To understand the performance characteristics of heat exchanger by LMTD and NTU method
- To identify the impact of stress formation on performance of heat exchangers
- To understand the working of compact heat exchanger and performance analysis
- To describe the working of surface and evaporative condensers and it performance analysis

Course Outcome (s) (COs):

CO1	Describe the classification of heat exchangers and basic mechanisms.
CO2	Analyse the performance of the heat exchangers by LMTD and NTU method
CO3	Describe the stress formation and its impact on heat exchangers.
CO4	Explain the working of compact heat exchanger and its performance analysis
CO5	Describe the performance characteristics of surface and evaporative condensers

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	-	-	-	-	-	-	-	-	-	2	-	-
CO2	3	3	2	1	2	2	-	1	-	-	-	-	3	-	2
CO3	3	3	2			-	-	-	-	-	-	-	3	-	-
CO4	3	3	2	-	-	-	-	-	-	-	-	-	3	-	-
CO5	3	3	2	-	1	1	-	-	-	-	-	-	3	-	2
CO (Avg)	2.8	2.8	1.8	1	1.5	1.5	-	1	-	-	-	-	2.8	-	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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UNIT I	**INTRODUCTION OF HEAT EXCHANGER**	**9**
Types of heat exchangers, shell and tube heat exchangers – regenerators and recuperators - Temperature distribution and its implications - Parts description, Classification as per Tubular Exchanger Manufacturers Association (TEMA).		
UNIT II	**PROCESS DESIGN OF HEAT EXCHANGERS**	**9**
Heat transfer correlations, Overall heat transfer coefficient, analysis of heat exchangers – LMTD and effectiveness method. Sizing of finned tube heat exchangers, U tube heat exchangers, Design of shell and tube heat exchangers, fouling factors, pressure drop calculations.		
UNIT III	**STRESS ANALYSIS**	**9**
Stress in tubes – header sheets and pressure vessels – thermal stresses, shear stresses - types of failures, buckling of tubes, flow induced vibration.		
UNIT IV	**COMPACT AND PLATE HEAT EXCHANGER**	**9**
Types- Merits and Demerits- Design of compact heat exchangers, plate heat exchangers, performance influencing parameters, limitations.		
UNIT V	**CONDENSERS AND COOLING TOWERS**	**9**
Design of surface and evaporative condensers – cooling tower – performance characteristics.		
Text Book (s)		
1	SadikKakac and Hongtan Liu, "Heat Exchangers Selection", Rating and Thermal Design, CRC Press.2012	
2	Shah,R. K., Dušan P. Sekulić, "Fundamentals of heat exchanger design", John Wiley & Sons, 2007.	
Reference (s)		
1	Robert W. Serth, "Process heat transfer principles and applications", Academic press, Elsevier, 2007.	
2	Sarit Kumar Das, "Process heat transfer", Alpha Science International, 2005.	
3	John E. Hesselgreaves, "Compact heat exchangers: selection, design, and operation", Elsevier science Ltd, 2001.	
4	Kuppan. T., "Heat exchanger design hand book", New York : Marcel Dekker, 2000.	
5	Eric M. Smith, "Advances in thermal design of heat exchangers: a numerical approach: direct- sizing, step-wise rating, and transients", John Wiley & Sons, 2001	

Regulation 2018		Semester V / VI / VII / VIII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18MEE016T	WASTE MANAGEMENT AND ENERGY RECOVERY	3	0	0	3

Prerequisite Course (s)

Thermal Engineering

Course Objective (s):

- To impart knowledge on sources and characteristics of various wastes and strategies for its prevention and control.
- To learn what is waste and how can it be minimized, what is pollution, how waste is disposed of through natural processes and how to harness those processes to better manage waste Engineering disposal.
- To learn about waste heat recovery systems and its application.
- To understand the waste heat recover system design and particulars.
- To identify the environmental impact.

Course Outcome (s) (COs):

CO1	Explain the operating principles of waste management system.
CO2	Identify the ways of environment pollution.
CO3	Describe the issues in waste management system.
CO4	Analyses the Waste Heat recovery system.
CO5	Illustrate the environmental impact on universal.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	-	-	3	3	-	-	-	-	1	-	-	-
CO2	3	2	1	-	-	3	3	2	-	-	-	2	1	-	-
CO3	3	1	3	1	-	2	3	2	-	-	-	1	1	-	2
CO4	3	1	3	1	-	2	3	2	-	-	-	-	2	-	2
CO5	3	2	2	2	-	3	3	2	-	-	-	2	2	-	1
CO (Avg)	3	1.4	2.2	1.3	-	2.6	3	2	-	-	-	1.5	1.5	-	1.6

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	**INTRODUCTION TO WASTE MANAGEMENT**	**9**
Waste management system - Pollution studies - Issues relating to waste management include – Needs of Waste management – Classification of waste - 3R system- 3D system.		
UNIT II	**SOLID WASTE MANAGEMENT**	**9**
Municipal Solid Waste Management: An Introduction.-Generation and Characteristics of Waste.-Waste Collection, Storage and Transport -Waste Disposal-Waste Processing Techniques- Source Reduction, Product Recovery and Recycling-Hazardous Waste: Management and Treatment-Integrated Waste Management (IWM).		
UNIT III	**WASTE HEAT RECOVERY**	**9**
Introduction - Principles of Thermodynamics and Second Law - sources of Waste Heat recovery - Power Plant.		
UNIT IV	**WASTE HEAT RECOVERY SYSTEMS**	**9**
Waste heat recovery systems - Design Considerations - fluidized bed heat exchangers - heat pipe exchangers - heat pumps -thermic fluid heaters - selection of waste heat recovery technologies		
UNIT V	**ENVIRONMENTAL NEEDS**	**9**
Environmental considerations for waste management and waste heat recovery – Pollution-Case studies		

Text Book (s)

1	Dr. Efstratios Kalogirou , " Waste-to-Energy Technologies and Global Applications", CRC Press;1 edition (31 August 2017).
2	John Pichtel , " Waste Management Practices: Municipal, Hazardous, and Industrial ,Second Edition ", CRC Press, 2014.

Reference (s)

1	Tchobanoglous G., Theisen H. and Vigil S. (2003) Integrated Solid Waste Management: Engineering Principles and Management Issues, New York, McGraw
2	Vesilind P.A., Worrell W.A. and Reinhart D.R. (2001) Solid Waste Engineering, Australia, CLEngineering
3	Fuel Economy in furnaces and Waste heat recovery-PCRA.
4	Heat Recovery Systems by D.A.Reay, E & F.N.Span, London, 2012.

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Regulation 2018		Semester V / VI / VII / VIII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18MEE017T	BIOMASS AND BIO GAS TECHNOLOGY	3	0	0	3

Prerequisite Course (s)

Nil

Course Objective (s):

- To understand the fundamental knowledge and relevant technologies for Biomass energy extraction and its conversion
- To provide the students with sufficient background to know about energy conversion from biomass
- To understand the related outcomes of practicing and implementing Gasification system.
- To provide the students Basics knowledge for Anaerobic digestion
- To apply concepts of Biogas energy conversion systems.

Course Outcome (s) (COs):

CO1	Analyse a suitable biomass to energy conversion route for the available biomass
CO2	Explain about pyrolysis and basics principle in Biomass convertion.
CO3	Explain about biomass gasification and liquefaction.
CO4	Describe the concept of Anaerobic digestion and Methanogenesis Process
CO5	Identify the design, Convertion and applications of biogas plant.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	-	2	3	-	-	-	-	1	2	-	-
CO2	3	2	1	-	-	1	3	-	-	-	-	1	-	-	-
CO3	3	2	1	-	-	1	3	-	-	-	-	-	-	-	-
CO4	3	2	2	-	-	1	3	-	-	-	-	-	-	-	-
CO5	3	3	2	2	-	2	3	-	-	-	-	1	1	-	-
CO (Avg)	2.6	2.4	1.6	2	-	1.4	3	-	-	-	-	1	1.5	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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UNIT I	BIOMASS	9
Biomass resources, Classification, Availability, Agricultural and Forest residue– surplus biomass – energy plantation – Energy from sewage -Treatment – Energy from industrial wastes – Photosynthesis of Biomass and its conversion related properties –Physical Conversion process of Biomass – dewatering, drying, size reduction, densification, briquetting .		
UNIT II	**BIOMASS CONVERSION**	**9**
Basic principle of Direct combustion process –Pyrolysis and heat of combustion of biomass and its component –Basic Principle of thermochemical conversion– Biomass combustion reactions – Advantages of bio mass conversion.		
UNIT III	**GASIFICATION**	**9**
Gasification of biomass – types of gasification technologies (Fixed bed, fluidized bed, entrained bed)– Liquefaction of biomass–Type of liquefaction technologies – Decentralised power generation		
UNIT IV	**BIOCHEMICAL CONVERSION PROCESS**	**9**
Basic principle of biomass conversion in Anaerobic digestion and Methanogenesis– Sludge utilization –Stages of Fermentation – Methanogens – Fermentative bacteria –Biomass conversion to methane.		
UNIT V	**BIO GAS CONVERSION**	**9**
Design and construction of small scale biogas plant –various substrates used to produce Biogas (cow dung, human and other agricultural waste, municipal waste etc.) – Economics of biogas plant with their Environmental and social impacts – Individual and community biogas operated engines and their use – Removal of CO2 and H2O – Application of Biogas in domestic, industry and vehicles.		

Text Book (s)

1	Rai G D, Non-Conventional Energy Sources, Khanna Publishers, 2011.
2	Samir S Sofer and Oskar R Zaborsky, Biomass conversion process for energy and fuels,Springer Science & Business Media, 2012.

Reference (s)

1	A.A. Vertès, N Qureshi, H Yukawa, "Biomass to biofuels: strategies for global industries", John Wiley and Sons, 2009
2	David M. Mousdale, Introduction to Biofuels, CRC Press, 2010
3	Nijaguna B T, Biogas Technology, New Age International Publisher, 2002
4	John Twidell, Tony Weir , Renewable Energy Sources, EFN Spon Ltd., UK, 3rd Edition 2015
5	Lijun Wang, Sustainable bioenergy Production, 2014, CRC Press.

Regulation 2018		Semester V / VI / VII / VIII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18MEE018T	POWER PLANT ENGINEERING	3	0	0	3

Prerequisite Course (s)

Thermal Engineering

Course Objective (s):

- To understand the construction and working of steam power plant and its components
- To understand the importance of Nuclear power plant and its effective waste disposal
- To explain the layout of diesel power plant and gas turbine performance improvement methods
- To understand the importance of various renewable energy sources and its working principle
- To analyse the cost of power plant and emission regulations

Course Outcome (s) (COs):

CO1	Explain with a layout, the working of steam power plant with fuel handling and ash handling systems
CO2	Illustrate the working principle of nuclear power plants and waste disposal methods
CO3	Demonstrate the working of diesel power plant and gas turbine power plants
CO4	Describe the importance and working principles of renewable energy sources
CO5	Calculate load factor, capacity factor, utilization factor and cost of power generation of power plants.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	-	-	1	-	2	-	-	-	1	1	-	-
CO2	3	1	-	-	-	2	2	2	-	-	-	1	2	-	-
CO3	3	1	-	-	-	1	-	2	-	-	-	1	1	-	-
CO4	2	2	-	-	-	1	-	2	-	-	-	1	2	-	-
CO5	3	2	2	2	-	2	2	2	-	-	-	1	3	-	-
CO (Avg)	2.6	1.4	2	2	-	1.4	2	2	-	-	-	1	1.8	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	STEAM POWER PLANT	9
Steam Power plant - Layout-Components - Steam generators - High pressure Boilers - Supercritical Boilers and Ultra supercritical boilers-Fluidized Bed Combustion Boilers-Boiler mountings–Boiler accessories. Fuel and Ash handling systems-Fuel firing system-Stoker firing system- Pulverised fuel firing system-Oil and gas firing system - Pulveriser types-Combustion equipments- burners and types-Dust Collection system and types - Electrostatic Precipitator and Mechanical dust collector.-Draught system and types-Condensers-Cooling towers-Feed water treatment Boiler blow down.		
UNIT II	**NUCLEAR POWER PLANT**	**9**
Nuclear fission and fusion-Chain reaction-Nuclear fuels used in reactor-Layout of Nuclear power plant-Elements of Nuclear reactor-Pressurized water reactor-Boiling water reactor-CANDU reactor-Fast Breeder reactor-Gas cooled and Metal cooled reactor-Radioactivity-Radiation hazards-Radioactive wastes –Global standards in Waste deposal and nuclear safety- site selection- Indian and World scenario – Recent Developments.		
UNIT III	**DIESEL AND GAS TURBINE POWER PLANT**	**9**
Layout of Diesel Power Plant -Types and Components - Engine Selection based on Application-Recent developments-Applications - Gas Turbine Power Plant – Layout – Fuels – Gas Turbine Material - Types of Combustion Chambers – Performance Improvement Methods-Reheating, Regeneration, Inter cooling, Combined Cycle Power Plant- Recent developments.		
UNIT IV	**HYDROELECTRIC AND RENEWABLE ENERGY SOURCES**	**9**
Hydel power plant-Layout-Components-Storage and Poundage type-Pumped storage plant – Site-selection - Indian Scenario. Construction and working of Wind Energy Conversion System-Horizontal and Vertical Wind Turbines, Tidal, Solar Power Plants- Geo Thermal, Biogas and MHD - OTEC Systems-Fuel Cell		
UNIT V	**POWER PLANT ECONOMICS**	**9**
Cost of Electrical energy-Load duration curves-Fixed and Operating costs-Energy rates- Types of tariffs-Economics of Load sharing-Comparison, Selection and economics of various power plants-Energy Conservation and Energy Audit in thermal power plant--Pollution Control methods – Emission Regulations		

Text Book (s)

1	Arora, S.C and Domkundwar S., "A Text Book of Power Plant Engineering", Dhanpat Rai & Co. (P) Limited; Eighth edition 2016
2	P.K. Nag, "Power Plant Engineering", Third Edition, Tata McGraw –Hill Publishing Company Ltd., Fourth edition 2017

Reference (s)

1	R.K Raj put, "Power Plant Engineering", Laxmi Publications Pvt Ltd; Fifth edition (1 December 2007)
2	El-Wakil. M.M., "Power Plant Technology", Tata McGraw –Hill Publishing Company Ltd., 2010
3	R K Hegde, "Power Plant Engineering" Pearson Education India; 1 edition (2015)
4	K. K. Ramalingam, A Textbook on Power Plant Engineering, SCITECH Publications India Limited, 2015
5	R.Yadav, Steam and Gas Turbines and Power Plant Engineering, Central Publishing House, 2005

Regulation 2018		Semester V / VI / VII / VIII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18MEE019T	ENERGY CONSERVATION AND MANAGEMENT	3	0	0	3

Prerequisite Course (s)

Thermal Engineering

Course Objective (s):

- Upon completion of this course, the students can able
- To analyze the energy data of industries
- Can carry out energy accounting and balancing
- Can suggest methodologies for energy savings
- To analyze the economics in energy utilization

Course Outcome (s) (COs):

CO1	Describe the importance of energy conservation and its auditing
CO2	Analyze the energy conserve aspects in electrical systems
CO3	Analyze the energy conserve aspects in thermal systems along with case studies
CO4	Study and Calculation of energy conservation in other utilities.
CO5	Demonstrate the economics and its relative terms.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	-	-	2	-	-	-	-	-	1	-	-	-
CO2	3	3	1	1	-	2	-	1	-	-	-	2	1	-	-
CO3	3	3	1	1	-	2	-	1	-	-	-	2	1	-	-
CO4	3	3	1	1	-	2	-	1	-	-	-	1	1	-	-
CO5	3	3	-	1	-	2	-	1	-	-	2	1	-	-	-
CO (Avg)	2.8	2.6	1	1	-	2	-	1	-	-	2	1.4	1	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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UNIT I	INTRODUCTION	9
Energy scenario – role of energy manager and auditior in industries: energy monitoring, auditing and targeting – economics of various energy conservation schemes – national energy consumption data – environmental aspects associated with energy utilization – energy auditing: methodology and barriers -Instruments for energy auditing.		
UNIT II	**ELECTRICAL SYSTEMS**	**9**
Components of EB billing – HT and LT supply, transformers, cable sizing, capacitors, power factor improvement, harmonics, electrical motors: motor efficiency computation, energy efficient motors - LED lighting.		
UNIT III	**THERMAL SYSTEMS**	**9**
Boilers: losses in boilers, furnaces and thermal fluid heaters – efficiency computation and case studies of energy conservation measures –Steam: steam traps, condensate recovery, flash steam utilization – insulators and refractories		
UNIT IV	**ENERGY CONSERVATION IN MAJOR UTILITIES**	**9**
Refrigeration and air conditioning – heat load estimation – energy conservation in cooling towers and spray ponds, case studies- electrical energy – energy efficiency in lighting, case studie for energy saving in buildings		
UNIT V	**ECONOMICS**	**9**
Energy economics – discount rate, play back period, internal rate of return, net present value, life cycle costing - ESCO concept		

Text Book (s)

1	D.Yogigoswami, Industrial Energy Conservation, 2nd Edition, CRC Press, 2017.
2	website administered by Bureau Of Energy Efficiency (BEE) a statutory body under ministry of Power, Gov Of India, 2004

Reference (s)

1	Turner. W.C., "Energy Management Hand book", Wiley, New York, 2012
2	Murphy. W.R. and G. Mc KAY, "Energy Management", Butterworths, London 2017.
3	Witte. L.C., P.S. Schmidt, D.R. Brown, "Industrial Energy Management and Utilisation" Hemisphere Publ, Washington, 1988.

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Regulation 2018		Semester V / VI / VII / VIII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18MEE020T	COMPUTATIONAL FLUID DYNAMICS	3	0	0	3

Prerequisite Course (s)

Fluid Mechanics and Machinery

Course Objective (s):

- To recall the fundamental laws of fluid mechanics, heat transfer and thermodynamics for the definition of problems.
- To identify the mathematical concepts and to formulate the governing equations and understandits physical meaning in engineering problems.
- To impart knowledge on numerical methods to solve simple and complex problems in Fluid flow.
- To impart one dimensional and two dimensional elements in finite element techniques for fluid flow problems
- To learn the structured and unstructured grids generation techniques.

Course Outcome (s) (COs):

CO1	Formulate and classify governing partial differential equations in fluid flow and heat transfer.
CO2	Identify and solve problems in engineering using Finite Difference method.
CO3	Solve fluid dynamics problems using Finite Volume methods.
CO4	Develop skills to apply Finite Element method for steady and incompressible flows.
CO5	Develop grids from algebraic and differential equation methods for different problems.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	-	-	-	-	-	-	-	-	2	-	-
CO2	3	3	3	3	2	1	-	-	-	-	-	-	3	-	3
CO3	3	2	3	3	2	-	-	-	-	-	-	-	3	-	3
CO4	3	3	3	2	2	1	-	-	-	-	-	-	3	-	3
CO5	3	3	3	2	2	-	-	-	-	-	-	-	3	-	3
CO (Avg)	3	2.8	2.8	2.4	2	1	-	-	-	-	-	-	2.8	-	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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UNIT I	INTRODUCTION	9
Introduction - Applications and impact of CFD in diverse fields - Governing equations of fluid dynamicscontinuit - momentum and energy - generic integral form for governing equations –Initial and Boundary conditions. Classification of partial differential Equations-Elliptic, Parabolic and Hyperbolic types.		
UNIT II	**FINITE DIFFERENCE METHOD**	**9**
Basics and discretization of simple and complex governing equations. Applications. In compressible inviscid Flows - Illustrative and physical examples of Elliptic, Parabolic and Hyperbolic equations - Discretization of partial Differential Equations. Implicit and explicit finite difference methods for viscous flows. Stability, convergence, accuracy.		
UNIT III	**FINITE VOLUME METHOD**	**9**
Basic rules for FV Discretization. Finite Volume (FV) Discretization of one and two dimensional steady state diffusion type problems - 1-D convection-diffusion type problem - Unsteady flows – implementation of boundary conditions in Finite Volume. Solution of discretized equations. Solution algorithm for Pressure Velocity coupling in steady flows - Pressure-velocity coupling.		
UNIT IV	**FINITE ELEMENT METHOD IN FLUIDS**	**9**
Over view of Finite Element Techniques in Computational Fluid Dynamics. Weighted residual and Variational formulations. Finite element interpolation. One and two dimensional elements. Steady state conduction and incompressible potential flow problems.		
UNIT V	**NUMERICAL GRID GENERATION**	**9**
Introduction. Algebraic grid generation. Differential Grid Generation. Structured and unstructured grids. Body fitted Coordinate Method, Grid refinement – Adaptive Grid – Software tools.		

