K.L.N. COLLEGE OF ENGINEERING

Pottapalayam - 630612, Sivagangai District

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

Estd: 1994

CURRICULUM AND SYLLABUS

I to VIII Semesters

REGULATIONS 2020

For under Graduate Program

B.E. MECHANICALENGINEERING

CHOICE BASED CREDIT SYSTEM

(For the students admitted during the academic year 2021-2022)

Dr.P.Udhayakumar,
Professor & Head,
Department of Mechanical Engineering,
K.L.N. College of Engineering,
Pottapalayam, Sivaganga – 630612.

K.L.N. COLLEGE OF ENGINEERING, POTTAPALAYAM
(An Autonomous Institution, Affiliated to Anna University, Chennai)

VISION OF THE INSTITUTION

To become a Centre of Excellence in Technical Education and Research in producing Competent and Ethical professionals to the society

MISSION OF THE INSTITUTION

To impart Value and Need based curriculum to the students with enriched skill development in the field of Engineering, Technology, Management and Entrepreneurship and to nurture their character with social concern and to pursue their career in the areas of Research and Industry**.**

VISION OF THE DEPARTMENT

To become a centre of excellence for Education and Research in Mechanical Engineering

MISSION OF THE DEPARTMENT

- Attaining academic excellence through effective teaching learning process and state of the art infrastructure.
- Providing research culture through academic and applied research.
- Inculcating social consciousness and ethical values through co-curricular and extra-curricular activities.

K.L.N. COLLEGE OF ENGINEERING, POTTAPALAYAM
(An Autonomous Institution, Affiliated to Anna University, Chennai)

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1 Graduates will have successful career in Mechanical Engineering and service industries.

PEO2 Graduates will contribute towards technological development through academic Research and industrial practices.

PEO3 Graduates will practice their profession with good communication, leadership, ethics And social responsibility.

PEO4 Graduates will adapt to evolving technologies through life-long learning.

PROGRAM SPECIFIC OUTCOMES(PSOs)

PSO1 Derive technical knowledge and skills in the design, develop, analyze and manufacture of mechanical systems with sustainable energy, by the use of modern tools and techniques and applying research based knowledge.

PSO2 Acquire technical competency to face continuous technological changes in the field of mechanical engineering and provide creative, innovative and sustainable solutions to complex engineering problems.

PSO3 Attain academic and professional skills for successful career and to serve the society needs in local and global environment.

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PO1: Engineering knowledge

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

PO2: Problem analysis

Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions

Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems

Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage

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

PO6:The engineer and society

Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability

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

PO8: Ethics

Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work

Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication

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

PO11: Project management and finance

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

PO12:Life-long learning

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

K.L.N. COLLEGE OF ENGINEERING, POTTAPALAYAM
(An Autonomous Institution, Affiliated to Anna University, Chennai)

REGULATIONS 2020

For Under Graduate Program

B.E. MECHANICAL ENGINEERING

CHOICE BASED CREDIT SYSTEM

CATEGORY OF COURSES

i. **Humanities and Social Sciences (HS) Courses** include Technical English, Environmental Science and Engineering, Engineering Ethics and human values, Communication Skills and Management courses.

ii. **Basic Sciences (BS**) **Courses** include Mathematics, Physics, and Chemistry.

iii. **Engineering Sciences (ES) Courses** include Engineering Practices, Engineering Graphics, Basics of Electrical / Electronics / Mechanical / Computer Engineering / Instrumentation etc.

iv. **Professional Core (PC) Courses** include the core courses relevant to the chosen programme of study.

v. **Professional Elective (PE) Courses** include the elective courses relevant to the chosen programme of study.

vi. **Open Elective (OE) Courses** include courses from other departments which a student can choose from the list specified in the curriculum of the students B.E. / B.Tech. Programmes.

vii. **Employability Enhancement Courses (EEC)** include Project Work and/or Internship, Seminar, Professional Practices, Case Study and Industrial/Practical Training.

viii. **Mandatory (MC) Courses** include Personality and Character development and the courses recommended by the regulatory bodies such as AICTE, UGC, etc

K.L.N. COLLEGE OF ENGINEERING, POTTAPALAYAM

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REGULATIONS 2020
CHOICE BASED CREDIT SYSTEM
B.E. MECHANICAL ENGINEERING
I TO VIII SEMESTERS
CURRICULUM AND SYLLABUS

SEMESTER I

(Common to all B.E / B.Tech Programmes)

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	20HS101	English for Technical Communication	HS	3	3	0	0	3
2.	20BS101	Fundamentals of Engineering Mathematics	BS	4	3	1	0	4
3.	20BS102	Engineering Physics	BS	3	3	0	0	3
4.	20BS103	Engineering Chemistry	BS	3	3	0	0	3
5.	20GE101	Problem Solving using Python Programming	ES	3	3	0	0	3
PRACTICAL								
6.	20BS1L1	Basic Science Laboratory	BS	3	0	0	3	1.5
7.	20GE1L1	Python Programming Laboratory	ES	4	0	0	4	2
8.	20GE1L2	Industrial Practices Workshop	ES	3	0	0	3	1.5
TOTAL								**21**

SEMESTER II

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	20HS201	Advanced Technical Communication (Common to all B.E./ B.Tech programmes)	HS	3	3	0	0	3
2.	20BS201	Laplace Transform and Advanced Calculus (Common to all B.E. / B.Tech programmes)	BS	4	3	1	0	4
3.	20BS202	Applied Physics	BS	3	3	0	0	3
4.	20GE201	Engineering Graphics (Common to all B.E./ B.Tech programmes)	ES	4	2	0	2	3
5.	20GE202	Engineering Mechanics	ES	4	3	1	0	4
6.	20GE203	Basic Electrical, Electronics and Instrumentation Engineering	ES	3	3	0	0	3
PRACTICAL								
7.	20HS2L1	Communication Skills Laboratory (Common to B.E Mech, B.E CSE, B.Tech IT & B.Tech AIDS programmes)	HS	2	0	0	2	1
8.	20GE2L1	Electrical, Electronics and Instrumentation Laboratory	ES	4	0	0	4	2
TOTAL								**23**

SEMESTER III

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	20BS301	Transforms and Partial Differential Equations (Common to B.E Mech & B.E. EEE programmes)	BS	4	3	1	0	4
2.	20ME301	Strength of Materials	PC	3	3	0	0	3
3.	20ME302	Fluid Mechanics and Machinery	PC	3	3	0	0	3
4.	20ME303	Manufacturing Processes	PC	3	3	0	0	3
5.	20ME304	Engineering Thermodynamics	PC	4	3	1	0	4
6.	20HS301	Universal Human Values (Common to all B.E./ B.Tech programmes)	HS	3	2	1	0	3
PRACTICAL								
7.	20ME3L1	Strength of Materials Laboratory	PC	3	0	0	3	1.5
8.	20ME3L2	Fluid Mechanics and Machinery Laboratory	PC	3	0	0	3	1.5
TOTAL								**23**

SEMESTER IV

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	20BS401	Statistics and Numerical Methods	BS	4	3	1	0	4
2.	20ME401	Kinematics of Machines	PC	4	3	1	0	4
3.	20ME402	Manufacturing Technology	PC	3	3	0	0	3
4.	20ME403	Thermal Engineering	PC	4	3	1	0	4
5.	20HS401	Environmental Science and Engineering (Common to all B.E / B.Tech programmes)	HS	2	2	0	0	2
THEORY CUM PRACTICAL								
6.	20ME404	Metrology and Measurement Practices	PC	5	3	0	2	4
PRACTICAL								
7.	20ME4L1	Manufacturing Technology Laboratory	PC	3	0	0	3	1.5
8.	20ME4L2	Thermal Engineering Laboratory	PC	3	0	0	3	1.5
TOTAL								**24**

SEMESTER V

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	20ME501	Design of Machine Elements	PC	4	3	1	0	4
2.	20ME506	Dynamics of Machines	PC	4	3	1	0	4
3.	20ME503	CAD / CAM	PC	3	3	0	0	3
4.	20ME507	Heat and Mass Transfer	PC	4	3	1	0	4
5.	20ME603	Lean Manufacturing	PC	3	3	0	0	3
6.		Professional Elective - I	PE	-	-	-	-	3
7.	20MC501	Constitution of India (Common to all B.E. / B.Tech programmes)	MC	1	1	0	0	-
PRACTICAL								
8.	20ME5L1	Dynamics Laboratory	PC	3	0	0	3	1.5
9.	20ME5L2	CAD / CAM Laboratory	PC	4	0	0	4	2
10.	20ME5L3	Heat and Mass Transfer Laboratory	PC	3	0	0	3	1.5
TOTAL								**26**

SEMESTER VI

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	20ME605	Design of Transmission Systems	PC	4	3	1	0	4
2.	20ME606	Finite Element Analysis	PC	4	3	1	0	4
3.		Open Elective - I	OE	3	3	0	0	3
4.		Management Elective	HS	3	3	0	0	3
5.		Professional Elective - II	PE	-	-	-	-	3
6.		Professional Elective – III	PE	-	-	-	-	3
PRACTICAL								
7.	20ME6L3	Computer Aided Simulation and Analysis Laboratory	PC	4	0	0	4	2
8.	20ME6L4	Design and Fabrication Project	EEC	4	0	0	4	2
TOTAL								**24**

SEMESTER VII

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	20ME701	Mechatronics	PC	3	3	0	0	3
2.		Open Elective – II	OE	3	3	0	0	3
3.		Professional Elective – IV	PE	-	-	-	-	3
4.		Professional Elective – V	PE	-	-	-	-	3
5.		Professional Elective – VI	PE	-	-	-	-	3
PRACTICAL								
6.	20ME7L1	Mechatronics Laboratory	PC	4	0	0	4	2
7.	20ME7L3	Technical Seminar	EEC	4	0	0	4	2
TOTAL								**19**

SEMESTER VIII

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
PRACTICAL								
1.	20ME8L1	Project Work	EEC	20	0	0	20	10
TOTAL								**10**

TOTAL NO. OF CREDITS: 170

PROFESSIONAL ELECTIVE (PE) : VERTICALS

Vertical I	Vertical II	Vertical III	Vertical IV	Vertical V	Vertical VI
Design and Development	**Modern Manufacturing**	**Clean Energy Technologies**	**Robotics and Automation**	**Industrial Engineering**	**Modern Mobility Systems**
Product Design and Development	Unconventional Machining Processes	Compressible Flow and Turbomachinery	Applied Hydraulics and Pneumatics	Statistical Quality and Control	Automobile Engineering
Product Life Cycle Management	Computer Integrated Manufacturing Systems	Power Plant Engineering	Industrial Robotics	Process Planning and Cost Estimation	Advanced Internal Combustion Engines
Design of Jigs, Fixtures and Press Tools	Composite Material and Mechanics	Engine Pollution and Control	Sensors and Actuators	Production Planning and Control	Two Wheeler and Four Wheeler Overhauling
Piping Design Engineering	Additive Manufacturing	Energy Conservation and Management	Automation in Manufacturing	Supply Chain and Logistic Management	Battery Technology
Computational Fluid Dynamics	Testing of Materials	Renewable Energy Sources	Virtual Instrumentation	Engineering Economics and Cost Analysis	Alternative Fuels for IC Engines
Innovation in Design	Digital Manufacturing	Fundamentals of HVAC Systems	Data Analytics for Mechanical Engineering	Maintenance Engineering	Intelligent Transportation System
		Energy Efficient Buildings	Micro Electro Mechanical Systems	Operations Research	

VERTICAL I : Design and Development

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20MEV11	Product Design and Development	PE	3	3	0	0	3
2.	20MEV21	Product Life Cycle Management	PE	3	3	0	0	3
3.	20MEV31	Design of Jigs, Fixtures and Press Tools	PE	3	3	0	0	3
4.	20MEV41	Piping Design Engineering	PE	3	3	0	0	3
5.	20MEV51	Computational Fluid Dynamics	PE	3	3	0	0	3
6.	20MEV61	Innovation in Design	PE	3	3	0	0	3

VERTICAL II : Modern Manufacturing

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20MEV12	Unconventional Machining Processes	PE	3	3	0	0	3
2.	20MEV22	Computer Integrated Manufacturing Systems	PE	3	3	0	0	3
3.	20MEV32	Composite Material and Mechanics	PE	3	3	0	0	3
4.	20MEV42	Additive Manufacturing	PE	3	3	0	0	3
5.	20MEV52	Testing of Materials	PE	3	3	0	0	3
6.	20MEV62	Digital Manufacturing	PE	3	3	0	0	3

VERTICAL III : Clean Energy Technologies

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20MEV13	Compressible Flow and Turbo machinery	PE	3	3	0	0	3
2.	20MEV23	Power Plant Engineering	PE	3	3	0	0	3
3.	20MEV33	Engine Pollution and Control	PE	3	3	0	0	3
4.	20MEV43	Energy Conservation and Management	PE	3	3	0	0	3
5.	20MEV53	Renewable Energy Sources	PE	3	3	0	0	3
6.	20MEV63	Fundamentals of HVAC Systems	PE	3	3	0	0	3
7.	20MEV73	Energy Efficient Buildings	PE	3	3	0	0	3

VERTICAL IV : Robotics and Automation

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20MEV14	Applied Hydraulics and Pneumatics	PE	3	3	0	0	3
2.	20MEV24	Industrial Robotics	PE	3	3	0	0	3
3.	20MEV34	Sensors and Actuators	PE	3	3	0	0	3
4.	20MEV44	Automation in Manufacturing	PE	3	3	0	0	3
5.	20MEV54	Virtual Instrumentation	PE	3	3	0	0	3
6.	20MEV64	Data Analytics for Mechanical Engineering	PE	3	3	0	0	3
7.	20MEV74	Micro Electro Mechanical Systems	PE	3	3	0	0	3

VERTICAL V : Industrial Engineering

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20MEV15	Statistical Quality and Control	PE	3	3	0	0	3
2.	20MEV25	Process Planning and Cost Estimation	PE	3	3	0	0	3
3.	20MEV35	Production Planning and Control	PE	3	3	0	0	3
4.	20MEV45	Supply Chain and Logistic Management	PE	3	3	0	0	3
5.	20MEV55	Engineering Economics and Cost Analysis	PE	3	3	0	0	3
6.	20MEV65	Maintenance Engineering	PE	3	3	0	0	3
7.	20MEV75	Operations Research	PE	3	3	0	0	3

VERTICAL VI : Modern Mobility Systems

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20MEV16	Automobile Engineering	PE	3	3	0	0	3
2.	20MEV26	Advanced Internal Combustion Engines	PE	3	3	0	0	3
3.	20MEV36	Two Wheeler and Four Wheeler Overhauling	PE	3	3	0	0	3
4.	20MEV46	Battery Technology	PE	3	3	0	0	3
5.	20MEV56	Alternative Fuels for IC Engines	PE	3	3	0	0	3
6.	20MEV66	Intelligent Transportation System	PE	3	3	0	0	3

OPEN ELECTIVE - I (OE - I)

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20OE201	Fundamentals of Renewable Energy System	OE	3	3	0	0	3
2.	20OE302	Microprocessor and Embedded Systems	OE	3	3	0	0	3
3.	20OE401	Fundamentals of Artificial Intelligence	OE	3	3	0	0	3
4.	20OE402	Introduction to Database Management Systems	OE	3	3	0	0	3
5.	20OE501	Principles of Software Testing	OE	3	3	0	0	3
6.	20OE502	Fundamentals of Web Technology	OE	3	3	0	0	3
7.	20OE503	Internet of Things and Applications	OE	3	3	0	0	3
8.	20OE601	Fundamentals of Electric Vehicles	OE	3	3	0	0	3
9.	20OE701	Biomedical Instrumentation and Measurements	OE	3	3	0	0	3
10.	20OE704	Instrumentation in Steel Industry	OE	3	3	0	0	3

OPEN ELECTIVE - II (OE - II)

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20OE205	Industrial Energy Auditing and Management	OE	3	3	0	0	3
2.	20OE305	Fundamentals of Image Processing	OE	3	3	0	0	3
3.	20OE405	Machine Learning Techniques	OE	3	3	0	0	3
4.	20OE407	Computer Graphics	OE	3	3	0	0	3
5.	20OE408	Essentials of Data Analytics	OE	3	3	0	0	3
6.	20OE507	Concepts of Ethical Hacking	OE	3	3	0	0	3
7.	20OE606	Modern Vehicle Technology	OE	3	3	0	0	3
8.	20OE607	New Generation Hybrid Vehicles	OE	3	3	0	0	3
9.	20OE608	Automotive Electrical and Electronics Systems	OE	3	3	0	0	3
10.	20OE708	Instrumentation for Agro Food Industry	OE	3	3	0	0	3

MANAGEMENT ELECTIVE

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	20HS5A1	Management Concepts and Organizational Behaviour	HS	3	3	0	0	3
2.	20HS5A2	Industrial Marketing	HS	3	3	0	0	3
3.	20HS6A1	Intellectual Property Rights	HS	3	3	0	0	3
4.	20HS6B1	Project Management and Entrepreneurship	HS	3	3	0	0	3
5.	20HS7A2	Total Quality Management	HS	3	3	0	0	3
6.	20HS8A1	Human Relations at Work	HS	3	3	0	0	3
7.	20HS8B2	Economics for Engineers	HS	3	3	0	0	3

OPEN ELECTIVE - I (VI SEMESTER) - offered to other Departments

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20OE101	Mechatronics and Applications	OE	3	3	0	0	3
2.	20OE102	Solid Free Form Manufacturing	OE	3	3	0	0	3
3.	20OE103	Refrigeration and Air Conditioning	OE	3	3	0	0	3
4.	20OE104	Production and Operations Management	OE	3	3	0	0	3

OPEN ELECTIVE - II (VII SEMESTER) - offered to other Departments

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20OE105	Solar Photovoltaic Fundamentals and Applications	OE	3	3	0	0	3
2.	20OE106	Fundamentals of Product Design	OE	3	3	0	0	3
3.	20OE107	Autonomous and Electric Vehicles	OE	3	3	0	0	3
4.	20OE108	Industrial Safety Practices	OE	3	3	0	0	3

HUMANITIES AND SOCIAL SCIENCES (HS)

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20HS101	English for Technical Communication	HS	3	3	0	0	3
2.	20HS201	Advanced Technical Communication	HS	3	3	0	0	3
3.	20HS2L1	Communication Skills Laboratory	HS	2	0	0	2	1
4.	20HS301	Universal Human Values	HS	3	2	1	0	3
5.	20HS401	Environmental Science and Engineering	HS	2	2	0	0	2
Total Credits (HS)								**12**

BASIC SCIENCES (BS)

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20BS101	Fundamentals of Engineering Mathematics	BS	4	3	1	0	4
2.	20BS102	Engineering Physics	BS	3	3	0	0	3
3.	20BS103	Engineering Chemistry	BS	3	3	0	0	3
4.	20BS1L1	Basic Science Laboratory	BS	3	0	0	3	1.5
5.	20BS201	Laplace Transform and Advanced Calculus	BS	4	3	1	0	4
6.	20BS202	Applied Physics	BS	3	3	0	0	3
7.	20BS301	Transforms and Partial Differential Equations	BS	4	3	1	0	4
8.	20BS401	Statistics and Numerical Methods	BS	4	3	1	0	4
Total Credits (BS)								**26.5**

PROFESSIONAL CORE (PC)

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20ME301	Strength of Materials	PC	3	3	0	0	3
2.	20ME302	Fluid Mechanics and Machinery	PC	3	3	0	0	3
3.	20ME303	Manufacturing Processes	PC	3	3	0	0	3
4.	20ME304	Engineering Thermodynamics	PC	4	3	1	0	4
5.	20ME3L1	Strength of Materials Laboratory	PC	3	0	0	3	1.5
6.	20ME3L2	Fluid Mechanics and Machinery Laboratory	PC	3	0	0	3	1.5
7.	20ME401	Kinematics of Machines	PC	4	3	1	0	4
8.	20ME402	Manufacturing Technology	PC	3	3	0	0	3
9.	20ME403	Thermal Engineering	PC	4	3	1	0	4
10.	20ME404	Metrology and Measurement Practices	PC	5	3	0	2	4
11.	20ME4L1	Manufacturing Technology Laboratory	PC	3	0	0	3	1.5
12.	20ME4L2	Thermal Engineering Laboratory	PC	3	0	0	3	1.5
13.	20ME501	Design of Machine Elements	PC	4	3	1	0	4
14.	20ME506	Dynamics of Machines	PC	4	3	1	0	4
15.	20ME503	CAD / CAM	PC	3	3	0	0	3
16.	20ME507	Heat and Mass Transfer	PC	4	3	1	0	4
17.	20ME603	Lean Manufacturing	PC	3	3	0	0	3
18.	20ME5L1	Dynamics Laboratory	PC	3	0	0	3	1.5
19.	20ME5L2	CAD / CAM Laboratory	PC	4	0	0	4	2
20.	20ME5L3	Heat and Mass Transfer Laboratory	PC	3	0	0	3	1.5
21.	20ME605	Design of Transmission Systems	PC	4	3	1	0	4
22.	20ME606	Finite Element Analysis	PC	4	3	1	0	4
23.	20ME6L3	Computer Aided Simulation and Analysis Laboratory	PC	4	0	0	4	2
24.	20ME701	Mechatronics	PC	3	3	0	0	3
25.	20ME7L1	Mechatronics Laboratory	PC	4	0	0	4	2
							Total Credits (PC)	**72**

ENGINEERING SCIENCES (ES)

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20GE101	Problem Solving using Python Programming	ES	3	3	0	0	3
2.	20GE1L1	Python Programming Laboratory	ES	4	0	0	4	2
3.	20GE1L2	Industrial Practices Workshop	ES	3	0	0	3	1.5
4.	20GE201	Engineering Graphics	ES	4	2	0	2	3
5.	20GE202	Engineering Mechanics	ES	4	3	1	0	4
6.	20GE203	Basic Electrical, Electronics and Instrumentation Engineering	ES	3	3	0	0	3
7.	20GE2L1	Electrical, Electronics and Instrumentation Laboratory	ES	4	0	0	4	2
							Total Credits (ES)	**18.5**

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20ME6L4	Design and Fabrication Project	EEC	4	0	0	4	2
2.	20ME7L3	Technical Seminar	EEC	4	0	0	4	2
3.	20ME8L1	Project Work	EEC	20	0	0	20	10
							Total Credits (EEC)	**14**

MANDATORY COURSES (MC)

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20MC501	Constitution of India	MC	1	1	0	0	-

SUMMARY

S.NO.	CATEGORY	NUMBER OF CREDITS									
		I SEM	II SEM	III SEM	IV SEM	V SEM	VI SEM	VII SEM	VIII SEM	Total Credits	Credit %
1.	Humanities and Social Sciences / Management Elective (HS)	3	4	3	2		3			15	8.82
2.	Basic Sciences (BS)	11.5	7	4	4					26.5	15.59
3.	Engineering Sciences (ES)	6.5	12							18.5	10.88
4.	Employability Enhancement Courses (EEC)						2	2	10	14	8.24
5.	Professional Core (PC)			16	18	23	10	5		72	42.35
6.	Professional Elective (PE)					3	6	9		18	10.59
7.	Open Elective (OE)						3	3		6	3.53
8.	Mandatory Courses (MC)					-				-	
Credits per Semester		21	23	23	24	26	24	19	10	170	
Credits per Year		44		47		50		29		170	
Total Credits		**170**									

I – SEMESTER

20HS101	ENGLISH FOR TECHNICAL COMMUNICATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- This course is designed for entry level Engineering and Technology curriculum enabling the students to learn, acquire and apply for their learning and career.
- The course is aimed at providing effective skills for promoting communication skills through English.
- Students will benefit in conversing with the peers, faculty and fellow professionals.
- The outcome of this course contains refined level of English proficiency by acquiring all four skills, listening, speaking, reading and writing to prepare them for global readiness.

PRE-REQUISITE: NIL

UNIT - I FOCUSING LANGUAGE DEVELOPMENT 9

Listening: Listening to TV News, Guest Lecturers, Note – taking. **Speaking**: Pronunciation Common Vocabulary – Technical Vocabulary – Answering Peer Questions – Conversation with Teacher. **Reading**: News magazines, Reading for unfamiliar words, Variety of News Items
Writing: Word formation – Auxiliary verbs – Modal Verbs – Sentence Types – Affirmative, Negative, Interrogative, Concord – Dialogue Writing, Letter to Principal / Director – Instructions using Auxiliary

UNIT - II GRAMMAR AND TECHNICAL READING 9

Listening: Listening to Peer Conversations – Brief Speeches – Listening for Specific Information – Recap of Speeches. **Speaking**: Wh Questions, Day today conversations, Telephonic enquiries official/formal enquiries. **Reading**: Technical Essays – Identifying Sentence Types – Classifying the verb patterns. **Writing**: Tenses – Simple Present, Present Progressive, Present Perfect, Present Perfect Continuous – Voice – Active & Passive – Précis Writing – Essay Writing

UNIT - III GRAMMAR AND LANGUAGE DEVELOPMENT 9

Listening: TV interviews, Commentaries, Digital Videos for World Information. **Speaking**: Telephonic Conversation – Classroom Activities – Conversing Information. **Reading**: Coherence, Development of Thoughts. **Writing**: Tenses – Simple Past, Past Progressive, Past Perfect, Past perfect continuous – Impersonal Passive-Narrating the past events, Letter to friend/father about Industrial Visit/Functions held – Narrating the past experience using Impersonal Passive voice

UNIT - IV READING AND LANGUAGE DEVELOPMENT 9

Listening: Listening to Dialects of English – British & American Regional. **Speaking**: Role Plays, Extempore, Responding to specific questions. **Reading**: Comprehensive passages, Reading for specific points. **Writing**: Tenses – Simple Future, Future progressive, Future Perfect, Future Perfect continuous – Definition – Phrases of Reason – Cause & Effect, Recommendations, Argumentative Essays, Letter to the Editor on Social Issues – Analytical Essays on Social hazards using Cause and Effect.

UNIT - V EXTENDED WRITING 9

Listening: Listening to Technical Seminar speeches – Listening to achievers, eminent personalities – Dialects – Australian – African – Asian. **Speaking**: Welcome address, Compeering, Vote of Thanks, Peer debates. **Reading**: Texts on self-confidence, motivation, success path. **Writing**: Contracted forms, Conditionals, Articles, Preposition, Tense – 'going

to' - Error Spotting, Sequence Words – Rearranging – Writing a Book Review – Summary writing – Rearranging Sentences using Sequence Words, Note Making

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Board of Editors. "Using English A Course book for Undergraduate Engineers and Technologists". Orient Black Swan Limited, Hyderabad: 2015
2. Richards, C. Jack. "Interchange Students' Book-2" New Delhi: CUP, 2015.

REFERENCES:

1. Murphy, Raymond "English Grammar in Use with Answers: Reference and Practice for Intermediate Students", Cambridge: CUP, 2004
2. Thomson, A.J. and Martinet, A.V. "A Practical English Grammar", OUP, New Delhi: 1986
   Anne Laws, "Writing Skills", Orient Black Swan, Hyderabad, 2011
3. Board of Editor, "English for Technical Communication", Great Mind Publication, Chennai : 2018

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: English for Technical Communication		**Course Code : 20HS101**			
CO	**Course Outcomes**	**Unit**	**K–CO**	**POs**	**PSOs**
C102.1	Listen, Comprehend and Correspond with others at various contexts	I – V	AD	9,10,12	3
C102.2	Speak legibly and fluently under various life-time situations by applying proper communication modules	I – V	AD	9,10,12	3
C102.3	Read and understand a variety of writings and technical text by analyzing the meaning and language	I – V	AD	9,10,12	3
C102.4	Apply clear and legible writing skills in error free style in coherent manner	I – V	AD	9,10,12	3
C102.5	Remember and use various communicative skills in precise and efficient way on technological contexts	I – V	AD	9,10,12	3
C102.6	Form situational conversations and technical writing styles for interpersonal and effective communication	I – V	AD	9,10,12	3

CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C102.1	-	-	-	-	-	-	-	-	3	3	-	2	-	-	3
C102.2	-	-	-	-	-	-	-	-	3	3	-	2	-	-	3
C102.3	-	-	-	-	-	-	-	-	2	3	-	2	-	-	3
C102.4	-	-	-	-	-	-	-	-	2	3	-	2	-	-	3
C102.5	-	-	-	-	-	-	-	-	3	3	-	2	-	-	3
C102.6	-	-	-	-	-	-	-	-	3	3	-	2	-	-	3

20BS101 FUNDAMENTALS OF ENGINEERING MATHEMATICS	L	T	P	C
	3	1	0	4

OBJECTIVES:

- To relate various methods of Matrix Algebra to handle practical problems arising in the field of engineering.
- The main aim of this course is to achieve conceptual understanding and to retain the best traditions of Calculus.
- The syllabus is designed to provide the basic tools of Calculus of Single and Multivariable, mainly for the purpose of modeling the engineering problems mathematically and obtaining solutions.

PRE-REQUISITE: NIL

UNIT - I MATRICES 12

Introduction to Matrices-Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley-Hamilton Theorem – Diagonalization of matrices – Reduction of a Quadratic form to Canonical form by Orthogonal transformation – Nature of Quadratic forms.

UNIT - II DIFFERENTIAL CALCULUS 12

Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules - Differentiation of Polynomials, Exponential, Trigonometric, Hyperbolic, Logarithmic and Implicit functions- Maxima and Minima of functions of single variable.

UNIT – III FUNCTIONS OF SEVERAL VARIABLES 12

Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Maxima and Minima of functions of two variables – Lagrange's method of undetermined multipliers.

UNIT – IV INTEGRAL CALCULUS 12

Definite and Indefinite integrals - Substitution rule - Techniques of integration - Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions, Improper integrals.

UNIT – V ORDINARY DIFFERENTIAL EQUATIONS 12

Higher order linear differential equations with constant coefficients - Method of variation of parameters – Homogenous equation of Euler's and Legendre's type – System of simultaneous linear differential equations with constant coefficients.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2017.

2. T. Veerarajan., “Engineering Mathematics”, The Tata Mc Graw Hill Publication-New Delhi, First Edition, 2018

REFERENCES:

1. James Stewart, “Calculus, Early Transcendental”, Cengage Learning, 7th Edition, New Delhi, 2015. .
2. 2. Kreyszig Erwin, “Advanced Engineering Mathematics”, John Wiley and Sons, 9th Edition, New Delhi, 2006.
3. Wiley, “Calculus- International Student version”, 10th Edition, Wiley India Pvt. Ltd, New Delhi 2017.
4. Jain R.K. and Iyengar S.R.K., “Advanced Engineering Mathematics”, Narosa Publications, New Delhi, 5th Edition, 2016.
5. Bali N., Goyal M. and Watkins C., “Advanced Engineering Mathematics”, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 9th Edition, 2014.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: FUNDAMENTALS OF ENGINEERING MATHEMATICS		**Course Code : 20BS101**			
CO	**Course Outcomes**	**Unit**	**K–CO**	**POs**	**PSOs**
C102.1	Determine the Eigen values, Eigen vectors to diagonalize a matrix and reduce quadratic form to canonical form.	I	K3	1,2,3, 8,9	1
C102.2	Apply the concept of limits, continuity, rules of differentiation, techniques of differentiation to differentiate standard functions.	II	K3	1,2,3, 8,9	1
C102.3	Apply the concepts of Concavity, Convexity to determine the critical points, point of Inflection, Maxima and Minima of Single variable functions.	II	K3	1,2,3, 8,9	1
C102.4	Compute the derivatives of functions of two variables and apply them to calculate the maxima and minima.	III	K3	1,2,3, 8,9	1
C102.5	Determine integrals using techniques of integration, such as substitution, partial fractions and integration by parts.	IV	K3	1,2,3, 8,9	1
C102.6	Apply various techniques to solve higher order differential equations with constant and variable Coefficients.	V	K3	1,2,3, 8,9	1

CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C102.1	3	2	1	-	-	-	-	1	1	-	-	-	2	-	-
C102.2	3	2	1	-	-	-	-	1	1	-	-	-	2	-	-
C102.3	3	2	1	-	-	-	-	1	1	-	-	-	2	-	-
C102.4	3	2	1	-	-	-	-	1	1	-	-	-	2	-	-
C102.5	3	2	1	-	-	-	-	1	1	-	-	-	2	-	-
C102.6	3	2	1	-	-	-	-	1	1	-	-	-	2	-	-

20BS102	ENGINEERING PHYSICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To inculcate the fundamental knowledge in properties of matter and crystal physics.
- To enrich the knowledge on Laser, fiber optics and ultrasonics and their applications relevant to various streams of Engineering and Technology.
- To introduce quantum physics and its applications.

PRE-REQUISITE: NIL

UNIT - I PROPERTIES OF MATTER **9**

Elasticity – Hooke's Law – Stress-strain diagram and its uses – Three modulus of elasticity (qualitative) – Poisson's ratio – factors affecting elastic modulus and tensile strength – twisting couple – torsional pendulum: theory and experiment – bending of beams – bending moment – cantilever: theory and experiment – uniform and non-uniform bending: theory and experiment – **I** -shaped girders.

UNIT - II LASER AND FIBER OPTICS **9**

Lasers: Interaction of radiation with atomic energy states – Einstein's A and B coefficients derivation – Population inversion – resonant cavity, optical amplification (qualitative) – solid state lasers – Nd:YAG laser, Semiconductor lasers: homojunction and heterojunction – Fiber optics: principle, numerical aperture and acceptance angle – types of optical fibers (material, refractive index, mode) – losses associated with optical fibers – fiber optic sensors: pressure and displacement sensor.

UNIT - III ULTRASONICS **9**

Ultrasonics – classification (qualitative) – properties – generation – magnetostriction and piezoelectric methods – detection of ultrasound – cavitations – velocity measurement – acoustic grating – Industrial applications (Drilling, Welding, Soldering and Cleaning) – SONAR – NDT – Pulse Echo system through Transmission and Reflection modes – A, B and C scan displays - Medical application – sonogram.

UNIT - IV QUANTUM PHYSICS **9**

Black body radiation – Planck's theory (derivation) – Compton effect: theory and experimental verification – wave particle duality – wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent equations – particle in a one-dimensional rigid box – tunneling (qualitative) – scanning tunneling microscope.

