AL-AMEEN ENGINEERING COLLEGE

(AUTONOMOUS)

Accredited by NAAC with "A" Grade :: An ISO Certified Institution
(Affiliated to Anna University, Chennai & Approved by AICTE, New Delhi)
Karundevanpalayam, NanjaiUthukkuli Post, Erode – 638 104, Tamilnadu, INDIA.

CURRICULUM & SYLLABI

SEMESTERS – I to VIII

(Regulations 2020)

CHOICE BASED CREDIT SYSTEM

B.E. Mechanical Engineering

Applicable to the Students admitted in the AY 2020-21 only

KNOWLEDGE LEVELS (BLOOM'S TAXONOMY)

Notation	Knowledge Levels
K1	Remembering
K2	Understanding
K3	Applying
K4	Analysing
K5	Evaluating
K6	Creating

VISION	
	To be a centre of excellence focusing on inventiveness for uplifting rural and the underprivileged with values, culture and high degree of trans-disciplinary expertise.

MISSION	
M1	To groom confident, wholesome mechanical engineers with good communication and entrepreneurial skills to transform the world of work in holism.
M2	To develop diverse experiences in students for enriching rural and under-privileged communities.
M3	To develop students focused on career in industries, engineering start-ups and management with awareness of social, economic and ethical impacts.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)	
PEO 1	Graduates will be prepared with critical thinking and ampliative abilities for the transformational mechanical engineering of the future.
PEO 2	Graduates with an interest in, and aptitude for starting-up and growing their own new firms in embedded systems of mechanical engineering.
PEO 3	Graduates will be prepared to demonstrate their ability to work effectively as a team member and accomplish research in an ever-changing professional environment.
PEO 4	Graduates will be prepared with an ethical work culture for taking sustainable mechanical engineering practices to the rural and the under-privileged.

PROGRAM OUTCOMES (POs)	
PO 1	**Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO 6	**The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage

	projects and in multidisciplinary environments.
PO 12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

PROGRAM SPECIFIC OUTCOMES (PSOs)	
PSO 1	Apply interdisciplinary engineering knowledge and skills, specifically the embedded systems in order to fit into core mechanical engineering including algorithms.
PSO 2	Designing, commissioning, implementing and operating environmentally sustainable safe systems by harnessing renewable energy, related to mechanical and allied engineering tasks.

CURRICULUM

SEMESTER I

Sl. No.	Course Code	Course Title	Category	CIA	ESE	L	T	P	C
THEORY COURSES									
1	20MA1T1	Engineering Mathematics-I	BS	50	50	3	1	0	4
2	20CY1T2	Engineering Chemistry	BS	50	50	3	0	0	3
3	20EN1T3	Communicative English-I	HS	50	50	3	1	0	4
4	20PH1T4	Engineering Physics	BS	50	50	3	0	0	3
5	20CS1T5	Fundamental of Computing and Programming	ES	50	50	3	0	0	3
LABORATORY COURSES									
6	20GE1L1	Physics and Chemistry Laboratory	BS	50	50	0	0	3	1.5
7	20CS1L2	Computer Practices Laboratory	ES	50	50	0	0	3	1.5
MANDATORY COURSE									
8		Universal Human Values 1 - Induction Programme	MC	-	-	-	-	-	-
Total						**15**	**2**	**6**	**20**

SEMESTER II

Sl. No.	Course Code	Course Title	Category	CIA	ESE	L	T	P	C
THEORY COURSES									
1	20MA2T1	Engineering Mathematics-II	BS	50	50	3	1	0	4
2	20EN2T3	Communicative English-II	HS	50	50	3	0	0	3
3	20EE2T4	Basics of Electrical Engineering	ES	50	50	3	0	0	3
4	20ME2T5	Engineering Mechanics	ES	50	50	3	1	0	4
THEORY COURSES WITH LABORATORY COMPONENTS									
6	20ME2LT	Engineering Drawing Practices	ES	50	50	2	0	2	3
LABORATORY COURSES									
5	20EM2L1	Engineering Practices Laboratory	ES	50	50	0	0	3	1.5
8	20EE2L2	Basics of Electrical Engineering Laboratory	ES	50	50	0	0	2	1
MANDATORY COURSE									
8	20CY2T2	Environmental Sciences	MC	100	--	3	0	0	0
Total						**17**	**2**	**7**	**19.5**

SEMESTER III

Sl. No.	Course Code	Course Title	Category	CIA	ESE	L	T	P	C
THEORY COURSES									
1	20EC3T1	Basics of Electronics Engineering	ES	50	50	3	0	0	3
2	20ME3T2	Manufacturing Technology -I	PC	50	50	3	0	0	3
3	20MA3T3	Transforms and Partial Differential Equations	BS	50	50	3	1	0	4
4	20ME3T4	Fluid Mechanics and Machinery	PC	50	50	3	0	0	4
5	20ME3T5	Mechanics of Materials	PC	50	50	3	1	0	4
6	20HSCT6	Principles of Management	HS	50	50	3	0	0	3
LABORATORY COURSES									
7	20ENCL1	Communication Skills Laboratory	HS	50	50	0	0	2	1
8	20ME3L2	Fluid Mechanics Laboratory	PC	50	50	0	0	2	1
9	20ME3L3	Strength of Materials Laboratory	PC	50	50	0	0	2	1
Total						**18**	**2**	**6**	**24**

SEMESTER IV

Sl. No.	Course Code	Course Title	Category	CIA	ESE	L	T	P	C
THEORY COURSES									
1	20MA4T1	Statistics and Numerical methods	BS	50	50	3	1	0	4
2	20ME4T2	Manufacturing Technology -II	PC	50	50	3	0	0	3
3	20ME4T3	Theory of Machines	PC	50	50	3	1	0	4
4	20ME4T4	Thermal Engineering-I	PC	50	50	3	1	0	4
5	20CSCT5	Python Programming	ES	50	50	3	0	0	3
LABORATORY COURSES									
6	20ME4L1	Theory of Machines Laboratory	PC	50	50	0	0	2	1
7	20ME4L2	Manufacturing Process Laboratory	PC	50	50	0	0	2	1
MANDATORY COURSE									
8	20HSCT1	Universal Human Values 2: Understanding Harmony	HS	100	--	2	1	0	3
Total						**17**	**4**	**4**	**23**

SEMESTER V

Sl. No.	Course Code	Course Title	Category	CIA	ESE	L	T	P	C
THEORY COURSES									
1	20ME5T1	Thermal Engineering-II	PC	50	50	3	1	0	4
2	20ME5T2	Design of Machine Elements	PC	50	50	3	1	0	4
3		Professional Elective-I	PE	50	50	3	0	0	3
4		Open Elective-I / SWAYAM	OE	50	50	3	0	0	3
5		Open Elective-II / SWAYAM	OE	50	50	3	0	0	3
THEORY COURSES WITH LABORATORY COMPONENTS									
6	20ME5LT1	Dynamics of Machinery	PC	50	50	2	0	4	4
LABORATORY COURSE									
7	20ME5L1	Thermal Engineering Laboratory	PC	50	50	0	0	3	1.5
8	20ME5L2	CAD / CAM Laboratory	PC	50	50	0	0	4	2
MANDATORY COURSE									
9	20MCCT1	Constitution of India	MC	100	--	3	0	0	0
Total						**20**	**2**	**12**	**24.5**

SEMESTER VI

Sl. No.	Course Code	Course Title	Category	CIA	ESE	L	T	P	C
THEORY COURSES									
1	20ME6T1	Finite Element Analysis	PC	50	50	3	1	0	4
2	20ME6T2	Design of Transmission Systems	PC	50	50	3	1	0	4
3		Professional Elective-II	PE	50	50	3	0	0	3
4		Open Elective III / SWAYAM	OE	50	50	3	0	0	3
THEORY COURSE WITH LABORATORY COMPONENTS									
5	20ME6LT1	Heat and Mass Transfer	PC	50	50	2	0	4	4
LABORATORY COURSE									
6	20ME6L1	Simulation and Analysis Laboratory	PC	50	50	0	0	4	2
7	20ME6L2	Mini project	EEC	100	--	0	0	2	1
MANDATORY COURSE									
8	20PT6T2	Career Competency Development	EEC	100	--	1	0	0	0
Total						**15**	**2**	**10**	**21**

SEMESTER VII

Sl. No.	Course Code	Course Title	Category	CIA	ESE	L	T	P	C
THEORY COURSES									
1	20ME7T1	Metrology and Measurements	PC	50	50	3	0	0	3
2		Professional Elective-III	PE	50	50	3	0	0	3
3		Professional Elective-IV	PE	50	50	3	0	0	3
4		Open Elective-IV / SWAYAM	OE	50	50	3	0	0	3
THEORY COURSE WITH LABORATORY COMPONENTS									
5	20ME7LT1	Mechatronics	PC	50	50	2	0	4	4
LABORATORY COURSE									
6	20ME7L1	Metrology and Measurements Laboratory	PC	50	50	0	0	4	2
7	20ME7L2	Design project	EEC	100	--	0	0	4	2
Total						**14**	**0**	**12**	**20**

SEMESTER VIII

Sl. No.	Course Code	Course Title	Category	CIA	ESE	L	T	P	C
LABORATORY COURSES									
1	20ME8L1	Project Work	EEC	50	50	0	0	20	10
2	20ME8L2	Industrial Training / Internship	EEC	100	0	4 Weeks			2
Total						**0**	**0**	**20**	**12**

Total Credits: 164

HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT (HS)

S. No.	Course Code	Course Title	L	T	P	C
1	20EN1T3	Communicative English I	3	1	0	4
2	20EN2T3	Communicative English II	3	0	0	3
3	20ENCL1	Communication Skills Laboratory	0	0	2	1
4	20HSCT6	Principles of Management	3	0	0	3
5	20HSCT1	Universal Human Values 2: Understanding Harmony	2	1	0	3

BASIC SCIENCES (BS)

Sl.No.	Course Code	Course Title	L	T	P	C
1	20MA1T1	Engineering Mathematics-I	3	1	0	4
2	20CY1T2	Engineering Chemistry	3	0	0	3
3	20PH1T4	Engineering Physics	3	0	0	3
4	20GE1L1	Physics and Chemistry Laboratory	0	0	3	1.5
5	20MA2T1	Engineering Mathematics-II	3	1	0	4
6	20MA3T3	Transforms and Partial Differential Equations	3	1	0	4
7	20MA4T1	Statistics and Numerical Methods	3	1	0	4

ENGINEERING SCIENCES (ES)

Sl.No.	Course Code	Course Title	L	T	P	C
1	20CS1T5	Fundamentals of Computing and Programming	3	0	0	3
2	20CS1L2	Computer Practices Laboratory	0	0	3	1.5
3	20EE2T4	Basics of Electrical Engineering	3	0	0	3
4	20ME2T5	Engineering Mechanics	3	1	0	4

5	20ME2LT	Engineering Drawing Practice	2	0	2	3
6	20EM2L1	Engineering Practices Laboratory	0	0	3	1.5
7	20EE2L2	Basics of Electrical Engineering Laboratory	0	0	2	1
8	20EC3T1	Basics of Electronics Engineering	3	0	0	3
9	20CSCT5	Python Programming	3	0	0	3

PROFESSIONAL CORE (PC)

Sl.No.	Course Code	Course Title	L	T	P	C
1	20ME3T2	Manufacturing Technology -I	3	0	0	3
2	20ME3T4	Fluid Mechanics and Machinery	3	0	0	3
3	20ME3T5	Mechanics of Materials	3	1	0	4
4	20ME3L2	Fluid Mechanics Laboratory	0	0	2	1
5	20ME3L3	Strength of Materials Laboratory	0	0	2	1
6	20ME4T2	Manufacturing Technology -II	3	0	0	3
7	20ME4T3	Theory of Machines	3	1	0	4
8	20ME4T4	Thermal Engineering-I	3	1	0	4
9	20ME4L1	Theory of Machines Laboratory	0	0	2	1
10	20ME4L2	Manufacturing Process Laboratory	0	0	2	1
11	20ME5T1	Thermal Engineering-II	3	1	0	4
12	20ME5T2	Design of Machine Elements	3	1	0	4
13	20ME5LT1	Dynamics of Machinery	2	0	4	4
14	20ME5L1	Thermal Engineering Laboratory	0	0	3	1.5
15	20ME5L2	CAD / CAM Laboratory	0	0	4	2
16	20ME6T1	Finite Element Analysis	3	1	0	4

17	20ME6T2	Design of Transmission Systems	3	1	0	4
18	20ME6LT1	Heat and Mass Transfer	2	0	4	4
19	20ME6L1	Simulation and Analysis Laboratory	0	0	4	2
20	20ME7T1	Metrology and Measurements	3	0	0	3
21	20ME7LT1	Mechatronics	2	0	4	4
22	20ME7L1	Metrology and Measurements Laboratory	0	0	4	2

PROFESSIONAL ELECTIVES (PE)

Semester – V (Elective I)						
Sl. No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	20ME5E1	CAD / CAM / CIM	3	0	0	3
2	20ME5E2	Tool Design	3	0	0	3
3	20ME5E3	Composite Materials and Mechanics	3	0	0	3
4	20ME5E4	Design for Manufacturing and Assembly	3	0	0	3
5	20ME5E5	Instrumentation and Control	3	0	0	3
6	20ME5E6	Hydraulics and Pneumatics	3	0	0	3
7	20ME5E7	Internal Combustion Engines	3	0	0	3

Semester – VI (Elective II)						
Sl. No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	20ME6E1	Automobile Engineering	3	0	0	3
2	20ME6E2	Non-Destructive Testing and Evaluation	3	0	0	3
3	20HSCT3	Total Quality Management	3	0	0	3
4	20ME6E4	Automation in Manufacturing	3	0	0	3
5	20ME6E5	Quality Control And Reliability Engineering	3	0	0	3
6	20ME6E6	Additive Manufacturing Processes	3	0	0	3

Semester – VII (Elective III)						
Sl. No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	20ME7E1	Introduction to Aircraft Structures	3	0	0	3
2	20ME7E2	Principle of Farm Machineries	3	0	0	3
3	20ME7E3	Power Plant Engineering	3	0	0	3
4	20ME7E4	Energy Conservation in HVAC system	3	0	0	3
5	20ME7E5	Nanotechnology for Mechanical Engineers	3	0	0	3
6	20ME7E6	Industrial Marketing	3	0	0	3

Semester – VII (Elective IV)						
Sl. No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	20ME7E7	Entrepreneurship development	3	0	0	3
2	20ME7E8	Production Planning and Control	3	0	0	3
3	20ME7E9	Computational Fluid Dynamics	3	0	0	3
4	20ME7E10	Industrial Robotics	3	0	0	3
5	20ME7E11	Operational Research	3	0	0	3

OPEN ELECTIVES (OE)

Sl.No.	Course Code	Course Title	L	T	P	C
1	20MEO01	Energy conservation in buildings	3	0	0	3
2	20HSCT2	Professional Ethics	3	0	0	3
3	20MEO03	Air pollution and control	3	0	0	3
4	20MEO04	Industrial Automation	3	0	0	3
5	20MEO05	Renewable Energy Sources	3	0	0	3
6	20MEO06	Fundamental of Ergonomics	3	0	0	3
7	20MEO07	Safety measures for Engineers	3	0	0	3
8	20MEO08	Optimization Techniques	3	0	0	3
9	20MEO09	Building Services	3	0	0	3
10	20ME7E10	Industrial Robotics	3	0	0	3
11	20MEO10	E waste management	3	0	0	3
12	20MEO11	Energy Resources, Economics and Environment	3	0	0	3
13	20MEO12	Innovation by Design	3	0	0	3
14	20MEO13	Energy auditing conservation and management	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)
PRACTICAL COURSES AND PROJECT WORK

Sl. No.	Course Code	Course Title	L	T	P	C
1	20ME6L2	Mini Project	0	0	2	1
2	20ME7L2	Design project	0	0	4	2
3	20ME8L1	Project Work	0	0	20	10
4	20ME8L2	Industrial Training / Internship	4 Weeks			2

MANDATORY COURSES (MC)

Sl.No.	Course Code	Course Title	L	T	P	C
1		Universal Human Values 1 - Induction Programme	0	0	0	0
2	20CY2T2	Environmental Sciences	3	0	0	0
3	20HSCT1	Universal Human Values 2: Understanding Harmony	2	1	0	3
4	20MCCT1	Constitution of India	3	0	0	0
5	20PT6T2	Career Competency Development	1	0	0	0

VALUE ADDED COURSES (VAC)

S.No.	Course Code	Course Title	Credit
1	20MEV01	Yoga for Youth Empowerment	1
2	20MEV02	Basics of Civil Engineering	1
3	20MEV03	Metallography	1
4	20MEV04	Micromachining	1
5	20MEV05	Wind Energy Management	1
6	20MEV06	Solar Energy Management	1
7	20MEV07	Project Management	1

8	20MEV08	Six Sigma	1
9	20MEV09	Professional Skills	1
10	20MEV10	Industrial Design Software	1
11	20MEV11	Industrial Analytical Software	1

CURRICULUM BREAKDOWN STRUCTURE

Subject	AICTE suggested breakdown of credits	Total number of credits	Curriculum Content (% of total number of credits of the program)
Humanities and Social Sciences including Management (HS)	15	**14**	8.54
Basic Sciences (BS)	25	**23.5**	14.33
Engineering Sciences (ES)	24	**23**	14.02
Professional Core (PC)	48	**64.5**	39.33
Program Electives (PE)	18	**12**	7.32
Open Electives (OE)	18	**12**	7.32
Employability Enhancement Courses (EEC) – Practical Courses and Project Work	15	**15**	9.15
Mandatory Courses (MC)	0	0	0
Total	**163**	**164**	**100.00**

CREDIT SUMMARY

Sl. No.	Subject Area	Credits per Semester								Total Credits	AICTE Suggested Credits
		I	II	III	IV	V	VI	VII	VIII		
1	HS	4	3	4	3					14	15
2	BS	11.5	4	4	4					23.5	25
3	ES	4.5	12.5	3	3					23	24
4	PC			13	13	15.5	14	9		64.5	48
5	PE					3	3	6		12	18
6	OE					6	3	3		12	18
7	EEC						1	2	12	15	15
8	MC									0	0
TOTAL		20	19.5	24	23	24.5	21	20	12	164	163

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

SEMESTER I

Sl. No.	Course Code	Course Title	Category	CIA	ESE	L	T	P	C
THEORY COURSES									
1	20MA1T1	Engineering Mathematics I	BS	50	50	3	1	0	4
2	20CY1T2	Engineering Chemistry	BS	50	50	3	0	0	3
3	20EN1T3	Communicative English I	HS	50	50	3	1	0	4
4	20PH1T4	Engineering Physics	BS	50	50	3	0	0	3
5	20CS1T5	Fundamental of Computing and Programming	ES	50	50	3	0	0	3
LABORATORY COURSES									
6	20GE1L1	Physics and Chemistry Laboratory	BS	50	50	0	0	3	1.5
7	20CS1L2	Computer Practices Laboratory	ES	50	50	0	0	3	1.5
MANDATORY COURSE									
8		Universal Human Values 1 - Induction Programme	MC	-	-	-	-	-	-
Total						**15**	**2**	**6**	**20**

Semester	Programme	Course Code	Course Name	L	T	P	C
I	B.E. / B.Tech., Common to all	20MA1T1	ENGINEERING MATHEMATICS I	3	1	0	4

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Identify Eigen values and Eigenvectors and apply orthogonal diagonalization to convert quadratic form to canonical form.	K3	1
CO2	Apply differentiation and integration technique to solve algebraic and transcendental function	K3	2
CO3	Evaluate the total derivative of the function, expand the given as series and locate the maximum and minimum for multivariate function	K5	3
CO4	Solve first order Ordinary Differential Equations and apply them to certain physical situations	K3	4
CO5	Choose appropriate integral techniques to find area and volume of the given region	K5	5

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3		3				1	3	3		3		
CO2	3	3		3				1	3	3		3		
CO3	3	3		3				1	3	3		3		
CO4	3	3		3				1	3	3		3		
CO5	3	3		3				1	3	3		3		

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignments and Tutorials
	3	End Semester Examinations
INDIRECT	1	Course Exit Survey

COURSE CONTENT		
Topic - 1	**MATRICES**	**9 + 3**
Eigen values and Eigen vectors of a real matrix – properties of Eigen values and Eigen vectors (without proof) – Cayley-Hamilton theorem (statement and applications) – orthogonal transformation of a symmetric matrix to diagonal form (concept only) – Reduction of quadratic form to canonical form by an orthogonal transformation		
Topic - 2	**DIFFERENTIATION AND INTEGRATION**	**9 + 3**
Basic differentiation formula for algebraic and transcendental functions – derivatives – differentiability rules and properties (without proof) – basic integral formula for algebraic and transcendental functions – integration by parts – partial fraction methods.		
Topic - 3	**FUNCTIONS OF SEVERAL VARIABLES**	**9 + 3**
Total derivatives – Taylor's series expansion – maxima and minima – Lagrange's multipliers method – Jacobian's method		
Topic - 4	**FIRST ORDER ORDINARY DIFFERENTIAL EQUATION**	**9 + 3**
Leibnitz's equations – Bernoulli's equation – equation of first order and higher degree – Clairaut's form – Linear first order differential equations and its applications.		
Topic - 5	**MULTIPLE INTEGRALS**	**9 + 3**
Double integrals: Double integration in Cartesian co-ordinates – change of order of integration – area as a double integration in Cartesian – volume as a triple integral in Cartesian co-ordinates (simple problems)		

THEORY	**45**		**TUTORIAL**	**15**		**PRACTICAL**	**0**		**TOTAL**	**60**

BOOK REFERENCES	
1	Jain R.K and Iyengar S.R.K, "Advanced Engineering Mathematics", 3rd Edition, Narosa Publishing House, New Delhi, Reprint 2009.
2	Ramana B.V., "Higher Engineering Mathematics", Tata Mcgraw Hill Publishing Company, New Delhi, 2008.
3	Kreyszig E., "Advanced Engineering Mathematics", 9th Edition, John Wiley Sons, 2012.
4	Glyn James., "Advanced Modern Engineering Mathematics", Pearson Education Limited, 2007.
5	N P Bali, Manish Goyal, "A Text Book of Engineering Mathematics", 3rd Edition, Laxmi Publication Private Limited, 2009.

OTHER REFERENCES	
1	https://www.slideshare.net/mailrenuka/matrices-and-application-of-matrices
2	https://www.slideshare.net/mailrenuka/matrices-and-application-of-matrices
3	https://youtu.be/wtuq1oSButE
4	https://www.slideshare.net/abhinavsomani3/applications-of-maths-in-our-daily-life-41607055

Semester	Programme	Course Code	Course Name	L	T	P	C
I	B.E. / B.Tech., Common to all	20CY1T2	ENGINEERING CHEMISTRY	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Categorize the important features of various materials and methods for burgeoning society.	K4	3,5
CO2	Identify the structure of unknown/new compounds with their properties.	K3	4,5
CO3	Analyse new solutions to problems in materials and energy usage in daily life	K4	1,2,3
CO4	Explain the properties & working techniques along with potential applications.	K2	2,3,4
CO5	Choose the appropriate method for specific application in engineering technology.	K3	1,2,3,5

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)

COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3		2					1	3	3		3		
CO2	3	2						1	3	3		3		
CO3	3	2						1	3	3		3		
CO4	3		2					1	3	3		3		
CO5	3	2	2					1	3	3		3		

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignment
	3	End Semester Examinations
INDIRECT	1	Course Exit Survey

COURSE CONTENT		
Topic - 1	**WATER CHEMISTRY**	**9**
Hardness of water – types – units –boiler troubles (scale and sludge) – treatment of boiler feed water – Internal treatment (phosphate, colloidal, carbonate and calgon conditioning) external treatment – Ion exchange process, zeolite process – desalination of brackish water – Reverse Osmosis.		
Topic - 2	**FUELS AND COMBUSTION**	**9**
Fuels: Introduction - classification of fuels – Combustion- coal – Analysis of coal - carbonization - manufacture of metallurgical coke (Otto Hoffmann method) - petroleum - knocking - octane number - diesel oil - cetane number - natural gas - compressed natural gas (CNG) - liquefied petroleum gases (LPG) - power alcohol.		
Topic - 3	**ENERGY STORAGE DEVICES**	**9**
Batteries - Types of batteries – primary battery - dry cell. Secondary battery - lead acid battery, Nickel- Cadmium battery, fuel cells – Hydrogen -Oxygen fuel cell. - Solar energy conversion - solar cells – Application.		
Topic - 4	**SPECTROSCOPY**	**9**
Introduction – Laws of spectroscopy - Block diagram, Instrumentation, Working and application of Visible spectroscopy and Ultra Violet spectroscopy – Infrared spectroscopy – Flame photometry – Atomic adsorption spectroscopy.		
Topic - 5	**ENGINEERING MATERIALS**	**9**
Polymer – Types of polymerization – Preparation, properties, uses of Nylon(6,6), Poly Vinyl Chloride (PVC). Plastics – Types - Rubbers – SBR – Nanomaterial – Synthesis and its applications of Nanomaterial. Abrasives – Classification, Properties- Manufacture of SiC.		

THEORY	**45**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**45**

BOOK REFERENCES	
1	S.S Dara and S.S. Umare ‘Engineering Chemistry’, S.Chand Publication, 2013
2	Jain & Jain ‘Engineering chemistry’ Dhanpat Rai Publishing Company, 2012
3	Shikha Agarwal , Engineering Chemistry, Cambridge University Press, 2015 edition
4	Manas Senapati, Advanced Engineering Chemistry, Firewall Media, 2006

OTHER REFERENCES	
1	https://www.freebookcentre.net/chemistry-books-download
2	https://nptel.ac.in/course.html
3	https://www2.chemistry.msu.edu/faculty/reusch/virttxtjml/polymers.htm
4	https://edu.rsc.org/resources/collections/analytical-chemistry-introductions

Semester	Programme	Course Code	Course Name	L	T	P	C
I	B.E. / B.Tech., Common to all	20EN1T3	COMMUNICATIVE ENGLISH I	3	1	0	4

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Develop language and vocabulary effectively for our real life contexts	K6	1 to 5
CO2	Analyze different spoken discourses like, short talks, comprehend differentdialogues, practice conversation for speaking skills	K4	2 & 3
CO3	Examine grammatical errors using correct vocabulary and generating ideaslogically on a topic	K5	1,3,4 & 5
CO4	Interpret graphical representation for composing passages and paraphrasetechnical texts	K4	4 & 5
CO5	Apply the rules of grammar to parts of speech, tenses, voices, degrees of comparison, compound nouns and articles	K3	1,3,4 & 5

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						3			3	3		3		
CO2						2			3	3		3		
CO3						3			3	3		3		
CO4						2			3	3		3		
CO5						3			3	3		3		

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Grammar Quizzes
	3	End Semester Examinations
INDIRECT	1	Course Exit Survey

COURSE CONTENT		
Topic - 1	**GRAMMAR AND VOCABULARY**	**9 + 3**
Word formation with Prefix and Suffix – Parts of Speech – Tenses - Voices – Degrees of comparison –Compound Nouns - Basic Vocabulary – Homonyms and Homophones – Articles- Idioms – Phrasal verbs – Subject-Verb Agreement.		
Topic - 2	**LISTENING**	**9 + 3**
Introduction to Listening – Listening Comprehension – Extensive and Intensive listening – Pronunciation – Intonation – Stress – Pause – Rhythm – Short and Long conversations.		
Topic - 3	**SPEAKING**	**9 + 3**
An introduction to Speech sounds – Verbal and Non-verbal Communication – Describing places, people,Technical Processes – Telephonic skills – Different types of Interview – Group Discussions – Debates.		
Topic - 4	**READING**	**9 + 3**
Skimming and Scanning – Reading Newspaper articles – Reading different types of texts – SpeedReading – Reading to identify Stylistic Features (Syntax, Lexis, Sentence Structures) – Comprehension.		
Topic - 5	**WRITING**	**9 + 3**
Introduction to aspects of technical writing – Letter writing – Formal Letters – Job application letter with CV and Resume - Official letters- Business letters- Circular letters- Employment letters – Punctuation – Writing reviews on books and movies – recommendations – Creative writing – email writing.		

THEORY	**45**		**TUTORIAL**	**15**		**PRACTICAL**	**0**		**TOTAL**	**60**

BOOK REFERENCES	
1	Board of Editors, Using English, Orient Black Swan, 2015.
2	Practical English Usage, Michael Swan, OUP 1995.
3	Communicative English, J.Anbazhagan Vijay, Global Publishers – Chennai 2018.
4	Effective Communication, Adair, John. London: Pan Macmillan Ltd., 2003.
5	Brilliant Communication Skills, Hasson, Gill. Great Britain: Pearson Education, 2012.

OTHER REFERENCES	
1	http://networketiquette.net/
2	http://www.englishdaily626.com/c-errors.php
3	http://www.dailywritingtips.com/

Semester	Programme	Course Code	Course Name	L	T	P	C
I	B.E. / B.Tech., Common to all	20PH1T4	ENGINEERING PHYSICS	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Classify the extensive properties of materials to use current field.	K2	1,2,3,4,5
CO2	Identify and develop the knowledge of atoms and matter, to apply recent engineering fields.	K3	1,2
CO3	Categorize the various types of materials in engineering and technology like energy conversation methods.	K4	2,3,4,5
CO4	Develop the principle and managing the energy in communication to prompt and efficient manner.	K3	4,5
CO5	Evaluate the materials and fabrication with behaviour by using advanced technical methods to build and develop new applications.	K5	1,2,3,4,5

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2			1	3	2	3	3	3	3	3		
CO2	2	1				3	2	3	3	3	3	3		
CO3	3	2	2			3	2	3	3	3	3	3		
CO4	2					3	2	3	3	3	3	3		
CO5	3	2				3	2	3	3	3	3	3		

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Mini Project
	3	End Semester Examinations
INDIRECT	1	Course Exit Survey

COURSE CONTENT		
Topic - 1	**PROPERTIES OF MATTER**	**9**
Hooke's Law - Stress-Strain Diagram - Elastic moduli - Poisson's Ratio - Expression for bending moment of beam and depression of Cantilever - Expression for Young's modulus by Non-uniform bending and its experimental determination.		
Topic - 2	**CRYSTAL PHYSICS**	**9**
Single crystalline, polycrystalline and amorphous materials – single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices – inter-planar distances - coordination number and packing factor for SC, BCC, FCC, HCP and diamond structures - growth of single crystals: solution and melt growth techniques.		
Topic - 3	**LASER TECHNOLOGY**	**9**
Introduction – principle of spontaneous emission and stimulated emission, population inversion, pumping mechanism. Laser characteristics - Einstein's A and B coefficients derivation. Two, three and four level systems. Threshold gain coefficient- Component of laser. Solid state laser (Nd:YAG). Diode lasers –Application of laser in science and engineering.		
Topic - 4	**THERMAL PHYSICS**	**9**
Transfer of heat energy - thermal conduction, convection and radiation – heat conductions in solids – thermal conductivity - Lee's disc method - theory and experiment - conduction through compound media (series and parallel) – thermal insulation – applications: heat exchangers, refrigerators, ovens and solar water heaters.		
Topic - 5	**NANO TECHNOLOGY**	**9**
Introduction to Nano materials- Moore's law- Properties of Nano materials- Quantum well, wire and dot- Fullerene, Carbon Nanotubes- Application of Nanotechnology in industry.		

THEORY	**45**		**TUTORIAL**	**00**		**PRACTICAL**	**00**		**TOTAL**	**45**

BOOK REFERENCES	
1	Serway and Jewett, "Physics for Scientists and Engineers with Modern Physics", 6th Edition, Thomson Brooks Cole, 2008
2	Charles P. Poole and Frank J.Owens, "Introduction to Nanotechnology", 2nd Edition, Wiley, Delhi, 2008.
3	S.O. Pillai, "Solid state Physics", 6th Edition, New Age International Publishers, 2008.

OTHER REFERENCES	
1	https://nptel.ac.in/courses/115/105/115105099/
2	https://nptel.ac.in/courses/115/106/115106061/
3	https://www.youtube.com/watch?v=_JOchLyNO_w
4	https://www.journals.elsevier.com › Journals
5	https://nptel.ac.in/courses/118/104/118104008/

Semester	Programme	Course Code	Course Name	L	T	P	C
I	B.E. / B.Tech., Common to all	20CS1T5	FUNDAMENTALS OF COMPUTING AND PROGRAMMING	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Understand the word processing tools using text documents	K2	1
CO2	Organize spreadsheet manipulation tools with sheets also describe the presentation and sliding with layouts	K3	1,2
CO3	Develop c program using managing input and output operations.	K6	3
CO4	Analyze an internet usage with social media tools	K4	2
CO5	Design array and string implementation in c programming	K6	3,4,5

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3				3		3					2		
CO2	3		2		2							2		
CO3	3		2		3									
CO4	3		2		2							2		
CO5	3											2		

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignments
	3	End Semester Examinations
INDIRECT	1	Course Exit Survey

COURSE CONTENT		
Topic - 1	**INTRODUCTION TO MS-WORD AND MS-EXCEL**	**9**
Introduction to word – Creating, editing, saving and printing text documents - Font and paragraph formatting - Simple character formatting -Inserting tables, smart art, page breaks -Using lists and styles-Working with images -Using Spelling and Grammar check -Understanding document properties Introduction to Spreadsheet basics - Creating, editing, saving and printing spreadsheets -Working with functions & formulas -Modifying worksheets with color & autoformats -Graphically representing data : Charts & Graphs - Data Menu, Subtotal, Filtering Data -Formatting worksheets -Securing & Protecting spreadsheets		
Topic - 2	**MS-POWERPOINT AND INTERNET**	**9**
Introduction to Powerpoint- Opening, viewing, creating, and printing slides -Applying auto layouts -Adding custom animation -Using slide transitions -Graphically representing data : Charts & Graphs -Creating Professional Slide for Presentation. Internet - Understanding how to search/Google -bookmarking and Going to a specific website -Copy and paste Internet content into your word file and emails -Understanding social media platforms such as Facebook & Many more -learn with best practices		
Topic - 3	**C PROGRAMMING BASICS**	**9**
Problem formulation – Problem Solving - Introduction to ‘ C’ programming –fundamentals – structure of a ‘C’ program – compilation and linking processes – Constants, Variables – Data Types – Expressions using operators in ‘C’ – Managing Input and Output operations – Decision Making and Branching – Looping statements – solving simple scientific and statistical problems.		
Topic - 4	**ARRAYS AND STRINGS**	**9**
Arrays – Initialization – Declaration – One dimensional and Two dimensional arrays. String- String operations – String Arrays. Simple programs- sorting- searching – matrix operations.		
Topic - 5	**FUNCTIONS, STRUCTURES AND UNIONS**	**9**
Function – definition of function – Declaration of function – Pass by value – Pass by reference – Recursion - Structure – need for structure data type – structure definition – Structure declaration – Structure within a structure - Union - Programs using structures and Unions – Storage classes, Pre-processor directives.		

THEORY	**45**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**45**

BOOK REFERENCES	
1	Microsoft Office 2010 In Depth 1st Edition by Joe Habraken (Author) ,2010
2	Byron S Gottfried, “Programming with C”, Schaum’s Outlines, Second Edition, Tata McGraw-Hill,2006.
3	“Computer basics absolute beginners”9thEdition, Michale Miller,2019

OTHER REFERENCES	
1	https://youtu.be/ZXAPCy2c33o
2	https://courses.lumenlearning.com/wm-compapp/chapter/internet-and-powerpoint/
3	https://www.geeksforgeeks.org/c-language-set-1-introduction/
4	https://www.studytonight.com/c/string-and-character-array.php
5	https://www.geeksforgeeks.org/difference-structure-union-c/

Semester	Programme	Course Code	Course Name	L	T	P	C
I	B.E. / B.Tech., Common to all	20GE1L1	PHYSICS & CHEMISTRY LABORATORY	3	0	0	3

COURSE LEARNING OUTCOMES (COs)		
After Successful completion of the course, the students should be able to		RBT Level
CO1	State the aim and develop the procedure to conduct the experiment / exercise in the Physics & Chemistry laboratory Course	K3
CO2	Demonstrate skills at the level of precision (reliably, quickly, smoothly, and accurately with negligible guidance) in performing the experiment / exercise	K3
CO3	Draw inferences from the experiment / exercise conducted and present it professionally	K4
CO4	Demonstrate professionally the results obtained through the experiment / exercise and present conclusions	K4
CO5	Demonstrate an understanding of the concepts, procedures, and applications through verbal and written communication	K3
CO6	Demonstrating an attitude at the level of valuing (attaching values and expressing personal opinions by showing some definite involvement and commitment)	K3

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3								3	3				
CO2	3				3			2	3		1			
CO3	3	2		2		1				3				
CO4	3									3				
CO5	3									3		1		
CO6						2		2	2	2		1		

COURSE ASSESSMENT METHODS		
DIRECT	1	Laboratory Record
	2	Model Practical Examinations
	3	End Semester Examinations
INDIRECT	1	Course Exit Survey

LIST OF EXPERIMENTS	
PHYSICS LABORATORY **(Any Five Experiments)**	
1	Torsional pendulum - determination of moment of inertia and rigidity modulus
2	Determination of young's modulus by non- uniform bending
3	(a) Determination of Wavelength, and particle size using Laser (b) Determination of acceptance angle in an optical fiber.
4	Determination of velocity of sound and compressibility of liquid – Ultrasonic Interferometer.
5	Air wedge – determination of thickness of a thin wire.
6	Determination of band gap of a semiconductor.
LIST OF EXPERIMENTS	
CHEMISTRY LABORATORY **(Any Five Experiments)**	
1	Determination of total, temporary and permanent hardness of water by EDTA method.
2	Estimate the dissolved oxygen content of the given water sample by Winkler's method.
3	Determine the chloride content of the given potassium chloride sample using standardized silver nitrate solution.
4	Determination of iron content of the given solution using a potentiometer
5	Determination of strength of acid using conductivity meter.
6	Using conductance measurements, determine the strength of acids in a mixture.