Text Book (s)

1	John D. Anderson, "Computational Fluid Dynamics", Tata-McGraw Hill Publisher, 2012.
2	Versteeg.H.K., and Malalasekera.W., "An Introduction to Computational Fluid Dynamics: The finite volume Method", Pearson Education Ltd. Second Edition, 2008.

Reference (s)

1	F. John Wendt (Editor), Computational Fluid Dynamics - An Introduction, Springer Verlag, Berlin,2009.
2	S. V. Patankar, Numerical Heat Transfer and Fluid Flow, Hemisphere, New York, 2017.
3	H. K. Versteeg and W. Malalasakera, An Introduction to Computational Fluid Dynamics The Finite Volume Method, Addison Wesley Longman Limited, England, 2006.
4	Muralidhar.K., and Sundararajan.T., "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, New Delhi, 2009.
5	Introduction to computational fluid dynamics http://nptel.ac.in/courses/112105045/.

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Regulation 2018		Semester V / VI / VII / VIII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18MEE021T	ADVANCES IN CASTING AND WELDING PROCESSES	3	0	0	3

Prerequisite Course (s)

Engineering Materials and Metallurgy , Manufacturing Technology

Course Objective (s):

- To design gating and raisering sytem for casting
- To understand the recent casting techniques
- To apply the welding metallurgy knowledge on various metals for achieving good weld joints
- To understand the principles and applications of solid state welding processes
- To understand the basics of new developments in fusion welding processes

Course Outcome (s) (COs):

CO1	Design gating and raisering sytem for casting considering the thermal, metallurgical aspects during solidification to achieve defect free castings
CO2	Explain the recent casting techniques, casting defects and castability of steel and cast iron
CO3	Discover a specific welding process for a specific metal by applying welding metallurgical knowledge
CO4	Explain the principles, parameters and applications of solid state welding process
CO5	Infer recent trends in fusion welding, Brazing and Soldering processes

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	-	-	1	-	-	-	-	-	1	2	1	-
CO2	3	2	2	-	-	1	-	-	-	-	-	-	-	-	-
CO3	3	3	3	2	-	-	-	2	-	-	-	-	2	1	2
CO4	3	2	2	-	-	1	-	1	-	-	-	1	-	1	-
CO5	2	2	2	1	-	-	-	-	-	-	-	-	1	-	1
CO (Avg)	2.8	2.4	2.4	1.5	-	1	-	1.5	-	-	-	1	1.6	1	1.5

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	CASTING DESIGN AND CASTING METALLURGY	9
Design considerations in casting – Designing for progressive directional solidification - principles and design of gating and risering - Heat transfer between metal and mould - Solidification of pure metal and alloys – Alloy Segregation - shrinkage in cast metals- Economics of Casting		
UNIT II	**RECENT TRENDS IN CASTING AND FOUNDRY LAYOUT**	**9**
Counter gravity low pressure casting, Squeeze casting, pressure die casting and semisolid processes. Layout of mechanized foundry – Continous casting, material handling in foundry pollution control in foundry - Degasification of the melt Castability of steel, Cast Iron. Computer aided design of casting – Casting defects and testing		
UNIT III	**WELDING METALLURGY AND DESIGN**	**9**
Heat transfer and solidification - Heat affected Zone and its characteristics – Weldability of steels, cast iron, stainless steel, aluminium alloys – Carbon Equivalent of Plain and alloy steels - Residual stress – Distortion and its control. Pre and post welding heat treatments – weld joint design – welding defects– Hydrogen embrittlement – Lamellar tearing –Testing of weldments.		
UNIT IV	**RECENT TRENDS IN SOLID STATE WELDING**	**9**
Friction welding, friction stir welding, friction stir processing, friction based additive manufacturing– explosive welding – diffusion bonding – high frequency induction welding – ultrasonic welding and diffusion processes (process principle, parameters, variants and applications only)		
UNIT V	**RECENT TRENDS IN FUSION WELDING**	**9**
Electron beam welding – Laser beam welding –Plasma welding – Electro slag welding, narrow gap, hybrid twin wire active TIG – Tandem MIG- CMT welding process, Wire Arc Additive manufacturing (WAAM), modern brazing and soldering techniques – induction, dip resistance,– Hot gas, wave and vapour phase soldering. Overview of automation of welding and under water welding.		

Text Book (s)

1	Parmer R.S., Welding Engineering and Technology, Khanna Publishers, 2002
2	Serope Kalpakjain and stevan R. Schmid, Manufacturing engineering and technology, sixth edition, P & H publishers, 2009

Reference (s)

1	ASM Handbook vol.6, welding Brazing & Soldering, 2003, ISBN: 978-0-87170-382-8
2	Sindo Kou, Welding Metallurgy, 3rd edition, John wiley & sons, 2020, ISBN-13 : 978-1119524816
3	Vishvesh J Badheka; Jaykumar Vora, Advances in Welding Technologies for Process Development, CRC Press, 2019
4	https://www.twi-global.com/technical-knowledge/job-knowledge/arc-based-additive-manufacturing-137
5	S. Rathee, M.Srivastava, S. Maheshwari, T.K. Kundra, A.N. Siddiquee, Friction Based Additive Manufacturing Technologies: Principles for Building in Solid State, Benefits, Limitations, and Applications, CRC Press, 2018

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Regulation 2018		Semester V / VI / VII / VIII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18MEE022T	MAINTENANCE ENGINEERING	3	0	0	3

Prerequisite Course (s)

Nil

Course Objective (s):

- To enable the student to understand the principles, functions of Maintance planning in industry.
- To explain the practices adapted in industry for the successful management of maintenance activities.
- To illustrate some of the simple instruments used for condition monitoring in industry.
- To study about different maintenance categories like Preventive maintenance, condition monitoring and repair of machine elements.
- To impart knowledge about the product life cycle assessments and environmental impact of materials,manufacturing methods and the way to minimize it

Course Outcome (s) (COs):

CO1	Understand the principles, functions and practices adapted in industry for the successful management of maintenance activities
CO2	Describe the basic principles of maintenance planning, objectives and principles of planned maintenance activity
CO3	Identify the maintenance categories of comparative merits of each category, Preventive maintenance, maintenance schedules
CO4	Understand the repair methods for beds, slide ways, spindles, gears, lead screws and bearings, failure analysis
CO5	Indicate repair methods for Material handling equipment, equipment records-Job order systems Apply the Techniques.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO 3
CO1	2	2	1	-	-	-	-	1	-	-	-	1	-	-	-
CO2	2	2	1	1	-	-	-	2	-	-	-	1	-	-	-
CO3	3	2	1	-	-	-	-	1	-	-	-	1	-	-	-
CO4	3	2	1	-	-	-	-	1	-	-	-	1	2	1	-
CO5	3	2	2	2	-	-	2	1	-	-	-	1	2	1	-
CO (Avg)	2.6	2	1.2	1.5	-	-	2	1.2	-	-	-	1	2	1	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	PRINCIPLES AND PRACTICES OF MAINTENANCE PLANNING	9
Basic Principles of Maintenance Planning – Objectives and Principles of Planned Maintenance Activity – Importance and Benefits of Sound Maintenance systems – Reliability and Machine Availability – Mean Time Between Failures, Mean Time to Repair and Mean Waiting Time – Factors of Availability – Maintenance Organization – Maintenance Economics.		
UNIT II	**MAINTENANCE POLICIES – PREVENTIVE MAINTENANCE**	**9**
Maintenance Categories – Comparative merits of each Category – Preventive Maintenance, Maintenance Schedules, Repair Cycle – Principles and Methods of Lubrication – Total Productive maintenance.		
UNIT III	**CONDITION MONITORING**	**9**
Condition Monitoring – Cost Comparison with and without CM – On Load Testing and Off Load Testing – Methods and Instruments for CM – Temperature Sensitive Tapes – Pistol Thermometers – Wear Debris Analysis.		
UNIT IV	**REPAIR METHODS FOR BASIC MACHINE ELEMENTS**	**9**
Repair Methods for Beds, Slide Ways, Spindles, Gears, Lead Screws and Bearings – Failure Analysis – Failures and their Development – Logical Fault Location Methods – Sequential Fault Location.		
UNIT V	**REPAIR METHODS FOR MATERIAL HANDLING EQUIPMENT**	**9**
Repair Methods for Material Handling Equipment – Equipment Records – Job Order Systems – Use of Computers in Maintenance.		

Text Book (s)

1	Sushil Kumar Srivastava, "Maintenance Engineering Principles, Practices & Management", S.Chand and Co Ltd., 1st Edition (reprint), 2012.
2	Venkataraman. K, "Maintancence Engineering and Management", Prentice Hall of India Private Limited, 2007.

Reference (s)

1	Higgins L.R., "Maintenance Engineering Hand book", McGraw Hill, 8th Edition, 2014.
2	Mishra R.C., Pathak.K, "Maintenance Engineering and Management", Prentice Hall of India Private Limited, 2012.
3	Davies, "Handbook of Condition Monitoring – Techniques and Methodology", Springer Science & Business Media, 1st Edition, 2012.
4	Garg H.P., "Industrial Maintenance", S.Chand & Co., 1st Edition, 2010.
5	Bhattacharya S.N., "Installation, Servicing and Maintenance", S.Chand and Co., 2nd Edition, 2001.

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Regulation 2018		Semester V / VI / VII / VIII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18MEE023T	AUTOMATION AND INDUSTRIAL ROBOTICS	3	0	0	3

Prerequisite Course (s)

Nil

Course Objective (s):

- To explain the fundamentals and working of robots
- To describe the importance of drives and end effectors of robots
- To explain the types of sensors and concept of machine vision system
- To instruct kinematics of robots and its programming
- To identify the applications of robots in industries

Course Outcome (s) (COs):

CO1	Understand the fundamentals and working of robots
CO2	Assimilate the functions of robot drive system and types of end effectors
CO3	Gain knowledge on different sensors and the concept of machine vision system
CO4	Follow the logics of kinematics of robots and syntax of programming
CO5	Summarize the usage and applications of robots in industries

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	-	1	-	2	-	-	-	-	-	1	-
CO2	3	3	3	2	-	-	-	2	-	-	-	-	2	1	-
CO3	3	3	3	3	2	1	-	2	-	-	-	-	-	2	-
CO4	3	3	3	2	2	-	-	2	-	-	-	-	2	2	-
CO5	3	2	1	2	-	1	-	2	-	-	-	-	2	1	-
CO (Avg)	2.8	2.6	2.4	2	2	1	-	2	-	-	-	-	2	1.4	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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UNIT I	FUNDAMENTAL OF AUTOMATION AND ROBOTICS PROCESS	9
Introduction to Automation – Definition, types, reasons for automating, Robotics and Automation, Robot -Definition -scope of industrial robot - Law of robotics -Robot Anatomy - Co-ordinate Systems, Work Envelope, classification - Specifications - Pitch, Yaw, Roll, Joint Notations, Speed of Motion, PayLoad - Need for Robots.		
UNIT II	**ROBOT DRIVE SYSTEM AND END EFFECTORS**	9
Pneumatic Drives, Hydraulic Drive, Mechanical Drives and Electrical Drives. End Effectors - Grippers- Pneumatic gripper, Hydraulic Grippers, Magnetic Grippers, Vacuum Grippers, and Mechanical Grippers - Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers - Selection and Design Considerations.		
UNIT III	**SENSORS AND MACHINE VISION SYSTEMS**	9
Sensors - types - tactile sensors, proximity and range sensors, contact and non contact sensors, velocity Sensors, touch and slip sensors, force and torque sensors. Robotic vision systems, imaging components, image representation, picture coding, object recognition and categorization, visual inspection, Artificial Intelligence		
UNIT IV	**ROBOT KINEMATICS AND ROBOT PROGRAMMING**	9
Forward Kinematics, Inverse Kinematics and Differences; Forward Kinematics and Reverse Kinematics of Manipulators with Two, Three Degrees of Freedom (In 2 Dimensional), Teach Pendant Programming, Lead through programming, Robot programming Languages - VAL Programming - Motion Commands, Sensor Commands, End effecter commands, and Simple programs.		
UNIT V	**IMPLEMENTATION AND ROBOT ECONOMICS**	9
RGV, AGV, Implementation of Robots in Industries - Material transfer and machine loading/Unloading, Welding and painting, Assembly operations, Inspection, Mobile robots, Safety Considerations for Robot Operations - Economic Analysis of Robots – Pay back Method, EUAC Method, Rate of Return Method		

Text Book (s)

1	Mikell P. Groover, Mitchell Weiss, "Industrial Robotics, Technology, Programming and Applications ", McGraw Hill International Editions, 1st Edition, 2012
2	Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, "Robotic Engineering – An Integrated Approach", Prentice Hall India, 2012

Reference (s)

1	Subir Kumar Saha, Introduction to Robotics, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2008
2	Rajput R.K., "Robotics and Industrial Automation", S.Chand and Company, 2008
3	Klafter R.D., Chmielewski T.A and Negin M., "Robotic Engineering - An Integrated Approach", Prentice Hall, 2003.

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Regulation 2018		Semester V / VI / VII / VIII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18MEE024T	NON DESTRUCTIVE TESTING	3	0	0	3

Prerequisite Course (s)

Manufacturing Technology

Course Objective (s):

To Acquire knowledge about different types of non destructive methods.

To Introduce all types of NDT and their application in engineering fileds

To understand the real time application of NDT methods.

Course Outcome (s) (COs):

CO1	The students will be able to differentiate various defect types and the NDT types and select the appropriate NDT methods for the specimen.
CO2	Explanation of eddy current testing and acoustic emission testing
CO3	Understanding the Magnetic Particle Testing & Thermography
CO4	Testing the different metals and alloys by Ultrasonic testing methods
CO5	To know the Radiography testing and its industrial applications.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	1	-	-	-	-	-	-	-	-	-	-
CO2	3	3	1	-	1	-	-	-	-	-	-	-	2	-	1
CO3	3	2	-	-	1	-	-	-	-	-	-	-	2	-	-
CO4	3	3	2	1	-	1	-	-	-	-	-	-	3	-	1
CO5	3	2	-	1	-	1	-	-	-	-	-	-	3	-	2
CO (Avg)	3	2.6	1.6	1	1	1	-	-	-	-	-	-	2.5	-	1.3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	OVERVIEW OF NON DESTRUCTIVE TESTING	9
Introduction to various non-destructive methods, Comparison of Destructive and Non destructive Tests, Visual Inspection, Optical aids used for visual inspection, Applications,Physical principles, procedure for liquid penetrant testing, Penetrant testing materials and methods– Emulsification,water washable and solvent removable methods, applications and limitations.		
UNIT II	**EDDY CURRENT TESTING AND ACOUSTIC EMISSION**	**9**
Principles, Instrumentation for ECT, Absolute, differential probes, Techniques – High sensitivity techniques, Multi frequency, High frequency ECT, Phased array ECT, Applications. Principle of AET, Instrumentation,Applications - testing of metal pressure vessels, Fatigue crack detection.		
UNIT III	**MAGNETIC PARTICLE TESTING AND THERMOGRAPHY**	**9**
Principle of MPT. Procedure used for testing a component, Equipment used for MPT, Magnetization methods, demagnetization, Applications. Principle of Thermography, techniques, Infrared Radiometry, Active and passive thermography measurements, Applications – Imaging entrapped water under an epoxy coating-thermal imaging for condition Monitoring of Industrial Components.		
UNIT IV	**ULTRASONIC TESTING**	**9**
Principle, Ultrasonic transducers, Ultrasonic Flaw detection Equipment, Modes of display A- scan, B- Scan, C- Scan. techniques ,applications, Inspection Methods - Normal Incident Pulse-Echo Inspection, Normal Incident through- transmission testing, Angle Beam Pulse-Echo testing, techniques of Normal Beam Inspection in detecting fatigue cracks, Inclusions, Slag, Porosity and Intergranular cracks and thickness measurement:corrosion detection.		
UNIT V	**RADIOGRAPHY**	**9**
Principle of Radiography, x-ray and gamma ray sources- safety procedures and standards, Effect of radiation on Film. Radiographic imaging, Inspection Techniques, Absorption, Scattering-Filters and screens – Single wall single image, Double wall Penetration, Multiwall Penetration technique, Lattitude and special techniques, real Time Radiography - Case studies on defects in cast, rolled, extruded, welded and heat treated components.		

Text Book (s)

1	Baldev Raj, T.Jayakumar, M.Thavasimuthu "Practical Non-Destructive Testing", Narosa Publishing House, 2009.
2	Jayamangal Prasad, C. G. Krishnadas Nair, Non-Destructive Test and Evaluation of Materials", Tata McGraw-Hill Education, 2011.

Reference (s)

1	Ravi Prakash, "Non-Destructive Testing Techniques", New Age International Publishers, 1st revised Edition, 2010.
2	ASM Metals Handbook,"Non-Destructive Evaluation and Quality Control", American Society of Metals, Metals Park, Ohio, USA, 2000, Volume-17.
3	Paul E Mix, "Introduction to Non-destructive testing: a training guide", Wiley,Edition New Jersey, 2005
4	Charles, J. Hellier," Handbook of Nondestructive evaluation", McGraw Hill, New York 2001

Regulation 2018		Semester V / VI / VII / VIII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18MEE025T	ADDITIVE MANUFACTURING	3	0	0	3

Prerequisite Course (s)

Manufacturing Technology

Course Objective (s):

- To acquire knowledge about the Classification and mechanism of Additive Manufacturing Technology.
- To familiarize the working of Softwares for Additive Manufacturing Technology .
- To obtain knowledge about liquid based and solid based additive manufacturing systems.
- To get wide knowledge and the concept of powder based additive manufacturing systems.
- To gainknowledge about the medical and bio-additive manufacturing.

Course Outcome (s) (COs):

CO1	Compare different method and discuss the effects of the Additive manufacturing
CO2	Analyze the characteristics of the different materials in Additive Manufacturing.
CO3	Demonstrate liquid and solid based additive manufacturing systems.
CO4	Explain the powder based additive manufacturing system.
CO5	Analyze medical and bio medical additive manufacturing systems.

CO-PO Mapping

Cos	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	2	-	-	-	-	-	-	-	-	2	-	2
CO3	3	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	1	-	-	-	-	-	-	-	-	-	1	-	-
CO5	3	3	3	2	-	2	2	1	-	-	-	-	2	-	2
CO (Avg)	3	2.8	2.2	2	-	2	2	1	-	-	-	-	1.6	-	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	INTRODUCTION	9
Overview – History – Need-Classification -Additive Manufacturing Technology in product development - Commonly used terms, process chain, 3D modelling, Data Conversion, and transmission, Checking and preparing, Building, Post processing,- Materials for Additive Manufacturing Technology – Tooling – Applications.		
UNIT II	**CAD & REVERSE ENGINEERING**	**9**
Basic Concept – Digitization techniques – Model Reconstruction – Data Processing for Additive Manufacturing Technology: CAD model preparation – Part Orientation and support generation – Model Slicing –Tool path Generation – Softwares for Additive Manufacturing Technology: MIMICS, MAGICS.		
UNIT III	**LIQUID BASED AND SOLID BASED ADDITIVE MANUFACTURING SYSTEMS**	**9**
Classification – Liquid based system – Stereo lithography Apparatus (SLA)- Principle, process, advantages and applications – Solid based system –Fused Deposition Modeling – Principle, process, advantages and applications, Laminated Object Manufacturing.		
UNIT IV	**POWDER BASED ADDITIVE MANUFACTURING SYSTEMS**	**9**
Selective Laser Sintering – Principles of SLS process – Process, advantages and applications, Three Dimensional Printing – Principle, process, advantages and applications- Laser Engineered Net Shaping (LENS), Electron Beam Melting.		
UNIT V	**MEDICAL AND BIO-ADDITIVE MANUFACTURING**	**9**
Customized implants and prosthesis: Design and production. Bio-Additive Manufacturing- Computer Aided Tissue Engineering (CATE) – Case studies		

Text Book (s)

1	Chua C.K., Leong K.F., and Lim C.S., "Rapid prototyping: Principles and applications", Third Edition, World Scientific Publishers, 2010.
2	Ian Gibson, David W.Rosen, Brent Stucker Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing Springer , 2010

Reference (s)

1	Tom Page Design for Additive Manufacturing LAP Lambert Academic Publishing, 2012.
2	Andreas Gebhardt Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing Hanser Gardner Publication 2011.
3	Liou L.W. and Liou F.W., "Rapid Prototyping and Engineering applications : A tool box for prototype development", CRC Press, 2007.
4	Liou L.W. and Liou F.W., Rapid Prototyping and Engineering applications :A tool box for prototype development, CRC Press, 2007.