UNIT - V CRYSTAL PHYSICS **9**

Crystalline and amorphous materials – unit cell, crystal systems, Bravais lattices, lattice planes - Miller indices – Inter planar spacing in cubic lattice – coordination number and packing factor for SC, BCC, FCC, HCP structures – growth of single crystals: solution and melt growth techniques – Mechanisms of plastic deformation, slip and twinning.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. R. K. Gaur and S. L. Gupta, “Engineering Physics”, Dhanpat Rai Publications, 2012.
2. B. K. Pandey and S. Chaturvedi, “Engineering Physics”, Cengage Learning India, 2018.
3. V.Rajendran, “Engineering Physics”, Tata McGraw Hill Education Private Limited, 2011.

REFERENCES:

1. D.Halliday, R. Resnick and J. Walker, “Principles of Physics”, Wiley publisher, 10th Edition, 2015.
2. R.A.Serway and J.W. Jewett, “Physics for Scientists and Engineers”, Cengage Learning, 2014.
3. P.A.Tipler and G. Mosca, “Physics for Scientists and Engineers with Modern Physics”, W.H.Freeman, 2007.
4. D.K.Bhattacharya and T. Poonam, “Engineering Physics”, Oxford University Press, 2017.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: ENGINEERING PHYSICS		**Course Code : 20BS102**			
CO	**Course Outcomes**	**Unit**	**K–CO**	**POs**	**PSOs**
C103.1	Demonstrate the properties of elasticity and measure the different moduli of elasticity	I	K3	1,2,3	1
C103.2	Discuss the characteristics of laser and optical fiber	II	K2	1,2,3	1
C103.3	Explain the concepts of ultrasonics in engineering	III	K2	1,2,8, 9,10	1
C103.4	Explain black body radiation, properties of matter waves and Schrodinger equation	IV	K2	1,2,8, 9,10	1
C103.5	Classify the Bravais lattices and different types of crystal structures	V	K3	1,2,3	1
C103.6	Summarize the informations on growth of crystals and deformations	V	K2	1,2,8, 9,10	1

CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C103.1	3	2	1	-	-	-	-	-	-	-	-	-	1	-	-
C103.2	2	1	-	-	-	-	-	1	1	1	-	-	1	-	-
C103.3	2	1	-	-	-	-	-	1	1	1	-	-	1	-	-
C103.4	2	1	-	-	-	-	-	1	1	1	-	-	1	-	-
C103.5	3	2	1	-	-	-	-	-	-	-	-	-	1	-	-
C103.6	2	1	-	-	-	-	-	1	1	1	-	-	1	-	-

20BS103	ENGINEERING CHEMISTRY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To make the students, familiar with boiler feed water requirements, related problems and water treatment techniques.
- To learn the principle of electrochemical cell, types of corrosion and its control.
- To develop an understanding of the basic concepts of phase rule and its applications to one and two component systems and appreciate the purpose and significance of alloys.
- To be familiar with different types of fuel and their characteristics and also functioning of energy storage devices.
- To understand the techniques of spectra and chromatography for analytical purpose.

PRE-REQUISITE: NIL

UNIT – I WATER AND ITS TREATMENT **9**

Characteristics of water; Hard water, Soft water, difference; Hardness – types of hardness, expression of hardness, units, removal of hardness (boiling, soda lime process), estimation of hardness of water by EDTA method (problems); Boiler feed water – requirements – disadvantages of using hard water in boilers (scale and sludge, priming and foaming, caustic embrittlement, boiler corrosion); Treatment of boiler feed water – internal treatment (carbonate, phosphate, and calgon conditioning) external treatment – ion exchange process, zeolite process**;** Purification of water - reverse osmosis, electro dialysis, Application of nanomaterials in water purification.

UNIT – II ELECTROCHEMISTRY AND CORROSION **9**

Electrochemical cell - redox reaction, electrode potential- origin of electrode potential- oxidation potential- reduction potential, - electrochemical series and its significance - Nernst equation (derivation and problems).

Corrosion- causes- factors, electrochemical corrosion (galvanic, differential aeration), corrosion control - material selection and design aspects - electrochemical protection – sacrificial anode method and impressed current cathodic method **–** corrosion inhibitors. Metallic coating – Electroplating – Factors - Electroplating of Copper and Electroless plating of Nickel.

UNIT – III PHASE RULE AND ALLOYS **9**

Phase rule - introduction, definition of terms with examples; One component system - water system; Reduced phase rule - two component system, classification, lead-silver system; Alloys – introduction, definition, properties of alloys, significance of alloying; Functions and effects of alloying elements; Heat treatment of steel - annealing, hardening, tempering, carburizing, nitriding; Ferrous alloys- nichrome and stainless steel (18/8); Non-ferrous alloys – brass and bronze.

UNIT - IV FUELS AND BATTERIES **9**

Fuels – classification, characteristics; Petrol – characteristics, knocking, octane number; Diesel – characteristics, cetane number; Natural gas (CNG), LPG, Power alcohol, Biodiesel, Gasohol; Combustion of fuels – calorific value, GCV and NCV (Problems),calculation of theoretical air for combustion (Problems), Ignition temperature, explosive range, flue gas analysis (Orsat apparatus); Batteries – primary and secondary batteries, lead-acid battery, lithium ion battery, Fuel cell (hydrogen oxygen fuel cell).

UNIT - V ANALYTICAL TECHNIQUES **9**

Spectroscopic techniques – UV-visible(Principle and Instrumentation – Block Diagram only

and applications), IR(Principle and Instrumentation – Block Diagram only and applications), ^{1}H NMR ((Principle and Instrumentation – Block Diagram only) – Chromatography – HPLC - Flame photometry – Estimation of sodium by Flame photometry.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. P.C. Jain and Monika Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company (P) LTD, New Delhi, 2017
2. S.S Dara and S.S Umare, "A Text Book of Engineering Chemistry", S.Chand & Company Limited, 20th Edition, 2018.

REFERENCES:

1. Shashi Chawla, "A Textbook of Engineering Chemistry", Dhanpat Rai & CO. (PVT) LTD, New Delhi, 2012.
2. B.R. Puri, L.R. Sharma, M.S. Pathania, Vishal, "Principles of Physical Chemistry", Vishal Publishing Co., Punjab, 47th Edition, 2017.
3. G Palanna, "Engineering Chemistry", McGraw Hill Education (India) PVT, LTD, Chennai, 2017.
4. Dr. Sunita Rattan, "A Textbook of Engineering Chemistry", S.K.Kataria & Sons, New Delhi, 2012

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: ENGINEERING CHEMISTRY														**Course Code : 20BS103**		
CO	**Course Outcomes**													**Unit**	**K–CO**	**POs**	**PSOs**
C104.1	Determine the hardness of water and explain the water treatment methods.													I	K2	1,2, 6,7	1
C104.2	Apply Nernst equation to determine the EMF of the cell and explain various corrosion control methods.													II	K3	1,2,3, 6,7	1
C104.3	Describe the phase diagram of one component and two component system and various methods of heat treatment of steel.													III	K2	1,2	1
C104.4	Classify the various types of fuels by their characteristics and explain the flue gas analysis by or sat method.													IV	K2	1,2, 6,7	1
C104.5	Illustrate the working of Lead acid battery, lithium ion battery and fuel cell.													IV	K2	1,2, 6,7	1
C104.6	Describe the instrumentation and working of UV, IR, 1HNMR, HPLC and flame photometry.													V	K2	1,2	1
CO-PO Mapping																	
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**		
C104.1	2	2	-	-	-	1	1	-	-	-	-	-	1	-	-		
C104.2	3	2	1	-	-	1	1	-	-	-	-	-	1	-	-		
C104.3	2	1	-	-	-	-	-	-	-	-	-	-	1	-	-		
C104.4	2	1	-	-	-	1	1	-	-	-	-	-	1	-	-		
C104.5	2	1	-	-	-	1	1	-	-	-	-	-	1	-	-		

C104.6	2	1	-	-	-	-	-	-	-	-	-	-	1	-	-

20GE101 PROBLEM SOLVING USING PYTHON PROGRAMMING

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

OBJECTIVES:

- To know the basics of Computers and algorithmic problem solving
- To understand Python programs with conditional and looping constructs.
- To define Python functions and strings.
- To use Python data structures – lists, tuples, sets and dictionaries.
- To do input/output with files in Python.

PRE-REQUISITE: NIL

UNIT - I COMPUTER FUNDAMENTALS AND PROBLEM SOLVING 9

Introduction to Computer System – Block Diagram of Computer, Types of Memory, I/O Devices, Application Programs, System Programs – Loader, linker, assembler, compiler, interpreter, Programming process – source code to executable code, Problem Solving Strategies – Problem analysis, Algorithms, Flow Charts, Pseudo Code. Illustrative problems: odd or even number, Leap year, Biggest of three numbers, square root of a number, Sum of n numbers, Armstrong number, Palindrome, Fibonacci Series, Prime number, Bubble Sort and Linear Search.

UNIT - II DATA, EXPRESSIONS, CONTROL FLOW STATEMENTS 9

Python interpreter and interactive mode, values and types – int, float, boolean, string, and list, variables, expressions, statements, tuple assignment, operators and precedence of operators, comments, Control Flow Statements – Conditionals – conditional (if), alternative (if-else), chained conditional (if-elif-else), Iteration – state, while, for, break, continue, pass, Illustrative programs – exchange the values with and without using temporary variables, circulate the values of n variables, distance between two points.

UNIT - III FUNCTIONS, STRINGS 9

Functions – function definition and use, flow of execution, parameters and arguments, function composition, Fruitful functions – return values, parameters, local and global scope, recursion, Strings – string slices, immutability, string functions and methods, string module, Illustrative programs – square root, GCD, exponentiation, Factorial of a number, linear search, binary search.

UNIT - IV LISTS, TUPLES, SETS, DICTIONARIES 9

Lists – list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters, Lists as arrays, Tuples – tuple assignment, tuple as return value, Sets - Creating a set, Modifying a set, Removing elements from a set, Set operations- Set Union, Set intersection, Set difference, Set membership test, Iterating through a set, Set methods, Built-in functions with set, Frozenset - Dictionaries – operations and methods, Advanced list processing –List comprehension, Illustrative programs – selection sort, insertion sort, Matrix addition and subtraction, sum an array of numbers.

UNIT – V 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 – Math and Rand, Illustrative programs – word count, copy file, merge two files.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. E. Balagurusamy, “Problem solving and Python Programming”, First edition, McGraw Hill Education (India) Private Limited, 2017.
2. Allen B. Downey, “Think Python: How to Think Like a Computer Scientist”, 2nd edition, Updated for Python 3, Shroff/O‘Reilly Publishers, 2016

(http://greenteapress.com/wp/think-python/)

REFERENCES:

1. Yashavant Kanetkar, Aditya Kanetkar, "Let Us Python", 2nd Edition, BPB Publications, 2020.
2. John V Guttag, "Introduction to Computation and Programming Using Python: With Application to Understanding Data", 2nd Edition, PHI Publisher, 2017.
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. Paul Gries, Jennifer Campbell and Jason Montojo, "Practical Programming: An Introduction to Computer Science using Python 3.6", 3rd edition, Shroff/O' Reilly Publishers, 2018.
6. Dr. A. Kannan, Dr. L. Sai Ramesh, "Problem Solving and Python Programming", Updated Edition, United Global Publishers Pvt. Ltd., April 2018.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: PROBLEM SOLVING USING PYTHON PROGRAMMING		**Course Code : 20GE101**			
CO	**Course Outcomes**	**Unit**	**K–CO**	**POs**	**PSOs**
C105.1	Explain Components of a Computer System, types of programming languages, types of software with examples and purpose.	I	K3	1,2	1,2
C105.2	Perform problem analysis, use algorithms and prepare flow charts, pseudo code for solving simple problems.	I	K3	1,2	1,2
C105.3	Use Conditional, iteration constructs of python programming and apply to solve simple problems	II	K3	1,2,3	1,2
C105.4	Use Functions, recursive function, String functions in python programming and apply to perform linear and binary search	III	K3	1,2,3	1,2
C105.5	Explain the various operations for manipulating Tuples, Dictionaries and Use List toper form simple and sorting operations	IV	K3	1,2,3	1,2
C105.6	Explain file handling operations, exception handling, modules and packages and illustrate programs for word count, file copy, merge operations and exception handling.	V	K3	1,2,3	1,2

CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C105.1	2	1	-	-	-	-	-	-	-	-	-	-	2	1	-
C105.2	2	1	-	-	-	-	-	-	-	-	-	-	2	1	-
C105.3	3	2	1	-	-	-	-	-	-	-	-	-	2	1	-
C105.4	3	2	1	-	-	-	-	-	-	-	-	-	2	1	-
C105.5	3	2	1	-	-	-	-	-	-	-	-	-	2	1	-

C105.6	3	2	1	-	-	-	-	-	-	-	-	-	2	1	-

20BS1L1	BASIC SCIENCE LABORATORY	L	T	P	C
		0	0	3	1.5

PHYSICS LABORATORY

OBJECTIVES:

- To introduce different experiments to test basic understanding of physics concepts applied in Optics, properties of matter and liquids.

PRE-REQUISITE: NIL

LIST OF EXPERIMENTS

(Any five to be carried out & one demonstration experiment)

1.	Determination of Rigidity modulus – Torsional Pendulum.
2.	Determination of Young's modulus – Non Uniform Bending.
3.	a. Determination of wavelength and particle size using diode laser.
	b. Determination of acceptance angle in an optical fiber.
4.	Determination of velocity of sound and compressibility of liquid using ultrasonic interferometer.
5.	Determination of band gap of a semiconductor diode.
6.	Determination of thickness of a thin wire – Air wedge method
7.	Determination of dispersive power of a prism – Spectrometer*
8.	Determination of wavelength of mercury spectrum – Spectrometer grating *Demonstration experiment

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No.	NAME OF THE EQUIPMENT	Qty.
1.	Torsional pendulum set	6
2.	Travelling microscope & accessories	6
3.	Laser kit	6
4.	Ultrasonic interferometer	6
5.	Semiconductor band gap kit	6
6.	Air wedge set up	6
7.	Spectrometer & prism	6
8.	Spectrometer & Grating	6

CHEMISTRY LABORATORY

OBJECTIVES:

- To make the students to acquire practical skill in the determination of water quality parameters through volumetric analysis.
- To have hands on experience in using instruments like pH meter, conductivity meter, potentiometer.
- To acquaint the students with the determination of molecular weight of polymer by viscometer.

PRE-REQUISITE: NIL

Any Five experiments to be given

1.	Determination of total, temporary & permanent hardness of water by EDTA method.
2.	Determination of alkalinity in water sample.
3.	Determination of dissolved oxygen content of water sample by Winkler's method.
4.	Determination of strength of given hydrochloric acid using pH meter.
5.	Estimation of iron content of the given solution using potentiometer.
6.	Conductometric titration of a strong acid Vs a strong base.
7.	Determination of strength of acids in a mixture of acids using conductivity meter.
8.	Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.
9.	Corrosion Experiment – Weight Loss Method.
10.	Estimation of sodium present in water using flame photometer.

TOTAL(Physics & Chemistry): 45 PERIODS

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: BASIC SCIENCE LABORATORY												Course Code : 20BS1L1			
CO	**Course Outcomes**											**Unit**	**K–CO**	**POs**	**PSOs**
PHYSICS															
C106.1	Calculate rigidity modulus and Young's modulus of a given material.											1,2	K3	1,2,3,8, 9,10	1
C106.2	Examine the size of a given particle, parameters of optical fiber and compute the thickness of a given thin wire.											3,6	K3	1,2,3,8, 9,10	1
C106.3	Calculate the velocity of ultrasound, compressibility of a given liquid and band gap of a given semiconductor diode.											4,5	K3	1,2,3,8, 9,10	1
C106.4	Predict dispersive power of prism and wavelength of mercury spectrum.											7,8	K2	1,2,8, 9,10	1
CHEMISTRY															
C106.5	Estimate the Chemical quality parameter of a water sample.											1,2,3	K3	1,2,3,8, 9,10	1
C106.6	Estimate the strength of acid by conductometric and pH metric titration.											4,6,7	K3	1,2,3,8, 9,10	1
C106.7	Estimate the amount of iron content in a given solution using potentiometer and the amount of sodium in water using flame photometer.											5,10	K3	1,2,3,8, 9,10	1
C106.8	Determine the molecular weight of polyvinyl alcohol using Ostwald viscometer and rate of corrosion by weight loss method. (Demo)											8,9	K2	1,2	1
CO-PO Mapping															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
PHYSICS															
C106.1	3	2	1	-	-	-	-	1	1	1	-	-	1	-	-
C106.2	3	2	1	-	-	-	-	1	1	1	-	-	1	-	-
C106.3	3	2	1	-	-	-	-	1	1	1	-	-	1	-	-
C106.4	2	1	-	-	-	-	-	1	1	1	-	-	1	-	-
CHEMISTRY															
C106.5	3	2	1	-	-	-	-	1	1	1	-	-	1	-	-
C106.6	3	2	1	-	-	-	-	1	1	1	-	-	1	-	-
C106.7	3	2	1	-	-	-	-	1	1	1	-	-	1	-	-
C106.8	2	1	-	-	-	-	-	-	-	-	-	-	1	-	-

20GE1L1 PYTHON PROGRAMMING LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES:

- To write, test, and debug simple Python programs using conditional statements.
- To implement Python programs using loops.
- To use functions for structuring Python programs.
- To implement Python programs using lists.
- To write Python programs for implementing file operations.

PRE-REQUISITE: NIL

LIST OF PROGRAMS

1.	Biggest of three numbers, odd or even number, Leap year.
2.	GCD, Armstrong Number, Palindrome, Fibonacci Series, Prime number
3.	Find the square root and exponentiation of a number with and without built-in functions
4.	Linear search and Binary search using Recursion.
5.	Find the maximum of a list of numbers
6.	Selection sort, Insertion sort
7.	First n prime numbers
8.	Transpose of a Matrix
9.	Multiply matrices
10.	Programs that take command line arguments (word count)
11.	Find the most frequent words in a text read from a file
12.	Merge two files

PLATFORM NEEDED: Python 3 interpreter for Windows/Linux

TOTAL: 60 PERIODS

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: PYTHON PROGRAMMING LABORATORY		**Course Code : 20GE1L1**			
CO	**Course Outcomes**	**Unit**	**K–CO**	**POs**	**PSOs**
C107.1	Develop simple Python programs using conditional and iterative constructs	1,2,7	K3	1,2,3,5	1,2
C107.2	Develop simple Python programs using built-in functions and user-defined functions	3	K3	1,2,3,5	1,2
C107.3	Develop a Python program using recursion to implement linear and binary search	4	K3	1,2,3,5	1,2
C107.4	Develop a Python program using list to implement selection and insertion sort	5,6	K3	1,2,3,5	1,2
C107.5	Develop Python programs to implement matrix operations	8,9	K3	1,2,3,5	1,2
C107.6	Develop a Python program to implement file handling	10,11,12	K3	1,2,3,5	1,2

CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C107.1	3	2	1	-	1	-	-	-	-	-	-	-	2	1	-
C107.2	3	2	1	-	1	-	-	-	-	-	-	-	2	1	-
C107.3	3	2	1	-	1	-	-	-	-	-	-	-	2	1	-
C107.4	3	2	1	-	1	-	-	-	-	-	-	-	2	1	-
C107.5	3	2	1	-	1	-	-	-	-	-	-	-	2	1	-
C107.6	3	2	1	-	1	-	-	-	-	-	-	-	2	1	-

20GE1L2	INDUSTRIAL PRACTICES WORKSHOP	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To provide exposure to the students with Hands on Experience on various Basic Industrial Practices in Civil, Mechanical, Electrical and Electronics Engineering.

PRE-REQUISITE: NIL

GROUP A (CIVIL & MECHANICAL)
LIST OF EXPERIMENTS

I. CIVIL ENGINEERING PRACTICE

UNIT - I CARPENTRY PRACTICE

1. Study of carpentry tools.
2. Preparation of Cross lap joint
3. Preparation of Dovetail joint
4. Preparation of T joint

UNIT - II PLUMBING PRACTICE

1. Study of plumbing tools, pipeline joints, its location and functions: valves, taps, couplings, unions, reducers and elbows in household fittings.
2. Exercise on Preparation of plumbing line sketches for water supply and sewage works.
3. Exercise on providing of basic water line connection for a residential house using plumbing components.
4. Exercise on providing Water line pipe connections for household utilities like water heater, wash basin etc.,

II. MECHANICAL ENGINEERING PRACTICE

UNIT - III SHEET METAL PRACTICE

1. Study of sheet metal forming tools.
2. Preparation of a Model of rectangular tray.
3. Preparation of a Model of Conical Funnel.

UNIT - IV MACHINING PRACTICE

1. Study of machining tools.
2. Exercise on Simple turning, Facing, Chamfering
3. Exercise on Taper turning.
4. Exercise on Drilling and Tapping.

UNIT – V METAL JOINING PROCESS

1. Study of welding tools.
2. Exercise to join two metal plates by single butt joint using arc welding.
3. Exercise to join two metal plates by T Fillet joint using arc welding.
4. Exercise to join two metal plates by lap joint using arc welding.

DEMONSTRATION

1. Gas welding process.
2. Refrigeration and Air conditioning process.

GROUP B (ELECTRICAL & ELECTRONICS)

LIST OF EXPERIMENTS

I. ELECTRICAL ENGINEERING PRACTICE

1.	Residential house wiring using switches, fuse, indicator, Fluorescent lamp and Energy Meter.
2.	Measurement of Power consumption for CFL, Fluorescent Lamp, LED Lamp and Incandescent lamp.
3.	Stair case wiring
4.	Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5.	Measurement of energy using single phase energy meter.
6.	Measurement of resistance to earth of an electrical equipment.

II. ELECTRONICS ENGINEERING PRACTICE

1.	Study of Electronic components – Resistor colour coding, Capacitor, Inductor- Measurement using LCR meter, Transistor & Diode – Terminal identification using Multimeter.
2.	Study of logic gates AND, OR, EX-OR and NOT.
3.	Measurement of AC signal parameter (peak-peak, rms value, period & frequency) using CRO and AFO.
4.	Soldering practice – Components Devices and Circuits – Using general purpose PCB.
5.	Measurement of ripple factor of HWR and FWR.

TOTAL: 45 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

CIVIL

S. No	Component Name	No. of Components
1.	Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, coupling, unions, elbows, plugs and other fittings	15 Sets
2.	Carpentry Vice (fitted to work bench)	15 Nos
3.	Standard wood working tools	15 Sets
4.	Models of industrial trusses, door joints, furniture joints	5 Each
5.	Power Tools a. Rotary Hammer b. Demolition Hammer c. Circular Saw d. Planer e. Hand Drilling Machine f. Jigsaw	 2 Nos 2 Nos 2 Nos 2 Nos 2 Nos 2 Nos
MECHANICAL		
1.	Arc welding transformer with cables and holders	5 Nos
2.	Welding booth with exhaust facility	5 Nos
3.	Welding accessories like welding shield, chipping hammer, wire brush, etc.	5 Sets
4.	Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.	2 Nos
5.	Centre Lathe	2 Nos
6.	Power Tool: Angle Grinder	2 Nos
7.	Study purpose items: Refrigerator and Air Conditioner	One Each
ELECTRICAL		
1.	Assorted electrical components for house wiring	10 Sets
2.	Electrical measuring instruments	10 Sets
3.	Study purpose items: Iron box, fan and regulator, emergency lamp	1 Each
4.	Megger (250V/500V)	1 No.
5.	Power Tools a. Range Finder b. Digital Live-wire detector	 2 Nos 2 Nos
ELECTRONICS		
1.	Soldering guns	10 Nos
2.	Assorted electronic components for making circuits	50 Nos
3.	Small PCBs	10 Nos
4.	Multimeters	10 Nos
5.	Regulated of power supply, CRO	1 No. Each

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: INDUSTRIAL PRACTICES WORKSHOP		Course Code : 20GE1L2			
CO	**Course Outcomes**	**Unit**	**K–CO**	**POs**	**PSOs**
GROUP A (CIVIL & MECHANICAL)					
C108.1	Prepare different carpentry joints and pipe connections with different joints.	I,II	K3	1,2,3,4	-
C108.2	Make the models using sheet metal.	III	K3	1,2,3,4	-
C108.3	Carry out the basic machining operations.	IV	K3	1,2,3,4	-
C108.4	Prepare arc welded joints using welding equipment	V	K3	1,2,3,4	-
GROUP B (ELECTRICAL & ELECTRONICS)					
C108.5	Demonstrate wiring for a simple residential house; identify the ratings of tube lamp, and calculate the different Electrical quantities	I	K3	1,2,3,4, 7,9,10	-
C108.6	Measure the electronics equipment using LCR meter, Transistor & Diode – Terminal identification using Multimeter.	II	K3	1,2,3,4 ,7,9,10	**-**
C108.7	Experimentally analyze AC signal parameters using CRO and AFO and to verify the Truth tables of Logic gates.	II	K3	1,2,3,4, 7,9,10	-
C108.8	Experimentally to design a Simple circuit using soldering in a PCB, measure ripple factor of Half Wave Rectifier and Full Wave Rectifier.	II	K3	1,2,3,4, 7,9,10	-

CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
GROUP A (CIVIL & MECHANICAL)															
C108.1	3	1	1	1	-	-	-	-	**-**	**-**	-	-	-	-	-
C108.2	3	1	1	1	-	-	-	-	-	-	-	-	-	-	-
C108.3	3	1	1	1	-	-	-	-	-	-	-	-	-	-	-
C108.4	3	2	1	1	-	-	-	-	-	-	-	-	-	-	-
GROUP B (ELECTRICAL & ELECTRONICS)															
C108.5	3	2	1	1	-	-	2	-	2	2	-	-	-	-	-
C108.6	3	2	1	1	-	-	2	-	2	2	-	-	-	-	-
C108.7	3	2	1	1	-	-	2	-	2	2	-	-	-	-	-
C108.8	3	2	1	1	-	-	2	-	2	2	-	-	-	-	-

II – SEMESTER

20HS201	ADVANCED TECHNICAL COMMUNICATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- This course is designed for Engineering and Technology curriculum enabling the students to learn, acquire and apply updated elements of English communication.
- The course is aimed at providing effective skills for procuring communication skills for business and advanced technology.
- Students will benefit by learning the four skills – Listening, Speaking, Reading and Writing – to meet the global requirements for their career and higher studies.

PRE-REQUISITE: NIL

UNIT - I TECHNICAL WRITING 9

Listening: Listening to audio-visuals on personal Interviews, Speeches from Company CEOs, TV Debates. **Speaking**: Wishing, Greeting, Enquiring Hobbies. **Reading**: Editorials, Letter to the Editor Columns, Technical Papers. **Writing**: Analytical writings, Emphasis Techniques, Letter Writing – Business Correspondence, Abstract Writing, Common Errors, Footnotes, Compound words, Preparation of Agenda

UNIT - II BUSINESS ENGLISH AND LANGUAGE DEVELOPMENT 9

Listening: Listening to Audio-Visual documentary, TV Programs of Celebrities Forum. **Speaking**: Self-Expression, Introducing the fellow students, Talking about celebrities, leaders
Reading: Company Correspondence, Business Correspondence, Technical Text for Vocabulary
Writing: Bibliography, Sentence Completion, Cloze exercises, Verbal Analogy, Letter – Business enquiry orders, payments, Minutes Preparation.

UNIT - III VISUAL BASED LANGUAGE DEVELOPMENT 9

Listening: Visuals on Group Discussion-Understanding the nuances of GD – Approach – Content – Methodology. **Speaking**: Discussing main points on burning issues, Social issues – Expressing ideas and suggestions. **Reading**: Etiquettes of Non-Verbal Communication. **Writing**: List of common expressions for specified situations – Sentence linkers – Formal Expressions – Suggestions – Reported Speech - Letter to the Editor on Common Issues – Writing the Points in Indirect Form – Check Lists – Numerical Expression.

UNIT - IV EMPLOYABILITY CORRESPONDENCE 9

Listening: Listening to Visuals of Technical Paper presentation – Technical and HR interviews
Speaking: Peer-to-Peer Interview – Mock Interview – Telephone Conversations. **Reading**: Comparative Analyses – Instructions on Public Spots – Time Management concepts – Email Correspondence. **Writing**: Compare and Contrast – Cause and Effect – Purpose and Function – Job Application Letter – Drafting Resume / CV,– Inferring the graphical / Pictorial representations – Bar chart – Pie chart, Instruction – common and technical instructions for a process or a component.

UNIT - V TECHNICAL REPORT WRITING 9

Listening: Key note speeches – Annual Reports of institutions / companies. **Speaking**: Answering to the Mock Panel Interview – Sharing of interview experiences – presenting a Technical Paper. **Reading**: Annual Reports – Company Reports – Newspaper reports – Comprehension passages. **Writing**: Homophones – Abbreviations and Acronyms – SI Units

– Report Writing with recommendations – Inferring the Graph – Flow Chart – Tables – Technical Papers.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Board of editors. “Fluency in English A Course book for Engineering and Technology”. Orient Blackswan, Hyderabad: 2016
2. Raman, Meenakshi and Sharma, Sangeetha “Technical Communication Principles and Practice”. Oxford University Press: New Delhi, 2014.

REFERENCES:

1. Booth-L. Diana, “Project Work”, Oxford University Press, Oxford: 2014
2. Grussendorf, Marion, “English for Presentations”, Oxford University Press, Oxford: 2007
3. Means, L. Thomas and Elaine Langlois, “English & Communication For Colleges. Cengage Learning”, USA: 2007
4. Board of Editor, “Advanced Technical Communication”, Great Mind Publication, Chennai : 2019

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: ADVANCED TECHNICAL COMMUNICATION		**Course Code : 20HS201**			
CO	**Course Outcomes**	**Unit**	**K–CO**	**POs**	**PSOs**
C109.1	Listen, Understand and create technical correspondence at advanced level.	I – V	AD	9,10,12	3
C109.2	Respond or answer to the contextual questions, interview questions, form instructions, draft reports	I – V	AD	9,10,12	3
C109.3	Speak and analyze social issues, come out with effective ideas for discussion, understand the passages for meaning and vocabulary	I – V	AD	9,10,12	3
C109.4	Assess error free technical writings, create legible and coherent technical papers, derive ideas of the given texts in a precise form	I – V	AD	9,10,12	3
C109.5	Remember the updated elements of communication skills, nuances of non-verbal communication, business communication	I – V	AD	9,10,12	3
C109.6	Create technical instructions, process instructions, self-appraisals, Resumes, reports on various situations	I – V	AD	9,10,12	3

CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C109.1	-	-	-	-	-	-	-	-	3	3	-	2	-	-	1
C109.2	-	-	-	-	-	-	-	-	3	3	-	2	-	-	1
C109.3	-	-	-	-	-	-	-	-	2	3	-	2	-	-	1
C109.4	-	-	-	-	-	-	-	-	2	3	-	2	-	-	1
C109.5	-	-	-	-	-	-	-	-	3	3	-	2	-	-	1
C109.6	-	-	-	-	-	-	-	-	3	3	-	2	-	-	1

20BS201	LAPLACE TRANSFORM AND ADVANCED CALCULUS	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To make the student familiar with topics such as Multiple Integrals, Vector Calculus, Analytic Functions, Complex Integration and Laplace Transform.
- To learn the concept of basic Vector Calculus which can be widely used for Modeling the various laws of Physics.
- To understand the various methods of Complex Analysis and Laplace Transform can be used for efficiently solving the problems that occur in various branches of Engineering disciplines.

PRE-REQUISITE: NIL

UNIT - I LAPLACE TRANSFORM 12

Existence Conditions – Transforms of Elementary Functions – Transform of Unit Step Function and Unit Impulse Function – Basic Properties – Shifting Theorems -Transforms of Derivatives and Integrals – Initial and Final Value Theorems – Inverse Transforms – Convolution Theorem – Transform of Periodic Functions – Application to Solution of Linear Second Order Ordinary Differential Equations with Constant Coefficients.

UNIT - II MULTIPLE INTEGRALS 12

Double integrals – Change of order of integration – Double integrals in Polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of Solids – Change of Variables in Double and Triple integrals.

UNIT - III VECTOR CALCULUS 12

Gradient and Directional Derivative – Divergence and Curl - Vector Identities – Irrotational and Solenoidal Vector fields – Line Integral over a Plane curve – Surface Integral - Area of a Curved Surface - Volume Integral – Green's, Gauss divergence and Stoke's theorems – Verification and Application in evaluating Line, Surface and Volume Integrals.

UNIT - IV ANALYTIC FUNCTIONS 12

Analytic functions – Necessary and Sufficient Conditions for Analyticity in Cartesian and Polar Coordinates – Properties – Harmonic Conjugates – Construction of Analytic Function – Conformal Mapping – Mapping by Functions w = z+c, cz, 1/z , z2 -Bilinear transformation.

UNIT - V COMPLEX INTEGRATION 12

Line integral – Cauchy's Integral Theorem – Cauchy's Integral Formula – Taylor's and Laurent's Series – Singularities – Residues – Residue Theorem – Application of Residue Theorem for Evaluation of Real Integrals – Use of Circular Contour.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2017.
2. T. Veerarajan., "Engineering Mathematics I", The Tata Mc Graw Hill Publication-New Delhi, First Edition 2018.