THEORY	**0**		**TUTORIAL**	**0**		**PRACTICAL**	**30**		**TOTAL**	**30**

BOOK REFERENCES	
1	C. Ramesh Kumar & Y. Devakumari, "Physics Laboratory Manual", Al-Ameen Publications, 2020.
2	N. Jafarulla & C. Krishna Moorthy C "Chemistry Laboratory Manual", Al-Ameen Publications, 2020.

Semester	Programme	Course Code	Course Name	L	T	P	C
I	B.E. / B.Tech., Common to all	20CS1L2	COMPUTER PRACTICES LABORATORY	0	0	3	1.5

COURSE LEARNING OUTCOMES (COs)		
After Successful completion of the course, the students should be able to		RBT Level
CO1	State the aim and develop the procedure to conduct the experiment / exercise in the Computer Practices Laboratory Course	K3
CO2	Demonstrate skills at the level of precision (reliably, quickly, smoothly, and accurately with negligible guidance) in performing the experiment / exercise	K3
CO3	Draw inferences from the experiment / exercise conducted and present it professionally	K4
CO4	Demonstrate professionally the results obtained through the experiment / exercise and present conclusions	K4
CO5	Demonstrate an understanding of the concepts, procedures, and applications through verbal and written communication	K3
CO6	Demonstrating an attitude at the level of valuing (attaching values and expressing personal opinions by showing some definite involvement and commitment)	K3

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3								3	3				
CO2	3				3			2	3		1			
CO3	3	2		2		1				3				
CO4	3									3				
CO5	3									3		1		
CO6						2		2	2	2		1		

COURSE ASSESSMENT METHODS		
DIRECT	1	Laboratory Record
	2	Model Practical Examinations
	3	End Semester Examinations
INDIRECT	1	Course Exit Survey

LIST OF EXPERIMENTS	
1	Study Experiment a) Hardware specification and PC Assembly b) Getting connected to internet
2	Word processing a) Documentation creation, Text Manipulation with scientific notation b) Table Creation, Table Formatting and Conversion c) Mail Merge d) Flow Chart Preparation.
3	Spread Sheet a) Charts- Bar Chart, Pie Chart, Line Chart, X,Y-Chart b) Object Inclusion, Picture and Graphics c) Protecting the Document
4	Power Point Presentation and Access a) Creation of Presentation b) Generation of Report Using Access
5	C Programming a) Simple C Program with Data Types, Expressions and Comment Lines b) Programming with Conditional Statements c) Programming with Branching and Looping Statements d) Programming with Arrays and String e) Programming with Function and Structure

THEORY	**0**		**TUTORIAL**	**0**		**PRACTICAL**	**45**		**TOTAL**	**45**

BOOK REFERENCES	
1	Computer Practices Laboratory manual, Al - Ameen Publications 2020
2	Microsoft Office 2008 In Depth 2nd Edition by Joe (Author) , 2010

OTHER REFERENCES	
1	https://youtu.be/ftyWKjT20S4
2	https://nptel.ac.in/about_nptel.html
3	https://nptel.ac.in/courses/106/106/106106092/

SEMESTER II

Sl. No.	Course Code	Course Title	Category	CIA	ESE	L	T	P	C
THEORY COURSES									
1	20MA2T1	Engineering Mathematics II	BS	50	50	3	1	0	4
2	20EN2T3	Communicative English II	HS	50	50	3	0	0	3
3	20EE2T4	Basics of Electrical Engineering	ES	50	50	3	0	0	3
4	20ME2T5	Engineering Mechanics	ES	50	50	3	1	0	4
THEORY COURSES WITH LABORATORY COMPONENTS									
6	20ME2LT	Engineering Drawing Practices	ES	50	50	2	0	2	3
LABORATORY COURSES									
5	20EM2L1	Engineering Practices Laboratory	ES	50	50	0	0	3	1.5
8	20EE2L2	Basics of Electrical Engineering Laboratory	ES	50	50	0	0	2	1
MANDATORY COURSE									
8	20CY2T2	Environmental Sciences	MC	100	--	3	0	0	0
Total						**17**	**2**	**7**	**19.5**

Semester	Programme	Course Code	Course Name	L	T	P	C
II	B.E. / B.Tech., Common to all	20MA2T1	ENGINEERING MATHEMATICS II	3	1	0	4

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Construct analytic function of complex variables and transform functions from z- plane to w- plane and vice-versa using conformal mappings.	K3	4
CO2	Apply various integral theorems for solving engineering problems involving cubes and parallelepipeds.	K3	2
CO3	Solve higher order differential equations and apply them to certain physical situations	K3	1
CO4	Apply the techniques of complex integration to evaluate real and complex integrals over suitable closed paths or contours.	K5	5
CO5	Solve linear differential equations using Laplace transform techniques.	K3	3

PRE-REQUISITE	Engineering Mathematics I

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3		3				1	3	3		3		
CO2	3	3		3				1	3	3		3		
CO3	3	3		3				1	3	3		3		
CO4	3	3		3				1	3	3		3		
CO5	3	3		3				1	3	3		3		

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignments and Tutorials
	3	End Semester Examinations
INDIRECT	1	Course Exit Survey

COURSE CONTENT		
Topic - 1	**SECOND AND HIGHER ORDER ORDINARY DIFFERENTIAL EQUATIONS**	**9 + 3**
Second order linear differential equations with constant co-efficient – Cauchy equation – Euler equation– Cauchy – Legendre equation– Method of variation of parameters– Solution of simultaneous equation with constant coefficients		
Topic - 2	**VECTOR CALCULUS**	**9 + 3**
Introduction– gradient–directional derivative–divergence and curl–angel between the surfaces–solenoidal and irrotational vector fields–Green's theorem in a plane–Gauss divergence theorem–Stoke's theorem (without proof).		
Topic - 3	**LAPLACE TRANSFORMS**	**9 + 3**
Condition for existence– Transform of elementary function– Basic properties(without proof)– Derivatives and integrals of transforms– Transform of unit step function– Initial and final value theorem(statement only)– Transform of a periodic function– Inverse Laplace transform– Partial fractions method–convolution theorem(statement only)– Solution of linear ODE of second order with constant co-efficients.		
Topic - 4	**ANALYTIC FUNCTIONS**	**9 + 3**
Analytic function – Necessary and sufficient condition – Cauchy Rieman equation (without proof) – Properties of analytic function (statement only) – Harmonic function – Constructions of analytic function – Bilinear transformation – Conformal mappings $w = z + a$, $w = az$, $w = \frac{1}{z}$		
Topic - 5	**COMPLEX INTEGRATION**	**9 + 3**
Cauchy's integral theorem (without proof) –Cauchy integral formula –Taylor's and Laurent's series (without proof) – Singularities –Cauchy's residue theorem – Contour Integration: Circular and Semi circular contour (excluding polar on real axis).		

THEORY	**45**		**TUTORIAL**	**15**		**PRACTICAL**	**0**		**TOTAL**	**60**

BOOK REFERENCES	
1	GrewalB.S., "Higher Engineering Mathematics", 42nd Edition,Khanna Publications New Delhi, 2011
2	JainR.K and Iyengar S.R.K, "Advanced Engineering Mathematics",4th Edition, NarosaPublishing House, New Delhi, Reprint 2014.
3	Ramana B.V., "Higher Engineering Mathematics",Tata Mcgraw Hill Publishing Company, New Delhi, 2011.
4	Kreyszig E., "Advanced Engineering Mathematics", 10th Edition, John Wiley Sons, 2010..

Semester	Programme	Course Code	Course Name	L	T	P	C
II	B.E. / B.Tech., Common to all (Except Civil)	20EN2T3	COMMUNICATIVE ENGLISH II	3	1	0	4

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Utilize functional grammar for improving employment oriented skills and sharing information about family and friends	K3	1 to 3
CO2	Differentiate general comprehending skills and it present lucid skills in free writing	K4	1 to 5
CO3	Explain the basic grammar techniques and utilize it in enhancing language development	K2	1 to 5
CO4	Combine an environment for reading and develop good language skills	K6	1 to 5
CO5	Evaluate the issues and find the rudiments of the problem individually and as a group	K5	1 to 5

PRE-REQUISITE	Communicative English I

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						3			3	3		3		
CO2						2			3	3		3		
CO3						3			3	3		3		
CO4						2			3	3		3		
CO5						3			3	3		3		

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Grammar Quizzes
	3	End Semester Examinations
INDIRECT	1	Course Exit Survey

COURSE CONTENT		
Topic - 1		**9**
Listening: Listening practice – different types of conversation and answering questions – gap exercises Speaking: Introduce one self and others – Opening a conversation Reading: Reading a novel, itinerary, Magazine and News papers Writing: Formal Letters – Job application letter with CV and Resume Grammar: Kinds of Sentences – Sentence Pattern (Parts/ Patterns/ Column Analysis).		
Topic - 2		**9**
Listening: Short texts – Listening to situation based dialogues – Listening to talks on engineering - Speaking: Sharing information of a personal kind – greeting – taking leave– Reading: Comprehension Questions (multiple choice questions and short questions) – short narrative stories - Writing: Paragraph Writing – Filling Forms – Basics of Business writing – Placing Orders, Letter of Complaint - Grammar: Asking Questions in the Simple Present – Using reference words, Yes/No type questions.		
Topic - 3		**9**
Listening: Listening to academic lectures and live speech – advertisements and announcements –Speaking: Giving and Justifying opinions – apologizing – Introduction to Presentation – Reading: Reading Blogs – Website articles – Paragraphing – Writing: Tweets – Texting and SMS language – Use of Sequence Words - Grammar: Using Past Tense to make correct sentences – WH questions.		
Topic - 4		**9**
Listening: Listening to a telephone conversation – Documentaries and making notes – Speaking: Giving Instructions – Role play – Asking about routine actions – Reading: Reading detailed comprehension - Writing: Writing Reports – Preparing Checklist - Grammar: Make sentences from Future Tense and their Usages (Compare the sentences with Degrees of Comparison).		
Topic - 5		**9**
Listening: Viewing a model group discussion and reviewing the performance of each participant – Casual Conversation - Speaking: Participating in a Group Discussion – Speeches for special Occasions– Reading: Making notes from long passage or any form of written materials – providing a suitable title – Writing: Brainstorming – Writing short essays - Grammar: Numerical Adjectives – Misspelled Words – Direct and Indirect speech – Spot the Errors.		

THEORY	**45**		**TUTORIAL**		**PRACTICAL**	**0**		**TOTAL**	**45**

BOOK REFERENCES	
1	Dr. Elango et al. “Resonance: English for Engineers and Technologist”, Foundation, Chennai, 2013.
2	Anderson, Paul V., “Technical Communication: A Reader-Centered Approach”, Cengage.
3	Sharma, Sangeetha and Binod Mishra**,** “Communication Skills for Engineers and Scientists”, PHI Learning , New Delhi, 2009.
4	“Exercises in Spoken English Part I –III”. EFLU, Hyderabad, OUP, 2014.
5	Raman, Meenakshi, & Sangeeta Sharma. Technical Communication: Principles and Practice, Second Edition. New Delhi: Oxford University Press, 2011.

OTHER REFERENCES	
1	http://www.owlnet.rice.edu/
2	http://zzyx.ucsc.edu/archer/intro.html
3	http://www.indiabix.com/group-discussion/topics-with-answers/

Semester	Programme	Course Code	Course Name	L	T	P	C
II	B.E. MECH, CSE & IT	20EE2T4	BASICS OF ELECTRICAL ENGINEERING	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Demonstrate and articulate the basic concepts related electrical machines.	K2	1
CO2	Apply the laws of electromagnetic & electric circuits in electrical machines.	K3	2
CO3	Compare electrical machines to rate their performance.	K4	3
CO4	Analyze electrical machines to infer their limitations.	K4	4
CO5	Evaluate a machines based on a set of criteria / applications and recommend a suitable electrical systems.	K5	5

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	2							3		2
CO2	3	3	2	2	3	3						2		2
CO3	3	3	2		2									
CO4	3	2	3			2				2		3		
CO5	3	2	2							3		2		

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignment
	3	End Semester Examinations
INDIRECT	1	Course Exit Survey

COURSE CONTENT		
Topic - 1	**ELECTRICAL CIRCUITS & MEASURMENTS**	**9**
Ohm's Law – Kirchoff's Laws — Introduction to AC Circuits – Operating Principles of Moving Coil and Moving Iron Instruments, Dynamometer type Wattmeter and Energy meters.		
Topic - 2	**DC MACHINES**	**9**
Construction, Principle of Operation and Characteristics of DC Generators, DC Motors, Single Phase Transformer.		
Topic - 3	**AC MACHINES**	**9**
Construction, Principle of Operation of AC Generators (Sailent& Non Sailent), Synchronous motor, Single and three phase induction Motors.		
Topic - 4	**STARTING METHODS**	**9**
Types of DC Motor starters (Two point, Three point & Four point) –Soft starter - Three phase squirrel cage and slip ring induction motors. (DOL Starter, Auto Transformer Starter, Rotor resistance Starter and Star/Delta Starter)		
Topic - 5	**CONVENTIONAL AND SOLID STATE SPEED CONTROL OF DC & AC DRIVES**	**9**
Armature and field control, Ward Leonard Scheme, Single phase rectifier controllers (half and Full), Slip power recovery scheme, Single phase voltage regulator.		

THEORY	**45**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**45**

BOOK REFERENCES	
1	A.K.Shawney, "A Course in Electrical and Electronics Measurements & Instrumentation", DhanpatRai& Co. 2010.
2	Bhattacharya, "Electrical Machines", Tata McGraw Hill, 2013.
3	Bakshi, "Electrical Machines –II", Technical Publications , Pune, 2015.
4	Dubey, "Fundamental of Electrical Drives", Narosa Publications, New Delhi, 2011.

OTHER REFERENCES	
1	https://youtu.be/u1gAh0cznp4
2	https://youtu.be/zs4MnEx7wTQ
3	https://youtu.be/shJAV59NS6k
4	https://youtu.be/j_F4limaHYI

Semester	Programme	Course Code	Course Name	L	T	P	C
II	B.E. / B.Tech., Common to Mech & Civil	20ME2T5	ENGINEERING MECHANICS	3	1	0	4

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Explain the basic laws and resolution of forces.	K2	1
CO2	Construct free body diagram to resolve the forces in real world mechanical systems.	K3	2
CO3	Examine the appropriate support system for the given force system due to various reactions & moment created by the applied force.	K4	3
CO4	Determine the centroid and moment of inertia for two dimensional sections, centre of gravity for geometrical bodies.	K5	4
CO5	Analyse the frictional forces in wedge and ladder.	K4	5

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2		1		3	2	3	3	3	3	3	3	3
CO2	3	3	2	3		3	2	3	3	3	3	3	3	3
CO3	3	3	3	2		3	2	3	3	3	3	3	3	3
CO4	3	3	3	3		3	2	3	3	3	3	3	3	3
CO5	3	3	3	3		3	2	3	3	3	3	3	3	3

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Mini project
	3	End Semester Examinations
INDIRECT	1	Course Exit Survey

COURSE CONTENT		
Topic - 1	**BASIC LAWS AND FORCE SYSTEMS**	**9**
Introduction to mechanics - Law of Mechanics – Lami's Theorem, Parallelogram, triangular and polygon law of forces – Principles of transmissibility – Force system – resultant force, composition of force, resolution of forces		
Topic - 2	**STATICS OF PARTICLES**	**9**
Free body diagram - Force on a particle – resultant of two forces and several concurrent forces – resolution of a force – equilibrium of a particle		
Topic - 3	**STATICS OF RIGID BODIES**	**9**
Equilibrium of rigid bodies– transmissibility – moment of a force – varignon's theorem– Simplification of forces and couple system – Beams – types of loads , supports and their reactions		
Topic - 4	**CENTROID, CENTRE OF GRAVITY AND MOMENT OF INERTIA**	**9**
Centroids of areas, composite areas, determination of moment of inertia of plane figures, polar moment of inertia-radius of gyration – mass moment of inertia of simple solids		
Topic - 5	**FRICTION**	**9**
Laws of friction – angles of friction- coefficient of friction - angle of repose - wedges Ladder.		

THEORY	**45**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**45**

BOOK REFERENCES	
1	Bansal R K, "Engineering Mechanics", Laxmi Publications Pvt. Ltd., New Delhi, 2006.
2	Young D H and Timashenko S, "Engineering Mechanics", Tata Mcgraw-Hill, 2006.
3	Bhavikatti S S, "Engineering Mechanics", New Age International Pvt. Ltd., New Delhi, 2003.

OTHER REFERENCES	
1	https://www.youtube.com/watch?v=LG0YzGeAFxk
2	https://www.youtube.com/watch?v=nGfVTNfNwnk
3	https://www.youtube.com/watch?v=v6VTMwxx4oA
4	https://www.youtube.com/watch?v=V0PLWR6mQkk
5	https://www.youtube.com/watch?v=yrJBouQkPhY

Semester	Programme	Course Code	Course Name	L	T	P	C
II	(Common to B.E. MECH & CIVIL)	20ME2LT	ENGINEERING DRAWING PRACTICES	2	0	2	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Identify the drawing instruments effectively and able to dimension the figure.	K2	1
CO2	Appraise the usage of engineering curves in tracing the path of simple machine components.	K3	2
CO3	Interpret the concept of projection and acquire visualization skills, projection of points.	K4	3
CO4	Construct the basic views related to projections of lines, planes.	K2	4
CO5	Plan to use the modern tool for drawing communication.	K2	5

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3				3			1	3	3		3	3	2
CO2	3	2	3		2			1	3	3		3	3	3
CO3	3	2	3					1	3	3		3	3	3
CO4	3	2	2		2			1	3	3		3	3	3
CO5	3		3		3			1	3	3		3	3	3

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests& Model Practical Examinations
	2	Assignment & Record
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic - 1	**BASICS OF ENGINEERING DRAWING**	**6**
Introduction and its importance – conventions – Engineering drawing sheets, Drawing instruments as per BIS SP:4-2003. – Types of lines and its application. Geometric figures– Lettering and Numbering as per BIS SP:4-2003. Dimensioning – Types, Methods, Arrow head and leader line.		
Topic - 2	**ORTHOGRAPHIC PROJECTION**	**6**
Concept of axes, planes and quadrant – Projection of plane figure – Visualisation of object – Procedure of Orthographic projection – related exercise.		
Topic - 3	**ISOMETRIC DRAWING**	**6**
Types of pictorial drawing (Isometric, Oblique, Perspective drawing) - Procedure of isometric Drawing – Simple isometric related exercise.		
Topic - 4	**FREEHAND SKETCHING**	**6**
Freehand sketching of multiple views from pictorial views of objects		
Topic - 5	**COMPUTER AIDED DRAFTING**	**6**
Introduction to AutoCAD – creating object – creating text and drawing – editing and modifying commands – Basic Dimensioning – Orthographic drawing – Isometric drawing– related exercise.		

THEORY	**30**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**30**

COURSE CONTENT		
Experiment - 1	Draw the 2D line diagram using AutoCAD software.	**5**
Experiment - 2	Draw the 2D rectangle block using AutoCAD software.	**5**
Experiment - 3	Practice Dimensioning and all Commands using Auto CAD Software.	**5**
Experiment - 4	Draw the Isometric diagram using AutoCAD software.	**5**
Experiment - 5	Draw the home civil layout plan using AutoCAD software.	5
Experiment - 6	Draw the Orthographic using AutoCAD software.	**5**

THEORY	**0**		**TUTORIAL**	**0**		**PRACTICAL**	**30**		**TOTAL**	**30**

BOOK REFERENCES	
1	R.K. Dhawan, "A text book of Engineering Drawing" , S.Chand Publishers, Delhi,2010.
2	Dhananjay. A.Jolhe, " Engineering Drawing with an introduction to AutoCAD", Tata McGrawHill Publishing Company Ltd., Delhi,2008.
3	Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 50th Edition, 2010.
4	Luzzader, Warren.J. and Duff,John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005
5	Shah M.B., and Rana B.C., "Engineering Drawing", Pearson, 2nd Edition, 2009.

OTHER REFERENCES	
1	https://nptel.ac.in/courses/112103019
2	https://nptel.ac.in/courses/112105294
3	https://www.youtube.com/watch?v=j5nwO-JwVv4
4	https://www.youtube.com/watch?v=1sjaelzuGAk
5	https://www.youtube.com/watch?v=viNCXvO9bzY

Semester	Programme	Course Code	Course Name	L	T	P	C
II	B.E./B.Tech (Common to all)	20EM2L1	ENGINEERING PRACTICES LABORATORY	0	0	3	1.5

COURSE LEARNING OUTCOMES (COs)		
After Successful completion of the course, the students should be able to		**RBT Level**
CO1	State the aim and develop the procedure to conduct the experiment / exercise in the Engineering Practices Laboratory Course	K3
CO2	Demonstrate skills at the level of precision (reliably, quickly, smoothly, and accurately with negligible guidance) in performing the experiment / exercise	K3
CO3	Draw inferences from the experiment / exercise conducted and present it professionally	K4
CO4	Demonstrate professionally the results obtained through the experiment / exercise and present conclusions	K4
CO5	Demonstrate an understanding of the concepts, procedures, and applications through verbal and written communication	K3
CO6	Demonstrating an attitude at the level of valuing (attaching values and expressing personal opinions by showing some definite involvement and commitment)	K3

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	**Programme Learning Outcomes (POs)**												**PSOs**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3								3	3				
CO2	3				3			2	3		1			
CO3	3	2		2		1				3				
CO4	3									3				
CO5	3									3		1		
CO6	3								3	3				

COURSE ASSESSMENT METHODS		
DIRECT	1	Laboratory Record
	2	Model Practical Examinations
	3	End Semester Examinations
INDIRECT	1	Course Exit Survey

LIST OF EXPERIMENTS	
1	**GROUP A (CIVIL & MECHANICAL) I. CIVIL ENGINEERING PRACTICE** **Buildings:** a) Study of plumbing and carpentry components of residential and industrial buildings safety aspects. **Plumbing Works:** a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings. b) Preparation of plumbing line sketches for water supply and sewage works. c) Hands-on-exercise: Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components. d) Demonstration of plumbing requirements of high-rise buildings. **Carpentry using manual and power tools:** a) Study of the joints in roofs, doors, windows and furniture. b) Hands-on-exercise: Wood work, joints by sawing, planning and cutting.
2	**II.MECHANICAL ENGINEERING PRACTICE** **Welding:** a) Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding. b) Gas welding practice **Basic Machining:** a) Simple Turning and Taper turning b) Drilling Practice **Sheet Metal Work:** a) Forming & Bending b) Model making – Trays and funnels. c) Different type of joints. **Machine Study practice:** a) Study of centrifugal pump b) Study of air conditioner
3	**GROUP B (ELECTRICAL AND ELECTRONICS)** **III.ELECTRICAL ENGINEERING PRACTICE** 1. Testing and connection of Fluorescent lamp wiring. 2. Stair case wiring. 3. Measurement of energy using single phase energy meter. 4. Assembly of Residential house wiring. 5. Measurement of earth resistance of an electrical equipment using meggar.
4	**IV.ELECTRONICS ENGINEERING PRACTICE** 1. Resistor colour coding & Measurement of AC signal parameters (Peak-Peak, RMS period, Frequency) using CRO. 2. Study of logic gates AND, OR, EX-OR and NOT. 3. Measurement of ripple factor of HWR and FWR. 4. Soldering practice for Components, Devices and Circuits. **5.** Generation of Clock Signal.

THEORY	**0**		**TUTORIAL**	**0**		**PRACTICAL**	**45**		**TOTAL**	**45**

BOOK REFERENCES	
1	"Engineering Practices Laboratory", Al-Ameen Publications, 2020.

Semester	Programme	Course Code	Course Name	L	T	P	C
II	B.E. MECH	20EE2L2	BASICS OF ELECTRICAL ENGINEERING LABORATORY	0	0	2	1

COURSE LEARNING OUTCOMES (COs)		
After Successful completion of the course, the students should be able to		RBT Level
CO1	State the aim and develop the procedure to conduct the experiment / exercise in the Basics of Electrical Engineering Laboratory Course	K3
CO2	Demonstrate skills at the level of precision (reliably, quickly, smoothly, and accurately with negligible guidance) in performing the experiment / exercise	K3
CO3	Draw inferences from the experiment / exercise conducted and present it professionally	K4
CO4	Demonstrate professionally the results obtained through the experiment / exercise and present conclusions	K4
CO5	Demonstrate an understanding of the concepts, procedures, and applications through verbal and written communication	K3
CO6	Demonstrating an attitude at the level of valuing (attaching values and expressing personal opinions by showing some definite involvement and commitment)	K3

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
Cos	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3								3	3				
CO2	3				3			2	3		1			
CO3	3	2		2		1				3				
CO4	3									3				
CO5	3									3		1		
CO6						2		2	2	2		1		

COURSE ASSESSMENT METHODS		
DIRECT	1	Laboratory Record
	2	Model Practical Examinations
	3	End Semester Examinations
INDIRECT	1	Course Exit Survey

LIST OF EXPERIMENTS	
1	Load test on DC Shunt motor.
2	Load test on DC Series motor.
3	O.C.C & Load characteristics of DC Shunt generator.
4	O.C.C & Load characteristics of DC Series generator.
5	Speed control of DC shunt motor (Armature, Field control)
6	Load test on single phase transformer.
7	O.C & S.C Test on a single phase transformer.
8	Regulation of an alternator by EMF & MMF methods.
9	Load test on Single phase squirrel cage Induction motor.
10	Load test on three phase squirrel cage Induction motor.

THEORY	**0**		**TUTORIAL**	**0**		**PRACTICAL**	**30**		**TOTAL**	**30**

BOOK REFERENCES	
1	Basics of Electrical Engineering Laboratory Manual, Al-Ameen Publications, 2020.

OTHER REFERENCES	
1	https://youtu.be/56fIDi-AwY4
2	https://youtu.be/32K7YjawjYI
3	https://youtu.be/J6BAUYE6mfs
4	https://youtu.be/SheW7HjDAUg
5	https://youtu.be/FbvDMetY

Semester	Programme	Course Code	Course Name	L	T	P	C
II	B.E. / B.Tech., Common to all	20CY2T2	ENVIRONMENTAL SCIENCES	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Demonstrate the importance of interdisciplinary nature of environment and health risk assessment.	K2	1
CO2	Discuss the ecosystem and their importance in the environment and conservation of biodiversity.	K2	2
CO3	Design the rain water harvesting system in their living area.	K6	3
CO4	Analyze the impact of pollution and hazardous waste in a global and societal context.	K4	4
CO5	Understand contemporary issues that result in environmental degradation that would attempt to provide solutions to overcome the problems.	K3	5

PRE-REQUISITE	Engineering Chemistry

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1					2	1	3	3		3		
CO2	2	2					1	1	3	3		3		
CO3	3	1	1					1	3	3		3		
CO4	3	2	1					1	3	3		3		
CO5	3	1					2	1	3	3		3		

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignment
	3	End Semester Examinations
INDIRECT	1	Course Exit Survey

COURSE CONTENT		
Topic - 1	**ENVIRONMENT AND ECOSYSTEMS**	**9**
Definition, scope and importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs – Introduction, types, characteristic features, structure and function of the forest ecosystem aquatic ecosystems (ponds, river and marine). Activity: Study of the ecosystem structure in Cauvery River.		
Topic - 2	**BIODIVERSITY**	**9**
Introduction to biodiversity definition: genetic, species and ecosystem diversity –value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity– endangered and endemic species of India – In-situ and ex- situ conservation of biodiversity. Activity: Study of common plants, insects, birds.		
Topic - 3	**ENVIRONMENTAL POLLUTION**	**9**
Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Thermal pollution (d) Noise pollution – solid waste management: causes, effects and control measures of municipal solid wastes – Hazardous and biomedical waste management -pollution case studies. Activity: Study of air and water pollution in industry.		
Topic - 4	**NATURAL RESOURCES**	**9**
Forest resources: over-exploitation, deforestation, – Water resources: Rain water harvesting-watershed management - utilization of surface and ground water, conflicts over water, dams-benefits and problems Food resources: effects of modern agriculture, fertilizer-pesticide problems - Principles of Green Chemistry- Case studies Activity: Tree plantation and maintenance within the campus.		
Topic - 5	**SUSTAINABILITY AND POPULATION**	**9**
From unsustainable to sustainable development – environmental Impact Assessment (EIA) – environmental ethics: Issues and possible solutions – climate change, acid rain, ozone layer depletion, and case studies – environment production act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act - environment and human health – value education – HIV / AIDS – women and child welfare. Activity: Small group meetings about environment and human health in local area peoples and making poster and short films about HIV / AIDS – women and child welfare.		

THEORY	**45**		**TUTORIAL**	**00**		**PRACTICAL**	**00**		**TOTAL**	**45**

BOOK REFERENCES	
1	Erach Bharucha,"Textbook of Environmental Studies", Universities Press(I) Pvt, Ltd, Hydrabad,2015.
2	Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, 2005.
3	Benny Joseph, "Environmental Science and Engineering", Tata McGraw-Hill Education, 2014.

OTHER REFERENCES	
1	https://www.onlinebiologynotes.com/food-chain-food-web-and-ecological-pyramids/
2	https://vikaspedia.in/energy/environment/biodiversity-1/conservation-of-biodiversity
3	https://www.sciencedirect.com/topics/earth-and-planetary-sciences/ozone-layer-depletion

SEMESTER III

Sl. No.	Course Code	Course Title	Category	CIA	ESE	L	T	P	C
THEORY COURSES									
1	20EC3T1	Basics of Electronics Engineering	ES	50	50	3	0	0	3
2	20ME3T2	Manufacturing Technology I	PC	50	50	3	0	0	3
3	20MA3T3	Transforms and Partial Differential Equations	BS	50	50	3	1	0	4
4	20ME3T4	Fluid Mechanics and Machinery	PC	50	50	3	0	0	4
5	20ME3T5	Mechanics of Materials	PC	50	50	3	1	0	4
6	20HSCT6	Principles of Management	HS	50	50	3	0	0	3
LABORATORY COURSES									
7	20ENCL1	Communication Skills Laboratory	HS	50	50	0	0	2	1
8	20ME3L2	Fluid Mechanics Laboratory	PC	50	50	0	0	2	1
9	20ME3L3	Strength of Materials Laboratory	PC	50	50	0	0	2	1
Total						**18**	**2**	**6**	**24**

Semester	Programme	Course Code	Course Name	L	T	P	C
III	B.E. MECH	20EC3T1	BASICS OF ELECTRONICS ENGINEERING	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Describe the construction and working principle of diode, BJT, rectifier etc.,	K2	1
CO2	Apply and verify the Boolean expression for combinational and sequential circuits.	K3	2
CO3	Characterize and analyze the application of analog IC.	K4	3
CO4	Demonstrate and understand the basic concepts of Op-amp and its characteristics.	K3	4
CO5	Evaluate the different types of interfacing with electronic devices.	K5	5

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2		2			2	2	3	3		3		
CO2	3	2		2		2	2	2	3	3		3		
CO3	2	2	3		2		2	2	3	3		3		
CO4	2	2		3		2	2	2	3	3		3		
CO5	3	2		2			2	2	3	3	2	3		

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Seminar
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic - 1	**ELECTRONIC DEVICES**	**9**
Diode construction and working, application of diode, clipper, clamper and rectifier. BJT-construction and working, BJT as switch and amplifier. CRO, Function generator, multimeter and power supply.		
Topic - 2	**DIGITAL CIRCUITS**	**9**
Number system, Boolean theorem, logic gates, Simplification of logic function, Combinational circuits- Adder, subtractor, Encoder, decoder, multiplexer, demultiplexer. Sequential circuits- latch, flip-flop, counter.		
Topic - 3	**ANALOG ICS**	**9**
Op-Amp (IC 741) - characteristics, application of Op-Amp adder, subtractor, comparator, ADC and DAC. Timer - (555) Astable and monostablemultivibrator.		
Topic - 4	**SPECIAL ELECTRONIC DEVICES**	**9**
Introduction to Op-Amp, Differential Amplifier Configurations, CMRR, PSRR, Slew Rate; BlockDiagram, Pin Configuration of 741 Op-Amp, Characteristics of Ideal Op-Amp, Concept of VirtualGround.		
Topic - 5	**INTERFACING ACTUATORS**	**9**
Interfacing DC motor with electronic devices, Interfacing SERVO motor with electronic devices,Interfacing stepper motor with electronic devices.		

THEORY	**45**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**45**

BOOK REFERENCES	
1	David. A. Bell (2003), Laboratory Manual for Electronic Devices and Circuits, Prentice Hall, India
2	J Millman, C. Halkias&Satyabrata JIT, Electronic Devices and Circuits, Tata McGraw-Hill, 2010.
3	S. Salivahanan, N.Suresh Kumar and A.Vallavaraj, Electronic Devices and Circuits, Tata McGraw-Hill Education, 2008.
4	D. Roy Choudhry, Shail Jain Linear Integrated Circuits, New Age International Pvt. Ltd., 2000.
5	M. Morris Mano, Michael D Ciletti Digital Design 4th edition Pearson, 2011.

OTHER REFERENCES	
1	https://www.youtube.com/watch?v=Hq_8zewfMpY&list=PLPg0ZVoGm25tT5OwcEKFawd-bk4XrmJqR
2	https://www.youtube.com/watch?v=eFPTBATfX70&list=PLwjK_iyK4LLCAN5TddEZyliChEMpF0oOL
3	https://www.youtube.com/watch?v=77FkWW75dX4

Semester	Programme	Course Code	Course Name	L	T	P	C
III	B.E. MECH	20ME3T2	MANUFACTURING TECHNOLOGY I	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Demonstrate suitable casting process to produce the simple casting components and prepare mould with core.	K3	1
CO2	Employ suitable welding equipment and weld the given material.	K2	2
CO3	Use the suitable bulk deformation process based on application.	K2	3
CO4	Employ sheet metal forming processes and create simple sheet metal components.	K2	4
CO5	Illustrate the suitable moulding and forming processes of plastics for produce simple plastic parts.	K3	5

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	1	3	2	3	3	3	3	3	2	3
CO2	3	2	1	-	2	3	2	3	3	3	3	3	2	3
CO3	3	1	2	-	2	3	2	3	3	3	3	3	2	3
CO4	3	2	1	-	1	3	2	3	3	3	3	3	2	3
CO5	3	1	2	-	2	3	2	3	3	3	3	3	2	3

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Mini Project
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic - 1	**CASTING PROCESSES**	**9**
Introduction to production processes and its classifications - Pattern Types and Allowances. Moulding sand - Types, Properties and Testing. Moulding machines and its types. Melting furnaces types – Arc furnaces - Induction. Fettling and cleaning. Sand casting defects. Special casting processes - Die casting, Centrifugal casting and Investment casting, continuous casting.		
Topic - 2	**METAL JOINING PROCESSES**	**9**
Introduction to welding processes and its classifications - Principle of Gas welding and its flames – Principle of arc welding. Principle of Resistance welding - Spot, butt and seam. Principle of Gas metal arc welding Submerged arc welding, Tungsten Inert Gas welding, Plasma arc welding, Thermit welding, Electron beam welding, Laser beam welding and Friction welding - Six weld defects - Brazing and soldering		
Topic - 3	**BULK DEFORMATION PROCESSES**	**9**
Introduction - Hot and cold working of metals - Forging processes - Open and close die forging, Forging equipment and operations. Rolling Types of Rolling mills, shape rolling operations, Tube piercing and Defects. Principle of Extrusion and its types. Principle of rod and wire drawing.		
Topic - 4	**SHEET METAL FORMING AND SPECIAL FORMING PROCESSES**	**9**
Introduction - Shearing, bending and drawing operations - Stretch forming operations - Principle of special forming processes - Hydro forming, Rubber pad forming, Metal spinning, Explosive forming, Magnetic pulse forming, Peen forming and Super plastic forming.		
Topic - 5	**MOULDING AND FORMING OF PLASTICS**	**9**
Introduction to plastics - Moulding of Thermoplastics - Principle and applications of Injection moulding and its types, Blow moulding, Rotational moulding, Thermoforming and Extrusion. Moulding of Thermosets - Principle and applications of Compression moulding and Transfer moulding - Bonding of Thermoplastics - Fusion and solvent methods		

THEORY	**45**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**45**

BOOK REFERENCES	
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

OTHER REFERENCES	
1	https://www.youtube.com/watch?v=szOwGvYO_Tc
2	https://www.youtube.com/watch?v=Cd6L9k51vug
3	https://www.youtube.com/watch?v=w6_Cx3BAdJI
4	https://www.youtube.com/watch?v=JmspmH4nB7U
5	https://www.youtube.com/watch?v=7O29V_fDdbQ

Semester	Programme	Course Code	Course Name	L	T	P	C
III	B.E.,EEE , ECE & MECH	20MA3T3	TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS	3	1	0	4

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Solve partial differential equations and apply them to certain physical situations	K3	1
CO2	Classify the PDE and use Fourier series techniques to find the solutions of one dimensional wave and heat equations.	K3	3
CO3	Analyse the situation and select an appropriate techniques for solving problems based on Fourier transforms.	K4	4
CO4	Evaluate Z-transform and estimate inverse Z-transform of certain functions and use it to solve difference equations	K5	5
CO5	Choose the appropriate methods related to Fourier series to solve the problems based on periodic and non periodic functions.	K6	2

PRE-REQUISITE	Engineering Mathematics I & Engineering Mathematics II

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3		3				1	2	3		3		
CO2	3	3		3				1	2	3		3		
CO3	3	3		3				1	2	3		3		
CO4	3	3		3				1	2	3		3		
CO5	3	3		3				1	2	3		3		

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignments and Tutorials
	3	End Semester Examinations
INDIRECT	1	Course Exit Survey

COURSE CONTENT		
Topic - 1	**PARTIAL DIFFERENTIAL EQUATIONS**	**9 + 3**
Formation of partial differential equations- Solutions of standard types of first order partial differential equations- Lagrange's linear equation- Linear partial differential equations of second and higher order with constant coefficients of homogeneous type.		
Topic - 2	**FOURIER SERIES**	**9 + 3**
Dirichlet's conditions- General Fourier series- Odd and even functions- Half range sine series- Half range cosine series- Parseval's identity- Harmonic analysis.		
Topic - 3	**APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS**	**9 + 3**
Classification of PDE- Method of separation of variables- Fourier series solutions of one dimensional wave equation- One dimensional equation of heat conduction- Steady state solution of two dimensional equation of heat conduction		
Topic - 4	**FOURIER TRANSFORMS**	**9 + 3**
Statement of Fourier integral theorem- Fourier transform pair- Fourier sine and cosine transforms- Properties (statement only)- Transforms of simple functions- Convolution theorem (without proof)- Parseval's identity.		
Topic - 5	**Z TRANSFORMS AND DIFFERENCE EQUATIONS**	**9 + 3**
Z-transforms- Elementary properties (statement only)- Inverse Z-transform (using partial fractions and residues)- Initial and final value theorems- Convolution theorem (without proof)- Formation of difference equations-Solution of difference equations using Z-transform.		