Regulation 2018		Semester V / VI / VII / VIII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18MEE026T	PRODUCTION PLANNING AND CONTROL	3	0	0	3

Prerequisite Course (s)

Nil

Course Objective (s):

- To understand the various components and functions of production planning.
- To know the production planning and control such as work study and product planning.
- To understand the process planning, production scheduling and inventory control.
- To understand the problem solving by production scheduling and related to inventory.
- To know the recent trends like manufacturing requirement planning (MRP II) and enterprise resource planning (ERP).

Course Outcome (s) (COs):

CO1	Understand the concepts of production planning and control, product analysis and production systems
CO2	Become familiar with work study methods
CO3	Understand the principles of product planning, process planning, production scheduling, Inventory Control
CO4	Solve the problems related to inventory, BEP, Machine capacity
CO5	Know the recent trends like manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	-	-	-	-	-	1	-	-	-	-	-	-	-
CO2	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	2	2	1	-	-	-	-	2	-	2	2	-	1	-	-
CO4	3	2	2	-	-	-	-	2	-	2	-	-	2	-	-
CO5	3	2	2	1	-	-	-	2	-	2	-	-	2	-	-
CO (Avg)	2.6	1.8	1.6	1	-	-	-	1.7	-	2	2	-	1.6	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	INTRODUCTION TO PPC	9
Objectives and benefits of planning and control-Functions of production control - Types of production – job- batch and continuous-Product development and design-Marketing aspect-Functional aspects-Operational aspect-Durability and dependability aspect-Aesthetic aspect. Profit consideration-Standardization, Simplification & Specialization-Break even analysis-Economics of a new design.		
UNIT II	**WORK STUDY**	**9**
Method study, Basic procedure – Selection-Recording of process - Critical analysis, Development - Implementation - Micro motion and memo motion study - Work measurement - Techniques of work measurement - Time study – Performance rating – Activity sampling - Production study Work sampling - Synthesis from standard data - Predetermined motion time standards		
UNIT III	**PRODUCT PLANNING AND PROCESS PLANNING**	**9**
Product planning - Extending the original product information - Value analysis - Problems in lack of product planning - Process planning and routing-Pre requisite information needed for process planning - Steps in process planning - Quantity determination in batch production - Machine capacity, Line balancing-Analysis of process capabilities in a multi-product system.		
UNIT IV	**PRODUCTION SCHEDULING**	**9**
Production Control Systems - Loading and scheduling - Master scheduling - Scheduling rules - Gantt charts -Perpetual loading - Basic scheduling problems - Line of balance - Flow production scheduling - Batch production scheduling - Product sequencing - Production control systems - Periodic batch control - Material requirement planning -Kanban– Dispatching - Progress reporting and expediting -Manufacturing lead time - Master production schedule along with lead time and MRP - Techniques for aligning completion times and due dates.		
UNIT V	**INVENTORY CONTROL AND RECENT TRENDS IN PPC**	**9**
Inventory control - Purpose of holding stock - Effect of demand on inventories - Ordering procedures. Two bin system - Periodic review system – Fixed order quantity system - Ordering cycle system - Determination of economic order quantity and economic lot size - ABC analysis - Recorder procedure - Elements of JIT - Fundamentals of MRP I & MRP II (only theory) and ERP. Recent trends- computer integrated PP systems		

Text Book (s)

1	MartandTelsang, "Industrial Engineering and Production Management", S. Chand, 3rd Edition, 2018.
2	Operations Management, Stevenson, William J, Published by McGraw-Hill Education Ltd (2020)

Reference (s)

1	Samuel Eilon, "Elements of Production Planning and Control", Macmillan, 3rd Reprint Edition, 2007.
2	Elwood S. Buffa and Rakesh K. Sarin, "Modern Production / Operations Management", John Wiley and Sons, 8th Edition, 2011.
3	Jain K. C, Aggarwal L. N., "Production Planning Control and Industrial Management", 6thEdition, Khanna Publishers, 2004.
4	Nair N. G., "Production and Operations Management", Tata McGraw Hill, 2004.
5	HajraChoudhury S. K, Nirjhar Roy, HajraChoudhury A. K., "Production Management", Media Promoters and Publishers Pvt. Ltd, 1998.

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Regulation 2018		Semester V / VI / VII / VIII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18MEE027T	PLANT LAYOUT AND MATERIAL HANDLING	3	0	0	3

Prerequisite Course (s)

Nil

Course Objective (s):

- Assess the value of facility planning on the strategy of a firm.
- Describe the product, process and schedule design and their interaction with facility planning and develop a systematic facility layout
- To find the computerized approach for material handling
- Understand the concept of Methods of grouping and Algorithms
- Explain design and analyze material handling used in the warehousing, manufacturing and supporting operations

Course Outcome (s) (COs):

CO1	Identify equipment requirements for a specific process at different locations and diverse working conditions
CO2	Understand the significance of an effective material handling system
CO3	Understand the computerized layout on the material handling system.
CO4	Get the knowledge about group technology and algorithm.
CO5	Recognize the effect of process layout on the material handling system

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	-	-	-	-	-	-	-	-	-	1	-	-
CO2	2	1	-	-	-	-	-	-	-	-	1	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	1	-	-	-	-
CO4	2	2	2	-	1	1	-	-	-	-	-	-	1	-	-
CO5	3	2	2	-	-	1	-	1	-	-	1	-	1	-	-
CO (Avg)	2	2	2	-	1	1	-	1	-	-	1	-	1	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	**PLANNING INTRODUCTION**	**9**
Facilities planning – need and objectives of facilities planning – facilities planning process – Facilities planning strategies, Facilities Location Analysis- Single facility location models - Multi-facility location problems		
UNIT II	**DESIGN LAYOUT**	**9**
Facilities Layout design- product design – process design – schedule design - Space and Area Requirements of Facilities, Layout construction techniques: systematic layout planning; activity relationship analysis, pair wise exchange, graph-based construction algorithmic		
UNIT III	**MATHEMATICAL COMPUTERIZED MODELS**	**9**
Layout design procedure-Algorithmic approach –Computerized layout planning BLOCPLAN, CRAFT, ALDEP and CORELAP		
UNIT IV	**GROUP TECHNOLOGY**	**9**
Group technology - Methods of grouping – Algorithms and models for Group technology – Line balancing		
UNIT V	**MATERIAL HANDLING PRINCIPLES**	**9**
Material handling design – Material handling principles - Classification of material handling equipment - Material handling models, Workstation Material Handling, Ethics in Facility Design		

Text Book (s)

1	Plant Layout and Material Handling by G.K.Agarawal (2008), Join Brothes, Delhi.
2	Facility Layout and Location- An Analytical Approach, Richard L. Francis, Leon F Mc Ginnes and John A. White, PHI II Edition (2006)

Reference (s)

1	Tompkins, J.A. and J.A.White, "Facilities planning", John Wiley, 2010.
2	Richard Francis.l. and John A.White, "Facilities layout and location - An analytical approach", PHI, 2002
3	Pannerselvam,R, "Production and Operations management", PHI,2012
4	B. Mahadevan, "Operations management: Theory and Practice",2nd Edition, Pearson education South Asia, 2010.

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Regulation 2018		Semester V / VI / VII / VIII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18MEE028T	VIBRATIONS AND NOISE CONTROL	3	0	0	3

Prerequisite Course (s)

Theory of Machine

Course Objective (s):

- The student will be able to understand the sources of vibration and noise in automobiles.
- The design modifications to reduce the vibration and noise and improve the life.
- To provide the knowledge about natural frequencies analysis, transmission noise, aerodynamic noise etc.
- To expose the student to different application of engine noise and energy absorption.
- To impart Knowledge on Noice and Control

Course Outcome (s) (COs):

CO1	Derive the equations and solve vibration dynamics problems for mechanical systems.
CO2	Validate the vibration system models, analyze vibration dynamics of the system.
CO3	Understand, explain and apply the physics behind semi-active and active vibration control.
CO4	Formulate and solve passive, semi-active as well as active vibration control problems for vibration systems.
CO5	Carry out vibration dynamics analysis and design vibration control solutions for vibrating systems.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	2	-	-	-	-	-	-	2	-	-
CO2	3	3	1	-	-	1	2	1	-	-	-	-	2	-	-
CO3	3	2	1	-	-	-	-	-	-	-	-	-	2	-	-
CO4	3	1	1	2	-	2	2	1	-	-	-	-	1	-	-
CO5	2	2	2	-	2	1	2	1	-	-	-	1	1	1	-
CO (Avg)	2.8	2	1.2	2	2	1.5	2	1	-	-	-	1	1.6	1	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	BASICS OF VIBRATION	9
Basic concepts - classification of vibration: free and forced vibration - undamped and damped vibration - linear and non-linear vibration - response of damped and undamped systems under harmonic force - analysis of single degree and two degree of freedom systems – torsional vibration - determination of natural frequencies.		
UNIT II	**BASICS OF NOISE**	**9**
Introduction – amplitude – frequency - wavelength and sound pressure level - addition – subtraction and averaging decibel levels - noise dose level – legislation - measurement and analysis of noise – measurement environment – equipment - frequency analysis - tracking analysis - sound quality analysis and measurement.		
UNIT III	**AUTOMOTIVE NOISE SOURCES**	**9**
Noise characteristics of engines - engine overall noise levels - assessment of combustion noise - assessment of mechanical noise - engine radiated noise - intake and exhaust noise – engine necessary contributed noise -transmission noise - aerodynamic noise - tire noise - brake noise.		
UNIT IV	**CONTROL TECHNIQUES**	**9**
Vibration isolation - tuned absorbers - un-tuned viscous dampers - damping treatments - application dynamic forces generated by IC engines - engine isolation - crank shaft damping - modal analysis of the mass elastic model shock absorbers.		
UNIT V	**SOURCE OF NOISE AND CONTROL**	**9**
Methods for control of engine noise - combustion noise - mechanical noise - predictive analysis – palliative treatments and enclosures - automotive noise control principles - sound in enclosures – sound energy absorption and insulaion, noise barriers, acoustic enclose, silencers - standard of noise level and exposure limits - methods of industrial noise control.		

Text Book (s)

1	Singiresu S. Rao., "Mechanical Vibrations", 6th Edition, Pearson Education, 2016.
2	M. L. Munjal, "Noise and Vibration Control", World Scientific Publishers in Collaboration with IISc Press, Singapore, 2013.

Reference (s)

1	Benson H. Tongue., "Principles of Vibrations", 2nd Edition, Oxford University, 2007.
2	William T. Thomson, Marie Dillon Dahleh, Chandramouli Padmanabhan., "Theory of Vibration with Application", 5th Edition Pearson Education, 2011.
3	Rao J.S and Gupta K., "Introductory course on Theory and Practice of Mechanical Vibration", 2nd Edition, New Age International Publications, 2010.
4	A.A. Shabana., "Theory of vibrations – An introduction", 2nd Edition, Springer, 2010.
5	Balakumar, Balachandran and Edward B. Magrab., "Fundamentalsof Vibrations", 1st Editon, Cengage Learning, 2009.

Regulation 2018		Semester V / VI / VII / VIII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18MEE029T	PROCESS PLANNING AND COST ESTIMATION	3	0	0	3

Prerequisite Course (s)

Manufacturing Technology

Course Objective (s):

- To learn about process planning concepts.
- To follow ergonomics in the workplace as well as designing of tools and equipment.
- To recognize the introduction for cost estimation.
- To analyze the cost and time for different shops.
- To estimate the time for various manufacturing processes.

Course Outcome (s) (COs):

CO1	Illustrate the process planning concepts to make cost estimation for various products after process planning.
CO2	Understand the work study and ergonomics concepts to implement in the workplace and design of tools and equipment.
CO3	Classify the various types of cost in the development of product
CO4	Estimate cost for various machining process to make or buy the product.
CO5	Examine time required for various machining operations for the manufacture of component.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	1	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	1	-	-	-	-	-	-	-
CO3	3	3	2	1	-	-	-	2	-	-	2	-	1	-	-
CO4	3	3	2	2	-	-	-	2	-	-	2	-	2	-	-
CO5	3	3	2	2	-	-	-	2	-	2	2	-	2	-	-
CO (Avg)	3	3	2	1.6	-	-	-	1.6	-	2	2	-	1.6	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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UNIT I	INTRODUCTION TO PROCESS PLANNING	9
Definition – Objective – Scope – Types of production - Approaches to process planning - Process planning activities –Approaches to process planning- manual process planning- computer aided process planning – approaches of CAPP-Retrieval, Generative – developing manufacturing logic and knowledge-Selection of process analysis		
UNIT II	**WORK STUDY AND ERGONOMICS**	**9**
Method study – Definition – Objectives - Motion economy - Principles – Tools and Techniques-Applications – Work measurements- purpose – use – procedure – tools and techniques- Standard time – Ergonomics – principles – Workstation design -Posture and movement- applications.		
UNIT III	**INTRODUCTION TO COST ESTIMATION**	**9**
Objective of cost estimation- costing – cost accounting- classification of cost- Elements of cost - Types of estimates – Estimating procedure- Estimation of labor cost, material cost-Methods of costing-components of cost- Analysis of overhead charges- Calculation of depreciation cost-allowances in estimation.		
UNIT IV	**ESTIMATION OF TIME AND COST IN DIFFERENT SHOPS**	**9**
Estimation in foundry shop – Pattern cost - Casting cost - Illustrative examples. Estimation in forging shop – Losses in forging – Forging cost - Illustrative examples - Estimation in welding shop – Gas cutting –Electric welding - Illustrative examples.		
UNIT V	**ESTIMATION OF MACHINING TIME**	**9**
Estimation of machining time for lathe operations- turning, facing, knurling - Estimation of machining time for drilling, boring, shaping, planning, milling and grinding operations –CNC operations- Illustrative examples.		

Text Book (s)

1	Panneerselvam R., Sivasankaran P, "Process Planning and Cost Estimation", PHI Learning Pvt. Ltd., 2016.
2	Banga.T.R and Sharma.S.C, "Estimating and Costing", Khanna publishers, New Delhi, 2015.

Reference (s)

1	Khanna R.B, "Production and Operations Management", PHI Learning Pvt. Ltd., 2015.
2	Nanua Singh, "System Approach to Computer Integrated Design and Manufacturing", John Wiley & Sons, New York, 2011.
3	Russell.R.S and Tailor, B.W, "Operations Management", PHI, 7th Edition, 2010.
4	R.Panneerselvam, "Production and Operations Management", PHI Learning Pvt. Ltd., 2012.
5	Sushil Gupta, Martin Starr, "Production and Operations Management Systems", CRC Press, 2014

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Regulation 2018		Semester V / VI / VII / VIII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18MEE030T	INDUSTRIAL SAFETY ENGINEERING	3	0	0	3

Prerequisite Course (s)

Nil

Course Objective (s):

- To anticipate, identify, evaluate, and control workplace hazardous conditions and practices.
- To develop effective safe operating procedures and comprehensive safety and health programs.
- To address identified hazards, conditions, and practices in a cost effective manner.
- To measure and evaluate occupational safety and health performance.
- To understand the provisions contained in the industrial laws.

Course Outcome (s) (COs):

CO1	List out the various safety considerations.
CO2	Monitor and review the safety performance followed in various industries.
CO3	Carryout safety study, undertake appraisal and audit of various industries.
CO4	Understand safety management system of an industry.
CO5	Get familiarize with the acts and rules applicable for industries.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	-	-	3	2	3	-	-	-	-	-	-	-
CO2	3	2	2	1	-	3	3	3	-	-	-	-	1	-	-
CO3	3	2	2	1	1	3	3	2	-	-	-	-	1	-	-
CO4	3	2	2	1	-	3	3	2	-	-	-	1	-	-	-
CO5	3	2	2	2	-	2	3	3	-	-	-	1	-	-	-
CO (Avg)	2.8	1.8	1.8	1.2	1	2.8	2.8	2.6	-	-	-	1	1	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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UNIT I	SAFETY IN PROCESS PLANTS	9
Hazards analysis - Energy source – Release of hazardous materials – Fires – Types of fires – Fire extinguishers – types and handling. Personal protective equipments – Types – Helmets – Respirator – Air purification – Chemical protective clothing – gloves for heat – electricity and chemical – Eye stakes – Ear marks – Industrial Hygiene – Principles – Health and safety Ergonomics.		
UNIT II	**SAFETY IN HIGH PREESURE OPERATIONS AND CHEMICAL INDUSTRIES**	**9**
Safety in process design, unit operations, pressure vessel, heat exchanger, safety valves –Plant commissioning and inspection, pressure vessel, non-destructive testing, vibration, corrosion Plant maintenance and emergency planning, management of maintenance HAZOP study, ALOHA SOFTWARE.		
UNIT III	**HAZARDS IN INDUSTRIES**	**9**
Engineering control of hazards and accidents due to fire explosion and natural causes in the Industries – Thermal power plant – Atomic power plant – mining industries – Fertilizers – petroleum refinery.		
UNIT IV	**SAFETY MANAGEMENT**	**9**
Concepts - Evolution, International Labour Organization (ILO), National Safety Council, Techniques - Job Safety Analysis (JSA), Safety survey, Safety inspection, Safety Sampling, Accident Investigation and Reporting - Concept of an accident, Accident causation models, cost of accident, investigation, Safety Performance Monitoring - Safety indices.Types of organization –Safety committee-Safety councils-Safety education-First aid.		
UNIT V	**THE OCCUPATIONAL SAFETY, HEALTH AND WORKING CONDITIONS CODE**	**9**
Factory Act 1948-Safety and Health chapters, Tamil Nadu Factories Rules- Safety and Health chapters, Environment and Pollution Laws, Building and other construction works act 1996, Motor Vehicle Rules, Explosive Act 1983, Boiler Act, Child labour and women employee Acts		

Text Book (s)

1	Rolland P. Blake, "Industrial safety" , II Edn.., Prentice Hall Inc . New york, Latest Edition.
2	Willaim Handley Mc, "Industrial Safety Hand book" , II Edn.., – Graw Hill Book Co., U. K. (1977).

Reference (s)

1	Blake R.B., Industrial Safety, Prentice Hall, Incorporated, New Jersey, 1973.
2	National Safety Council, Accident Prevention Manual for Industrial Operations, Chicago, 1988.
3	Explosive Act-1884, Eastern Book Company, Lucknow -266 001,1984.
4	Subramanian V., The Factories Act, 1948, with Tamil Nadu Factories Rules, 1950, Madras.
5	"Occupational Accident Prevention Judson & Brown ", john Wiley , london (1944).

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Regulation 2018		Semester V / VI / VII / VIII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18MEE031T	ENGINEERING ECONOMICS AND COST ANALYSIS	3	0	0	3

Prerequisite Course (s)

NIL

Course Objective (s):

- To learn about the basics of economics and cost analysis related to engineering so as to take economically sound decisions.
- To explain the practices adapted in industry for the successful management of maintenance activities.
- To illustrate some of the simple instruments used for condition monitoring in industry.
- To study about replacement and maintenance analysis.
- To impart knowledge about the depreciation.