REFERENCES:

1. Kreyszig Erwin, “Advanced Engineering Mathematics”, John Wiley and Sons, 9thEdition, New Delhi, 2006.
2. James Stewart, “Calculus, Early Transcendental”, Cengage Learning, 7th Edition, New Delhi, 2015.
3. Bali N., Goyal M. and Watkins C., “Advanced Engineering Mathematics II”, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 9th Edition, 2014.
4. Jain R.K. and Iyengar S.R.K., “Advanced Engineering Mathematics II”, Narosa Publications, New Delhi, 5th Edition, 2016.
5. Sastry, S.S. “Engineering Mathematics”, Vol.I & II, PHI Learning Pvt. Ltd, 4th Edition, New Delhi, 2014.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: LAPLACE TRANSFORM AND ADVANCED CALCULUS		**Course Code : 20BS201**			
CO	**Course Outcomes**	**Unit**	**K–CO**	**POs**	**PSOs**
C110.1	Determine the Laplace transform of standard functions using properties	I	K3	1,2,3, 8,9	1
C110.2	Apply Laplace transform and inverse transform to solve the initial value problems	I	K3	1,2,3, 8,9	1
C110.3	Solve the multiple integrals and apply the concept to find areas, volumes	II	K3	1,2,3, 8,9	1
C110.4	Determine the line, surface and volume integrals using Green’s, Gauss and Stokes theorems	III	K3	1,2,3, 8,9	1
C110.5	Determine Analytic functions, Bilinear Transformations and apply the concept of conformal mapping to find the images of given curves.	IV	K3	1,2,3, 8,9	1
C110.6	Determine the Contour Integrals using Cauchy’s Integral and Residue theorems.	V	K3	1,2,3, 8,9	1

CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C110.1	3	2	1	-	-	-	-	1	1	-	-	-	2	-	
C110.2	3	2	1	-	-	-	-	1	1	-	-	-	2	-	
C110.3	3	2	1	-	-	-	-	1	1	-	-	-	2	-	
C110.4	3	2	1	-	-	-	-	1	1	-	-	-	2	-	
C110.5	3	2	1	-	-	-	-	1	1	-	-	-	2	-	
C110.6	3	2	1	-	-	-	-	1	1	-	-	-	2	-	

20BS202	APPLIED PHYSICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the phase diagrams and their usage.
- To establish testing methodologies of materials science.
- To inculcate the knowledge on new Engineering materials for Mechanical and Automobile Engineering applications.

PRE-REQUISITE: NIL

UNIT - I PHASE DIAGRAMS 9

Solid solutions - Hume Rothery's rules – the phase rule - single component system - one-component system of iron - binary phase diagrams - isomorphous systems - the tie-line rule - the lever rule - application to isomorphous system - eutectic phase diagram - peritectic phase diagram - other invariant reactions – free energy composition curves for binary systems - microstructural change during cooling.

UNIT - II FERROUS ALLOYS 9

The iron-carbon equilibrium diagram – phases, invariant reactions – microstructure of slowly cooled steels – eutectoid steel, hypo and hypereutectoid steels – effect of alloying elements on the Fe-C system – diffusion in solids – Fick's law – phase transformations – T-T-T diagram for eutectoid steel – pearlitic and martensitic transformations – tempering of martensite steels – stainless steels – cast irons.

UNIT - III NON DESTRUCTIVE TESTING METHODS 9

Non-destructive testing – objectives of NDT – types of defects – cracking, spalling, staining, honeycombing, dusting and blistering – methods of NDT – Liquid penetration method – radiographic testing –magnetic particle inspection-thermography testing– Eddy current testing.

UNIT - IV MAGNETIC AND DIELECTRIC MATERIALS 9

Magnetic materials: Origin of magnetic moment – Bohr magneton- comparison of Dia, para and ferro magnetism- domain theory – types of energy- hysteresis- soft and hard magnetic materials-antiferromagnetic materials-ferrites and its applications. Dielectric materials: Electrical susceptibility – dielectric constant- electronic, ionic, orientational and space charge polarization- Langevin-Debye equation - internal field - clausius- mosotti relation (derivation)- dielectric loss – dielectric breakdown- ferroelectricity and application.

UNIT - V ADVANCED ENGINEERING MATERIALS 9

Composites: Classifications, role of matrix and reinforcement processing of fiber – reinforced plastics – Polymers: types of polymers- properties and engineering applications-metallic glasses: production and types –melt spinning process – applications – shape memory alloys: phases, shape memory effect, pseudo elastic effect, NiTi alloy, applications – Nanomaterials: preparation (bottom up and top down approaches), properties and applications – Biomaterials and its applications.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. V.Raghavan, “Materials science and Engineering (a first course)”, PHI learning private limited, Delhi, 6th Edition, 2017
2. S. O. Pillai, “Solid State Physics”, New Age International publisher, 8th Edition, 2018
3. Charles Kittel, “Introduction to Solid State Physics”, John Wiley & sons, 8th Edition, 2015

REFERENCES:

1. B. K. Pandey and S.Chaturvedi, “Engineering Physics”, Cengage learning India Pvt Ltd, 2013
2. D. K. Bhattacharya and Poonam tendon, “Engineering Physics”, Oxford University Press, New Delhi, First Edition, 2017
3. Dr. V. Jeyakumar, “Engineering Metallurgy”, Lakshmi Publications, 2017

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: APPLIED PHYSICS		**Course Code : 20BS202**			
CO	**Course Outcomes**	**Unit**	**K–CO**	**POs**	**PSOs**
C111.1	Explain various phase diagrams	1	K2	1,2,11, 12	1
C111.2	Demonstrate the microstructure and phase transformations of ferrous alloys	2	K3	1,2,3,8, 9,10	1
C111.3	Infer the defects by Nondestructive testing	3	K2	1,2,8, 9,10	1
C111.4	Distinguish magnetic properties of materials	4	K2	1,2	1
C111.5	Explain dielectric properties of materials and their applications	4	K2	1,2,8, 9,10	1
C111.6	Discuss the information’s on composites, metallic glasses, SMA and nanomaterials	5	K2	1,2,8, 9,10	1

CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C111.1	2	1									2	1	1		
C111.2	3	2	1					1	1	1	3	2	1		
C111.3	2	1						1	1	1	2	1	1		
C111.4	2	1									2	1	1		
C111.5	2	1						1	1	1	2	1	1		
C111.6	2	1						1	1	1	2	1	1		

20GE201	ENGINEERING GRAPHICS	L	T	P	C
		2	0	2	3

OBJECTIVES:

- To develop graphic skills for communication of concepts, ideas and design of Engineering products.
- To expose national standards related to technical drawings.

PRE-REQUISITE: NIL

CONCEPTS AND CONVENTIONS (Not for Examination)

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

UNIT - I PROJECTION OF POINTS AND LINES 6+6

Orthographic projection – Principles - Principal planes - Projection of points in all quadrants - Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method.

UNIT - II PROJECTION OF PLANE SURFACES 6+6

Projection of planes (Polygonal and Circular surfaces) inclined to both the principal planes by rotating object method.

UNIT - III PROJECTION OF SOLIDS 6+6

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one of the principal planes by rotating object method.

UNIT - IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 6+6

Sectioning of simple solids in vertical position when the cutting plane is inclined to one of the principal planes and perpendicular to the other – obtaining true shape of section - Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids, cylinder and cone.

UNIT - V ISOMETRIC PROJECTION AND FREEHAND SKETCHING 6+6

Principles of Isometric Projection – Isometric scale – Isometric projections of simple solids - truncated Prisms and Pyramids.
Visualization concepts and Free Hand sketching : Principles – Representation of Three Dimensional objects – Layout of views - Freehand sketching of multiple views from pictorial views of objects

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Natarajan K.V., “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 30th Edition, 2017.
2. Venugopal K. and Prabhu Raja V., “Engineering Graphics”, New Age International (P) Limited, 15th Edition, 2018.

REFERENCES:

1. Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 53rd Edition, 2019.
2. Shah M.B., and Rana B.C., “Engineering Drawing”, Pearson Education, 3rd Edition, 2012.

PUBLICATION OF BUREAU OF INDIAN STANDARDS:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001: Technical drawings - General principles of presentation.
4. IS 11669 – 1986: General principles of dimensioning on technical drawings.
5. *SP 46 (2003)*: Engineering Drawing Practice for Colleges.
6. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

SPECIAL POINTS APPLICABLE TO EXAMINATIONS ON ENGINEERING GRAPHICS:

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: ENGINEERING GRAPHICS														**Course Code : 20GE201**			
CO	**Course Outcomes**													**Unit**	**K–CO**	**POs**	**PSOs**
C112.1	Familiarize with the fundamentals and standards of engineering graphics.													**-**	K2	1,2,8	2
C112.2	Draw the orthographic projections of points and lines.													I	K3	1,2,3,8	2
C112.3	Draw the orthographic projections of plane surfaces.													II	K3	1,2,3,8	2
C112.4	Draw the projections of simple solids like prisms, pyramids, cylinder and cone.													III	K3	1,2,3,8	2
C112.5	Draw the projections of sectional views of solids and develop its lateral surfaces.													IV	K3	1,2,3,8	2
C112.6	Draw the isometric projection and free hand sketching of simple objects.													V	K3	1,2,3,8	2
CO-PO Mapping																	
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**		
C112.1	2	1	-	-	-	-	-	1	-	-	-	-	-	1	-		
C112.2	3	2	1	-	-	-	-	1	-	-	-	-	-	1	-		
C112.3	3	2	1	-	-	-	-	1	-	-	-	-	-	1	-		
C112.4	3	2	1	-	-	-	-	1	-	-	-	-	-	1	-		
C112.5	3	2	1	-	-	-	-	1	-	-	-	-	-	1	-		
C112.6	3	2	1	-	-	-	-	1	-	-	-	-	-	1	-		

20GE202	ENGINEERING MECHANICS	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To develop capacity to predict the effect of force and motion in the course of carrying out the design functions of Engineering.
- To apply the techniques to find out centroid and mass moment of inertia of plane surfaces.
- To enhance skills to carry out kinematic and kinetic analyses for system of particles.

PRE-REQUISITE: NIL

UNIT - I BASICS AND STATICS OF PARTICLES 12

Introduction - Units and Dimensions - Laws of Mechanics - Vectorial representation of forces – Resolution and Composition of forces -Equilibrium of a particle –Forces in space – Equilibrium of a particle in space –Equivalent systems of forces –Principle of transmissibility –Single equivalent force.

UNIT - II EQUILIBRIUM OF RIGID BODIES 12

Free body diagram –Types of supports and their reactions –Moments and Couples – Moment of a force about a point and about an axis, Vectorial representation of moments and couples –Scalar components of a moment-Varignon's theorem –Equilibrium of Rigid bodies in two dimensions.

UNIT - III PROPERTIES OF SURFACES AND SOLIDS 12

First moment of area and the Centroid of sections- Rectangle, circle, triangle from integration- T section , I section, Angle section, Hollow section by using standard formula- Pappus and Guldinus theorems - moment of inertia of plane areas -Parallel and perpendicular axis theorem -radius of gyration.

UNIT - IV DYNAMICS OF PARTICLES 12

Displacements -Velocity and acceleration, their relationship –Rectilinear and Curvilinear motion –Newton"s law –Work Energy Equation of particles –Impulse and Momentum.

UNIT - V FRICTION AND ELEMENTS OF RIGID BODY DYNAMICS 12

Frictional force -Laws of friction -Simple contact friction –Rolling resistance –Belt friction – Translation and Rotation of Rigid Bodies –Velocity and acceleration –General Plane motion.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Vela Murali, "Engineering Mechanics", Oxford University Press, 2010
2. Beer FP, Mazurek DF, Sanghi S, Eisenberg ER, Johnson ER and Cornwell PJ, "Vector Mechanics for Engineers: Statics and Dynamics", Tata McGraw Hill Education Private Limited, 10th Edition, 2012.

REFERENCES:

1. Hibbeler RC, "Engineering Mechanics: Statics & Dynamics", Pearson India Education Services Private Limited, 13th Edition, 2012.
2. Palanichamy M.S and Nagan S, "Engineering Mechanics – Statics and Dynamics", Tata McGraw Hill, 3rd Edition, 2004
3. Meriam J.L and Kraig L.G, 'Engineering Mechanics-Statics and Dynamics', John Wiley & sons, Newyork, 2008
4. Irving H Shames, "Engineering Mechanics – Statics and Dynamics", Pearson Education Asia Private Limited, 4thEdition, 2003.
5. Murugaperumal P, "Engineering Mechanics – Sri Krishna Hitech Publishing Company Private Limited., 2013.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: ENGINEERING MECHANICS		**Course Code : : 20GE202**			
CO	**Course Outcomes**	**Unit**	**K–CO**	**POs**	**PSOs**
C113.1	Illustrate the vectorial and scalar representation of forces and moments.	I	K3	1,2,8	1
C113.2	Solve problems in engineering systems using the concept of static equilibrium.	I	K3	1,2,3,8	1
C113.3	Draw the free body diagram and apply equilibrium principles for two dimensional bodies.	II	K3	1,2,8	1
C113.4	Determine the centroid and moment of inertia of plane lamina.	III	K3	1,2,8,9	1
C113.5	Apply fundamental principles to solve problems in dynamics of particles.	IV	K3	1,2,8, 9,10	1
C113.6	Summarize the basic principles of friction and general plane motion.	V	K3	1,2,3,8, 10,12	1

CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C113.1	3	3	-	-	-	-	-	1	-	-	-	-	2	-	-
C113.2	3	3	1	-	-	-	-	1	-	-	-	-	2	-	-
C113.3	3	3	-	-	-	-	-	1	-	-	-	-	2	-	-
C113.4	3	3	-	-	-	-	-	1	2	-	-	-	2	-	-
C113.5	3	3	-	-	-	-	-	1	2	1	-	-	2	-	-
C113.6	3	3	1	-	-	-	-	1	-	1	-	1	2	-	-

20GE203	BASIC ELECTRICAL, ELECTRONICS AND INSTRUMENTATION ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concept of electric circuit laws and theorems.
- To analyze the single phase and three phase circuits.
- To study about the working principles of Electrical Machines, electronic devices, circuits and various measuring instruments.

PRE-REQUISITE: NIL

UNIT - I DC NETWORKS **9**

Basic Concepts-Atomic structure-Electric charge-Electric Current-Circuit components - Resistance-Capacitance -Inductance-potential and potential difference-Ohm's Law-work-power and Energy-DC Network Terminologies-Series and parallel circuits-Voltage and current divider rules-Kirchhoff's Laws-Maxwell's mesh current method-Nodal Analysis.

UNIT - II AC FUNDAMENTALS **9**

Introduction to AC circuits –Generation of AC power-advantages– waveforms and RMS value –average value-form factor and peak factor-power and power factor, single phase and three-phase balanced circuits.

UNIT - III ELECTRICAL MACHINES **9**

Construction , principles of operation, characteristics and applications of ; DC machines-Transformers (single and three phase) -Synchronous machines -three phase and single phase induction motors.(Qualitative Treatment Only)

UNIT - IV ELECTRONIC DEVICES & CIRCUITS **9**

Types of Materials – conductor, semiconductor and insulators-comparison-Silicon & Germanium- N type and P type materials – PN Junction –Forward and Reverse Bias – Semiconductor Diodes –Bipolar Junction Transistor – Characteristics - Introduction to operational Amplifier –Inverting Amplifier –Non Inverting Amplifier.

UNIT - V MEASUREMENTS & INSTRUMENTATION **9**

Classification of instruments - Types of indicating Instruments –moving coil and moving iron instruments-dynamometer type wattmeter and induction type energy meter- three-phase power measurements -Introduction to transducers - Classification of Transducers-selection of transducers- Resistive, Inductive, Capacitive.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. S.K Bhattacharya, "Basic Electrical and Electronics Engineering", Pearson, second Edison 2017.
2. D P Kothari and I.J Nagrath, "Basic Electrical and Electronics Engineering", McGraw Hill Education(India) Private Limited, Third Reprint, 2017

REFERENCES:

1. Thereja .B.L., “Fundamentals of Electrical Engineering and Electronics”, S. Chand & Co. Ltd., 2017
2. N K De, Dipu Sarkar, “Basic Electrical Engineering”, Universities Press (India)Private Limited 2016
3. Del Toro, “Electrical Engineering Fundamentals”, Pearson Education, New Delhi, 2015
4. Rajendra Prasad, “Fundamentals of Electrical Engineering”, Prentice Hall of India, 2014
5. John Bird, “Electrical Circuit Theory and Technology”, Elsevier, First Indian Edition, 2013
6. Allan S Moris, “Measurement and Instrumentation Principles”, Elseveir, First Indian Edition, 2011
7. A.E.Fitzgerald, David E Higginbotham and Arvin Grabel, “Basic Electrical Engineering”, McGraw Hill Education (India) Private Limited, 2009

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: BASIC ELECTRICAL, ELECTRONICS AND INSTRUMENTATION		**Course Code : 20GE203**			
CO	**Course Outcomes**	**Unit**	**K–CO**	**POs**	**PSOs**
C114.1	Explain the basic circuit components and apply the Network theorems to solve simple and complex linear circuits.	1	K3	1,2,3,4,9	1
C114.2	Solve the series, parallel A.C circuits and explain the three phase balanced star, delta connected network.	2	K3	1,2,3,4,9	1
C114.3	Demonstrate and analyze the construction, operation and characteristics of D.C, A.C machines, single and three phase transformers.	3	K3	1,2,3,4,9	1
C114.4	Compare the configurations, Characteristics and biasing of Diode, BJT,OP-AMP and its applications.	4	K3	1,2,3,4,9	1
C114.5	Classification of various types of transducers and explain the construction and working principle of display devices.	5	K3	1,2,3,4,9	1
C114.6	Explain the construction and working principle of measuring instruments.	-	K3	1,2,3,4,9	1

CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C114.1	2	3	2	2	-	-	-	-	2	-	-	-	2	-	-
C114.2	3	2	3	3	-	-	-	-	2	-	-	-	3	-	-
C114.3	2	2	2	2	-	-	-	-	2	-	-	-	2	-	-
C114.4	3	1	1	1	-	-	-	-	2	-	-	-	2	-	-
C114.5	2	1	2	3	-	-	-	-	3	-	-	-	2	-	-
C114.6	2	1	2	3	-	-	-	-	3	-	-	-	2	-	-

20HS2L1	COMMUNICATION SKILLS LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES:

- This course is framed for imparting practical approach in learning and enhancing communication skill to develop in students.
- Students will be able to identify appropriate expressions in speaking and writing.
- They will also be able to understand the style and perfection of language in reading and listening various contexts of engineering and technology.
- The course will benefit to the students to gain confidence for every day communication, aptitude test and interviews.

PRE-REQUISITE: NIL

UNIT - I LISTENING **6**

Listen and takes notes of Lecture, Listen and Write appropriate word, Talks on Engineering and Technology, Developing effective listening skills, barriers to effective listening

UNIT - II SPEAKING **6**

Self-Introduction, Role play of Celebrities, Sharing memorable incidents

UNIT - III READING **6**

Reading Online Blogs, Reading Advertisement in Online, Newspaper archives reading

UNIT - IV WRITING **6**

Process Description, Narrating experiences, Creating Email blogs, Review Writing – Books, Movies, and Journals

UNIT - V SUMMARIZED ACTIVITIES **6**

Reading – cloze exercises, Identifying redundant words, Jargon words, Foreign words, Technical terms. **Writing** – Error free sentences, Sequential paragraphs, Essay writing on various levels – basic, middle, and advanced. **Speaking** – Face to face conversation on specific topics, interviewing celebrities, getting acquaintance with new people, sharing information with persons from abroad.

TOTAL: 30 PERIODS

TEXT BOOKS:

1. E. Suresh Kumar et al. “Communication for Professional Success”. Orient Blackswan: Hyderabad, 2015

REFERENCES:

1. Butterfield, Jeff “Soft Skills of Everyone”. Cengage Learning: New Delhi, 2015
2. “Interact English Lab Manual for Undergraduate Students”, Orient BlackSwan: Hyderabad, 2016.
3. Raman, Meenakshi and Sangeetha Sharma. “Professional Communication”. Oxford University Press: Oxford, 2014.
4. S. Hariharanetal. “Soft Skills”. MJP Publishers: Chennai, 2010

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: COMMUNICATION SKILLS LABORATORY		**Course Code : 20HS2L1**			
CO	**Course Outcomes**	**Unit**	**K–CO**	**POs**	**PSOs**
C115.1	Express ideas and concepts on par global communication	1,2	AD	9,10,12	-
C115.2	Involve inter-personal communication with flair and error-free verbatim	3,4	AD	9,10,12	-
C115.3	Face interviews confidently and respond in proper language ability	5,6	AD	9,10,12	-
C115.4	Participate in group discussion and share innovative ideas in technical environments	7,8	AD	9,10,12	-
C115.5	Adapt multi-national exposure on employment	9,10	AD	9,10,12	-
C115.6	Master all-round competency in delivering apt communication for employability	1-10	AD	9,10,12	-

CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C115.1	-	-	-	-	-	-	-	-	2	3	-	3	-	-	-
C115.2	-	-	-	-	-	-	-	-	2	3	-	3	-	-	-
C115.3	-	-	-	-	-	-	-	-	3	3	-	3	-	-	-
C115.4	-	-	-	-	-	-	-	-	2	3	-	3	-	-	-
C115.5	-	-	-	-	-	-	-	-	3	3	-	3	-	-	-
C115.6	-	-	-	-	-	-	-	-	2	3	-	3	-	-	-

20GE2L1	ELECTRICAL, ELECTRONICS AND INSTRUMENTATION LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To train the students in performing various tests on electrical drives, electronic devices, measuring instruments sensors and circuits.

PRE-REQUISITE: NIL

LIST OF EXPERIMENTS:

1.	Load test on separately excited DC shunt generator
2.	Load test on Single phase Transformer
3.	Load test on single phase Induction motor
4.	Load test on DC shunt motor.
5.	Measurement of three phase power
6.	Verification of Circuit Laws
7.	Transistor based application circuits
8.	Study of CRO
9.	Characteristics of LVDT
10.	Calibration of Rotameter
11.	Measurement of temperature by using RTD
12.	Measurement of temperature by using Thermistor

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No.	NAME OF THE EQUIPMENT	Quantity
1.	D. C. Motor Generator Set	2
2.	D.C. Shunt Motor	2
3.	Single Phase Transformer	2
4.	Single Phase Induction Motor	2
5.	Ammeter A.C and D.C	20
6.	Voltmeters A.C and D.C	20
7.	Watt meters LPF and UPF	4
8.	Resistors & Breadboards	-
9.	Cathode Ray Oscilloscopes	4
10.	Dual Regulated power supplies	6
11.	A.C. Signal Generators	4
12.	Transistors (BJT, JFET)	-

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: ELECTRICAL, ELECTRONICS AND INDTRUMNTATION LABORATORY		**Course Code : 20GE2L1**			
CO	**Course Outcomes**	**Unit**	**K–CO**	**POs**	**PSOs**
C116.1	Determine the efficiency of DC shunt motor, single phase induction motor, single phase transformer, Draw the internal and external characteristics of separately excited DC shunt generator and Describe the working of DC and AC motor starters.	1,2	K2	1,2,3,4,9	1
C116.2	Calculate the power and power factor of three phase circuit by two wattmeter method and verify the circuit laws and theorems.	3,4	K3	1,2,3,4,9	1
C116.3	Explain the working of diode and transistor based application circuits such as clipper and Common Emitter Amplifier.	5,6	K3	1,2,3,4,9	1
C116.4	Discuss the operation of Cathode Ray Oscilloscope and measure the AC quantities such as voltage, current and Explain the characteristics of Linear Variable differential transformer.	7,8	K3	1,2,3,4,9	1
C116.5	Measure the error during the flow of fluid or gas in Rotameter by calibrating them	9,10	K3	1,2,3,4,9	1
C116.6	Calculate and sense the temperature by Resistance Temperature Detector and Thermistor.	11,12	K3	1,2,3,4,9	1

CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C116.1	2	3	2	2	-	-	-	-	2	-	-	-	2		
C116.2	3	2	3	3	-	-	-	-	2	-	-	-	3		
C116.3	2	2	2	2	-	-	-	-	2	-	-	-	2		
C116.4	3	1	1	1	-	-	-	-	2	-	-	-	2		
C116.5	2	1	2	3	-	-	-	-	3	-	-	-	2		
C116.6	2	1	2	3	-	-	-	-	3	-	-	-	2		

III – SEMESTER

		L	T	P	C
20BS301	TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS	3	1	0	4

OBJECTIVES

- To make the student familiar with the topics such as Fourier Transforms, Z-Transforms and Fourier series.
- To learn the formation of partial differential equations and the solution of first order and higher order partial differential equations.
- To apply Fourier series to solve one dimensional wave, one and two dimensional heat equations which occur frequently in various branches of engineering disciplines.

PRE-REQUISITE: NIL

UNIT - I PARTIAL DIFFERENTIAL EQUATIONS 12

Formation of partial differential equations – Singular integrals - 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 both homogeneous and non-homogeneous types.

UNIT – II FOURIER SERIES 12

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Complex form of Fourier series – Parseval's identity – Harmonic analysis.

UNIT - III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 12

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.

UNIT – IV FOURIER TRANSFORMS 12

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT - V Z -TRANSFORMS AND DIFFERENCE EQUATIONS 12

Z-transforms - Elementary properties – Inverse Z-transform (using partial fraction and residues) – Initial and final value theorems - Convolution theorem - Formation of difference equations – Solution of difference equations using Z - transform.

TOTAL : 60 PERIODS

TEXT BOOKS:

1. Grewal .B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2017.
2. Bali.N.P. and Manish Goyal, "A Textbook of Engineering Mathematics", Laxmi Publications Pvt. Ltd, 9th Edition, 2014.

REFERENCES:

1. Erwin Kreyszig, "Advanced Engineering Mathematics ", John Wiley, India, 8th Edition, 2016.
2. James.G., "Advanced Modern Engineering Mathematics", Pearson Education, 3rd Edition, 2007.
3. Andrews.L.C., L.C and Shivamoggi .B, "Integral Transforms for Engineers", SPIE Press, 1999.
4. Narayanan.S., Manicavachagom Pillay.T.K. and Ramanaiah.G, "Advanced Mathematics for Engineering Students", S.Viswanathan Publishers Pvt. Ltd, Chennai, Vol. II 2003 & Vol.III 2002.
5. Ramana.B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: **TRANSFORMS and PARTIAL DIFFERENTIAL EQUATIONS**															**Course Code : 20BS301**
CO	**Course Outcomes**														**Unit**	**K–CO**	**POs**	**PSOs**
C201.1	Solve the given first order partial differential equations.														1	K3	1,2,3, 8&9	1
C201.2	Solve linear partial differential equation of second and higher order with constant coefficients.														1	K3	1,2,3, 8&9	1
C201.3	Solve differential equations using Fourier series analysis.														2	K3	1,2,3, 8&9	1
C201.4	Solve one, two dimensional heat flow problems and one dimensional wave equation problems.														3	K3	1,2,3, 8&9	1
C201.5	Compute the Fourier transforms of various functions.														4	K3	1,2,3, 8&9	1
C201.6	Apply Z-transforms techniques to solve difference equation.														5	K3	1,2,3, 8&9	1
CO-PO Mapping																		
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**			
C201.1	3	2	1					1	1				2					
C201.2	3	2	1					1	1				2					
C201.3	3	2	1					1	1				2					
C201.4	3	2	1					1	1				2					
C201.5	3	2	1					1	1				2					
C201.6	3	2	1					1	1				2					

20ME301	STRENGTH OF MATERIALS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study the concepts of simple stresses, strains, and strain energy due to external loads.
- To understand the two dimensional stress systems, stresses and deformations induced in thin and thick shells.
- To compute stresses and deformation in circular shafts and helical spring due to torsion.
- To understand the concept of shearing force and bending moment due to external loads in beams and their effect on stresses.
- To determine the deflection of beams by various methods and crippling load of columns under various conditions.

PREREQUISITE:
Course Code: 20BS101& 20GE202
Course Name: Fundamentals of Engineering Mathematics & Engineering Mechanics

UNIT - I STRESS, STRAIN AND DEFORMATION OF SOLIDS 9

Rigid bodies and deformable solids – Tension, Compression and Shear Stresses. Stress-Strain Diagram for ductile and brittle materials, True stress, True strain. Deformation of simple and compound bars, Thermal stresses, Elastic constants, Volumetric strain, Strain energy and unit strain energy, Strain energy in Uniaxial loads.

UNIT – II ANALYSIS OF STRESSES IN TWO DIMENSIONS 9

Stresses in thin cylindrical shell, circumferential and longitudinal stresses. Deformation in thin and thick cylinders, Compound cylinders, Stresses in spherical shells, Deformation in spherical shells. Stresses on inclined planes, principal stresses and principal planes, Mohr's circle for plane stress

UNIT - III TORSION 9

Torsion formulation, stresses and deformation in circular and hollow shafts, Stepped shafts. Deflection in shafts fixed at the both ends. Stresses in helical springs, Deflection of helical springs

UNIT – IV BEAMS 9

Beams – types, Standard Rolled sections, transverse loading on beams, Shear force and bending moment in beams - Cantilever, Simply supported and over hanging.
Theory of simple bending, bending stress distribution, Load carrying capacity, Proportioning of sections, Flitched beams, Shear stress distribution.

UNIT - V DEFLECTION OF BEAMS, COLUMNS 9

Computation of slopes and deflections in beams - Double Integration method, Macaulay's method. Maxwell's reciprocal theorems.
COLUMNS – Long and short columns, Euler's formula for crippling load with different end conditions, eccentric loading, Rankine formulae.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Beer F. P. and Johnson R, “Mechanics of Materials”, McGraw-Hill Book Co, 8th Edition, 2019.
2. Bansal R.K, “A Textbook of Strength of Materials”, Laxmi Publications Pvt. Ltd., New Delhi, 6th Edition, 2019.
3. Khurmi R.S, Khurmi N, “Strength of Materials”, S.Chand, New Delhi, 2015.

REFERENCES:

1. Popov E.P, “Engineering Mechanics of Solids”, Prentice-Hall of India, New Delhi, 2nd Edition, 2015.
2. S. S. Bhavikatti, Strength of Materials, Vikas Publishing House-Pvt. Ltd., 4th Edition. 2013.
3. Rajput, R K, “Strength of Materials”, S.Chand & Co, New Delhi, 2015
4. Singh D.K, “Mechanics of Solids” Pearson Education, 2008.
5. R. C. Hibbeler, Mechanics of Materials, Prentice Hall, Pearson Education., 2005

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: STRENGTH OF MATERIALS		**Course Code : 20ME301**			
CO	**Course Outcomes**	**Unit**	**K–CO**	**POs**	**PSOs**
C202.1	Explain the fundamental concepts of stress and strain	I	K2	1,2,8,10	1,2
C202.2	Determine the deformation of bars while applying loads	I	K3	1,2,3,9	1,2
C202.3	Compute stresses due to internal pressure in cylinders and spherical shells	II	K3	1,2,3,10	1,2
C202.4	Apply basic equation of simple torsion in designing of shafts and helical springs	III	K3	1,2,3,10	1,2
C202.5	Construct Shear force and Bending moment diagrams for beams for various combinations of transverse loads.	IV	K3	1,2,3,10	1,2
C202.6	Calculate the slope and deflection of beams under various loading conditions.	V	K3	1,2,3, 10,12	1,2

CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C202.1	2	1	-	-	-	-	-	2	-	2	-	-	2	1	-
C202.2	3	2	1	-	-	-	-	-	2	-	-	-	2	1	-
C202.3	3	2	1	-	-	-	-	-	-	2	-	-	2	1	-
C202.4	3	2	1	-	-	-	-	-	-	2	-	-	2	1	-
C202.5	3	2	1	-	-	-	-	-	-	2	-	-	2	1	-
C202.6	3	2	1	-	-	-	-	-	-	2	-	2	2	1	-

20ME302 FLUID MECHANICS AND MACHINERY

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the properties of fluids and flow characteristics.
- To gain knowledge about the applications of the conservation laws to flow through pipes.
- To study about dimensional analysis and model analysis
- To understand the working principle and performance of hydraulic turbines.
- To understand the working principle and performance of hydraulic pumps.

PREREQUISITE:
Course Code: 20BS101
Course Name: Fundamentals of Engineering Mathematics

UNIT - I FLUID PROPERTIES AND FLOW CHARACTERISTICS 9

Units and dimensions- Properties of fluids- mass density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapor pressure, surface tension and capillarity. Flow measurement, Flow characteristics, Types of fluid flow, concept of control volume, application of continuity equation, energy equation and momentum equation.

UNIT – II FLOW THROUGH CIRCULAR CONDUITS 9

Laminar flow through circular conduits and circular annuli, Hagen Poisueille's Equation, Darcy Weisbach equation, major and minor losses, Hydraulic and energy gradient, Moody diagram. Commercial pipes - Flow through pipes in series and parallel. Boundary layer concepts, types of boundary layer thickness.

UNIT - III DIMENSIONAL ANALYSIS 9

Need for dimensional analysis, methods of dimensional analysis. Similitude –types of similitude. Dimensionless parameters, application of dimensionless parameters. Model analysis.

UNIT – IV TURBINES 9

Classification of turbines, heads and efficiencies, velocity triangles. Axial, radial and mixed flow turbines. Pelton wheel, Francis turbine and Kaplan turbines- working principles, workdone by water on the runner, draft tube. Specific speed, unit quantities, performance curves for turbines, governing of turbines. Concepts of Water Hammer.