THEORY	**45**		**TUTORIAL**	**15**		**PRACTICAL**	**0**		**TOTAL**	**60**

BOOK REFERENCES	
1	Jain .R.K And Iyengar S.R.K,"Advanced Engineering Mathematics",3rd Edition, Narosa Publishing House, New Delhi , Reprint 2009
2	Ramana B.V., "Higher Engineering Mathematics",Tata Mcgraw Hill Publishing Company, New Delhi, 2008
3	Kreyszig.E.,"Advanced engineering mathematics', 9th Edition , John Wiley Sons , 2012
4	Glyn James., "Advanecd Modern Engineering Mathematics", Pearson Education Limited, 2007

OTHER REFERENCES	
1	https://byjus.com/maths/differential-equations-applications/
2	https://www.analyzemath.com/calculus/Differential_Equations/applications.html
3	https://math.stackexchange.com/questions/579453/real-world-application-of-fourier-series
4	https://www.slideshare.net/zakilivebuzz/math-presentation-by-syed-ahmed-zaki
5	https://cadcammodelling.wordpress.com/2011/04/14/fourier-transform-and-its-applications/

Semester	Programme	Course Code	Course Name	L	T	P	C
III	B.E. MECH	20ME3T4	FLUID MECHANICS AND MACHINERY	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Relate the continuity equation, Euler equation and Bernoulli's equation the fluid flow equipments.	K3	1
CO2	Estimate the major and minor losses in flow through pipes.	K4	2
CO3	Calculate the velocity potential and stream function in fluid flows.	K4	3
CO4	Select the required hydraulic turbine and draw the characteristics curve of pump.	K5	4
CO5	Select the required hydraulic pump and draw the characteristics curve of pump.	K5	5

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2						1	3	3		3	3	
CO2	3	3						1	3	3		3	2	
CO3	3	3					3	1	3	3		3	2	
CO4	3	2		3				1	3	3		3	2	2
CO5	3	3	3	3				1	3	3		3		2

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignments
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic - 1	**INTRODUCTION AND FLUID PROPERTIES**	**10**
Types of flow - laminar, turbulent, unsteady, steady, non-uniform and uniform flows. Units and Dimensions – Fluid properties – Density, Specific gravity, Viscosity, Surface tension capillarity, Compressibility and Bulk Modulus.		
Topic - 2	**FLUID KINEMATICS AND DYNAMICS**	**10**
Control volume – Continuity equation in one dimension and three dimension – velocity potential and stream function – Energy equation – Euler and Bernoulli's equations – orifice meter, Venturi meter and pitot tube.		
Topic - 3	**FLOW THROUGH CIRCULAR CONDUITS**	**9**
Laminar flow through circular conduits and circular annuli-Boundary layer concepts – types of boundary layer thickness – Darcy Weisbach equation –friction factor- Moody diagram- commercial pipes- minor losses – Flow through pipes in series and parallel.		
Topic - 4	**HYDRAULIC TURBINES**	**8**
Definition of turbine Classification -Types of head and efficiencies of turbine-Impulse turbine –Reaction turbine-Francis turbine, Kaplan turbine - working principles and velocity triangle- Work done by water on the runner Specific speed - unit quantities performance curves.		
Topic - 5	**HYDRAULIC PUMPS**	**8**
Definition -Centrifugal pump Classification Construction working principle and velocity Triangle Definition of heads-Losses and efficiencies-Multistage Centrifugal pump- Specific speed Priming and cavitation effects of centrifugal pump. Reciprocating pump Classification Working Principle Coefficient of discharge and slip- Indicator diagram (Descriptive treatment only).		

THEORY	**45**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**45**

BOOK REFERENCES	
1	R.K.Bansal, A Textbook of Fluid Mechanics and Machinery, LaxmiPublications(P) Ltd., New Delhi, Revised Ninth edition, 2014.
2	Frank M White, "Fluid Mechanics", Tata McGraw Hill Education Pvt. Ltd., New Delhi,2011.
3	Kumar K L, "Engineering Fluid Mechanics", Eurasia Publications Limited, New Delhi,1990.
4	YunusCengel and John Cimbala, Fluid Mechanics Fundamentals and Application, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi2009.

OTHER REFERENCES	
1	https://www.youtube.com/watch?v=A0BuHEqDm88
2	https://www.youtube.com/watch?v=-AS9GsP1Ac8
3	https://www.youtube.com/watch?v=4Lz8M2FL8dU
4	https://www.youtube.com/watch?v=la-5TqEUCt0
5	https://www.youtube.com/watch?v=dlXvmgDav-Y

Semester	Programme	Course Code	Course Name	L	T	P	C
III	B.E. MECH	20ME3T5	MECHANICS OF MATERIALS	3	1	0	4

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Estimate stress and strains in various types of bars.	K5	1
CO2	Compare beam bending moment and their shear forces.	K4	2
CO3	Estimate bending stress and torsion in circular shafts and springs.	K5	3
CO4	Access the principal stress and strains of given plane.	K5	4
CO5	Evaluate the related parameters in deflection of determinate beams.	K5	5

PRE-REQUISITE	Engineering Mechanics

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3						1	3	3		3	3	3
CO2	3	3	3	2			1	1	3	3		3	2	3
CO3	3	2	3				1	1	3	3		3	2	2
CO4	3	2	3				1	1	3	3		3	3	3
CO5	3	3	2	3				1	3	3		3	3	2

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignments
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic - 1	**STRESSES - STRAINS AND CHANGES IN DIMENSIONS AND VOLUME**	**9 + 3**
Stress and strain due to axial force, elastic limit, Hooke's law-factor of safety - stepped bars, uniformly varying sections, stresses in composite bar due to axial force and temperature. Strain Energy due to axial force- proof resilience, stresses due to gradual load, sudden load and impact load. Lateral strain - Poisson's ratio, volumetric strain, changes in dimensions and volume, shear stress, shear strain, relationship between elastic constants. Hoop and Longitudinal stresses in thin cylindrical and spherical.		
Topic - 2	**BENDING MOMENT AND SHEAR FORCE**	**9 + 3**
Relationship between load, shear force and bending moment - shear force and bending moment diagrams for cantilever, simply supported and overhanging beams under concentrated loads, uniformly distributed loads, uniformly varying loads, concentrated moments, maximum bending moment and point of contra flexure.		
Topic - 3	**BENDING STRESSES AND TORSION**	**9 + 3**
Theory of simple bending and assumptions - derivation of equation, section modulus, normal stresses due to bending. Theory of failures, torsion and assumptions-derivation of the equation, polar modulus, stresses in solid and hollow circular shafts – Deflection of helical springs.		
Topic - 4	**PRINCIPAL STRESSES AND STRAINS**	**9 + 3**
(Two dimensional only) State of stress at a point - normal and tangential stresses on a given plane, principal stresses and their planes, plane of maximum shear stress, analytical method, Mohr's circle method.		
Topic - 5	**DEFLECTION OF DETERMINATE BEAMS**	**9 + 3**
Governing differential equation - Macaulay's method-moment area method, application to simple problems. Computation of slopes and deflection in beams – conjugate beams and strains energy – Maxwell's reciprocal theorem.		

THEORY	**45**		**TUTORIAL**	**15**		**PRACTICAL**	**0**		**TOTAL**	**60**

BOOK REFERENCES	
1	Jindal U C, "Textbook on Strength of Materials", Asian Books Pvt. Ltd.,2009.
2	Don H Morris, William F Riley and Leroy D Sturges, "Mechanics of Materials", John Wiley and Sons Inc., 2007
3	Russell C Hibbler, "Mechanics of Materials", 2014
4	Gere & Timoshenko, "Strength of Materials", Second edition, CBS Publisher, 2006.

OTHER REFERENCES	
1	https://www.youtube.com/watch?v=wjB9rccGUEI
2	https://www.youtube.com/watch?v=EpQgdvUXFMM
3	https://www.youtube.com/watch?v=coRgpxG2pyY
4	https://www.youtube.com/watch?v=ojWAdkEMEfI
5	https://www.youtube.com/watch?v=cQGQYXSJFLw

Semester	Programme	Course Code	Course Name	L	T	P	C
III	B.E. MECH	20HSCT6	PRINCIPLES OF MANAGEMENT	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Cognize and determine the relevance of management concepts	K2	1
CO2	Characterize, discuss and relate management techniques adopted within an organization	K2	2
CO3	Apply the management techniques for meeting prevailing and future management challenges confronted by an organization	K3	3
CO4	Correlate the management theories and models critically and to inspect and question its validity in the real world	K3	4
CO5	Appraise different theories of management so as to relate it to enhance prevailing technologies and for eliminating hindrances in communication.	K4	5

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						3	2	2	3	3	3	3		
CO2						2	2	2	3	3	3	3		
CO3							2	2	3	3	3	3	1	
CO4						3	2	2	3	3		3		
CO5							2	2	3	3	3	3	1	

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Seminar
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic - 1	**INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS**	**9**
Definition of Management – Science or Art – Manager Vs Entrepreneur - types of managers - managerial roles and skills – Evolution of Management – Scientific, human relations , system and contingency approaches – Types of Business organization - Sole proprietorship, partnership, company-public and private sector enterprises - Organization culture and Environment – Current trends and issues in Management.		
Topic - 2	**PLANNING**	**9**
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.		
Topic - 3	**ORGANISING**	**9**
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 - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management , Career planning and management		
Topic - 4	**DIRECTING**	**9**
Foundations of individual and group behaviour – motivation – motivation theories – motivational techniques – job satisfaction – job enrichment – leadership – types and theories of leadership – communication – process of communication – barrier in communication – effective communication – communication and IT.		
Topic - 5	**CONTROLLING**	**9**
System and process of controlling – budgetary and non-budgetary control techniques–use of computers and IT in Management control–Productivity problems and management – control and performance – direct and preventive control – reporting.		

THEORY	**45**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**45**

BOOK REFERENCES	
1	Stephen A. Robbins & David A. Decenzo& Mary Coulter,Fundamentals of Management" 7th Edition, Pearson Education,2011.
2	Robert Kreitner&MamataMohapatra, " Management", Biztantra,2008.
3	Harold Koontz & Heinz Weihrich, "Essentials of Management", TataMcGraw Hill,1998.
4	Tripathy PC & Reddy PN, "Principles of Management", Tata Mcgraw Hill,1999

OTHER REFERENCES	
1	https://www.youtube.com/watch?v=CmC8UaCNQFc
2	https://www.youtube.com/watch?v=DsYcnapehvA
3	https://www.youtube.com/watch?v=lj7ZnyskZuA
4	https://www.youtube.com/watch?v=vOykcERGw9Y
5	https://www.youtube.com/watch?v=VI0Eu5uZxXQ

Semester	Programme	Course Code	Course Name	L	T	P	C
III	B.E. / B.Tech., Common to all	20ENCL1	COMMUNICATION SKILLS LABORATORY	0	0	2	1

COURSE LEARNING OUTCOMES (COs)		
After Successful completion of the course, the students should be able to		RBT Level
CO1	State the aim and develop the procedure to conduct the experiment / exercise in the Communication Skills Laboratory Course	K3
CO2	Demonstrate skills at the level of precision (reliably, quickly, smoothly, and accurately with negligible guidance) in performing the experiment / exercise	K3
CO3	Draw inferences from the experiment / exercise conducted and present it professionally	K4
CO4	Demonstrate professionally the results obtained through the experiment / exercise and present conclusions	K4
CO5	Demonstrate an understanding of the concepts, procedures, and applications through verbal and written communication	K3
CO6	Demonstrating an attitude at the level of valuing (attaching values and expressing personal opinions by showing some definite involvement and commitment)	K3

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3								3	3				
CO2	3				3			2	3		1			
CO3	3	2		2		1				3				
CO4	3									3				
CO5	3									3		1		
CO6						2		2	2	2		1		

COURSE ASSESSMENT METHODS		
DIRECT	1	Laboratory Record
	2	Model Practical Examinations
	3	End Semester Examinations
INDIRECT	1	Course Exit Survey

LIST OF EXPERIMENTS	
1	Laboratory Practice Sessions
2	Conversation Practice Sessions (To be done as real life interactions)
3	Group Discussion Sessions
4	Interview Sessions
5	Presentation

THEORY	**0**		**TUTORIAL**	**0**		**PRACTICAL**	**30**		**TOTAL**	**30**

BOOK REFERENCES	
1	Baul Emmerson and Nick Hamilton, 'Five Minute Activities for Business English', Cambridge University Press, New York, 2005.
2	Arthur Brookes and Peter Grundy, 'Beginning to Write: Writing Activities for Elementary and Intermediate Learners', Cambridge University Press, New York, 2003.
3	George, Livingston. 'Using Communication Skills Lab in Enhancing Speaking Skills of Engineering Students' 2018.
4	Nira Konar: English Language Laboratory: A Comprehensive Manual, PHI Learning, 2011.
5	Pandey, Dr.Meenu. 'A Practical Book of Communication Skills', NIRALI Prakashan advancement of knowledge, second edition 2018.

OTHER REFERENCES	
1	Khan Academy Videos on English Speaking and Writing
2	https://learningenglish.britishcouncil.org/en/listening
3	Adrian Duff et.al. (ed.): Cambridge Skills for Fluency
4	Mark Hancock: English Pronunciation in Use
5	Audio Cassettes/CD'S OUP 2004

Semester	Programme	Course Code	Course Name	L	T	P	C
III	B.E. MECH	20ME3L2	FLUID MECHANICS LABORATORY	0	0	2	1

COURSE LEARNING OUTCOMES (COs)		
After Successful completion of the course, the students should be able to		RBT Level
CO1	State the aim and develop the procedure to conduct the experiment / exercise in the Fluid Mechanics Laboratory Course	K3
CO2	Demonstrate skills at the level of precision (reliably, quickly, smoothly, and accurately with negligible guidance) in performing the experiment / exercise	K3
CO3	Draw inferences from the experiment / exercise conducted and present it professionally	K4
CO4	Demonstrate professionally the results obtained through the experiment / exercise and present conclusions	K4
CO5	Demonstrate an understanding of the concepts, procedures, and applications through verbal and written communication	K3
CO6	Demonstrating an attitude at the level of valuing (attaching values and expressing personal opinions by showing some definite involvement and commitment)	K3

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	1	1				2		2		3	3
CO2	3	1	1	2					1		1		3	2
CO3	3	2	1	3	1				2		2		3	2
CO4	2	2	1	3	1				1		2		3	2
CO5	3	1	1	2					1		2		3	3
C06	3	1	1	3	1				1		2		3	3

COURSE ASSESSMENT METHODS		
DIRECT	1	Model Practical Examination
	2	Record
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Experiment - 1	Determination of Darcy's friction factor	**3**
Experiment - 2	Calculation of the rate of flow using rotometer	**3**
Experiment - 3	Calibration flow meters	**3**
Experiment - 4	Flow through mouth piece / orifice	**3**
Experiment - 5	Study on performance characteristic of reciprocating pump	**3**
Experiment - 6	Study on performance characteristic of Gear pump	**3**
Experiment - 7	Study on performance characteristic of Pelton wheel	**4**
Experiment - 8	Study on performance characteristic of Francis turbine	**4**
Experiment - 9	Study on performance characteristic of Kaplan turbine	**4**

THEORY	**0**	**TUTORIAL**	**0**	**PRACTICAL**	**30**	**TOTAL**	**30**

BOOK REFERENCES	
1	Fluid Mechanics laboratory Manual:- Al-Ameen Publication

OTHER REFERENCES	
1	https://www.youtube.com/watch?v=HxhNmnXhUyc
2	https://www.youtube.com/watch?v=VuryHPGpDl8
3	https://www.youtube.com/watch?v=-RvwXGzzv4c
4	https://www.youtube.com/watch?v=Y5k4vxoztFo
5	https://www.youtube.com/watch?v=hZVvByoCDAU

Semester	Programme	Course Code	Course Name	L	T	P	C
III	B.E. MECH	20ME3L3	STRENGTH OF MATERIALS LABORATORY	0	0	2	1

COURSE LEARNING OUTCOMES (COs)		
After Successful completion of the course, the students should be able to		RBT Level
CO1	State the aim and develop the procedure to conduct the experiment / exercise in the Strength of Materials Laboratory Course	K3
CO2	Demonstrate skills at the level of precision (reliably, quickly, smoothly, and accurately with negligible guidance) in performing the experiment / exercise	K3
CO3	Draw inferences from the experiment / exercise conducted and present it professionally	K4
CO4	Demonstrate professionally the results obtained through the experiment / exercise and present conclusions	K4
CO5	Demonstrate an understanding of the concepts, procedures, and applications through verbal and written communication	K3
CO6	Demonstrating an attitude at the level of valuing (attaching values and expressing personal opinions by showing some definite involvement and commitment)	K3

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	1	1				2		2		3	3
CO2	3	1	1	2					1		1		3	2
CO3	3		1	3					2		2		3	2
CO4	2		1	3					1		2		3	2
CO5	3	1	1	2					1		2		3	3
C06	3	1	1	3	1				1		2		3	3

COURSE ASSESSMENT METHODS		
DIRECT	1	Model Practical Examination
	2	Record
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Experiment - 1	Tension test on steel rods using universal testing machine	**3**
Experiment - 2	Double shear on mild steel	**3**
Experiment - 3	Torsion test on mild steel bar	**3**
Experiment - 4	Tension and compression test on springs	**3**
Experiment - 5	Deflection test on simply supported aluminium beam	**3**
Experiment - 6	Hardness test on different metals like Mild steel, Brass, Copper and aluminium	**3**
Experiment - 7	Bend test on steel rod	**4**
Experiment - 8	Compression test	**4**
Experiment - 9	Impact test on Charpy and Izod Impact Test	**4**

THEORY	**0**		**TUTORIAL**	**0**		**PRACTICAL**	**30**		**TOTAL**	**30**

BOOK REFERENCES	
1	Strength of Material Laboratory Manual:- Al-Ameen Publication

OTHER REFERENCES	
1	https://www.youtube.com/watch?v=mMNE0U17v-E
2	https://www.youtube.com/watch?v=zphmE5WEFpg
3	https://www.youtube.com/watch?v=cdJ37PSMvUM
4	https://www.youtube.com/watch?v=AV5VXW4CaUU
5	https://www.youtube.com/watch?v=v0n2Yh7gJW0

SEMESTER IV

Sl. No.	Course Code	Course Title	Category	CIA	ESE	L	T	P	C
THEORY COURSES									
1	20MA4T1	Statistics and Numerical methods	BS	50	50	3	1	0	4
2	20ME4T2	Manufacturing Technology II	PC	50	50	3	0	0	3
3	20ME4T3	Theory of Machines –I	PC	50	50	3	1	0	4
4	20ME4T4	Thermal Engineering – I	PC	50	50	3	1	0	4
5	20CSCT5	Python Programming	ES	50	50	3	0	0	3
LABORATORY COURSES									
6	20ME4L1	Theory of Machines Laboratory	PC	50	50	0	0	2	1
7	20ME4L2	Manufacturing Process Laboratory	PC	50	50	0	0	2	1
MANDATORY COURSE									
8	20HSCT1	Universal Human Values 2: Understanding Harmony	HS	100	--	2	1	0	3
Total						**17**	**4**	**4**	**23**

Semester	Programme	Course Code	Course Name	L	T	P	C
IV	B.E. MECH	20MA4T1	STATISTICS AND NUMERICAL METHODS	3	1	0	4

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Identify and apply various numerical techniques for solving non-linear equations and systems of linear equations.	K3	3
CO2	Analyse and apply the knowledge of interpolation and determine the integration and differentiation of the functions by using the numerical data.	K4	4
CO3	Justify the concept of testing of hypothesis for small and large samples and interpret the results.	K5	1
CO4	Classify the principles of design of experiments and perform analysis of variance.	K2	2
CO5	Determine the dynamic behaviour of the system through solution of ordinary differential equations by using numerical methods.	K5	5

PRE-REQUISITE	Engineering Mathematics I , Engineering Mathematics II and Transforms and Partial Differential Equations

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3		3				1	3	3		3		
CO2	3	3		3				1	3	3		3		
CO3	3	3		3				1	3	3		3		
CO4	3	3		3				1	3	3		3		
CO5	3	3		3				1	3	3		3		

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignments and tutorials
	3	End Semester Examinations
INDIRECT	1	Course Exit Survey

COURSE CONTENT		
Topic - 1	**TESTING OF HYPOTHESIS**	**9 + 3**
Sampling distributions – Estimation of parameters – Statistical hypothesis – Large sample tests based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square and F distributions for mean, variance and proportion – Contingency table (test for independent) – Goodness of fit.		
Topic - 2	**DESIGN OF EXPERIMENTS**	**9 + 3**
One way and two way classifications – Completely randomized design – Randomized block design – Latin square design – 22 factorial design		
Topic - 3	**SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS**	**9 + 3**
Solution of algebraic and transcendental equations – Fixed point iteration method – Newton Raphson method – Solution of linear system of equations – Gauss elimination method – Pivoting – Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel – Eigenvalues of a matrix by Power method.		
Topic - 4	**INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION**	**9 + 3**
Lagrange's and Newton's divided difference interpolations – Newton's forward and backward difference interpolation – Approximation of derivates using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules.		
Topic - 5	**NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS**	**9 + 3**
Single step methods : Taylor's series method – Euler's method – Modified Euler's method – Fourth order Runge-Kutta method for solving first order equations – Multi step methods : Milne's predictor corrector methods for solving first order equations.		

THEORY	**45**		**TUTORIAL**	**15**		**PRACTICAL**	**0**		**TOTAL**	**60**

BOOK REFERENCES	
1	Gerald. C. F. and Wheatley. P. O., **"Applied Numerical Analysis"**, Pearson Education,Asia, 7th Edition, New Delhi, 2006.
2	Grewal, B.S., and Grewal, J.S., **"Numerical Methods in Engineering and Science"**, Khanna Publishers, 9th Edition, New Delhi, 2010
3	Burden, R.L and Faires, J.D, **"Numerical Analysis",** 9th Edition, Cengage Learning, 2016.
4	Vijay K. Rohatgi , EhsanesSaleh,**"An Introduction to Probability and Statisics",** 2nd Edition,2009
5	N. G. Das**.,"Statistical Methods"**, Tata McGraw Hill Publishing Ltd,2008

OTHER REFERENCES	
1	https://www.sobtell.com/blog/38-real-life-applications-of-numerical-analysis
2	https://www.scienceabc.com/eyeopeners/why-do-we-need-numerical-analysis-in-everyday-life.html
3	https://leverageedu.com/blog/application-of-statistics/

Semester	Programme	Course Code	Course Name	L	T	P	C
IV	B.E. MECH	20ME4T3	THEORY OF MACHINES	3	1	0	4

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Design and analyze various mechanisms in machines.	K4	1
CO2	Draw and predict various components of Coriolis acceleration.	K4	2
CO3	Draw and construct cam profile for various followers.	K4	3
CO4	Design and analyze of mechanical power transmission systems.	K6	4
CO5	Calculate and compare the gears for power transmission systems.	K4	5

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	3	2		1		1	3	3		3	3	2
CO2	3	3	2	2		1		1	3	3		3	3	3
CO3	3	3	2	2		1		1	3	3		3	3	2
CO4	3	3	2	1				1	3	3		3	3	3
CO5	3	3	3	3		1		1	3	3		3	3	3

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignments
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT

Topic - 1	BASICS OF MECHANISMS	9 + 3
Classification of mechanisms – Basic kinematic concepts and definition – Degrees of freedom, Mobility – Kutzbach criterion, Grubler's criterion – Grashof's law – Kinematic inversions of four bar chain and slider – Crank Chains – Toggle mechanism – Intermittent motion mechanism – Ratchets and Escapements – Indexing mechanisms – Straight line generators.		
Topic - 2	**KINEMATIC ANALYSIS**	**9 + 3**
Displacement, Velocity and Acceleration analysis of simple mechanisms – Graphical method – Velocity and acceleration polygons – Graphical and analytical techniques – Instantaneous centre of velocity – Coriolis component.		
Topic - 3	**CAMS**	**9 + 3**
Classification of cams and followers – Terminology and Definitions – Displacement diagrams – Uniform velocity, Parabolic and Cycloidal motion – Construction of cam profiles for SHM, Uniform acceleration and Retardation with reciprocating and Oscillating followers – Knife edge, Roller and Flat – Circular arc and Tangent cams.		
Topic - 4	**FRICTION DRIVES**	**9 + 3**
Belt and rope drive – Open and Cross belt drive – Belt materials – Initial tension – Slip and Creep – Ratio of Tensions – Effect of centrifugal force – Condition for maximum power – Friction Clutches – Friction in Brakes – Band and Block brakes.		
Topic - 5	**GEARS**	**9 + 3**
Introduction – Types – Terminology – Law of Toothed Gearing – Velocity of sliding – Involute and Cycloidal tooth profiles – Interchangeable gears – Length of path and arc of contact – Contact ratio – Interference in pinion and gear – Gear Trains – Speed ratio, Train value.		

THEORY	45		TUTORIAL	15		PRACTICAL	0		TOTAL	60

BOOK REFERENCES	
1	Shigley J.E Anduicker J.J, "Theory of Machines and Mechanisms", McgrawHill Inc,1995.
2	V.P.Singh, "Theory of Machines", Dhanaparatrai& Sons,2005.

OTHER REFERENCES	
1	https://www.youtube.com/watch?v=ONGxFMSKvyE
2	https://www.youtube.com/watch?v=7WppBa-cLuk
3	https://www.youtube.com/watch?v=e7paMBFHcsM
4	https://www.youtube.com/watch?v=3-2R2joq8Mk
5	https://www.youtube.com/watch?v=OQ_XJxVpLFs

Semester	Programme	Course Code	Course Name	L	T	P	C
IV	B.E. MECH	20ME4T4	THERMAL ENGINEERING I	3	1	0	4

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Apply the law of thermodynamics and steady flow energy equation for thermal system.	K3	1
CO2	Analyze and derive the efficiency of thermodynamic cycles.	K4	2
CO3	Estimate the properties of steam by stem table, dryness fraction and other properties.	K3	3
CO4	Formulate the Maxwell equation, Tds equation and Energy equation.	K3	4
CO5	Analyze and differentiate the working principle of IC engine.	K4	5

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1				1	3	3		3	3	3
CO2	3	3	2	1				1	3	3		3	3	
CO3	3		3					1	3	3		3		3
CO4	3			1				1	3	3		3	3	
CO5	3	3						1	3	3		3	3	3

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignments
	3	End Semester Examinations

INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic - 1	**BASIC LAWS AND CONCEPTS**	**10 + 5**
Introduction – thermodynamics system – boundary – surroundings – thermodynamic properties - point and path function. Boyle's law, Charles law, Gay-lussac's law, first law , second law of thermodynamics – Zeroth law of thermodynamics – Steady flow energy equation.		
Topic - 2	**THERMODYNAMIC PROCESS AND CYCLES**	**10 + 5**
P-V diagram, T-S diagram - Isobaric process, Isochoric process, isothermal process, isoentropic process and polytropic process. Concept of thermodynamic cycle with PV and TS diagram – (Carnot cycle, Otto cycle, diesel cycle, dual cycle, Brayton cycle, Atkinson cycle, Ericsson cycle, Stirling cycle and Lenoir cycle). Problems on otto cycle, diesel cycle and dual cycle.		
Topic - 3	**STEAM ENERGY**	**9 + 5**
Steam- Liquid – vapour mixture, saturated steam, super heated steam, H-S diagram, dryness fraction, steam table.		
Topic - 4	**THERMO DYNAMIC RELATION**	**7**
Maxwell equation – Tds equation – Energy equation.		
Topic - 5	**IC ENGINE**	**9**
Concepts of engine, compressor, nozzle, turbine, diffuser and heat exchanger. IC engine classification based on fuel and stroke. Working principle of IC engine. Valve and port timing diagram.		

THEORY	**45**		**TUTORIAL**	**15**		**PRACTICAL**	**0**		**TOTAL**	**60**

BOOK REFERENCES	
1	P.K.Nag, "Engineering Thermodynamics", Tata Mcgraw-Hill, 2006
2	Ballaney. P.L ." Thermal Engineering", Khanna publishers, 24th Edition 2012
3	Ramalingam. K.K., "Thermal Engineering", SCITECH Publications (India) Pvt. Ltd., 2009.
4	Rudramoorthy, R, "Thermal Engineering ",Tata McGraw-Hill, New Delhi,2003
5	Sarkar, B.K,"Thermal Engineering" Tata McGraw-Hill Publishers, 2007

OTHER REFERENCES	
1	Kothandaraman.C.P.,Domkundwar. S,Domkundwar. A.V., “A course in thermal Engineering", Fifth Edition, ”DhanpatRai& sons , 2016
2	Rajput. R. K., “Thermal Engineering” S.Chand Publishers, 2017
3	https://www.youtube.com/watch?v=SPg7hOxFItI
4	https://www.youtube.com/watch?v=cT9UN1XENNk
5	https://www.youtube.com/watch?v=fw8Jfoif1BM

Semester	Programme	Course Code	Course Name	L	T	P	C
IV	B.E. / B.Tech., CSE. IT & MECH	20CSCT5	PYTHON PROGRAMMING	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Classify and make use of python programming elements to solve and debug simple logical problems.	K2	1
CO2	Experiment with the various control statements in Python.	K3	2
CO3	Develop python programs using functions and strings.	K3	3
CO4	Experiment with the usage of pointers and functions.	K3	4
CO5	Analyze a problem and use appropriate data structures to solve it.	K4	5

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		3			2		2	2	3	3		3		
CO2			2				2	2	3	3		3		
CO3			2				2	2	3	3		3		2
CO4			2		2		2	2	3	3		3	2	2
CO5	3	3	2				2	2	3	3		3		

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Seminar
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic - 1	**BASICS OF PYTHON PROGRAMMING**	**9**
Introduction - Python Interpreter - Interactive and script mode -Values and types, operators, expressions, statements, precedence of operators, Multiple assignments, comments.		
Topic - 2	**CONTROL STATEMENTS AND FUNCTIONS IN PYTHON**	**9**
Conditional (if), alternative (if-else), chained conditional (if-elif-else) – Iteration - while, for, break, continue, pass – Functions - Introduction, inbuilt functions, user defined functions, passing parameters, return values, recursion, Lambda functions.		
Topic - 3	**DATA STRUCTURES: STRINGS, LISTS AND SETS**	**9**
Strings - String slices, immutability, string methods and operations –Lists - creating lists, list operations, list methods, mutability, aliasing, cloning lists, list and strings, list and functions - list processing - list comprehension, searching and sorting, Sets - creating sets, set operations		
Topic - 4	**DATASTRUCTURES TUPLES, DICTIONARIES**	**9**
Tuples - Tuple assignment, Operations on Tuples, lists and tuples, Tuple as return value – Dictionaries - operations and methods, Nested Dictionaries.		
Topic - 5	**FILES, MODULES, PACKAGES**	**9**
Files and exception: text files, reading and writing files format operator-Command line arguments-errors and exceptions-handling exceptions –Modules-Packages-illustrative programs-word count-copy file.		

THEORY	**45**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**45**

BOOK REFERENCES	
1	Ashok NamdevKamthane,Amit Ashok Kamthane, “Programming andProblem Solving with Python” , Mc-Graw Hill Education,2018.
2	Allen B. Downey, “Think Python: How to Think Like a Computer Scientist”, Second edition, Updated for Python 3, Shroff / O’Reilly Publishers,2016.
3	Robert Sedgewick, Kevin Wayne, Robert Dondero, “Introduction to Programming in Python: An Inter-disciplinary Approach”, Pearson India Education Services Pvt.Ltd.,2016.
4	Timothy A. Budd,” Exploring Python”, Mc-Graw Hill Education (India) Private Ltd.,2015.
5	Kenneth A. Lambert, “Fundamentals of Python: First Programs”, CENGAGE Learning,2012.

OTHER REFERENCES	
1	https://www.coursera.org/specializations/python
2	https://www.youtube.com/watch?v=rfscVS0vtbw

Semester	Programme	Course Code	Course Name	L	T	P	C
IV	B.E. MECH	20ME4T2	MANUFACTURING TECHNOLOGY II	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Distinguish various cutting metals and cutting tool materials and explain tool geometry.	K2	1
CO2	Demonstrate lathe, shaping and planning machines.	K2	2
CO3	Illustrate drilling, broaching and grinding machines.	K2	3
CO4	Relate the principles, operation and working of milling and gear generating machines.	K2	4
CO5	Revise the details about various techniques of non-traditional machines.	K2	5

PRE-REQUISITE	MANUFACTURING TECHNOLOGY I

CO / PO MAPPING (1 – Weak, 2 – Med0ium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2		3	2	3	3	3	3	3	2	3
CO2	3	1	2	1		3	2	3	3	3	3	3	2	3
CO3	3	1	2	1		3	2	3	3	3	3	3	2	3
CO4	3	1	2	1		3	2	3	3	3	3	3	2	3
CO5	3	1	2	1	3	3	2	3	3	3	3	3	2	3

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Mini project
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic - 1	**THEORY OF METAL CUTTING**	**9**
Mechanism of metal cutting – types – cutting force – chip formation – merchant's circle diagram – calculations – tool geometry – machinability – tool wear – tool life – cutting tool materials – cutting fluids – types		
Topic - 2	**AUTOMATS, SHAPING AND PLANNING MACHINES**	**9**
Capstan and turret lathes – construction – indexing mechanism – operations – working principle of single and multi – spindle automats – shaping and planning machines – types– construction – mechanism – principle of operation – different shaping operation – work holding devices.		
Topic - 3	**DRILLING , BROACHING AND GRINDING MACHINES**	**9**
Drilling machines – specifications, types – feed mechanism, operations – drilltool nomenclature – broaching – specifications, types, tool nomenclature, broaching operations – grinding – types of grinding machines – grinding wheels, bonds – mounting and reconditioning of grindingwheels.		
Topic - 4	**MILLING AND GEAR GENERATING MACHINES**	**9**
Milling – specifications – types – cutter nomenclature – types of cutters – milling processes – indexing – gear forming in milling – gear generation – gear shaping and gear hobbing – specifications – cutters – coated tools & inserts – cutting spur and helical gears– generators – gear finishing methods.		
Topic - 5	**NON-TRADITIONAL MACHINING**	**9**
Classification of machining process – process selection – ultrasonic machining – abrasive jet machining – water jet machining – laser beam machining electron beam machining – plasma arc machining.		

THEORY	**45**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**45**

BOOK REFERENCES	
1	SeropeKalpakjiam and Steven R. Schmid, ‘’Manufacturing Engineering and Technology ‘’, Addiison Wesley longmam (Singapore) Pte Ltd, Delhi, 2009
2	Jain R.K. and Gupta S.C., “Production Technology “’ Khanna Publishers, New Delhi, 1999
3	Richerd R Kibbe, John E. Neely, Ronald O. Merges and Warren J. White “Machine Tool Practices”, Premtice Hail of India, 1998
4	Roy. A. Lindberg, “Process and Materials of Manufacture “, Fourth edition, PHI/Pearson Education 2006.