Course Outcome (s) (COs):

CO1	Explain the concept of cost associated towards economics.
CO2	Explain the value engineering concepts for interest ratio estimation.
CO3	Compare the cash flow methods with cash flow diagram
CO4	Describe the maintenance analysis and replacement of an asset.
CO5	Illustrate the methods of depreciation value of an asset.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	2	2	-	-	-	-	-	-	2	-	-	1	-
CO3	2	3	2	-	-	-	-	1	-	1	2	-	-	-	-
CO4	2	2	1	1	-	-	-	1	-	-	-	-	-	1	-
CO5	2	3	2	1	-	-	1	1	-	-	-	-	1	-	-
CO (Avg)	2.2	2.2	1.7	1.3	-	-	1	1	-	1	2	-	1	1	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	INTRODUCTION TO ECONOMICS	9
Introduction to Economics- Flow in an economy, Law of supply and demand, Concept of Engineering Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics- Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis- V ratio, Elementary economic Analysis Material selection for product Design selection for a product, Process planning, Micro economics, Macro economics, GDP, Inflation, RBI, Effect of union budget on industrial growth. Introduction to GST – GST calculation – GST merits and demerits.		
UNIT II	**VALUE ENGINEERING**	**9**
Make or buy decision, Value engineering – Function, aims, Value engineering procedure. Interest formulae and their applications –Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series payment Present worth factor- equal payment series capital recovery factor-Uniform gradient series annual equivalent factor, Effective interest rate, Examples in all the methods.		
UNIT III	**CASH FLOW**	**9**
Methods of comparison of alternatives – present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), Annual equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), rate of return method.		
UNIT IV	**REPLACEMENT AND MAINTENANCE ANALYSIS**	**9**
Replacement and Maintenance analysis – Types of maintenance, types of replacement problem, determination of economic life of an asset, Replacement of an asset with a new asset – capital recovery with return and concept of challenger and defender, Simple probabilistic model for items which fail completely.		
UNIT V	**DEPRECIATION**	**9**
Depreciation- Introduction, Straight line method of depreciation, declining balance method of depreciation-Sum of the years digits method of depreciation, sinking fund method of depreciation/ Annuity method of depreciation, service output method of depreciation-Evaluation of public alternatives- introduction, Examples.		

Text Book (s)

1	Panneer Selvam, R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi, Second Edition, 21st printing, Oct 2017.

Reference (s)

1	Suma Damodaran, " Managerial economics", Oxford university press, second Edition, 2010
2	Chan S.Park, "Contemporary Engineering Economics", Prentice Hall of India, 2002.
3	Donald.G. Newman, Jerome.P.Lavelle, "Engineering Economics and analysis" Engg.Press, Texas, 2002.
4	GDP - https://www.investopedia.com/terms/g/gdp.asp
5	RBI-https://www.economicsdiscussion.net/monetary-policy/advantages/monetary-policy-objectives-advantages-and-disadvantages/12768 https://cleartax.in/s/gst-law-goods-and-services-tax

Regulation 2018		Semester V / VI / VII / VIII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18MEE032T	GAS DYNAMICS AND JET PROPULSION	3	0	0	3

Prerequisite Course (s)

Fluid Mechanics and Machinery, Engineering Thermodynamics

Course Objective (s):

- Understand the fundamental principles of compressible flow.
- Resolve the problems on isentropic flow through variable area ducts, Fanno flow and Rayleigh flow.
- Understand the effect of flow properties on normal and oblique shock.
- Apply the basic gas dynamics theories for aircraft Propulsion systems.
- Describe the working of solid propellant and liquid propellant rocket engines

Course Outcome (s) (COs):

CO1	Illustrate the fundamental principles of compressible flow.
CO2	Solve the problems in Rayleigh and Fanno flow for constant area sections.
CO3	Interpret the effect of flow properties on normal and oblique shock.
CO4	Explain the basic gas dynamics theories for aircraft propulsion systems.
CO5	Discuss the working of solid propellant and liquid propellant rocket engines

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	-	-	-	-	-	1	-	-	-
CO2	3	3	2	2	-	-	-	-	-	-	-	-	2	-	-
CO3	3	3	2	2	-	-	-	-	-	-	-	-	2	-	2
CO4	3	2	2	1	-	2	-	1	-	-	-	1	-	-	1
CO5	3	2	2	1	-	2	-	1	-	-	-	1	-	-	1
CO (Avg)	3	2.6	2	1.5	-	2	-	1	-	-	-	1	2	-	1.3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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UNIT I	COMPRESSIBLE FLOW – FUNDAMENTALS AND ISENTROPIC FLOW	9

Energy and momentum equations for compressible fluid flows, various regions of flows, reference velocities, stagnation state, velocity of sound, critical states, Mach number, critical Mach number, types of waves, Mach cone, Mach angle, effect of Mach number on compressibility- Use of Gas tables - Isentropic flow through variable area ducts- Chocking flow

UNIT II	FLOW THROUGH CONSTANT AREA DUCTS	9

Flow in constant area ducts with friction (Fanno flow) ,Fanno curves and Fanno length. Flow in constant area ducts with heat transfer (Rayleigh flow), Rayleigh line and Rayleigh flow equation, variation of flow properties, maximum heat transfer- Applications.flow equation, variation of flow properties- variation of Mach number with duct.

UNIT III	NORMAL AND OBLIQUE SHOCKS	9

Governing equations, variation of flow parameters like static pressure, static temperature, density, stagnation pressure and entropy across the normal and oblique shock, Prandtl – Meyer equation, impossibility of shock in subsonic flows, flow in convergent and divergent nozzle with shock- Use of tables and charts.

UNIT IV	JET PROPULSION	9

Theory of jet propulsion –Thrust equation –Thrust power and propulsive efficiency –Operation principle, cycle analysis and use of stagnation state performance of ram jet, turbojet, turbofan and turbo prop engines.

UNIT V	SPACE PROPULSION	9

Types of rocket engines –Propellants-feeding systems –Ignition and combustion –Theory of rocket propulsion –Performance study –Staging –Terminal and characteristic velocity –Applications space fligh- Solid, Liquid and hybrid propellants.

Text Book (s)

1	S. M. Yahya, Fundamentals of Compressible Flow with Aircraft and Rocket Propulsion, 6th edition, New Age International Publishers, 2018.
2	S. M. Yahya, Gas table for Compressible Flow Calculations, 8th edition, New Age International Publishers, 2018.

Reference (s)

1	Patrick H. Oosthuizen and William E. Carscallen, Introduction to Compressible Fluid Flow, 2nd edition, CRC Press, Taylor & Francis Group, Florida, 2013.
2	V.Ganesan,GasTurbines,TataMcGrawHill PublishingCo.,New Delhi,2010.
3	Anderson,J.D.,ModernCompressibleflow,McGrawHill,3rdEdition,2003.
4	Babu,Fundamentals ofGasDynamics,ANEBooksIndia,2008

Regulation 2018		Semester V / VI / VII / VIII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18MEE033T	TOTAL PRODUCTIVE MAINTENANCE	3	0	0	3

Prerequisite Course (s)

Nil

Course Objective (s):

- To enable the students Understand of Basic Maintence System
- To Enable the students aware of analytical tools in maintenance management
- To enable the students describe the Reliability Centered Maintenance for industrial systems
- To enable the students understand the TPM and global trends in maintenance management
- To enable the students to use simple instruments used for condition monitoring in maintenance

Course Outcome (s) (COs):

CO1	Describe modern maintenance concepts and practices
CO2	Apply analytical tools in maintenance management
CO3	Apply Reliability Centered Maintenance for industrial systems
CO4	Illustrate TPM and global trends in maintenance management
CO5	Demonstrate use of simple instruments used for condition monitoring in maintenance

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	-	-	-	-	-	-	1	-	-	-	-	-
CO2	2	2	1	-	1	-	-	-	-	1	1	-	-	1	-
CO3	3	2	1	-	-	-	-	-	-	1	-	-	1	1	-
CO4	2	1	-	-	2	-	-	1	-	2	2	-	1	-	-
CO5	2	1	-	1	-	-	-	1	-	2	1	-	-	-	-
CO (Avg)	2.2	1.4	1	1	1.5	-	-	1	-	1.4	1.3	-	1	1	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	MODERN MAINTENANCE CONCEPTS AND PRACTICES	9
Maintenance definition –Maintenance management – Maintenance Concepts: Objectives, Organization and Functions of Maintenance, Maintenance strategies, Types of Maintenance – Maintenance systems – (Planned, Unplanned / Breakdown, Corrective, Opportunistic, Routine, Preventive, Predictive, Condition based maintenance systems),Maintenance planning and scheduling, Maintenance Logistics, Maintenance Management Information Systems, Capacity Assurance Technicians, Total Economic Maintenance, Team-Based Maintenance. The Future of TPM, Maintaining the TPM Vision.		
UNIT II	**ANALYTICAL TOOLS IN MAINTENANCE MANAGEMENT**	**9**
Failure Data Analysis, MTBF,MTTF, Useful life-Survival curves, Repair time, Breakdown time distributions- Poisson's, Normal, Exponential, Availability, Reliability, Balancing PM and breakdown maintenance, PM schedules: deviations on both sides of target values, PM schedules: functional characteristics, Replacement models Replacement Decisions: Optimal interval between preventive replacements, Overall Equipment Effectiveness		
UNIT III	**RELIABILITY CENTERED MAINTENANCE**	**9**
Reliability Centered Maintenance (RCM), Objectives and function, Steps in RCM implementation, steps in RCM analysis, System selection, Tero technology – RCM effectiveness indicators, RCM tasks Proactive Maintenance, Reliability models - System reliability- Series, Parallel and mixed configuration, System reliability determination; Reliability improvement, Scheduled restoration and scheduled discard, The P-F interval and P-F curves, linear as non linear PF curves , Default actions, RCM Decision diagrams.		
UNIT IV	**TPM AND GLOBAL TRENDS**	**9**
Concept of TPM, Characteristics of TPM, Zero breakdown concepts, Zero Defects and TPM, FMECA – Maintainability prediction– Design for maintainability, Maximizing equipment effectiveness, Autonomous maintenance program, Five pillars of TPM, TPM Small group activities. Implementing TPM. Philosophy / Indications of TPM. TPM Development - Preparation phase, Master Plan, Initiatives, Promotion, Planning, Organization, Awareness, Training, Establishment of basic policies and goals, TPM organization, Implementation phase; Consolidation phase. TPM implementation, Maintenance Inventory Controls, Improving Maintenance Efficiency and Effectiveness.		
UNIT V	**CONDITION MONITORING IN MAINTENANCE**	**9**
Condition Based Maintenance: Machine signatures, Signature Analysis-MMIS Expert systems, Temperature noise, and vibration and wear particle analysis, on line and off line techniques. Online Monitoring Condition Monitoring Techniques, Vibration Monitoring and Signature Analysis. Wear Debris Monitoring, Maintenance Management Information System, Expert systems, Corrosion Monitoring and Control, Case Studies in Maintenance, Measurement and benchmarking of performance, MIS for maintenance		

Reference (s)

1	Seiichi Nakajima, —Introduction to TPM‖, Productivity Press, Chennai, 2016.
2	Goto, F., —Equipment planning for TPM Maintenance Prevention Design‖, Productivity Press, 2012.
3	Shirose, K., —Total Productive Maintenance for Workshop Leaders‖, Productivity Press, 2012.
4	David J. Sumanth, —Total Productivity Management : A Systematic and Quantitative Approach to Compete in Quality, Price and Time‖, Productivity Press, 2016
5	Shirose, K., "TPM for Operators", Productivity Press, 2015
6	Dolly, A., "Maintenance Planning and Control", Butterworth, London, 2016.

Regulation 2018		Semester V / VI / VII / VIII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18MEE034T	INDUSTRIAL TRIBOLOGY	3	0	0	3

Prerequisite Course (s)

Engineering Mechanics, Manufacturing Technology.

Course Objective (s):

- To introduce tribology as an important design consideration that affects the performance of various machine components in relative motion and in contact.
- To understand the significance of wear while designing components for functional applications.
- To recognize the importance of lubrication in machine components and in the design of various types of bearing.
- To understand the pressure development mechanism in a full film bearing and analyze a journal bearing.
- To introduce latest developments in fields such as micro and nanoscale tribology.

Course Outcome (s) (COs):

CO1	Describe surface topography and Friction characteristics.
CO2	Estimate wear in interacting surfaces.
CO3	Apply the principles of Lubrication.
CO4	Analyse the pressure and estimate load carrying capacity of a bearing.
CO5	Test components and characterise tribological failures.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	2	-	-	-	1	-	-	-	-	-	1	-	2
CO3	3	3	2	-	-	-	1	1	-	-	-	-	1	-	-
CO4	3	3	3	2	1	-	1	1	-	-	-	-	3	-	3
CO5	3	3	3	2	1	-	1	1	-	-	-	-	3	-	3
CO (Avg)	3	2.8	2.2	2	1	-	1	1	-	-	-	-	2	-	2.6

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	SURFACES AND FRICTION	9
Topography of engineering surfaces- Contact between surfaces - Laws of friction -Stick-slip phenomenon -Friction characteristics of metals and non-metals - Ploughing theory of friction - Measurement of friction.		
UNIT II	**WEAR**	**9**
Types of wear - Simple theory of Sliding Wear Mechanism of sliding wear of metals - Abrasive wear Materials for Adhesive and Abrasive wear situations - Corrosive wear - Surface Fatigue wear situations - Brittle Fracture - wear - Wear of Ceramics and Polymers - Wear Measurements.		
UNIT III	**LUBRICANTS AND LUBRICATION**	**9**
Lubrication types, Regimes, Basic Modes of Lubrication, Properties of Lubricants, Lubricant additives-Fluid film in simple shear –Mechanism of pressure development in a convergent film – pressure induced and velocity induced flows -Reynolds equation for fluid film lubrication –Slider bearing-Load carrying capacity -Journal bearing Pressure development. Squeeze film lubrication.		
UNIT IV	**LUBRICATION OF BEARINGS**	**9**
Bearing Terminology –Sliding contact bearings –Rolling contact bearings, Comparison between Sliding and Rolling Contact Bearings- Long bearing and short bearing approximations - Load carrying capacity –Sommerfeld Number –Friction –Petroff's equation –Oil flow and Thermal equilibrium		
UNIT V	**TRIBOLOGY TESTING AND APPLICATIONS**	**9**
Common Geometries, Instrumentation and Methods used for Testing, Influences of Test Parameters – Tribology in metal cutting –Automotive Tribology – Nano scale tribology- Interatomic interactions Atomic Force Microscope (AFM) - Challenges of Tribological Testing at Small Scales.		

Text Book (s)

1	GwidonStachowiak, Andrew W Bachelor, Engineering Tribology, Butterworth-Heinemann, 2013.
2	Williams.J.A, "Engineering Tribology", Cambridge University Press, 2012.

Reference (s)

1	Bharat Bhushan, Introduction to Tribology, John Wiley & Sons, 2013.
2	Majumdar, "Introduction of Tribology and bearings", A.H. Wheeler Co, 2010.
3	M.M.Khonsari&E.R.Booser, "Applied Tribology", John Willey & Sons, New York, 2001.
4	Dudley D. Fuller, "Theory and practice of Lubrication for Engineers", John Wiley and Sons, 1984.
5	Cameron A., "Basic Lubrication Theory", Wiley Eastern Ltd, 1987.

Regulation 2018		Semester V / VI / VII / VIII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18MEE035T	INDUSTRIAL PROCESS ENGINEERING	3	0	0	3

Prerequisite Course (s)

Nil

Course Objective (s):

- To impart the knowledge on production planning methodologies and layout design
- To learn about production planning and its control methods
- To provide the knowledge of work study, process charts and ergonomic condition
- To impart the knowledge on inventory control and material handling.
- To learn about system analysis and different types of maintenance processes.

Course Outcome (s) (COs):

CO1	Select proper plant layout for the required production system
CO2	Plan the resources required for the production and to perform the control methods
CO3	Apply work study method, prepare charts to outline the process and develop ergonomic condition suitable for the processes
CO4	Analyze the inventory required based on production needs and material handling
CO5	Perform system analysis and use different types of maintenance process for smooth operations

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	2	-	-	-	-	-	-	2	-	-	1	2	-
CO4	2	2	1	1	-	-	-	1	-	-	-	-	1	2	-
CO5	2	3	1	-	-	-	-	1	-	-	-	-	-	1	-
CO (Avg)	2.4	2.2	1.2	1	-	-	-	1	-	2	-	-	1	1.6	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	INDUSTRIAL ENGINEERING	9
Industrial engineering - Concept, History and development, Applications, Roles of Industrial engineer- Production management, Industrial engineering versus production management, operations management. Plant layout, Criteria for good layout, Types of layout - Process layout, Product layout, Combination layout and fixed position layout. Flow (material movement) pattern, Workstation Selection and design.		
UNIT II	**PROCESS PLANNING**	9
Introduction to Process planning-Definition, Procedure, Process selection, Machine capacity, Process sheet.Process analysis - Group technology, classification and coding system, formation of component family - Production planning, loading, scheduling. Production control -dispatching, routing – Progress control bar, curve, Gantt chart, route and schedule chart.		
UNIT III	**WORK STUDY AND ERGONOMICS**	9
Work study - Definition, Need, Advantages, objectives of method study and work measurement, method study procedure, Process chart - symbols, outline process chart, flow process chart, principles of motion economy, ergonomics- applications of ergonomic principles in the shop floor- work benches-seating arrangement, Industrial physiology.		
UNIT IV	**INVENTORY MANAGEMENT**	9
Inventory control, classification, management, objectives, functions. Economic order quantity, Economic batch quantity, inventory models,ABC analysis, Material Requirement Planning(MRPI), Manufacturing Resource Planning (MRPII), Operating cycle, lean manufacturing, Supply chain management - Material handling.		
UNIT V	**SYSTEM ANALYSIS AND MAINTENANCE**	9
System concept - system analysis, systems engineering, value engineering, value control, types of values. Plant maintenance - objectives, importance. Maintenance engineer - duties, functions and responsibilities. Types - breakdown, scheduled, preventive and predictive - Plant maintenance schedule , Condition monitoring.		
Text Book (s)		
1	Panneerselvam R., Production and operations management, Heritage Publishers, 2006	
2	Martand T.Telsang, Industrial Engineering and Production Management, S Chand Publishers,2006	
Reference (s)		
1	Ravi Shankar, Industrial Engineering and Management, Golgotia Publications Pvt. Ltd., New Delhi, 2009	
2	Khanna O.P., Industrial Engineering and management, Dhanpat Rai Publications.,2010	

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Regulation 2018		Semester V / VI / VII / VIII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18MEE036T	SUPPLY CHAIN MANAGEMENT AND LOGISTICS	3	0	0	3

Prerequisite Course (s)

Nil

Course Objective (s):

- Enable the students to aware of strategic role of a supply chain in the business process
- Enable the students to apply key strategic drivers of supply chain performance for effective results
- Enable the students to apply the forecasting techniques to improve the facility and network design
- Enable the students to understand the analytic methodologies for supply chain.
- Enable the students to describe the network design and improve transportation time for achieving shortest route

Course Outcome (s) (COs):

CO1	Explain the strategic role of a supply chain in the business process
CO2	Use key strategic drivers of supply chain performance for effective results
CO3	Apply the forecasting techniques to improve the facility and network design
CO4	Analyze the analytic methodologies for supply chain.
CO5	Analyze the network design and improve transportation time for achieving shortest route

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	-	-	-	-	2	-	1	-	-	-	-	-
CO2	2	2	1	-	-	-	-	2		1	-	-	-	-	-
CO3	3	3	2	1	-	-	-	2	-	-	1	-	1	1	1
CO4	3	2	2	-	-	-	-	2	-	-	1	-	1	2	1
CO5	3	2	2	-	-	-	-	2	-	1	1	-	2	1	-
CO (Avg)	2.6	2.2	1.6	1	-	-	-	2	-	1	1	-	1.3	1.3	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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UNIT I	INTRODUCTION TO SUPPLY CHAIN	9
Supply Chain – Fundamentals, Importance, Decision Phases, Process View. Supplier- Manufacturer-Customer chain. Drivers of Supply Chain Performance. Structuring Supply Chain Drivers. Overview of Supply Chain Models and Modeling Systems. Business processes in supply chains, Types of supply chains and examples		
UNIT II	**OVERVIEW OF DEMAND FORECASTING IN THE SUPPLY CHAIN**	**9**
Aggregate planning, Managing predictable variability. Managing supply chain cycle inventory, Uncertainty, safety inventory, Determination of optimal level of product availability, Supply Chain Integration - Building partnership and trust in SC Value of Information: Bullwhip Effect - Effective forecasting - Coordinating the supply chain.		
UNIT III	**DISTRIBUTION NETWORK DESIGN**	**9**
Role, factors influencing network, options, Value Addition. Models for facility location and capacity planning. Network design: Impact of uncertainty, decisions using decision trees. Distribution centre location models. Supply chain network optimization models. Supply Chain Network optimization models. Impact of uncertainty on Network Design - Network Design decisions using Decision trees.		
UNIT IV	**LOGISTIC SYSTEM**	**9**
Evolution, Infrastructure and Networks. Freight Management, Route Planning, Containerization. Modal Characteristics, Inter-modal operators and transport economies. Ocean carrier management, import-export logistics management. Logistics outsourcing, 3PL / 4PL, Importance of Insurance		
UNIT V	**TRANSACTIONAL LOGISTICS**	**9**
Framework and role of supply chain in e- business and b2b practices. Supply Chain IT Framework. International supply chain, GPS, tracking system. Agile Supply Chains -Reverse Supply chain. Agro Supply Chains.		