UNIT - V PUMPS 9

Impact of jets, Euler's equation. Theory of rotodynamic machines, various efficiencies, velocity components at entry and exit of the rotor, velocity triangles. Centrifugal pumps–working principle, workdone by the impeller, performance curves. Reciprocating pump-working principle. Rotary pumps –classification, working principle. Submergible pumps.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. R.K. Bansal, "A Text Book of Fluid Mechanics and Hydraulic Machines", 10th Edition, Laxmi Publications Pvt. Ltd., 2018.
2. Modi P.N. and Seth, S.M. "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi, 21st Edition, 2017.
3. Kumar K. L., "Engineering Fluid Mechanics", Eurasia Publishing House Pvt. Ltd., New Delhi, 2016

REFERENCES:

1. Frank White, “Fluid Mechanics”, 8th Edition, McGraw Hill Education (India) Pvt. Ltd, 2017.
2. Streeter, V. L. and Wylie E. B., "Fluid Mechanics", 9th Edition, McGraw Hill Publishing Co. 2017.
3. Yunus A Cengel and John A Cimbala, Fluid Mechanics-Fundamentals & Applications, 4th Edition, Tata McGraw Hill, 2017.
4. Fox and MacDonald, Introduction to Fluid Mechanics, 9th Edition, Wiley India, 2015
5. S. K. Som, Gautam Biswas, Suman Chakraborty, Introduction to Fluid Mechanics and Fluid Machines, 3rd Edition, Tata McGraw-Hill Education, 2012.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: FLUID MECHANICS AND MACHINERY														**Course Code : 20ME302**	
CO	**Course Outcomes**													**Unit**	**K–CO**	**POs**	**PSOs**
C203.1	Determine the effect of fluid properties on a flow system.													I	K2	1,2,3,9	1,2,3
C203.2	Apply the kinematic concepts and dynamic concepts which relates to the conservation principles of mass and energy													I	K3	1,2,3,9	1,2,3
C203.3	Compute losses in circular conduits using conservation laws													II	K3	1,2,3,8,9	1,2,3
C203.4	Use dimensional analysis to design physical or numerical experiments and to apply dynamic similarity													III	K3	1,2,3,9	1,2,3
C203.5	Analyze the performance of hydraulic turbines.													IV	K4	1,2,3,4, 8,9,10	1,2,3
C203.6	Analyze the performance of pumps.													V	K4	1,2,3,4, 8,9,12	1,2,3
CO-PO Mapping																	
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**		
C203.1	3	2	1	-	-	-	-	-	1	-	-	-	3	2	1		
C203.2	3	2	1	-	-	-	-	-	1	-	-	-	3	2	1		
C203.3	3	2	1	-	-	-	-	2	2	-	-	-	3	2	1		
C203.4	3	2	1	-	-	-	-	-	2	-	-	-	3	2	1		
C203.5	3	3	2	1	-	-	-	2	2	1	-	-	3	2	1		
C203.6	3	3	2	1	-	-	-	2	2	-	-	1	3	2	1		

20ME303 MANUFACTURING PROCESSES

L	T	P	C
3	0	0	3

OBJECTIVES

- To provide knowledge on the working, advantages, limitations and applications of metal casting, metal joining, bulk deformation and sheet metal processes.
- To gain knowledge about the defects in various manufacturing processes.
- To provide knowledge about the load and power calculation for various manufacturing processes.
- To understand the working principles of moulding of plastic components.
- To understand the concepts of powder metallurgy and additive manufacturing process.

PREREQUISITE: NIL

UNIT - I METAL CASTING PROCESSES 9

Pattern – Types, Materials, allowances. Molding sand – Types and Properties, Design of patterns, cores, Moulds, Riser and gating design (Qualitative treatment ONLY). Basic steps in sand casting, Cupola and crucible furnace, Procedural Steps and applications of special casting processes (Shell, Investment, Pressure die casting, Centrifugal Casting, CO_2 casting), Defects in Sand casting process

UNIT – II METAL JOINING PROCESSES 9

Welding Equipment – Fusion welding: Oxy-fuel gas Welding, Arc welding, MIG welding, TIG welding, CO_2 Welding, Thermit welding, Plasma arc welding, Laser Beam welding.
Solid State welding: Resistance Welding, friction stir welding, ultra sonic welding, explosion welding. Defects in welding. Testing and Inspection of welding, Brazing and soldering

UNIT - III BULK DEFORMATION PROCESSES 9

Hot working and cold working of metals, Forging processes – Open, impression and closed die forging, Defects in forging. Types of Rolling, Rolling mill, Defects in rolling. Principle of rod, wire and tube drawing. Classification of extrusion processes. Estimation of load and power for forging, rolling, drawing, extrusion operations.

UNIT – IV SHEET METAL AND POWDER METALLURGY PROCESSES 9

Sheet metal forming methods: shearing, bending, deep drawing, stretch forming, spinning processes. High velocity forming: Hydro forming, Explosive forming, magnetic pulse forming, Shot peening. Estimation of load and power for shearing, bending, deep drawing
Introduction to Powder metallurgy process.

UNIT - V PROCESSING OF PLASTICS AND ADDITIVE MANUFACTURING 9

Molding of plastics, working principles. Injection molding, Compression molding, Transfer Molding, Blow molding, Rotational molding, Film blowing, Extrusion, Thermoforming.
Additive Manufacturing: Classification – Fusion deposition modeling, Selective Laser Sintering, Stereolithography, Benefits, Applications.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Kalpakjian. S, “Manufacturing Engineering and Technology”, Pearson Education India 7th Edition, 2014.
2. Hajra Choudhary S.K. and Hajra Choudhury. A. K., Elements of Workshop Technology, Volume I and II, Media Promoters and Publishers Pvt. Limited, Mumbai, 13th Edition 2010.
3. Pham, D.T. and Dimov, S.S., “Rapid manufacturing”, Springer-Verlag, London, 2011.

REFERENCES:

1. Gosh A, Mallik, A.K., Manufacturing Science, East-West Press Pvt Ltd, 2010.
2. Geofrey Boothroyd, "Fundamentals of Metal Machining and Machine Tools", Mc Graw Hill, 3rd Edition, 2006.
3. Rao. P. N., Manufacturing Technology Foundry, Forming and Welding, 5th Edition, Tata McGraw Hill, 2013.
4. Sharma, P.C., A Textbook of Production Technology (Manufacturing Processes), S.Chand and Co. Ltd., 2007.
5. Roy. A. Lindberg, Processes and materials of manufacture, PHI / Pearson education, 2006.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: MANUFACTURING PROCESSES		**Course Code : 20ME303**			
CO	**Course Outcomes**	**Unit**	**K–CO**	**POs**	**PSOs**
C204.1	Identify defects and interpret causes for defects in product of metal casting processes	I	K3	1,2,3,8,10	1,2,3
C204.2	Select the suitable metal joining process for a given product or component.	II	K3	1,2,3,8, 9,10,12	1,2,3
C204.3	Determine the power required for bulk deformation process	III	K3	1,2,3,8	1,2,3
C204.4	Determine the power required for shearing, bending and deep drawing.	IV	K3	1,2,3,8	1,2,3
C204.5	Explain the steps involved in manufacturing of parts by powder metallurgy	IV	K2	1,2,8,10	1,2,3
C204.6	Choose a suitable plastic molding process and additive manufacturing process for producing a given part	V	K3	1,2,3,8, 10,12	1,2,3

CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C204.1	3	2	1	**-**	**-**	-	-	2	-	1	-	-	2	2	2
C204.2	3	2	1	-	-	-	-	2	2	1	-	2	2	2	2
C204.3	3	2	1	-	-	-	-	1	-	-	-	-	2	2	2
C204.4	3	2	1	-	-	-	-	1	-	-	-	-	2	2	2
C204.5	2	1	-	-	-	-	-	1	-	1	-	-	2	2	2
C204.6	3	2	1	-	-	-	-	2	-	2	-	2	2	2	2

20ME304 ENGINEERING THERMODYNAMICS

L	T	P	C
3	1	0	4

Use of Standard and approved Steam Table, Mollier Chart, Compressibility Chart and Psychrometric Chart permitted)

OBJECTIVES

- To understand the first law of thermodynamics for various systems.
- To understand the second law of thermodynamics and Entropy.
- To understand the properties of pure substance and steam power cycles.
- To understand behavior of real gas.
- To understand Psychrometric properties.

PREREQUISITE:

Course Code: 20BS101
Course Name: Fundamentals of Engineering Mathematics

UNIT - I BASIC CONCEPT AND FIRST LAW 12

Thermodynamic Processes and systems, First law of thermodynamics-applied to closed and open systems. Steady flow energy equation (SFEE), applications of SFEE. Zeroth law of thermodynamics and temperature scales.

UNIT – II SECOND LAW AND ENTROPY 12

Second law of thermodynamics - irreversible processes, Carnot theorem, Clausius Inequality, Entropy, Entropy change for pure substances – T-S diagram, Entropy change applied to closed and open systems. Availability and irreversibility.

UNIT - III PROPERTIES OF PURE SUBSTANCE AND STEAM POWER CYCLE 12

Properties of pure substances- Phase Rule, property diagrams (PV, PT, TV, TS & HS). Work transfer with steam-Non-Flow Processes. Vapour power cycles - Rankine cycle, Improvisations of Rankine cycle, Superheating, Reheat cycle, Regenerative cycle

UNIT – IV IDEAL AND REAL GASES, THERMODYNAMIC RELATIONS 12

Thermodynamic relations: Partial derivatives - Maxwell relations - Clapeyron equation, Internal energy, Enthalpy, Entropy, Specific heat- Equations of state for real gases, Reduced properties-Law of corresponding states- Generalized Compressibility Chart

UNIT - V GAS MIXTURES AND PSYCHROMETRY 12

Mixture of non-reacting gases - Dalton's and Amalgam's model - Calculation of C_p, C_v, R, u, h and s changes for gas mixtures. Psychrometry- dry and atmospheric air, Psychrometric properties of moist air specific and relative humidity, dew point temperature - Psychrometric chart.

TOTAL : 60 PERIODS

TEXT BOOKS:

1. Nag.P.K., Engineering Thermodynamics, 6th Edition, McGraw Hill Education, 2017.
2. R.K.Rajput, “A Text Book Of Engineering Thermodynamics”, 5th Edition, 2017.
3. Cengel. Y and M.Boles, "Thermodynamics - An Engineering Approach", 9th Edition, McGraw Hill, 2019.

REFERENCES:

1. William C. Reynolds, Henry C. Perkins, Engineering thermodynamics, Mc Graw Hill, 2009
2. Michael J. Moran, Howard N. Shapiro, “Fundamentals of Engineering Thermodynamics”, 8th Edition, 2003.

3. Sonntag, R.E., Borgnakke, C., and Van Wylen, Fundamentals of Thermodynamics, 7th Edition, Wiley Eastern Ltd, 2009.
4. Prasannakumar, "Thermodynamics", Pearson – Dorling Kindersley (India) Pvt. Ltd., 2013.
5. Single.O.P., Engineering Thermodynamics, Macmillan Publishers India Limited, 2000.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: ENGINEERING THERMODYNAMICS														**Course Code : 20ME304**			
CO	**Course Outcomes**													**Unit**	**K–CO**	**POs**	**PSOs**
C205.1	Apply first law of thermodynamics and determine energy exchange in closed systems and flow process													I	K3	1,2,3,9	1,2,3
C205.2	Apply second law of thermodynamics to determine the performance limits of thermodynamic cycles													II	K3	1,2,3, 10,12	1,2,3
C205.3	Determine thermodynamic properties of pure substances													III	K3	1,2,3,8	1,2,3
C205.4	Calculate efficiency of simple and improved Rankine cycle													III	K3	1,2,3,8	1,2,3
C205.5	Derive simple thermodynamic relations of ideal gases													IV	K3	1,2,3,10	1,2,3
C205.6	Calculate properties of gas mixtures and moist air using thermodynamic relations and psychrometric chart.													V	K3	1,2,3,10	1,2,3
CO-PO Mapping																	
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**		
C205.1	3	2	1	0	0	0	0	0	2	0	0	0	3	2	1		
C205.2	3	2	1	0	0	0	0	0	0	2	0	2	3	2	1		
C205.3	3	2	1	0	0	0	0	2	0	0	0	0	3	2	1		
C205.4	3	2	1	0	0	0	0	2	0	0	0	0	3	2	1		
C205.5	3	2	1	0	0	0	0	0	0	2	0	0	3	2	1		
C205.6	3	2	1	0	0	0	0	0	0	2	0	0	3	2	1		

20HS301	UNIVERSAL HUMAN VALUES	L	T	P	C
		2	1	0	3

OBJECTIVES:

- To create an awareness on Engineering Ethics and Human Values.
- To understand social responsibility of an engineer.
- To appreciate ethical dilemma while discharging duties in professional life.

PRE-REQUISITE: NIL

UNIT - I INTRODUCTION TO VALUE EDUCATION 9

Value Education – Definition - Concept and Need for Value Education - The Evolution of Value Education: Natural acceptance, Self exploration - Fundamentals of value education - Happiness and Prosperity as parts of Value Education- fulfilling human aspirations.
Practice sessions: To discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

UNIT - II HARMONY IN THE HUMAN BEING 9

Human being vs Value education – I' and Body synchronization - Understanding Myself as Co-existence of the Self and the Body - Realization - Self, Body needs - Scanning of Karma - Self and Body - Understanding Sanyam and Health.
Practice sessions: To discuss the role others have played in making material goods available to self. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.

UNIT - III HARMONY IN THE FAMILY, SOCIETY AND NATURE 9

Family as a basic unit of Human Interaction - Values in Relationships - The Basics for Trust and Respect in today's Crisis: Affection, e-Guidance, Reverence, Glory, Gratitude and Love – Harmony in society : Resolution, Prosperity, Fearlessness and Co-existence as Comprehensive Human Goal - Harmony in Nature: The Four Orders in Nature - The Holistic Perception of Harmony in Existence.
Practice sessions: To discuss on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education. Gratitude as a universal value in relationship. Discuss with scenarios. Elicit examples from students' lives

UNIT - IV SOCIAL ETHICS 9 9

The Basics for Ethical Human Conduct - Defects in Ethical Human Conduct - Holistic Alternative and Universal Order - Universal Human Order and Ethical Conduct - Human Rights violation and Social Disparities.

Practice sessions: To discuss human being as cause of imbalance in nature, pollution, depletion of resources and role of technology

UNIT - V PROFESSIONAL ETHICS 9

Value based Life and Profession - Professional Ethics and Right Understanding - Competence in Professional Ethics - Issues in Professional Ethics – The Current Scenario - Vision for Holistic Technologies, Production System and Management Models.
Practice sessions: To discuss the conduct as an engineer or scientist

TOTAL: 45 PERIODS

TEXT BOOKS:

1. R.R.Gaur, R. Sangal and G.P. Bagaria, "A Foundation Course in Human Values and Professional Ethics", Excel Books, 2nd Revised Edition, New Delhi, Re-print 2019.
2. A.N. Tripathy, "Human Values", New Age International Publishers, New Delhi, 2003.

REFERENCES:

1. E.G.Seebauer and Robert L. Berry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, 2000.
2. M.Govindrajran, S.Natrajan and V.S.Senthil Kumar, "Engineering Ethics (including Human Values)", Eastern Economy Edition, Prentice Hall of India Ltd., 2004.
3. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, New York, 1996.
4. Charles E. Harries, Michael S. Protchard and Michael J. Rabins, "Engineering Ethics - Concepts and Cases", Thomson Learning, 2000.
5. S.K.Chakraborty and Dabangshu Chakraborty, "Human Values and Ethics: Achieving Holistic Excellence", ICFAI University Press, 2006.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: UNIVERSAL HUMAN VALUES		**Course Code : 20HS301**			
CO	**Course Outcomes**	**Unit**	**K–CO**	**POs**	**PSOs**
C206.1	Explain the significance of value inputs in a classroom and start applying them in their life and profession	I	AD	6,7,8, 9,12	3
C206.2	Distinguish between Values & Skills to ensure happiness and prosperity.	I	AD	6,7,8, 9,12	3
C206.3	Identify the synchronization between Thyself & the Body to ensure competency of an individual	II	AD	6,7,8, ,12	3
C206.4	Generalize the role of a human being in ensuring harmony in society and nature.	III	AD	6,7,8, 9,12	3
C206.5	Distinguish between ethical and unethical practices, and Analyze harmonious working environments	IV	AD	6,7,8, 9,12	3
C206.6	Assess the importance of value based life and Evaluate the role of professional ethics.	V	AD	6,7,8, 9,12	3

CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C206.1	-	-	-	-	-	3	2	1	1	-	-	1	-	-	2
C206.2	-	-	-	-	-	3	2	1	1	-	-	1	-	-	2
C206.3	-	-	-	-	-	3	2	1	1	-	-	1	-	-	2
C206.4	-	-	-	-	-	3	2	1	1	-	-	1	-	-	2
C206.5	-	-	-	-	-	3	2	1	1	-	-	1	-	-	2
C206.6	-	-	-	-	-	3	2	1	1	-	-	1	-	-	2

20ME3L1 STRENGTH OF MATERIALS LABORATORY

L	T	P	C
0	0	3	1.5

OBJECTIVES:

- To understand the fundamental modes of loading of the structures
- To measure loads, displacements and strains.
- To obtain the strength of the material and stiffness properties of structural elements
- To study the mechanical properties of materials when subjected to different types of loading.
- To understand the hardening and tempering process

PREREQUISITE: NIL

LIST OF EXPERIMENTS

1.	Tensile test
2.	Double shear test
3.	Torsion test
4.	Impact test
5.	Strain Measurement using Single and Tri axial strain gauges.
6.	Hardness test - Brinell Hardness Number
7.	Hardness test - Rockwell Hardness Number
8.	Deflection test on beams
9.	Compression test on helical springs
10.	Effect of hardening- Improvement in hardness and impact resistance of steels.
11.	Tempering- Improvement Mechanical properties Comparison
	(i) . Unhardened specimen and
	(ii). Quenched Specimen

TOTAL: 45 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S. No.	Name of The Equipment	Quantity
1.	Universal Tensile Testing machine with double shear attachment	1
2.	Torsion Testing Machine	1
3.	Impact Testing Machine	1
4.	Brinell Hardness Testing Machine	1
5.	Rockwell Hardness Testing Machine	1
6.	Spring Testing Machine for tensile and compressive loads	1
7.	Muffle Furnace	1
8.	Rosette strain gauge	1
9.	Metallurgical Microscope	1
10.	Disc Polishing Machine	1

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: STRENGTH OF MATERIALS LABORATORY		**Course Code : 20ME3L1**			
CO	**Course Outcomes**	**Unit**	**K–CO**	**POs**	**PSOs**
C207.1	Explain the concept of determining stresses and strains from the member forces.	1	K3	1,2,3,5	1,2
C207.2	Apply the basic concepts and effects of axial loads, shear, and torsion on structural components.	2,3, 4,5	K3	1,2,3	1,2
C207.3	Determine the young's modulus of beams by means of deflection of beam experiments	6	K3	1,2,3,8,9	1,2
C207.4	Calculate the hardness of different materials by means of Brinell and Rockwell hardness experiments	7,8	K3	1,2,3,10	1,2
C207.5	Calculate the modulus of rigidity and stiffness of spring by means of open coil and closed coil experiments	9,10	K3	1,2,3	1,2
C207.6	Calculate the hardness and Physical insight into the behaviour materials by means of hardening and tempering experiments.	11,12	K3	1,2,3,10	1,2

CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C207.1	3	2	1	-	1	-	-	-	-	-	-	-	2	1	-
C207.2	3	2	1	-	-	-	-	-	-	-	-	-	2	1	-
C207.3	3	2	1	-	-	-	-	1	2	-	-	-	2	1	-
C207.4	3	2	1	-	-	-	-	-	-	2	-	-	2	1	-
C207.5	3	2	1	-	-	-	-	-	-	-	-	-	2	1	-
C207.6	3	2	1	-	-	-	-	-	-	2	-	-	2	1	-

20ME3L2 FLUID MECHANICS AND MACHINERY LABORATORY

L	T	P	C
0	0	3	1.5

OBJECTIVES:

- To determine the coefficient of discharge for Orifice meter and Venturimeter.
- To measure rate of flow using rotameter.
- To study the performance characteristics of various hydraulic pumps.
- To conduct performance tests in hydraulic turbines.
- To gain practical knowledge about friction factor.

PREREQUISITE: NIL

LIST OF EXPERIMENTS

1.	Determination of coefficient of discharge for Orifice meter.
2.	Determination of coefficient of discharge for Venturimeter
3.	Determination of rate of flow using Rotameter and its calibration.
4.	Performance characteristics of Centrifugal pump
5.	Performance characteristics of Submergible pump.
6.	Performance characteristics of Reciprocating pump
7.	Performance characteristics of Gear pump.
8.	Performance characteristics of Pelton turbine.
9.	Performance characteristics of Francis turbine.
10.	Performance characteristics of Kaplan turbine.
11.	Determination of friction factor for flow through pipes.

TOTAL: 45 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S. No.	Name of The Equipment	Quantity
1	Orifice meter	1
2	Venturimeter	1
3	Rotameter	1
4	Centrifugal pump	1
5	Submergible pump.	1
6	Reciprocating pump	1
7	Gear pump.	1
8	Pelton turbine.	1
9	Francis turbine.	1
10	Kaplan turbine.	1
11	Pipe friction apparatus	1

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: FLUID MECHANICS AND MACHINERY LABORATORY														**Course Code : 20ME3L2**			
CO	**Course Outcomes**													**Unit**	**K–CO**	**POs**	**PSOs**
C208.1	Determine the coefficient of discharge for Orificemeter and Venturimeter													1,2	K3	1,2,3, 8,9,10	1,2,3
C208.2	Determine the rate of flow using Rotameter and calibrate it													3	K3	1,2,3, 8,9,10	1,2,3
C208.3	Predict performance characteristics of centrifugal pump and submergible pump.													4,5	K3	1,2,3, 8,9,10	1,2,3
C208.4	Predict performance characteristics of reciprocating pump and gear pump.													6,7	K3	1,2,3, 8,9,10	1,2,3
C208.5	Predict performance characteristics of turbines.													8,9,10	K3	1,2,3, 8,9,10	1,2,3
C208.6	Determine the friction factor for flow through pipes.													11	K3	1,2,3, 5,8,9,10	1,2,3
CO-PO Mapping																	
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**		
C208.1	3	2	1	0	-	-	-	2	2	2	-	-	3	2	1		
C208.2	3	2	1	0	-	-	-	2	2	2	-	-	3	2	1		
C208.3	3	2	1	0	-	-	-	2	2	2	-	-	3	2	1		
C208.4	3	2	1	0	-	-	-	2	2	2	-	-	3	2	1		
C208.5	3	2	1	0	-	-	-	2	2	2	-	-	3	2	1		
C208.6	3	2	1	0	1	-	-	2	2	2	-	-	3	2	1		

IV – SEMESTER

20BS401	STATISTICS AND NUMERICAL METHODS	L	T	P	C
		3	1	0	4

OBJECTIVES:

- This course aims at providing the necessary basic concepts of statistical and numerical methods and give procedures of testing of hypothesis for small and large samples for solving numerically different kinds of problems occurring in engineering and technology.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.
- To introduce the basic concepts of solving algebraic and transcendental equations and to introduce the numerical techniques of interpolation in various intervals which plays an important role in engineering and technology disciplines.

PRE-REQUISITE: NIL

UNIT - I TESTING OF HYPOTHESIS 12

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.

UNIT – II DESIGN OF EXPERIMENTS 12

One way and two way classifications - Completely randomized design – Randomized block design – Latin square design - 2^2 factorial design.

UNIT - III SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 12

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 - Eigen values of a matrix by Power method and Jacobi's method for symmetric matrices.

UNIT – IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION 12

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.

UNIT - V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 12

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 and Adams - Bash forth predictor corrector methods for solving first order equations.

TOTAL : 60 PERIODS

TEXT BOOKS:

1. Grewal. B.S. ,"Numerical Methods in Engineering and Science", Khanna Publishers, New Delhi, 14th Edition, 2016.
2. Veerajan.T., "Probability,Statistics and Random Processes", Tata McGraw Hill, New Delhi ,2006.

REFERENCES:

1. Johnson.R.A., Miller, I and Freund J., "Miller and Freund‘s Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
2. Burden.R.L and Faires, J.D, "Numerical Analysis", Cengage Learning, 9th Edition, 2016.
3. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 8th Edition, 2011.
4. Venkatraman.M.K., "Numerical Methods in Science and Engineering", National Publishing Co., Madras, 2000.
5. Subramaniam.N., "Statistics and Numerical Methods", SCM Publication,Reprint 2015.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: STATISTICS AND NUMERICAL METHODS															**Course Code : 20BS401**
CO	**Course Outcomes**														**Unit**	**K–CO**	**POs**	**PSOs**
C209.1	Apply the concepts of testing of hypothesis for large samples.														I	K3	1,2,3,8,9	1,2
C209.2	Apply t-test, chi-square and F-test for small samples.														I	K3	1,2,3,8,9	1,2
C209.3	Apply the basic concepts of design of experiments in the field of agriculture.														II	K3	1,2,3,8,9	1,2
C209.4	Solve algebraic and transcendental equations.														III	K3	1,2,3,8,9	1,2
C209.5	Solve numerical differentiation and integration using numerical techniques.														IV	K3	1,2,3,8,9	1,2
C209.6	Apply numerical techniques to solve the partial differential equations with initial and boundary conditions with engineering applications.														V	K3	1,2,3,8,9	1,2
CO-PO Mapping																		
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**			
C209.1	3	2	1					1	1				2	2				
C209.2	3	2	1					1	1				2	2				
C209.3	3	2	1					1	1				2	2				
C209.4	3	2	1					1	1				2	2				
C209.5	3	2	1					1	1				2	2				
C209.6	3	2	1					1	1	3	2	1	2	2				

20ME401	KINEMATICS OF MACHINES	L	T	P	C
		3	1	0	4

OBJECTIVES

- To understand the basic components and layout of linkages in the assembly of a system.
- To understand the principles in analyzing the assembly with respect to the displacement, velocity and acceleration at any point in a link of a mechanism.
- To understand the cam mechanisms for specified output motions.
- To understand the basic concepts of toothed gearing and kinematics of gear trains
- To understand the effects of friction in motion transmission and in machine components.

PREREQUISITE: NIL

Course Code: 20BS101, 20GE202,
Course Name: Fundamentals of Engineering Mathematics, Engineering Mechanics

UNIT - I BASICS OF MECHANISMS 12

Classification of mechanisms, Basic kinematic concepts and definitions, Degree of freedom. Mobility–Kutzbach criterion, Gruebler's criterion. Grashof's Law, Kinematic inversions of four bar mechanism, slider crank mechanism, Quick return mechanisms, Straight line generators, Universal Joint – rocker mechanisms.

UNIT – II KINEMATICS OF LINKAGE MECHANISMS 12

Velocity and acceleration analysis of four bar mechanism and slider crank mechanism by vector polygons: relative velocity and acceleration of particles in a common link, relative velocity and accelerations of coincident particles on separate links – Coriolis component of acceleration. Angular velocity and angular acceleration of links, velocity of rubbing.

UNIT - III KINEMATICS OF CAM MECHANISMS 12

Classification of cams and followers, Terminology and definitions. Displacement diagrams, Uniform velocity, parabolic, simple harmonic and cycloidal motions. Derivatives of follower motions, Layout of plate cam profiles.

UNIT – IV GEARS AND GEAR TRAINS 12

Law of toothed gearing, Involutes and cycloidal tooth profiles, Spur Gear terminology and definitions, Gear tooth action, contact ratio, Interference and undercutting. Helical, Bevel, Worm, Rack and Pinion gears.
Gear trains, Speed ratio, train value, Parallel axis gear trains, Epicyclic Gear Trains algebraic and tabular methods of finding velocity ratio of epicyclic gear trains. Tooth load and torque calculations in epicyclic gear train.

UNIT - V FRICTION 12

Surface contacts– Sliding and Rolling friction, Friction in drives, Friction in screw threads, Friction in clutches, Friction in brakes-band and Block brakes, Friction in screw jacks, wedge, vehicles.

TOTAL : 60 PERIODS

TEXT BOOKS:

1. Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", 5th Edition, Oxford University Press, 2017
2. Rattan, S.S, "Theory of Machines", 5th Edition, Tata McGraw-Hill, 2019.
3. J. K. Gupta & R S Khurmi "Theory of Machines", 14th Edition, S. Chand Publication, 2008.

REFERENCES:

1. F.B. Sayyad, "Kinematics of Machinery", MacMillan Publishers Pvt Ltd., Tech-max Educational resources, 2011.
2. Robert Norton., "Kinematics and Dynamics of machinery" 1st Edition., McGraw Hill India., 2009
3. Rao and Dukkipati, R.V, "Mechanism and Machine Theory", New Age International Pvt. Ltd., 2010.
4. Thomas Bevan, "Theory of Machines", CBS – 3rd Edition, 2010.
5. Amitabha Ghosh, Asok Kumar Mallik, "Theory of Mechanisms and Machines" East West Press, 2020.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: KINEMATICS OF MACHINES		**Course Code : 20ME401**			
CO	**Course Outcomes**	**Unit**	**K–CO**	**POs**	**PSOs**
C210.1	Calculate the degrees of freedom in simple kinematics chain	I	K3	1,2,3, 4,8	1,2,3
C210.2	Determine the velocity and acceleration analysis for simple mechanisms.	II	K3	1,2,3, 4,8,10	1,2,3
C210.3	Develop the cam profile for various type of followers.	III	K3	1,2,3, 4,5,8, 9,10	1,2,3
C210.4	Determine the speed and contact ratio of gear pair and gear trains	IV	K3	1,2,3, 4,8	1,2,3
C210.5	Determine the tooth load and torque in gear trains	IV	K3	1,2,3, 4,8	1,2,3
C210.6	Determine the friction of various machine elements	V	K3	1,2,3, 4,8,10	1,2,3

CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C210.1	3	2	1	1	-	-	-	1	-	-	-	-	2	1	1
C210.2	3	2	1	1	-	-	-	1	-	1	-	-	2	1	1
C210.3	3	2	1	1	1	-	-	2	2	1	-	-	2	1	1
C210.4	3	2	1	1	-	-	-	1	-	-	-	-	2	1	1
C210.5	3	2	1	1	-	-	-	1	-	-	-	-	2	1	1
C210.6	3	2	1	1	-	-	-	2	-	2	-	-	2	1	1

20ME402	MANUFACTURING TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the mechanics of metal cutting, tool materials and tool life.
- To gain knowledge about the working principles of turning, shaping, planning, milling, drilling and grinding machines.
- To calculate the process parameters such as cutting speed, feed, Depth of Cut & machining time.
- To understand the working principle of NC and CNC machine tools.
- To gain knowledge about CNC Programming.

PRE-REQUISITE: NIL

UNIT - I THEORY OF METAL CUTTING 9

Mechanics of chip formation, Cutting forces in orthogonal and oblique cutting, Merchant circle diagram and measurement of cutting forces, Types of chips, single point cutting tool – nomenclature, cutting tool materials, tool wear, tool life and Taylor's equation, variables affecting tool life, Thermal effects, cutting fluids and Machinability. Economics of machining

UNIT – II TURNING MACHINES 9

Centre lathe and Capstan and turret lathe: constructional features, specification, lathe accessories, operations, calculation of process parameters (cutting speed, feed, Depth of Cut) & machining time.
Automats: single spindle: swiss type, multi spindle

UNIT - III SPECIAL PURPOSE MACHINE TOOLS 9

Shaping, Planning, Drilling, Milling Machines: Classification, Constructional features (Horizontal Shaper and Planner, Radial & Bench Drilling machines, Column and Knee & Vertical Milling machine), specification, driving mechanisms, operations, calculation of process parameters, (cutting speed, feed, Depth of Cut) & machining time.
Gear cutting: Indexing calculations in milling machine, Gear hobbing, Gear shaping processes.

UNIT – IV GRINDING MACHINES 9

Constructional features (cylindrical, surface, centreless and internal grinding), specification, Operations, Selection of grinding wheel, mounting, glazing & loading, dressing, balancing, calculation of process parameters (cutting speed, feed, Depth of Cut) & machining time, honing, lapping, polishing and buffing.

UNIT - V NC AND CNC MACHINES 9

Numerical Control (NC) and Computer Numerical Control (CNC) machine tools – Construction and working principle - CNC programming – Lathe and Milling.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Hajra Choudhury, "Elements of Workshop Technology", Vol.II., Media Promoters 2014
2. Rao. P.N "Manufacturing Technology - Metal Cutting and Machine Tools" (Vol. – II), 4th Edition, Tata McGraw-Hill, New Delhi, 2018.
3. Geofrey Boothroyd, "Fundamentals of Metal Machining and Machine Tools", Mc Graw Hill, 3rd Edition, 2006

REFERENCES:

1. Chapman, W.A.J., Workshop Technology, Vol - II, Oxford & IBH Publishing Co. Ltd., 2007
2. HMT, "Production Technology", Tata McGraw Hill, 28th Reprint, 2008.
3. Philip F. Oswald, and Jairo Munoz, “Manufacturing Process and Systems”, John Wiley India Edition, 9th Edition, Reprint 2008.
4. Mikell P.Groover, “Fundamentals of Modern Manufacturing”, Wiley India Edition, 3rd Edition, Reprint, 2012.
5. E. Paul DeGarmo, J.T. Black and Ronald A. Kohser, “Degarmo's Materials and Processes in Manufacturing”, John Wiley & Sons, 11th Edition 2011.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: MANUFACTURING TECHNOLOGY		**Course Code : 20ME402**			
CO	**Course Outcomes**	**Unit**	**K–CO**	**POs**	**PSOs**
C211.1	Calculate the cutting forces in orthogonal cutting and cutting tool life.	I	K3	1,2,3, 8,10	1,2,3
C211.2	Develop process sheet for machining operation of a given part in turning machine	II	K3	1,2,3, 8,10,12	1,2,3
C211.3	Calculate the machining time for producing components in shaper, drilling and milling machine.	III	K3	1,2,3,8	1,2,3
C211.4	Identify and select suitable abrasive process for producing a given product and explain the process in detail.	IV	K3	1,2,3,8	1,2,3
C211.5	Explain the constructional features and working principles of NC/CNC machine tools	V	K2	1,2,8,9, 10,12	1,2,3
C211.6	Develop CNC program for the given part	V	K3	1,2,3,8, 9,10,12	1,2,3

CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C211.1	3	2	1	-	-	-	-	1	-	1	-	-	2	2	2
C211.2	3	2	1	-	-	-	-	2	-	2	-	2	2	2	2
C211.3	3	2	1	-	-	-	-	1	-	-	-	-	2	2	2
C211.4	3	2	1	-	-	-	-	1	-	-	-	-	2	2	2
C211.5	2	1	-	-	-	-	-	1	2	1	-	1	2	2	2
C211.6	3	2	1	-	-	-	-	2	2	1	-	1	2	2	2

20ME403 THERMAL ENGINEERING

L	T	P	C
3	1	0	4

(Use of standard refrigerant property data book, Steam Tables, Mollier diagram and Psychrometric chart permitted)

OBJECTIVES:

- To understand thermodynamic concepts to different air standard cycles.
- To understand various IC engine Performance parameters.
- To understand the various Refrigeration systems and Coefficient of performance of Refrigeration systems.
- To understand the importance of Psychrometric process and Air conditioning systems.
- To understand the single stage and multistage air compressors.