OTHER REFERENCES	
1	https://www.youtube.com/channel/UCYihp-A43UpzDqZzNwsEKOA
2	https://www.youtube.com/channel/UCTdGJFL8ko-jYuXEXNUnqMQ
3	https://www.youtube.com/watch?v=k301tNeEEAU
4	https://www.youtube.com/watch?v=16ZgvPNB7QQ
5	https://www.youtube.com/watch?v=gQZv6B88Z2o

Semester	Programme	Course Code	Course Name	L	T	P	C
IV	B.E. MECH	20ME4L1	THEORY OF MACHINES LABORATORY	0	0	2	1

COURSE LEARNING OUTCOMES (COs)		
After Successful completion of the course, the students should be able to		RBT Level
CO1	State the aim and develop the procedure to conduct the experiment / exercise in the Theory of Machines Laboratory Course	K3
CO2	Demonstrate skills at the level of precision (reliably, quickly, smoothly, and accurately with negligible guidance) in performing the experiment / exercise	K3
CO3	Draw inferences from the experiment / exercise conducted and present it professionally	K4
CO4	Demonstrate professionally the results obtained through the experiment / exercise and present conclusions	K4
CO5	Demonstrate an understanding of the concepts, procedures, and applications through verbal and written communication	K3
CO6	Demonstrating an attitude at the level of valuing (attaching values and expressing personal opinions by showing some definite involvement and commitment)	K3

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3		2		3				2	2		2		2
CO2	3		3		3				2	2		2		2
CO3	3	2	2		3				3	2	2	2	2	2
CO4	3		2		3				3	2	2	3	2	3
CO5	3	2	2		3				3	2		2		2
CO6	3		3		3				2	2		2		2

COURSE ASSESSMENT METHODS		
DIRECT	1	Laboratory Record
	2	Model Practical Examinations
	3	End Semester Examinations
INDIRECT	1	Course Exit Survey

LIST OF EXPERIMENTS	
1	(a)Study of gear parameters. (b)Experimental study of velocity ratios of simple, compound, Epicyclic and differential gear trains
2	(a)Kinematics of Four Bar, Slider Crank, Double crank Mechanisms. (b) Kinematics of single and double universal joints
3	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
4	Motorized gyroscope – Study of gyroscopic effect and couple
5	Governor - Determination of range sensitivity, effort etc., for Watts, Porter, Proell, and Hartnell Governors
6	Cams – Cam profile drawing, Motion curves and study of jump phenomenon
7	(a)Single degree of freedom Spring Mass System – Determination of natural Frequency – Damping coefficient determination b) Multi degree freedom suspension system – Determination of influence coefficient
8	Determination of torsional natural frequency of single and Double Rotor systems- Undamped and Damped Natural frequencies
9	Vibration of Equivalent Spring mass system – undamped and damped vibration
10	Whirling of shafts – Determination of critical speeds of shafts with concentrated loads
11	Balancing of rotating masses and reciprocating masses
12	a) Transverse vibration of Free-Free beam b) Forced Vibration of Cantilever beam

THEORY	**0**		**TUTORIAL**	**0**		**PRACTICAL**	**30**		**TOTAL**	**30**

BOOK REFERENCES	
1	Theory of Machines Laboratory Manual, Al-AmeenPublications,2020

OTHER REFERENCES	
1	https://www.youtube.com/watch?v=8hkmFClpwPU
2	https://www.youtube.com/watch?v=4dEgd4IYBAE
3	https://www.youtube.com/watch?v=opLktcB7Ias
4	https://www.youtube.com/watch?v=HwMF5neBDDg

Semester	Programme	Course Code	Course Name	L	T	P	C
IV	B.E. MECH	20ME4L2	MANUFACTURING PROCESS LABORATORY	0	0	2	1

COURSE LEARNING OUTCOMES (COs)		
After Successful completion of the course, the students should be able to		**RBT Level**
CO1	State the aim and develop the procedure to conduct the experiment / exercise in the Manufacturing Process Laboratory Course	K3
CO2	Demonstrate skills at the level of precision (reliably, quickly, smoothly, and accurately with negligible guidance) in performing the experiment / exercise	K3
CO3	Draw inferences from the experiment / exercise conducted and present it professionally	K4
CO4	Demonstrate professionally the results obtained through the experiment / exercise and present conclusions	K4
CO5	Demonstrate an understanding of the concepts, procedures, and applications through verbal and written communication	K3
CO6	Demonstrating an attitude at the level of valuing (attaching values and expressing personal opinions by showing some definite involvement and commitment)	K3

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	**Programme Learning Outcomes (POs)**												**PSOs**	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3		2		3				2	2		2		2
CO2	3		3		3				2	2		2		2
CO3	3	2	2		3				3	2	2	2	2	2
CO4	3		2		3				3	2	2	3	2	3
CO5	3	2	2		3				3	2		2		2
CO6	3		3		3				2	2		2		2

COURSE ASSESSMENT METHODS		
DIRECT	1	Laboratory Record
	2	Model Practical Examinations
	3	End Semester Examinations
INDIRECT	1	Course Exit Survey

LIST OF EXPERIMENTS	
1	Spur Gear cutting using Milling machine
2	External keyway machining using milling machine
3	Dove tail machining using shaper machine
4	Drilling, reaming and tapping for a given dimension of hole
5	Facing, plain and step turning
6	Surface grinding of a rectangular block
7	Spur, helical gear hobbing
8	Shaft grinding, Tool & cutter grinder
9	Shaping & slotting

THEORY	**0**		**TUTORIAL**	**0**		**PRACTICAL**	**30**		**TOTAL**	**30**

BOOK REFERENCES	
1	Manufacturing Process Laboratory Manual, Al-AmeenPublications,2020

OTHER REFERENCES	
1	https://www.youtube.com/watch?v=i9OXRU2fwb4
2	https://www.youtube.com/watch?v=cWEC1pTmDw8
3	https://www.youtube.com/watch?v=PH0fHF9laoY
4	https://www.youtube.com/watch?v=lU2p6RsDKag
5	https://www.youtube.com/watch?v=uqO-zlS2ey8

Semester	Programme	Course Code	Course Name	L	T	P	C
IV	B.E. / B.Tech., Common to all	20HS4T1	UNIVERSAL HUMAN VALUES 2: UNDERSTANDING HARMONY	2	1	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Understand and aware of themselves, and their surroundings (family, society, nature)	K2	1
CO2	Build more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind	K3	2
CO3	Relate the critical ability and sensitive to their commitment towards what they have understood (human values, human relationship and human society).	K2	3
CO4	Appraise local, regional and a national culture in harmony with others	K5	4
CO5	Leading to the development of a holistic and humane world vision: Universal Human Values of truth, love and compassion	K5	5

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		3					2	2	3	3		3	2	
CO2		3					2	2	3	3		3	2	
CO3							2	2	3	3		3	2	
CO4							2	2	3	3		3	2	
CO5							2	2	3	3		3	2	

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Seminar
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic - 1	**Course Introduction - Need, Basic Guidelines, Content and Process for Value Education**	**9**
1. Purpose and motivation for the course, recapitulation from Universal Human Values-I 2. Self-Exploration–what is it? - Its content and process; „Natural Acceptance" and Experiential Validation- as the process for self-exploration 3. Continuous Happiness and Prosperity- A look at basic Human Aspirations 4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority 5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario 6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.		
Topic - 2	**Understanding Harmony in the Human Being - Harmony in Myself!**	**9**
7. Understanding human being as a co-existence of the sentient „I" and the material „Body" 8. Understanding the needs of Self („I") and „Body" - happiness and physical facility 9. Understanding the Body as an instrument of „I" (I being the doer, seer and enjoyer) 10. Understanding the characteristics and activities of „I" and harmony in „I" 11. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail 12. Programs to ensure Sanyam and Health.		
Topic - 3	**Understanding Harmony in the Family and Society- Harmony in Human Relationship**	**9**
13. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship 14. Understanding the meaning of Trust; Difference between intention and competence 15. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship 16. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals 17. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.		

Topic - 4	Understanding Harmony in the Nature and Existence - Whole existence as Coexistence	9

18. Understanding the harmony in the Nature
19. Interconnectedness and mutual fulfilment among the four orders of nature recyclability and self regulation in nature
20. Understanding Existence as Co-existence of mutually interacting units in all pervasive space
21. Holistic perception of harmony at all levels of existence.

Topic - 5	Implications of the above Holistic Understanding of Harmony on Professional Ethics	8

22. Natural acceptance of human values
23. Definitiveness of Ethical Human Conduct
24. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
25. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
26. Case studies of typical holistic technologies, management models and production systems
27. Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations
28. Sum up

THEORY	44		TUTORIAL	1		PRACTICAL	0		TOTAL	45

BOOK REFERENCES	
1	Jeevan Vidya: E.K. Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2	Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004
3	The Story of Stuff (Book)by Annie Leonard , 2011
4	The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5	Small is Beautiful - E. F Schumacher.
6	Slow is Beautiful - Cecile Andrews
7	Economy of Permanence - J C Kumarappa
8	India Wins Freedom - Maulana Abdul Kalam Azad
9	Vivekananda - Romain Rolland (English)
10	Gandhi - Romain Rolland (English)

OTHER REFERENCES	
1	**https://www.youtube.com/watch?v=XGxNCFjDGEg**
2	**https://www.c-span.org/video/?292709-1/the-story-stuff**

SEMESTER V

Sl. No.	Course Code	Course Title	Category	CIA	ESE	L	T	P	C
THEORY COURSES									
1	20ME5T1	Thermal Engineering-II	PC	50	50	3	1	0	4
2	20ME5T2	Design of Machine Elements	PC	50	50	3	1	0	4
3		Professional Elective I	PE	50	50	3	0	0	3
4		Open Elective I / SWAYAM	OE	50	50	3	0	0	3
5		Open Elective II / SWAYAM	OE	50	50	3	0	0	3
THEORY COURSES WITH LABORATORY COMPONENTS									
6	20ME5LT1	Dynamics of Machinery	PC	50	50	2	0	4	4
LABORATORY COURSE									
7	20ME5L1	Thermal Engineering Laboratory	PC	50	50	0	0	3	1.5
8	20ME5L2	CAD / CAM Laboratory	PC	50	50	0	0	4	2
MANDATORY COURSE									
9	20MCCT1	Constitution of India	MC	100	--	3	0	0	0
Total						**20**	**2**	**11**	**24.5**

Semester	Programme	Course Code	Course Name	L	T	P	C
V	B.E. MECH	20ME5T1	THERMAL ENGINEERING – II	3	1	0	4

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Understand about the fuel and parameters of IC engine.	K2	1
CO2	Evaluate the performance of IC engine	K4	2
CO3	Analysis the performance of Air compressor	K4	3
CO4	Evaluate the performance of Refrigeration and Air conditioning system	K4	4
CO5	Understand the concept of Co-Generation and Residual Heat Recovery	K2	5

PRE-REQUISITE	Thermal Engineering – I

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3					2	2	1	3	3		3	3	3
CO2	3	3	3	3				1	3	3		3	3	3
CO3	3	3	3	3				1	3	3		3	3	3
CO4	3	3	3	3		2	2	1	3	3		3	3	3
CO5	3	3	3	3		2	2	1	3	3		3	3	3

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignment
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic - 1	**IC ENGINE AND ITS FUELS**	**5**
Fuel- Types, Fuel Properties – Flash point, Fire Point, Calorific Value, Pour Point, Viscosity. IC Engine Terms- Brake Power Indicated Power, Friction Power, TFC, SFC, Efficiency. Emission –Bharat Emission Standards.		
Topic - 2	**TEST ON IC ENGINE**	**10 + 3**
Performance Test- Mechanical Loading, Electrical Loading and Hydraulic Loading. Heat Balance Sheet Preparation. Test to find Friction power - Willan's line method, Retardation Test and Morse Test Problems.		
Topic – 3	**AIR COMPRESSOR**	**10 + 4**
Classifications of compressors - Reciprocating air compressor - performance characteristics, effect of clearance volume, free air delivery and displacement, intercooler, after cooler. Rotary compressor - vane type, centrifugal and axial, Screw compressor. Problems on Reciprocating air compressor		
Topic – 4	**REFRIGERATION AND AIR CONDITIONING**	**10 +4**
Fundamentals of refrigeration air conditioning system – COP - Vapour compression refrigeration system - cycle, p-h chart, Vapour absorption system- comparison, properties of refrigerants. Sensible Cooling, Heating – Humidification- Dehumidification. Psychometric chart - Heat load estimation Problems.		
Topic – 5	**STEAM TURBINES , COGENERATION AND RESIDUAL HEAT RECOVERY**	**10 +4**
Steam Turbines - Types, Impulse and reaction principles. Cogeneration Principles, Cycle Analysis, Applications, Source and utilization of residual heat. Heat pipes, Heat pumps, Recuperative and Regenerative heat exchangers Problems.		

THEORY	**45**		**TUTORIAL**	**15**		**PRACTICAL**	**0**		**TOTAL**	**60**

BOOK REFERENCES	
1	Kothandaraman, C.P., Domkundwar .S and Domkundwar A.V.,"A course in Thermal Engineering", Dhanpat Rai & Sons, 2016.
2	Ballaney. P.L ." Thermal Engineering", Khanna publishers, 24th Edition 2012
3	Arora .C.P., "Refrigeration and Air Conditioning", Tata Mc Graw Hill, 2008
4	Sydney Reiter "Industrial and Commercial Heat Recovery Systems" Van Nostrand Reinhols, 1985
5	Rajput. R. K., "Thermal Engineering" S.Chand Publishers, 2017

OTHER REFERENCES	
1	https://gmpua.com/CleanRoom/HVAC/Cooling/Handbook%20of%20Air%20Conditioning%20and%20Refrigeration.pdf
2	https://beeindia.gov.in/sites/default/files/2Ch8.pdf
3	https://theicct.org/sites/default/files/publications/India%20BS%20VI%20Policy%20Update%20vF.pdf
4	http://www.thermodynamicsheatengines.com/HeatEnginesVol%202%20Chapter%207%20RS.pdf
5	https://pdfcoffee.com/download/refrigeration-table-pdf-free.html

Semester	Programme	Course Code	Course Name	L	T	P	C
V	B.E. MECH	20ME5T2	DESIGN OF MACHINE ELEMENTS	3	1	0	4

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Classify and explain the various steps involved in the design process, steady stresses and variable stresses in machine members.	K3	1
CO2	Explain procedures involved in the design of shafts keys, splines and couplings.	K6	2
CO3	Demonstrate the knowledge on the designs of threaded fasteners, Knuckle joints, and Cotter joints, welded and riveted joints.	K6	3
CO4	Design of flywheel, fasteners and different types spring for the specific applications.	K6	4
CO5	Select appropriate rolling contact bearing, gasket and seal from the standard catalog based on loads	K6	5

PRE-REQUISITE	-

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3				1	3	3		3	3	3
CO2	3	3	3	3				1	3	3		3	3	3
CO3	3	3	3	3				1	3	3		3	3	3
CO4	3	3	3	3				1	3	3		3	3	3
CO5	3	3	3	3				1	3	3		3	3	3

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignment
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic - 1	**STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS**	**9+3**
Introduction to the design process - Factors influencing machine design, selection of materials based on mechanical properties – Preferred numbers, fits and tolerances – Direct, bending and torsional stress equations – Impact and shock loading – Eccentric loading. Design of curved beams – Crane hook and 'C' frame - Factor of safety - Theories of failure – Stress concentration – Design for variable loading – Soderberg, Goodman relations.		
Topic - 2	**DESIGN OF SHAFTS AND COUPLINGS**	**9+3**
Design of solid and hollow shafts based on strength and rigidity–Design of keys, keyways and splines. Design of rigid coupling - Muff coupling - Flange coupling - Design of flexible couplings - Bushed pin type coupling.		
Topic - 3	**DESIGN OF TEMPORARY AND PERMANENT JOINTS**	**9+3**
Threaded fasteners - Fine threads, Coarse threads - Design of bolted joints including eccentric loading - Design of Knuckle joints - Design of welded joints - Theory of bonded joints. Design of Riveted Joints		
Topic - 4	**DESIGN OF ENERGY STORING ELEMENTS**	**9+3**
Design of various types of springs, helical springs, leaf springs - Design of flywheels considering stresses in rims and arms for engines and punching machines.		
Topic - 5	**DESIGN OF BEARINGS AND SEALS**	**9+3**
Sliding contact and rolling contact bearings – Design of hydrodynamic journal bearings – Selection of rolling contact bearings- Theory of Lubrication. Design of hydrostatic bearing – Design of seals and gaskets.		

THEORY	**45**		**TUTORIAL**	**15**		**PRACTICAL**	**0**		**TOTAL**	**60**

BOOK REFERENCES	
1	Bhandari V, "Design of Machine Elements", 4th Edition, McGraw-Hill Educations, 2017.
2	Khurmi.R.S and Gupta.J.K, "A Textbook of Machine Design", S.Chand and company Ltd., New Delhi, 2014.
3	Sadhu singh, "Mechanical Machine Design", OBI Publishers, New Delhi,2013.
4	Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett, "Mechanical Engineering Design", 10th Edition, McGraw-Hill Educations, 2015.
5	S.Md.Jalaludeen, "A Text book of Machine Design – I", Anuradha Publications, Chennai, 2014.

OTHER REFERENCES	
1	http://nptel.ac.in/courses/112105124/ Prof.B.Maitietal, IIT kharagpur, Design of Machine Elements.
2	https://www.coursera.org/learn/machine-design1
3	https://nptel.ac.in/courses/112105125 Design of Machine Elements I, IIT Kharagpur Prof. G. Chakraborty, Prof. S.K. Roychowdhury, Prof. B. Maiti
4	https://www.nptelvideos.com/course.php?id=791
5	https://web.iitd.ac.in/~hirani/MEL311.pdf

Semester	Programme	Course Code	Course Name	L	T	P	C
V	B.E MECH	20ME5LT1	DYNAMICS OF MACHINERY	2	0	4	4

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Summarize dynamic forces and turning moments in mechanisms	K3	1
CO2	Minimize unbalance in mechanical systems by means of static and dynamic balancing	K3	2
CO3	Demonstrate longitudinal vibrations, transverse vibrations and torsional vibrations in single degree of freedom systems	K3	3
CO4	Compute the frequency of forced vibrations and critical speed of the shaft	K3	4
CO5	Calculate the speed of the governor and Analyze gyroscopic effect in ships	K3	5

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3							2		1	3	3
CO2	3	3	3	2						2		1	3	3
CO3	3	3	3	2		2				2		1	3	3
CO4	3	3	3	2		2				2		1	3	3
CO5	3	3	3							2		1	3	3

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Laboratory Record & Model Examinations
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic - 1	**DYNAMIC FORCE ANALYSIS OF MECHANISMS**	**6**
Theory:-Introduction, D'alembert's principle, dynamic analysis of slider crank mechanism,velocity & acceleration of piston, angular velocity & angular acceleration of connecting rod, engine force analysis, inertia force in reciprocating engines, Turning moment diagram for various type of engines, fluctuation of energy, fluctuation of speed, flywheel.		
Topic - 2	**BALANCING**	**6**
Theory:-Introduction, static balancing, dynamic balancing, transference of force from one plane to another plane, balancing of several masses in different planes.		
Topic - 3	**FREE VIBRATIONS**	**6**
Theory:-Types of vibrations, spring mass system, free undamped vibrations, equation of motion for viscous damper, damping factor, under damped system, critically damped system, over damped system, logarithmic decrement.		
Topic - 4	**FORCED VIBRATION AND CRITICAL SPEED OF SHAFTS**	**6**
Theory:-Analytical solution of forced damped vibration, Magnification factor, force transmissibility. Critical speed of shafts.		
Topic - 5	**APPLICATION LAYER**	**6**
Theory:-Governors – Types – Centrifugal governors – Gravity controlled and spring controlled centrifugal governors, Estimate the gyroscopic effect on ships.		

THEORY	**30**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**30**

COURSE CONTENT		
Experiment - 1	Study of slider crank mechanisms	**5**
Experiment - 2	Study of universal joints, Gear models	**5**
Experiment - 3	Dynamic balancing of rotating masses	**5**
Experiment - 4	Determination of natural frequency of given spring mass system	**5**
Experiment - 5	Determination of natural frequency and deflection of free beam	**5**
Experiment - 6	Determination of torsional frequency of a single rotor system	**5**
Experiment - 7	Determination of transmissibility ratio using vibrating table	**5**

Experiment - 8	Determination of natural frequency and critical speed of given shaft	**5**
Experiment - 9	Determination of sensitivity and power of Porter governor	**5**
Experiment - 10	Determination of sensitivity and power of Proell governor	**5**
Experiment – 11	Determination of sensitivity and power of Hartnell governor	**5**
Experiment - 12	Determination of gyroscopic couple using Motorized Gyroscope	**5**

THEORY	**0**		**TUTORIAL**	**0**		**PRACTICAL**	**60**		**TOTAL**	**60**

BOOK REFERENCES	
1	F. B. Sayyad, “Dynamics of Machinery”, McMillan Publishers India Ltd., Tech-Max Educational resources, 2011.
2	Rattan, S.S, “Theory of Machines”, 4th Edition, Tata McGraw-Hill, 2014.
3	Uicker,J.J.,Pennock G.R and Shigley, J.E., “Theory of Machines and Mechanisms”,4th Edition, Oxford University Press, 2014.
4	Cleghorn. W. L, “Mechanisms of Machines”, Oxford University Press, 2014
5	Ghosh. A and Mallick, A.K., “Theory of Mechanisms and Machines", 3r d Edition Affiliated East-West Pvt. Ltd., New Delhi, 2006

OTHER REFERENCES	
1	Dynamics of machines from Wikipedia, the free encyclopaedia
2	https://youtu.be/tP98oFDuNNU
3	https://youtu.be/m7Y1aaLnL-U
4	https://youtu.be/iEf3ykvdUK0
5	https://youtu.be/eW20XDUIQLI

Semester	Programme	Course Code	Course Name	L	T	P	C
V	B.E. MECH	20ME5L1	THERMAL ENGINEERING LABORATORY	0	0	3	1.5

COURSE LEARNING OUTCOMES (COs)		
After Successful completion of the course, the students should be able to		RBT Level
CO1	State the aim and develop the procedure to conduct the experiment / exercise in the Thermal Engineering Laboratory Course	K3
CO2	Demonstrate skills at the level of precision (reliably, quickly, smoothly, and accurately with negligible guidance) in performing the experiment / exercise	K3
CO3	Draw inferences from the experiment / exercise conducted and present it professionally	K4
CO4	Demonstrate professionally the results obtained through the experiment / exercise and present conclusions	K4
CO5	Demonstrate an understanding of the concepts, procedures, and applications through verbal and written communication	K3
CO6	Demonstrating an attitude at the level of valuing (attaching values and expressing personal opinions by showing some definite involvement and commitment)	K3

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3								3	3				
CO2	3				3			2	3		1			
CO3	3	2		2		1				3				
CO4	3									3				
CO5	3									3		1		
CO6						2		2	2	2		1		

COURSE ASSESSMENT METHODS		
DIRECT	1	Laboratory Record
	2	Model Practical Examinations
	3	End Semester Examinations
INDIRECT	1	Course Exit Survey

LIST OF EXPERIMENTS	
1	Determination of Flash Point and Fire Point of various fuels / lubricants
2	Determination of Viscosity of lubricants
3	Draw the actual Valve Timing Diagram of Four stroke Petrol Engine
4	Draw the actual Valve Timing Diagram of Four stroke Diesel Engine
5	Draw the actual Port Timing diagram of Two Stroke Petrol Engine
6	Performance Test on 4 – Stroke Diesel Engine using Mechanical / Electrical / Hydraulic Loading
7	Heat Balance Test on 4 –Stroke Diesel Engine using Mechanical / Electrical / Hydraulic Loading
8	Retardation Test on a Diesel Engine
9	Morse Test on Multi-cylinder Petrol Engine
10	Performance test on a reciprocating air compressor
11	Study on Steam Generators and Turbines to conduct performance and heat test
12	Determination of COP of a refrigeration system
13	Determination of COP of a Air Conditioning system
14	Experiments on Psychometric processes

THEORY	0		TUTORIAL	0		PRACTICAL	30		TOTAL	30

BOOK REFERENCES	
1	Thermal Engineering Laboratory Manual, Al-Ameen Publications, 2020.

OTHER REFERENCES	
1	https://www.youtube.com/watch?v=csZzm71C0xI
2	https://www.youtube.com/watch?v=oeiho7-CeZA
3	https://www.youtube.com/watch?v=gfq1rmIog-g
4	https://www.youtube.com/watch?v=Q6MaHSxi3bA
5	https://www.youtube.com/watch?v=gEeF8sEQTEc

Semester	Programme	Course Code	Course Name	L	T	P	C
V	B.E. MECH	20ME5L2	CAD / CAM LABORATORY	0	0	4	2

COURSE LEARNING OUTCOMES (COs)		
After Successful completion of the course, the students should be able to		RBT Level
CO1	State the aim and develop the procedure to conduct the experiment / exercise in the CAD / CAM Laboratory Course	K3
CO2	Demonstrate skills at the level of precision (reliably, quickly, smoothly, and accurately with negligible guidance) in performing the experiment / exercise	K3
CO3	Draw inferences from the experiment / exercise conducted and present it professionally	K4
CO4	Demonstrate professionally the results obtained through the experiment / exercise and present conclusions	K4
CO5	Demonstrate an understanding of the concepts, procedures, and applications through verbal and written communication	K3
CO6	Demonstrating an attitude at the level of valuing (attaching values and expressing personal opinions by showing some definite involvement and commitment)	K3

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3								3	3				
CO2	3				3			2	3		1			
CO3	3	2		2		1				3				
CO4	3									3				
CO5	3									3		1		
CO6						2		2	2	2		1		

COURSE ASSESSMENT METHODS		
DIRECT	1	Laboratory Record
	2	Model Practical Examinations
	3	End Semester Examinations
INDIRECT	1	Course Exit Survey

LIST OF EXPERIMENTS	
3D Geometric Modelling	
1	Introduction of 3D Modelling software Creation of 3D assembly model of following machine elements using 3D Modelling software.
2	Flange Coupling
3	Plummer Block
4	Screw Jack
5	Lathe Tailstock
6	Universal Joint
7	Machine Vice
8	Stuffing box
9	Crosshead
10	Safety Valves
Manual Part Programming	
11	CNC Machining Centre a) Linear Cutting b)Circular cutting c)Cutter Radius Compensation d) Canned Cycle Operations
12	CNC Turning Centre a) Straight, Taper and Radius Turning b) Thread Cutting c) Rough and Finish Turning Cycle d) Drilling and Tapping Cycle

THEORY	**0**		**TUTORIAL**	**0**		**PRACTICAL**	**30**		**TOTAL**	**30**

BOOK REFERENCES	
1	CAD / CAM Laboratory Manual, Al-Ameen Publications, 2020.

Semester	Programme	Course Code	Course Name	L	T	P	C
V	B.E. /B. Tech. Common to All	20MCCT1	CONSTITUTION OF INDIA	3	0	0	0

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Understand and abide the rules of the Indian constitution.	K2	1
CO2	Applying the functions of Central government.	K2	2
CO3	Applying the function of state government.	K2	3
CO4	Evaluate the various constitutional functions.	K2	4
CO5	Explain the different culture among the people of India	K2	5

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1							2	2	3	3		3		
CO2							2	2	3	3		3		
CO3							2	2	3	3		3		
CO4							2	2	3	3		3		
CO5							2	2	3	3		3		

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Seminar
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic - 1	**INTRODUCTION**	**9**
Historical Background – Constituent Assembly of India – Philosophical foundations of the Indian Constitution – Preamble – Fundamental Rights – Directive Principles of State Policy – Fundamental Duties – Citizenship – Role of the Election Commission.		
Topic - 2	**STRUCTURE AND FUNCTION OF CENTRAL AND STATE GOVERNMENT**	**9**
Union Government – Structures of the Union Government and Functions – President – Vice President– Prime Minister – Cabinet – Parliament – Supreme Court of India – Judicial Review. State Government – Structure and Functions – Governor – Chief Minister – Cabinet – State Legislature – Judicial System in States – High Courts and other Subordinate Courts.		
Topic - 3	**CONSTITUTION FUNCTIONS OF INDIA AND INDIAN SOCIETY**	**9**
Indian Federal System – Central – State Relations – President's Rule – Constitutional Amendments – Constitutional Functionaries - Assessment of working of the Parliamentary System in India. Society : Nature, Meaning and definition; Indian Social Structure; Caste, Religion, Language in India; Constitutional Remedies for citizens – Political Parties and Pressure Groups; Right of Women, Children and Scheduled Castes and Scheduled Tribes and other Weaker Sections		
Topic - 4	**POLICIES AND ACTS – GENERAL**	**9**
Insurance and Bonding – Laws Governing Sale, Purchase and use of Urban and Rural Land – Land Revenue Codes – Tax Laws – Income Tax, Sales Tax , Excise and Custom duties and their Influence on Construction Cost – Legal Requirements for Planning – Property Law– Agency Law – Local Government Laws for Approval.		
Topic - 5	**POLICIES AND ACTS ON INFRASTRUCTURE DEVELOPMENT**	**9**
A Historical Review of the Government Policies on Infrastructure – Current Public Policies on Transportations – Power and telecom Sector – Plans for Infrastructure Development – Legal framework for Regulating Private Participation in Roads and Highways – Ports and Airport and Telecom		

THEORY	**45**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**45**

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

OTHER REFERENCES	
1	https://nptel.ac.in/courses/106/105/106105034/
2	https://www.youtube.com/watch?v=6XTYoZymbwE
3	https://www.youtube.com/watch?v=MP6VlAE_7WY

SEMESTER VI

Sl. No.	Course Code	Course Title	Category	CIA	ESE	L	T	P	C
THEORY COURSES									
1	20ME6T1	Finite Element Analysis	PC	50	50	3	1	0	4
2	20ME6T2	Design of Transmission Systems	PC	50	50	3	1	0	4
3		Professional Elective III	PE	50	50	3	0	0	3
4		Open Elective II / SWAYAM	OE	50	50	3	0	0	3
THEORY COURSE WITH LABORATORY COMPONENTS									
5	20ME6LT1	Heat and Mass Transfer	PC	50	50	2	0	4	4
LABORATORY COURSE									
6	20ME6L1	Simulation and Analysis Laboratory	PC	50	50	0	0	4	2
7	20ME6L2	Mini project	EEC	50	50	0	0	2	1
MANDATORY COURSE									
8	20PT6T2	Career competency development	MC	100	--	1	0	0	0
Total						**15**	**2**	**10**	**21**

(*Softskill Courses to be added)

Semester	Programme	Course Code	Course Name	L	T	P	C
VI	B.E. MECH	20ME6T1	FINITE ELEMENT ANALYSIS	3	1	0	4

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Identify and explain a mathematical model for solving engineering problems.	K3	1
CO2	Analyze 1-D finite elements and build the stiffness matrix.	K4	2
CO3	Solve the vector variable problems using two dimensional elements.	K4	3
CO4	Solve the time-dependent and non-linear problems by applying discretization methods.	K4	4
CO5	Explain the principles of finite element analysis in iso-parametric applications.	K3	5

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3			1	3	3		3	3	3
CO2	3	3	3	3	3			1	3	3		3	3	3
CO3	3	3	3	3	3			1	3	3		3	3	3
CO4	3	3	3	3	3			1	3	3		3	3	3
CO5	3	3	3	3	3			1	3	3		3	3	3

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignments
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic - 1	**INTRODUCTION**	**9+3**
Historical Background – Mathematical Modeling of field problems in Engineering – Governing Equations – Discrete and continuous models – Weighted Residual Methods – Variational Formulation of Boundary Value Problems –Rayleigh Ritz Technique – Basic concepts of the Finite Element Method - Matrix solution techniques.		
Topic - 2	**ONE-DIMENSIONAL PROBLEMS**	**9+3**
One Dimensional Second Order Equations – Discretization – Element types- Linear bar– Derivation of Shape functions and Stiffness matrices and force vectors- Assembly of Matrices – beam element – nodal approximation – shape functions – element matrices and vectors – assembly – solution – example problems.		
Topic - 3	**TWO-DIMENSIONAL PROBLEMS**	**9+3**
Introduction – approximation of geometry and field variable – 3 noded triangular elements – four noded rectangular elements – higher order elements – generalized coordinates approach to nodal approximations – structural mechanics applications in 2-dimensions – elasticity equations– stress strain relations – plane problems of elasticity – element equations – assembly– example problems in plane stress, plane strain and axisymmetric applications – Body forces and temperature effects – Stress calculations – Application to Field Problems - Thermal problems.		
Topic - 4	**DYNAMIC ANALYSIS USING FINITE ELEMENT METHOD**	**9+3**
Introduction – vibrational problems – equations of motion based on weak form – longitudinal vibration of bars – transverse vibration of beams – consistent mass matrices – Lumped mass matrices – element equations–solution of eigenvalue problems – vector iteration methods – normal modes – transient vibrations – modelling of damping		
Topic - 5	**ISOPARAMETRIC FORMULATION**	**9+3**
Natural co-ordinate systems – Isoparametric elements – Shape functions and Element stiffness matrix and force vector for isoparametric elements – two dimensions – Numerical integration – Gaussian quadrature – Introduction to Analysis Software. Application of FEA.		

THEORY	**45**		**TUTORIAL**	**15**		**PRACTICAL**	**0**		**TOTAL**	**60**

BOOK REFERENCES	
1	Reddy. J.N., “An Introduction to the Finite Element Method”, 3rd Edition, McGraw-Hill Education, 2014.
2	Seshu, P, “Text Book of Finite Element Analysis”, Prentice-Hall of India Pvt. Ltd., New Delhi, 2014
3	Chandrupatla & Belagundu, “Introduction to Finite Elements in Engineering”, 4th Edition, Prentice Hall College Div, 2014
4	Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, “Concepts and Applications of Finite Element Analysis”, 4th Edition, Wiley Student Edition, 2015.
5	S. S. Bhavikati, Finite Element Analysis, New Age International Publishers, 2015.

OTHER REFERENCES	
1	http://nptel.ac.in/courses/112104115/ Prof.C.S. Upadhyay, IIT Kanpur, Finite Element Method
2	https://www.edx.org/course/finite-element-method-fem-analysis-tsinghuax-70120073x-1
3	https://www.engr.uvic.ca/~mech410/lectures/FEA_Theory.pdf
4	https://www.iist.ac.in/sites/default/files/people/IN08026/FEM.pdf
5	https://nptel.ac.in/courses/112104116 Finite Element Method, IIT Kanpur Prof. P.M. Dixit

Semester	Programme	Course Code	Course Name	L	T	P	C
VI	B.E.MECH	20ME6T2	DESIGN OF TRANSMISSION SYSTEMS	3	1	0	4

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Select, design and analyze flexible drives	K6	1
CO2	Design of spur and Helical gears based on Lewis and Buckingham equation and gear life	K6	2
CO3	Design of bevel and Worm gears based on Lewis and Buckingham equation and gear life	K6	3
CO4	Design and analyze the multi speed gear box	K6	4
CO5	Design and analyze the frictional drives	K6	5

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2		2		1	3	3		3	3	3
CO2	3	3	3	2		2		1	3	3		3	3	3
CO3	3	3	3	2		2		1	3	3		3	3	3
CO4	3	3	3	2		2		1	3	3		3	3	3
CO5	3	3	3	2		2		1	3	3		3	3	3

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignment
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic - 1	**DESIGN OF FLEXIBLE ELEMENTS**	**9+3**
Design of Flat belts and pulleys - Selection of V belts and pulleys – Selection of hoisting wire ropes and pulleys – Design of Transmission chains and Sprockets.		
Topic - 2	**DESIGN OF SPUR AND HELICAL GEARS**	**9+3**
Force analysis -Tooth stresses - Dynamic effects – Fatigue strength - Factor of safety - Gear materials – Design of straight tooth spur & helical gears based on strength and wear considerations – Pressure angle in the normal and transverse plane-Equivalent number of teeth-forces for helical gears.		
Topic - 3	**DESIGN OF BEVEL AND WORM GEARS**	**9+3**
Straight bevel gear: Tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of pair of straight bevel gears. Worm Gear: Merits and demerits-terminology. Thermal capacity, materials-forces and stresses, efficiency, estimating the size of the worm gear pair.		
Topic - 4	**DESIGN OF GEAR BOXES**	**9+3**
Geometric progression - Standard step ratio - Ray diagram, kinematics layout -Design of sliding mesh gear box - Design of multi speed gear box for machine tool applications - Constant mesh gear box - Speed reducer unit. – Variable speed gear box.		
Topic - 5	**DESIGN OF FRICTIONAL DRIVES**	**9+3**
Design of plate clutches –axial clutches-cone clutches-internal expanding rim clutches-Electromagnetic clutches. Band and Block brakes - external shoe brakes – Internal expanding shoe brake.		

THEORY	**45**		**TUTORIAL**	**15**		**PRACTICAL**	**0**		**TOTAL**	**60**

BOOK REFERENCES	
1	Bhandari V, “Design of Machine Elements”, 4th Edition, Tata McGraw
2	Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett “Mechanical Engineering Design”, 8th Edition, Tata McGraw
3	Merhyle F. Spotts, Terry E. Shoup and Lee E. Hornberger, “Design of Machine Elements” 8th Edition, Printice Hall, 2003
4	Orthwein W, “Machine Component Design”, Jaico Publishing Co, 2003. Prabhu. T.J., “Design of Transmission Elements”, Mani Offset, Chennai, 2000.

OTHER REFERENCES	
1	Design of transmission systems from wikipedia
2	https://youtu.be/AVgV6gW-Q6A
3	https://youtu.be/z3WJLFtUjYA
4	https://youtu.be/nZbqWg_BXcY
5	https://youtu.be/5b1EVZaOBcs

Semester	Programme	Course Code	Course Name	L	T	P	C
VI	B.E. MECH	20ME6LT1	Heat and Mass Transfer	2	0	4	4

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	To understand the conductive heat transfer principle and its applications.	K2	1
CO2	To understand the convective heat transfer principle and its applications.	K2	2
CO3	To analyze the phase change heat transfer problems and sizing of heat exchangers.	K4	3
CO4	To understand the radiation heat transfer principle & its applications	K2	4
CO5	To understand the basic concepts of mass transfer in analogous to heat transfer.	K2	5

PRE-REQUISITE	Thermal Engineering – I & Thermal Engineering – II

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3			2	1	1	1	1	2	2		1	2	
CO2	3	2	1	2	1			1	2	2	1	2	2	
CO3	3	3	1	2	1			1	2	2	1	1	2	2
CO4	2			2	1	1	1	1	1	1			1	
CO5	2		1		1	1		1	1	1			1	

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Laboratory Record & Model Examinations
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic - 1	**CONDUCTION**	**6**
One Dimensional Steady State Heat Conduction – plane and Composite Systems – Conduction with Internal Heat Generation – Extended Surfaces – Unsteady Heat Conduction.		
Topic - 2	**CONVECTION**	**6**
Free and Forced Convection – Hydrodynamic and Thermal Boundary Layer.		
Topic – 3	**PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS**	**6**
Heat Exchanger Types – Overall Heat Transfer Coefficient – Fouling Factors – Analysis – LMTD method.		
Topic – 4	**RADIATION**	**6**
Black Body Radiation – Grey body radiation – Shape Factor – Radiation Shields. Radiation through gases.		
Topic – 5	**MASS TRANSFER**	**6**
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.		