Text Book (s)

1	Khalid Zidan, "Supply Chain Management: Fundamentals, Strategy, Analytics & Planning for Supply Chain & Logistics Management" , 2016
2	Sunil Chopra and Peter Meindi, Supply Chain Management-Strategy Planning and Operation, Pearson Education, Indian Reprint, 2014.

Reference (s)

1	David N. Burt, Donald W. Dobler and Stephen L. Starling , World Class Supply Management: The Key to Supply Chain Management, New Delhi: McGraw-Hill, 2015
2	Sople Vinod V, Logistics Management – The Supply Chain Imperative, New Delhi: Pearson Education, 2014.
3	Ballou Ronald H, Business Logistics and Supply Chain Management, Pearson Education, Second Indian Reprint, 2014.
4	Burt, Dobbler, Starling, World Class Supply Management, TMH. 7th Edition, (2015)
5	Bowersox, Closs, Cooper, Supply Chain Logistics Management, McGraw Hill. 4th Edition, (2016)

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Regulation 2018		Semester V / VI / VII / VIII	Total Hours			45
			Hours / Week			C
Category	Course Code	Course Name	L	T	P	
E	18MEE037T	LEAN MANUFACTURING	3	0	0	3

Prerequisite Course (s)

Nil

Course Objective (s):

- To make the students understand how the philosophy and core methods of lean manufacturing are applied to any business
- To make the students understand how to select the various tools and techniques of lean manufacturing
- To make the students understand the value chain and to map the current state of material and information flow through the value chain and to understand where the added value is for the customer
- To help the students to develop a road map of lean implementation by understanding the activities and strategies of lean manufacturing
- To make the students to use their Entrepreneurship skills needed to drive lean initiatives.

Course Outcome (s) (COs):

CO1	Identify key requirements and concepts in lean manufacturing
CO2	Apply the tools in lean manufacturing to analyze a manufacturing system and plan for its improvements.
CO3	Map the value chain and predict the value addition
CO4	Find the common pitfalls encountered during lean implementation and initiate a continuous improvement change program in a manufacturing organization.
CO5	Start the own enterprise with the help of lean concepts and financial sources.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	2	-	-	-	-	2	-	-	-	-
CO2	3	3	3	2	3	-	-	1	-	-	-	1	3	1	2
CO3	3	2	2	3	2	-	-	-	-	-	2	-	3	-	2
CO4	3	1	1	1	-	1	-	1	-	-	-	-	-	-	-
CO5	2	-	3	-	1	3	-	2	-	-	3	1	3	1	2
CO (Avg)	2.8	2	2.2	2	2	2	-	1.3	-	-	2.3	1	3	1	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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UNIT I	INTRODUCTION TO LEAN MANUFACTURING	9
Definition and concept of lean manufacturing - Principles of lean manufacturing - Just in time, Types of pull systems - Toyota Production systems - Benefits of lean manufacturing - Types of Wastes, Types of activities –Value Added, Non Value Added and Necessary but Non Value Added activities Reduction of wastes - Mass vs Lean Manufacturing		
UNIT II	**LEAN MANUFACTURING TOOLS & TECHNIQUES**	**10**
Basic Tools - 5S, Total Productive Maintenance, OEE Calculation (Overall Equipment Effectiveness), Plan Do Check Act, Root Cause Analysis, Poka Yoke, Work Cell, Bottleneck analysis, continuous flow. Secondary Tools – Gemba, Heijunka, Jidoka, Load leveling, 5 whys, SMED (Single Minute Exchange of Dies), Standardized work, Visual factory, Zero quality control		
UNIT III	**PROCESS MAPPING AND VALUE STREAM MAPPING**	**8**
Process mapping –Need for process map-Types-Detailed instructions -common mistakes in mapping -limits –facilitation; Value stream mapping: -Overview -Where to use –When to use-Step by step approach –How to use –Present and future states -VSM symbols		
UNIT IV	**LEAN INTEGRATION AND IMPLEMENTATION**	**10**
Integration with other strategies ; Lean Six Sigma, Lean principles in ERP, Lean in service domain - Lean production in Industry 4.0; Impact of industry 4.0 on lean production system - Focused factory concept; Availability, Variability, Lean implementation strategies, causes for failures, sustaining lean, and constraint management		
UNIT V	**LEAN START-UP MANAGEMENT**	**8**
Creativity and Design Thinking; identify the vertical for business opportunity, understand your customers, accurately assess market opportunity - Business Model Development; Channels and Partners, Revenue Model and streams, Key Resources, Activities and Costs, Customer Relationships and Customer Development Processes - Business Plan and Access to Funding; visioning your venture, taking the product/ service to market, start-up finance -Costs/Profits		

Text Book (s)

1	Pascal Dennis, Lean production Simplified, Productivity press, New York, 2013.
2	Steve Blank, K &S Ranch (2012) The Startup Owner's Manual: The Step-By-Step Guide for Building a Great Company, 1st edition

Reference (s)

1	Devadasan S R, Mohan Sivakumar V, Murugesh R and Shalij P R, —Lean and Agile Manufacturing: Theoretical, Practical and Research Futuritiesl, Prentice Hall of India Learning Limited, New Delhi, 2012
2	P. James Womack, Lean Thinking: Banish Waste and Create Wealth in Your Corporation, Simon & Schuster, 2003.
3	AskinR G and Goldberg J B, "Design and Analysis of Lean Production Systems", John Wiley and Sons Inc., 2003.2.Hobbs, D.P. "Lean Manufacturing implementation", Narosa Publisher, 2004.
4	Gopalakrishnan N, —Simplified Lean Manufacture: Elements, Rules, Tools and Implementationl, Prentice Hall of India Learning Private Limited, India, 2010
5	Eric Ries (2011) The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses, Crown Business

Regulation 2018		Semester V / VI / VII / VIII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18MEE038T	INTELLECTUAL PROPERTY RIGHTS	3	0	0	3

Prerequisite Course (s)

Nil

Course Objective (s):

- To gain knowledge to familiarize with the Intellectual Property Rights in India.
- To familiarize with IP patents and Copyrights and patent application procedures.
- To familiarize with Trademarks and GATT, particularly for the developing nations.
- To comprehend the concepts of competition, unfair trade practices, relevant market, anti-competitive agreements, combinations and appreciate the need for competition advocacy.
- To provide an understanding of the law relating to Intellectual Property and Competition in India.

Course Outcome (s) (COs):

CO1	Describe the concepts of Intellectual Property Rights
CO2	Compare and contrast the different forms of IP protection in terms of their differences and similarities.
CO3	Analysis and establishment of WIPO and National Intellectual Property Policy
CO4	Explain the limitations of IPR and comprehend some basic legal pitfalls.
CO5	Explain the current trends in IPR and Govt. steps in fostering IPR.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	3	2	3	1	2	-	1	-	-	-
CO2	-	-	-	-	-	2	3	3	-	3	-	2	-	-	-
CO3	-	-	-	-	-	2	3	2	-	3	1	2	-	-	-
CO4	-	-	-	-	-	1	2	3	1	2	1	1	-	-	-
CO5	-	-	-	-	-	2	2	3	1	2	1	1	-	-	-
CO (Avg)	-	-	-	-	-	2	2.4	2.8	1	2.4	1	1.4	-	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	INTRODUCTION	9
Introduction – Invention and Creativity – Intellectual Property (IP) – Importance of IPR – Nature of Intellectual Property, Industrial Property, Technological Research, Inventions and Innovations – Protection of IPR – Basic types of property (i. Movable Property ii. Immovable Property and iii. Intellectual Property).		
UNIT II	**PATENTS AND COPYRIGHTS**	**9**
IP – Patents – Copyrights and related rights – Trade Marks and rights arising from Trademark registration – Definitions – Industrial Designs and Integrated circuits – Protection of Geographical Indications at National and International levels – Application Procedures.		
UNIT III	**IP CONVENTIONS AND PROTECTION**	**9**
International convention relating to Intellectual Property – Establishment of WIPO – Mission and Activities – History – General Agreement on Trade and Tariff (GATT). Indian Position Vs WTO and Strategies – Indian IPR legislations – Commitments to WTO – Patent Ordinance and the Bill – Draft of a National Intellectual Property Policy.		
UNIT IV	**IP AGREEMENTS AND LEGISLATION**	**9**
International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act.		
UNIT V	**ENFORCEMENT OF IPRs**	**9**
Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies on – Patents (Basumati rice, turmeric, Neem, etc.) – Copyright and related rights – Trade Marks – Industrial design and Integrated circuits – Geographic indications – Protection against un fair competition.		

Text Book (s)

1	Vinod V Scople, Managing Intellectual Property: The Strategic Imperative, Prentice Hall of India pvt. Ltd., 4th Edition 2014
2	Prasad Karhad, How to Patent an idea in India: From idea to granted Patent in quickest time, saving costs and making money with your patented invention, Independently Published, 2018.

Reference (s)

1	Subbaram N R, Handbook of Indian Patent Law and Practice, S.Viswanathan Printers, 1998.
2	Prabuddha Ganguli, Intellectual Property Rights: Unleashing the Knowledge Economy, McGraw Hill Education, 2011.
3	Ahuja V K, Law relating to Intellectual Property Rights, Lexis Nexis, 2017
4	Kompal Bansal, Parikshit Bansal, Fundamentals of Intellectual Property for Engineers, BS Publications, 2014
5	WIPO Intellectual Property Handbook : Policy, Law and Use (web resource)

Regulation 2018		Semester V / VI / VII / VIII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18MEE039T	INDUSTRIAL INTERNET OF THINGS	3	0	0	3

Prerequisite Course (s)

Nil

Course Objective (s):

- To learn about introduction of IIoT.
- To learn about the challenges and networking in IIoT.
- To learn about smart manufacturing in IIoT.
- To learn about new technologies and concepts in IIoT.
- To learn about applications of IIoT.

Course Outcome (s) (COs):

CO1	Describe the IIoT concepts.
CO2	Illustrate the cyber networking in IIoT.
CO3	Estimate the IoT in smart automation in IIoT.
CO4	Describe the advanced technologies in IIoT.
CO5	Illustrate the IoT economy and applications of IIoT.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	2	-	3	1	-	1	-	-	-	-	1	-	-
CO2	2	-	2	-	2	2	-	2	-	-	-	-	2	2	1
CO3	2	1	3	-	2	1	-	2	-	-	-	-	2	2	-
CO4	2	2	2	-	3	1	-	2	-	-	-	-	1	1	-
CO5	3	2	2	-	3	1	-	2	-	-	1	-	2	2	1
CO (Avg)	2.4	1.6	2.2	-	2.6	1.2	-	1.8	-	-	1	-	1.6	1.7	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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UNIT I	INTRODUCTION	9
Introduction to IoT, What is IIoT? IoT Vs. IIoT, Evolution of IIoT, Components of IIoT – Difference in IoT and M2M – Functional blocks of IoT – IoT Platform, Interfaces, API, clouds, Data Management Analytics, Mining & Manipulation – Role of IIoT in Manufacturing Processes – Use of IIoT in plant maintenance practices – Challenges & Benefits in implementing IIoT.		
UNIT II	**CHALLENGES IN IIoT**	**9**
Challenges – Design, Development, Security - Wireless medium access issues - Sensor deployment – Manufacturing Grid in IIoT – cloud manufacturing – Networked manufacturing – Key features of IIoT – standard and Integration method – Cyber manufacturing system – Cyber Physical System – Robot based CPS.		
UNIT III	**IIoT IN SMART ASSEMBLY SYSTEM**	**9**
Introducing the Smart Factory – Real time manufacturing in IIoT – status monitoring - multiple sensor manager – cloud manufacturing – service selection and composition – smart automation – smart mobility and transport - communication and networking of IIoT – IIoT security and Artificial intelligence concepts – self optimization and self healing concepts.		
UNIT IV	**ADVANCED TECHNOLOGIES IN IIoT**	**9**
Sensing element: Wi-Fi - Connectivity – Processing - Process Control - Introduction to different IoT tools, Developing applications through IoT tools – IoT Prototype system – Smart shopfloor – system architecture – Information model – Logical flow of prototype system – Smart material handling modeling – Designing Industrial Internet Systems.		
UNIT V	**APPLICATIONS OF IIoT**	**9**
Management data - Data Center Networks – IIoT economy – IIoT consumer applications - Factories and Assembly Line – Domain applications of IIoT : Agriculture, Automobile, Education, Transportation, Healthcare, Environmental. IIOT Case Studies on Food Industry, Oil and Gas Industry, Surveillance applications – Real life examples of IIoT in Manufacturing Sector.		

Text Book (s)

1	"Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", Apress 1st ed. Edition, 2017.
2	Dirk Slama, Frank Puhlmann, Jim Morrish, Rishi M Bhatnagar, "Enterprise IoT: Strategies and Best Practices for Connected Products and Services", O'Reilly Media, Inc., USA, 2015.

Reference (s)

1	Dr.Ovidiu vermesan, Dr.Prter fries, "Digitising the Industry - Internet of Things Connecting the Physical digital and virtual worlds", River Publishers, 2016.
2	Yingfeng Zhang, Fei Tao, "Optimization of Manufacturing Systems Using the Internet of Things", ISBN: 978–0–12–809910–0, Elsevier Publications, 2017.
3	Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat, " Industrial Internet of Things: Cyber Manufacturing Systems", ISSN 2365–4147, Springer Publishing Company, 2017.
4	Ulrich Sendler, "The Internet of Things: Industrie 4.0 Unleashed", ISBN 978–3–662–54904–9, Springer Publishing Company, 2018.
5	Sudip Misra, "Introduction to Industry 4.0 and Industrial Internet of Things", NPTEL, Indian Institute of Technology, Kharagpur, 2018.

Regulation 2018		Semester V / VI / VII / VIII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18MEE040T	SUSTAINABLE MANUFACTURING DESIGN	3	0	0	3

Prerequisite Course (s)

MANUFACTURING TECHNOLOGY

Course Objective (s):

- To acquire knowledge about the Sustainable Manufacturing
- To obtain knowledge about the tools and techniques in Sustainable Manufacturing design
- To get wide knowledge and the concept of Environment impact assessment techniques
- To impart knowledge on Recycling Process
- To study about sustainability Assessment

Course Outcome (s) (COs):

CO1	Demonstrate sustainable development and its different levels.
CO2	Summarize the tools and techniques in Sustainable Manufacturing design.
CO3	Illustrate the information about Environment impact assessment techniques.
CO4	Demonstrate recycling process and its concepts.
CO5	Summarize the Sustainability Assessment and social responsibility.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	2	3	3	-	-	-	-	-	-	-
CO2	3	3	2	1	-	3	3	3	-	-	-	-	2	-	2
CO3	3	2	1	-	-	3	3	3	-	-	-	-	2	-	2
CO4	3	2	-	1	-	2	3	3	-	1	-	-	-	-	-
CO5	3	2	1	-	-	3	3	3	-	1	-	-	1	-	1
CO (Avg)	3	2	1.3	1	-	2.6	3	3	-	1	-	-	1.6	-	1.6

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	INTRODUCTION TO SUSTAINABLE MANUFACTURING	9
Sustainable Manufacturing - Concept of Triple bottom line, Environmental, Economic and Social Dimensions of Sustainability, Sustainable Product Development – Various Phases.		
UNIT II	**TOOLS AND TECHNIQUES**	**9**
Tools and Techniques – Environmental Conscious Quality Function Deployment, Life cycle assessment, Design for Environment, R3 and R6 cycles, Design for Disassembly.		
UNIT III	**ENVIRONMENTAL IMPACT ASSESSMENT TECHNIQUES**	**9**
EIA Methods –CML, EI 95 and 99, ISO 14001 EMS and PAS 2050 standards, Environmental Impact parameters.		
UNIT IV	**DESIGN FOR RECYCLING**	**9**
Design for recycling – Eco friendly product design methods – Methods to infuse sustainability in early product design phases.		
UNIT V	**SUSTAINABILITY ASSESSMENT**	**9**
Sustainability Assessment – Concept Models and Various Approaches, Product Sustainability and Risk/Benefit assessment– Corporate Social Responsibility.		

Text Book (s)

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

Reference (s)

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

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Regulation 2018		Semester V / VI / VII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
O	18MEO001T	INDUSTRIAL SAFETY FOR ENGINEERS	3	0	0	3

Prerequisite Course (s)

Nil

Course Objective (s):

- To anticipate, identify, evaluate, and control workplace hazardous conditions and practices.
- To develop effective safe operating procedures and comprehensive safety and health programs.
- To address identified hazards, conditions, and practices in a cost effective manner.
- To measure and evaluate occupational safety and health performance.
- To understand the provisions contained in the industrial laws.

Course Outcome (s) (COs):

CO1	List out the various safety considerations.
CO2	Monitor and review the safety performance followed in various industries.
CO3	Carryout safety study, undertake appraisal and audit of various industries.
CO4	Understand safety management system of an industry.
CO5	Get familiarize with the acts and rules applicable for industries.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	-	-	-	3	2	3	-	-	-	1	-	-	-
CO2	3	2	2	1	2	3	3	3	-	-	-	-	-	-	-
CO3	3	2	2	1	2	3	3	2	-	-	-	-	-	-	-
CO4	3	2	-	1	2	3	2	2	-	-	-	1	-	-	-
CO5	2	1	-	-	2	2	2	3	-	-	-	1	-	-	-
CO (Avg)	2.6	1.8	2	1	2	2.8	2.4	2.6	-	-	-	1	-	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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UNIT I	INTRODUCTION TO HEALTH AND SAFETY	9
Health –Safety – Reasons to maintain Health and Safety – Direct Cost- Indirect cost – Roles and Responsibility of Employer and Employee – Deterioration of Health and Safety- Personal protective equipments – Types – Helmets – Respirator – Air purification –Fall Arrest - Chemical protective clothing – gloves for heat – electricity and chemical – Eye stakes – Ear marks – Bhopal disaster.		
UNIT II	**FIRE SAFETY**	**9**
Basic principle Fires – Types of fires – Common causes of Workplace Fire – Fire and Life Safety Awareness – Fire extinguishers – Fire Detection and Alarm System – Types and handling.– Industrial Hygiene – Principles – Health and safety Ergonomics.		
UNIT III	**HAZARDS ANALYSIS**	**9**
Job Safety Analysis (JSA), Safety survey, Safety inspection, Safety Sampling, Accident Investigation and Reporting - Concept of an accident, Accident causation models, cost of accident, investigation, Safety Performance Monitoring.		
UNIT IV	**SAFETY EDUCATION**	**9**
International Labour Organization (ILO) – Roles and Functions of International Labour Organization – Governing Bodies, National Safety Council, Types of organization – Safety committee – Safety councils – Safety education – First aid.		
UNIT V	**THE OCCUPATIONAL SAFETY, HEALTH AND WORKING CONDITIONS CODE**	**9**
Factory Act 1948-Safety and Health chapters, Tamil Nadu Factories Rules- Safety and Health chapters, Environment and Pollution Laws, Building and other construction works act 1996, Motor Vehicle Rules, Explosive Act 1983, Boiler Act, Child labour and women employee Acts.		

Text Book (s)

1	Rolland P. Blake, "Industrial safety" , II Edn.., Prentice Hall Inc . New york, Latest Edition.
2	Willaim Handley Mc, "Industrial Safety Hand book" , II Edn.., – Graw Hill Book Co., U. K. (1977).