PRE-REQUISITE: NIL

Course Code: 20ME304
Course Name: Engineering Thermodynamics.

UNIT - I GAS POWER CYCLES 12

Classification of IC engines, Working of two and four stroke engines, Valve and Port timing diagrams, Comparison of air and fuel standard cycles.
Air Standard Cycles - Otto, Diesel, Dual, Brayton. Cycle Analysis, Performance and Comparison.

UNIT – II INTERNAL COMBUSTION ENGINE: COMBUSTION AND PERFORMANCE 12

Fuels for IC engines, Combustion in SI and CI engines, Knocking and detonation – phenomena and control. Engine exhaust emissions and air pollution, Emissions control technique. Performance parameters and calculations. Morse and Heat Balance tests.

UNIT - III REFRIGERATION SYSTEMS 12

Refrigerants, Vapour compression refrigeration cycle- Super heating, Sub cooling. Performance calculations. Vapour absorption refrigeration system – Ammonia - water, Lithium bromide - water.

UNIT – IV PSYCHROMETRIC PROCESSES AND AIR CONDITIONING SYSTEMS 12

Psychrometric process, Air conditioning system – Working principles and concept of RSHF, GSHF, ESHF, Cooling Load calculations.

UNIT - V RECIPROCATING AIR COMPRESSOR 12

Compressors, Classification of compressors, Performance of reciprocating air compressor, Effect of clearance volume. Multi stage reciprocating air compressor. Optimum intermediate pressure for perfect inter cooling, Compressor mean effective pressure.

TOTAL : 60 PERIODS

TEXT BOOKS:

1. Rajput. R. K., “Thermal Engineering” S.Chand Publishers, 10th Edition, 2018
2. Kothandaraman.C.P., Domkundwar. S, Domkundwar. A.V., “A course in thermal Engineering", 5th Edition, ”Dhanpat Rai & sons , 2016
3. Nag.P.K., Engineering Thermodynamics, 6th Edition, Tata McGraw-Hill, New Delhi 2017.

REFERENCES:

1. Cengel. Y and M.Boles, "Thermodynamics - An Engineering Approach", 7th Edition, Tata McGraw Hill, 2010.
2. Michael J. Moran, Howard N. Shapiro, “Fundamentals of Engineering Thermodynamics”, 8th Edition, 2003.
3. Sarkar, B.K, “Thermal Engineering” Tata McGraw-Hill Publishers, 2007
4. Sonntag, R.E., Borgnakke, C., and Van Wylen, Fundamentals of Thermodynamics, 7th Edition, Wiley Eastern Ltd, 2009.
5. Rudramoorthy, R, “Thermal Engineering “,Tata McGraw-Hill, New Delhi,2003

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: THERMAL ENGINEERING													**Course Code : 20ME403**		
CO	**Course Outcomes**												**Unit**	**K–CO**	**POs**	**PSOs**
C212.1	Calculate efficiency of gas power cycles												I	K3	1,2,3, 10,12	1,2,3
C212.2	Explain the working of IC engines												II	K2	1,2,3, 10	1,2,3
C212.3	Determine the performance parameters of IC engines												II	K3	1,2,3, 6,10	1,2,3
C212.4	Calculate the performance of refrigeration cycles												III	K3	1,2,3, 8,10	1,2,3
212.5	Determine cooling load using psychrometric chart												IV	K3	1,2,3, 9	1,2,3
C212.6	Determine the performance of reciprocating air compressors												V	K3	1,2,3, 10	1,2,3
CO-PO Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	
C212.1	3	2	1	0	0	0	0	0	0	2	0	2	3	2	1	
C212.2	3	2	1	0	0	0	0	0	0	2	0	0	3	2	1	
C212.3	3	2	1	0	0	2	0	0	0	2	0	0	3	2	1	
C212.4	3	2	1	0	0	0	0	2	0	2	0	0	3	2	1	
C212.5	3	2	1	0	0	0	0	0	2	0	0	0	3	2	1	
C212.6	3	2	1	0	0	0	0	0	0	2	0	0	3	2	1	

20HS401	ENVIRONMENTAL SCIENCE AND ENGINEERING (Common to all B.E. / B.Tech Programmes)	L	T	P	C
		2	0	0	2

OBJECTIVES

- To study the scope and significance of environment
- To understand the interrelationship between living organism and environment
- To get a conceptual knowledge on various types of pollution and its effects
- To gain knowledge on various natural resources and its significances
- To provide knowledge on solid wastes ,disposal methods and natural disasters and its management
- To learn social issues such as human welfare, sustainability related to population

PREREQUISITE: NIL

UNIT - I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 6

Environment – definition, importance, public awareness Ecosystem – concept, structure and function– producers, consumers and decomposers - characteristic features, structure and function of the forest ecosystem and grassland ecosystem. Biodiversity– definition, types - genetic, species and ecosystem diversity – values - consumptive use, productive use, social, ethical, aesthetic and option values – hot-spots of biodiversity –threats to biodiversity: habitat loss, poaching of wildlife – endangered and endemic species of India – Assignment on conservation of biodiversity.

UNIT – II ENVIRONMENTAL POLLUTION 6

Definition, causes, effects and control measures of (i) Air pollution (ii) Water pollution (iii) Soil pollution (iv) Marine pollution – role of an individual in prevention of pollution – pollution case studies -Climate change - global warming, acid rain, ozone layer depletion.

UNIT - III NATURAL RESOURCES 6

Forest resources: Uses, over-exploitation, deforestation, case studies Water resources: Surface water and ground water - uses, over-utilization, conflicts over water, Conservation of water - rain water harvesting, dams-benefits and problems. Mineral resources: uses,over exploitation, environmental effects of extracting mineral resources, case studies.

UNIT – IV SOLID WASTE AND DISASTER MANAGEMENT 6

Solid waste management Introduction, types ,effects on human beings and disposal management. Disaster management Introduction, causes, effects and management of flood, cyclone, earthquake, landslide disasters – case studies- roles and responsibilities of Government and community.

UNIT - V HUMAN POPULATION AND SOCIAL ISSUES 6

Population growth, population explosion – family welfare programme –women and child welfare – human rights – value education – sustainable development – resettlement and rehabilitation –waste land reclamation – role of information technology in environment and human health- Debate on women and child welfare.

TOTAL : 30 PERIODS

TEXT BOOKS:

1. Anubha Kaushik and Kaushik C.P., Environmental Science and Engineering, New Age International (P) Ltd, Sixth Edition, 2018.
2. Benny Joseph, Environmental Science and Engineering, Tata McGraw-Hill Publishing Company Ltd, New Delhi, ISBN: 0070601690, 2006.

REFERENCES:

1. Erach Bharucha, “Text book of Environmental Studies”, Universities Press (I) PVT LTD, Hyderabad, 2015
2. G. Tyler Miller and Scott E.Spoolman, “Environmental Science”, Cengage Learning India PVT, LTD, Delhi, 2014
3. Gilbert M. Masters, “Introduction to Environmental Engineering and Science”, 2nd edition, Pearson Education, 2004

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: ENVIRONMENTAL SCIENCE AND ENGINEERING		**Course Code : 20HS401**			
CO	**Course Outcomes**	**Unit**	**K–CO**	**POs**	**PSOs**
C213.1	Describe the environment ecosystem and their significances.	I	K2	6,7	3
C213.2	Identify the threats to biodiversity and methods to conserve biodiversity	I	K3	6,7	3
C213.3	Identify and implement technological and economical solution to environmental pollution	II	K3	6,7	3
C213.4	Develop the knowledge on various natural resources and effect on environment due to over utililization	III	K3	6,7	3
C213.5	Record the consequences of natural disasters	IV	K2	6,7	3
C213.6	Outline the social issues such as welfare, sustainability etc., and to relate with population growth	V	K2	6,7	3

CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C213.1	-	-	-	-	-	2	3	-	-	-	-	-	-	-	2
C213.2	-	-	-	-	-	2	3	-	-	-	-	-	-	-	2
C213.3	-	-	-	-	-	2	3	-	-	-	-	-	-	-	2
C213.4	-	-	-	-	-	2	3	-	-	-	-	-	-	-	2
C213.5	-	-	-	-	-	2	3	-	-	-	-	-	-	-	2
C213.6	-	-	-	-	-	2	3	-	-	-	-	-	-	-	2

20ME404 METROLOGY AND MEASURMENT PRACTICES

L	T	P	C
3	0	2	4

OBJECTIVES

- To make the students, familiar with characteristics of generalized measurement system limits, fits and tolerances.
- To relate various types of comparators, linear and angular measurement of part.
- To understand the principles of interference, principles of form measurement.
- To understand the methods of measurements of power, flow, temperature, speed, acceleration.
- To gain practical knowledge on dimensional measurement techniques such as linear and angular measurement of part, and physical measurement techniques such as force, torque, temperature, surface finish measurements and inspection methods using calipers, comparators, gauges and measuring machines.

PREREQUISITE: NIL

UNIT - I BASICS OF METROLOGY **9**

Basics of Measurement- significance, generalized measuring system, Standards, Precision, Accuracy, Sensitivity, Repeatability, Reproducibility, Linearity, Calibration, Errors- Systematic and Random, Uncertainty of Measurement, Limits, fits and tolerances, Tolerance grades, Types of fits, IS919, GO and NO GO gauges (plug, ring, snap)- Taylor's principle, design of GO and NO GO gauges.

LAB COMPONENT **6**

1. Calibration and use of Vernier caliper, Micrometer.
2. Calibration and use of Vernier height gauge.

UNIT – II LINEAR AND ANGULAR MEASUREMENT **9**

Linear Measuring Instruments –Types, procedure, Comparators - mechanical, optical, electrical/electronic and pneumatic comparators, advantages, limitations and field of applications.
Angular measuring instruments – Types – Bevel protractor clinometers, angle gauges, spirit levels, sine bar, Angle alignment telescope, Angle dekkor, Autocollimator – Applications.

LAB COMPONENT **6**

1. Measurement of linear dimensions using comparators.
2. Measurement of angles using Bevel protractor and Sine bar.

UNIT - III FORM MEASUREMENT **9**

Principles and methods of straightness, flatness, roundness and roughness measurement, Screw Thread Measurement, Gear Measurement. Principles of measurement using Tool Maker's microscope, profile projector.

LAB COMPONENT **6**

1. Measurement of screw thread parameters using Three wire method (floating carriage micrometer).
2. Measurement of screw thread parameters using Profile Projector, Tool Maker's Microscope
3. Measurement of gear parameters using Gear tooth Vernier caliper.

UNIT – IV SPECIAL MEASURING EQUIPMENTS **9**

Principles of interference, optical flats, optical interferometer and laser interferometer, coordinate measuring machine – Construction, types, accessories and applications, machine vision. 3D Scanning metrology

LAB COMPONENT **6**

1. Testing of straightness of a machine tool guide way using Autocollimator.
2. Measurement of features in a prismatic component using Coordinate Measuring Machine (CMM).

UNIT – V MISCELLANEOUS MEASUREMENT **9**

Measurement of Force, Torque, Power : mechanical , Pneumatic, Hydraulic and Electrical type
Measurement of Flow: Differential Pressure Meters, Rotameter, Turbine Meters, Electromagnetic Flow meters, Ultrasonic Flow meters
Measurement of Temperature: Bimetallic strip, Resistance Temperature Detectors, Thermistor, Thermocouples, Pyrometers.
Measurement of Speed: Contact & non- contact type, Measurement of acceleration

LAB COMPONENT **6**

1. Measurement of force
2. Measurement of temperature
3. Measurement of torque

TOTAL : 75 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S. No.	Name of The Equipment	Quantity
1.	Micrometer	5
2.	Vernier Caliper	5
3.	Vernier Height Gauge	2
4.	Vernier depth Gauge	2
5.	Slip Gauge Set	1
6.	Gear Tooth Vernier	1
7.	Sine Bar	1
8.	Floating Carriage Micrometer	1
9.	Profile Projector / Tool Makers Microscope	1
10.	Parallel/counter flow heat exchanger apparatus	1
11.	Mechanical / Electrical / Pneumatic Comparator	1
12.	Autocollimator	1
13.	Temperature Measuring Setup	1
14.	Force Measuring Setup	1
15.	Torque Measuring Setup	1
16.	Coordinate measuring machine	1
17.	Surface finish measuring equipment	1
18.	Bore gauge	1
19.	Telescope gauge	1

TEXT BOOKS:

1. R. K. Jain, “Engineering Metrology”, Khanna Publishers, 2015
2. Gupta, I.C., Engineering Metrology, Dhanpat Rai & Sons, 2019.
3. N.V. Raghavendra and L. Krishnamurthy, “Engineering Metrology and Measurements”, Oxford University Press, 2017

REFERENCES:

1. J. P. Holman, “Experimental Methods for Engineers”, Tata McGraw Hill, 2012
2. Galyer.J.F.W. Shotbolt, C.R., “Metrology for Engineers”, ELBS with Casell Ltd., UK, 5th Edition, 1990.
3. Thomas G. Beckwith, Roy D. Marangoni, John H. Lienhard V, “Mechanical Measurements”, Pearson Learning Solution, 2011.
4. Ernest O. Doebelin, “Measurement Systems: Application and Design” McGraw Hill Education, 2017
5. Alan S Morris, Reza Langari, “Measurement and Instrumentation”, Academic Press, 2012

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: **METROLOGY AND MEASUREMENT PRACTICES**		**Course Code : 20ME404**				
CO	**Course Outcomes**	**Unit**	**EXP**	**K–CO**	**POs**	**PSOs**
C214.1	Design tolerances and fits for a selected product quality.	1	-	K3	1,2,3, 8,10	1,2
C214.2	Select a suitable comparator/ angular measuring device for inspecting the products in a given industry.	2	-	K3	1,2,3, 9,10	1,2
C214.3	Choose appropriate method and instruments for inspection of various forms.	3	-	K3	1,2,3, 8,10	1,2
C214.4	Select suitable advanced measuring instruments for special requirement in the industries.	4	-	K3	1,2,3,5, 12	1,2
C214.5	Choose appropriate method for the measurement of power, flow for a given application.	5	-	K3	1,2,3,8	1,2
C214.6	Conduct experiments on various dimensional/physical measuring instruments and determine the parameters like diameter, angle, straightness, force, temperature, torque etc.,	-	1,2,3, 4,5,6, 7,8,9, 10,11,12	K3	1,2,3,5, 8,9,10	1,2

CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C214.1	3	2	1	-	-	-	-	2	-	2	-	-	3	2	-
C214.2	3	2	1	-	-	-	-	-	2	2	-	-	3	1	-
C214.3	3	2	1	-	-	-	-	2	-	2	-	-	2	2	-
C214.4	3	2	1	-	3	-	-	-	-	-	-	-	2	2	-
C214.5	3	2	1	-	-	-	-	2	-	-	-	-	2	2	-
C214.6	3	2	1	-	3	-	-	1	2	2	-	-	2	2	-

20ME4L1 MANUFACTURING TECHNOLOGY LABORATORY

L	T	P	C
0	0	3	1.5

OBJECTIVES:

- To practice the various operations that can be performed in Lathe.
- To gain practical knowledge about shaper, drilling, milling machines etc.
- To understand the various grinding processes.
- To measure the cutting forces in Turning/ Milling Process.
- To write CNC programs for Machining processes.

PREREQUISITE: NIL

LIST OF EXPERIMENTS

1.	External Thread cutting in lathe
2.	Eccentric Turning in lathe
3.	Square Head Shaping
4.	Spur gear cutting in milling machine
5.	Helical gear cutting in milling machine
6.	Contour milling in vertical milling machine
7.	Angular drilling in Radial drilling machine
8.	Gear generation in gear hobbing machine
9.	Gear generation in gear shaping machine
10.	Surface grinding and Cylindrical grinding
11.	Measurement of cutting forces in Milling / Turning Process
12.	Simple CNC Programming – Lathe and Milling

TOTAL: 45PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S. No.	Name of The Equipment	Quantity
1.	Centre Lathes	7
2.	Shaper	1
3.	Radial Drilling Machine	1
4.	Horizontal Milling Machine	1
5.	Vertical Milling Machine	1
6.	Surface Grinding Machine	1
7.	Cylindrical Grinding Machine	1
8.	Centerless grinding machine	1
9.	Gear Hobbing Machine	1
10.	Gear Shaping machine	1
11.	Lathe Tool Dynamometer	1
12.	Milling Tool Dynamometer	1
13.	CNC Lathe	1
14.	CNC Milling machine	1

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: MANUFACTURING TECHNOLOGY LABORATORY		**Course Code : 20ME4L1**			
CO	**Course Outcomes**	**Unit**	**K–CO**	**POs**	**PSOs**
C215.1	Perform various operations in Lathe.	1,2	K3	1,2,3,5, 8,9,10, 12	1,2,3
C215.2	Perform shaping, drilling and milling operations	3,4, 6,7	K3	1,2,3,5, 8,9,10, 12	1,2,3
C215.3	Generate gear profile using milling, gear hobbing and gear shaping machines.	5,8, 9	K3	1,2,3,5, 8,9,10, 12	1,2,3
C215.4	Use grinding machine for surface finishing operations on simple parts	10	K3	1,2,3,5, 8,9,10, 12	1,2,3
C215.5	Calculate cutting forces using cutting tool dynamometer in Turning/ Milling Process	11	K3	1,2,3,5, 8,9,10	1,2,3
C215.6	Develop CNC programming for the simple components produced in CNC lathe and CNC milling	12	K3	1,2,3,5, 8,9,10, 12	1,2,3

CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C215.1	3	2	1	-	1	-	-	1	3	1	-	1	2	2	2
C215.2	3	2	1	-	1	-	-	1	3	1	-	1	2	2	2
C215.3	3	2	1	-	1	-	-	1	3	1	-	1	2	2	2
C215.4	3	2	1	-	1	-	-	1	3	1	-	1	2	2	2
C215.5	3	2	1	-	1	-	-	1	3	1	-	-	2	2	2
C215.6	3	2	1	-	1	-	-	1	3	1	-	1	2	2	2

20ME4L2 THERMAL ENGINEERING LABORATORY

L	T	P	C
0	0	3	1.5

OBJECTIVES:

- To understand the construction, working and performance of I.C.Engines.
- To measure viscosity of lubricants
- To measure performance characteristics of refrigerator.
- To determine COP of an air conditioner.
- To gain practical knowledge about the working of air compressor.

PREREQUISITE: NIL

LIST OF EXPERIMENTS

1.	Valve Timing diagrams of four stroke diesel engine and Port Timing diagrams of two stroke petrol engine.
2.	Determination of Flash Point and Fire Point of various fuels / lubricants.
3.	Determination of viscosity of a lubricant.
4.	Determination of p-v diagram of IC engine using Data acquisition system.
5.	Performance Test on 4 – stroke Diesel Engine.
6.	Heat Balance Test on 4 – stroke Diesel Engine.
7.	Retardation Test on a Diesel Engine.
8.	Morse Test on Multi-cylinder Petrol Engine
9.	Determination of COP of a refrigeration system.
10.	Performance test in a HC Refrigeration System.
11.	Determination of COP of an air conditioning system.
12.	Performance test on a reciprocating air compressor.

TOTAL: 45PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S. No.	Name of The Equipment	Quantity
1.	I.C Engine – 2 stroke and 4 stroke model.	1
2.	Apparatus for Flash and Fire Point.	1
3.	Viscometer	1
4.	4-stroke Diesel Engine with mechanical loading.	1
5.	4-stroke Diesel Engine with hydraulic loading.	1
6.	4-stroke Diesel Engine with electrical loading.	1
7.	Multi-cylinder Petrol Engine.	1
8.	Refrigeration test rig.	1
9.	Air-conditioning test rig.	1
10.	Reciprocating air compressor.	1
11.	Refrigeration test rig with HC as the Refrigerant.	1

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: THERMAL ENGINEERING LABORATORY		**Course Code : 20ME4L2**			
CO	**Course Outcomes**	**Unit**	**K–CO**	**POs**	**PSOs**
C216.1	Conduct tests on I.C Engine – 2 stroke and 4 stroke model and Calculate Valve Timing and Port Timing Values	1	K3	1,2,3, 8,9,10	1,2,3
C216.2	Conduct tests on Flash and Fire Point apparatus and determine the value of Flash and Fire Point of fossil fuels and Lubricants.	2,3	K3	1,2,3, 8,9,10	1,2,3
C216.3	Conduct Performance tests on Diesel and Petrol engine Test rigs and analyze the performance Parameters of different engines.	4,5,6, 7,8	K3	1,2,3,6 8,9,10	1,2,3
C216.4	Conduct tests on refrigeration test rigs and determine the COP of refrigeration test rigs.	9,10	K3	1,2,3, 8,9,10	1,2,3
C216.5	Conduct tests on air conditioning test rigs and determine the COP of air conditioning test rigs.	11	K3	1,2,3, 8,9,10	1,2,3
C216.6	Conduct tests on reciprocating air compressor test rigs and determine the volumetric efficiency of reciprocating air compressor test rigs.	12	K3	1,2,3, 8,9,10	1,2,3

CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C216.1	3	2	1	--	--	--	--	1	**3**	2	--	--	3	1	1
C216.2	3	2	1	--	--	--	--	1	3	2	--	--	3	1	1
C216.3	3	2	1	--	--	1	--	1	3	2	--	--	3	1	1
C216.4	3	2	1	--	--	--	--	1	3	2	--	--	3	1	1
C216.5	3	2	1	--	--	--	--	1	3	2	--	--	3	1	1
C216.6	3	2	1	--	--	--	--	1	3	2	--	--	3	1	1

V – SEMESTER

20ME501	DESIGN OF MACHINE ELEMENTS	L	T	P	C
		3	1	0	4

(Use of PSG Design data book is permitted)

OBJECTIVES

- To understand the procedure for choosing standard data.
- To understand the selection of suitable material properties for the requirement.
- To know about the theories of failure.
- To know about the design procedure for shaft, couplings, joints and springs.
- To understand the theory of lubrication and the design procedure for bearings.

PREREQUISITE:

Course Code: 20BS202, 20GE202, 20ME301
Course Name: Applied Physics, Engineering Mechanics, Strength of materials

UNIT - I INTRODUCTION 12

Basic requirements of machine elements, Use of standards in design, Aesthetic and ergonomic considerations in Design, Selection of Materials, Determination of Loads, Deflection in simple machine parts, Theories of Failure, Factor of safety, Design against Static Load, , Design against Fluctuating loads, Fatigue failure theories.

UNIT – II DESIGN OF SHAFTS AND COUPLINGS 12

Shaft materials, Design of solid and hollow shafts on strength and torsional rigidity basis, Types of keys, Design of square, flat and Kennedy keys, Design of splines, Design of Couplings - Rigid and flexible couplings.

UNIT – III DESIGN OF SPRINGS AND POWER SCREWS 12

Springs: Types of springs, Terminology of helical spring, Styles at end, series and parallel connection,-exponential relationship Spring material, Design of helical, concentric, multi leaf Springs against variable loading, Surge in springs.
Power screws: Forms of threads, Terminology, Torque requirement, self-locking, Design of power screw.

UNIT – IV DESIGN OF JOINTS 12

Threaded joints, Screw threads –Terminology, ISO metric, Bolted joint – Simple analysis and eccentrically loaded, Welded joints - Butt, parallel fillet and transverse fillet welds - Welded joints subjected to axial and eccentric load, bending and torsional moment.
Types of rivet heads, rivet materials, Types of failure, Longitudinal butt joint, circumferential lap joint, eccentrically loaded riveted joint for boiler shells. Joint failure and evaluation, Fail - safe design

UNIT - V DESIGN OF BEARINGS 12

Rolling contact bearings – types, selection, static and dynamic load carrying capacity, Design for cyclic loads and speeds, Reliability of bearings, bearing failure – causes and remedies.
Sliding contact bearing – basic modes of lubrication, Petroff's equation, Mckee's investigation, Bearing design – selection of parameters, bearing construction, bearing materials, Lubricating oils, selection of lubricants, bearing failure – causes and remedies.
Comparison of rolling and sliding contact bearings.

TOTAL : 60 PERIODS

TEXT BOOKS:

1. Bhandari V B, “Design of Machine Elements”, Tata McGraw-Hill Book Co, 5th Edition, 2020.
2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett “Mechanical Engineering Design”, 11th Edition, Tata McGraw-Hill, 2020.
3. Robert C. Juvinall and Kurt M. Marshek, “Fundamentals of Machine Design”, Global Edition, Wiley, 2018.

REFERENCES:

1. Sundararajamoorthy T. V. Shanmugam .N, “Machine Design”, Anuradha Publications, Chennai, 2018.
2. Alfred Hall, Halowenko, A and Laughlin, H., “Machine Design”, Tata McGraw-HillBookCo.(Schaum’s Outline), 2010
3. Bernard Hamrock, Steven Schmid,Bo Jacobson, “Fundamentals of Machine Elements”, Tata McGraw-Hill Book Co., 3rd Edition, 2013.
4. AnselUgural, “Mechanical Design – An Integral Approach", Tata McGraw-Hill Book Co, 1stEdition, 2003.
5. Ganesh Babu, Sridhar, “Machine Design” Tata McGraw-Hill Education, 2nd Edition 2010.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: DESIGN OF MACHINE ELEMENTS														**Course Code : 20ME501**			
CO	**Course Outcomes**													**Unit**	**K–CO**	**POs**	**PSOs**
C301.1	Design the given machine component for static and fluctuating loads.													I	K3	1,2,3,4, 10,12	1,2,3
C301.2	Design a shaft/ coupling for a given application.													II	K3	1,2,3,4, 10,12	1,2,3
C301.3	Design a suitable spring under various loading conditions.													III	K3	1,2,3,4, 10,12	1,2,3
C301.4	Design a suitable joint for the given application.													IV	K3	1,2,3,4, 10,12	1,2,3
C301.5	Design suitable sliding contact bearing for the given application.													V	K3	1,2,3,4, 10,12	1,2,3
C301.6	Select suitable rolling contact bearings from data book.													V	K3	1,2,3,4, 10,12	1,2,3
CO-PO Mapping																	
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**		
C301.1	3	3	3	1	0	0	0	0	0	2	0	1	3	2	1		
C301.2	3	3	3	1	0	0	0	0	0	2	0	1	3	2	1		
C301.3	3	3	3	1	0	0	0	0	0	2	0	1	3	2	1		
C301.4	3	3	3	1	0	0	0	0	0	2	0	1	3	2	1		
C301.5	3	3	3	1	0	0	0	0	0	2	0	1	3	2	1		
C301.6	3	3	3	1	0	0	0	0	0	2	0	1	3	2	1		

20ME506	DYNAMICS OF MACHINES	L	T	P	C
		3	1	0	4

OBJECTIVES

- To provide knowledge about dynamic force analysis in reciprocating engines.
- To provide knowledge about analytical and graphical methods for calculating balancing of rotary and reciprocating masses.
- To understand about natural frequency, resonance and critical speeds.
- To study about forced vibrations, transmissibility of forces and isolation of systems.
- To study about governors and effect of gyroscope.

PREREQUISITE:

Course Code: 20ME401
Course Name: Kinematics of Machines

UNIT - I DYNAMIC FORCE ANALYSIS 12

Inertia force and D' Alembert's principle; Dynamic force analysis of mechanisms; Turning moment diagram: Fluctuation of energy and speed, mass of flywheel required for IC engines and mechanical presses.

UNIT – II BALANCING 12

Balancing of rotating masses: Masses in single plane and several planes; Balancing of reciprocating masses: Primary and secondary forces and couples, balancing of multi-cylinder inline engines, V and radial engines.

UNIT – III FREE VIBRATION 12

Basic features of vibratory systems: Elements, single degree of freedom system; Undamped free vibration: Equation of motion, natural frequency; Damped free vibration: Damping ratio, logarithmic decrement; Transverse vibration: Dunkerley"s method; Critical speed of shaft.

UNIT – IV FORCED VIBRATION 12

Torsional vibration: Two and three rotor systems, geared systems; Response to periodic force: Forcing by unbalance, support motion, force and amplitude transmissibility, vibration isolation; Vibration measurement and analysis: General considerations, vibration measurement, vibration pickups, signature analysis.

UNIT - V MECHANISM FOR CONTROL: GOVERNORS AND GYROSCOPE 12

Governors - Types - Centrifugal governors - Watt, Porter and Proell - Spring loaded governors - Hartnell and Hartung governors - Characteristics - Effect of friction - Controlling force curves.
Gyroscopes - Gyroscopic forces and torques - Gyroscopic stabilization – Gyroscopic effects in automobiles, ships and airplanes

TOTAL : 60 PERIODS

TEXT BOOKS:

1. Rattan SS, "Theory of Machines", 4th Edition, Tata Mc Graw Hill, New Delhi, 2017.
2. Thomas Bevan, "Theory of Machines", 3rd Edition, Pearson India, 2009.
3. F. B. Sayyad, "Dynamics of Machinery", McMillan Publishers India Ltd., Tech-Max Educational resources, 2019.

REFERENCES:

1. Uicker JJ, Pennock GR and Shigley JE “Theory of Machines and Mechanisms”, 5th Edition, Oxford University Press, New Delhi, 2017.
2. Khurmi, R.S.,”Theory of Machines”, S Chand Publications, 14th Edition, 2020.
3. Ballaney P L, “Theory of Machines and Mechanisms”, Khanna Publishers, 25th edition NewDelhi, 2015.
4. Ambedkar AG,” Mechanism and Machine Theory”, PHI Learning, New Delhi, 2007.
5. Robert L. Norton, "Kinematics and Dynamics of Machinery", Tata McGraw-Hill, 2009.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: DYNAMICS OF MACHINES															**Course Code : 20ME506**
CO	**Course Outcomes**											**Unit**	**K–CO**	**POs**	**PSOs**
C302.1	Determine the dynamic forces in the reciprocating engine and calculate the maximum fluctuation of energy of the flywheel using turning moment diagram.											I	K3	1,2,3,4, 10,12	1,2,3
C302.2	Calculate the required mass and the relative angular position for balancing of several masses rotating in same plane / different planes.											II	K3	1,2,3,4, 10,12	1,2,3
C302.3	Determine the natural frequency of longitudinal and transverse vibration.											III	K3	1,2,3,4, 5,10,12	1,2,3
C302.4	Calculate the critical damping, damping factor, logarithmic decrement and ratio of two consecutive amplitude for the mechanical vibrating systems.											IV	K3	1,2,3,4, 5,10,12	1,2,3
C302.5	Determine the amplitude of the forced vibration and it’s resonance.											IV	K3	1,2,3,4, 5,10,12	1,2,3
C302.6	Calculate the range of speed of the mechanical governors, and analyze the effect of gyroscopic couple on automobiles, ships and aero plane.											V	K3	1,2,3,4, 10,12	1,2,3
CO-PO Mapping															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C302.1	3	3	1	1	-	-	-	-	-	1	-	1	3	2	1
C302.2	3	3	1	1	-	-	-	-	-	1	-	1	3	2	1
C302.3	3	3	1	1	-	-	-	-	-	1	-	1	3	2	1
C302.4	3	3	1	1	1	-	-	-	-	1	-	1	3	2	1
C302.5	3	3	1	1	1	-	-	-	-	1	-	1	3	2	1
C302.6	3	3	1	1	-	-	-	-	-	1	-	1	3	2	1

		L	T	P	C
20ME503	**CAD / CAM**	**3**	**0**	**0**	**3**

OBJECTIVES

- To understand the applications of computers in design and manufacturing of mechanical components.
- To understand surface and solid modeling techniques.
- To know about the CAD standards.
- To understand part programming for manufacturing components in lathe and milling machines.
- To know about IoT enabled manufacturing system.

PREREQUISITE: NIL

UNIT - I INTRODUCTION **8**

Product life cycle, Design process- Shigley model, Computer aided design, methodology, Reasons for implementing CAD, Benefits, Applications, CAD System architecture, co-ordinate systems- 2D and 3D transformations, Projective transformation, homogeneous coordinates. Computer Aided Manufacturing – Hierarchy, Elements – CAM data base, Production management, manufacturing control.

UNIT – II GEOMETRIC MODELING **11**

Wireframe modeling and its limitations; Parametric representation of analytic curves, parametric representation of synthetic curves - Cubic spline, Bezier, B-spline, NURBS, curve manipulation;
Surface models: Types of surfaces, parametric representation of surfaces, design examples.
Fundamentals of solid modeling: Boundary representation, Constructive Solid Geometry, solid manipulations, solid modeling based applications.

UNIT – III CAD STANDARDS AND MASS PROPERTY CALCULATIONS **8**

Standards - Graphical Kernel System, standards for exchange images - Open Graphics Library, Data exchange standards. CG and interference, Geometric Tolerance, automation
Mass Property Calculations: Introduction, geometrical property formulation, mass property formulation; Design and engineering applications.

UNIT – IV CNC MACHINING AND PART PROGRAMING **9**

Classification of CNC machines, Tooling for CNC machines, Automatic tool changer, work handling devices, Drive systems – stepper and servo motors, Recirculating ball screw and nut assembly.
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.

UNIT - V IOT IN CAM **9**

Introduction, overview of IOT enabled manufacturing system, Real-time and multi-source manufacturing information sensing system, IOT enabled smart assembly station, cloud computing based manufacturing resources configuration method, Real-time key production performances analysis method, Real-time information driven production scheduling system.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Ibrahim Zeid “Mastering CAD CAM” Tata McGraw-Hill PublishingCo.2007
2. Mikell.P.Groover “Automation, Production Systems and Computer Integrated Manufacturing”, Pearson, 4th Edition 2016.
3. Dr. Sadhu Singh, “Computer Aided Design & Manufacturing, Khanna Publishers 5th Edition 2018.