LIST OF EXPERIMENTS		
Experiment - 1	Thermal conductivity measurement using guarded plate apparatus.	6
Experiment - 2	Thermal conductivity measurement of pipe insulation using lagged pipe apparatus.	6
Experiment - 3	Determination of Thermal conductivity of insulating powder.	6
Experiment - 4	Determination of Thermal conductivity of composite wall.	6
Experiment - 5	Determination of heat transfer coefficient under natural convection.	6
Experiment - 6	Determination of heat transfer coefficient under forced convection.	**6**
Experiment - 7	Heat transfer from pin-fin apparatus	**6**
Experiment - 8	Effectiveness of Parallel / counter flow heat exchanger.	**6**
Experiment - 9	Determination of Stefan – Boltzmann constant.	**6**
Experiment - 10	Determination of emissivity of a grey surface.	**6**

THEORY	**30**		**TUTORIAL**	**0**		**PRACTICAL**	**60**		**TOTAL**	**90**

BOOK REFERENCES	
1	Sachdeva R C, “Fundamentals of Engineering Heat and Mass Transfer”, New Age International,2008.
2	YunusCengal, “Heat and Mass Transfer”, Tata McGraw Hill,2008.
3	Holman J.P, “Heat Transfer” Tata Mc Graw Hill,2007.
4	Ozisik M.N, “Heat Transfer”, McGraw-Hill Book Co,2001.
5	Nag P.K, “Heat Transfer”, Tata McGraw-Hill, New Delhi, 2002.

OTHER REFERENCES	
1	https://gptcadoor.org/assets/downloads/zf72gvy9l6ynm0n.pdf
2	https://kntu.ac.ir/DorsaPax/userfiles/file/Mechanical/OstadFile/dr_avami/9.pdf
3	https://www.energy.gov/sites/default/files/2020/07/f77/2018%20Portsmouth%20ASER-introduction-to-radiation.pdf
4	https://archive.nptel.ac.in/content/storage2/courses/103103027/pdf/mod1.pdf
5	https://ceng.tu.edu.iq/ched/images/lectures/chem-lec/st3/c3/Lectures-Mass%20Transfer-1.pdf

Semester	Programme	Course Code	Course Name	L	T	P	C
VI	B.E. MECH	20ME6L1	SIMULATION AND ANALYSIS LABORATORY	0	0	4	2

COURSE LEARNING OUTCOMES (COs)		
After Successful completion of the course, the students should be able to		RBT Level
CO1	State the aim and develop the procedure to conduct the experiment / exercise in the Simulation And Analysis Laboratory Course	K3
CO2	Demonstrate skills at the level of precision (reliably, quickly, smoothly, and accurately with negligible guidance) in performing the experiment / exercise	K3
CO3	Draw inferences from the experiment / exercise conducted and present it professionally	K4
CO4	Demonstrate professionally the results obtained through the experiment / exercise and present conclusions	K4
CO5	Demonstrate an understanding of the concepts, procedures, and applications through verbal and written communication	K3
CO6	Demonstrating an attitude at the level of valuing (attaching values and expressing personal opinions by showing some definite involvement and commitment)	K3

PRE-REQUISITE	POWER ELECTRONICS LABORATORY

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3								3	3				
CO2	3				3			2	3		1			
CO3	3	2		2		1				3				
CO4	3									3				
CO5	3									3		1		
CO6						2		2	2	2		1		

COURSE ASSESSMENT METHODS		
DIRECT	1	Laboratory Record
	2	Model Practical Examinations
	3	End Semester Examinations
INDIRECT	1	Course Exit Survey

LIST OF EXPERIMENTS	
1	A. SIMULATION MATLAB basics, Dealing with matrices, Graphing-Functions of one variable and two variables Use of Matlab to solve simple problems in vibration Mechanism Simulation using Multibody Dynamic software Determination of Darcy's friction factor
2	B. ANALYSIS Force and Stress analysis using link elements in Trusses, cables etc
3	Stress and deflection analysis in beams with different support conditions
4	Stress analysis of flat plates and simple shells
5	Stress analysis of axi – symmetric components
6	Thermal stress and heat transfer analysis of plates
7	Thermal stress analysis of cylindrical shells
8	Vibration analysis of spring-mass systems
9	Model analysis of Beams
10	Harmonic, transient and spectrum analysis of simple systems

THEORY	**0**		**TUTORIAL**	**0**		**PRACTICAL**	**60**		**TOTAL**	**60**

BOOK REFERENCES	
1	Simulation And Analysis Laboratory Manual, Al-Ameen Publications, 2020.

OTHER REFERENCES	
1	https://www.youtube.com/watch?v=3TtudPJeg9M
2	https://www.youtube.com/watch?v=MXkCE7_w4YE
3	https://www.youtube.com/watch?v=p2FJSUrKgzs
4	https://www.youtube.com/watch?v=JBFp0l6lUSY
5	https://www.youtube.com/watch?v=h752xp5mcNs

Semester	Programme	Course Code	Course Name	L	T	P	C
VI	B.E. MECH	20ME6L2	MINI PROJECT	0	0	2	1

COURSE LEARNING OUTCOMES (COs)	
After Successful completion of the course, the students should be able to	
CO1	Develop concept for the project
CO2	Estimate the time frame and cost for the project execution and completion
CO3	Analyze the project progress with remedial measures individual in a team
CO4	Examine the environmental impact of the project
CO5	Demonstrate the project functionality along with report and presentation

PRE-REQUISITE	Nil

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	3				3	2			3	3
CO2	3	2	2						3		3		3	3
CO3	3	3		2	3				3	3	3	3	3	3
CO4	3					3	3	3		2			3	3
CO5	3	2							3	3	2		3	3

COURSE ASSESSMENT METHODS		
DIRECT	1	Project Review
	2	End Semester Examinations
INDIRECT	1	Course End Survey

GUIDELINE FOR REVIEW AND EVALUATION
The students may be grouped into 2 to 4 and work under a project supervisor. The mini project work may be decided in consultation with the supervisor. A project report to be submitted by the group which will be reviewed and evaluated by a Committee constituted by the Head of the Department. At the end of the semester examination the project work is evaluated based on oral presentation and the project report jointly by external and internal examiners

Semester	Programme	Course Code	Course Name	L	T	P	C
VI	B.E.	20PT6T2	Career Competency Development (CCD)	1	0	0	0

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Apply aptitude	K3	1
CO2	Relate logical and verbal reasoning	K2	2
CO3	Develop Leadership qualities and essentials	K3	3
CO4	Apply effectively (Verbal and Non Verbal)	K3	4
CO5	Develop presentations	K3	5
CO6	Develop interview skills	K3	5

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1				1						1	1	
CO2	1	1				1						1	1	
CO3	1	1				1			3			1	1	
CO4	1	1				1				3		1	1	
CO5	1	1				1						1	1	
CO6	1	1				1						1	1	

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests

COURSE CONTENT		
Topic - 1	**Aptitude**	**3**
Aptitude & Analytical Ability section consists of questions from topics such as coding-decoding, puzzles, blood relations, pie charts and tables, syllogism and figure odd-1, problems on trains, age, averages, probability, percentage, time & Work, Time & distance, Partnership.		
Topic - 2	**Verbal Reasoning,**	**3**
Verbal Ability Section consists of questions from error in sentences, rearrangement, passages and jumbled sentences. **Logical Reasoning,** Analogy, Blood Relation, Directional Sense, Number and Letter Series, Coding – Decoding, Calendars, Clocks, Venn Diagrams, Seating Arrangement, Syllogism, Mathematical Operations.		
Topic - 3	**Group Discussion,**	**3**
Introduction, Communication skills in group discussion, Do‘s and Dont‘s of group discussion Topics, rules and importance.		
Topic - 4	**Oral and Written Communication Skills,**	**3**
Basic Listening Skills: Introduction, Self-Awareness, Active Listening, Becoming an Active Listener, Listening in Difficult Situations. Effective Written Communication: Introduction, When and When Not to Use Written Communication - Complexity of the Topic, Amount of Discussion, Required, Shades of Meaning, Formal Communication.		
Topic - 5	**Technical Paper Presentation, Resume Preparation and Interview Skills.**	**3**
Giving Presentations: Dealing with Fears, Planning your Presentation, Structuring Your Presentation, Delivering Your Presentation, Techniques of Delivery Resume Preparation Interview Skills: Purpose of an interview, Do‘s and Dont‘s of an interview		

THEORY	**15**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**15**

BOOK REFERENCES	
1	Quantitative aptitude for Competitive examination By R S Agarwal
2	Quantitative Aptitude by Competitive Examinations by Abhijit Guha 4 th edition
3	A Modern Approach To Verbal & Non Verbal Reasoning By R S Agarwal
4	Analytical and Logical reasoning By Sijwali B S
5	Analytical and Logical reasoning for CAT and other management entrance test By Sijwali B S Sherfield, R. M. ; Montgomery, R.J. and Moody, P, G. (2010).
6	Developing Soft Skills. 4th ed. 2. R.S.Agarwarl, S.Chand Publishing Quantitative Aptitude Latest Edition Paperback – 1 January 2018.
7	www.positivepsychology.com www.skillsyouneed.com www.businessjargons.com www.careerbless.com/aptitude/qa www.indiabix.com/aptitude https://prepinsta.com/ https://www.javatpoint.com/

SEMESTER VII

Sl. No.	Course Code	Course Title	Category	CIA	ESE	L	T	P	C
THEORY COURSES									
1	20ME7T1	Metrology and Measurements	PC	50	50	3	0	0	3
2		Professional Elective III	PE	50	50	3	0	0	3
3		Professional Elective IV	PE	50	50	3	0	0	3
4		Open Elective IV / SWAYAM	OE	50	50	3	0	0	3
THEORY COURSE WITH LABORATORY COMPONENTS									
5	20ME7LT1	Mechatronics	PC	50	50	2	0	4	4
LABORATORY COURSE									
6	20ME7L1	Metrology and Measurements Laboratory	PC	50	50	0	0	4	2
7	20ME7L2	Design project	EEC	100	--	0	0	4	2
Total						**14**	**0**	**12**	**20**

Semester	Programme	Course Code	Course Name	L	T	P	C
VII	B.E. MECH	20ME7T1	METROLOGY AND MEASUREMENTS	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Understand the fundamental knowledge on metrology.	K2	1
CO2	Apply the principles of linear and angular measurement tools used for industrial applications	K3	2
CO3	Demonstrate the techniques of form measurement used for industrial components	K3	3
CO4	Apply the procedure for conducting inspection using modern techniques	K3	4
CO5	Discuss various measuring techniques of mechanical properties in industrial applications.	K3	5

PRE-REQUISITE	Nil

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3						2	2	3	3		3	3	3
CO2	3	2					2	2	3	3		3	3	3
CO3	3	2					2	2	3	3		3	3	3
CO4	3	2			2		2	2	3	3		3	3	3
CO5	3	2					2	2	3	3		3	3	3

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignment
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic - 1	**BASICS OF METROLOGY**	**9**
Introduction to Metrology – Need – Elements – Work piece, Instruments – Persons – Environment – their effect on Precision and Accuracy – Errors – Types – Error Control techniques – concepts of Interchangeability - Types of standards.		
Topic - 2	**LINEAR AND ANGULAR MEASUREMENTS**	**9**
Linear Measuring Instruments – Types – Micrometer, Vernier calliper, Slip Gauges, Comparators. Limit gauges – gauge design – terminology – procedure – Angular measuring instruments – Types – Bevel protractor, angle gauges, sin bar – Angle alignment telescope – Autocollimator – Applications.		
Topic - 3	**FORM MEASUREMENT**	**9**
Principles and Methods of straightness – Flatness measurement – Thread measurement, gear measurement, surface finish measurement, Roundness measurement – Applications.		
Topic - 4	**ADVANCES IN METROLOGY**	**9**
Laser Interferometers – types – DC and AC Lasers interferometer – Applications –. Basic concept of CMM – Types of CMM – Constructional features – Calibration of CMM – Applications – Basic concepts of Machine Vision System – Element – Applications		
Topic - 5	**MEASUREMENT OF POWER, FLOW AND TEMPERATURE**	**9**
Force, torque, power - Mechanical, Pneumatic, Hydraulic and Electrical type. Flow measurement: Venturimeter, Orifice meter, Rotameter, Pitot tube – Temperature Measurements: Thermometer, Bimetallic strip, Thermocouples, Electrical Resistance Thermometer.		

THEORY	**45**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**45**

BOOK REFERENCES	
1	Jain R.K. “Engineering Metrology”, Khanna Publishers, 2009.
2	Beckwith, Marangoni, Lienhard, “Mechanical Measurements”, Pearson Education , 2014.
3	Charles Reginald Shotbolt, “Metrology for Engineers”, 5th edition, Cengage Learning EMEA,1990.
4	Gupta. I.C., “Engineering Metrology”, Dhanpatrai Publications, 2005.

OTHER REFERENCES	
1	https://libres.uncg.edu/ir/wcu/f/Guardiola2009.pdf
2	http://archives.njit.edu/vol01/etd/1990s/1993/njit-etd1993-004/njit-etd1993-004.pdf
3	https://nitsri.ac.in/Department/Mechanical%20Engineering/MEC_405_Book_2,_for_Unit_2B.pdf
4	https://www.sukhamburg.com/documents/Article_LaserLines.pdf
5	http://archives.njit.edu/vol01/etd/1990s/1993/njit-etd1993-004/njit-etd1993-004.pdf

Semester	Programme	Course Code	Course Name	L	T	P	C
VII	B.E.MECH	20ME7LT1	MECHATRONICS	2	0	4	4

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Interface the different types of sensor with mechatronics system	K2	1
CO2	Control position and speed of actuators used in mechatronics system.	K3	2
CO3	Design a feedback controller for mechatronics system.	K4	3
CO4	Programming the microcontroller to control actuators and sensor.	K2	4
CO5	Programming PLC to develop a mechatronic system	K2	5

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	2	2	-	3	-	-	1	2	3	-	-
CO2	2	1	-	2	2	-	3	-	-	1	2	3	-	-
CO3	2	1	-	2	2	-	3	-	1	-	2	3	-	-
CO4	3	2	1	3	3	-	-	-	-	-	3	-	3	1
CO5	3	2	1	3	3	-	-	-	-	-	3	-	3	-

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignment & Record
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic - 1	**SENSOR**	**6**
Components of mechatronics system, Sensor-terminology - Potentiometer, Linear Variable differential transformer, strain gauge, Piezoelectric sensor, Optical encoder, Hall effect sensor, thermistor		
Topic - 2	**ACTUATOR**	**6**
Mechanical Actuation system - cam, gear, belt & chain, Ball screw, Pneumatic & hydraulic Actuation system. Electrical actuation system -relay & solenoid, working & control of Stepper & servo motor.		
Topic - 3	**FEEDBACK CONTROL**	**6**
Open loop system, closed loop system, Transfer Function, Mathematical Modeling of Mechanical & Electrical system, First order system, second order system, Proportional control, derivative control, Integral control, PID control		
Topic - 4	**MICRO CONTROLLER**	**6**
Architecture of 8051- i/o pins, ports and circuits, memory, counter, timer, interrupt, instruction set-moving data, logical ,arithmetic operation, jump & call instruction, examples -windscreen wiper motion, car engine management		
Topic - 5	**PROGRAMMABLE LOGIC CONTROLLER**	**6**
Basic Structure - Input / Output Processing - Programming - Mnemonics - Timers, Internal relays and counters - Shift Registers - Master and Jump Controls. Examples -Pick and place robot. Car park barrier system.		

THEORY	**30**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**30**

COURSE CONTENT		
Experiment - 1	Electro Pneumatic Control of Double Acting Cylinder Using SPDT and PUSH button Switch	**6**
Experiment - 2	Actuation of Single Acting Cylinder by OR Gate Using PLC	**6**
Experiment - 3	Actuation of Single Acting Cylinder By AND Gate Using PLC	**6**
Experiment - 4	Servo Controller Interfacing for Open Loop System	**6**
Experiment - 5	Servo Controller Interfacing for Closed Loop System	**6**
Experiment - 6	Continuous Reciprocating of Single Acting and Double Acting Cylinder Using Pilot Valves	**6**

Experiment - 7	Design and Testing for Actuation Of Hydraulic Cylinder to find out Force Vs Pressure	**3**
Experiment - 8	Design and Testing for Actuation Of Hydraulic Cylinder to find out Speed Vs Discharge	**6**
Experiment - 9	Addition ,Subtraction & Multiplication of Two 8-Bit Numbers	**6**
Experiment - 10	Stepper Motor & Traffic Light Interfacing with 8051	**6**

THEORY	**0**		**TUTORIAL**	**0**		**PRACTICAL**	**60**		**TOTAL**	**60**

BOOK REFERENCES	
1	W. Bolton, Mechatronics, Pearson Education, New Delhi, 2012.
2	Godfrey Onwubolu, Mechatronics: Principles and Applications Butterworth-Heinemann Ltd, 2005.
3	NitaigourPremchandMahalik, Mechatronics : Principles, Concepts and Applications, Tata McGraw Hill Publishing Company Pvt.
4	Krishna Kant, Microprocessors & Microcontrollers, Prentice Hall of India, 2007. .

OTHER REFERENCES	
1	P. Ramachandran, G. K. Vijayaraghavan, and M. S. Bala-Sundram, Mechatronics: Integrated Mechanical Electronic Systems, Wiley India Pvt. Ltd., New Delhi 2008.
2	Introduction to Embedded Systems: Shibu K V, McGRAW Hill Publications.
3	Frank D petruzella, “Programmable logic controllers”, Fourth edition, McGraw Hill higher education ,2016
4	https://www.youtube.com/watch?v=3_kzxq_X2II
5	https://www.youtube.com/watch?v=FNvcnMpBk48

Semester	Programme	Course Code	Course Name	L	T	P	C
VII	B.E. MECH	20ME7L1	METROLOGY AND MEASUREMENTS LABORATORY	0	0	3	1.5

COURSE LEARNING OUTCOMES (COs)		
After Successful completion of the course, the students should be able to		RBT Level
CO1	State the aim and develop the procedure to conduct the experiment / exercise in the Metrology And Measurements Laboratory Course	K3
CO2	Demonstrate skills at the level of precision (reliably, quickly, smoothly, and accurately with negligible guidance) in performing the experiment / exercise	K3
CO3	Draw inferences from the experiment / exercise conducted and present it professionally	K4
CO4	Demonstrate professionally the results obtained through the experiment / exercise and present conclusions	K4
CO5	Demonstrate an understanding of the concepts, procedures, and applications through verbal and written communication	K3
CO6	Demonstrating an attitude at the level of valuing (attaching values and expressing personal opinions by showing some definite involvement and commitment)	K3

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3								3	3				
CO2	3				3			2	3		1			
CO3	3	2		2		1				3				
CO4	3									3				
CO5	3									3		1		
CO6						2		2	2	2		1		

COURSE ASSESSMENT METHODS		
DIRECT	1	Laboratory Record
	2	Model Practical Examinations
	3	End Semester Examinations
INDIRECT	1	Course Exit Survey

LIST OF EXPERIMENTS	
1	Vernier caliper, Micrometer
2	Tool Maker's Microscope
3	Comparator
4	Sine Bar
5	Gear Tooth Vernier Caliper
6	Floating carriage Micrometer
7	Surface Finish Measuring Equipment
8	Vernier Height Gauge, Vernier Depth Gauge
9	Bore diameter measurement using telescope gauge
10	Bore diameter measurement using micrometer
11	Force Measurement
12	Torque Measurement
13	Temperature measurement
14	Autocollimator

THEORY	0		TUTORIAL	0		PRACTICAL	45		TOTAL	45

BOOK REFERENCES	
1	Metrology And Measurements Laboratory Manual, Al-Ameen Publications, 2020

OTHER REFERENCES	
1	https://www.youtube.com/watch?v=NF2YSTPx8lc
2	https://www.youtube.com/watch?v=5GS6MAPx598
3	https://www.youtube.com/watch?v=dgkLbX4cqr4
4	https://www.youtube.com/watch?v=1a1e9rMgbyY
5	https://www.youtube.com/watch?v=bcxdKa37taM

Semester	Programme	Course Code	Course Name	L	T	P	C
VII	B.E. MECH	20ME7L2	DESIGN PROJECT	0	0	4	2

COURSE LEARNING OUTCOMES (COs)	
After Successful completion of the course, the students should be able to	
CO1	Develop concept for the project
CO2	Estimate the time frame and cost for the project execution and completion
CO3	Analyze the project progress with remedial measures individual in a team
CO4	Examine the environmental impact of the project
CO5	Demonstrate the project functionality along with report and presentation

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	3				3	2			3	3
CO2	3	2	2						3		3		3	3
CO3	3	3		2	3				3	3	3	3	3	3
CO4	3					3	3	3		2			3	3
CO5	3	2							3	3	2		3	3

COURSE ASSESSMENT METHODS		
DIRECT	1	Project Review
	2	End Semester Examinations
INDIRECT	1	Course End Survey

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

Semester	Programme	Course Code	Course Name	L	T	P	C
VIII	B.E. MECH	20ME8L1	PROJECT WORK	0	0	20	10

COURSE LEARNING OUTCOMES (COs)	
After Successful completion of the course, the students should be able to	
CO1	Discover potential research areas in the field of Mechanical Engineering.
CO2	Compare and contrast the several existing solutions for the problems identified.
CO3	Formulate and propose a plan for creating a solution for the research plan identified.
CO4	Conduct the experiments as a team and interpret the results.
CO5	Report and present the findings of the work conducted.

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)

COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	2	2	2	3	3	3	3	3	3
CO2	3	3	3	3	3	2	2	2	3	3	2	3	3	3
CO3	3	3	3	3	3	3	2	2	3	3	3	3	3	3
CO4	2	2	2	2	2	3	2	3	3	3	2	3	3	3
CO5	3	3	3	3	2	3	2	3	3	3	2	3	3	3

COURSE ASSESSMENT METHODS		
DIRECT	1	Project Review
	2	End Semester Examinations
INDIRECT	1	Course End Survey

GUIDELINE FOR REVIEW AND EVALUATION

The students in a group of 3 to 4 work on a topic approved by the head of the department under the guidance of a faculty member and prepare a comprehensive project report after completing the work tothe satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee shall be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department. Progressive weight-age shall be assigned to the project reviews as decided by the project review committee.

Semester	Programme	Course Code	Course Name	L	T	P	C
V	B.E. MECH	20ME5E1	CAD/CAM/CIM	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Explain the 2D and 3D transformations, clipping algorithm, Manufacturing models and Metrics	K2	1
CO2	Explain the fundamentals of parametric curves, surfaces and Solids	K3	2
CO3	Summarize the different types of Standard systems used in CAD	K3	3
CO4	Apply NC & CNC programming concepts to develop part programme for Lathe & Milling Machines	K3	4
CO5	Summarize the different types of techniques used in Cellular Manufacturing and FMS	K3	5

PRE-REQUISITE	NIL-

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3		2	-	3	1	-	-	-	-	-	2	1	3
CO2	3	2	-	-	-	-	-	-	-	-	-	3	2	3
CO3	3	-	2	-	3	2	-	-	-	2	-	2	2	3
CO4	3	2	2	1	3	-	-	-	2	-	-	2	2	1
CO5	3	1	-	-	3	1	-	-	2	-	-	2	2	2

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignments
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic - 1	**INTRODUCTION**	**9**
Product cycle- Design process- sequential and concurrent engineering- Computer aided design – CAD system architecture- Computer graphics – co-ordinate systems- 2D and 3D transformations- homogeneous coordinates - Line drawing -Clipping- viewing transformation-Brief introduction to CAD and CAM – Manufacturing Planning, Manufacturing control- Introduction to CAD/CAM –CAD/CAM concepts — Types of production - Manufacturing models and Metrics – Mathematical models of Production Performance.		
Topic - 2	**GEOMETRIC MODELING**	**9**
Representation of curves- Hermite curve- Bezier curve- B-spline curves-rational curves-Techniques for surface modeling – surface patch- Coons and bicubic patches- Bezier and B-spline surfaces. Solid modeling techniques- CSG andB-rep.		
Topic - 3	**CAD STANDARDS**	**9**
Standards for computer graphics- Graphical Kernel System (GKS) - standards for exchange images- Open Graphics Library (OpenGL) - Data exchange standards - IGES, STEP, CALS etc. - communication standards.		
Topic - 4	**FUNDAMENTAL OF CNC AND PART PROGRAMING**	**9**
Introduction to NC systems and CNC - Machine axis and Co-ordinate system- CNC machine tools- Principle of operation CNC- Construction features including structure- Drives and CNC controllers- 2D and 3D machining on CNC- Introduction of Part Programming, types - Detailed Manual part programming on Lathe & Milling machines using G codes and M codes- Cutting Cycles, Loops, Sub program and Macros- Introduction of CAM package.		
Topic - 5	**CELLULAR MANUFACTURING AND FLEXIBLE MANUFACTURING SYSTEM (FMS)**	**9**
Group Technology(GT),Part Families–Parts Classification and coding–Simple Problems in Opitz Part Coding system–Production flow Analysis–Cellular Manufacturing–Composite part concept–Types of Flexibility - FMS – FMS Components – FMS Application & Benefits – FMS Planning and Control–Quantitative analysis in FMS.		

THEORY	**45**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**45**

BOOK REFERENCES	
1	Chris McMahon and Jimmie Browne “CAD/CAM Principles", "Practice and Manufacturing management “ Second Edition, Pearson Education, 1999.
2	Donald Hearn and M. Pauline Baker “Computer Graphics”’. Prentice Hall, Inc,1992.
3	Foley, Wan Dam, Feiner and Hughes - "Computer graphics principles & practice" Pearson Education -2003

4	William M Neumann and Robert F.Sproul “Principles of Computer Graphics”, McGraw Hill Book Co. Singapore, 1989.

OTHER REFERENCES	
1	https://nptel.ac.in/courses/106106088, IIT Medras
2	https://easyengineering.net/cad-cam-cim-by-radhakrishnan/
3	http://www.freepdfbook.com/cad-cam-cim-book/
4	https://studymaterialz.in/cad-cam-cim-by-radhakrishnan/
5	https://www.technicalbookspdf.com/cad-cam-cim/

Semester	Programme	Course Code	Course Name	L	T	P	C
V	B.E –MECH	20ME5E2	TOOL DESIGN	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Select standard components, clamping and locating devices using basic principles of jigs and fixtures	K3	1
CO2	Formulate the design procedure and select the materials used for manufacture	K3	2
CO3	Design jigs and fixtures for a given component	K6	3
CO4	Identify and choose the types of presses for a given sheet metal component	K3	4
CO5	Design a die-set for a given sheet metal component using the design procedure for various sheet metal workingprocesses.	K6	5

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	-	-	-	-	-	-	-	1	2	2
CO2	2	2	1	-	-	-	-	-	-	1	1	2	2	2
CO3	3	3	3	2	-	-	-	-	3	1	1	3	2	2
CO4	2	2	1	-	-	-	-	-	-	1	1	2	2	2
CO5	3	3	3	-	-	-	-	-	3	1	1	3	2	2

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignments
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic - 1	**DESIGN OF JIGS**	**9**
Introduction - Location Principles – Six Point Location Principle – Locators – Clamping Principles– Clamping Devices – Drill Jigs – Drill Bushes – Drill Jig Types – Design and Development of Jigs for given components.		
Topic - 2	**DESIGN OF FIXTURES**	**9**
Milling Fixtures – Milling Methods – Milling Fixture Types – Turning fixtures – Broaching Fixtures – Grinding Fixtures – Assembly, Inspection and Welding Fixtures – Modular Fixtures – Design and Development of Fixtures for given components.gauges, McLeod pressure gauge.		
Topic - 3	**DESIGN OF DIES**	**9**
Power presses types and construction details, die cutting operation, cutting action in die and punch, center of pressure, clearance and its significance, cutting forces, methods of reducing cutting forces, methods of punch support, strippers, stock stops, guide pilots, knockout, design of blanking and piercing dies. Design Concepts and description of the components of progressive dies. Design of progressive dies. Design of compound dies. Designof combination dies.		
Topic - 4	**DRAWING DIES**	**9**
Metal flow and factors affecting drawing, blank size calculations, drawing force, single and double acting drawing dies, design and development of drawing dies for different components.		
Topic - 5	**BENDING AND FORMING DIES**	**9**
Spring back, bend allowance; calculation of development length, bending force calculations types of bending dies. Curling dies.Forging process and forging dies. (Introductory Treatment).		

THEORY	**45**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**45**

BOOK REFERENCES	
1	John G. Nee - 'Fundamentals of Tool Design' - Society of Manufacturing - 1998 - 4th Edition.
2	E. K. Henriksen – 'Jig and Fixture Design Manual' - Industrial Press, New York - 1973
3	Paquin and Crowley – 'Die Design Fundamentals' - Industrial Press, New York – 1979
4	Donaldson, Lecain and Goold – 'Tool Design' - McGraw Hill, New York – 1976

OTHER REFERENCES	
1	Design tool –wikipedia
2	https://youtu.be/xz89fkrVzcc
3	https://youtu.be/NGfoQOepuXI
4	https://youtube.com/playlist?list=PLQmc-I2-FO2HTjIKRUw9WPIs61FVZZ7Ng
5	https://youtu.be/EvYC2yJnQKA

Semester	Programme	Course Code	Course Name	L	T	P	C
V	B.E –MECH	20ME5E3	COMPOSITE MATERIALS AND MECHANICS	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Summarize the various types of Fibres and matrices for Composite materials	K3	1
CO2	Summarize the various types manufacturing methods for Composite materials	K3	2
CO3	Derive Flat plate Laminate equations	K3	3
CO4	Analyze Lamina strength	K4	4
CO5	Analyze Laminate flat plates	K4	5

PRE-REQUISITE	Nil

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3					2	2	2		3			3	3
CO2	3					2	2	2		3			3	3
CO3	3	3	3	3						3			3	3
CO4	3	3	3	3						3			3	3
CO5	3	3	3	3						3			3	3

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignments
	3	Group Presentation & Cooperative Learning Report
	4	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic – 1	**INTRODUCTION**	**9**
Introduction: Definitions, Composites, Reinforcements and matrices, Types of reinforcements, Types of matrices, Types of composites, Carbon Fibre composites, Properties of composites in comparison with standard materials, Applications of metal, ceramic and polymer matrix composites.		
Topic – 2	**MANUFACTURING METHODS**	**9**
Hand and spray lay - up, injection molding, resin injection, filament winding, pultrusion, centrifugal casting and prepregs. Fibre/Matrix Interface, mechanical. Measurement of interface strength. Characterization of systems; carbon fibre/epoxy, glass fibre/polyester, etc.		
Topic – 3	**FLAT PLATE LAMINATE CONSTITUTE EQUATIONS**	**9**
Definition of stress and Moment Resultants. Strain Displacement relations. Basic Assumptions of Laminated anisotropic plates. Laminate Constitutive Equations .		
Topic - 4	**LAMINA STRENGTH ANALYSIS**	**9**
Introduction – Maximum Stress and Strain Criteria. Von-Misses Yield criterion for Isotropic Materials. Generalized Hills Criterion for Anisotropic materials. Tsai-Hills Failure Criterion for Composites.		
Topic - 5	**ANALYSIS OF LAMINATED FLAT PLATES**	**9**
Equilibrium Equations of Motion. Energy Formulations. Static Bending Analysis. Buckling Analysis. Free Vibrations – Natural Frequencies		

THEORY	**45**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**45**

BOOK REFERENCES	
1	Gibson, R.F., “Principles of Composite Material Mechanics”, Second Edition, McGraw-Hill, CRC press in progress, 1994.
2	Hyer, M.W., Stress Analysis of Fiber – Reinforced Composite Materials, McGraw Hill, 1998
3	Mallick, P.K., Fiber, Reinforced Composites: Materials, Manufacturing and Design, Maneel Dekker Inc, 1993
4	Mallick, P.K. and Newman, S., (edition), Composite Materials Technology: Processes and Properties, Hansen Publisher, Munish, 1990.

OTHER REFERENCES	
1	https://www.asminternational.org/documents/10192/1849770/05287G_Sample_Chapter.pdf
2	https://www.me.iitb.ac.in/~ramesh/courses/ME338/comp.pdf
3	https://ntrs.nasa.gov/api/citations/19950009349/downloads/19950009349.pdf
4	https://www.mdpi.com/2076-3417/6/9/267/pdf
5	http://ethesis.nitrkl.ac.in/5685/1/110ME0327-3.pdf

Semester	Programme	Course Code	Course Name	L	T	P	C
V	B.E –MECH	20ME5E4	DESIGN FOR MANUFACTURING & ASSEMBLY	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Understand the product development cycle	K2	1
CO2	Know the manufacturing issues that must be considered in the mechanical engineering design process	K3	2
CO3	Know the principles of assembly to minimize the assembly time	K4	3
CO4	Know the effect of manufacturing process and assembly operations on the cost of product	K2	4
CO5	Be familiar with tools and methods to facilitate development of manufacture mechanical designs	K4	5

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	2	2	2	-	-	-	-	-	2	-	1	2	2	2
CO 2	2	2	2	-	1	-	1	2	1	-	-	2	2	2
CO 3	2	2	2	2	-	2	-	-	2	-	1	2	2	2
CO 4	2	2	2	-	1	-	1	2	1	-	1	2	2	2
CO 5	2	2	2	-	-	-	-	-	2	-	1	2	2	2

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignments
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENTS		
Topic - 1	**INTRODUCTION**	**9**
Introduction Need Identification and Problem Definition, Concept Generation andEvaluation, Embodiment Design, Selection of Materials and Shapes.		
Topic - 2	**MATERIAL CONSIDERATION**	**9**
Properties of Engineering Materials, Selection of Materials – I, Selection of Materials – II,Case Studies – I, Selection of Shapes, Co-selection of Materials and Shapes, Case Studies – II.		
Topic - 3	**DESIGN FOR MANUFACTURE**	**9**
Selection ofManufacturingProcesses, Review of Manufacturing Processes, Design forCasting, Design for Bulk Deformation Processes, Design for Sheet Metal Forming Processes,Design for Machining, Design for Powder Metallurgy,Design for Polymer Processing, Selectionof Materials and Processes, Case-Studies – III.		
Topic - 4	**DESIGN FOR ASSEMBLY**	**9**
Design for Assembly, Review of Assembly Processes, Design for Welding – I, Design forWelding – II, Design for Brazing and Soldering, Design for Adhesive Bonding, Design for Joiningof Polymers, Design for Heat Treatment, Case-Studies – IV.		
Topic - 5	**DESIGN FOR RELIABILITY**	**9**
Design for Reliability, Failure Mode and Effect Analysis and Quality, Design for Quality,Approach to Robust Design, Design for Optimization**.**		

THEORY	**45**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**45**

BOOK REFERENCES	
1	T H Courtney, “Mechanical Behavior of Materials”, McGraw Hill, NY, 2010.
2	G Dieter, Engineering Design - a materials and processing approach, McGraw Hill, NY, 2010.
3	K G Swift and J D Booker, Process selection: from design to manufacture, London: Arnold, 1997.
4	S S Rao, “Engineering Optimization: theory and practice”, John Wiley, NY, 1996.
5	G Boothroyd, P Dewhurst and W Knight, Product design for manufacture and assembly, John Wiley, NY: Marcel Dekkar, 1994.

OTHER REFERENCES	
1	DFMA-wikipedia
2	https://youtu.be/55-QxaUDxS0
3	https://youtu.be/NT8o5Bo8M2E
4	https://youtu.be/1O7d2b05A-E
5	https://youtu.be/ryEHgaxqPKk

Semester	Programme	Course Code	Course Name	L	T	P	C
V	B.E –MECH	20ME5E5	INSTRUMENTATION AND CONTROL	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Understand the basic principles and performance characteristics of measurement.	K2	1
CO2	Apply the basic principles to measure the temperature, pressure with the help of Thermocouple and different pressure gauges.	K2	2
CO3	Measure speed, flow and level with the help of various instruments.	K4	3
CO4	Understand the measurement of Acceleration, Vibration and Stress Strain.	K2	4
CO5	Understand the Measurement of Humidity, Force, Torque and measurement of power and Applications of various control Systems.	K2	5

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	-	-	3	-	2	2	1	3	2
CO2	3	3	3	3	-	-	-	3	-	2	2	1	3	2
CO3	3	3	3	3	-	-	-	3	-	2	2	1	3	2
CO4	3	3	3	3	-	-	-	3	-	2	2	1	3	2
CO5	3	3	3	3	-	-	-	3	-	2	2	-	3	2

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Seminar
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENTS		
Topic - 1	**INTRODUCTION**	**9**
Definition – Basic principles of measurement – Measurement systems, generalized configuration and functional description of measuring instruments – examples. Static and Dynamic performance characteristics– sources of errors, Classification and elimination of errors. Measurement of Displacement: Theory and construction of various transducers to measure displacement – Using Piezo electric, Inductive, capacitance, resistance, ionization and Photo electric transducers; Calibration procedures.		
Topic - 2	**MEASUREMENT OF TEMPERATURE**	**9**
Measurement of Temperature: Various Principles of measurement-Classification: Expansion Type: Bimetallic Strip- Liquid in glass Thermometer; Electrical Resistance Type: Thermistor, Thermocouple, RTD; Radiation Pyrometry: Optical Pyrometer; Changes in Chemical Phase: Fusible Indicators and Liquid crystals. Measurement of Pressure: Different principles usedClassification: Manometers, Dead weight pressure gauge Tester (Piston gauge), Bourdon pressure gauges, Bulk modulus pressure gauges, Bellows, Diaphragm gauges. Low pressure measurement – Thermal conductivity gauges, ionization pressure gauges, McLeod pressure gauge.		
Topic - 3	**MEASUREMENT OF LEVEL**	**9**
Direct methods – Indirect methods – Capacitive, Radioactive, Ultrasonic, Magnetic, Cryogenic Fuel level indicators –Bubbler level indicators. Flow measurement: Rotameter, magnetic, Ultrasonic, Turbine flowmeter, Hot – wire anemometer, Laser Doppler Anemometer (LDA). Measurement of Speed: Mechanical Tachometers, Electrical tachometers, Non- contact type Stroboscope; Measurement of Acceleration and Vibration: Different simple instruments – Principles of Seismic instruments – Vibrometer and accelerometer using this principle-Piezo electric accelerometer.		
Topic - 4	**STRESS-STRAIN MEASUREMENTS**	**9**
Various types of stress and strain measurements –Selection and installation of metallic strain gauges; electrical strain gauge – gauge factor – method of usage of resistance strain gauge for bending, compressive and tensile strains – Temperature compensation techniques, Use of strain gauges for measuring torque, Strain gauge Rosettes. Measurement of Humidity: Moisture content of gases, Sling Psychrometer, Absorption Psychrometer, Dew point meter. Measurement of Force, Torque and Power- Elastic force meters, load cells, Torsion meters, Dynamometers.		
Topic - 5	**ELEMENTS OF CONTROL SYSTEMS**	**9**
Introduction, Importance – Classification – Open and closed systems- Servomechanisms – Examples with block diagrams – Temperature, speed and position control systems- Transfer functions- First and Second order mechanical systems.		