Reference (s)

1	Blake R.B., Industrial Safety, Prentice Hall, Incorporated, New Jersey, 1973.
2	National Safety Council, Accident Prevention Manual for Industrial Operations, Chicago, 1988.
3	Explosive Act-1884, Eastern Book Company, Lucknow -266 001,1984.
4	Subramanian V., The Factories Act, 1948, with Tamil Nadu Factories Rules, 1950, Madras.
5	"Occupational Accident Prevention Judson & Brown ", john Wiley , london (1944).

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Regulation 2018		Semester V / VI / VII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
O	18MEO002T	ENERGY ENGINEERING	3	0	0	3

Prerequisite Course (s)

NIL

Course Objective (s):

- To know the basic of energy
- To know the Indian and global energy scenario
- To study the various modelling techniques of energy storage systems using TRNSYS.
- To learn the methodology adopted for an energy audit
- To Comprehend the impact of energy on environment

Course Outcome (s) (COs):

CO1	Analyse the various forms of energy
CO2	Know the Indian and global energy scenario
CO3	Identify the energy storage technologies for suitable applications.
CO4	Analyse the energy sharing and cost sharing pattern of fuels used in industries
CO5	Assess the sources of additional revenue generation for energy conservation projects adopting UNFCC

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	3	3	-	-	-	-	2	-	-	-
CO2	3	-	2	1	2	2	3	1	-	-	2	1	-	-	-
CO3	3	2	2	1	1	1	2	2	-	-	2	-	-	-	-
CO4	3	2	-	1	2	1	1	2	-	-	2	-	-	-	-
CO5	3	-	-	-	-	2	3	3	-	-	2	2	-	-	-
CO (Avg)	3	2	2	1	1.6	1.8	2.4	2	-	-	2	1.66	-	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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UNIT I	INTRODUCTION TO CONVENTIONAL AND NON CONVENTIONAL ENERGY SOURCES	9
Conventional Sources – Commercial sourses - coal, electricity,petroleum and natural gas. Non-commercial energy sources- Straw, dried dung, firewood. Non-Conventional Sources- solar energy, bioenergy,wind energy and ocean and geothermal energy.		
UNIT II	**ENERGY SCENARIO**	**9**
Indian energy scenario in various sectors – domestic, industrial, commercial, agriculture, transportation and others – Present conventional energy status – Present renewable energy status. Potential of various renewable energy sources-Global energy status-Per capita energy consumption - Future energy plans		
UNIT III	**THERMAL STORAGE SYSTEM**	**9**
Thermal storage – Types – Modelling of thermal storage units – Simple water and rock bed storage system – pressurized water storage system – Modelling of phase change storage system – Simple units, packed bed storage units - Modelling using porous medium approach, Use of TRNSYS.		
UNIT IV	**ENERGY MANAGEMENT**	**9**
Energy audit - need – types – methodology – barriers - analysis on energy costing and sharing - bench marking - fuel and energy substitution – billing parameters in TANGEDCO – demand side management - instruments for energy audit – energy monitoring and targeting – CUSUM - energy labelling		
UNIT V	**ENERGY AND ENVIRONMENT**	**9**
Greenhouse effect and the carbon cycle - current evidence and future effects of climate change - Global Environmental Concerns - United Nations Framework Convention on Climate Change (UNFCC), Kyoto Protocol, Conference of Parties (COP), Emissions trading (ET), Joint implementation (JI), Clean Development Mechanism (CDM), Prototype Carbon Fund (PCF), Sustainable Development		

Text Book (s)

1	Twidell, J.W. & Weir A., "Renewable Energy Resources", EFNSpon Ltd., UK, 2015.
2	Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, U.K., 2012.

Reference (s)

1	Ibrahim Dincer and Mark A. Rosen, Thermal Energy Storage Systems and Applications, John Wiley & Sons 2002
2	Rai.G.D., "Non-Conventional Energy Sources", Khanna Publishers, New Delhi, 2014
3	Energy Manager Training Manual (4Volumes) available at http://www.em-ea.org/gbook1.asp, a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India.2004.

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Regulation 2018		Semester V / VI / VII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
O	18MEO003T	AUTOMOBILE TECHNOLOGY	3	0	0	3

Prerequisite Course (s)

Nil

Course Objective (s):

- To impart knowledge on the principles of operation and constructional details of various automobile engine power source.
- To impart knowledge on the working of fuel supply system and combustion technique in various automobiles.
- To provide knowledge on the requirement and function of various components in power transmission and suspension system in vehicle.
- To impart knowledge on the emission in automobile.
- To provide advance automotive driving control.

Course Outcome (s) (COs):

CO1	Explain the operating principles and constructional details of various automobile engine power source.
CO2	Identify the appropriate Fuel supply system for a particular automobile vehicle based on the requirements.
CO3	Analyze the function of various components in transmission and safety driving line of a vehicle.
CO4	Explain the emission control technique and its importance.
CO5	Analyze the advance automotive driving methods.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	3	-	2	1	2	-	-	-	3	-	-	-
CO2	3	2	2	2	-	1	1	2	-	-	-	3	-	-	-
CO3	3	2	3	2	-	1	1	2	-	-	-	3	-	-	-
CO4	3	2	3	2	-	3	3	3	-	-	-	3	-	-	-
CO5	3	3	2	2	-	2	3	2	-	-	-	3	-	-	-
CO (Avg)	3	2.2	2.2	2.2	-	1.8	1.8	2.2	-	-	-	3	-	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	VEHICLE STRUCTURE AND ENGINES	9
Types of automobiles, Automotive components, sub systems and their positions, vehicle construction and different layouts, chassis, frame and body, resistances to vehicle motion and aerodynamics of vehicles, Introduction to automobile engine power source.		
UNIT II	**ENGINE AUXILIARY SYSTEMS**	**9**
Carburetor-basic type and working principles- Electronic fuel injection system for petrol and diesel engine- supercharging and turbo charging. Review of cooling and lubrication system. Electrical sytem (General electrical circuits, Battery, Starting motor, DC generator, Alternator, Ignition circuit, Dash board instrumentation, Lighting system) and electronics system - Ignition system (Magneto coil and Electronic type). Electronic engine management system.		
UNIT III	**TRANSMISSION SYSYTEMS**	**9**
Clutch-types and construction, gear boxes- manual and automatic, Wheel drive components, Wheel and tyres - Steering geometry ,Power Steering, Front and Rear Axle-Suspension Systems. Braking Systems- ABS and electronic brake force distribution (EBD). Stabilizer, Air Bags		
UNIT IV	**EMISSION CONTROL AND ALTERNATIVE ENERGY SOURCES**	**9**
Emission Norms and Bharat standard – Non exhaust and exhaust emission (SCR).Use of alternative fuels in Automobiles - Engine modifications required –Performance and Combustion Characteristics of SI and CI engines with these alternate fuels.		
UNIT V	**ADVANCES IN AUTOMOTIVE TECHNOLOGY**	**9**
Electric and Hybrid Vehicles, Fuel Cell, Advanced driving controls – Electronic Stability Program (ESP), Traction control system (TCS), Hill hold control, automatic climate control. Fuel smart engines, Autonomous driving – Google car-GPS Technology.		

Text Book (s)

1	Kirpal Singh, "Automobile Engineering Vol. 1& 2" , Standard Publishers, 7th Edition 2012
2	William. H. Crouse, Donald L Anglin, Automotive Mechanics, 10th Edition, McGraw-Hill, 2017.

Reference (s)

1	Ganesan V.," Internal Combustion Engines" , Third Edition, Tata Mcgraw-Hill ,2007
2	Jain,K.K.,and Asthana .R.B, "Automobile Engineering" Tata McGraw Hill Publishers,New Delhi,2002
3	Julian Happian-Smith "Introduction to Modern Vehicle Design", Publisher: Society of Automotive Engineers Inc.2012.
4	Bosch Automotive Hand Book, 8th Edition, Bentley Publishers, 2011.

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Regulation 2018		Semester V / VI / VII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
O	18MEO004T	ADVANCES IN NANO TECHNOLOGY	3	0	0	3

Prerequisite Course (s)

Physics

Course Objective (s):

- To foundational knowledge of the Nanoscience, nano technology and related fields.
- Educate various concepts of methods of preparation nano materials and synthesis.
- Make them to understand the various types nano materials
- Outline the various characterization techniques of nano materials
- Enable them to apply the various applications of nano materials

Course Outcome (s) (COs):

CO1	Describe the basic conceps of nano science and nanotechnology
CO2	Understand the general methods and preparation Nano technology process
CO3	Describe the various types of nanomaterials.
CO4	Understand the various characterization techniques of nano materials
CO5	Identify various principles and their industrial applications of Nanotechnology.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	2	-	-	-	-	-	-	-	-
CO2	3	3	2	-	2	3	-	-	-	-	-	-	-	-	-
CO3	3	3	-	-	1	3	-	-	-		-	-	-	-	-
CO4	3	3	2	-	2	-	2	1	-	-	-	2	-	-	-
CO5	3	3	2	-	1	3	2	1	-	-	-	2	-	-	-
CO (Avg)	3	3	2	-	1.5	3	2	1	-	-	-	2	-	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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UNIT I	**INTRODUCTION**	**9**
Basic concepts of Nanoscience and technology- Classifications of nanostructured materials- nano particles- quantum dots - quantum wires-ultra thinfilms multilayered materials. Effect on properties of Mechanical, Electronic, Optical, Magnetic and Thermal properties.		
UNIT II	**GENERAL METHODS OF PREPARATION**	**9**
Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE		
UNIT III	**NANO MATERIALS**	**9**
Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth. laser ablation, CVD routes, Plasma CVD), Nanometal oxides-ZnO, TiO2,MgO, ZrO2, NiO, nanoalumina, CaO, AgTiO2, Ferrites, Nanoclays- preparation of Quantum wires, Quantum dots.		
UNIT IV	**CHARACTERIZATION TECHNIQUES**	**9**
X-ray diffraction technique, Scanning Electron Microscopy (SEM) - Transmission Electron Microscopy (TEM) - Surface Analysis techniques of AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation		
UNIT V	**APPLICATIONS**	**9**
NanoInfoTech: - nanocomputer, molecular switch, super chip, nanocrystal, Nano fludics- Building blocks-Biogical applications- Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, Nanoparticles for sunbarrier products - printing, solar cell, battery.		
Text Book (s)		
1	Charles P. Poole, Frank J. Owens, (2000), Introduction to Nanotechnology, John Wiley & Sons.	
2	Nanomaterials:Synthesis, properties and applications C.N.R.Rao, P.J.Thomas and U.Kulkarni, Springer-Verlag (2007).	
Reference (s)		
1	Nanocrystalline materials,Glieter, Progress in Materials Science Vol. 33, pp. 223-315, 1989.	
2	Mechanical alloying and milling, C. Suryanarayana, Progress in Materials Science 46 (2001) 1,184.	
3	Guozhong Cao, Nanosructures and nanomarterials , Imperial college press , 2003.	
4	H.Nalwa ; Encyclopedia of nanoscience and nanotechnology.Ameriacan Scientific publishers.	
5	T. Pradeep, Nano: The Essentials Understanding Nanoscience and Nanotechnology, New Delhi.	

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Regulation 2018		Semester V / VI / VII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
O	18MEO005T	PRODUCT DESIGN AND DEVELOPMENT	3	0	0	3

Prerequisite Course (s)

Nil

Course Objective (s):

- To enable the students to gain knowledge on the process of product development based on customer needs
- To enable the students to understand the standard procedure available for concept development
- To facilitate the students to use design process and system level design issues
- To make the students to familiarize with the Intellectual property rights
- To develop the students creative and Innovative skills

Course Outcome (s) (COs):

CO1	Understand the process to plan and develop products
CO2	List the process of collecting information and develop product specifications
CO3	Discuss the concept generation, selection and testing processes.
CO4	Explain the concepts of industrial design and design for manufacture
CO5	Explain about Intellectual property rights and how to write claims

CO-PO Mapping

COs	POs												PSOs		
	PO 1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO12	PSO 1	PSO2	PSO 3
CO1	3	3	3	1	2	-	-	1	-	-	-	2	-	-	-
CO2	3	3	3	1	2	-	-	1	-	-	-	2	-	-	-
CO3	3	3	3	3	3	3	3	2	-	-	1	2	-	-	-
CO4	3	3	2	1	2	1	1	1	-	-	1	2	-	-	-
CO5	3	2	2	-	2	-	2	3	-	-	-	2	-	-	-
CO (Avg)	3	2.8	2.6	1.5	2.2	2	2	1.6	-	-	1	2	-	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	CREATIVITY	9
Concept and history of creativity, need for creativity, creative environment, stages of creativity process, creativity and intelligence, creative problem solving – brain storming and various techniques, lateral thinking. Role of creativity in entrepreneurship – creativity vis-à-vis innovation, conceptualizing innovation, types of innovation, sources of innovation, goals of innovation, process of technological innovation, diffusion of innovation, factors contributing to successful technological innovation, failure of innovations.		
UNIT II	**PROJECT PLANNING AND EVALUATION**	**9**
Definition and purpose of project, collection of ideas, screening ideas, selection criteria for new projects, development of project plan, project evaluation – purpose, kinds of evaluation, stages of evaluation process, techniques of project evaluation, project analysis, benefits and risks of new projects.		
UNIT III	**PRODUCT DEVELOPMENT AND EVALUATION**	**9**
Definition – Estimation of Manufacturing cost – reducing the component costs and assembly costs – Minimize system complexity – Prototype basics – principles of prototyping – planning for prototypes – Economic Analysis – Understanding and representing tasks – baseline project planning – accelerating the project – project execution.		
UNIT IV	**PRODUCT PRICING AND MARKETING RESEARCH**	**9**
Objectives, pricing, decisions and pricing methods, pricing management. Introduction, uses, process of marketing research, Components of marketing plan-strategy formulations and the marketing process, implementations, portfolio analysis, BCG, GEC grids		
UNIT V	**PROTECTION OF INNOVATION**	**9**
Intellectual property (IP), classes of IP – industrial property and copyrights; Intellectual Property Rights(IPR); Patents, patentability, patent acts, governing laws, history of patent laws and acts, patent administration; patenting process – patent application, patent search, prosecution, publication, examination, opposition, grant, renewal, patent rights; international code for patents. Intellectual Property Rights, Write the description of the invention, Refine Claims, Pursue application. Economics and Management Accelerating Projects, Project Execution		

Text Book (s)

1	Frederick Betz, Managing Technological innovation, John Wiley & Sons, Inc., Third Edition, 2015
2	Product design and development "Karl T Ulrich; Steven D Eppinger" New York, NYMcGraw-Hill Education,2016

Reference (s)

1	Product Design Kavin N Aotto, Kritine I Wood, Prentice Hall Publications 2015
2	Dieter.G.E., —Engineering Design, McGraw Hill Company International Edition 2017
3	[illegible] Per Koch, Innovation in Public Sector Services: Entrepreneurship, Creativity and Management, Edward Elgar Publishing Limited, 2012.

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Regulation 2018		Semester III / VI / V /VI / VII	Total Hours	15
Category	Course Code	Course Name	Credit	1
X	18MEX001J	CERTIFICATION COURSE IN MODELING		

Course Objective (s):

The course is aimed at giving exposure to and enhancing the knowledge and skills of engineers involved in CAD packages and for those who want to provide training to others in this area.

It gives exposure and on hand experience in the field of CAD, 3D Modeling and Analysis.

Course Outcome (s) (COs):

CO1	Understand the concepts of CAD and CAD tools
CO2	Design and draft 2D and 3D models, Understand concepts 3D Modeling: Concepts, Wireframe, Surface, and Solid Modeling
CO3	Understand the concepts of Analysis.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	-	-	-	-	-	-	1	-	-	-
CO2	3	3	3	2	3	-	-	-	-	-	-	1	-	-	1
CO3	3	2	2	2	2	-	-	-	-	-	-	1	-	-	1
CO (Avg)	3	2.3	2.3	2	2.3	-	-	-	-	-	-	1	-	-	1

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

UNIT I	FUNDAMENTALS OF CAD	05

Drawings- 2d Modeling- Creating Views Sectional Views Detail Views - Dimensioning Surface Texture Weld Symbol Tolerance Standard Template.

UNIT II	PART MODELLING	05

Extrude-Revolve-Sweep-Thin Features -Fully Constrained- Plane Offset- Rib- Exercise- Plane -Shell – Holes- Helical Sweep- Pattern –Blend -Toroidal Bend -Spinal Bend -Cosmetic -Warp -Solid Free From – Round- Chamfer-Draft

UNIT III	ASSEMBLY MODELLING	05

All Mates - Assembly Pattern -Equation Editor- Editing Parts In A Assembly,

Reference (s)

1	Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 50th Edition, 2014.
2	Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2010.
3	Ibrahim Zeid, 'CAD/CAM Theory and Practice', McGraw-Hill Publishing Co.Ltd., 2015.

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Regulation 2018		Semester III / VI / V /VI / VII	Total Hours	15
Category	**Course Code**	**Course Name**	**Credit**	**1**
X	18MEX002J	CERTIFICATION COURSE IN ANALYSIS		

Course Objective (s):

To expose the students to different applications of simulation and analysis tools.

To give exposure to software tools needed to analyze engineering problems.

Course Outcome (s) (COs):

CO1	Analyze the behavior of a component subjected to structural, dynamic and thermal loading conditions by using Finite Element Method based package.
CO2	Find deformations and stresses in components subjected to combined structural and thermal loads.
CO3	Validate the design of the product by analyzing and comparing the stresses induced with analytical /experimental results.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	-	-	-	-	-	-	-	2	-	1
CO2	3	3	3	2	3	-	-	-	-	-	-	-	2	-	1
CO3	3	3	3	2	3	-	-	-	-	-	-	-	2	-	1
CO (Avg)	3	3	3	2	3	-	-	-	-	-	-	-	2	-	1

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

UNIT I	**PREPROCESSING**	**05**

Introduction - Mechanical Basics- General Preprocessing-Classifications, Geometry creation, Meshing, Boundary conditions- Exporting techniques.

UNIT II	**PROCESSING/SOLVING**	**05**

Introduction- Solving methods- Materials properties, residual monitoring, iterative process

UNIT III	**POST PROCESSING**	**05**

Introduction- Plotting techniques, Contours, Vectors, path lines, report creations and validation with experimentations

Reference (s)

1	Sham Tickoo "ANSYS Workbench 14.0 for Engineers & Designers: A Tutorial Approach", Dreamtech Press, 2012.
2	Tadeusz Stolarski , Y. Nakasone, S. Yoshimoto , " Engineering Analysis with ANSYS Software", 1st Edition , Elsevier, 2011.

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Regulation 2018		Semester III / VI / V /VI / VII	Total Hours	15
Category	Course Code	Course Name	Credit	1
X	18MEX003J	ENERGY AUDITING AND MANAGEMENT		

Course Objective (s):

The objective of this course is for the students to gain knowledge of Energy auditing and management.

Discover the Energy auditing techniques

Course Outcome (s) (COs):

CO1	Identify and assess the energy conservation/saving opportunities in different electric system
CO2	Identify and assess energy conservation opportunities in thermal system
CO3	Demonstrate skills required for energy audit and management.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	1	1	2	2	-	-	1	-	-	1	-
CO2	3	2	1	-	1	1	1	1	-	-	1	-	-	2	-
CO3	2	1	-	-	1	1	2	2	-	-	1	-	-	2	-
CO (Avg)	2.6	1.3	1	-	1	1	1.6	1.6	-	-	1	-	-	1.6	-

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

UNIT I	ENERGY AUDIT AND APPLICATIONS	05

Types, methodology, questionnaire development, specific energy consumption (unit wise/section wise), identification of energy conservation measures / technologies, economic and cost benefit analysis, energy benchmarking and targeting, case studies, ESCOS and energy service providers. Energy Conservation Act 2001, ISO standards.

UNIT II	ELECTRICAL ENERGY AUDIT	05

Electrical energy use and electrical energy audit, tariff and billing system, energy and demand charges, electrical demand and load factor improvement, power factor correction, power demand control, demand shifting, maximum demand controllers, transmission and distribution losses.

UNIT III	DEMAND SIDE MANAGEMENT	05

Basic concepts, load research, importance of demand side management, types of DSM, efficiency gains, estimation of energy efficiency potential, barriers for energy efficiency and DSM, measurement and verification protocols, smart grids.

Reference (s)

1	Opens haw Taylor E, "Utilization of Electric Energy", Orient Longman Ltd., 2003.
2	Donald R Wulfinghoff, "Energy Efficiency Manual", Energy Institute Press, 2009.
3	Energy Audit and Management, Volume-I, IECC Press 2003.