REFERENCES:

1. Chris McMahon and Jimmie Browne “CAD/CAM Principles", "Practice and Manufacturing management “ 2nd Edition, Pearson Education, 2001
2. M.S.Sehrawat and J.S.Narang “CNC Machines Computer Numerical Control” Dhanpat rai & Co Publishers, 2nd Revised Edition 2002.
3. S.Kant Vajpayee “Principles of Computer Integrated Manufacturing” Prentice hall of India, New Delhi 2003
4. Dr. K.C. Jain and Vikas Gohil “ CAD/CAM/CIM” Khanna Publishers 2014.
5. K.Lalit Narayanan, K.Mallikarjuna Rao, M.M.M.Sarcar, “Computer Aided Design and Manufacturing” Prentice hall of India, New Delhi 2008

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: CAD / CAM													**Course Code : 20ME503**		
CO	**Course Outcomes**												**Unit**	**K–CO**	**POs**	**PSOs**
C303.1	Describe the design process and elements of CAM.												1	K2	1,2,3	1,3
C303.2	Explain the fundamentals of parametric curves, surfaces and Solids												2	K2	1,2,3	1,3
C303.3	Explain the different types of Standard systems used in CAD												3	K2	1,2,3	1,3
C303.4	Explain the principles of tooling and drive systems in CNC.												4	K2	1,2,3,5	1,3
C303.5	Apply CNC programming concepts to develop part programme for Lathe & Milling Machines												4	K3	1,2,3,5	1,2,3
C303.6	Explain applications of IOT in computer aided manufacturing												5	K2	1,2,3,5	1,3
CO-PO Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	
C303.1	2	1	-	-	-	-	-	1	1	1	-	-	1	-	1	
C303.2	2	1	-	-	-	-	-	1	1	1	-	-	1	-	1	
C303.3	2	1	-	-	-	-	-	1	1	1	-	-	1	-	1	
C303.4	2	1	-	-	2	-	-	1	1	1	-	-	1	-	1	
C303.5	3	2	1	-	2	-	-	1	2	1	-	-	1	1	1	
C303.6	2	1	-	-	2	-	-	1	1	1	-	-	1	-	1	

20ME507 HEAT AND MASS TRANSFER

L	T	P	C
3	1	0	4

(Use of standard HMT data book is permitted)

OBJECTIVES

- To understand the mechanisms of conductive heat transfer under steady and transient conditions.
- To understand the concepts of convective heat transfer.
- To learn the thermal analysis and sizing of heat exchangers and to understand the basic concepts of phase change transfer.
- To understand the mechanism of radiative heat transfer
- To understand the mechanism of mass transfer

PREREQUISITE:

Course Code: 20ME302, 20ME304, 20ME403
Course Name: Fluid Mechanics and Machinery, Engineering Thermodynamics, Thermal Engineering

UNIT - I CONDUCTION 12

Conduction – general 3D equation – One Dimensional Steady State Heat Conduction — plane walls and cylinders, Composite walls – Critical thickness of insulation - Conduction with Internal Heat Generation – Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis – Semi Infinite and Infinite Solids –Use of Heisler's charts.

UNIT – II CONVECTION 12

Free and Forced Convection - Hydrodynamic and Thermal Boundary Layer. Free and Forced Convection during external flow over Plates and Cylinders and Internal flow through tubes.

UNIT - III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS 12

Nusselt's theory of condensation - Regimes of Pool boiling and Flow boiling. Correlations in boiling and condensation. Heat Exchanger Types - Overall Heat Transfer Coefficient – Fouling Factors - Analysis – LMTD method - NTU method.

UNIT – IV RADIATION 12

Black Body Radiation – Grey body radiation - Shape Factor – Electrical Analogy – Radiation Shields. Radiation through gases.

UNIT - V MASS TRANSFER 12

Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state Molecular Diffusion – Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy –Convective Mass Transfer Correlations.

TOTAL : 60 PERIODS

TEXT BOOKS:

1. Holman, J.P., "Heat and Mass Transfer", Tata McGraw Hill, 10th Edition 2010
2. Yunus A. Cengel, "Heat Transfer A Practical Approach", Tata McGraw Hill, 5th Edition 2015
3. Nag, P.K., "Heat Transfer", Tata McGraw Hill, New Delhi,3rd edition 2011

REFERENCES:

1. Bergman T.L., Lavine A.S., Incropera, F.P. and Dewitt, D.P., Fundamentals of Heat and Mass Transfer, 7th ed., John Wiley, 2011.
2. Rajput R.K., A Text Book of Heat and Mass Transfer, S. Chand Publishers, 2018
3. R.C. Sachdeva, “Fundamentals of Engineering Heat & Mass transfer”, New Age International Publishers, 2009
4. Kothandaraman, C.P., "Fundamentals of Heat and Mass Transfer", New Age International, New Delhi, 2006.
5. Ozisik, M.N., "Heat Transfer", McGraw Hill Book Co., 1994.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: HEAT AND MASS TRANSFER													**Course Code : 20ME504**		
CO	**Course Outcomes**												**Unit**	**K–CO**	**POs**	**PSOs**
C304.1	Determine heat transfer rate in simple geometries under steady state and transient conditions by applying heat conduction equations.												I	K3	1,2,3,4	1,2
C304.2	Determine heat transfer in internal and external flows by applying free and forced convective heat transfer correlations.												II	K3	1,2,3,4	1,2
C304.3	Calculate heat transfer rate during boiling and condensation.												III	K3	1,2,3,4	1,2
C304.4	Determine the performance of different types of heat exchangers by applying LMTD and NTU methods of thermal analysis.												III	K3	1,2,3,4	1,2
C304.5	Calculate radiative heat transfer between different types of surfaces.												IV	K3	1,2,3,4	1,2
C304.6	Calculate mass transfer rate by applying diffusive and convective mass transfer equations and correlations.												V	K3	1,2,3,4	1,2
CO-PO Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	
C304.1	3	2	1	1	-	-	-	-	-	-	-	-	3	2	1	
C304.2	3	2	1	1	-	-	-	-	-	-	-	-	3	2	1	
C304.3	3	2	1	1	-	-	-	-	-	-	-	-	3	2	1	
C304.4	3	2	1	1	-	-	-	-	-	-	-	-	3	2	1	
C304.5	3	2	1	1	-	-	-	-	-	-	-	-	3	2	1	
C304.6	3	2	1	1	-	-	-	-	-	-	-	-	3	2	1	

20ME603	LEAN MANUFACTURING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the principles and elements of lean manufacturing.
- To understand the value chain and to map the current state of material and information flow through the value chain.
- To develop road map of lean implementation by understanding the activities.
- To apply the lean tools to implement lean manufacturing system in an organization.
- To understand about six sigma concept methodologies.

PREREQUISITE: NIL

UNIT - I INTRODUCTION TO LEAN MANUFACTURING 9

Conventional Manufacturing versus Lean Manufacturing – Necessity - Principles of Lean Manufacturing – Basic elements of lean manufacturing – Introduction to LM Tools.

UNIT – II LEAN TRANSFORMATION 9

Five step approach to transforming conventional manufacturing into Lean manufacturing plants – Value Stream Mapping – Process Cycle Efficiency – Bottlenecks and Lean Projects.

UNIT - III FLOW ENABLERS 9

Set up time reduction – Definition, philosophies, and reduction approaches. Kanban & Supermarkets, FIFO lane and Andon.

UNIT – IV LEAN TOOLS FOR CONTINUOUS IMPROVEMENT 9

TPM – Principles and implementation. 5S Principles and implementation. Poka-Yoke Principle and Implementation. Kaizen – Gemba level improvement, Problem Solving with A3 reports.

UNIT - V SIX SIGMA FUNDAMENTALS 9

Six Sigma – Definition, statistical considerations, variability reduction, design of experiments, Six Sigma implementation. Design for Six Sigma (DFSS), Design for Six Sigma Method - Failure Mode Effect Analysis (FMEA)
Various case studies of implementation of lean manufacturing at industries.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Pascal Dennis, Lean production simplified, CRC press, New York, 3rd edition , 2016
2. Steve Blank, Bob Dorf, K&S Ranch (2012) the startup Owner's Manual: The Step-By-Step Guide for Building a great company, Wiley, Kindle Edition, 2020.
3. James Womack. P, Lean thinking: Banish waste and create wealth in your corporation, Simon & Schuster, 2nd edition, 2003.

REFERENCES:

1. Design and Analysis of Lean Production Systems, Ronald G. Askin and Jeffrey B. Goldberg, Wiley, 2001.
2. Mikell P. Groover, Automation, Production Systems and CIM, Pearson Education, 4th Edition, 2016
3. Rother M. and Shook J, Learning to See: Value Stream Mapping to Add Value and Eliminate Muda , Lean Enterprise Institute, Version 1.3 , 2003
4. Jeffrey K. Liker, the Toyota Way,: 14 Management Principles from the World's Greatest Manufacturer, Tata Mc Grew Hill, 2nd Edition,2021
5. Prof. Kate & Prof. Phadke: Toyota Production System - Elementary Concepts, Everest publishing house, 1st edition, 2016

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: LEAN MANUFACTURING													**Course Code : 20ME603**		
CO	**Course Outcomes**												**Unit**	**K–CO**	**POs**	**PSOs**
C305.1	Explain the fundamental concepts of lean manufacturing												1	K2	1,2,3,8	2
C305.2	Develop a roadmap for successful implementation of lean principles												2	K3	1,2,3,8, 10	1
C305.3	Solve the industrial problems by applying the concepts of lean manufacturing												3	K3	1,2,3,8, 9,10	1
C305.4	Explain the importance and the role of TPM												4	K2	1,2,3,8	1
C305.5	Demonstrate the concepts of FMEA towards solving productivity related problems												5	K3	1,2,3,8	1
C305.6	Determine the role of Six Sigma in lean manufacturing												5	K3	1,2,3	1
CO-PO Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	
C305.1	3	2	1	-	-	-	-	1	-	-	-	-	-	1	-	
C305.2	3	2	1	-	-	-	-	1	-	1	-	-	1	-	-	
C305.3	3	2	1	-	-	-	-	2	2	1	-	-	1	-	-	
C305.4	3	2	1	-	-	-	-	1	-	-	-	-	1	-	-	
C305.5	3	2	1	-	3	-	-	1	-	-	-	-	1	-	-	
C305.6	3	2	1	-	-	-	-	2	2	1	-	-	1	-	-	

20MC501	CONSTITUTION OF INDIA (Common to all B.E. / B.Tech programmes)	L T P C 1 0 0 0

OBJECTIVES

- To enable the student to understand the importance of the constitution.
- To understand the structure of executive, legislature, and judiciary.
- To understand the philosophy of fundamental rights, duties and Emergency Provisions.
- To understand the autonomous nature of constitutional bodies like Supreme Court and high court.
- To understand the central and state relation financial and administrative.

PREREQUISITE: NIL

UNIT - I INTRODUCTION 3

History of Making of the Indian Constitution - Drafting Committee - (Composition & Working) - Philosophy of the Indian Constitution – Preamble - Salient Features

UNIT – II CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES 3

Fundamental Rights - Right to Equality - Right to Freedom - Right against Exploitation Right to Freedom of Religion - Cultural and Educational Rights - Right to Constitutional Remedies Directive Principles of State Policy - Fundamental Duties

UNIT - III ORGANS OF GOVERNANCE 3

Parliament – Composition - Qualifications and Disqualifications - Powers and Functions - Executive President – Governor - Council of Ministers - Judiciary, Appointment and Transfer of Judges, Qualifications Powers and Functions

UNIT – IV EMERGENCY PROVISIONS 3

Emergency Provisions - National Emergency, President Rule, Financial Emergency

UNIT - V LOCAL ADMINISTRATION 3

District's Administration head- Role and Importance - Municipalities – Introduction - Mayor and role of Elected Representative - CEO of Municipal Corporation - Pachayat raj – Introduction – PRI - Zila Pachayat Elected officials and their roles - CEO Zila Pachayat - Position and role-Block level - Organizational Hierarchy (Different departments) - Village level - Role of Elected and Appointed officials - Importance of grass root democracy

TOTAL : 15 PERIODS

TEXT BOOKS:

1. Rajesh Kumar, 'Universal's Guide to the Constitution of India', Universal Law Publications, 2016.
2. D.C. Gupta, 'Indian Government and Politics', Vikas Pub, 2018.

REFERENCES:

1. H.M.Sreevai, 'Constitutional Law of India', 4th Edition in 3 volumes, Universal Law Publication.
2. J.C. Johari, 'Indian Government and Politics', Shoban Lal & Co, 2012.
3. Noorani A.G.,(South Asia Human Rights Documentation Centre), 'Challenges to Civil Rights Guarantees in India', Oxford University Press, 2012.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: CONSTITUTION OF INDIA															**Course Code : 20MC501**	
CO	**Course Outcomes**														**Unit**	**K–CO**	**POs**	**PSOs**
C307.1	Explain history and philosophy of Indian Constitution.														I	K2	6,8, 9,10	-
C307.2	Explain the premises informing the twin themes of liberty and freedom from a civil rights perspective.														II	K2	6,8, 9,10	-
C307.3	Explain the powers and functions of Indian government														III	K2	6,8, 9,10	-
C307.4	Explain the emergency rules of Indian Constitution.														IV	K2	6,8, 9,10	-
C307.5	Explain the structure and functions of local administration.														V	K2	6,8, 9,10	-
CO-PO Mapping																		
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**			
C307.1	-	-	-	-	-	3	-	2	2	2	-	-	-	-	-			
C307.2	-	-	-	-	-	3	-	2	2	2	-	-	-	-	-			
C307.3	-	-	-	-	-	3	-	2	2	2	-	-	-	-	-			
C307.4	-	-	-	-	-	3	-	2	2	2	-	-	-	-	-			
C307.5	-	-	-	-	-	3	-	2	2	2	-	-	-	-	-			

20ME5L1 DYNAMICS LABORATORY

L	T	P	C
0	0	3	1.5

OBJECTIVES:

- To understand simple mechanisms like gears, cam, four bar and slider crank mechanism.
- To understand dynamic testing of machines.
- To understand the concept of torsional vibration of rotors.
- To know about the mass moment of inertia of axisymmetric bodies.
- To understand machine dynamics with various equipments like governors, gyroscopes and balancing machines.

PREREQUISITE:

Course Code: 20GE202, 20ME301, 20ME401

Course Name: Engineering Mechanics, Strength of materials, Kinematics of machines

LIST OF EXPERIMENTS

1.	Study of Kinematics of four bar, slider crank, crank rocker, double crank, double rocker, oscillating cylinder mechanisms, single and double universal joints.
2.	Study of gyroscopic effect and couple.
3.	Determine the velocity ratio of simple and compound gear train.
4.	Determine the mass moment of inertia of fly wheel and axle system.
5.	Determine the mass moment of Inertia of axisymmetric bodies using Turn Table apparatus.
6.	Determine the mass moment of Inertia using bifilar suspension and compound pendulum.
7.	Draw the controlling force diagram for Watts, Porter, Proell, and Hartnell Governors.
8.	Draw the Cam profile and study about jump phenomenon.
9.	Determine the natural frequency, damping coefficient for single and multi-degree spring mass system.
10.	Determine the natural frequency of single rotor system.
11.	Determine the natural frequency of double rotor system.
12.	Determine the critical speeds of shafts with concentrated loads.
13.	Determine the deflection in Cantilever beam under different loading conditions.
14.	Determine the unbalanced mass and relative angular setting for balancing the rotating body.

TOTAL: 45 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S. No.	Name of The Equipment	Quantity
1.	Cam follower setup.	1
2.	Motorized gyroscope.	1
3.	Governor apparatus -Watt, Porter, Proell and Hartnell governors	1
4.	Whirling of shaft apparatus	1
5.	Dynamic balancing machine	1
6.	Spring mass vibration system	1
7.	Torsional Vibration of single rotor system setup	1
8.	Gear Models	1
9.	Kinematic Models	5
10.	Turn table apparatus	1
11.	Transverse vibration setup of a cantilever	1

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: DYNAMICS LABORATORY															**Course Code : 20ME5L1**	
CO	**Course Outcomes**														**Unit**	**K–CO**	**POs**	**PSOs**
C308.1	Calculate the deflection of the cantilever beam and Determine the critical speed of the shaft.														1,2	K3	1,2,3, 4,9	1,2,3
C308.2	Determine the unbalanced mass and relative angular setting for balancing the rotating body and cam analysis														3,4	K3	1,2,3, 4,9	1,2,3
C308.3	Calculate the natural frequency of the longitudinal, transverse and torsional vibratory systems.														5,6	K3	1,2,3, 4,9	1,2,3
C308.4	Calculate the Effect of Actual Spindle Speed on Sleeve Displacement, Effect of Radius of Rotation on Centrifugal Force and draw the characteristics curve for different types of governors.														7	K3	1,2,3, 4,9	1,2,3
C308.5	Determination of Mass moment of inertia of Fly wheel and Axle system and calculate the speed ratio and train value of simple and compound gear train														8,9	K3	1,2,3, 4,9	1,2,3
C308.6	Determine the Mass Moment of Inertia of axisymmetric bodies using Turn Table apparatus, compound pendulum and bifilar suspension														10,11, 12	K3	1,2,3, 4,9	1,2,3
CO-PO Mapping																		
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**			
C308.1	3	2	1	1	-	-	-	-	2	-	-	-	2	1	1			
C308.2	3	2	1	1	-	-	-	-	2	-	-	-	2	1	1			
C308.3	3	2	1	1	-	-	-	-	2	-	-	-	2	1	1			
C308.4	3	2	1	1	-	-	-	-	2	-	-	-	2	1	1			
C308.5	3	2	1	1	-	-	-	-	2	-	-	-	2	1	1			
C308.6	3	2	1	1	-	-	-	-	2	-	-	-	2	1	1			

20ME5L2	CAD / CAM LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To gain practical experience in handling 2D drafting and 3D modelling software systems.
- To study the features of CNC Machine Tool.
- To gain knowledge in modern control systems.
- To know the application of various CNC machines.
- To know the application of CAM packages.

PREREQUISITE:

Course code: 20GE201, 20ME402
Course Name: Engineering graphics, Manufacturing Technology

LIST OF EXPERIMENTS

3D GEOMETRIC MODELLING

1. Introduction of 3D Modelling software
2. Creation of 3D assembly model of following machine elements using 3D Modelling software
    - Flange Coupling
    - Plummer Block
    - Screw Jack
    - Universal Joint
    - Geneva mechanism
    - CAM and follower mechanism
    - Quick return mechanism of shaping machine

3. Manual Part Programming.

(i). Part Programming - CNC Turning Centre

- Straight, Taper and Radius Turning.
- Thread Cutting.
- Rough and Finish Turning Cycle.
- Drilling and Tapping Cycle.
- Linear Cutting.
- Circular cutting.

(ii).

- Cutter Radius Compensation.
- Canned Cycle Operations.
- Pocketing

4. Design and fabrication of a component using extrusion based additive manufacturing.
5. Perform machining operation in the given work piece using Wire cut EDM

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S. No.	Name of The Equipment	Quantity
	HARDWARE	
1.	Computer Server	1
2.	Computer systems networked to the server	30
3.	Laser Printer	1
4.	CNC Lathe	1
5.	CNC milling machine	1
6.	3D Printer	1
7.	Wire cut EDM	1
	SOFTWARE	
8.	High end integrated modeling and manufacturing CAD / CAM software	15 licenses

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: CAD / CAM LABORATORY		**Course Code : 20ME5L2**			
CO	**Course Outcomes**	**Unit**	**K–CO**	**POs**	**PSOs**
C309.1	Practice the basic commands in 3D modeling software.	1,2	K3	1,2,3,5, 8,9,12	1,2,3
C309.2	Draw 3D part drawings and assemble them using 3D modeling software.	3,4	K3	1,2,3,5, 8,9,12	1,2,3
C309.3	Prepare manual part programming and perform machining process in CNC Lathe for the given component.	5,6, 7,8	K3	1,2,3,5, 8,9,12	1,2,3
C309.4	Prepare manual part programming and perform machining process in CNC milling for the given component.	9,10, 11,12	K3	1,2,3,5, 8,9,12	1,2,3
C309.5	Develop a component using 3D printer.	13	K3	1,2,3,5, 8,9,12	1,2,3
C309.6	Prepare a component using wire cut EDM.	14	K3	1,2,3,5, 8,9,12	1,2,3

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C309.1	3	2	1	-	3	-	-	3	3	-	-	-	2	1	1
C309.2	3	2	1	-	3	-	-	3	3	-	-	-	2	1	1
C309.3	3	2	1	-	3	-	-	3	3	-	-	-	2	1	1
C309.4	3	2	1	-	3	-	-	3	3	-	-	-	2	1	1
C309.5	3	2	1	-	3	-	-	3	3	-	-	-	2	1	1
C309.6	3	2	1	-	3	-	-	3	3	-	-	-	2	1	1

20ME5L3 HEAT AND MASS TRANSFER LABORATORY

L	T	P	C
0	0	3	1.5

OBJECTIVES:

- To learn to measure thermal conductivity of materials
- To study the free and forced convective heat transfer
- To study condensation heat transfer
- To study the performance of Heat exchangers
- To study the applicability of Stefan – Boltzmann law

PREREQUISITE:

Course Code: 20ME302, 20ME304, 20ME403

Course Name: Fluid Mechanics and Machinery, Engineering Thermodynamics, Thermal Engineering

LIST OF EXPERIMENTS

1.	Thermal conductivity measurement of pipe insulation using lagged pipe apparatus.
2.	Determination of Thermal conductivity of insulating powder, liquid and composite wall
3.	Heat transfer from pin-fin apparatus (natural & forced convection modes)
4.	Determination of heat transfer coefficient under natural convection from a vertical cylinder.
5.	Determination of heat transfer coefficient under forced convection from a tube.
6.	Determination of heat transfer coefficient in film wise and drop wise condensation
7.	Effectiveness of double pipe heat exchangers.
8.	Effectiveness of cross flow heat exchanger.
9.	Determination of Stefan – Boltzmann constant.
10.	Determination of emissivity of a grey surface.

TOTAL: 45 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No.	Name of the Equipment	Qty
1.	Guarded plate apparatus	1
2.	Lagged pipe apparatus	1
3.	Composite wall apparatus	1
4.	Thermal conductivity of insulating powder apparatus	1
5.	Pin-fin apparatus	1
6.	Natural convection-vertical cylinder apparatus	1
7.	Forced convection inside tube apparatus	1
8.	Parallel flow heat exchanger apparatus	1
9.	Counter flow heat exchanger apparatus	1
10.	Cross flow heat exchanger apparatus	1
11.	Stefan-Boltzmann apparatus	1
12.	Emissivity measurement apparatus	1

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: HEAT AND MASS TRANSFER LABORATORY		**Course Code : 20ME5L3**			
CO	**Course Outcomes**	**Unit**	**K–CO**	**POs**	**PSOs**
C310.1	Determine thermal conductivity of materials by conducting tests on heat conduction apparatus	1,2	K3	1,2,3,4	1,2,3
C310.2	Determine heat transfer rate and fin efficiency of a pin fin under natural/forced convective mode	3	K3	1,2,3,4	1,2,3
C310.3	Calculate natural/forced convective heat transfer coefficient by conducting tests on convective heat transfer apparatus.	4,5,6	K3	1,2,3,4	1,2,3
C310.4	Determine the performance of parallel/counter/cross flow heat exchangers	7,8	K3	1,2,3,4	1,2,3
C310.5	Calculate the Stefan-Boltzmann constant by conducting tests on radiative heat transfer apparatus.	9	K3	1,2,3,4	1,2,3
C310.6	Calculate the emissivity of a gray surface.	10	K3	1,2,3,4	1,2,3

CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C310.1	3	2	1	1	-	-	-	-	-	-	-	-	3	2	1
C310.2	3	2	1	1	-	-	-	-	-	-	-	-	3	2	1
C310.3	3	2	1	1	-	-	-	-	-	-	-	-	3	2	1
C310.4	3	2	1	1	-	-	-	-	-	-	-	-	3	2	1
C310.5	3	2	1	1	-	-	-	-	-	-	-	-	3	2	1
C310.6	3	2	1	1	-	-	-	-	-	-	-	-	3	2	1

VI – SEMESTER

20ME605 DESIGN OF TRANSMISSION SYSTEMS

L	T	P	C
3	1	0	4

(Use of PSG Design data book is permitted)

OBJECTIVES

- To gain knowledge on the working principle of power transmission components.
- To understand the step by step procedure for the design of mechanical drives
- To understand the force and thermal considerations for design of components.
- To learn to draw ray diagram of gear box
- To understand the design of clutches and brakes.

PREREQUISITE:
Course Code: 20ME501
Course Name: Design of Machine Elements

UNIT - I DESIGN OF BELT AND CHAIN DRIVES 12

Belt drive – Belt construction, belt length- geometric relationships, Analysis of belt tensions, conditions for maximum power, Characteristics of belt drives, Basic procedure for selection of V belt.
Chain drive – Construction of roller chain, chain length – geometrical relationship, polygonal effect, Sprocket wheels, design of chain drive. Wire ropes

UNIT – II SPUR GEARS AND HELICAL GEARS 12

Gear drives – classification, selection, Spur gear – terminology, gear trains, interference and undercutting, backlash, force analysis - beam strength, wear strength, gear tooth failure, selection of material, Design of spur gear, Spiral gears, Helical Gears – terminology, virtual number of teeth, tooth proportions, force analysis – beam strength, effective load, wear strength, design of helical gear.

UNIT - III BEVEL GEARS, WORM AND WORM GEARS 12

Bevel gears – terminology, force analysis – beam and wear strength, effective load, design of bevel gears.
Worm gears – terminology, proportion, force analysis, friction, selection of material, strength and wear rating, thermal considerations. Design of worm gears.

UNIT – IV GEAR BOXES 12

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.

UNIT - V CLUTCHES AND BRAKES 12

Clutches – torque transmitting capacity, friction materials, design of multidisk, cone, centrifugal clutches.
Brakes – energy equations, block brake with short and long shoe, pivoted block brake with long shoe, internal expanding brake, band and disk brakes.

TOTAL : 60 PERIODS

TEXT BOOKS:

1. Bhandari V B, “Design of Machine Elements”, Tata McGraw-Hill Book Co, 5th Edition, 2020.
2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett “Mechanical Engineering Design”, 11th Edition, Tata McGraw-Hill, 2020.
3. Robert C. Juvinall and Kurt M. Marshek, “Fundamentals of Machine Design”, Global Edition, Wiley, 2018.

REFERENCES:

1. Sundararajamoorthy T. V. Shanmugam .N, “Machine Design”, Anuradha Publications, Chennai, 2018.
2. Alfred Hall, Halowenko, A and Laughlin, H., “Machine Design”, Tata McGraw-HillBookCo.(Schaum’s Outline), 2010
3. Bernard Hamrock, Steven Schmid,Bo Jacobson, “Fundamentals of Machine Elements”, Tata McGraw-Hill Book Co., 3rd Edition, 2013.
4. AnselUgural, “Mechanical Design – An Integral Approach", Tata McGraw-Hill Book Co, 1stEdition,2003.
5. Ganesh Babu, Sridhar, “Machine Design” Tata McGraw-Hill Education, 2nd Edition 2010.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: DESIGN OF TRANSMISSION SYSTEMS		**Course Code : 20ME601**			
CO	**Course Outcomes**	**Unit**	**K–CO**	**POs**	**PSOs**
C311.1	Design a suitable belt drive for a given application.	I	K3	1,2,3,4, 10,12	1,2,3
C311.2	Design chain sprockets for the given power transmission conditions.	I	K3	1,2,3,4, 10,12	1,2,3
C311.3	Design spur and helical gears based on strength and wear consideration.	II	K3	1,2,3,4, 10,12	1,2,3
C311.4	Design bevel gear and worm gear pair based on strength and wear consideration.	III	K3	1,2,3,4, 10,12	1,2,3
C311.5	Design various gear boxes (sliding mesh, constant mesh, multispeed) through geometric progression, standard step ratio, ray diagram and kinematics layout.	IV	K3	1,2,3,4, 10,12	1,2,3
C311.6	Design various clutches, internal and external shoe brakes.	V	K3	1,2,3,4, 10,12	1,2,3

CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C311.1	3	3	3	1	-	-	-	-	-	2	-	1	3	2	1
C311.2	3	3	3	1	-	-	-	-	-	2	-	1	3	2	1
C311.3	3	3	3	1	-	-	-	-	-	2	-	1	3	2	1
C311.4	3	3	3	1	-	-	-	-	-	2	-	1	3	2	1
C311.5	3	3	3	1	-	-	-	-	-	2	-	1	3	2	1
C311.6	3	3	3	1	-	-	-	-	-	2	-	1	3	2	1

20ME606	FINITE ELEMENT ANALYSIS	L	T	P	C
		3	1	0	4

OBJECTIVES

- To apply knowledge of mathematics, science and engineering to the analysis of simple structures using the finite element method.
- To identify, formulate, and solve engineering problems using the finite element method.
- To perform steady-state heat transfer analysis including the effects of conduction and convection.
- To perform structural analysis of a part to determine its displacements, stress, strain and reactions.
- To study about the fatigue and nonlinear analysis.

PREREQUISITE:

Course Code: 20ME301, 20ME504/20ME507

Course Name: Strength of materials, Heat and mass transfer

UNIT - I INTRODUCTION 12

Methods to solve engineering problems, past present and future of FEA, Theoretical FEA, Variational (Ritz) method, Weighted residual method, General procedure of FEA, Types of FEA analysis.

UNIT – II ONE-DIMENSIONAL PROBLEMS 12

One Dimensional Second Order Equations, Discretization, Derivation of Shape functions, Stiffness matrices, force vectors and assembly of matrices, Solution of structural problems - Bar and Beam.

Longitudinal vibration frequencies of bars and mode shapes. Fourth Order Beam Equation, Transverse deflections and Natural frequencies of beams

UNIT - III TWO-DIMENSIONAL PROBLEMS 12

Second Order 2D Equations - Scalar and Vector Variable Functions, Variational formulation, Finite Element formulation, 3 noded triangular elements-Shape functions and element matrices and vectors.

Equations of elasticity – Plane stress, plane strain and axisymmetric problems – Body forces and temperature effects – Stress and strain calculations.

UNIT – IV HEAT FLOW PROBLEMS AND ISOPARAMETRIC FORMULATION 12

Steady state heat transfer analysis: 1D analysis of composite walls and fins – 2D analysis of thin plate

Natural co-ordinate systems, Isoparametric elements –Shape functions- stress-strain and strain-displacement relations – Numerical integration

UNIT - V FATIGUE AND NON LINEAR ANALYSIS 12

Introduction to fatigue, various approaches in fatigue analysis – SN curve, factors affecting fatigue analysis. General FEA procedure for fatigue analysis.

Introduction to non-linear analysis, Types of nonlinearity, Stress–strain measures for nonlinear analysis, General FEA procedure for nonlinear static analysis.

Simulation life cycle management - Introduction

TOTAL : 60 PERIODS

TEXT BOOKS:

1. David V Hutton “Fundamentals of Finite Element Analysis”, McGraw-Hill International Editions, 2018.
2. J.N.Reddy, “An Introduction to the Finite Element Method”, McGraw-Hill International Editions (Engineering Mechanics Series), 2018.
3. P.Seshu, “Text Book of Finite Element Analysis”, Prentice-Hall of India Pvt. Ltd. New Delhi, 2007.

REFERENCES:

1. Cook,Robert.D., Plesha,Michael.E&Witt,Robert.J. “Concepts and Applications of Finite Element Analysis”,Wiley Student Edition, 2004.
2. Chandrupatla & Belagundu, “Introduction to Finite Elements in Engineering”, 3rd Edition, Prentice-Hall of India, Eastern Economy Editions.
3. Bhatti Asghar M, "Fundamental Finite Element Analysis and Applications", John Wiley & Sons,2005 (Indian Reprint 2013)
4. Logan, D.L., “A first course in Finite Element Method”, Thomson Asia Pvt. Ltd., 2002
5. Gokhale Nitin S “Practical Finite Element Analysis” Finite To Infinite edition, 2020.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: FINITE ELEMENT ANALYSIS		**Course Code : 20ME602**			
CO	**Course Outcomes**	**Unit**	**K–CO**	**POs**	**PSOs**
C312.1	Determine the mathematical modeling constant for the given governing equation by variational and weighted residual methods.	I	K3	1,2,3,4, 12	1,2,3
C312.2	Determine the nodal stresses of the structural components using one dimensional analysis.	II	K3	1,2,3,4, 5,12	1,2,3
C312.3	Demonstrate suitable two-dimensional triangular element equation to solve structural problems under plane stress, plane strain and axisymmetric conditions.	III	K3	1,2,3,4, 5,12	1,2,3
C312.4	Determine the steady state nodal temperature for heat flow problems.	IV	K3	1,2,3,4, 5,12	1,2,3
C312.5	Determine the stress-strain and strain-displacement relations of the 2-dimensional structural problems by using isoparametric elements	IV	K3	1,2,3,4, 12	1,2,3
C312.6	Explain the FEA procedure for fatigue analysis and non linear analysis and various approaches in fatigue analysis.	V	K2	1,2,3,4, 12	1,2,3

CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C312.1	3	3	2	1	-	-	-	-	-	-	-	1	3	2	1
C312.2	3	3	2	1	1	-	-	-	-	-	-	1	3	2	1
C312.3	3	3	2	1	1	-	-	-	-	-	-	1	3	2	1
C312.4	3	3	2	1	1	-	-	-	-	-	-	1	3	2	1
C312.5	3	3	2	1	-	-	-	-	-	-	-	1	3	2	1
C312.6	3	2	1	1	-	-	-	-	-	-	-	1	3	2	1

20ME6L3	COMPUTER AIDED SIMULATION AND ANALYSIS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To understand the applications of various software tools for analysis.
- To understand geometric modeling in analysis software.
- To find the stress and other related parameters of bars, beams loaded with loading conditions.
- To derive the output from the analysis software.
- To solve real time problems using these tools.