THEORY	**45**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**45**

BOOK REFERENCES	
1	Principles of Industrial Instrumentation & Control Systems, - Alavala, - Cengage Learning
2	Basic Principles – Measurements (Instrumentation) & Control Systems – S. Bhaskar – Anuradha Publications.
3	Measurement Systems: Applications & design, E. O. Doebelin, TMH
4	Instrumentation, Measurement & Analysis, B.C. Nakra & K.K. Choudhary, TMH
5	Experimental Methods for Engineers / Holman

OTHER REFERENCES	
1	https://www.assystem.com/en/offers/instrumentation-and-control-systems/
2	http://ldce.ac.in/departments/instrumentation-control-engineering
3	https://www.eit.edu.au/resources/fundamentals-of-instrumentation-process-control-plcs-and-scada-for-plant-operators-and-other-non-instrument-personnel/
4	https://www.sciencedirect.com/topics/engineering/control-instrumentation
5	https://www.robots.ox.ac.uk/~gari/teaching/b18/background_lectures/2A2-Signal-Conditioning-L1-Notes-Collins.pdf

Semester	Programme	Course Code	Course Name	L	T	P	C
V	B.E. -MECH	20ME5E6	HYDRAULICS AND PNEUMATICS	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Explain the Fluid power and operation of different types of pumps.	K3	1
CO2	Summarize the features and functions of Hydraulic motors, actuators and Flow control valves	K3	2
CO3	Explain the different types of Hydraulic circuits and systems	K3	3
CO4	Explain the working of different pneumatic circuits and systems	K3	4
CO5	Summarize the various trouble shooting methods and applications of hydraulic and pneumatic systems.	K4	5

PRE-REQUISITE	Thermodynamics, thermal engineering

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	2	3	1	3	-	-	-	-	-	3	3
CO2	3	3	1	3	3	1	3	-	-	3	-	1	3	3
CO3	3	3	1	3	2	-	3	-	-	3	-	-	3	3
CO4	3	3	1	3	3	1	3	-	-	3	-	-	3	3
CO5	3	3	-	3	3	1	3	-	-		-	1	3	3

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Seminar
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic – 1	**POWER PRINICIPLES AND HYDRAULIC PUMPS**	**9**
Introduction to Fluid power – Advantages and Applications – Fluid power systems – Types of fluids- Properties of fluids and selection – Basics of Hydraulics – Pascal's Law – Principles of flow- Friction loss – Work, Power and Torque Problems, Sources of Hydraulic power : Pumping Theory – Pump Classification – Construction , Working, Design, Advantages, Dis-advantages, Performance, Selection criteria of Linear and Rotary – Fixed and Variable displacement pumps – Problems.		
Topic – 2	**HYDRAULIC ACTUATORS AND CONTROL COMPONENTS**	**9**
Hydraulic Actuators: Cylinders – Types and construction, Application, Hydraulic cushioning – Hydraulic motors - Control Components : Direction Control, Flow control and pressure control valves – Types, Construction and Operation – Servo and Proportional valves – Applications – Accessories : Reservoirs, Pressure Switches – Applications – Fluid Power ANSI Symbols – Problems.		
Topic – 3	**HYDRAULIC CIRCUITS AND SYSTEMS**	**9**
Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double-Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Hydrostatic transmission, Electro hydraulic circuits, Mechanical hydraulic servo systems.		
Topic – 4	**PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS**	**9**
Properties of air – Perfect Gas Laws – Compressor – Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit – Cascade method – Electro Pneumatic System – Elements – Ladder diagram – Problems, Introduction to fluidics and pneumatic logic circuits.		
Topic – 5	**TROUBLE SHOOTING AND APPLICATIONS**	**9**
Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems, Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications. Design of Pneumatic circuits for Pick and Place applications and tool handling in CNC Machine tools – Low cost Automation – Hydraulic and Pneumatic power packs.		

THEORY	**45**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**45**

BOOK REFERENCES	
1	Anthony Esposito, "Fluid Power with Applications", Pearson Education 2005.
2	Majumdar S.R., "Oil Hydraulics Systems – Principle and Maintenance", Tata McGraw- Hill, 2001.
3	R. Srinivasan "Hydraulic and Pneumatic Control",Vijay Nicole, 2004

OTHER REFERENCES	
1.	https://nptel.ac.in/courses/112106300 Hydraulics and Pneumatics, IIT Madras Prof. Somashekhar S
2.	https://nptel.ac.in/courses/112105046 Fundamentals of Industrial Oil Hydraulics and Pneumatics, IIT Kharagpur Prof. R.N. Maiti
3.	https://www.youtube.com/watch?v=8xd7cWvMrvE
4.	https://www.youtube.com/watch?v=jKb-KLVzCtw
5.	https://www.youtube.com/watch?v=iIB02kKH6BA

Semester	Programme	Course Code	Course Name	L	T	P	C
V	B.E. -MECH	20ME5E7	INTERNAL COMBUSTION ENGINES	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Explain the types of fuel injection system and combustion process of spark ignition engines.	K2	1
CO2	Illustrate the combustion process and fuel spray characteristics inside the cylinder of compression ignition engines.	K2	2
CO3	Identify the cause of the pollutant formation and emission control techniques to control pollutants in spark ignition and compression ignition engines.	K3	3
CO4	Explain the use of air flow, pressure, temperature, speed, exhaust gas oxygen, knock and position sensor of engine management system in an automobile.	K2	4
CO5	Illustrate the advancements in Internal Combustion engines.	K2	5

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3													
CO2	3													
CO3	3	3	2			3								
CO4	3		3		2	2								
CO5	3		3		2	2								

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignments
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic - 1	**SPARK IGNITION ENGINES**	**9**
Air fuel ratio requirements, Simple Carburetor, Fuel injection systems- Monopoint, Multipoint & Direct injection, Stages of combustion – Normal and Abnormal combustion –Knock - Factors affecting knock– Combustion chambers.		
Topic - 2	**COMPRESSION IGNITION ENGINES**	**9**
Diesel fuel injection systems, Stages of combustion – Knocking – Factors affecting knock, Combustion chambers – Fuel spray behavior – Spray structure and spray penetration – Air motion – Turbocharging.		
Topic - 3	**ENGINE EMISSIONS AND CONTROL**	**9**
Engine emissions – Carbon Monoxide, hydrocarbon, Oxides of Nitrogen, Smoke and Particulate matter. Methods of controlling Emissions - Three-way Catalytic Converter, Selective Catalytic Reduction, Diesel Oxidation Catalyst and Particulate Trap. Emission norms –Bharat stages.		
Topic - 4	**ENGINE ELECTRONICS**	**9**
Basics of electronics - Engine management System- Sensors – Intake Air flow, Pressure, Temperature, Position Displacement and speed, Exhaust gas Oxygen and knock.		
Topic - 5	**ADVANCEMENTS IN IC ENGINES**	**9**
Homogeneous Charge Compression Ignition (HCCI) engines – Lean burn engine, Stratified charge engine – Reactivity Controlled Compression Ignition (RCCI) engines, Low Temperature Combustion, Low Heat Rejection (LHR) engines, Marine Engines and Variable Compression Ratio (VCR) engine.		

THEORY	**45**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**45**

BOOK REFERENCES	
1	Ganesan V, "Internal Combustion Engines", 4th Edition, McGraw-Hill India Pvt Ltd., 2014.
2	Domkundwar V.M. and Domkundwar A.V., "Internal Combustion Engines", 1st Edition, Dhanpat Rai& Co. Pvt. Ltd., New Delhi 2012.

OTHER REFERENCES	
1	https://www.grc.nasa.gov/www/k-12/airplane/engopt.html
2	https://ocw.mit.edu/courses/...engineering/internal-combustion-engines/lecture-not
3	https://onlinecourses.nptel.ac.in/noc19_me10
4	https://www.youtube.com/watch?v=XI9Wjig36MY
5	https://www.youtube.com/watch?v=HcRGOHJhREk

Semester	Programme	Course Code	Course Name	L	T	P	C
VI	B.E. MECH	20ME6E1	AUTOMOBILE ENGINEERING	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Classify vehicles and identify each component and their functions in the automobile.	K2	1
CO2	Explain the function of fuel injectors and awareness of emissions through various norms.	K2	2
CO3	Discuss about torque transmission to wheels through types of gear boxes and its associated components.	K2	3
CO4	Differentiate steering gear boxes and know the latest developments in braking system.	K4	4
CO5	Illustrate about automotive electronics system for engine, chassis & Occupant-protection systems.	K4	5

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3				2								2	
CO2	3	2			2									1
CO3	3				2								2	2
CO4	3		2		3									1
CO5	3	2	3		3								2	

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Seminar
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic - 1	**VEHICLE STRUCTURE AND ENGINES**	**9**
Types of automobiles - Vehicle construction and different layouts - Chassis, frame and body. Vehicle aerodynamics (various resistances and moments involved) - IC engines – Components, functions and materials – Introduction to Electric Vehicles – Energy Sources Battery-Lead acid battery, Li-ion Battery - Construction, Cell Discharge & Cell Charge Operation - Introduction to Hybrid Vehicles.		
Topic - 2	**ENGINE AUXILIARY SYSTEMS**	**9**
Electronically controlled gasoline injection system for SI engines - Electronically controlled diesel injection system (Unit injector system, Rotary distributor type and common rail direct injection system). Electronic ignition system (Transistorized coil ignition system, capacitive discharge ignition system) - Super charging and Turbo charging - Engine emission control by three way catalytic converter system - Emission norms (Euro and BS).		
Topic - 3	**TRANSMISSION SYSTEMS**	**9**
Clutch: Need – Dry and wet type – Single plate clutch – Diaphragm clutch –Fluid coupling. Gear boxes- Manual and automatic (hydramatic transmission system) - Gear shift mechanisms - Over drive, Transfer box.Fluid flywheel - Torque converter, Propeller shaft, Slip joints, Universal joints, Differential and Rear axle, Hotchkiss drive and Torque tube drive.		
Topic - 4	**STEERING, BRAKES AND SUSPENSION SYSTEMS**	**9**
Steering geometry and types of steering gear box- Power Steering - Types of Front Axle - Types of Suspension systems. Pneumatic and hydraulic braking systems - Antilock Braking System (ABS) - Electronic brake forcedistribution (EBD) and Traction control - Electronic stability control.		
Topic - 5	**RECENT AUTOMOBILE TECHNOLOGIES**	**9**
Components for electronic engine management - Electronic management of chassis system - Vehicle motion control, Occupant-protection systems- Seat belts & Air bags - Introduction to super capacitor. Advanced Driver Assistance Systems, Automatic Emergency Braking.		

THEORY	**45**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**45**

BOOK REFERENCES	
1	Kirpal Singh, "Automobile Engineering",Vol.1&2, 13th Edition, Standard Publishers 2013.
2	Jain and Asthana, "Automobile Engineering",Mc Graw Hill Education,2017.

OTHER REFERENCES	
1	https://www.youtube.com/watch?v=Sh6qZ-Sh7Jk
2	nptel.ac.in/courses/125106002/Dr. R. Ravi Chandran et. al.,IIT Chennai,Vehicle dynamics.
3	https://www.dieselnet.com/standards/in/
4	https://www.youtube.com/watch?v=Shr0u85MUQw
5	https://www.youtube.com/watch?v=ZhHs5nI1iZk

Semester	Programme	Course Code	Course Name	L	T	P	C
VI	B.E –MECH	20ME6E2	NON - DESTRUCTIVE TESTING AND EVALUATION	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		**RBT Level**	**Topics Covered**
CO1	Select appropriate surface inspection techniques for the components to be inspected.	K2	1
CO2	Explain the non destructive testing method to identify the sub surface defects in materials.	K2	2
CO3	Select and explain the suitable testing method for testing internal defects.	K4	3
CO4	Apply radiography testing methods for different suitable applications.	K3	4
CO5	Choose the suitable special non-destructive technique for various applications.	K2	5

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	**Program Outcomes (POs)**													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	-	1	3	3	-	-	-	1	-	3	2	-
CO 2	3	3	-	-	3	3	1	-	-	1	-	3	1	1
CO 3	3	3	-	1	3	3	-	-	1	1	-	3	1	2
CO 4	3	3	-	1	3	3	1	-	-	-	-	3	-	-
CO 5	3	3	1	-	3	3	-	-	-	-	-	3	-	-

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignments
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic - 1	**SURFACE TECHNIQUES**	**9**
Introduction and Scope of NDT, Discontinuities and Defects in various manufactured Components, Types of NDT techniques, Visual or Optical Testing - Direct and remote visual inspection and Aides. Liquid Penetrant Testing (LPT) Principles - Types and properties of liquid penetrants and developers - Preparation of test materials		
Topic - 2	**SUB SURFACE TECHNIQUES TESTING**	**9**
Magnetic Particle Testing (MPT) - Principles, applications, magnetization methods, magnetic particles - Dry particle technique and Wet fluorescent particle technique - Advantages and Limitations. Eddy Current Inspection - Principle, Methods, Equipment for ECT.		
Topic - 3	**ULTRASONIC TESTING**	**9**
Ultrasonic Testing (UT) - Principle, Types and characteristics of Ultrasonic waves - Attenuation, Couplants, Probes - Inspection methods - Pulse echo -Angle beam inspection of welds - Calibration of ASTM Test blocks.		
Topic - 4	**RADIOGRAPHY TESTING**	**9**
Radiographic testing (RT) -Principle, Sources of X-rays and Gamma rays and their characteristics - Absorption, scattering, Filters and screens, imaging modalities - Film radiography and Digital - Inverse square law, Safety in radiography- Applications.		
Topic - 5	**SPECIAL NDT TECHNIQUES**	**9**
Acoustic Emission Testing (AET) Principle - Instrumentation and applications, advantages and limitations. Infra-Red Thermography (IRT) - Principle, Techniques and applications. Leak Testing - Principle, Testing Procedure and applications.		

THEORY	**45**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**45**

BOOK REFERENCES	
1	Charles J. Hellier, Handbook Of Nondestructive Evaluation, McGraw-Hill Education; 2 edition 2012
2	Baldev Raj, Jayakumar T, Thavasimuthu M, Practical Non-Destructive Testing, Narosa Publishing, 2009.

OTHER REFERENCES	
1	ASM Metals Handbook, Non-Destructive Evaluation and Quality Control, American Society of Metals, Metals Park, Ohio, USA, 2001
2	Mc Gonnagle W T, Non-Destructive Testing, McGraw Hill Book Co., 1988.
3	Louis Cartz, Non-Destructive Testing, ASM International, Metals Park Ohio, US, 1995.
4	https://onlinecourses.nptel.ac.in/noc19_mm07/course
5	https://www.youtube.com/watch?v=7e3nuHEJYBI

Semester	Programme	Course Code	Course Name	L	T	P	C
VI	B.E. MECH	20HSCT3	TOTAL QUALITY MANAGEMENT	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Outline the Dimensions and Barriers regarding with Quality.	K2	1
CO2	Illustrate the TQM Principles	K3	2
CO3	Demonstrate Tools utilization for Quality improvement.	K3	3
CO4	Explain the various types of Techniques are used to measure Quality.	K3	4
CO5	Apply various Quality Systems and Auditing on implementation of TQM.	K3	5

PRE-REQUISITE	Nil

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	3	-	3	3	2	3	3	2	-
CO2	-	-	-	-	-	2	-	-	-	2	3	3	-	1
CO3	-	-	-	-	-	2	-	-	3	-	-	-	-	-
CO4	2	3	-	3	-	-	-	-	-	3	-	-	1	1
CO5	2	1	-	3	-	3	-	3	3	3	-	3	3	3

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Seminar
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic - 1	**INTRODUCTION**	**9**
Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention.		
Topic - 2	**TQM PRINCIPLES**	**9**
Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement,Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.		
Topic - 3	**TQM TOOLS AND TECHNIQUES I**	**9**
The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.		
Topic - 4	**TQM TOOLS AND TECHNIQUES II**	**9**
Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.		
Topic - 5	**QUALITY MANAGEMENT SYSTEM**	**9**
Introduction—Benefits of ISO Registration—ISO 9000 Series of Standards—Sector-Specific Standards—AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements—Implementation— Documentation—Internal Audits—Registration--ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001—Benefits of EMS.		

THEORY	**45**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**45**

BOOK REFERENCES	
1	James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
2	Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
3	Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
4	ISO 9001-2015 standards

OTHER REFERENCES	
1	https://nptel.ac.in/courses/110104080, IIT KANPUR
2	https://easyengineering.net/total-quality-management-books/
3	https://www.researchgate.net/publication/344826139_A_TEXTBOOK_ON_TOTAL_QUALITY_MANAGEMENT
4	http://naac.gov.in/docs/Books/Total%20Quality%20Management%20for%20Tertiary%20Education.pdf
5	https://link.springer.com/content/pdf/bfm%3A978-1-4615-5281-9%2F1.pdf

Semester	Programme	Course Code	Course Name	L	T	P	C
VI	BE-MECH	20ME6E4	AUTOMATION IN MANUFACTURING	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	The process of automation and types	K2	1
CO2	Get exposure to workstation, which refers to the location in the factory where some well-defined task or operation is accomplished by an automated machine	K2	2
CO3	Worker-and-machine combination or a worker using hand tools	K2	3
CO4	Understand the Automated Material handling equipments and types	K2	4
CO5	Gets exposure on portable power tools	K2	5

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Med0ium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1		2		2	1			2	1		2	2	2
CO2	1		2		2	1			2	1		2	2	2
CO3	1		2		2	1			2	1		2	2	1
CO4	1		3		2	1			2	1		2	2	1
CO5	1		2		2	1			2	1		2	2	2

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignments
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic - 1	**INTRODUCTION**	**9**
Types and strategies of automation, pneumatic and hydraulic components circuits, Automation in machine tools, Mechanical Feeding and to changing and machine tool control transfer the automation.		
Topic - 2	**AUTOMATED FLOW LINES**	**9**
Methods or work part transport transfer Mechanical buffer storagecontrol function, design and fabrication consideration.Analysis of Automated flow lines: General terminology and analysis of transfer lines withoutand with buffer storage, partial automation, implementation of automated flow lines.		
Topic - 3	**ASSEMBLY SYSTEM AND LINE BALANCING**	**9**
Assembly process and systems assembly line, line balancing methods, ways of improving line balance, flexible assembly lines.		
Topic - 4	**AUTOMATED MATERIAL HANDLING AND STORAGE**	**9**
Automated material handling: Types of equipment, functions, analysis and design of material handling systems conveyor systems, automated guided vehicle systems. **Automated storage systems:** Automated storage and retrieval systems; work in process storage, interfacing handling and storage with manufacturing.		
Topic - 5	**FUNDAMENTALS OF INDUSTRIAL CONTROLS**	**9**
Review of control theory, logic controls, sensors and actuators, Data communication and LAN in manufacturing.Business process Re-engineering: Introduction to BPE logistics, ERP, Software configuration of BPE.		

THEORY	**45**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**45**

BOOK REFERENCES	
1	Nick Dawkins - Automation and Controls.
2	Tien-Chien Chang, Richard A. Wysk and Hsu-Pin Wang - Computer Aided Manufacturing, Pearson 2009
3	Peter G. Martin and Gregory Hale - Automation Made Easy

OTHER REFERENCES	
1	https://www.youtube.com/watch?v=LTaDBl265Mg
2	https://www.youtube.com/watch?v=OHAC6EO86Ls
3	https://www.youtube.com/watch?v=YYdgLAlogpY
4	https://www.youtube.com/watch?v=QFjAY6yzMgo
5	https://www.youtube.com/watch?v=pE7SDhvuamY

Semester	Programme	Course Code	Course Name	L	T	P	C
VI	B.E - MECH	20ME6E5	QUALITY CONTROL AND RELIABILITY ENGINEERING	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Select suitable control charts for production process	K2	1
CO2	Explain the importance of sampling methods and its characteristics	K2	2
CO3	Implement the Taguchi method for experimental design	K2	3
CO4	Evaluate the reliability concept with their models	K2	4
CO5	Determine and analyze the reliability process	K2	5

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Med0ium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3	1	2				1		2	1	2	2
CO2	2	2	3	1	2				1		2	1	2	2
CO3	3	2	3	3	2				1		2	1	2	2
CO4	2	3	2		2				1		2	1	2	2
CO5	2	3	2		1				1		2	1	2	2

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignments
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic - 1	**QUALITY AND STATISTICAL PROCESS CONTROL**	**9**
Quality-Definition, Quality Assurance-Variation in process-Factors, Process capability. Control charts variables X, R and X, Attributes P, C and U-Chart tolerance design. Establishing and interpreting control charts-Charts for variables. Quality rating-Short run.		
Topic - 2	**ACCEPTANCE SAMPLING**	**9**
Lot by lot sampling-Types, Probability of acceptance in single, double, multiple sampling plans-Operating Characteristic curves-Producer's risk and consumer's risk-Acceptable Quality Limit, Lot Tolerance Percent Defective, Average Outgoing Quality, Concepts-Standard sampling plans for average outgoing quality and Lot Tolerance Percent Defective, Use of standard sampling plans.		
Topic - 3	**EXPERIMENTAL DESIGN AND TAGUCHI METHOD**	**9**
Fundamentals-Factorial experiments, Random design, Latin square design, Taguchi method-Loss function-Experiments, Signal/Noise ratio and performance measure, Orthogonal array.		
Topic - 4	**CONCEPT OF RELIABILITY**	**9**
Definition, reliability vs quality, reliability function-Mean Time Between Failures(MTBF),Mean Time To Repair(MTTR), availability, bathtub curve-time dependent failure models-Distributions- Normal, weibull, log normal-Reliability of system and models-serial, parallel and combined configuration - Markove analysis, load sharing systems, standby systems, co-variant models, static models, dynamic models.		
Topic - 5	**DESIGN FOR RELIABILITY**	**9**
Reliability design process, system effectiveness, economic analysis and life cycle cost, reliability allocation, design methods, parts and material selection, derating, stress strength and analysis, failure analysis, identification determination of causes, assessments of effects, computation of criticality index, corrective action, System safety-analysis of down-time-Repair time distribution.		

THEORY	**45**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**45**

BOOK REFERENCES	
1	Amitava Mitra, Fundamentals of Quality Control and improvement, Wiley, 2013.
2	Patrick D Connor, Practical Reliability Engineering,Wiley,2012.
3	Charles E Ebling, An Introduction to Reliability and Maintainability Engineering, Overseas Press,2011

OTHER REFERENCES	
1	https://www.youtube.com/watch?v=mvT-z7AOT1A
2	https://www.youtube.com/watch?v=YCdUmlOsP8w
3	https://www.youtube.com/watch?v=52u2lrcL2pw
4	https://www.youtube.com/watch?v=sy4S6XcfkvY

Semester	Programme	Course Code	Course Name	L	T	P	C
VI	B.E - MECH	20ME6E6	ADDITIVE MANUFACTURING PROCESSES	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Explain the generic steps and classification of Additive Manufacturing processes	K2	1
CO2	Select the suitable material and AM process based on applications	K2	2
CO3	Identify the suitable AM process to fabricate metallic components	K2	3
CO4	Design their own open source 3D printer based on application.	K2	4
CO5	Implement the reverse engineering techniques for developing prototype	K2	5

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Med0ium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	1	2				1	1		1	2	2
CO2	2	2	1	1	2				1	1		1	2	2
CO3	2	2	1	2	2				1	1		1	2	2
CO4	2	2	1	2	2				1	1		1	2	2
CO5	2	2	2	1	2				1	1		1	2	2

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Seminar
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic - 1	**INTRODUCTION**	**9**
Needs - Impact of AM and Rapid Tooling on Product Development - Distinction between AM and CNC Machining- The Generalized AM Process chain - CAD Model - Input file formats - Generation and Conversion of STL file - File Verification and Repair - Build File Creation - Part Construction - Part Cleaning and finishing - RP Benefits - Classification of RP systems.		
Topic - 2	**LIQUID POLYMER AND SOLID BASED SYSTEMS**	**9**
Stereolithography Apparatus (SLA), Digital Light Projection (DLP), Continuous Liquid Interface Production (CLIP), Photo polymerization process, Fused Deposition Modeling (FDM) and Laminated Object Manufacturing (LOM) - Working Principle, Construction, Materials and Applications.		
Topic - 3	**POWDER BASED SYSTEMS**	**9**
Selective Laser Sintering (SLS), Color Jet Printing, Direct Metal Deposition (DMD), Ballistic Particle Manufacturing (BPM), Electron Beam Melting (EBM) and Laser Engineered Net Shaping (LENS)- Working Principle, Construction, Process Variables, Materials and Applications		
Topic - 4	**OPEN SOURCE PRINTER AND RAPID TOOLING**	**9**
Concept of open source 3D printer - Structural details, Control mechanism - Materials and Applications. Introduction to rapid tooling (RT) - Direct and Indirect tooling - Silicone rubber moulding, Epoxy tooling, Spray Metal Coating, 3D printing direct, Electro Optical Sintering (EOS) - Working Principle, Materials and Applications		
Topic - 5	**REVERSE ENGINEERING AND APPLICATIONS OF ADDITIVE MANUFACTURING**	**9**
Reverse Engineering - Application of CMM, Laser scanner, CT and MRI scan in acquiring point data Software for STL file processing. Application of Rapid prototyping in Medical field, Manufacturing, Automotive industries, Aerospace and Electronics and Retail industries. Leading manufacturer of RP systems		

THEORY	**45**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**45**

BOOK REFERENCES	
1	C. K. Chua, K. F. Leong and C. S. Lim, Rapid prototyping: Principles and applications, Cambridge University Press, 2010.
2	D. T. Pham and S. S.Dimov, Rapid manufacturing, Springer-Verlag, London, 2001.

OTHER REFERENCES	
1	www.all3dp.com, www.3dprintingindustry.com, www.reprap.org, www.thingiverse.com
2	https://www.youtube.com/watch?v=Fzi-Px9XwwE
3	https://www.youtube.com/watch?v=iLndYWw5_y8
4	https://www.youtube.com/watch?v=NRTXFVmVzKk
5	https://www.youtube.com/watch?v=E44W54z_Ykw

Semester	Programme	Course Code	Course Name	L	T	P	C
VII	B.E- MECH	20ME7E1	INTRODUCTION TO AIRCRAFT STRUCTURES	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Ability to perform linear static analysis of determinate and indeterminate aircraft structural components.	K4	1
CO2	Calculate the response of statically indeterminate structures under various loading conditions.	K3	2
CO3	Calculate the reactions of structures using strain energy concept.	K3	3
CO4	Create a structure to carry the given load.	K4	4
CO5	Examine the structural failures using failure theories	K4	5

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2	-	-	-	-	-	-	-	-	-	-	3	-
CO 2	-	3	-	2	-	-	-	-	-	-	-	-	2	-
CO 3	-	3	2	-	-	-	-	-	-	-	-	-	3	-
CO 4	3	-	-	2	-	-	-	-	-	-	-	-	2	-
CO 5	2	-	-	-	-	-	-	-	-	-	-	-	3	-

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Seminar
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT										
Topic - 1	**STATICALLY DETERMINATE & INDETERMINATE STRUCTURES**									**9**
Plane truss analysis – method of joints – method of sections – method of shear – 3-D trusses – principle of super position, Clapeyron's 3 moment equation and moment distribution method for indeterminate beams.										
Topic - 2	**ENERGY METHODS**									**9**
Strain Energy in axial, bending, torsion and shear loadings. Castigliano's theorems and their applications. Energy theorems – dummy load & unit load methods – energy methods applied to statically determinate and indeterminate beams, frames, rings & trusses.										
Topic - 3	**COLUMNS**									**9**
Euler's column curve – inelastic buckling – effect of initial curvature – Southwell plot – columns with eccentricity – use of energy methods – theory of beam columns – beam columns with different end conditions – stresses in beam columns.										
Topic - 4	**FAILURE THEORIES**									**9**
Ductile and brittle materials – maximum principal stress theory - maximum principal strain theory - maximum shear stress theory - distortion energy theory – octahedral shear stress theory.										
Topic - 5	**INDUCED STRESSES**									**9**
Thermal stresses – impact loading – Fatigue – Creep - Stress Relaxation										
THEORY	**45**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**45**

BOOK REFERENCES	
1	Mechanics of Materials' by James M. Gere & Barry J Goodno, cengage Learning Custom Publishing; 8th edition, 2012.
2	Megson T M G, `Aircraft Structures for Engineering students' Butterworth-Heinemann publisher, 5th edition
3	N.C. Pandya, C.S. Shah, "Elements of Machine Design", Charotar Publishing House, 15th edition, 2009.
4	Peery, D.J., and Azar, J.J., Aircraft Structures, 2nd edition, McGraw – Hill, N.Y., 1999

OTHER REFERENCES	
1	https://aerotoolbox.com/intro-airframe-structure/
2	https://www.sciencedirect.com/topics/engineering/aircraft-structure
3	https://www.ufv.ca/aerospace/
4	https://www.pce.uw.edu/certificates/modern-aircraft-structures

Semester	Programme	Course Code	Course Name	L	T	P	C
VII	B.E- MECH	20ME7E2	PRINCIPLES OF FARM MACHINERIES	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Describe the nature of soil condition and different types of farming equipments	K2	1
CO2	Illustrate the working of tillage equipments	K3	2
CO3	Identify the fertilizer application equipments and explain its working construction	K3	3
CO4	Explain the cutting mechanisms for various crops	K3	4
CO5	Demonstrate the principle of harvesting equipments for various crop	K3	5

PRE-REQUISITE	Nil

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3					1	3					2	2	3
CO2	3					1	3					2	2	3
CO3	3					1	3					2	2	3
CO4	3					1	3					2	2	3
CO5	3					1	3					2	2	3

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Seminar
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic - 1	**INTRODUCTION TO FARM MACHINES AND SOIL**	**9**
Introduction to Farm Machines: Objectives of Farm Mechanisms - Classification of Farm Machines - Materials for Construction of Farm Machines - Principles of Operation and Selection of Machines for Production of Crops - Field Capacities & Economics. Soil: Nature and Origin of Soil- Soil Forming Rocks and Minerals - Soil Classification and Composition - Soil Forming Processes.		
Topic - 2	**TILLAGE**	**9**
Primary and Secondary Tillage Equipment - Forces Acting on Tillage Tools - Field Operation Patterns - Draft Measurement of Tillage Equipment - Earth Moving Equipment - Construction & Working Principles of Bulldozer - Trencher - Excavators - Sowing - Planting and Transplanting Equipment their Calibration and Adjustments.		
Topic - 3	**FERTILIZER APPLICATION EQUIPMENT**	**9**
Selection - Calibration - Construction Features - Different Components and Adjustment of Weed Control - Plant Protection Equipment - Sprayers and Dusters		
Topic - 4	**PRINCIPLES AND TYPES OF CUTTING MECHANISMS**	**9**
Construction and Adjustments of Shear and Impact Type Cutting Mechanisms - Crop Harvesting Machinery: Mowers - Windrowers - Reapers - Reaper Binders and Forage Harvesters - Forage Chopping and Handling Equipment - Threshing Mechanics - Types of Threshers - Straw Combines - Grain Combines - Maize Harvesting - Shelling Equipment - Root Crop Harvesting Equipment - Cotton Picking and Sugarcane Harvesting Equipment.		
Topic - 5	**PRINCIPLES OF HARVESTING TOOLS AND MACHINES**	**9**
Horticultural Tools and Gadgets - Testing of Farm Machine - Test Codes and Procedure - Interpretation of Test Results - Selection and Management of Farm Machines for Optimum Performance - Workplace Layout for Men and Women.		

THEORY	**45**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**45**

BOOK REFERENCES	
1	Donnel Hunt, " Farm Power and Machinery Management", 10th Edition, Medtech, Ames, USA, 2013.
2	Boson E.S.., "Theory, Construction and Calculation of Agricultural Machines", 1st Edition, Scientific Publishers, New Delhi, 2016.
3	Kepner R. A., Bainer Roy and Barger E. L, "Principals of Farm Machinery", 3rd Edition, CBS Publishers and Distributors, New Delhi, 2005.
4	J.M. Shippen, C.R.Ellin and C.H.Clover, Basic farm machinery, Pergamon press Ltd, 1987.

OTHER REFERENCES	
1	https://nptel.ac.in/courses/126105009 Farm Machinery, IIT Kharagpur Prof. VK Tewari
2	https://acsess.onlinelibrary.wiley.com/doi/abs/10.2134/agronj1955.00021962004700120021x
3	http://ecoursesonline.iasri.res.in/course/view.php?id=57
4	https://content.kopykitab.com/ebooks/2017/10/11971/sample/sample_11971.pdf
5	http://www.hillagric.ac.in/edu/coa/agengg/lecture/243/agriengg-243.htm

Semester	Programme	Course Code	Course Name	L	T	P	C
VII	B.E. MECH	20ME7E3	POWER PLANT ENGINEERING	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Describe the construction and working principle of steam power plant and boilers.	K2	1
CO2	Discuss the components and working principles of diesel and gas turbine power plants.	K2	2
CO3	Explain the principles and working of nuclear power plants.	K3	3
CO4	Explain the importance of renewable energy and its utilization of renewable energy sources.	K3	4
CO5	Calculate the cost of power generation for various power plants.	K3	5

PRE-REQUISITE	**NIL**

CO / PO MAPPING (1 – Weak, 2 – Med0ium, 3 – Strong)														
COs	**Programme Learning Outcomes (POs)**												**PSOs**	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	2	3	3		3	2	2	3	3		3	3	1
CO2	3	2	3	3		1	2	2	3	3		2	3	1
CO3	3	2	3	2		3	2	2	3	3		3	3	1
CO4	3	1	3	2		3	2	2	3	3		3	2	1
CO5	3	3	2	3		3	2	2	3	3		2	3	1

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Mini Project
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic - 1	**COAL BASED STEAM POWER PLANT**	**9**
Plant Layout, Working of different Circuits, Fuel and handling equipments, types of coals, coal handling, choice of handling equipment, coal storage, Ash handling systems. Properties of coal – overfeed and underfeed fuel beds, traveling grate stokers, spreader stokers, retort stokers, pulverized fuel burning system and its components, combustion needs and draught system, cyclone furnace, design and construction, Dust collectors, cooling towers and heat rejection.		
Topic - 2	**DIESEL AND GAS TURBINE POWER PLANT**	**9**
Diesel Power Plant: Introduction – IC Engines, types, construction– Plant layout with auxiliaries – fuel supply system, air starting equipment, lubrication and cooling system – super charging. Introduction – classification – construction – Layout with auxiliaries – Principles of working of closed and open cycle gas turbines. Combined Cycle Power Plants and comparison.		
Topic - 3	**NUCLEAR POWER PLANT**	**9**
Nuclear fuel – breeding and fertile materials – Nuclear reactor – reactor operation. Types of Reactors: Pressurized water reactor, Boiling water reactor, sodium-graphite reactor, fast Breeder Reactor, Homogeneous Reactor, Gas cooled Reactor, Radiation hazards and shielding – radioactive waste disposal.		
Topic - 4	**POWER FROM RENEWABLE ENERGY**	**9**
Hydro Electric Power Plants – Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, Solar Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biogas and Fuel Cell power systems.		
Topic - 5	**ENERGY,ECONOMICS AND ENVIRONMENTAL ISSUES OF POWER PLANT**	**9**
Capital cost, investment of fixed charges, operating costs, general arrangement of power distribution, Load curves, load duration curve.Definitions of connected load, Maximum demand, demand factor, average load, load factor, diversity factor – related exercises. Effluents from power plants and Impact on environment – pollutants and pollution standards – Methods of Pollution control.		

THEORY	**45**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**45**

BOOK REFERENCES	
1	Arora S.C and Domkundwar S, "A Course in Power Plant Engineering", 5th Edition, Dhanpat Rai & Co. Pvt Ltd., New Delhi, 2014.
2	P.K. Nag, "Power Plant Engineering", 3rd Edition, McGraw-Hill Education Pvt Ltd., New Delhi,2009.
3	R.K.Rajput, "Power Plant Engineering", 4th Edition, Laxmi Publications, New Delhi, 2012.
4	G.D.Rai, "An Introduction to Power Plant Technology", 3rd Edition Khanna Publishers, New Delhi, 2012.
5	K.K.Ramalingam, "Power Plant Engineering", Scitech Publication (India) Pvt. Ltd., Chennai, 2011.