Regulation 2018		Semester III / VI / V /VI / VII	Total Hours	15
Category	Course Code	Course Name	Credit	1
X	18MEX004J	DESIGN OF EXPERIMENTS		

Course Objective (s):

To familiarize the various steps involved in the Design of Experiments.

To understand the methods involved in evaluating the machining parameter.

To learn to select the standard methods and procedures.

Course Outcome (s) (Cos):

CO1	Identify the factor and levels of the experiments.
CO2	Demonstrate the applications of these techniques to problems drawn from industry.
CO3	Interprt the concepts of surface designs

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	1	-	-	-	-	-	-	-	-	-	-
CO2	3	2	2	1	1	-	-	-	-	-	-	-	1	-	-
CO3	3	3	2	2	2	-	-	-	-	-	-	-	1	-	-
CO (Avg)	3	2	2	1.5	1.3	-	-	-	-	-	-	-	1	-	-

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

UNIT I	INTRODUCTION TO DOE	05

Introduction to the Design of Experiments – Basic principles of DOE - Planning, Screening, Optimization - Modifying and Using Worksheet Data

UNIT II	FACTORIAL DESIGNS & MIXTURE DESIGNS	05

Overview - Factorial Experiments in Minitab - Choosing a Factorial Design - Preprocess Responses for Analyze Variability - Response Optimizer. Overview - Mixture Experiments in Minitab - Triangular Coordinate Systems - Select Optimal Design - Simplex Design Plot - Analyze Mixture Design - Response Trace Plot.

UNIT III	RESPONSE SURFACE DESIGNS & TAGUCHI DESIGNS	05

Introduction - Define Custom Response Surface Design - Analyze Response Surface Design - Contour/Surface Plots – Response. Introduction - Create Taguchi Design - Analyze Taguchi Design - Predict Taguchi Results

Note: (Use of Minitab or Design of Expert software for DOE)

TEXT BOOK(S):

D.C. Montgomery (2001). Design and Analysis of Experiments, 5th Edition. John Wiley & Sons.

Reference (s)

1	Opens haw Taylor E, "Utilization of Electric Energy", Orient Longman Ltd., 2003.
2	Donald R Wulfinghoff, "Energy Efficiency Manual", Energy Institute Press, 2009.
3	Energy Audit and Management, Volume-I, IECC Press 2003.
4	Energy Conservation in Electrical Systems, Volume-II, IECC Press 2003.

Regulation 2018		Semester III / IV / V/ VI / VII	Total Hours	15
Category	Course Code	Course Name	Credit	1
X	18MEX005J	TOOL DESIGN AND MANUFACTURING		

Prerequisite Course (s)

Nil

Course Objective (s):

The objective of this course is for the students to gain knowledge of Tool Design.

Discover the Four types of a manufacturing.

Course Outcome (s) (COs):

CO1	Understand the basic tool.
CO2	Be able to navigate typical tool design software.
CO3	Be aware of the different manufacturing process.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	1	-	2	-	-	1	-	-	-	-	2	-	1
CO3	3	2	1	-	-	-	-	-	-	-	-	1	1	-	-
CO (Avg)	3	2	1	-	2	-	-	1	-	-	-	1	1.5	-	1

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

UNIT I	INTRODUCTION TO TOOL DESIGN	05

i) History and Development of TOOL.
ii) Need of TOOL, Difference between Conventional and Unconventional tool.
iii) Classification of tool.
iv) Benefits of tool, Applications of tool.

UNIT II	SOFT WARES IN TOOL DESIGN	05

i) Computer Aided Design (SolidWorks)
ii) Computer Aided Drafting (AutoCAD)
iii) Computer Numerical Control (CNC) Programming
iv) Computer Assisted Manufacturing (CAM) (Mastercam) software

UNIT III	MANUFACTURING	05

i) Casting
ii) Forming
iii) Joining
iv) Machining

Reference (s)

1	N.K.METHA "Machine Tool Design and Numerical Control:" Mc, Hill Publications, 2012.
2	N.K.METHA "MACHINE TOOL DESIGN:" Mc, Hill Publications, 1984.
3	Rajput, R K, "Manufacturing Technology", Laxmi Publications (P) Ltd, New Delhi, 2007.
4	Richerd R Kibbe, John E Neely, Roland O Merges and Warren J White, "Machine Tool Practices", Prentice Hall of India, New Delhi, 2003
5	Serope Kalpakjian and Steven R Schmid, "Manufacturing Engineering and Technology", Pearson Education, New Delhi, 2002.

Regulation 2018		Semester III / IV / V/ VI / VII	Total Hours	15
Category	Course Code	Course Name	Credit	1
X	18MEX006J	VEHICLE TECHNOLOGY		

Prerequisite Course (s)

Automobile Engineering

Course Objective (s):

The objective of this course is for the students to gain knowledge of basics in vehicle technology and recent development in vehicles

Course Outcome (s) (COs):

CO1	Understand working principles of various systems in vehicles.
CO2	Understand the concepts of vehicle dynamics.
CO3	Be able to understand the hybrid and fuel cell vehicle technology.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO2	3	2	1	-	-	1	1	-	-	-	-	1	1	-	-
CO3	3	2	1	-	-	1	3	-	-	-	-	1	2	2	1
CO (Avg)	3	2	1	-	-	1	2	-	-	-	-	1	1.5	2	1

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

UNIT I	STUDY OF SYSTEMS IN A VEHICLE	05

i) Power system: gasoline, diesel, bio-diesel, electrical.
ii) Transmission system: clutch, gear trains, steering, brakes.
iii) Suspension systems.
iv) Electronic management system.

UNIT II	VECHILE STRUCTURE AND DYNAMICS	05

i) Chassis.
ii) Introduction to vehicle dynamics.
iii) Aerodynamics of vehicle.
iv) Tire mechanics.

UNIT III	RECENT DEVELOPMENT IN VEHICLE	05

i) Introduction to electric and hybrid vehicle.
ii) Hybrid vehicle architectures
iii) Fuel cell vehicles
iv) Energy management

Reference (s)

1	Kirpal Singh, "Automobile Engineering", Standard publisher's, 13th edition 2013.
2	V.Ganesan, "Internal Combustion Engines" McGraw Hill Publications ,4th edition 2012
3	Chris Mi, M. Abul Masrur, D W Gao, " Hybrid Electric Vehicles – Principles and applications with practical perspectives", Wiley, 2011

Regulation 2018		Semester III / IV / V/ VI / VII	Total Hours	15
Category	Course Code	Course Name	Credit	1
X	18MEX007J	AUTOMOTIVE EXHAUST SYSTEM		

Prerequisite Course (s)

Thermal engineering and Automobile engineering

Course Objective (s):

The main objective of this course is to impart knowledge in automotive pollution control.

Detailed concept of formation and control techniques of pollutants.

Course Outcome (s) (COs):

CO1	Identify exhaust gas emission and its regulations
CO2	Identify the SI engine exhaust formation and its effect
CO3	Identify the CI engine emission and its effect

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	2	3	-	-	-	-	1	-	-	-
CO2	3	2	1	-	-	2	3	-	-	-	-	1	2	-	2
CO3	3	2	1	-	-	2	3	-	-	-	-	1	2	-	2
CO (Avg)	3	1.6	1	-	-	2	3	-	-	-	-	1	2	-	2

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

UNIT I	INTRODUCTION:	05

Pollutants – sources – formation – effects of pollution on environment - human – transient operational effects on pollution – Regulated – Unregulated emissions - Emission Standards.

UNIT II	EMISSIONS IN SI ENGINE	05

Chemistry of SI engine combustion – HC and CO formation in SI engines – NO formation in SI engines – Smoke emissions from SI engines – Effect of operating variables on emission formation

UNIT III	EMISSIONS IN CI ENGINE	05

Basics of diesel combustion – Smoke emission and its types in diesel engines – NOx emission and its types from diesel engines – Particulate emission in diesel engines. Odor, sulfur and Aldehyde emissions from diesel engines – effect of operating variables on emission formation.

Reference (s)

1	Springer and Patterson, "Engine Emission", Plenum Press, 1990
2	Pundir. B.P., " IC Engines Combustion and Emissions" Narosa Publishers, 2010
3	Ramalingam. K.K., "Internal Combustion Engines", Scitech Publications, 2003
4	Ganesan,V., "Internal Combustion Engines", Tata McGraw Hill Co., 2013

Regulation 2018		Semester III / IV / V/ VI / VII	Total Hours	15
Category	Course Code	Course Name	Credit	1
X	18MEX008J	SIX SIGMA CERTIFICATION		

Course Objective (s):

The course will give you an overview of Six Sigma and organizational goals and show you how to apply the DMAIC (Define, Measure, Analyze, Improve, Control) methodology, measure current performance to identify projects, identify root causes of issues, and generate and implement solutions with real life applications on various industry case studies.

Course Outcome (s) (COs):

CO1	Understand the 5S implementation
CO2	Be able to implement the 5S in working area
CO3	Be aware of the different materials TQM tools and Techniques

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	2	-	-	-	-	-	-	-	1	-	2
CO (Avg)	2.3	1.6	1	-	2	-	-	-	-	-	-	-	1	-	2

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

UNIT I	INTRODUCTION TO 5S	05

i) Introduction to 5S
ii) Benefits of implementing 5S
iii) Case studies of 5S implantation in an industry
iv) 5S Implementation in manufacturing and service sector

UNIT II	SIX SIGMA	05

i) Introduction to Six Sigma
ii) Six Sigma Methodology
iii) Six Sigma implementation issues
iv) Six Sigma implementation in manufacturing and service sectors
v) Six Sigma Certification courses

UNIT III	IMPLEMENTATION OF 5S AND SIX SIGMA	05

i) Practical Assignment : 5S implementation in working area (Class room)
ii) Measuring the outcome before and after implementing 5S in class room
iii) Case studies related to Six Sigma
iv) Other TQM Tools and Techniques

Reference (s)

1. The Six Sigma Way: How to Maximize the Impact of Your Change and Improvement Efforts, Second edition Hardcover – 16 Feb 2013 by Peter Pande (Author), Robert Neuman (Author), Roland Cavanagh (Author)
2. The Lean Six Sigma Pocket Tool book: A Quick Reference Guide to Nearly 100 Tools for Improving Quality and Speed: A Quick Reference Guide to 70 Tools for Improving Quality and Speed Paperback – 4 Jul 2005 by David Kovelan (Author), Michael George (Author), John Maxey (Author), Malcolm Upton (Author)

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Regulation 2018		Semester III / IV / V/ VI / VII	Total Hours	15
Category	Course Code	Course Name	Credit	1
X	18MEX009J	QUALITY MANAGEMENT SYSTEMS		

Prerequisite Course (s)

Nil

Course Objective (s):

The objective of this course is for the students to gain knowledge To facilitate the understanding of Quality Management principles and process and quality certifications.

Course Outcome (s) (COs):

CO1	Explain how to protect new and innovative product
CO2	Explain the quality management philosophies and Framework.
CO3	Discuss the need of customer expectations, employee involvement and Supplier partnership.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	-	-	-	-	-	-	-	-	-	-	1	-
CO2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	2	2	2	-	-	1	-	2	-	2	-	-	-	1	-
CO (Avg)	2	2	1.5	-	-	1	-	2	-	2	-	-	-	1	-

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

UNIT I	INTRODUCTION	05

The concept of Quality Management, Quality and Business performance, attitude and Involvement of top management, communication, culture and management systems. Management of Process Quality: Definition of quality, Quality Control, a brief history, Product Inspection vs, Process Control, Statistical Quality Control, Control Charts and Acceptance Sampling.

UNIT II	CUSTOMER FOCUS AND SATISFACTION	05

The importance of customer satisfaction and Loyalty Crating satisfied customers, Understanding the customer needs, Process Vs. Customer, internal customer conflict, quality focus, Customer Satisfaction, role of Marketing and Sales, Buyer –Supplier relationships.

QUALITY MANAGEMENT: Quality Circles, Productivity, Quality and Reengineering: The leverage of Productivity and Quality, Management systems Vs. Technology, Measuring Productivity, Improving Productivity Re - engineering.

UNIT III	THE COST OF QUALITY	05

Definition of the Cost of Quality, Quality Costs, Measuring Quality Costs, use of Quality Cost Information, Accounting Systems and Quality Management. ISO9000: Universal Standards of Quality: ISO around the world, The ISO9000 ANSI/ASQCQ-90. Series Standards, benefits of ISO9000 certification, the third party audit, Documentation ISO9000 and services, the cost of certification implementing the system

Reference (s)

1	Quality Management/KanishkaBedi/Oxford University Press/2011
2	Statistical Quality Control / E.L. Grant / McGraw Hill. 2007
3	James R Evans and William M Lindsay, "The Management and Control of Quality", 6thEdition, South-Western (Thomson Learning), 2005.

Regulation 2018		Semester III / IV / V/ VI / VII	Total Hours	15
Category	Course Code	Course Name	Credit	1
X	18MEX010J	VALUE ANALYSIS AND VALUE ENGINEERING		

Prerequisite Course (s)

Nil

Course Objective (s):

To make the student to understand various terms ,techniques and processes involved in value engineering so as to familiarize with this essential tool

Course Outcome (s) (COs):

CO1	Discuss various phases of value engineering and analysis of function.
CO2	Selection and evaluation of value engineering projects
CO3	Study of value engineering techniques.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	1	-	-	-	-	-	-	1	-	-
CO2	3	2	1	-	-	1	-	-	-	-	2	-	1	-	-
CO3	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO (Avg)	3	1.6	1	-	-	1	-	-	-	-	2	-	1	-	-

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

UNIT I	INTRODUCTION	05

Value Engineering concepts, advantages and applications problem recognitition and role in productivity, criteria for comparison, and element of choice.

UNIT II	ANALYSIS OF FUNCTION	05

Introduction, orientation, information phase, speculation phase, analysis phase .Introduction, orientation, information phase, speculation phase, analysis phase. Selection and evaluations of value engineering. Projects and project selection

UNIT III	VALUE ENGINEERING TECHNIQUES	05

Approach of function Evaluation of function ,determining function ,classifying function ,evaluation of costs, evaluation of worth ,determining worth, evaluation of value.

Reference (s)

1	Del L. Younker, "Value Engineering analysis anmethodology", Marcel Dekker Inc, New York, 2004.
2	Anil Kumar Mukhopadhyaya, "Value Engineering Mastermind: From concept to Value Engineering Certification", SAGE Publications, 2003
3	S,S Iyer,Value Engineering: How to Manual, New Age International publishers 2 nd edition ,2009.
4	Dr.M.A.Bulsaro,Dr.H.R.Thakkar,Product design and value engineering,Charator publishers,1 st edition ,2015
5	Del,L.Longker,Value engineering analysis and methodology, CRC press, New york

Regulation 2018		Semester III / IV / V/ VI / VII	Total Hours	15
Category	Course Code	Course Name	Credit	1
X	18MEOC11J / 18MEX011J	GEOMETRICAL DIMENSIONING AND TOLERANCE		

Prerequisite Course (s)

Nil

Course Objective (s):

The objective of this course is for the students to understand the concepts and industrial symbols behind the dimensioning and tolerance

Course Outcome (s) (COs):

CO1	Understand the applications of dimensioning
CO2	Understand the applications of tolerances
CO3	Read and interpret the industrial drawings

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	1	-	-	-	-	-	-	-	-	-
CO2	3	1	-	-	-	1	-	-	-	-	-	-	-	-	-
CO3	3	2	1	-	-	-	-	1	-	2	-	-	1	-	-
CO (Avg)	3	1.3	1	-	-	1	-	1	-	2	-	-	1	-	-

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

UNIT I	INTRODUCTION TO DIMENSIONING AND TOLERANCE	05

i) History of dimensioning and tolerance
ii) Need of dimensioning and tolerance.
iii) Fundamental drawing rules.
iv) Demonstrate proper way to specify dimensioning and tolerance.

UNIT II	DATUM'S	05

i) Definition and applications of datum's
ii) Datum feature selection and identification.
iii) Inclined and cylindrical datum feature.
iv) Establishing datum and multiple datum feature
v) Partial surface datum feature and datum targets.

UNIT III	CONTROLS AND PROFILES	05

i) Flatness, Straightness, Circularity, Cylindricity
ii) Orientation, Parallelism, Perpendicularity, Angularity
iii) Line Element Controls, Specifying Profile,
iv) Combing Profile Tolerances with Other Geometric Controls
v) A radius refinement with profile

Reference (s)

1	Gene R. Cogorno, "Geometric Dimensioning and Tolerancing for Mechanical Design", McGraw Hill second edition 2010.
2	P. S. Gill, "Textbook of Geometric Dimensioning and Tolerancing", S. K. Kataria & Sons second edition 2009
3	Alex Kurlikowshi, " Fundamentals of Geometric Dimensioning and Tolerancing" ASME, third edition-2009

Regulation 2018		Semester III / IV / V/ VI / VII	Total Hours	15
Category	Course Code	Course Name	Credit	1
X	18MEOC12J / 18MEX012J	MANUFACTURING PROCESS		

Prerequisite Course (s)

Nil

Course Objective (s):

The objective of this course is for the students to gain knowledge of Manufacturing, Assembly and Production.

Course Outcome (s) (COs):

CO1	Understand the different manufacturing process.
CO2	Upon completion of this course, the students can able to apply the different manufacturing
CO3	process and use this in industry for component production.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO2	3	2	1	-	-	1	-	-	-	-	-	1	1	-	-
CO3	3	3	2	1	1	-	-	-	-	-	-	-	1	-	1
CO (Avg)	3	2.5	1.5	1	1	1	-	-	-	-	-	1	1	-	1

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

UNIT I	INTRODUCTION TO INDUSTRY	05

i) History and Development of industry
ii) Need of advanced technologies in industry.
iii) Classification of moulding.
iv) Joining processes.

UNIT II	MANUFACTURING PROCESSES IN INDUSTRY	05

i) Types and characteristics of plastics.
i) Manufacturing of plastic components.
ii) Moulding of thermoplastics.
iii) Injection moulding and working principles and typical applications.

UNIT III	METAL CASTING PROCESSES	05

i) Pattern materials and pattern allowances.
ii) Moulding machines-types and applications.
iii) Principles of special casting processes.
iv) Sheet metal processes.

Reference (s)

1	Rao, P.N. "Manufacturing Technology Foundry, Forming and Welding", 2ndEdition, TMH-2003; 2003.
2	Roy. A. Lindberg, "Processes and Materials of Manufacture",.PHI / Pearson education, 2006.
3	Paul Degarma E, Black J.T and Ronald A. Kosher, "Materials and Processes, in Manufacturing", 7th Edition, Prentice – Hall of India, 1997.

Regulation 2018		Semester III / IV / V/ VI / VII	Total Hours	15
Category	Course Code	Course Name	Credit	1
X	18MEX013J	DESIGN AND METROLOGY		

Prerequisite Course (s)

Nil

Course Objective (s):

The objective of this course is for the students to gain knowledge of Measurements and its importance to Know about Drawings, Dimensioning and Tolerancing

Course Outcome (s) (COs):

CO1	Understand the basic concepts of Metrology
CO2	Aware of Dimensioning and Tolerancing
CO3	Able to Read and Interpret Drawings

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	1	2	-	1	-	-	-	1	-	-	-
CO2	3	1	-	-	1	2	-	-	-	-	-	1	-	-	-
CO3	3	2	1	-	-	-	-	1	-	2	-	-	1	-	-
CO (Avg)	3	1.5	1	-	1	2	-	1	-	2	-	1	1	-	-

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

UNIT I	**METROLOGY**	**05**

i) Concept of Measurement
ii) Linear Angular and Form Measurements
iii) Advances in Metrology (Application of Laser)
iv) Measurements of Mechanical Parameters

UNIT II	**GEOMETRICAL DIMENSIONING & TOLERANCING**	**05**

i) Introduction to Symbols and Terms
ii)Datums
iii)Material Condition and Material Boundary Form , Orientation and Location Tolerances

UNIT III	**READING & INTERPRETATION OF DRAWINGS**	**05**

i) Assembly Drawing
ii) Working Drawing
iii) Detailed Drawing
iv) Free Hand Sketching and Interpretation

Reference (s)

1	Metrology & Measurement, Vinay A Kulkarni , Tata McGraw-Hill, 2009
2	Geometric Dimensioning & Tolerancing, David A Madsen: Goodheart-Willcox Publisher, 2012
3	Machine Drawing , Ajeet Singh Tata McGraw-Hill, 2012
4	Ultimate GD&T Pocket Guide: Alex Krulikowski Ring-bound – 2009
5	"Mechanical Measurements", Beckwith, Marangoni, Lienhard, "Mechanical Measurements", Pearson Education, 2007

Regulation 2018		Semester III / IV / V/ VI / VII	Total Hours	15
Category	Course Code	Course Name	Credit	1
X	18MEX014J	PROBLEM SOLVING METHODS		

Prerequisite Course (s)

Nil

Course Objective (s):

To students can gain knowledge in Problem solving skills in team work.