PREREQUISITE:

Course Code: 20ME301, 20ME304, 20ME502/20ME506

Course Name: Strength of Materials, Thermal engineering, Dynamics of Machinery

LIST OF EXPERIMENTS

1.	1D application problems like composite walls/beams
2.	2D application problems like flat plates, simple shells, cylinder
3.	Stress analysis of axi – symmetric components.
4.	Modal analysis (Beams).
5.	3D modeling of pulley.
6.	3D analysis of rotating shaft.
7.	Nonlinear analysis using contact elements
8.	Thermo mechanical analysis of plate.
9.	Transient analysis of Fin.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No.	NAME OF THE EQUIPMENT	Qty.
1.	Computer Work Station	30
2.	Printer	1
3.	ANSYS Software	30 License

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: COMPUTER AIDED SIMULATION AND ANALYSIS LABORATORY		**Course Code : 20ME6L1**			
CO	**Course Outcomes**	**Unit**	**K–CO**	**POs**	**PSOs**
C317.1	Determine the stresses induced in plates and brackets	1,2	K3	1,2,3,4, 5,9,12	1,2,3
C317.2	Determine the deflection of beam with various types of loading problem	3,4	K3	1,2,3,4, 5,9,12	1,2,3
C317.3	Calculate the thermal stress and heat transfer in plates.	5,6	K3	1,2,3,4, 5,9,12	1,2,3
C317.4	Determine the Stress analysis of axi – symmetric components.	7	K3	1,2,3,4, 5,9,12	1,2,3
C317.5	Calculate the natural frequency and mode shape analysis of 2D components and beams.	8,9	K3	1,2,3,4, 5,9,12	1,2,3
C317.6	Determine the response of harmonic and transient analysis.	10,11	K3	1,2,3,4, 5,9,12	1,2,3

CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C317.1	3	2	1	1	2	-	-	-	2	-	-	1	2	1	1
C317.2	3	2	1	1	2	-	-	-	2	-	-	1	2	1	1
C317.3	3	2	1	1	2	-	-	-	2	-	-	1	2	1	1
C317.4	3	2	1	1	2	-	-	-	2	-	-	1	2	1	1
C317.5	3	2	1	1	2	-	-	-	2	-	-	1	2	1	1
C317.6	3	2	1	1	2	-	-	-	2	-	-	1	2	1	1

20ME6L4 DESIGN AND FABRICATION PROJECT

L	T	P	C
0	0	4	2

OBJECTIVES:

- To get hands on training in the fabrication of one or more components of a complete working model, designed by the student.

PREREQUISITE:

Course Code: 20ME303, 20ME501
Course Name: Manufacturing Processes, Design of machine elements

GUIDELINE FOR REVIEW AND EVALUATION

Design and Fabrication Project shall carry 100 marks and shall be evaluated through continuous assessment only. Every student is expected to present a minimum of 2 technical seminars / demonstrations per semester before the evaluation committee and for each technical seminar, marks can be equally apportioned. The three member committee appointed by Head of the Department will evaluate the seminar and at the end of the semester the marks can be consolidated and taken as the final mark. The evaluation shall be based on the seminar paper/ report (40%), presentation (40%) and response to the questions asked during presentation (20%).

TOTAL: 60 PERIODS

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: DESIGN AND FABRICATION PROJECT		**Course Code : 20ME6L2**			
CO	**Course Outcomes**	**Unit**	**K–CO**	**POs**	**PSOs**
C318.1	Identify and apply the real world and societal importance problems in the mechanical and its allied area	-	K4	1,2,3,4,5,67, 8,9,10,11,12	1,2,3
C318.2	Identify, analyze, design, implement and handle prototype projects with a complete and organized solution methodologies	-	K4	1,2,3,4,5,6,7, 8,9,10,11,12	1,2,3
C318.3	Apply modern engineering tools for solution	-	K4	1,2,3,4,5,6,7, 8,9,10,11,12	1,2,3
C318.4	Contribute as an individual or in a team in development of technical projects	-	K4	1,2,3,4,5,6,7, 8,9,10,11,12	1,2,3
C318.5	Develop effective communication skills for presentation of project related activities	-	K4	1,2,3,4,5,6,7, 8,9,10,11,12	1,2,3
C318.6	Prepare reports and examination following professional ethics	-	K4	1,2,3,4,5,6,7, 8,9,10,11,12	1,2,3

CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C318.1	3	3	2	1	1	1	1	1	1	1	1	1	2	2	2
C318.2	3	3	2	1	1	1	1	1	1	1	1	1	2	2	2
C318.3	3	3	2	1	1	1	1	1	1	1	1	1	2	2	2
C318.4	3	3	2	1	1	1	1	1	1	1	1	1	2	2	2
C318.5	3	3	2	1	1	1	1	1	1	1	1	1	2	2	2
C318.6	3	3	2	1	1	1	1	1	1	1	1	1	2	2	2

VII – SEMESTER

		L	T	P	C
20ME701	**MECHATRONICS**	**3**	**0**	**0**	**3**

OBJECTIVES

- To understand the functional key elements of mechatronics system.
- To study the characteristics and applications of various types of sensors and transducers.
- To impart knowledge in basic structure and programming of microprocessor.
- To learn about real-time interfacing system.
- To study the architecture, ladder logic program and applications of PLC.

PREREQUISITE:

Course code:20GE203
Course Name: Basic Electrical, Electronics and Instrumentation Engineering

UNIT - I INTRODUCTION TO MECHATRONICS - SENSORS AND TRANSDUCERS 9

Introduction to Mechatronics – Systems - Key elements – Concepts of Mechatronics approach – Need for Mechatronics – Emerging areas of Mechatronics – Classification of Mechatronics. Sensors and Transducers: Static and dynamic Characteristics of Sensor, Potentiometers – LVDT – Capacitance sensors – Strain gauges – Eddy current sensor– Hall effect sensor – Temperature sensors – Optical Encoders- Pyroelectric sensor- Piezoelectric sensor- tactile sensor- Light sensors.

UNIT – II MICROPROCESSOR AND MICROCONTROLLER 9

Introduction – Architecture of 8085 – Pin Configuration – Addressing Modes –Instruction set, Timing diagram of 8085- Assembly language programming – Examples. Concepts of 8051 microcontroller – Block diagram– Memory map - Addressing modes, I/O Ports.

UNIT – III PROGRAMMABLE PERIPHERAL INTERFACE 9

Introduction – Architecture of 8255, Keyboard interfacing, LED display –interfacing, ADC and DAC interface, Temperature Control – Stepper Motor Control – Traffic Control interface.

UNIT – IV PROGRAMMABLE LOGIC CONTROLLER AND VIRTUAL INSTRUMENTATION 9

Introduction – Basic structure and Specifications – Input and output processing – PLC hardware components Analog & digital I/O modules, Programming – Mnemonics – Timers, counters and internal relays – Data handling – Selection of PLC- Applications.
Virtual Instrumentation: Block diagram and architecture of a virtual instrument, data -flow techniques, graphical programming in data flows.

UNIT - V ACTUATORS AND MECHATRONIC SYSTEM DESIGN 9

Types of Stepper and Servo motors – Construction – Working Principle – Advantages and Disadvantages. Design process-stages of design process – Traditional and Mechatronics design concepts – Case studies of Mechatronics systems – Pick and place Robot – Engine Management system – Automatic car park barrier- Washing machine system- Automatic Camera.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Bolton, W “Mechatronics”, Pearson Higher Education, 2017.
2. Ramesh S Gaonkar, “Microprocessor Architecture, Programming, and Applications with the 8085”, Prentice Hall, 6th Edition, 2013.

3. Michael B.Histand and Davis G. Alciatore, “Introduction to Mechatronics and Measurement systems”, McGraw Hill International edition, 2007.

REFERENCES:

1. Bradley D.A, Dawson D, Buru N.C and Loader A.J, “Mechatronics”, Chapman and Hall, 1993.
2. Clarence W, de Silva, "Mechatronics" CRC Press, First Indian Re-print, 2015.
3. Devadas Shetty and Richard A. Kolk, “Mechatronics Systems Design”, PWS publishing company, 2007.
4. Krishna Kant, “Microprocessors & Microcontrollers”, Prentice Hall of India, 2016.
5. Jovitha Jerome, “Virtual Instrumentation Using LabVIEW”, Kindle Edition, PHI Publishers, 2010.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: MECHATRONICS		**Course Code : 20ME701**			
CO	**Course Outcomes**	**Unit**	**K–CO**	**POs**	**PSOs**
C401.1	Describe the interdisciplinary applications of Electronics, Electrical, Mechanical and Computer Systems for the Control of Mechanical, Electronic Systems and sensor technology.	I	K2	1,2,3	1,2,3
C401.2	Explain the architecture of Microprocessor and Microcontroller, Pin Diagram, Addressing Modes and Programming of Microprocessor and Microcontroller.	II	K2	1,2,3,4	1,2,3
C401.3	Discuss the Programmable Peripheral Interface, Architecture of 8255 PPI, and various device interfacing.	III	K2	1,2,3,4,5	1,2,3
C401.4	Describe the architecture, Programming and applications of Programmable Logic Controllers in industries.	IV	K2	1,2,3,4,5	1,2,3
C401.5	Explain the architecture, data flow techniques and graphical programming of Virtual Instruments.	IV	K2	1,2,3,4,5	1,2,3
C401.6	Discuss about the various actuators used in mechatronics system using the knowledge and skills acquired through the course.	V	K2	1,2,3,4,5	1,2,3

CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C401.1	2	2	1	-	-	-	-	-	-	-	-	-	2	2	1
C401.2	2	2	1	1	-	-	-	-	-	-	-	-	2	2	1
C401.3	2	2	2	1	1	-	-	-	-	-	-	-	2	2	1
C401.4	2	2	2	1	2	-	-	-	-	-	-	-	2	2	1
C401.5	2	2	2	1	2	-	-	-	-	-	-	-	2	2	1
C401.6	2	2	2	1	1	-	-	-	-	-	-	-	2	2	1

20ME7L1 MECHATRONICS LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES:

- To know the assembly language programming in microprocessor and microcontroller.
- To impart knowledge in the design, modeling & analysis of basic electrical, hydraulic, pneumatic system.
- To understand the working of interfacing circuits for stepper motor, servo motor and traffic light controller.
- To know the programming of LabVIEW and Fluidsim software.
- To understand the circuit connection for PLC based Electro Pneumatic system.

PREREQUISITE:

Course Code: 20GE203
Course name: Basic Electrical, Electronics and Instrumentation Engineering

LIST OF EXPERIMENTS

1.	Assembly language programming of 8085 – Addition – Subtraction – Multiplication – Division – Sorting – Code Conversion.
2.	Stepper motor interface.
3.	Traffic light interface.
4.	Speed control of DC motor.
5.	Study of various types of optical transducers.
6.	Study of hydraulic, pneumatic and electro-pneumatic circuits.
7.	Modelling and analysis of basic hydraulic, pneumatic and electrical circuits using software.
8.	Study of PLC based Electro Pneumatic circuit with multiple cylinder sequences.
9.	Study of Image processing technique.
10.	Real-time temperature data logging system with LabVIEW software and DAQ cards.
11.	Study of Process control trainer for controlling pressure and flow rate of the liquid.

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S. No.	Name of The Equipment	Quantity
1.	Basic Pneumatic Trainer Kit with manual and electrical Controls / PLC Control each	1
2.	Basic Hydraulic Trainer Kit	1
3.	Hydraulics and Pneumatics Systems Simulation Software	10
4.	8051 - Microcontroller kit with stepper motor and drive circuit sets	2
5.	8051 – Microcontroller kit with traffic light control and Dc motor control	1
6.	8085 microprocessor with interfacing kit	2
7.	Optical transducer trainer kit (LDR, Photo diode, Photo Transistor)	1
8.	Image processing system with hardware & software	1
9.	LabVIEW software with DAQ cards	2
10.	Process Control trainer kit	1

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: MECHATRONICS														Course Code : 20ME701		
CO	**Course Outcomes**													**Unit**	**K–CO**	**POs**	**PSOs**
C406.1	Describe the interdisciplinary applications of Electronics, Electrical, Mechanical and Computer Systems for the Control of Mechanical, Electronic Systems and sensor technology.													I	K2	1,2,3	1,2,3
C406.2	Explain the architecture of Microprocessor and Microcontroller, Pin Diagram, Addressing Modes and Programming of Microprocessor and Microcontroller.													II	K2	1,2,3,4	1,2,3
C406.3	Discuss the Programmable Peripheral Interface, Architecture of 8255 PPI, and various device interfacing.													III	K2	1,2,3,4,5	1,2,3
C406.4	Describe the architecture, Programming and applications of Programmable Logic Controllers in industries.													IV	K2	1,2,3,4,5	1,2,3
C406.5	Explain the architecture, data flow techniques and graphical programming of Virtual Instruments.													IV	K2	1,2,3,4,5	1,2,3
C406.6	Discuss about the various actuators used in mechatronics system using the knowledge and skills acquired through the course.													V	K2	1,2,3,4,5	1,2,3
CO-PO Mapping																	
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**		
C406.1	2	2	1	-	-	-	-	-	-	-	-	-	2	2	1		
C406.2	2	2	1	1	-	-	-	-	-	-	-	-	2	2	1		
C406.3	2	2	2	1	1	-	-	-	-	-	-	-	2	2	1		
C406.4	2	2	2	1	2	-	-	-	-	-	-	-	2	2	1		
C406.5	2	2	2	1	2	-	-	-	-	-	-	-	2	2	1		
C406.6	2	2	2	1	1	-	-	-	-	-	-	-	2	2	1		

20ME7L3 **TECHNICAL SEMINAR** **L T P C**
0 0 4 2

A student has to present three Technical papers or recent advances in engineering/technology that will be evaluated by a Committee constituted by the Head of the Department.

TOTAL: 60 PERIODS

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: TECHNICAL SEMINAR															**Course Code : 20EI6L3**
CO	**Course Outcomes**											**Unit**	**K–CO**	**POs**	**PSOs**
C407.1	Function effectively as an individual and Make effective presentation on Engineering/ technology.											-	K4	1-12	1,2
C407.2	Review, prepare and present technological developments in the field of mechanical engineering.											-	K4	1-12	1,2
C407.3	Design documentation and write effective reports on seminar topics											-	K4	1-12	1,2
CO-PO Mapping															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C407.1	3	3	2	1	1	1	1	1	1	1	1	1	2	2	-
C407.2	3	3	2	1	1	1	1	1	1	1	1	1	2	2	-
C407.3	3	3	2	1	1	1	1	1	1	1	1	1	2	2	-

VIII - SEMESTER

20ME8L1 **PROJECT WORK** **L T P C**
0 0 20 10

The student individually or in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL: 300 PERIODS

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : PROJECT WORK														**Course Code : 20ME8L1**		
CO	**Course Outcomes**													**Unit**	**K–CO**	**POs**	**PSOs**
C408.1	Identify and apply the real world and societal importance problems in the mechanical engineering and its allied area													-	K4	1-12	1,2,3
C408.2	Identify, analyze, design, implement and handle prototype projects with a complete and organized solution methodologies													-	K4	1-12	1,2,3
C408.3	Apply modern engineering tools for solution													-	K4	1-12	1,2,3
C408.4	Contribute as an individual or in a team in development of technical projects													-	K4	1-12	1,2,3
C408.5	Develop effective communication skills for presentation of project related activities													-	K4	1-12	1,2,3
C408.6	Prepare reports and examination following professional ethics													-	K4	1-12	1,2,3
CO-PO Mapping																	
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**		
C408.1	3	3	2	1	1	1	1	1	1	1	1	1	3	2	1		
C408.2	3	3	2	1	1	1	1	1	1	1	1	1	3	2	1		
C408.3	3	3	2	1	1	1	1	1	1	1	1	1	3	2	1		
C408.4	3	3	2	1	1	1	1	1	1	1	1	1	3	2	1		
C408.5	3	3	2	1	1	1	1	1	1	1	1	1	3	2	1		
C408.6	3	3	2	1	1	1	1	1	1	1	1	1	3	2	1		

VERTICAL – I : DESIGN AND DEVELOPMENT

		L	T	P	C
20MEV11	PRODUCT DESIGN AND DEVELOPEMENT	3	0	0	3

OBJECTIVES

- To understand various global trends and identify the scope of a new product development.
- To translate conceptual idea into detailed design.
- To understand the concept of product development.
- To impart knowledge on various industrial design process.
- To create prototype to demonstrate the product.

PREREQUISITE: NIL

UNIT - I INTRODUCTION 9

Strategic importance of Product development – Modern Product development process – Examples of Product development process - Understanding customer needs – Types of Customer needs - Gathering Customer needs – Benchmarking and Establishing Engineering Specifications – A benchmarking Approach - Examples.

UNIT – II CONCEPT GENERATION AND SELECTION 9

Task – Structured approaches – clarification – search – externally and internally – explore systematically – reflect on the solutions and processes – concept selection – methodology –benefits.

UNIT - III PRODUCT ARCHITECTURE 9

Implications – Product change – variety – component standardization – product performance –manufacturability – product development management – establishing the architecture – creation –clustering – geometric layout development – fundamental and incidental interactions – related system level design issues.

UNIT – IV DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT 9

Definition – Estimation of Manufacturing cost – reducing the component costs and assembly costs– Minimize system complexity – Prototype basics – principles of prototyping – planning for prototypes

UNIT - V INDUSTRIAL DESIGN 9

Integrated process design – Managing costs – Robust design – Need for industrial design – impact – design process – investigation of for industrial design – impact – design process– conceptualization – refinement – management of the industrial design process – technology driven products – user – driven products – assessing the quality of industrial design.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Anita Goyal, Karl T Ulrich, Steven D Eppinger, “Product Design and Development”, Tata McGraw Hill Education, 4thEdition, 2009.
2. Kevin Otto, Kristin Wood, “Product Design”, Indian Reprint 2004, Pearson Education.
3. George E Dieter, Linda C Schmidt, “Engineering Design”, Mc-Graw Hill International Edition, 5th Edition, 2012

REFERENCES:

1. Kemnneth Crow, Concurrent Engg./Integrated Product Development, DRM Associates, 26/3,Via Olivera, Palos Verdes, CA 90274(310) 377-569, Workshop Book.
2. Stephen Rosenthal, Effective Product Design and Development, Business One Orwin, Homewood, 1992.
3. Staurt Pugh, Tool Design -Integrated Methods for Successful Product Engineering, Addison Wesley Publishing, New york.
4. Reddy G B, "Intellectual Property Rights and the Law", Gogia Law Agency, 7th Edition Reprint, 2009
5. Chiu-Shui Chan, "Style and creativity in design" Springer, 2015.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: PRODUCT DESIGN AND DEVELOPEMENT		**Course Code : 20MEV11**			
CO	**Course Outcomes**	**Unit**	**K–CO**	**POs**	**PSOs**
C316E2.1	Explain the basic concepts of product design and development	I	K2	1,2,3,6, 9,10	1,2,3
C316E2.2	Describe the basic concepts of concurrent Engineering	I	K2	1,2,3,6, 9,10	1,2,3
C316E2.3	Generate various concepts for a product design and to select the best concept	II	K3	1,2,3,4, 6,9,10	1,2,3
C316E2.4	Discuss the concepts and importance of product architecture	III	K2	1,2,3,6, 9,10	1,2,3
C316E2.5	Illustrate the importance of industrial design in view of aesthetics factors and ergonomic factors	IV	K2	1,2,3,6, 9,10	1,2,3
C316E2.6	Apply design for manufacture guidelines for reducing manufacturing cost without compromising quality	V	K3	1,2,3,4, 6,9,10	1,2,3

CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C316E2.1	3	2	1	-	-	1	-	-	1	1	-	-	2	1	1
C316E2.2	3	2	1	-	-	1	-	-	1	1	-	-	2	1	1
C316E2.3	3	2	1	1	-	1	-	-	1	1	-	-	2	1	1
C316E2.4	3	2	1	-	-	1	-	-	1	1	-	-	2	1	1
C316E2.5	3	2	1	-	-	1	-	-	1	1	-	-	2	1	1
C316E2.6	3	2	1	1	-	1	-	-	1	1	-	-	2	1	1

20MEV21	PRODUCT LIFE CYCLE MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study about the history, concepts and terminology in PLM
- To apply different modules offered in commercial PLM/PDM tools.
- To understand the functions and features of PLM/PDM
- To develop the techniques of PLM/PDM approaches for industrial applications.
- To use PLM/PDM with legacy data bases, CAx & ERP systems.

PREREQUISITE: NIL

UNIT - I INTRODUCTION TO PLM 9

Introduction to PLM, Need for PLM, opportunities of PLM, Different views of PLM - Engineering Data Management (EDM), Product Data Management (PDM), Collaborative Product Definition Management (CPDM), Collaborative Product Commerce (CPC), Product Lifecycle Management (PLM). PLM/PDM Infrastructure – Network and Communications, Data Management, Heterogeneous data sources and applications.

UNIT – II PLM/PDM FUNCTIONS AND FEATURES 9

User Functions – Data Vault and Document Management, Workflow and Process Management, Product Structure Management, Product Classification and Programme Management. Utility Functions – Communication and Notification, data transport, data translation, image services, system administration and application integration.

UNIT – III DETAILS OF MODULES IN A PDM/PLM SOFTWARE 9

Case studies based on top few commercial PLM/PDM tools – Team center, Windchill, ENOVIA, Aras PLM, SAP PLM, Arena, Oracle Agile PLM and Autodesk Vault.

UNIT – IV ROLE OF PLM IN INDUSTRIES 9

Case studies on PLM selection and implementation (like auto, aero, electronic) - other possible sectors, PLM visioning, PLM strategy, PLM feasibility study, change management for PLM, financial justification of PLM, barriers to PLM implementation, ten step approach to PLM, benefits of PLM for–business, organization, users, product or service, process performance.

UNIT - V BASICS ON CUSTOMISATION / INTEGRATION OF PDM / PLM SOFTWARE 9

PLM Customization, use of EAI technology (Middleware), Integration with legacy data base, CAD, SLM and ERP

TOTAL : 45 PERIODS

TEXT BOOKS:

1. AnttiSaaksvuori and AnselmiImmonen, “Product Lifecycle Management”, Springer Publisher, 2008.
2. Michael Grieves, “Product Life Cycle Management”, Tata McGraw Hill, 2006.
3. IvicaCrnkovic, Ulf Asklund and AnnitaPerssonDahlqvist, “Implementing and Integrating Product Data Management and Software Configuration Management”, Artech House Publishers, 2003.

REFERENCES:

1. ArieKarniel and Yoram Reich, Managing the Dynamics of New Product Development Processes: A New Product Lifecycle Management Paradigm, Springer, 2011.
2. John Stark, “Global Product: Strategy, Product Lifecycle Management and the Billion Customer Question”, Springer Publisher, 2007.
3. John Stark, “Product Lifecycle Management: 21st Century Paradigm for Product Realisation”, Springer Publisher, 2011.
4. Kevin Roebuck, Product Lifecycle Management (PLM): High-impact Strategies - What You Need to Know: Definitions, Adoptions, Impact, Benefits, Maturity, Vendors, Emereo, 2011.
5. Fabio Giudice, Guido La Rosa, Product Design for the environment-A life cycle approach, Taylor & Francis 2006

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: PRODUCT LIFE CYCLE MANAGEMENT		**Course Code : 20MEV21**			
CO	**Course Outcomes**	**Unit**	**K–CO**	**POs**	**PSOs**
C405E1.1	Explain the history, concepts and terminology of PLM	I	K2	1,2,3	1,2,3
C405E1.1	Describe the functions of PLM/PDM	II	K2	1,2,3	1,2,3
C405E1.1	Explain the features of PLM/ PDM	III	K2	1,2,3	1,2,3
C405E1.1	Classify the different modules offered in commercial PLM/PDM tools.	IV	K2	1,2,3	1,2,3
C405E1.1	Predict PLM/PDM approach techniques for industrial applications.	IV	K2	1,2,3	1,2,3
C405E1.1	Explain PLM/PDM with legacy data bases, CAx& ERP systems	V	K2	1,2,3	1,2,3

CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C405E1.1	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
C405E1.1	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
C405E1.1	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
C405E1.1	3	2	1	-	-	-	-	-	-	-	-	-	3	1	1
C405E1.1	3	2	1	-	-	-	-	-	-	-	-	-	3	1	1
C405E1.1	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1

20MEV31 DESIGN OF JIGS, FIXTURES AND PRESS TOOLS

L	T	P	C
3	0	0	3

Use of P S G Design Data Book is permitted.

OBJECTIVES

- To provide knowledge about locating and clamping devices.
- To provide knowledge about functions and design principles of Jigs.
- To provide knowledge about functions and design principles of fixtures
- To provide knowledge about functions and design principles of press tools.
- To provide knowledge about the development of required views of the final design of jigs and fixtures.

PREREQUISITE:

20ME303 Manufacturing Processes

UNIT - I LOCATING AND CLAMPING PRINCIPLES 9

Objectives of tool design- Function and advantages of Jigs and fixtures – Basic elements – principles of location – Locating methods and devices – Redundant Location – Principles of clamping – Mechanical actuation – pneumatic and hydraulic actuation Standard parts – Drill bushes and Jig buttons – Tolerances and materials used

UNIT – II JIGS AND FIXTURES 9

Design and development of jigs and fixtures for given component- Types of Jigs – Post, Turnover, Channel, latch, box, pot, angular post jigs – Indexing jigs – General principles of milling, Lathe, boring, broaching and grinding fixtures – Assembly, Inspection and Welding fixtures – Modular fixturing systems- Quick change fixtures.

UNIT – III PRESS WORKING TERMINOLOGIES AND ELEMENTS OF CUTTING DIES 9

Press Working Terminologies – operations – Types of presses – press accessories – Computation of press capacity – Strip layout – Material Utilization – Shearing action – Clearances – Press Work Materials – Center of pressure- Design of various elements of dies – Die Block – Punch holder, Die set, guide plates – Stops – Strippers – Pilots – Selection of Standard parts – Design and preparation of four standard views of simple blanking, piercing, compound and progressive dies

UNIT – IV BENDING AND DRAWING DIES 9

Difference between bending and drawing – Blank development for above operations – Types of Bending dies – Press capacity – Spring back – knockouts – direct and indirect – pressure pads -Ejectors – Variables affecting Metal flow in drawing operations – draw die inserts – draw beads- ironing – Design and development of bending, forming, drawing, reverse redrawing and combination dies – Blank development for axisymmetric, rectangular and elliptic parts – Single and double action dies.

UNIT - V FORMING TECHNIQUES AND EVALUATION 9

Bulging, Swaging, Embossing, coining, curling, hole flanging, shaving and sizing, assembly, fine Blanking dies – recent trends in tool design- computer Aids for sheet metal forming Analysis – basic introduction – tooling for numerically controlled machines- setup reduction for work holding – Single minute exchange of dies – Poka Yoke.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Joshi, P.H. "Jigs and Fixtures", Tata McGraw Hill Publishing Co., 2nd Edition, 2010.
2. Joshi P.H "Press tools – Design and Construction", wheels publishing, 1996.
3. Venkataraman. K., "Design of Jigs Fixtures and Press Tools", Tata McGraw Hill, New Delhi, 2005.

REFERENCES:

1. ASTME Fundamentals of Tool Design Prentice Hall of India.
2. Design Data Hand Book, PSG College of Technology, Coimbatore.
3. Donaldson, Lecain and Goold "Tool Design", Tata McGraw Hill, 5th Edition, 2017.
4. Hoffman "Jigs and Fixture Design", Thomson Delmar Learning, Singapore, 2004.
5. Kempster, "Jigs and Fixture Design", Hoddes and Stoughton, 3rd Edition, 1974.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: DESIGN OF JIGS, FIXTURES AND PRESS TOOLS		**Course Code : 20MEV31**			
CO	**Course Outcomes**	**Unit**	**K–CO**	**POs**	**PSOs**
C405E2.1	Summarize the different methods of Locating Jigs and Fixtures and Clamping principles	I	K2	1,2,3	1,2,3
C405E2.1	Design and develop jigs and fixtures for given component	I	K3	1,2,3	1,2,3
C405E2.1	Discuss the press working terminologies and elements of cutting dies	II	K2	1,2,3	1,2,3
C405E2.1	Distinguish between Bending and Drawing dies.	III	K2	1,2,3	1,2,3
C405E2.1	Discuss the different types of forming techniques	IV	K2	1,2,3	1,2,3
C405E2.1	Summarize the different methods of Locating Jigs and Fixtures and Clamping principles	V	K3	1,2,3	1,2,3

CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C405E2.1	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
C405E2.1	3	2	1	-	-	-	-	-	-	-	-	-	3	1	1
C405E2.1	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
C405E2.1	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
C405E2.1	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
C405E2.1	3	2	1	-	-	-	-	-	-	-	-	-	3	1	1

20MEV41 PIPING DESIGN ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES

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

PREREQUISITE:

Course Code: 20GE201, 20BS202,20ME301, 20ME302
Course Name: Engineering Graphics, Applied Physics, Strength of Materials, Fluid mechanics and Machinery

UNIT - I INTRODUCTION TO PIPING 9

Introduction to Piping, Piping components- Fittings- Flanges, Valves , Gaskets ,Bolting and piping special items, Piping Codes and Standards used in power and process industries, Types of equipment's, Types of instruments, Process diagrams – PFD, UFD, P and IDs and line list etc.,

UNIT – II PIPING MATERIALS 9

Basics of metallurgy, Piping commodity's material grades, Influence of corrosion piping design, preparation of piping material specifications, piping wall thickness calculations, Branch reinforcement calculations, and Valve material specification.

UNIT - III DESIGN OF LAYOUT 9

Preparation of plot plan preparation of equipment layouts, Preparation of piping general arrangement drawings, preparation of cross sectional drawings, piping isometric drawings, Introduction to piping software tools.

UNIT – IV JUNCTION STRESSES, OPENINGS AND REINFORCEMENTS 9

Stresses in piping systems-discontinuity stresses-thermal stresses-methods of determination stresses-stress concentration in plate having circular hole due to bi-axial loading-Theory of reinforced opening and reinforcement elements.

UNIT - V INTRODUCTION TO STRESS ANALYSIS 9

Types of stresses-Significance of forces and moments in piping system-Expansion loop and bellows-pipe supports-types of supports-support selection-Support location-Support Span Calculation.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Mohinder L Nayyar, "Piping Handbook", McGraw Hill Handbook, 7th Edition, 2000.
2. George A Antaki, "Piping and Pipeline Engineering: Design, Construction, Maintenance Integrity and Repair", CRC Press, 2003.
3. 3. Roy A. Parisher, Rhea, "Pipe Drafting and Design", Gulf Professional Publishing, 2012.

REFERENCES:

1. Samkannapan, Introduction to Pipe stress analysis" Abi Enterprises Inc.,2008
2. Peter Smith, Fundamentals of piping design",Gulf publishing Company,2007
3. "Power and Process Piping Standards" ASME B 31.1 & B 31.3, 2012.
4. Kellogg M W, "Design of Piping Systems", John Wiley & Sons, 2019.
5. Liang-Chuan Peng and Tsen-Loong Peng, "Pipe Stress Engineering", ASME Press, New York, 2009.
6. Dennis R, Moss, "Pressure Vessel Design Manual", Elsevier Publications, 2004.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: PIPING DESIGN ENGINEERING														**Course Code : 20MEV41**			
CO	**Course Outcomes**													**Unit**	**K–CO**	**POs**	**PSOs**
C316E1.1	Explain the various piping components and process diagrams													1	K2	1,2,3,8, 9,10,12	2
C316E1.2	Apply various codes and standards for piping systems													1	K3	1,2,3,8, 9,10	1
C316E1.3	Calculate the piping wall thickness and branch reinforcement													2	K3	1,2,3,9	1
C316E1.4	Draw the layout for piping systems and equipment													3	K2	1,2,3,8	1
C316E1.5	Determine the stresses induced in the pipes under various loadings													4	K3	1,2,3,8, 9,10	1
C316E1.6	Explain the concept of piping layout and stresses acting on it.													5	K2	1,2,3,8, 9,10	1
CO-PO Mapping																	
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**		
C316E1.1	3	2	1	-	-	-	-	1	1	1	-	1	-	1	-		
C316E1.2	3	2	1	-	-	-	-	2	2	1	-	-	1	-	-		
C316E1.3	3	2	1	-	3	-	-	1	-	-	-	-	1	-	-		
C316E1.4	3	2	1	-	-	-	-	1	-	-	-	-	1	-	-		
C316E1.5	3	2	1	-	-	-	-	1	1	1	-	-	1	-	-		
C316E1.6	3	2	1	-	-	-	-	2	2	1	-	-	1	-	-		

20MEV51	COMPUTATIONAL FLUID DYNAMICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To apply the fundamentals of CFD, and developing case specific governing equations.
- To perform finite difference and finite volume based analysis for steady and transient diffusion problems.
- To implement various mathematical schemes under finite volume method for convention diffusion.
- To solve complex problems in the field of fluid flow and heat transfer with the support of high speed computers.
- To apply the various discretization methods, solution procedure and the concept of turbulence modeling.

PREREQUISITE:

20BS401Statistics and Numerical Methods for Mechanical Engineers
20ME302 Fluid Mechanics and Machinery
20ME403 Thermal Engineering

UNIT - I GOVERNING EQUATIONS AND BOUNDARY CONDITIONS 9

Basics of computational fluid dynamics – Governing equations– Continuity, Momentum and Energy equations – boundary conditions – Time-averaged equations for Turbulent Flow – Turbulent–Kinetic Energy Equations – Mathematical behaviour of PDEs - Elliptic, Parabolic and Hyperbolic equations.

UNIT – II FINITE DIFFERENCE AND FINITE VOLUME METHODS FOR DIFFUSION 9

Discretization methods - Finite difference methods: Well posed boundary value problem, Possible types of boundary conditions, Conservativeness, Boundedness, Transportiveness, Finite volume method (FVM), Discretization of 1-D unsteady state diffusion problems

UNIT – III FINITE VOLUME METHOD FOR 2–D DIFFUSION 9

Important Consequences of Discretization of Time Dependent Diffusion Type Problems: Consistency, Stability, Convergence, Grid independent and time independent study, Stability analysis of parabolic and hyperbolic equations. Finite Volume Discretization of 2-D unsteady State Diffusion type problems

UNIT – IV FINITE VOLUME METHOD FOR CONVECTION DIFFUSION 9

Finite volume discretization of Convection-Diffusion Equations: Schemes. The concept of false diffusion, QUICK scheme. Discretization of Navier Stokes Equations: Discretization of the Momentum Equation, Staggered grid and Collocated grid, pressure-velocity coupling, SIMPLE Algorithm.