OTHER REFERENCES	
1	https://youtu.be/ftyWKjT20S4
2	https://nptel.ac.in/about_nptel.html
3	https://nptel.ac.in/courses/106/106/106106092/
4	http://www.nptelvideos.in/2012/11/energy-resources-and-technology.html Prof.S.Banerjee etal., Indian Institute of Technology Kharagpur, Energy Resources and Technology
5	https://www.coursera.org/learn/future-of-energy/lecture/AykFe/the-future-of-nuclear-energy-part-1 Prof.G.R.Tynan etal., Jacobs School of Engineering, US San Diego, What is the Future for Nuclear-Based Energy Sources?

Semester	Programme	Course Code	Course Name	L	T	P	C
VII	B.E-MECH	20ME7E4	ENERGY CONSERVATION IN HVAC SYSTEM	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Learn to analysis heat conversion systems for HVAC applications.	K2	1
CO2	Learn energy audit and management practices on HVAC systems	K2	2
CO3	To update new system/ equipments for the utilization of both thermal and electrical energy optimally	K4	3
CO4	Analyze energy conservation feasibility	K2	4
CO5	Comprehension on heat conversion systems	K2	5

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	1	1		1	-	1						2	3
CO2	3	1	1		1	-	1						2	3
CO3	3	1	1		1	-	1						2	3
CO4	3	1	1		1	-	1						2	3
CO5	3	1	1		1	-	1						2	3

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Seminar
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic - 1	**FIRST AND SECOND LAW ANALYSIS**	**9**
Thermodynamics of Energy conservation-Second law -Exergy-Irreversibility and efficiency - Analysis of Refrigeration and Air conditioning cycles, Heat pumps.		
Topic – 2	**ENERGY CONSERVATION TECHNIQUES**	**9**
Principle of Energy audit, Identifying avenues for Energy conservation, Conservation through periodic maintenance of HVAC systems, Predictive and Preventive maintenance, Thermal insulation.		
Topic - 3	**REFRIGERATION AND AIR-CONDITIONING EQUIPMENTS**	**9**
Energy conservation in Air Handling units-Fans, Air conditioning apparatus-Unitary equipments, Refrigeration Equipments-Reciprocating Refrigeration Machine, Centrifugal Refrigeration Machine, Absorption Refrigeration Machine, Heat Rejection Equipments, and Energy Efficient motors.		
Topic - 4	**HEATING AND VENTILATING SYSTEMS**	**9**
Energy conservation feasibility analysis-conventional ventilating systems, constant volume induction system, Multizone unit system, Variable volume induction system, constant temperature system. Heat Pipe Applications in Air conditioning systems.		
Topic - 5	**HEAT CONVERSION SYSTEMS**	**9**
Theory of Heat transformers-Heat Pumps, Two temperature level, Three Temperature level-Vapour compression, Heat pump.		

THEORY	**45**	**TUTORIAL**	**0**	**PRACTICAL**	**0**	**TOTAL**	**45**

BOOK REFERENCES	
1	George Alefeld and Reinhard Radermacher , Heat conversion systems , CRC press , 1994
2	Carrier Air conditioning Co., Hand Book of Air conditioning System Design , McGraw-Hill , 1985.
3	Plant Engineers and Manager's Guide to Energy Conservation, Fair Mount Press, 2008.
4	ASHRAE Hand Book–Equipment, 2005
5	Energy conservation in Heating, Cooling and Ventilating Building, Proceeding Hemisphere Publishing Corporation, 1988.

OTHER REFERENCES	
1	https://hvacc.net/services/energy-management-systems-ems
2	https://www.coolingindia.in/energy-conservation-in-refrigeration-hvac-system/
3	https://www.sciencedirect.com/science/article/pii/S0378778805000939
4	https://energywise.net.au/energy-management-system/
5	https://ieeexplore.ieee.org/abstract/document/8281624/

Semester	Programme	Course Code	Course Name	L	T	P	C
VII	B.E- MECH	20ME7E5	NANOTECHNOLOGY FOR MECHANICAL ENGINEERS	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Interpret the fundamental of nanotechnology.	K2	1
CO2	Present the different techniques involved in nanoscale fabrication and characterization.	K2	2
CO3	Demonstrate the synthesis route, properties and applications of metal based nanomaterials and fluidics.	K3	3
CO4	Describe the synthesis route and correlate the structure – property relationship of carbon nanomaterials.	K3	4
CO5	Select appropriate materials and fabrication techniques to prepare nanocomposites for desired applications.	K3	5
PRE-REQUISITE	Nil		

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1												2
CO2	3				3								3	2
CO3	3	3	1	2	3								3	3
CO4	3	3	1	2	3								3	3
CO5	3	2	1		3	1							3	3

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignments
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic - 1	**FUNDAMENTALS OF NANOTECHNOLOGY**	**9**
Nanoscience and Nanotechnology – Fundamentals - Classification and General Themes of Nanotechnology - Nanoscale Science - Fabrication and Processing Technology - Size Dependence of Materials Properties - Characterization Tools - Properties of Nanomaterials - Structural Properties - Thermal Properties - Chemical Properties - Mechanical Properties - Magnetic Properties - Optical Properties - Electronic Properties - Biological Properties.		
Topic - 2	**NANOSCALE FABRICATION AND CHARACTERIZATION**	**9**
Nanoscale Fabrication - Bottom-up Approach - Chemical Synthesis - Self-Assembly - Top-down approach – Photolithography - Electron Beam Lithography - Focused Ion Beam Lithography - Extreme Ultraviolet Lithography – Nano Imprint Lithography - X-ray Lithography - Soft Lithography. Characterization of Nanomaterials - Atomic Structure and Chemical Composition - Vibrational Spectroscopies - Ultraviolet–Visible Spectroscopies - Electron Microscopy - Zeta Potential Analyzer - Laser Granulometry.		
Topic - 3	**METAL BASED NANOMATERIALS AND FLUIDICS**	**9**
Classifications of Nanostructured Materials – Nanopowders - Metal Nanopowders - Metal Oxide Nanopowders - Nanoporous Materials - Silica - Transition Metal Oxides - Metal Sulfides – Metal Aluminium Phosphates - Silicon Nitrides - Aluminum Oxides – Nanodusts – Nanowires - Zinc oxide Nanostructures - Micro and Nano Fluidics - Synthesis – Properties – Applications.		
Topic - 4	**CARBON NANOMATERIALS**	**9**
Carbon Allotropes - Molecule Structures - Physical and Chemical Properties - Synthesis Methods - Electric Arc Method - Laser Ablation Method - Solar Energy Method. Carbon Nanotubes – Structure and Synthesis - Arc Discharge Method - Laser Ablation Method - Chemical Vapor Deposition Method. Properties - Electrical Conductivity - Optical Activity - Vibrational Properties - Mechanical Strength - Specific Heat and Thermal Conductivity – Applications - Defects in Carbon Nanotubes - Fullerenes - Synthesis – Properties – Applications.		
Topic - 5	**NANOCOMPOSITES**	**9**
Nanoscale Reinforcements – Synthesis and Properties: Nano Clays - Equi-axed Nanoparticles. Ceramic Matrix Nanocomposites, Metal Matrix. Nanocomposites Magnetic Nanocomposites. Polymeric Nanocomposites, - Synthesis methods - Sol-gel Processing - Chemical Vapor Deposition - Mechanical Alloying - Thermal Spraying. Metal Matrix Nanocomposites - Magnetic Nanocomposites. Polymeric Nanocomposites - Synthesis - Melt Mixing Method - Solution Mixing - Thermal Spray Method - Properties - Mechanical Properties - Abrasion and Wear Resistance - Permeability - Thermal Stability - Flammability - Rubber Matrix Nanocomposites - Nano-BioComposites - Smart and Intelligent Nanocomposites.		

THEORY	**45**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**45**

BOOK REFERENCES	
1	Vijay K Varadan, Sivathanu Pillai A, Debashish Mukherji, Mayank Dwivedi, Linfeng Chen, "Nanoscience and Nanotechnology in Engineering ", 1st Edition, World Scientific, Singapore, 2010.
2	Maria Stepanova, Steven Dew, "Nanofabrication Techniques and Principles", 1st Edition, Springer International Publishing, Switzerland, 2012.
3	Thangadurai, T.D., Manjubaashini, N., Thomas, S., Maria, H.J, "Nanostructured Materials", 1st Edition, Springer International Publishing, Switzerland, 2020.
4	Paulo Davim J. and Constantinos A. Charitidis, "Nanocomposites - Materials, Manufacturing and Engineering", 1st Edition, De Gruyter, Germany, 2013.

OTHER REFERENCES	
1	https://www.btechguru.com/courses--nptel--nanotechnology-video-lecture--nt.html
2	https://nptel.ac.in/courses/118107015
3	https://nptel.ac.in/courses/118102003
4	https://nptel.ac.in/courses/118104008
5	https://www.youtube.com/watch?v=tXmFD4Ab7Ss

Semester	Programme	Course Code	Course Name	L	T	P	C
VII	B.E-MECH	20ME7E6	INDUSTRIAL MARKETING	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Explain industrial marketing system and concepts.	K2	1
CO2	Analyze industrial markets models of organizational buying behaviour.	K4	2
CO3	Examine the importance of marketing information systems and marketing research processes.	K4	3
CO4	Discuss industrial products and recall the factors influencing its pricing decisions.	K4	4
CO5	Dissever channel design process and appraise industrial.	K4	5

PRE-REQUISITE	Nil

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2					3	3	2						2
CO2	2	2				3	3	2		1				2
CO3	2	2				3	3	2		1				2
CO4	2	2				3	3	2		1				2
CO5	2	2				3	3	2		1				2

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Seminar
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic - 1	**INTRODUCTION**	**9**
Introduction to Industrial Markets - Marketing System - Concepts - Characteristics – Definition Exchange Processes – Characteristics of Industrial and Consumer Markets –Market Demand – Cross Elasticity of Demand- Business Ethics.		
Topic - 2	**INDUSTRIAL PURCHASING**	**9**
Types of Industrial Customers - Purchasing Practices - Industrial Buyer Behaviour – Industrial Buying Situation – Decision Making Units – Models of Organizational Buying Behaviour- Modern Purchasing Terminologies.		
Topic - 3	**MARKETING PLANNING AND RESEARCH**	**9**
Marketing Planning: Business Marketing – Marketing Planning – Corporate Strategic Planning – Target Marketing - Marketing Information Systems. **Marketing Research:** Market Evaluation - Role of IT in Marketing Information Systems - Definition and Process of Marketing Research - Research Instruments.		
Topic - 4	**PRODUCT DEVELOPMENT AND PRICING**	**9**
Industrial Products and Services Definition - New Industrial Product Development – Product Life Cycle - Marketing Strategies - Industrial Pricing Characteristics- Influencing Factors in Pricing Decisions of Industrial Markets-Classification of Costs-Pricing Strategies.		
Topic - 5	**CHANNEL DESIGN**	**9**
Economic Performances and Channel Management Decisions- Industrial Logistics System- Role and Characteristics of Industrial Distributors- Sales Promotion – Personal Selling - Sales Force Management – Advertising in Marketing – Industrial Communication Programs.		

THEORY	**45**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**45**

BOOK REFERENCES	
1	Hawaldar, K. Krishna, "Industrial Marketing", 4th Edition, Tata McGraw Hill, New Delhi, 2015.
2	Philip Kotler, Gary Armstrong & Prafulla Agnihotri, "Principles of Marketing", 17th Edition , Pearson Education, 2018.
3	Robert R. Reeder, Briety & Betty H. Reeder, "Industrial Marketing", 4th Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2015.

OTHER REFERENCES	
1	https://nptel.ac.in/courses/110104068
2	https://nptel.ac.in/courses/110104070
3	https://nptel.ac.in/courses/110108141
4	https://ycmou.ac.in/media/publication/ycmou_book/SNP_YB_100.pdf
5	https://industrialmarketingexperts.com/industrial-video-production-and-marketing/

Semester	Programme	Course Code	Course Name	L	T	P	C
VII	B.E - MECH	20ME7E7	ENTREPRENEURSHIP DEVELOPMENT	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Understand the concept of management, organization, planning, staffing	K2	1
CO2	Understand the importance of Directing and controlling, leadership styles, Communication, Coordination and Controlling.	K2	2
CO3	Understand the role of entrepreneurs in economic development	K3	3
CO4	Understand the contents of project report, ERP and project.	K2	4
CO5	Understand IPRs and institutional support in entrepreneurship, Case Study of Entrepreneurs.	K4	5

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						3	3	3	3	3	3			
CO2						3	3		2	3				
CO3						3	3	3	3	3	3			
CO4								3	3					
CO5								3	3	3				

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Seminar
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic - 1	**ENTREPRENEURSHIP**	**9**
Entrepreneur –Types of Entrepreneurs –Difference between Entrepreneur and Intrapreneur Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth.		
Topic - 2	**MOTIVATION**	**9**
Major Motives Influencing an Entrepreneur – Achievement Motivation Training, Self Rating, Business Games, Thematic Apperception Test – Stress Management, Entrepreneurship Development Programs – Need, Objectives.		
Topic - 3	**BUSINESS**	**9**
Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – Project Formulation – Steps involved in setting up a Business – identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies.		
Topic - 4	**FINANCING AND ACCOUNTING**	**9**
Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of working Capital, Costing, Break Even Analysis, Taxation – Income Tax, Excise Duty – Sales Tax.		
Topic - 5	**SUPPORT TO ENTREPRENEURS**	**9**
Sickness in small Business – Concept, Magnitude, Causes and Consequences, Corrective Measures - Business Incubators – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger and Sub Contracting.		

THEORY	**45**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**45**

BOOK REFERENCES	
1	Venkateshwara Rao and Udai Pareek,(Eds)Developing Entrepreneurship-A Handbook.
2	Raja Gopal, Agriculture Business and Entrepreneurship .
3	H.Sadhak, industrial development in Backward Regions in India
4	Ravi J. Mathai, Rural Entrepreneurship A Frame Work in Development Entrepreneurship – Ahandbook

OTHER REFERENCES	
1	https://nptel.ac.in/courses/110107141
2	https://depintegraluniversity.in/userfiles/Entrepreneurship%20Development.pdf
3	https://www.researchgate.net/publication/351173753_Entrepreneurship_Development_in_India
4	https://www.himpub.com/documents/Chapter2011.pdf

Semester	Programme	Course Code	Course Name	L	T	P	C
VII	B.E – MECH	20ME7E8	PRODUCTION PLANNING AND CONTROL	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Explain various production control methods which can be applied to specific situations and state their relationship to the product/process involved.	K2	1
CO2	Make forecasts in the manufacturing and service sectors using selected quantitative and qualitative techniques.	K2	2
CO3	Apply the principles and techniques for planning and control of the production and service systems to optimize/make best use of resources.	K3	3
CO4	Understand the importance and function of inventory and to be able to apply selected techniques for its control and management under dependent and independent demand circumstances	K2	4
CO5	Demonstrate and explain the use of Manufacturing Requirements Planning (MRP2), Just - In - Time (JIT) techniques in terms of operation and their importance in Lean World Class Manufacturing.	K4	5

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	-	2	-	-	-	-	-	3	1	-
CO2	3	1	-	-	-	-	-	-	2	-	1	2	2	2
CO3	3	1	-	-	2	-	-	-	3	-	1	3	2	2
CO4	3	1	-	-	3	-	-	-	3	-	1	2	3	3
CO5	3	3	-	-	3	1	-	1	3	-	3	3	3	3

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Seminar
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic - 1	**INTRODUCTION**	**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.		
Topic - 2	**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 - Production study - Work sampling - Synthesis from standard data - Predetermined motion time standards.		
Topic - 3	**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, balancing- Analysis of process capabilities in a multi product system.		
Topic - 4	**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- Dispatching-Progress reporting and expediting-Manufacturing lead time-Techniques for aligning completion times and due dates.		
Topic - 5	**INVENTORY CONTROL AND RECENT TRENDS IN PPC**	**9**
Inventory control-Determination of Economic order quantity and economic lot size- ABC analysis - Recorder procedure-Introduction to computer integrated production planning systems- elements of JUST IN TIME SYSTEMS-Fundamentals of MRP II and ERP.		

THEORY	**45**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**45**

BOOK REFERENCES	
1	James. B. Dilworth, ”Operations management –Design,Planning and Control for manufacturing and services” Mcgraw Hill International edition 1992.
2	Martand Telsang,“Industrial Engineering and Production Management”,First edition, S. Chand and Company, 2000.
3	K.C. Jain & L.N. Aggarwal, “Production Planning Control and Industrial Management”, Khanna Publishers 1990.
4	Jain. K.C. & Aggarwal. L.N., “Production Planning Control and Industrial Management”, Khanna Publishers, 1990.

5	Upendra Kachru, " Production and Operations Management – Text and cases" 1st Edition, Excel books 2007

OTHER REFERENCES	
1	https://nptel.ac.in/courses/110107141
2	https://www.pdfdrive.com/production-planning-and-control-e52042341.html
3	https://instapdf.in/production-planning-and-control-book/
4	http://brharnetc.edu.in/br/wp-content/uploads/2018/11/22.pdf
5	https://www.smartzworld.com/notes/production-planning-and-control-pdf-notes-ppc-pdf-notes/

Semester	Programme	Course Code	Course Name	L	T	P	C
VII	B.E - MECH	20ME7E9	COMPUTATIONAL FLUID DYNAMICS	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Explain the fundamentals of governing equations of viscous fluid flow.	K2	1
CO2	Apply the knowledge on finite difference method for fluid flow calculations.	K3	2
CO3	Discuss the concepts of finite volume method (FVM) for diffusion.	K2	3
CO4	Identify and explain the significance of finite volume method for convection diffusion.	K4	4
CO5	Apply the concepts of FVM for fluid flow calculations.	K3	5

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3												
CO2	2	3		2	2									
CO3	3	2			2									
CO4	2	3			2									
CO5	2		3	2										

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignments
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic - 1	**GOVERNING EQUATIONS AND BOUNDARY CONDITIONS**	**9**
Basics of computational fluid dynamics – Governing equations of fluid dynamics – Continuity, Momentum and Energy equations –Physical boundary conditions – Time-averaged equations for Turbulent Flow – Turbulent–Kinetic energy equations – Mathematical behaviour of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations.		
Topic - 2	**FINITE DIFFERENCE METHOD**	**9**
Derivation of finite difference equations – Simple methods – General methods for first and second order accuracy – Solution methods for finite difference equations – Elliptic equations – Iterative solution Methods – Parabolic equations – Explicit and implicit schemes – Example problems on elliptic and parabolic equations - Use of Finite Difference methods		
Topic - 3	**FINITE VOLUME METHOD FOR DIFFUSION**	**9**
Finite volume formulation for steady state one, two and three dimensional diffusion problems. One dimensional unsteady heat conduction through explicit and fully implicit schemes. Two-dimensional Transient Problems - Use of Finite Volume methods - Difference between FDM and FVM methods.		
Topic - 4	**FINITE VOLUME METHOD FOR CONVECTION DIFFUSION**	**9**
Steady one-dimensional convection and diffusion – Central, upwind differencing schemes-Properties of discretization schemes – Conservativeness, Boundedness, Trasnportiveness, Hybrid, Power-law, QUICK Schemes		
Topic - 5	**FLOW FIELD ANALYSIS AND MESH GENERATION**	**9**
SIMPLE algorithm - Navier-Stokes equations- Representation of the pressure gradient term and continuity equation – Pressure correction equation- Structured grid generation - Unstructured grid generation – Mesh refinement – Adaptive mesh – Software tools- Applications of CFD.		

THEORY	**45**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**45**

BOOK REFERENCES	
1	Versteeg, H.K., and Malalasekera W., “An Introduction to Computational Fluid Dynamics: The finite volume Method”, Longman, second edition, 2010.
2	Muralidhar, K., and Sundararajan, T., “Computational Fluid Flow and Heat Transfer”, Narosa Publishing House, New Delhi, second edition, 2011.

OTHER REFERENCES	
1	http://nptel.ac.in/courses/112105045/ Prof.Dr.Suman Chakrabortyetal., IIT kharagpur, Computational Fluid Dynamics
2	https://ocw.mit.edu/courses/mechanical-engineering/2-29-numerical-fluid-mechanics-spring-2015/ Prof. Pierre Lermusiaux et.al.,Massachusetts Institute of Technology, Numerical Fluid Mechanics.
3	https://www.youtube.com/watch?v=aShONtHloUk&list=PLbRMhDVUMngcFmWiK1YBhAbsYo8mYvPKJ
4	https://www.youtube.com/watch?v=oQL4CFbHY_g&list=PLaDq_DX7U7V91gf-LrGdx0Yg68KW1Xljq
5	https://www.youtube.com/watch?v=kwqoyuZTglQ&list=PL3zvA_WajfGBi-0-A9goGqB0cbe5-aU4N

Semester	Programme	Course Code	Course Name	L	T	P	C
VII	B.E - MECH	20ME7E10	INDUSTRIAL ROBOTICS	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Understand the functions of the basic components of a Robot.	K2	1
CO2	Study the use of various types of End of Effectors and Sensors	K2	2
CO3	Comprehend sensors and machine vision.	K2	3
CO4	Imparting knowledge in Robot Kinematics and Programming	K3	4
CO5	Learn Robot safety issues and economics.	K2	5

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2	2	2	-	-	-	-	2	-	-	-	3	3
CO 2	2	3	2	3	-	3	-	-	-	-	-	-	3	3
CO 3	3	2	2	2	-	2	-	-	2	-	-	-	3	3
CO 4	2	2	2	2	-	2	-	-	-	-	-	-	2	2
CO 5	2	2	2	-	-	3	3	-	2	-	-	-	2	3

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Seminar
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENTS										
Topic - 1	**FUNDAMENTALS OF ROBOT**									**9**
Robot - Definition - Robot Anatomy - Co ordinate Systems, Work Envelope Types and Classification- Specifications-Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load- Robot Parts and their Functions- Need for Robots-Different Applications.										
Topic - 2	**ROBOT DRIVES AND END EFFECTORS**									**9**
Pneumatic Drives-Hydraulic Drives-Mechanical Drives-Electrical Drives-D.C. Servo Motors, Stepper Motors, A.C. Servo Motors-Salient Features, Applications and Comparison of all these Drives, End Effectors-Grippers- Mechanical Grippers, Pneumatic and Hydraulic- Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations.										
Topic - 3	**SENSORS AND MACHINE VISION**									**9**
Requirements of a sensor, Principles and Applications of the following types of sensors- Position sensors - Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, pneumatic Position Sensors, Range Sensors Triangulations Principles, Structured, Lighting Approach, Time of Flight, Range Finders, Laser Range Meters, Touch Sensors ,binary Sensors., Analog Sensors, Wrist Sensors, Compliance Sensors, Slip Sensors, Camera, Frame Grabber, Sensing and Digitizing Image Data- Signal Conversion, Image Storage, Lighting Techniques, Image Processing and Analysis-Data Reduction, Segmentation, Feature Extraction, Object Recognition, Other Algorithms, Applications- Inspection, Identification, Visual Serving and Navigation.										
Topic - 4	**ROBOT KINEMATICS AND ROBOT PROGRAMMING**									**9**
Forward Kinematics, Inverse Kinematics and Difference; Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), Four Degrees of freedom (in 3 Dimension) Jacobians, Velocity and Forces-Manipulator Dynamics, Trajectory Generator, Manipulator Mechanism Design- Derivations and problems. Lead through Programming, Robot programming Languages-VAL Programming- Motion Commands, Sensor Commands, End Effector commands and simple Programs.										
Topic - 5	**IMPLEMENTATION AND ROBOT ECONOMICS**									**9**
RGV, AGV; Implementation of Robots in Industries-Various Steps; Safety Considerations for Robot Operations - Economic Analysis of Robots.										
THEORY	**45**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**45**

BOOK REFERENCES	
1	Klafter R.D., Chmielewski T.A and Negin M., “Robotic Engineering - An Integrated Approach”, Prentice Hall, 2003.
2	Groover M.P., “Industrial Robotics -Technology Programming and Applications”, McGraw Hill, 2001.
3	Craig J.J., “Introduction to Robotics Mechanics and Control”, Pearson Education, 2008
4	Deb S.R., “Robotics Technology and Flexible Automation” Tata McGraw Hill Book Co., 1994.

OTHER REFERENCES	
1	https://www.sciencedirect.com/topics/engineering/industrial-robot
2	https://www.fanucamerica.com/products/robots
3	https://www.mdpi.com/2076-3417/12/1/135
4	https://www.therobotreport.com/state-of-industrial-robotics-challenges-opportunities/
5	https://www.infineon.com/cms/en/applications/industrial/robotics/industrial-robots/

Semester	Programme	Course Code	Course Name	L	T	P	C
VII	B.E - MECH	20ME7E11	OPERATIONAL RESEARCH	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Explain the basic concepts of different models of operations research and their applications.	K4	1
CO2	Apply the models to incorporate rational decision making process in real life situations.	K3	2
CO3	Analyze various modelling alternatives & select appropriate modelling techniques for a given situation.	K4	3
CO4	Evaluate output from model to check feasibility of implementations.	K3	4
CO5	Construct Operations Research models for a given situation.	K3	5

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	1				2		1	3	3		3	1	2
CO2	2	3	3					1	3	3		3	1	2
CO3	2	2			2			1	3	3		3	1	1
CO4	2	1	2					1	3	3		3	1	1
CO5	2	2		1				1	3	3		3	1	1

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignment
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic - 1	**BASICS OF OPERATIONS RESEARCH**	**9**
Basics of Operations Research: History, definition, operations research models, phases of implementing operations research in practice. Linear Programming Problem(LPP): Introduction, Formulation, Graphical solution, Simplex method, Artificial variable techniques: Big-M and Two-phase methods, Special cases: degeneracy, multiple optima, unbounded solution, infeasible solution, Concept of Primal and Dual problems, Economic analysis of dual, Sensitivity analysis.		
Topic - 2	**TRANSPORTATION MODEL**	**9**
LPP formulation of transportation problem, Initial feasible solution: North-West Corner rule, Least-cost method, Vogel's approximation method, Optimal solution: Stepping stone method, Modified Distribution (MODI) method, Special cases: unbalanced transportation problems, profit maximization, degeneracy, alternate optimal solutions, prohibited transportation routes, transshipment problems.		
Topic - 3	**ASSIGNMENT MODEL**	**9**
LPP formulation of assignment problem, Hungarian method for solution and optimization, Special cases: alternate optimal solution, restrictions on assignment, maximization, crew layover problem, travelling salesman problem.		
Topic - 4	**PROJECT MANAGEMENT**	**9**
Introduction to PERT and CPM, Terms used in network analysis, Network diagram, Fulkerson's rule, Concept of floats, PERT, Project cost analysis: Crashing of network, Resource smoothing and Resource leveling.		
Topic - 5	**INVENTORY MANAGEMENT**	**9**
Objectives of inventory management, Inventory classification, Inventory costs, EOQ, Inventory models with deterministic demand: Purchase model without and with quantity discount, Manufacturing model, Model with planned shortages, Inventory with safety stock, Inventory models with probabilistic demand, ABC analysis of inventory		

THEORY	**45**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**45**

BOOK REFERENCES	
1	Taha.H.A ,operation Research : An Introduction, McMilan publishing Co., 1982. 7 th ed
2	Ravindran A, Philips D.T & Solbery.J.J, Operations Research: Principles and practice, John Wiley & Sons, New York, 1987.
3	Frank S. Budnick, Dennis Mcleavey and Richard Mojena, Principles of Operations Research for Management. All India Traveler Book seller, Delhi.
4	Gillet.B.E., Introduction to Operations Research - A Computer oriented algorithmic approach, McGraw Hill, 1987.
5	Joseph.G.Ecker & Michael Kupper Schimd, Introduction to operations Research, John Wiley & Sons, 1988.

6	Hillier.F.S & Liberman.G.J, operation Research, Second Edition, Holden Day Inc, 1974.
7	Kanti Swarup, Gupta.P.K. & Man Mohan, operations Research, S.Chand & Sons.

OTHER REFERENCES	
1	A .M. Natarajan, P. Balasubramani, A.Tamilarasi, “Operations Research” , Pearson Education, Asia, 2005.
2	Prem Kumar Gupta , D.S. Hira “Operations Research”, S. Chand & Company Ltd., New Delhi, Third Edition, 2003.
3	Manmohan .,Kandi swarp.,Gupta., “Operations Research”,Sultan Chand & Sons(first edition),New delhi.”.
4	Introduction to Operation Research, Hiller and Liberman, 8th Edition, 2004, Tata McGraw Hill, ISBN : 0073017795.
5	Operations Research Theory and Application, J K Sharma, 2nd Edition, 2003, Pearson Education Pvt Ltd, ISBN: 0333-92394-4.

Semester	Programme	Course Code	Course Name	L	T	P	C
		20MEO01	ENERGY CONSERVATION IN BUILDINGS	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Explain the climate responsive building design and concepts	K2	1
CO2	Explain the basic terminologies related to buildings	K2	2
CO3	Explain the passive (air) conditioning techniques	K2	3
CO4	Summarize the performance of buildings	K2	4
CO5	Outline the renewable energy systems in buildings	K2	5

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)													
COs	Program Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2		1	2		1	2	1	2	1	
CO2	3	1	3		3					1		2		2
CO3	3	1	3	3		1			1		1	1	1	1
CO4	3		3		3		1			1				
CO5	3		3											

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignments
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENTS		
Topic - 1	**INTRODUCTION**	**9**
Conventional versus Energy Efficient buildings – Historical perspective - Water – Energy – IAQ requirement analysis – Future building design aspects – Criticality of resources and needs of modern living.		
Topic - 2	**LANDSCAPE AND BUILDING ENVELOPES**	**9**
Energy efficient Landscape design - Micro-climates – various methods – Shading, water bodies-Building envelope: Building materials, Envelope heat loss and heat gain and its evaluation, paints, Insulation, Design methods and tools.		
Topic - 3	**HEATING, VENTILATION AND AIR-CONDITIONING**	**9**
Natural Ventilation, Passive cooling and heating - Application of wind, water and earth for cooling, evaporative cooling, radiant cooling – Hybrid Methods – Energy Conservation measures, Thermal Storage integration in buildings.		
Topic - 4	**HEAT TRANSMISSION IN BUILDINGS**	**9**
Surface co-efficient: air cavity, internal and external surfaces, overall thermal transmittance, wall and windows; Heat transfer due to ventilation/infiltration, internal heat transfer; Solar temperature; Decrement factor; Phase lag. Design of day lighting; Estimation of building loads: Steady state method, network method, numerical method, correlations; Computer packages for carrying out thermal design of buildings and predicting performance.		
Topic - 5	**PASSIVE COOLING & RENEWABLE ENERGY IN BUILDINGS**	**9**
Passive cooling concepts: Evaporative cooling, radiative cooling; Application of wind, water and earth for cooling; Shading, paints and cavity walls for cooling; Roof radiation traps; Earth air-tunnel. Introduction of renewable sources in buildings, Solar water heating, small wind turbines, stand-alone PV systems, Hybrid system – Economics.		

THEORY	**45**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**45**

BOOK REFERENCES	
1	Clarke, Joseph. “Energy simulation in building design”2ND Edition, Routledge, 2007
2	Krishan, Arvind, ed. Climate responsive architecture: a design handbook for energy efficient buildings. Tata McGraw-Hill Education, 2001

OTHER REFERENCES	
1	Krieder, J and Rabi, A., Heating and Cooling of buildings : Design for Efficiency, McGraw Hill, 1994.
2	Rajeshwar, K., McConnell, R., Licht, S., Solar Hydrogen Generation, ISBN 978-0-387-72810-0, Springer-Verlag New York, 2008.
3	Kreith F., Goswami D.Y. (2007). Energy Management and Conservation Handbook. CRC Press. ISBN: 9781420044294
4	https://www.youtube.com/watch?v=TIHrypTKTlo
5	https://www.youtube.com/watch?v=37iI5KgYtqc

Semester	Programme	Course Code	Course Name	L	T	P	C
		20HSCT2	PROFESSIONAL ETHICS	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Articulate engineering ethics theory with sustained lifelong learning actions.	K2	1
CO2	Adopt a good character and follow high professional ethical life.	K2	2
CO3	Contribute to shape a better character by following ethical.	K3	3
CO4	Confront and resolve moral issues occurred during technological activities.	K4	4
CO5	Resolve moral and ethical problems through exploration and assessment by established experiments	K4	5

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	2					2	1	3	3	2	2	1	1	
CO 2	2					3	1	2	2	1	2	1	1	
CO 3	2					1	2	3	3	1	2			1
CO 4	1					2	1	3	2	1	2			1
CO 5	2					1		2	1		2			

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignments
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENTS		
Topic - 1	**HUMAN VALUES**	**9**
Morals and Ethics - Honesty - Integrity - Values - Work Ethic - Civic Virtue - Respect for Others – Living Peacefully - Caring and Sharing - Self-Confidence - Courage - Co-operation - Commitment – Empathy.		
Topic - 2	**ENGINEERING ETHICS AND PROFESSIONALISM**	**9**
Scope of Engineering Ethics- Variety of moral issues - Types of inquiry - Accepting and sharing responsibility - Ethical dilemmas - Moral autonomy - Kohlbergs and Gilligan's theory - Consensus and controversy - Senses of corporate responsibility - Codes of ethics: Importance - justification - limitation - Abuse.		
Topic - 3	**ENGINEERING AS SOCIAL EXPERIMENTATION**	**9**
Engineering as experimentation - Engineers as responsible experimenters - Balanced outlook on law - Cautious optimism - Safety and risk - Assessing and reducing risk - Safe exits - The Challenger case study - Bhopal Gas Tragedy - The Three Mile Island and Chernobyl.		
Topic - 4	**WORKPLACE RESPONSIBILITIES AND RIGHTS**	**9**
Fundamental Rights - Responsibilities and Duties of Indian Citizens - Teamwork - Ethical corporate Climate - Collegiality and loyalty - Managing conflict - Respect for authority - Collective bargaining - Confidentiality - Conflicts of interest - Occupational crime - Professional rights - Employee rights..		
Topic - 5	**GLOBAL ISSUES**	**9**
Multinational corporations: Technology transfer and appropriate technology - International rights - promoting morally just measures - Environmental ethics: Engineering, ecology - economics - Human and sentient centred - and bio and eco centric ethics - Consulting engineers - Engineers as expert witnesses and advisors - Moral leadership		

THEORY	**45**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**45**

BOOK REFERENCES	
1	Mike W Martin and Roland Schinzinger, Ethics in Engineering, 4th edition, Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi, 2014.
2	2. M Govindarajan, S Natarajan and V S Senthil Kumar, Engineering Ethics, PHI Learning Private Ltd, New Delhi, 2012.

OTHER REFERENCES	
1	R S Naagarazan, A text book on professional ethics and human values, New age international (P) limited, New Delhi, 2006.
2	Charles D Fleddermann, Engineering Ethics, Pearson Education/ Prentice Hall of India, New Jersey, 2004.
3	Charles E Harris, Michael S Protchard and Michael J Rabins, Engineering Ethics - Concepts and Cases, Wadsworth Thompson Learning, United States, 2005.
4	http://www.slideworld.org/slidestag.aspx/human-values-and- Professional-ethics
5	https://www.youtube.com/watch?v=0ibZPqHcb5Y

Semester	Programme	Course Code	Course Name	L	T	P	C
		20MEO03	AIR POLLUTION AND CONTROL	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Know how to interpret meteorological data for atmospheric stability, transportation and dispersion of air pollutants.	K2	1
CO2	Get an insight into the some of the most widely used commercial and freely available air quality models.	K2	2
CO3	Present detailed information about the theory and design of various equipments for control of particulate matter.	K3	3
CO4	Learn the concepts, strategies and techniques for control of gaseous air pollutants.	K3	4
CO5	Articulate current air pollution policies and measures for control.	K3	5

PRE-REQUISITE	Nil

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2				1		1					1	
CO2	1	2					1	1						
CO3	1							1						2
CO4	2		2		1			1						2
CO5	2		3		3			1						3

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignments
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic - 1	**INTRODUCTION TO AIR POLLUTION**	**9**
Current scenario of air pollution at national and global scales, Sources and types air pollutants, criteria air pollutants and their effects, Ambient air quality standards.		
Topic - 2	**METEOROLOGY AND AIR POLLUTION**	**9**
Structure and composition of atmosphere, Wind circulation, Wind rose diagram, Lapse rates, Stability of atmosphere, Inversion and its types, Plume behaviour, Maximum Mixing Depth, Cyclones and anticyclones, Precipitation & its relation to removal of air pollutants.		
Topic - 3	**DISPERSION OF AIR POLLUTANTS**	**9**
Air quality dispersion models, Gaussian dispersion model for point sources and line sources, applications and limitations of Gaussian model, plume rise- causes and significance, Formulas for estimation of Plume Rise, Plume down wash, Stability classes, Box model , Street canyon model, Introduction to AERMOD and other software.		
Topic - 4	**AIR QUALITY MANAGEMENT**	**9**
Control of air pollution from stationary and mobile sources, measures for effective control of air pollution in India, , Alternative fuels, Air quality index, National Air quality Monitoring Program, Legislative measures International treaties for control and mitigation of air pollution.		
Topic - 5	**CONTROL OF PARTICULATE MATTER**	**9**
Sources of SPM, Terminal settling velocity, Particulate removal mechanisms, study of working principle and design of Particulate Control Equipments : - Settling chamber, Cyclone separator, Fabric filter, Electrostatic precipitator, Wet collectors, removal efficiency- block flow and mixed flow.		