Course Outcome (s) (COs):

CO1	Choose and apply appropriate problem solving and decision making processes and methods
CO2	Identify common obstacles to effective problem solving and decision making
CO3	Recognize the human variable in problem solving and decision making

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	-	-	-	-	-	1	2	-	1	2	-	1	-
CO2	1	-	-	-	-	-	-	2	2	-	2	2	-	2	-
CO3	1	-	-	-	-	-	-	2	2	-	2	2	-	2	-
CO (Avg)	1	-	-	-	-	-	-	1.6	2	-	1.6	2	-	1.6	-

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

UNIT I	INTRODUCTION TO PROBLEM SOLVING	05

Decision Making and Problem Solving in Organizations
Types of Problems
Categories of Problem Solving

UNIT II	CHARTS AND DIAGRAMS	05

Pareto Chart
Cause and Effect Diagram
Histograms

UNIT III	DECISION MAKING METHODS & IMPLEMENTING DECISIONS	05

Group Decision Making
Decision Methods
Consensus and Ethical Decisions
Basing Decisions on Information
Control Charts
Implementing Decision Results

Reference (s)

1	https://www.coursera.org/learn/problem-solving#instructors
2	Problem Solving: Proven Strategies to Mastering Critical Thinking, Problem Solving and Decision 17 March 2015 by Thomas Richards (Author)
3	Decision Making and Problem Solving Strategies: Learn Key Problem Solving Strategies; Sharpen Your Creative Thinking Skills; Make Effective Decisions – February 1, 2010 by John Adair (Author)

Regulation 2018		Semester III / IV / V/ VI / VII	Total Hours	15
Category	Course Code	Course Name	Credit	1
X	18MEX015J	PRODUCTIVITY IMPROVEMENT TECHNIQUES		

Prerequisite Course (s)

Nil

Course Objective (s):

The course aims to impart basic skills of application of various methods for Productivity Improvement.

Course Outcome (s) (COs):

CO1	Understand Productivity.
CO2	Interpret concepts of Method Study
CO3	Connect the different concepts of Work Measurement..

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	1	-	-	1	-	-	-	-	-	-	1	-	-
CO3	2	2	2	-	-	1	-	-	-	1	-	-	1	-	-
CO (Avg)	2.3	2	1.5	-	-	1	-	-	-	1	-	-	1	-	-

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

UNIT I	PRODUCTIVITY	05

concepts and measurements. Productivity metrics – Quality route to productivity - approach to ERCSS, Individual and Organizational competencies and responsibilities, Value Stream mapping, In-direct productivity - Job analysis.

UNIT II	METHOD STUDY	05

Selection of jobs, recording tools and techniques – Flow chart, Process chart, Man-machine chart, two handed process chart, Process flow diagram, Process Flow Analysis, Analyzing, Development of improved methods.

UNIT III	WORK MEASUREMENT	05

Setting of standard time - Stop watch time study, rating, allowances, Work sampling, Analytical estimation, Synthesis and Predetermined Motion Time Standards (PMTS). Methodology to evaluate resources, Methodology to evaluate capacity, Principles of Assembly line balancing- concepts and Rank position weight method problems.

Reference (s)

1	Introduction to Work study, ILO, Oxford
2	Work Study, Khanna , Dhanpat Rai Publications
3	Total Quality Management , K.C.Arora, Katsons
4	Industrial Engineering and Management, Khana, Dhanpat Rai
5	Industrial Engineering and Management, Reddy, New Age

Regulation 2018		Semester III / IV / V/ VI / VII	Total Hours	15
Category	Course Code	Course Name	Credit	1
X	18MEX016J	ENERGY STORAGE TECHNOLOGIES		

Prerequisite Course (s)

Nil

Course Objective (s):

To understand the basics of energy storages and Technologies

To understand the different methods of Energy Storage

Course Outcome (s) (COs):

CO1	Explain the energy storage in power plant
CO2	Summerize Electric Energy Storage
CO3	Explain the Hybriud energy storage and Energy Management

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	2	2	-	-	-	-	-	-	-	-
CO2	3	2	1	-	-	2	2	-	-	-	-	-	1	1	-
CO3	3	2	2	1	-	2	2	-	-	-	-	-	1	-	1
CO (Avg)	3	2	1.3	1	-	2	2	-	-	-	-	-	1	1	1

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

UNIT I	INTRODUCTION TO ENERGY STORAGE	05

Introduction to energy storage for power systems: Role of energy storage systems, applications. Overview of energy storage technologies: Thermal, Mechanical, Chemical, Electrochemical, Electrical. Efficiency of energy storage systems

UNIT II	ELECTRICAL ENERGY STORAGE	05

Electrical energy storage: Batteries, Super capacitors, Superconducting Magnetic Energy Storage (SMES), charging methodologies, SoC, SoH estimation techniques. Hydrogen production and storage, fuel cells. Mobile storage system: electric vehicle, G2V, V2G

UNIT III	HYBRID ENERGY STORAGE SYSTEMS	05

Hybrid Energy storage systems: configurations and applications. Storage for renewable energy systems: Solar energy, Wind energy, Pumped hydro energy, fuel cells. Energy storage in Microgrid and Smart grid. Energy Management with storage systems, Battery SCADA, Increase of energy conversion efficiencies by introducing energy storage

Reference (s)

1	A. R. Pendse, "Energy Storage Science and Technology", SBS Publishers & Distributors Pvt. Ltd., New Delhi, (ISBN - 13:9789380090122), 2011
2	Electric Power Research Institute (USA), "Electricity Energy Storage Technology Options: A White Paper Primer on Applications, Costs, and Benefits" (1020676), December 2010.
3	Francisco Díaz-González, Andreas Sumper, Oriol Gomis-Bellmunt," Energy Storage in Power Systems", Wiley Publication, ISBN: 978-1-118-97130-7, Mar 2016.

Regulation 2018		Semester III / IV / V/ VI / VII	Total Hours	15
Category	Course Code	Course Name	Credit	1
X	18MEX017J	INDUSTRIAL CONTROL VALVES		

Prerequisite Course (s)

Nil

Course Objective (s):

To understand the basics of control valves and its applications

To understand the global market outlook, competition, growth in industries and job opportunities in a global scale

Course Outcome (s) (COs):

CO1	Explain the basics of control valves, manufacturers, global presence and market outlook
CO2	Interpret the control valves application in industries like power plant and compressors
CO3	Explain the manufacturing of control valves

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	-	-	-	-	-	-	1	-	-	-	-	-
CO2	3	3	2	1	-	1	-	-	-	-	-	-	1	-	-
CO3	3	2	1	-	-	-	-	-	-	-	-	-	1	-	-
CO (Avg)	3	2.6	1.6	1	-	1	-	-	-	1	-	-	1	-	-

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

UNIT I	INTRODUCTION	05

Introduction - Principle of control valves – Classification of control valves - Application of control valves – Making - materials

UNIT II	ADVANTAGES AND DISADVANTAGES OF CONTROL VALVE	05

Advantages and disadvantages of control valve in power plant and compressor industries

UNIT III	MANUFACTURING	05

The makers in global scale - Indigenized control valves makers in India - Market overlook and trends - Job opportunities – Standards in valve

Reference (s)

1	Pippenger, J.J., and R.M. Koff, Fluid Power Control systems, New York: McGraw Hill
2	Herbert E. Merritt: Hydraulic control systems, John Wiley and Sons Inc
3	Anthony Esposito, "Fluid Power with applications", Pearson Education

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Regulation 2018		Semester III / IV / V/ VI / VII	Total Hours	15
Category	Course Code	Course Name	Credit	1
X	18MEX018J	GLASS ENGINEERING		

Prerequisite Course (s)

Nil

Course Objective (s):

To understand the basics of Glass making and various types in real world practice

To understand the applications of commercial and special purpose glasses for various engineering applications

Course Outcome (s) (COs):

CO1	Classify glasses and select suitable type of glass for suitable given application
CO2	Explain the glass making and treatment processes in a glass Industry
CO3	Explain a engineering application of glasses

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	1	-	-	-	-	-	1	-	-
CO2	3	2	1	-	-	-	1	-	-	-	-	-	1	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO (Avg)	3	2	1	-	-	-	1	-	-	-	-	-	1	-	-

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

UNIT I	HISTORY OF GLASS	05

Introduction, History of Glass, Raw Materials & Manufacturing Process, Glass Properties, Care and Storage, Glass Processing, Types of glass based on application, Float Glass, Processed Glasses - (Laminated Safety Glass, Heat Treated Glass, Curved Toughened Glass, Insulated Glass),

UNIT II	SPECIAL PURPOSE GLASSES	05

Reflective & Coated Glass, Special Purpose Glasses for fire resistance, bullet proof & sound proof requirements, Decorative Glass, Standards and Testing

UNIT III	APPLICATION	05

Fields of application - applied engineering - facades - selection of glass for facades

Reference (s)

1	Glass Engineering Handbook, by Errol Bertram Shand (Author), W. H. Armistead (Foreword), Literary Licensing, LLC (May 19, 2012)
2	Introduction to Glass Science and Technology , Royal Society of Chemistry, James E Shelby, 12 Jan 2005

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19 OCT 2020
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Regulation 2018		Semester III / IV / V/ VI / VII	Total Hours	15
Category	Course Code	Course Name	Credit	1
X	18MEX019J	OPTIMIZATION TECHNIQUES		

Prerequisite Course (s)

Nil

Course Objective (s):

The objective of this course is to gain knowledge about basics of various Optimization Techniques.

Course Outcome (s) (COs):

CO1	Able to understand the need and classification of Optimization Techniques.
CO2	Able to understand numerical Optimization Techniques.
CO3	Be aware of recent Optimization Techniques.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	-	-	-		-	-
CO2	2	2	2	1	2	-	-	-	-	-	1	-	2	2	2
CO3	2	2	2	2	2	-	-	-	-	-	1	-	2	2	3
CO (Avg)	2.3	2	1.6	1.5	2	-	-	-	-	-	1	-	2	2	2.5

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

UNIT I	INTRODUCTION TO OPTIMIZATION TECHNIQUES	05

i) Introduction of optimization.
ii) Need for Optimization.
iii) Classification of Optimization techniques.
iv) Classical Optimization Techniques

UNIT II	NUMERICAL OPTIMIZATION TECHNIQUES	05

i) Introduction of Numerical optimization
ii) Linear Programming.
iii) Integer Programming

UNIT III	ADVANCED OPTIMIZATION TECHNIQUES	05

i) Ant colony Optimization
ii) Simulated Annealing
iii) Genetic Algorithm

Reference (s)

1	Philips, Ravindran and Solberg, "Operations Research", John Wiley,2002.
2	J.K.Sharma, "Operations Research Theory and Applications", Macmillan India, 3rd Edition, 2009.
3	R.Pannerselvam, "Operational Research", PHI Learning pvt ltd., New Delhi, second Edition, 2010.
4	Taha H.A., "Operations Research", Prentice Hall of India, Eighth Edition, 2012.

Regulation 2018		Semester III / IV / V/ VI / VII	Total Hours	15
Category	Course Code	Course Name	Credit	1
X	18MEX020J	INDIAN PATENT LAWS		

Prerequisite Course (s)

Nil

Course Objective (s):

To make students familiar about Indian patent law

To make the students find the patentability of any invention

To make the students aware of legal background of various process of Indian Patent

Course Outcome (s) (COs):

CO1	Summarize the various provisions of Indian Patent Law
CO2	Find patentability of any invention
CO3	Assess the legal provisions of Indian patent system

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	2	-	3	-	2	-	-	-	-	-
CO2	-	-	-	-	-	3	1	3	-	2	1	-	-	-	-
CO3	-	-	-	-	-	3	1	3	-	1	1	-	-	-	-
CO (Avg)	-	-	-	-	-	2.6	1	3	-	1.6	1	-	-	-	-

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

UNIT I	INTRODUCTION TO INTELLECTUAL PROPERTY	05

Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights

Preliminary, Inventions Not Patentable, Applications for Patents, Publication and Examination of Applications, Opposition Proceedings to Grant of Patents, Anticipation , Provisions for Secrecy of Certain Inventions

UNIT II	PATENT LAWS	05

Grant of Patents and Rights Conferred Thereby, Patents of Addition, Restoration of Lapsed Patents, Surrender and Revocation of Patents, Register of Patents, Patent Office and Its Establishment Powers of Controller Generally, Working of Patents, Compulsory Licenses and evocation, Central Government, Suits Concerning Infringement of Patents, Appeals to the Appellate Board, Penalties, Patent Agents, International Arrangements

UNIT III	NEW DEVELOPMENT OF INTELLECTUAL PROPERTY	05

New developments in trade mark law; copy right law, patent law, intellectual property audits. International overview on intellectual property, international - trade mark law, copy right law, international patent law, international development in trade secrets law

Reference (s)

1	Indian Patent Act ,1970
2	Indian Patent Rules,2003
3	Intellectual property rights: Unleashing the knowledge economy, prabuddha ganguli, Tata Mc Graw Hill Publishing Company ltd. 2001

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Regulation 2018		Semester III / IV / V/ VI / VII	Total Hours	15
Category	Course Code	Course Name	Credit	1
X	18MEX021J	3D PRINTING		

Prerequisite Course (s)

Nil

Course Objective (s):

The objective of this course is for the students to gain knowledge of Additive Manufacturing, and File Format (stereolithography).

Discover the three stages of a 3D print: modeling, slicing and printing

Course Outcome (s) (COs):

CO1	Understand the design issues for a 3D printable file
CO2	Be able to navigate typical 3D model databases
CO3	Be aware of the different materials available for consumer 3D printing

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	3	-	-	-	-	-	-	-	-	-	-
CO2	3	2	2	1	3	1	-	-	-	-	-	-	2	-	2
CO3	2	2	1	-	3	1	-	-	-	-	-	-	1	-	2
CO (Avg)	2.6	2	1.3	1	3	1	-	-	-	-	-	-	1.5	-	2

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

UNIT I	INTRODUCTION TO ADDITIVE MANUFACTURING SYSTEMS	05

i) History and Development of AM.
ii) Need of AM, Difference between AM and CNC.
iii) Classification of AM Processes.
iv) N Benefits of AM, Applications of AM.

UNIT II	3D PRINTING MANUFACTURING SYSTEMS	05

i) Three Dimensional Printing (3DP): Principle, Process, Advantages, Limitations, Applications.
ii) Machine Specifications.
iii) Printing process
iv) Suitable software (Cura)
v) 3D Printing with support material.

UNIT III	3D PRINTING MATERIALS	05

i) ABS
ii) PLA
iii) 3D Printing with 2 colors
iv) Cutting and repairing process

Reference (s)

1	Pham D.T. and Dimov S.S., "Rapid Manufacturing; the technologiesand application of RPT and Rapid tooling", Springer, London 2001.
2	Gebhardt, A., "Rapid prototyping", Hanser Gardener Publications, 2003.
3	Hilton, P.D. and Jacobs, P.F., "Rapid Tooling: Technologies and Industrial Applications", CRCpress, 2005.
4	Ian Gibson, David Rosan, Brent Stucker, "Additive Manufacturing Technologies", Springer, 2010.
5	Chua C.K., Leong K.F., and Lim C.S., "Rapid Prototyping: Principles and Applications", Second edition, World scientific Publishers, 2003.

Regulation 2018		Semester III / IV / V/ VI / VII	Total Hours	15
Category	Course Code	Course Name	Credit	1
X	18MEX022T	INDIAN BUSINESS LAWS		

Prerequisite Course (s)

Nil

Course Objective (s):

To provide the brief idea about the frame work of Indian Business Laws.

To orient students, about the legal aspects of business.

To familiarize the students with case law studies related to Business Laws

Course Outcome (s) (COs):

CO1	Gain Knowledge about business law
CO2	Awareness about contract act
CO3	Bringing awareness about sales and goods act

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	2	-	2	-	1	-	1	-	-	-
CO2	-	-	-	-	-	2	-	2	-	2	-	1	-	-	-
CO3	-	-	-	-	-	2	-	2	-	2	-	1	-	-	-
CO (Avg)	-	-	-	-	-	2	-	2	-	1.6	-	1	-	-	-

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

UNIT I	INTRODUCTION	05

Agreement, kinds of Agreements, Contract- kinds of contracts: Valid, Void, Voidable, Contingent and Quasi Contract and E-contract, distinguish between Agreement and Contract

UNIT II	INDIAN CONTRACT ACT	05

Essentials of Valid proposal or offer, counter offer, Standing or open offer, distinguish between offer and invitation to offer, Acceptance-definition, Essentials of a valid acceptance, Promise. Communication of Offer and acceptance and Revocation.

UNIT III	THE SALE OF GOODS ACT	05

Law of Indemnity and Guarantee, Law of Bailment and pledge, Law of Agency, Conditions and Warranties, Transfer of property as between the seller and the buyer, Rights of an unpaid seller

Reference (s)

1	Kapoor N.D., Elements of Mercantile Law, All India, Sultan Chand & Sons, 2014.
2	R S N Pillai., Business Law, S. Chand Publishing, 1999
3	Denis J. Keenan, Sarah Riches, Business Law, Pearson/Longman, 2005

Regulation 2018		Semester III / IV / V/ VI / VII	Total Hours	15
Category	Course Code	Course Name	Credit	1
X	18MEOC23J / 18MEX023J	INDUSTRY 4.0		

Prerequisite Course (s)

Nil

Course Objective (s):

To learn about the basics of Internet of Things

To learn about the Automation in Industry 4.0

Course Outcome (s) (COs):

CO1	Describe the introduction of Industry 4.0
CO2	Illustrate the automation and factors of Industry 4.0
CO3	Estimate the technologies and function concept

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	1	-	-	-	-	-	-	-	-	-
CO2	3	2	2	-	2	1	-	-	-	-	1	-	1	2	1
CO3	3	2	2	1	2	1	-	-	-	2	1	-	2	2	1
CO (Avg)	3	2	2	1	2	1	-	-	-	2	1	-	1.5	2	1

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

UNIT I	INTRODUCTION	05

Industry 4.0 : The Hype, the Reality and the Challenges - Need for industry 4.0 – Connectivity - Industrial Revoluations - Smart Manufacturing - Smart Devices and Products - Drivers of Industry 4.0 - Predictive Analytics - Support System for Industry 4.0 - Internet of Services (IoS)

UNIT II	AUTOMATION AND FACTORS OF INDUSTRY 4.0	05

Automotive Industry - Robotic Automation and Collaborative - Mobile Computing - Designing Industrial Internet Systems – IoT concepts for Industry 4.0 - Function aspect of technologies - Technology classification of I4.0 - Closed Loop Economy - Concept of Knowledge Economy - Sustainability and circular economy

UNIT III	TECHNOLOGIES AND FUNCTION CONCEPT INDUSTRY 4.0	05

Security Challenges in the Industry 4.0 - Intelligent Objects of CPS - Cyber Security - Wireless Communication - Cloud Computing and Industry 4.0 - 3D Printing and Manufacturing – consumer products in 3D printing - Artificial Intelligence and Decision-Making of I4.0 - E-commerce for Manufacturing

Reference (s)

1	Mohammad Dastbaz , Peter Cochrane "Industry 4.0 and Engineering for a Sustainable Future" Springer ISBN 978-3-030-12953-8- 2019.
2	Alasdair Gilchrist "Industry 4.0, The Industrial Internet of Things" Springer ISBN-13 (electronic): 978-1-4842-2047-4 - 2016
3	Elena G. Popkova, Yulia V. Ragulina, Aleksei V. Bogoviz "Industry 4.0: Industrial Revolution of the 21st Century" Springer,2018