THEORY	**45**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**45**

BOOK REFERENCES	
1	K. Wark, C.F. Warner & W.T. Davis Air Pollution Control: its Origin and Control, Addision-Wesley, (1998).
2	Stern A.C., ―Air Pollution Vol. I and II‖, Allied Publishers Limited, 1st Edition, 1994.
3	Nevers N., "Air Pollution control Engineering" McGraw-Hill, New York, 2nd edition, 1995.
4	Air Pollution and Control Technologies by Anjaneyulu, D‖, Allied Publishers, Mumbai, 2002.
5	Industrial Air Pollution Control Systems by W.L.Heumann, McGraw-Hill, New York, 1997

OTHER REFERENCES	
1	https://nptel.ac.in/courses/110104068
2	https://nptel.ac.in/courses/110104070
3	https://nptel.ac.in/courses/110108141
4	https://ycmou.ac.in/media/publication/ycmou_book/SNP_YB_100.pdf
5	https://industrialmarketingexperts.com/industrial-video-production-and-marketing/

Semester	Programme	Course Code	Course Name	L	T	P	C
		20MEO04	INDUSTRIAL AUTOMATION	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Select & identify suitable automation hardware for the given application.	K2	1
CO2	Describe & explain potential areas of automation, material handling, and Fluid power systems.	K2	2
CO3	Analysis of Manufacturing systems & Mathematical models of production lines.	K3	3
CO4	To know Industrial Automated production lines and work part transfer mechanism and buffer storage analysis.	K3	4
CO5	To understand Cellular Manufacturing, Flexible manufacturing Systems, planning implementation issues and implementation quality programs in production systems.	K3	5

PRE-REQUISITE	Nil

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3		3		3								3	
CO2	3	3	3		3								3	3
CO3	3	3		3	3								3	
CO4	3	3		3	3								3	
CO5	3		3		3								3	

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignments
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic - 1	**INTRODUCTION**	**9**
Introduction , Automation In Production System, Manual Labor in production systems ,Principles and Strategies of Automation, Basic Elements of An Automated System, Levels of Automation, production concepts and mathematical models.		
Topic - 2	**FLUID POWER AND PNEUMATIC SYSTEMS**	**9**
Introduction to Fluid power, Pascal's Law, Hydraulic Circuit Design and Analysis-Introduction, Control of A Single-Acting Hydraulic Cylinder Circuit, Control of a Double Acting Hydraulic Cylinder Circuit, Regenerative Cylinder Circuit. Basic Pneumatic systems, Types of Cylinders-Single acting Cylinder-Double acting Cylinder, Direction Control Valves-Valve position, Shuttle Valve, Basic Pneumatic Circuits-Control of Single acting Cylinder Circuit-Control of Double acting circuit, Impulse operation-Pilot operation of single acting and Double acting cylinder.		
Topic - 3	**MANUFACTURING SYSTEMS**	**9**
Introduction to Manufacturing systems, Components of Manufacturing systems, Classification scheme for Manufacturing systems, Simple problems using Mathematic models of production performance, single station manufacturing cells, fundamentals of manual assembly lines, automated production lines.		
Topic - 4	**AUTOMATED PRODUCTION LINES AND ASSEMBLY SYSTEMS**	**9**
Fundamentals of Automated Production Lines, Applications of Automated production lines, System configurations, Work Part Transfer Mechanisms, Storage Buffers, Power Transmission Systems-Gears, Power Screws(Linear Guide ways), Other Transmissions Systems such as chains and ropes.		
Topic - 5	**CELLULAR MANUFACTURING AND FLEXIBLE MANUFACTURING SYSTEMS**	**9**
Introduction, Part Families, Manufacturing Cells, Cellular Manufacturing, Part classification and coding, Production Flow Analysis, Group Technology and its applications. Introduction to FMS, FMS Industrial Applications and its benefits, FMS components.		

THEORY	**45**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**45**

BOOK REFERENCES	
1	Industrial Robotics, Technology, Programming, and applications-Mikell P.Groover.
2	Fluid Power with Applications-Anthony Esposito, Peason, Sixth Addition.
3	Pneumatic Systems, Principles and Maintenance-SR Majumdar, 2011 Edition.
4	An Introduction to Automated Process Planning Systems Tiess Chiu Chang & Richard A. Wysk.
5	Computer Based Industrial Control-Krishna Kant, EEE-PHI,2nd edition,2010

OTHER REFERENCES	
1	https://nptel.ac.in/courses/108105088
2	https://nptel.ac.in/courses/108105062
3	https://www.youtube.com/watch?v=oxMdDsud5vg
4	https://www.iare.ac.in/sites/default/files/IARE_IAC_PPT_0.pdf
5	https://forumautomation.com/t/free-industrial-automation-and-plc-programming-ebooks-pdf/4720

Semester	Programme	Course Code	Course Name	L	T	P	C
		20MEO05	RENEWABLE ENERGY SOURCES	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Demonstrate the Environmental consequences of Fossil fuel use, Importance of renewable sources	K2	1
CO2	Apply the concepts of wind energy with the power generation systems.	K3	2
CO3	Develop the system producing power using Solar Radiation, Radiation Measurement, Solar Thermal Power Plant.	K3	3
CO4	Experiment with the usage of biomass resources and its energy.	K3	4
CO5	Identify the Basic properties of hydrogen, Technologies of hydrogen production, Transformation of hydrogen energy	K3	5

PRE-REQUISITE	Nil

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	1	1	-	2	3	1	1	2	-	3	2	2
CO2	3	-	2	2	-	2	3	1	1	2	-	3	2	2
CO3	3	-	2	2	-	2	3	1	1	2	-	3	2	2
CO4	3	-	2	2	-	2	3	1	1	2	-	3	2	2
CO5	3	-	2	2	-	2	3	1	1	2	-	3	2	2

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignments
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic - 1	**INTRODUCTION**	**9**
World Energy Use – Reserves of Energy Resources – Environmental Aspects of Energy Utilisation – Renewable Energy Scenario in Tamilnadu, India and around the World – Potentials - Achievements / Applications – Economics of renewable energy systems.		
Topic - 2	**WIND ENERGY**	**9**
Wind Data and Energy Estimation – Types of Wind Energy Systems – Performance – Site Selection – Details of Wind Turbine Generator – Safety and Environmental Aspects		
Topic - 3	**SOLAR ENERGY**	**9**
Solar Radiation – Measurements of Solar Radiation - Flat Plate and Concentrating Collectors – Solar direct Thermal Applications – Solar thermal Power Generation - Fundamentals of Solar Photo Voltaic Conversion – Solar Cells – Solar PV Power Generation – Solar PV Applications.		
Topic - 4	**BIO-ENERGY**	**9**
Biomass direct combustion – Biomass gasifiers – Biogas plants – Digesters – Ethanol production – Bio diesel – Cogeneration - Biomass Applications		
Topic - 5	**OTHER RENEWABLE ENERGY SOURCES**	**9**
Tidal energy – Wave Energy – Open and Closed OTEC Cycles – Small Hydro-Geothermal Energy – Hydrogen and Storage - Fuel Cell Systems – Hybrid Systems.		

THEORY	**45**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**45**

BOOK REFERENCES	
1	Rai. G.D., Non Conventional Energy Sources, Khanna Publishers, New Delhi, 2011.
2	Twidell, J.W. & Weir, A., Renewable Energy Sources, EFN Spon Ltd., UK, 2006
3	Boyle, Godfrey. 2004. Renewable Energy (2nd edition). Oxford University Press, (ISBN: 0-19-926178-4).
4	Schaeffer, John. 2007. Real Goods Solar Living Sourcebook: The Complete Guide to Renewable Energy Technologies and Sustainable Living (30th anniversary edition). Gaiam.
5	Sukhatme, Suhas P., and J. K. Nayak. Solar energy. McGraw-Hill Education, 2017.

OTHER REFERENCES	
1	Sunggyu Lee and Y.T. Shah – "Biofuels and Bio-energy Processes and Technology", CRC Press Taylor and Francis Group, 2013.
2	B.H.Khan – "Non-Conventional Energy Sources", 3rd Edition, McGraw Hill Education India, 2016.
3	D.P.Kothari – "Renewable Energy Sources and Emerging Technologies", Second Edition, PHILearning Private Limited, 2011.
4	https://nptel.ac.in/courses/102104057/ , Prof. Mainak Das, IIT Kanpur, Bioene
5	https://www.intechopen.com/books/liquid-gaseous-and-solid-biofuels-conversion-techniques/biofuel-sources-extraction-and-determination

Semester	Programme	Course Code	Course Name	L	T	P	C
		20MEO06	FUNDAMENTALS OF ERGONOMICS	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Interpret ergonomics and its components.	K3	1
CO2	Apply the statistical treatment of data in designing the components of office and shop floor.	K3	2
CO3	Assess the common risk factors and areas for ergonomic improvement.	K6	3
CO4	Apply ergonomic principles in framing work content for workers.	K3	4
CO5	Plan the essential elements for an effective ergonomics programme.	K5	5

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2					2		2				2	2
CO2	2	2					2		2				2	2
CO3	2	2					2		2				2	2
CO4	2	2					2		2				2	2
CO5	2	2					2		2				2	2

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignments
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic - 1	**INTRODUCING ERGONOMICS**	**9**
Introducing Ergonomics: Fundamentals of Ergonomics / Human factors - Disciplines - Physical - Cognitive and Organizational - Needs of Ergonomics in workplace - Ergonomic Principles - Applications -Ergonomic Evaluation - Questionnaire survey.		
Topic - 2	**ANTHROPOMETRY**	**9**
Anthropometry: Human body - structure and function - Types of anthropometric data - Application of anthropometry in design - Anthropometric measuring techniques - Statistical treatment of data and percentile calculations.		
Topic - 3	**POSTURE AND MOVEMENT**	**9**
Posture and Movement: Biomechanical Background - Physiological Background - Sitting - Standing Change of Posture - Hand and arm postures - Movement - Lifting - Carrying - Pulling - Pushing - Repetitive motions - Rapid Upper Limb Assessment (RULA) – Rapid Entire Body Assessment (REBA) and Ovako Working Posture Assessment (OWAS) method.		
Topic - 4	**WORK COUNTER BEHAVIOR AND PERCEPTION**	**9**
Work Counter Behavior and Perception: Environmental issues - Physical work capacity - Factors affectingwork capacity - Communication and cognitive issues - Information processing and perception – Interaction with machines - mental workload.		
Topic - 5	**WORK SYSTEM EVALUATION AND SAFETY**	**9**
Work system Evaluation and Safety: Contribution of ergonomics to workstation design -Analysis of workplace design - Work envelopes - Workplace evaluation tools - case studies - Occupational / Ergonomic safety and stress at various workplaces - health management rules - Scope of Ergonomics inIndia-case studies.		

THEORY	**45**		**TUTORIAL**			**PRACTICAL**	**0**		**TOTAL**	**45**

BOOK REFERENCES	
1	Bridger R.S., "Introduction to Ergonomics", 3rd Edition, Taylor & Francis, New York, 2011.
2	Pamela McCauley-Bush, "Ergonomics: Foundational Principles, Applications, and Technologies", 1st Edition, Taylor & Francis, CRC Press, New York, 2011.

OTHER REFERENCES	
1	https://nptel.ac.in/courses/107/103/107103004/
2	https://onlinecourses.nptel.ac.in/noc20_de12/preview
3	https://www.youtube.com/watch?v=a2x-rCNJn3w
4	https://www.youtube.com/watch?v=5FC9kpRKYIU
5	https://www.youtube.com/watch?v=1IbPs3E9i4k

Semester	Programme	Course Code	Course Name	L	T	P	C
		20MEO07	SAFETY MEASURES FOR ENGINEERS	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Explain the safety management concepts and accident prevention methods.	K2	1
CO2	Apply appropriate measuring and /or insulating equipment, use of fire extinguishers and safe earthing practices.	K3	2
CO3	Identify the different source of ignition and their prevention techniques	K2	3
CO4	Interprett the PPE based on the type of industry and standards.	K3	4
CO5	Plan the techniques like risk assessment disaster management and emergency preparedness with the proper knowledge on accident prevention.	K5	5

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3							2				2	2
CO2	2	3							2				2	2
CO3	2	3							2				2	2
CO4	2	3							2				2	2
CO5	2	3							2				2	2

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignments
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic - 1	**SAFETY MANAGEMENT AND ACCIDENT PREVENTION**	**9**
Introduction: Need for Safety - Safety and Productivity - Safety Management Techniques - Job Safety Analysis - Safety Sampling Technique - Incident Recall Technique - Plant Safety Inspection - Accident: Nature and Causes of Accidents - Accident Proneness - Cost of Accident - Accident Prevention Methods - Accident Reporting and Investigation - Safety Education and Training- Environmental Safety' (OHSAS, Paris Agreement etc.,)- Indian Factories Act.		
Topic - 2	**ELECTRICAL SAFETY EQUIPMENTS**	**9**
Voltage Measuring Instruments: Safety Voltage Measurement - Contact and Non-Contact Type Testers Rubber Insulating Equipment: Rubber Mats - Rubber Blankets - Rubber Covers - Line Hoses and Sleeves - Inspection Techniques - Standards Insulated Tools: Hot Sticks - Cherry Picker - Standards for Tools - Safety Barriers and Signs - Safety Tags - Lock and Locking devices - Prevention from the damages ofstatic electricity - Lighting arrester.		
Topic - 3	**SAFETY PRACTICES**	**9**
Fire Extinguishers: Fire Safety Against Electrical fire - Types of Extinguishers Safety Earthing Practices: Distinction Between System Grounding and Equipment Grounding - Functional Requirement of Earthing Systems - Earth Electrodes - Types. Earth Mats - Procedure for Laying Earth Mat - Earth Resistance Measurements- First Aid-first aid for burns.		
Topic - 4	**PERSONNEL PROTECTION EQUIPMENT (PPE)**	**9**
Flash and Thermal protection: Glossary of Terminologies - Flame Resistant - Arc Thermal Performance Value (ATPV) - Energy Breakthrough (EBT) - ASTM Standard for Clothing Materials - Choice of Clothing - Flame and Non-Flame Resistant Materials - Guidelines for Selection - Flash Suit Head Protection: Hard Hats – ANSI Z 89.1 Standard - Eye Protection - Requirements of Safety Glasses - Goggles - Selection - Face shield. Hearing Protection – Requirement - Ear plugs and Ear muffs - Noise Reduction Ratio - Thumb Rule. Arm and Hand Protection: Rubber Gloves - ASTM Standards – Leather Protective Glove - Level of Protection. Foot and Leg Protection and Respiratory Protection.		
Topic - 5	**RISK ASSESSMENT AND CONTROL TECHNIQUES**	**9**
Risk Assessment: Basic Concepts of Risk - Safety Appraisal, Analysis and Control Techniques - AccidentInvestigation, Analysis and Reporting - Hazard and Risk Assessment Techniques - Reliability Engineering- Major Accident Hazard (MAH) Control - On-site and Off-site Emergency Plans.		

THEORY	**45**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**45**

BOOK REFERENCES	
1	Mistry K.U., "Fundamentals of Industrial Safety and Health", 2nd Edition, Siddharth Prakashan,Ahmedabad, 2008.
2	Benjamin O.Alli, Fundamental Principles of Occupational Health and Safety ILO 2008.

OTHER REFERENCES	
1	https://nptel.ac.in/courses/110/105/110105094/
2	https://freevideolectures.com/course/4619/nptel-principles-construction-management/24

Semester	Programme	Course Code	Course Name	L	T	P	C
		20MEO08	OPTIMIZATION TECHNIQUES	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Construct and solve linear programming models to answer business optimization	K1	1
CO2	Apply transportation and assignment models to find optimal solution in warehousing and Travelling.	K2	2
CO3	Prepare project scheduling using PERT and CPM.	K6	3
CO4	Appraise theoretical predictions obtained from Game Theory analyses against real world conflicts.	K3	4
CO5	Identify and analyze appropriate queuing model to reduce the waiting time in queue	K3	5

PRE-REQUISITE	-

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1		2	1	1				1	2	1	2	2
CO2	3	2		2	1	1				1	2	1	2	2
CO3	3	2		2	1	1				1	2	1	2	2
CO4	3	2		2	1	1				1	2	1	2	2
CO5	3	2		2	1	1				1	2	1	2	2

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Seminar
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic - 1	**LINEAR PROGRAMMING MODELS**	**9**
Mathematical Formulation - Graphical Solution of Linear Programming Models - Simplex Method - Big-M Method		
Topic - 2	**TRANSPORTATION AND ASSIGNMENT MODELS**	**9**
Mathematical Formulation of Transportation Problem - Methods for Finding Initial Basic Feasible Solution: North West Corner Rule, Least Cost Method, VAM - Optimum solution – Mathematical Formulation of Assignment Models.		
Topic - 3	**PERT AND CPM**	**9**
Network Construction – Critical Path Method – Project Evaluation and Review Technique		
Topic - 4	**GAME THEORY**	**9**
Definition - Pay-off - Two Person Zero - Sum Games -The Maximin - Minimax Principle - Games without Saddle Points (Mixed Strategies) - 2x2 Games without Saddle Points - Graphical Method for 2xn or mx2 Games.		
Topic - 5	**QUEUING MODELS**	**9**
Characteristics of Queuing Models – Poisson Queues – (M/M/1): (FIFO/∞/∞), (M/M/1): (FIFO/N/∞), (M/M/C): (FIFO/∞/∞), (M/M/C) : (FIFO/N/∞) Models.		

THEORY	**45**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**45**

BOOK REFERENCES	
1	Taha, H.A. “Operations Research: An Introduction”, 8th Edition, Pearson Education, 2008.
2	V.Sundaresan, K.S.Ganapathy Subramanian, K.Ganesan, ”Resource Management Techniques”, A.R.Publication, 2002.
3	A .M. Natarajan, P. Balasubramani, A.Tamilarasi, “Operations Research” , Pearson Education, Asia, 2005.
4	Prem Kumar Gupta , D.S. Hira “Operations Research”, S. Chand & Company Ltd., New Delhi, Third Edition, 2003.

OTHER REFERENCES	
1	https://nptel.ac.in/courses/111105039 Optimization, IIT Kharagpur, Prof. A. Goswami, Dr. Debjani Chakraborty
2	https://nptel.ac.in/courses/105108127 Optimization Methods, IISc Bangalore Dr. D. Nagesh Kumar
3	https://www.youtube.com/watch?v=aJKuM4U-eYg
4	https://www.iare.ac.in/sites/default/files/OT%20Complete%20Notes.pdf

Semester	Programme	Course Code	Course Name	L	T	P	C
		20MEO09	BUILDING SERVICES	**3**	**0**	**0**	**3**

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		**RBT Level**	**Topics Covered**
CO1	Explain machineries techniques and practice for building services.	K4	1
CO2	Apply different Electrical systems and its installation in buildings.	K3	2
CO3	Show the Principles of Illumination & Design.	K2	3
CO4	Explain Refrigeration Principles & its Applications.	K4	4
CO5	Choose the safety of equipment and its installation.	K1	5

PRE-REQUISITE	CIVIL ENGINEERING MATERIALS AND CONSTRUCTIONS-I

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	**Programme Learning Outcomes (POs)**												**PSOs**	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3		2	3	2						3	3	
CO2	3	2		2	3	2						3	3	
CO3	3	2		2	3	2						3	3	
CO4	3	2	2		3	2						3	3	
CO5	3	3	2		3	3						3	3	

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Seminar
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic - 1	**MACHINERIES**	**8**
Hot Water Boilers – Lifts and Escalators – Special features required for physically handicapped and elderly – Conveyors – Vibrators – Concrete mixers – DC/AC motors – Generators – Laboratory services – Gas, water, air and electricity		
Topic - 2	**ELECTRICAL SYSTEMS IN BUILDINGS**	**10**
Basics of electricity – Single / Three phase supply – Protective devices in electrical installations – Earthing for safety – Types of earthing – ISI specifications – Types of wires, wiring systems and their choice – Planning electrical wiring for building – Main and distribution boards – Transformers and switch gears – Layout of substations.		
Topic - 3	**PRINCIPLES OF ILLUMINATION & DESIGN**	**8**
Visual tasks – Factors affecting visual tasks – Modern theory of light and colour – Synthesis of light – Additive and subtractive synthesis of colour – Luminous flux – Candela – Solid angle illumination – Utilisation factor – Depreciation factor – MSCP – MHCP – Lans of illumination – Classification of lighting – Artificial light sources – Spectral energy distribution – Luminous efficiency – Colour temperature– Colour rendering. Design of modern lighting – Lighting for stores, offices, schools, hospitals and house lighting. Elementary idea of special features required and minimum level of illumination required for physically handicapped and elderly in building types.		
Topic - 4	**REFRIGERATION PRINCIPLES & APPLICATIONS**	**10**
Thermodynamics - Heat - Temperature , measurement transfer - Change of state - Sensible heat - Latent heat of fusion , evaporation , sublimation - saturation temperature - Super heated vapour - Subcooled liquid - Pressure temperature relationship for liquids - Refrigerants - Vapour compression cycle - Compressors - Evaporators - Refrigerant control devices - Electric motors - Starters - Air handling units - Cooling towers - Window type and packaged air - conditioners - Chilled water plant - Fan coil systems - Water piping - Cooling load - Air conditioning systems for different types of buildings - Protection against fire to be caused by A.C. Systems		
Topic - 5	**FIRE SAFETY INSTALLATION**	**9**
Causes of fire in buildings – Safety regulations – NBC – Planning considerations in buildings like non-combustible materials, construction, staircases and lift lobbies, fire escapes and A.C. systems. Special features required for physically handicapped and elderly in building types – Heat and smoke detectors – Fire alarm system, snorkel ladder – Fire lighting pump and water storage – Dry and wet risers – Automatic sprinklers.		

THEORY	**45**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**45**

BOOK REFERENCES	
1	E.R.Ambrose, “Heat Pumps and Electric Heating”, John and Wiley and Sons, Inc., New York, 1968.
2	Handbook for Building Engineers in Metric systems, NBC, New Delhi, 1968.

3	Philips Lighting in Architectural Design, McGraw-Hill, New York, 1964.
4	R.G.Hopkinson and J.D.Kay, “The Lighting of buildings”, Faber and Faber, London, 1969.
OTHER REFERENCES	
1	William H.Severns and Julian R.Fellows, “Air-conditioning and Refrigeration”, John Wiley and Sons, London, 1988.
2	A.F.C. Sherratt, “Air-conditioning and Energy Conservation”, The Architectural Press, London, 1980. National Building Code.
4	NPTEL
5	YOUTUBE

Semester	Programme	Course Code	Course Name	L	T	P	C
		20ME7E10	INDUSTRIAL ROBOTICS	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Understand the functions of the basic components of a Robot.	K2	1
CO2	Study the use of various types of End of Effectors and Sensors	K2	2
CO3	Comprehend sensors and machine vision.	K2	3
CO4	Imparting knowledge in Robot Kinematics and Programming	K3	4
CO5	Learn Robot safety issues and economics.	K2	5

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2	2	2	-	-	-	-	2	-	-	-	3	3
CO 2	2	3	2	3	-	3	-	-	-	-	-	-	3	3
CO 3	3	2	2	2	-	2	-	-	2	-	-	-	3	3
CO 4	2	2	2	2	-	2	-	-	-	-	-	-	2	2
CO 5	2	2	2	-	-	3	3	-	2	-	-	-	2	3

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Seminar
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENTS		
Topic - 1	**FUNDAMENTALS OF ROBOT**	**9**
Robot - Definition - Robot Anatomy - Co ordinate Systems, Work Envelope Types and Classification- Specifications-Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load- Robot Parts and their Functions- Need for Robots-Different Applications.		
Topic - 2	**ROBOT DRIVES AND END EFFECTORS**	**9**
Pneumatic Drives-Hydraulic Drives-Mechanical Drives-Electrical Drives-D.C. Servo Motors, Stepper Motors, A.C. Servo Motors-Salient Features, Applications and Comparison of all these Drives, End Effectors-Grippers- Mechanical Grippers, Pneumatic and Hydraulic- Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations.		
Topic - 3	**SENSORS AND MACHINE VISION**	**9**
Requirements of a sensor, Principles and Applications of the following types of sensors- Position sensors - Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, pneumatic Position Sensors, Range Sensors Triangulations Principles, Structured, Lighting Approach, Time of Flight, Range Finders, Laser Range Meters, Touch Sensors ,binary Sensors., Analog Sensors, Wrist Sensors, Compliance Sensors, Slip Sensors, Camera, Frame Grabber, Sensing and Digitizing Image Data- Signal Conversion, Image Storage, Lighting Techniques, Image Processing and Analysis-Data Reduction, Segmentation, Feature Extraction, Object Recognition, Other Algorithms, Applications- Inspection, Identification, Visual Serving and Navigation.		
Topic - 4	**ROBOT KINEMATICS AND ROBOT PROGRAMMING**	**9**
Forward Kinematics, Inverse Kinematics and Difference; Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), Four Degrees of freedom (in 3 Dimension) Jacobians, Velocity and Forces-Manipulator Dynamics, Trajectory Generator, Manipulator Mechanism Design- Derivations and problems. Lead through Programming, Robot programming Languages-VAL Programming- Motion Commands, Sensor Commands, End Effector commands and simple Programs.		
Topic - 5	**IMPLEMENTATION AND ROBOT ECONOMICS**	**9**
RGV, AGV; Implementation of Robots in Industries-Various Steps; Safety Considerations for Robot Operations - Economic Analysis of Robots.		

THEORY	**45**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**45**

BOOK REFERENCES	
1	Klafter R.D., Chmielewski T.A and Negin M., “Robotic Engineering - An Integrated Approach”, Prentice Hall, 2003.
2	Groover M.P., “Industrial Robotics -Technology Programming and Applications”, McGraw Hill, 2001.
3	Craig J.J., “Introduction to Robotics Mechanics and Control”, Pearson Education, 2008
4	Deb S.R., “Robotics Technology and Flexible Automation” Tata McGraw Hill Book Co., 1994.

OTHER REFERENCES	
1	https://www.sciencedirect.com/topics/engineering/industrial-robot
2	https://www.fanucamerica.com/products/robots
3	https://www.mdpi.com/2076-3417/12/1/135
4	https://www.therobotreport.com/state-of-industrial-robotics-challenges-opportunities/
5	https://www.infineon.com/cms/en/applications/industrial/robotics/industrial-robots/

Semester	Programme	Course Code	Course Name	L	T	P	C
		20MEO10	**E-WASTE MANAGEMENT**	**3**	**0**	**0**	**3**

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		**RBT Level**	**Topics Covered**
CO1	Learn basic concepts of Hazardous waste and e –waste and its constituents.	K2	1
CO2	Cognizance on generation and classification of E –waste.	K2	2
CO3	Assimilating the adverse effects of E-waste in Environment, health and safety.	K4	3
CO4	Discernment of collection, treatment and disposal of E-waste.	K2	4
CO5	Assessment on E –waste management in India and its legislations.	K2	5

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	**Program Outcomes (POs)**													
	PO	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	2	1	-	-	-	-	2	-	2	-	1	2	1	1
CO 2	3	-	2	-	1	-	2	2	1	-	-	2	-	-
CO 3	2	1	2	2	-	2	3	-	2	-	1	2	-	-
CO 4	3	-	2	-	1	-	2	2	1	-	1	2	-	-
CO 5	2	1	-	-	-	-	3	-	2	-	1	2	2	2

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignments
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic – 1	**INTRODUCTION**	**9**
Hazardous wastes- source and types – E- waste – preface – causes for wastage – constituent materials and pollutants – challenges in E-waste management.		
Topic – 2	**GENERATION**	**9**
Sources of E - waste generation – classification - Temperature exchange equipment - Screens, monitors – Lamps - Large equipments -Small equipment -Small IT and telecommunication equipment.		
Topic – 3	**IMPACTS AND ADVERSE EFFECTS**	**9**
Environment concerns – Effects of E-waste – Air, soil and water - Impact of hazardous substances on health and safety - Residents living near recycling sites, Prenatal exposure and neonates' health, children and workers – Data security.		
Topic - 4	**CONTROL MEASURES**	**9**
Collection, Treatment and Disposal System – Landfilling - Incineration - Recycling of E- waste – Reuse – Extended Producer Responsibility (EPR).		
Topic - 5	**E-WASTE IN INDIA**	**9**
Regions – Health and safety – Environmental impacts – Disposal techniques – Regulations and legislations in India.		

THEORY	**45**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**45**

BOOK REFERENCES	
1	Anish khan, Inamuddin and Abdullah M.Asiri: E-waste Recycling and Management.
2	Johri R., "E-waste: implications, regulations, and management in India and current global best practices", TERI Press, New Delhi
3	Hester R.E., and Harrison R.M. 2009. Electronic Waste Management. Science.
4	Fowler B. 2017. Electronic Waste – 1st Edition (Toxicology and Public Health Issues). Elsevier.

OTHER REFERENCES	
1	https://www.youtube.com/watch?v=75SU5h1PjxY
2	https://www.youtube.com/watch?v=hffEs1JXFmI
3	https://www.youtube.com/watch?v=Sh_mwszuE2I
4	https://www.youtube.com/watch?v=JxLDgMVlnoQ

Semester	Programme	Course Code	Course Name	L	T	P	C
		20MEO11	ENERGY RESOURCES, ECONOMICS AND ENVIRONMENT	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Prepare an analytical policy report that develops knowledge and practical implementation of relevant economic theory in understanding and addressing an environmental or natural resource issue.	K2	1
CO2	Apply economic analysis to the management of the environment and natural	K2	2
CO3	Identify materials usage in energy sources	K2	3
CO4	Apply finance energy analysis to the management of the environment and natural resources	K2	4
CO5	Demonstrate good inter-personal and communication skills through writing a policy report	K2	5

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2		2			3	2					2	2	2
CO2	2		2			3	2					2	2	1
CO3	2		2			3	2					2	2	2
CO4	2		2			3	2					2	1	2
CO5	2		2			3	2					2	1	2

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignment
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic - 1	**ENERGY AND QUALITY OF LIFE**	**9**
Energy Flow Diagram, global trends in energy use, india and world- disaggregation by supply, end use, energy and environment, the kaya identity, emission factor, energy and quality of life, energy inequality, energy security, introduction to country energy balance assignment.		
Topic - 2	**ENERGY ECONOMICS**	**9**
Energy economics - simple payback period, time value of money- discount rate, criteria for assessing energy projects –(net present value (npv), benefit/cost ratio (b/c), inflation, internal rate of return (irr), resources & reserves growth rates in consumption, estimates of duration of fossil fuels, mckelvey diagram, peak oil, hubbert's model.		
Topic - 3	**MATERIALS USED IN RENEWABLE ENERGY**	**9**
Materials used in renewable energy (kuznet's curve, betting on the planet, simon's change), non renewable energy economics (hotelling's rule), preferences and utility, utility and social choice.		
Topic - 4	**EXTERNALITIES FINANCING ENERGY**	**9**
Public and private goods / bads, demand curves , externalities financing energy – debt/ equity- sources of funds, innovative financing models input output analysis.		
Topic - 5	**PRIMARY ENERGY ANALYSIS**	**9**
Primary energy analysis, net energy analysis, examples, energy cost of energy, life cycle analysis of bio energy net energy examples, energy policy examples, practice problems solution.		

THEORY	**45**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**45**

BOOK REFERENCES	
1	Tester J.W., Drake E.M., Driscoll M. J., Golay, M.W, Peters, W.A.,Sustainable Energy Choosing Among Options, PHI Learning Private Limited,New Delhi, 2009.
2	Conrad, J. M., Resource Economics, 2nd Edition, Cambridge University Press, New Delhi, 2010.
3	J.M. Conrad and C.W. Clark, Natural Resource Economics, Cambridge University Press (1987).

OTHER REFERENCES	
1	https://www.youtube.com/watch?v=CtKYyLurFfI
2	https://www.youtube.com/watch?v=1ngAsPoFUe0
3	https://www.youtube.com/watch?v=Yf-VmsLc40k
4	https://www.youtube.com/watch?v=kUPm2tMCbGE

Semester	Programme	Course Code	Course Name	L	T	P	C
		20MEO12	INNOVATION BY DESIGN	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Explain the concept of design thinking for product and service development	K2	1
CO2	Explain the fundamental concept of innovation and design thinking	K2	2
CO3	Discuss the methods of implementing design thinking in the real world.	K2	3
CO4	Understanding the concepts of comprehension in design	K2	4
CO5	Explain the concepts of checking prototypes	K3	5

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	3	3			3	2	3	3	3	3	3	3	2
CO2	3	3	3			3	2	3	3	3	3	3	3	2
CO3	3	3	3			3	2	3	3	3	3	3	2	2
CO4	3	3	3			3	2	3	3	3	3	3	3	2
CO5	3	3	3			3	2	3	3	3	3	3	3	2

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Mini Project
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic - 1	**INTRODUCTION**	**9**
The Seven Concerns-Design Thinking & Collaboration-Challenges to Innovation-Understanding Users-Arriving at Design Insights.		
Topic - 2	**FIRST C- THE CAUSE**	**9**
The Cause-1st C The Cause-Crossing the First Pitfall-Trial and Error- User Feedback for Development-New users, new needs to meet.		
Topic - 3	**SECOND C- THE CONTEXT**	**9**
Second C: The Context-The Basic Need-Ingenious Attempts-Further Insights-The Working Rig-Concepts generation.		
Topic - 4	**THIRD C-THE COMPREHENSION**	**9**
Third C: The Comprehension-Understanding Constraints- Positioning the Product-Exploring Possibilites-More Experiments-Understanding the Technology-At the 2nd Valley of Death.		
Topic - 5	**FOURTH C- THE CHECK**	**9**
Fourth C: The Check-The Check- The Cause-The Product, the Users and the Context-The Prototyping-User needs-The Crucial Step Missed.		

THEORY	**45**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**45**

BOOK REFERENCES	
1	John.R.Karsnitz, Stephen O'Brien and John P. Hutchinson, "Engineering Design",Cengage learning (International edition) Second Edition, 2013.
2	Roger Martin, "The Design of Business: Why Design Thinking is the Next Competitive Advantage", Harvard Business Press , 2009.
3	Hasso Plattner, Christoph Meinel and Larry Leifer (eds), "Design Thinking: Understand – Improve – Apply", Springer, 2011
4	Idris Mootee, "Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School", John Wiley & Sons 2013.
5	Yousef Haik and Tamer M.Shahin, "Engineering Design Process", CengageLearning, Second Edition, 2011.

OTHER REFERENCES	
1	www.tutor2u.net/business/presentations//productlifecycle/default.html
2	https://docs.oracle.com/cd/E11108_02/otn/pdf/. /E11087_01.pdf
3	https://onlinecourses.swayam2.ac.in/aic19_de02/preview
4	https://www.youtube.com/watch?v=2mjSDIBaUlM
5	www.vertabelo.com/blog/documentation/reverse-engineering

Semester	Programme	Course Code	Course Name	L	T	P	C
		20MEO13	ENERGY AUDITING, CONSERVATION AND MANAGEMENT	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Explain the types of energy based on three criteria's and importance of energy conservation	K2	1
CO2	Evaluate the efficiency of thermal utilities such as boilers, pumps, compressors and RAC systems	K2	2
CO3	Evaluate the efficiency of fluid machinery such as centrifugal pump and air compressor	K2	3
CO4	Evaluate the efficiency of electrical utilities such as electrical motors, heating and lighting systems	K2	4
CO5	Implement appropriate steps to be followed for conducting preliminary and detailed energy audit in industries	K2	5

PRE-REQUISITE	NIL

CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)														
COs	Programme Learning Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	2	2	1	1		2	2	2			2	2	2	2
CO2	2	1	1	2		2	2	2			2	2	1	2
CO3	2	1	1	1		2	2	2			2	2	2	2
CO4	2	2	1	2		2	2	2			2	2	1	1
CO5	2	2	1	2		2	2	2			2	2	2	1

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignment
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic - 1	**ENERGY CONSERVATION**	**9**
Energy scenario- principles of energy conservation-resource availability-energy savings-roles and responsibilities of energy managers in india.		
Topic - 2	**ENERGY CONSERVATION IN STEAM SYSTEMS**	**9**
Power plant components-conservation measures in steam systems, losses in boiler-methodology of upgrading boiler performance-blow down control, excess air control-pressure reducing stations-condensate recovery-condensate pumping-thermo compressor-recovery of flash steam-air removal and venting-steam traps-cooling towers.		
Topic - 3	**ENERGY CONSERVATION IN FLUID MACHINERY**	**9**
Centrifugal pumps-energy consumption and energy saving potentials-design consideration-minimizing over design-fans and blowers: specification, safety margin, choice of fans, controls and design considerations-air compressor and compressed air systems: selection of compressed air layout, energy conservation aspects to be considered at design stage.		
Topic - 4	**ELECTRICAL ENERGY CONSERVATION**	**9**
Potential areas for electrical energy conservation in various industries: conservation methods, energy management opportunities in electrical heating, lighting system, cable selection-energy efficient motors-factors involved in determination of motor efficiency-adjustable AC drives-varible speed drives-energy efficiency in electrical system.		
Topic - 5	**ENERGY AUDITING**	**9**
Energy audit, need, preliminary audit, detailed audit, methodology and approach-instruments for audit, monitoring energy and energy savings.		

THEORY	**45**		**TUTORIAL**	**0**		**PRACTICAL**	**0**		**TOTAL**	**45**

BOOK REFERENCES	
1	Smith.C.B – Energy Management Principles, Pergamon Press, 2006.
2	Trivedi.P.R and Joika.K.R, - Energy Management, Common Wealth Publication, 2002.

OTHER REFERENCES	
1	https://www.youtube.com/watch?v=159HC_BVHuk
2	https://www.youtube.com/watch?v=sjCirD2qNCQ
3	https://www.youtube.com/results?search_query=energy+savings
4	https://www.youtube.com/watch?v=n0hklqbWws4
5	https://www.youtube.com/watch?v=8x3-Rk5gKug