UNIT - V TURBULENCE MODELS AND MESH GENERATION 9

Turbulence models, mixing length model, Two equation models (k-Є) – High and low Reynolds number models, Mesh Generation and refinement Techniques-software tools.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Tannehill, J.E., Anderson, D.A., and Pletcher, R.H., Computational Fluid Mechanics and Heat Transfer, Taylor & Francis, 2nd edition, 2012
2. Versteeg, H.K., and Malalasekera, W.,"An Introduction to Computational Fluid Dynamics": The finite volume Method, Pearson Education, 2007
3. Ghoshdastidar, P.S., "Computer Simulation of flow and heat transfer", Tata McGraw Hill, 1998.

REFERENCES:

1. John. F. Wendt, “Computational Fluid Dynamics – An Introduction”, Springer, 2013.
2. Suhas V, Patankar, “Numerical Heat transfer and Fluid flow”, Taylor & Francis, 2009.
3. Muralidhar, K., and Sundararajan, T., “Computational Fluid Flow and Heat Transfer”, Narosa Publishing House, 2014.
4. Uriel Frisch, Turbulence, Cambridge University Press, 1999.
5. Yogesh Jaluria & Kenneth E. Torrance, “Computational Heat Transfer”, CRC press, 2002.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: COMPUTATIONAL FLUID DYNAMICS													**Course Code : 20MEV51**		
CO	**Course Outcomes**												**Unit**	**K–CO**	**POs**	**PSOs**
C404E5.1	Apply the fundamentals of CFD to derive governing equations												I	K3	1,2,3,4	1,2,3
C404E5.2	Discretize 1 D steady and transient diffusion equations using finite difference method.												II	K3	1,2,3,4	1,2,3
C404E5.3	Discretize 1 D steady and transient diffusion equations using finite volume method												III	K3	1,2,3,4	1,2,3
C404E5.4	Derive finite volume equations for 1 D convention diffusion problem.												IV	K3	1,2,3,4	1,2,3
C404E5.5	Explain SIMPLE algorithm.												IV	K2	1,2,3,4	1,2,3
C404E5.6	Describe various turbulence models.												V	K2	1,2,3,4	1,2,3
CO-PO Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	
C404E5.1	3	2	1	1	-	-	-	-	-	-	-	-	3	2	1	
C404E5.2	3	2	1	1	-	-	-	-	-	-	-	-	3	2	1	
C404E5.3	3	2	1	1	-	-	-	-	-	-	-	-	3	2	1	
C404E5.4	3	2	1	1	-	-	-	-	-	-	-	-	3	2	1	
C404E5.5	2	2	1	1	-	-	-	-	-	-	-	-	2	2	1	
C404E5.6	2	2	1	1	-	-	-	-	-	-	-	-	2	2	1	

20MEV61 INNOVATION IN DESIGN

L	T	P	C
3	0	0	3

OBJECTIVES

- To know about Design Thinking process.
- To empower with innovative-thinking and a systematic approach to problem-solving.
- To identify opportunity and generate innovative idea.
- To evaluate the idea for problem-solution fit and proceed with effective prototyping.
- To apply design thinking approach with human-centric and sustainable products, services and robust business models.

PREREQUISITE:

UNIT - I INTRODUCTION 9

Seven Concerns, Design Thinking & Collaboration, Challenges to Innovation, Understanding Users, Arriving at Design Insights, Prototyping for User Feedback

UNIT – II CAUSE AND CONTEXT 9

Cause, Crossing the First Pitfall, Trial and Error, User Feedback for Development, New users, new needs to meet, Knowing the Context.
Context, The Basic Need, Ingenious Attempts, Further Insights, Working Rig, Concepts generation, Experiencing the Product, Refinements

UNIT – III COMPREHENSION AND CHECK 9

Comprehension, Understanding Constraints, Positioning the Product, Exploring Possibilities, More Experiments, Understanding the Technology, At the 2nd Valley of Death, Finishing Touch
Check, Cause, Product, Users and the Context, Prototyping, User needs, Crucial Step Missed

UNIT – IV CRAFTING 9

Crafting, Recap, Manufacturing Challenge, User Feedback, Iterative Process.

UNIT - V CONNECTION 9

Connection, Seed for Innovation, Pinnacle for Innovation, Connection - Part B, Innovation Timeline, Innovation Champions, Innovation Domains, Connection - Part C, Innovation Templates, Serial Innovation

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Robert Curedale, Design Thinking Process & Methods 5th Edition, Design Community College Incorporated, 2019
2. Michael Lewrick, Patrick Link, Larry Leifer, The Design Thinking Playbook - Mindful Digital Transformation of Teams, Products, Services, Businesses and Ecosystems, Wiley, 2018
3. Stephen Wunker, Jessica Wattman and David Farber, Jobs to Be Done: A Roadmap for Customer-Centered Innovation, AMACOM, 2016

REFERENCES:

1. Michael G. Luchs, Scott Swan, Abbie Griffin, Design Thinking: New Product Development Essentials from the PDMA, Wiley, 2015
2. Alexander Osterwalder, Yves Pigneur, Patricia Papadakos, Gregory Bernarda, Value Proposition Design: How to Create Products and Services Customers Want, Wiley, 2014
3. Nigel Cross, Design Thinking: Understanding How Designers Think and Work, Bloomsbury Publishing India Private Limited, 2011

4. Jeanne Liedtka and Tim Ogilvie, Designing for Growth: A Design Thinking Tool Kit for Managers, Columbia University Press, 2011
5. Roger Martin, The Design of Business: Why Design Thinking Is the Next Competitive Advantage, Harvard Business Review Press, 2009

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: INNOVATION IN DESIGN													**Course Code : 20MEV61**		
CO	**Course Outcomes**												**Unit**	**K–CO**	**POs**	**PSOs**
C406E1.1	Explain seven concerns in design thinking.												I	K2	1,2,3	1,2,3
C406E1.1	Describe new needs to context with example.												II	K3	1,2,3	1,2,3
C406E1.1	Describe the constraints and technologies for comprehension.												III	K2	1,2,3	1,2,3
C406E1.1	Identify the crucial steps missed in check												IV	K3	1,2,3	1,2,3
C406E1.1	Identify the manufacturing challenges in crafting.												V	K3	1,2,3	1,2,3
C406E1.1	Explain the innovation domains.												V	K2	1,2,3	1,2,3
CO-PO Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	
C406E1.1	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1	
C406E1.1	3	2	1	-	-	-	-	-	-	-	-	-	3	1	1	
C406E1.1	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1	
C406E1.1	3	2	1	-	-	-	-	-	-	-	-	-	3	1	1	
C406E1.1	3	2	1	-	-	-	-	-	-	-	-	-	3	1	1	
C406E1.1	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1	

VERTICAL – II : MODERN MANUFACTURING

20MEV12 UNCONVENTIONAL MACHINING PROCESSES

L	T	P	C
3	0	0	3

OBJECTIVES

- To learn about various unconventional machining processes, the various process parameters and their influence on performance and their applications and apply the knowledge to remove material by mechanical energy processes.
- To gain knowledge about Thermal and Electrical energy based processes.
- To apply knowledge in Chemical and Electro-chemical energy based processes.
- To know various nono abrasives based unconventional machining processes.
- To gain knowledge about recent trends in non-traditional machining processes.

PREREQUISITE: NIL

UNIT - I INTRODUCTION AND MECHANICAL ENERGY BASED PROCESSES 9

Introduction – Need for non-traditional machining methods - Classification of modern machining processes – considerations in process selection. Materials. Applications and material removal phenomena - Brief overview - merits and demerits.
Abrasive Jet Machining – Water Jet Machining – Abrasive Water Jet Machining – Ultrasonic Machining (AJM, WJM, AWJM and USM). Working principles – equipment used – Process parameters – MRR – Applications and numerical problems

UNIT – II THERMAL AND ELECTRICAL ENERGY BASED PROCESSES 9

Electric Discharge Machining (EDM) – Wire cut EDM – Working Principle – equipments – Process Parameters – Surface Finish and MRR – electrode / Tool – Power and control circuits – Tool wear – Dielectric – Flushing – Applications. problems. Laser Beam machining and drilling. (LBM), plasma arc machining (PAM) and Electron Beam Machining (EBM), Principles – Equipment –Types – Beam control techniques – Applications and numerical problems.

UNIT – III CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES 9

Chemical machining and Electro-Chemical machining (CHM and ECM) – Etchants – Maskant – techniques of applying maskants – Process Parameters – Surface finish and MRR –Applications. Principles of ECM – equipments – Surface Roughness and MRR Electrical circuit – Process Parameters – ECG and ECH –Anode shape prediction and tool design for ECM processes Applications and numerical problems.

UNIT – IV ADVANCED NANO FINISHING PROCESSES 9

Abrasive flow machining, chemo-mechanical polishing, magnetic abrasive finishing, magneto rheological finishing, magneto rheloogical abrasive flow finishing and their working principles, equipments – effect of process parameters, applications, advantages and limitations.

UNIT - V RECENT TRENDS IN NON-TRADITIONAL MACHINING PROCESSES 9

Recent developments in non-traditional machining processes, their working principles, equipments, effect of process parameters, applications, advantages and limitations, Comparison of non-traditional machining processes.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Vijay.K.Jain"Advanced Machining Processes" Allied Publishers Pvt.Ltd., 1st Edition 2013
2. Pandey P.C. and Shan H.S. "Modern Machining Processes" Tata McGraw-Hill,1st Edition 2013
3. Benedict. G.F." Nontraditional Manufacturing Processes", Marcel Dekkerr Inc., 1987

REFERENCES:

1. J. A. Mcgeough, “Advanced Methods of Machining”, Springer, 2011.
2. Paul De Gamo, J.T.Black, and Ronald, A.Kohser, “Material and Processes in Manufacturing” Prentice Hall of India Pvt. Ltd., 8th Edition, New Delhi, 2001.
3. Bhattacherya A, “New Technology”, The Institute for Engineers, 1st Edition, 2000.
4. C. Elanchezhian, B. VijayaRamnath, M. Vijayan, “Unconventional Machining processes”, Anuradha Publication, 1st Edition, 2005.
5. M. K. Singh, “Unconventional Machining processes”, New Age International Publishers, 1st Edition, 2010.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: UNCONVENTIONAL MACHINING PROCESSES												**Course Code : 20MEV12**			
CO	**Course Outcomes**											**Unit**	**K–CO**	**POs**	**PSOs**
C408E2.1	Explain the need for unconventional machining processes and its classification.											I	K2	1,2,8,10	1,3
C408E2.2	Explain various mechanical energy based unconventional machining processes.											I	K2	1,2,8,10	1,3
C408E2.3	Compare various thermal energy and electrical energy based unconventional machining processes.											II	K2	1,2,8,9,10	1,3
C408E2.4	Summarize various chemical and electro-chemical energy based unconventional machining processes.											III	K2	1,2,8,10	1,3
C408E2.5	Explain various nono abrasives based unconventional machining processes.											IV	K2	1,2,8,10	1,3
C408E2.6	Distinguish various recent trends based unconventional machining processes**.**											V	K2	1,2,8,10	1,3
CO-PO Mapping															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C408E2.1	2	1	-	-	-	-	-	1	-	1	-	-	2	-	1
C408E2.2	2	1	-	-	-	-	-	1	-	1	-	-	2	-	1
C408E2.3	2	1	-	-	-	-	-	1	2	1	-	-	2	-	1
C408E2.4	2	1	-	-	-	-	-	1	-	1	-	-	2	-	1
C408E2.5	2	1	-	-	-	-	-	1	-	1	-	-	2	-	1
C408E2.6	2	1	-	-	-	-	-	1	-	1	-	-	2	-	1

20MEV22 COMPUTER INTEGRATED MANUFACTURING SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the application of computers in manufacturing systems.
- To know the concept of cellular manufacturing systems.
- To familiarize about FMS and its applications.
- To comprehend the application of automation and AGVS in industry.
- To know the application of computer for generating process planning of the product.

PREREQUISITE: NIL

UNIT - I INTRODUCTION TO CIM AND AUTOMATION 9

Automation in Production Systems, automated manufacturing systems- types of automation, reasons for automating, Computer Integrated manufacturing, computerized elements of a CIM system, CAD/CAM and CIM.
Mathematical models and matrices: production rate, production capacity, utilization and availability, manufacturing lead time, work-in process, numerical problems.

UNIT – II CELLULAR MANUFACTURING SYSTEMS 9

Group technology-Part Families, Features and Optiz of Parts Classification and Coding Systems, Machine Cell Design, Applications Of Group Technology.
Quantitative analysis of Cellular Manufacturing, Grouping of parts and Machines by Rank Order Clustering method - Hollier Method – Simple Problems.

UNIT – III FLEXIBLE MANUFACTURING SYSTEMS 9

FMS- Flexibility – Types of FMS- Components - work stations –FMS layout configurations- Computer control and functions – Applications.
Analysis of flexible manufacturing systems – Bottleneck model – sizing the FMS –simple numerical problems.

UNIT – IV AUTOMATED ASSEMBLY SYSTEMS AND AUTOMATED GUIDED VEHICLE SYSTEM (AGVS) 9

Automation – Basic elements- power - program of instructions – control system – levels of automation. Fundamentals of automated assembly systems – system configurations - parts delivery – applications.
Automated Guided Vehicle System (AGVS) – AGVS Application – Vehicle Guidance technology – Vehicle Management & Safety.

UNIT - V COMPUTER AIDED PROCESS PLANNING SYSTEMS 9

Computer aided Process Planning – Variant process planning – Generative process planning– Forward and backward planning, input format.
Totally Integrated process planning systems – Expert process planning-Commercial systems: CAM-I, CAPP, MIPLAN, APPAS, CPPP.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Mikell.P.Groover “Automation, Production Systems and Computer Integrated Manufacturing”, Pearson Education Limited, 5th Edition, 2019.
2. Radhakrishnan P, SubramanyanS.andRaju V., “CAD/CAM/CIM”, New Age, International (P) Ltd, 4th Edition, 2016.
3. James A. Rehg, and Henry W Kraebber, ‘Computer-Integrated Manufacturing’, Pearson Education Limited, 2nd Edition, 2000.

REFERENCES:

1. Kant Vajpayee S, “Principles of Computer Integrated Manufacturing”, Prentice Hall India, 2003.
2. Gideon Halevi and Roland Weill, “Principles of Process Planning – A Logical Approach”, Chapman & Hall, 1995.
3. Rao. P, N Tewari&T.K. Kundra, “Computer Aided Manufacturing”, Tata McGraw Hill, Publishing Company, 2000.
4. Vollmann, T.E. and Bery, W.E., “Manufacturing Planning and Control Systems, Galgotia Publications, 5th Edition, 2004.
5. YoramKoren, ‘Computer Control of Manufacturing Systems’, McGraw Hill Education, Indian Edition, 2017.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: COMPUTER INTEGRATED MANUFACTURING SYSTEM															**Course Code : 20MEV22**
CO	**Course Outcomes**											**Unit**	**K–CO**	**POs**	**PSOs**
C404E2.1	Explain the knowledge about role of computer and automation in manufacturing.											I	K2	1,2,8,10	1,2,3
C404E2.2	Explain the concept of group technology and formation of parts – machine cell.											II	K3	1,2,3,8,10	1,2,3
C404E2.3	Explain the concept of FMS, and sizing of FMS systems.											III	K2	1,2,8,10	1,2,3
C404E2.4	Describe the automation, types of automation and automation strategies.											IV	K2	1,2,8,10	1,2,3
C404E2.5	Describe Automated Guided Vehicle System and its application.											IV	K2	1,2,8,10	1,2,3
C404E2.6	Describe the application of computer in CAPP, and explore to integrated planning software.											V	K2	1,2,8,10	1,2,3
CO-PO Mapping															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C404E2.1	2	1	-	-	-	-	-	1	-	1	-	-	2	1	1
C404E2.2	3	2	1	-	-	-	-	1	2	1	-	-	2	1	1
C404E2.3	2	1	-	-	-	-	-	1	-	1	-	-	2	1	1
C404E2.4	2	1	-	-	-	-	-	1	-	1	-	-	2	1	1
C404E2.5	2	1	-	-	-	-	-	1	-	1	-	-	2	1	1
C404E2.6	2	1	-	-	-	-	-	1	-	1	-	-	2	1	1

20MEV32 COMPOSITE MATERIALS AND MECHANICS

L	T	P	C
3	0	0	3

OBJECTIVES

- To provide knowledge about composite materials and its applications.
- To provide knowledge about different types of processing techniques of polymer composites.
- To provide knowledge about different types of processing techniques of metal matrix composites.
- To know about the constitutive equations for polymer composites.
- To provide knowledge about bending and buckling analysis of polymer composites

PREREQUISITE: NIL

UNIT - I INTRODUCTION TO COMPOSITES 9

Fundamentals of composites – need for composites – enhancement of properties – classification of composites – Matrix-Polymer matrix composites (PMC), Metal matrix composites (MMC), Ceramic matrix composites (CMC) – Reinforcement – particle reinforced composites, Fibre reinforced composites. Applications of various types of composites. Fiber production techniques for glass, carbon and ceramic fibers

UNIT – II POLYMER MATRIX COMPOSITES 9

Polymer resins – thermosetting resins, thermoplastic resins – reinforcement fibres – roving's – woven fabrics – non woven random mats – various types of fibres. PMC processes – hand layup processes – spray up processes – compression moulding – reinforced reaction injection moulding – resin transfer moulding – Pultrusion – Filament winding – Injection moulding. Fibre reinforced plastics (FRP), Glass Fibre Reinforced Plastics (GFRP). Laminates- Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates. -applications of PMC in aerospace, automotive industries

UNIT – III METAL MATRIX COMPOSITES 9

Characteristics of MMC, various types of metal matrix composites alloy vs. MMC, advantages of MMC, limitations of MMC, Reinforcements – particles – fibres. Effect of reinforcement – volume fraction – rule of mixtures. Processing of MMC – powder metallurgy process – diffusion bonding – stir casting – squeeze casting, a spray process, Liquid infiltration In-situ reactions-Interface-measurement of interface properties-applications of MMC in aerospace, automotive industries

UNIT – IV LAMINA CONSTITUTIVE EQUATIONS FOR POLYMER COMPOSITES 9

Lamina Constitutive Equations: Lamina Assumptions – Macroscopic Viewpoint. Generalized Hooke's Law. Reduction to Homogeneous Orthotropic Lamina – Isotropic limit case, Orthotropic Stiffness matrix (Qij), Typical Commercial material properties, Rule of Mixtures. Generally Orthotropic Lamina –Transformation Matrix, Transformed Stiffness.

UNIT - V ANALYSIS OF LAMINATED FLAT PLATES 9

Equilibrium Equations of Motion. Energy Formulations. Static Bending Analysis. Buckling Analysis. Free Vibrations – Natural Frequencies

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Mathews F. L. and Rawlings R. D., "Composite Materials: Engineering and Science", 1st Edition, Chapman and Hall, London, England, 1994.
2. Chawla K. K., "Composite materials", 2nd Edition, Springer – Verlag, 1998.
3. Kaw.K., "Mechanics of Composite Materials", 2nd Edition, CRC publication,2005.

REFERENCES:

1. Clyne, T. W. and Withers, P. J., “Introduction to Metal Matrix Composites”, Cambridge University Press, 1993.
2. Strong, A.B., “Fundamentals of Composite Manufacturing”, SME, 1989.
3. Sharma, S.C., “Composite materials”, Narosa Publications, 2000.
4. Broutman, L.J. and Krock,R.M., “ Modern Composite Materials”, Addison-Wesley, 1967.
5. ASM Hand Book, “Composites”, Vol.21, ASM International, 2001

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : COMPOSITE MATERIALS AND MECHANICS												**Course Code : 20MEV32**			
CO	**Course Outcomes**											**Unit**	**K–CO**	**POs**	**PSOs**
C409E4.1	Explain the different types of the composite materials and its applications.											I	K2	1,2,8, 10	1,2,3
C409E4.2	Explain the various processing techniques for polymer composites manufacturing.											II	K2	1,2,8, 10	1,2,3
C409E4.3	Explain the different types of processing techniques for metal matrix composites manufacturing.											III	K2	1,2,8, 9,10	1,2,3
C409E4.4	Determine the stress strain and strain displacement relationship matrix for polymer composites.											IV	K3	1,2,3, 8,10	1,2,3
C409E4.5	Determine the buckling, and bending behaviours of polymer composites.											V	K3	1,2,3, 8,10	1,2,3
C409E4.6	Determine the natural frequency of polymer composites.											V	K3	1,2,3, 8,10	1,2,3
CO-PO Mapping															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C409E4.1	2	1	-	-	-	-	-	1	-	1	-	-	2	1	1
C409E4.2	2	1	-	-	-	-	-	1	-	1	-	-	2	1	1
C409E4.3	2	1	-	-	-	-	-	1	2	1	-	-	2	1	1
C409E4.4	3	2	1	-	-	-	-	1	-	1	-	-	2	1	1
C409E4.5	3	2	1	-	-	-	-	1	-	1	-	-	2	1	1
C409E4.6	3	2	1	-	-	-	-	1	-	1	-	-	2	1	1

20MEV42	ADDITIVE MANUFACTURING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To provide detailed understanding of additive manufacturing processes.
- To understand the various software tools, processes and techniques that enable advanced/additive manufacturing and personal fabrication.
- To be familiar with the characteristics of the different materials those are used in Additive Manufacturing.
- To Know the principle methods, areas of usage, possibilities and limitations as well as environmental effects of the Additive Manufacturing technologies.
- To help the students to select the best process among various alternative and to think about the possibility of combining different process to develop more efficient AM process

PREREQUISITE: NIL

UNIT - I INTRODUCTION 8

Overview – Need - Development of Additive Manufacturing Technology -Principle – AM Process Chain- Classification –Rapid Prototyping- Rapid Tooling – Rapid Manufacturing – Applications- Benefits –Case studies.

UNIT – II CAD & REVERSE ENGINEERING 10

Basic Concept – Digitization techniques – Model Reconstruction – Data Processing for Additive Manufacturing Technology: CAD model preparation – Part Orientation and support generation – Model Slicing – Tool path Generation – Softwares for Additive Manufacturing Technology: MIMICS, MAGICS.

UNIT – III LIQUID BASED AND SOLID BASED ADDITIVE MANUFACTURING SYSTEMS 10

Classification – Liquid based system – Stereolithography Apparatus (SLA)- Principle, process, advantages and applications - Solid based system – Solid Ground Curing (SGC): working principle, process, strengths, weaknesses and applications. Fused Deposition Modeling - Principle, process, advantages and applications, Laminated Object Manufacturing

UNIT – IV POWDER BASED ADDITIVE MANUFACTURING SYSTEMS 10

Selective Laser Sintering (SLS): Principle, process, materials, advantages, limitations, Applications.
Laser Engineered Net Shaping (LENS): Processes, materials, products, advantages, limitations and applications– Case Studies

UNIT - V OTHER ADDITIVE MANUFACTURING SYSTEMS 9

Three dimensional Printing (3DP): Principle, basic process, Physics of 3DP, types of printing, process capabilities, material system. Solid based, Liquid based and powder based 3DP systems, strength and weakness, Applications and case studies. Shape Deposition Manufacturing (SDM)

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Andreas Gebhardt and Jan-Steffen Hotter “Additive Manufacturing: 3D Printing for Prototyping and Manufacturing”, Hanser publications, United States, 2015, ISBN: 978-156990-582-1.
2. Ian Gibson, David W. Rosen and Brent Stucker “Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing”, 2nd edition, Springer., United States, 2015, ISBN-13: 978-1493921126.

3. Chua C.K., Leong K.F., and Lim C.S., “Rapid prototyping: Principles and applications”, Third edition, World Scientific Publishers, 2010.

REFERENCES:

1. AmitBandyopadhyay and Susmita Bose, “Additive Manufacturing”, CRC Press., 1st Edition, 2015.
2. Andreas Gebhardt, “Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing”, Hanser Gardner Publication, 2011.
3. Kamrani A.K. and Nasr E.A., “Rapid Prototyping: Theory and practice”, Springer, 2006.
4. Liou L.W. and Liou F.W., “Rapid Prototyping and Engineering applications: A tool box for prototype development”, CRC Press, 2007.
5. Majumdar J.D and Manna.I, Laser assisted fabrication of materials, Springer series in material science.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: ADDITIVE MANUFACTURING												**Course Code : 20MEV42**			
CO	**Course Outcomes**											**Unit**	**K–CO**	**POs**	**PSOs**
C404E3.1	Explain the process of Rapid prototyping, Rapid tooling and Rapid manufacturing and describe the benefits and applications of AM process.											I	K2	1,2,5,8, 10	1,2,3
C404E3.2	Explain data processing for Additive Manufacturing Technology.											II	K2	1,2,3,4, 5,8,10	1,2,3
C404E3.3	Differentiate MIMICS and MAGICS software’s used in AM process.											II	K2	1,2,5,8, 10	1,2,3
C404E3.4	Explain the principle, Processes, applications of SLA, SGC, FDM and LOM processes.											III	K2	1,2,5,7, 8,9,10	1,2,3
C404E3.5	Explain the principle, Processes, applications of SLS and LENS.											IV	K2	1,2,5,7, 8,10	1,2,3
C404E3.6	Explain the principle, Processes, applications of 3D printing and SDM processes											V	K2	1,2,5,7, 8,10	1,2,3
CO-PO Mapping															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C404E3.1	2	1	-	-	-	-	-	1	-	1	-	-	3	2	2
C404E3.2	2	1	-	-	-	-	-	1	-	1	-	-	3	2	2
C404E3.3	2	1	-	-	2	-	-	1	-	1	-	-	3	2	2
C404E3.4	2	1	-	-	-	-	-	1	2	1	-	-	3	2	2
C404E3.5	2	1	-	-	-	-	-	1	-	1	-	-	3	2	2
C404E3.6	2	1	-	-	-	-	-	1	-	1	-	-	3	2	2

20MEV52 **TESTING OF MATERIALS**

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the purpose of testing and its development.
- To understand the different types of Destructive testing methods.
- To study the various Non-Destructive testing methods.
- To study the different material characterization testing techniques and its applications.
- To know the concepts of Thermal and Chemical Testing techniques

PREREQUISITE: 20ME301 Strength of Materials

UNIT - I INTRODUCTION TO MATERIALS TESTING 9

Overview of materials, Classification of material testing, Purpose of testing, Selection of material, Development of testing, Testing organizations and its committee, Testing standards, Result Analysis, Advantages of testing.

UNIT – II MECHANICAL TESTING 9

Introduction to mechanical testing, Hardness test – Types and Techniques, Tensile test- Stress-Strain Diagram, Impact test – Types, Principles, Advantages and Limitations, Applications. Bend test, Shear test, Creep test - Principles, Techniques, Methods, Advantages and Limitations, Applications, Fatigue test – S-N Curve

UNIT – III NON DESTRUCTIVE TESTING 9

Visual inspection, Liquid penetrant test, Magnetic particle test, Thermography test – Principles, Techniques, Advantages and Limitations, Applications. Radiographic test, Eddy current test, Ultrasonic test, Acoustic emission- Principles, Techniques, Methods, Advantages and Limitations, Applications.

UNIT – IV MATERIAL CHARACTERIZATION TESTING 9

Macroscopic and Microscopic observations, Optical and Electron microscopy (SEM and TEM) - Principles, Types, Advantages and Limitations, Applications. Diffraction techniques, Spectroscopic Techniques, Electrical and Magnetic Techniques- Principles, Types, Advantages and Limitations, Applications.

UNIT - V THERMAL AND CHEMICAL TESTING 9

Thermal Testing: Differential scanning calorimetry, Differential thermal analysis. Thermo-mechanical and Dynamic mechanical analysis: Principles, Advantages, Applications. Chemical Testing: X-Ray Fluorescence, Elemental Analysis by Inductively Coupled Plasma-Optical Emission Spectroscopy and Plasma-Mass Spectrometry.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Metals Handbook: Mechanical testing, (Volume 8) ASM Handbook Committee, 9th Edition, American Society for Metals, 1978.
2. ASM Metals Handbook, “Non-Destructive Evaluation and Quality Control”, American Society of Metals, Metals Park.
3. Cullity, B. D., “Elements of X-ray diffraction”, Addison-Wesley Company Inc., 3rd Edition, 2000.

REFERENCES:

1. Baldev Raj, T.Jayakumar, M.Thavasimuthu “Practical Non-Destructive Testing”, Narosa Publishing House, 2009.
2. P. Field Foster, “The Mechanical Testing of Metals and Alloys” Cousens Press, 7th Edition, 2007.
3. Brandon D.G., “Modern Techniques in Metallography”, Von Nostrand Inc. 1986.
4. A V K Suryanarayana, “Testing of Metallic Materials”, BS Publications, 2018.
5. Vernon John “Testing of Materials”, Macmillan Publisher, 1992

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : TESTING OF MATERIALS												**Course Code : 20MEV52**			
CO	**Course Outcomes**											**Unit**	**K–CO**	**POs**	**PSOs**
C408E5.1	Explain the purpose of testing and its classification.											I	K2	1,2,10	1,3
C408E5.2	Explain different types of testing standards and advantages of testing.											I	K2	1,2,10	1,3
C408E5.3	Explain the working principles of mechanical testing methods											II	K2	1,2,6, 8,10	1,3
C408E5.4	Describe the concepts of non-destructive testing and their applications											III	K2	1,2,8,10	1,3
C408E5.5	Explain the working of material characterization testing methods and their applications.											IV	K2	1,2,8,10	1,3
C408E5.6	Explain the concepts of thermal and chemical testing methods.											V	K2	1,2,8,9	1,3
CO-PO Mapping															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C408E5.1	2	1	-	-	-	-	-	-	-	1	-	-	2	-	1
C408E5.2	2	1	-	-	-	-	-	-	-	1	-	-	2	-	1
C408E5.3	2	1	-	-	-	2	-	1	-	2	-	-	2	-	1
C408E5.4	2	1	-	-	-	-	-	1	-	1	-	-	2	-	1
C408E5.5	2	1	-	-	-	-	-	1	-	2	-	-	2	-	1
C408E5.6	2	1	-	-	-	-	-	1	2	-	-	-	2	-	1

20MEV62 DIGITAL MANUFACTURING

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the technological advancements in industrial production.
- To learn about the product life cycle management.
- To understand about the digital thread and digital twin.
- To learn about Big data and cloud computing.
- To understand about machine learning and artificial intelligence.

PREREQUISITE: NIL

UNIT - I INTRODUCTION TO DIGITAL MANUFACTURING 9

Definition-Components of DM- Introduction to 4th industrial revolution-cyber physical systems-Introduction to Digital thread and Digital twin- Introduction to product life cycle management (PLM),

UNIT – II DIGITAL THREAD 9

Digital thread components-Data Sharing Strategies- Interoperability and Data Formats-semantic data-Technical data packages-Strategic issues in implementing the digital thread-Cyber infrastructure Components of the Digital Thread –Digital Thread and the Manufacturing Enterprise. Case study on smart factory using Digital thread.

UNIT - III DIGITAL TWIN 9

Types of Digital Twin -Product twin – Process Twin – Performance Twin-Virtual commissioning of Digital Twin– Data mapping – Simulation of Digital Twin – Data collection and visualization-Case study on smart factory using Digital twin.

UNIT – IV ADVANCED MANUFACTURING PROCESS ANALYSIS 9

Data analysis-Manufacturing Settings and Data Collection-Traditional Data Sets vs Big Data-Data Storage and Organization-Data preprocessing- computational techniques and platform-Components, Categories and Capabilities-high performance and cloud computing

UNIT - V INTELLIGENT MANUFACTURING 9

Concepts and features of intelligent Manufacturing –Intelligent Multi Information Sensing and Fusion in the Manufacturing Process -Intelligent machining components- sensors and sensing techniques-machine learning and artificial intelligence in sensing techniques.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Zudezhou ,"Fundamentals of Digital Manufacturing Science",Springer,2012
2. Mark J. Barrenechea, Tom Jenkins, "Digital manufacturing", open text corpn,2018
3. KEN English, "Specialization course in Digital Manufacturing Design and Technology", Coursera.

REFERENCES:

1. Andrew Kusiak, Smart Manufacturing, Publisher, Taylor & Francis, 2018
2. Tien-Chein Chang, Richard A. Wysk, Hsu-Pin (Ben) Wang, Computer Aided Manufacturing (2016), Pearson Education.
3. Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things, Apress, 2016.
4. Elvis Hozdić, "Smart factory for Industry 4.0" International Journal of Modern Manufacturing Technologies ISSN 2067–3604, Vol. VII, No. 1 / 2015
5. Frank Lamb, Industrial Automation: Hands On, McGraw Hill Professional, 2013.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: DIGITAL MANUFACTURING												**Course Code : 20MEV62**			
CO	**Course Outcomes**											**Unit**	**K–CO**	**POs**	**PSOs**
C316E3.1	Describe the basic components of Digital manufacturing											I	K2	1,2	1,2
C316E3.2	Implement digital thread components in Manufacturing enterprise											II	K3	1,2,3,5	1,2
C316E3.3	Perform virtual commissioning of Digital Twin in Smart Factory											III	K3	1,2,3,5	1,2
C316E3.4	Perform advanced manufacturing process analysis in digital manufacturing enterprise											IV	K3	1,2,3,5, 7,10	1,2
C316E3.5	Design intelligent manufacturing operations in manufacturing enterprise.											V	K3	1,2,3,5, 11,12	1,2
C316E3.6	Formulate business models for advanced manufacturing process											V	K3	1,2,3,12	1,2
CO-PO Mapping															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C316E3.1	2	1	-	-	-	-	-	-	-	-	-	-	2	1	-
C316E3.2	3	2	1	-	2	-	-	-	-	-	-	-	2	1	-
C316E3.3	3	2	1	-	3	-	-	-	-	-	-	-	2	1	-
C316E3.4	3	2	1	-	1	-	2	-	-	2	-	-	2	1	-
C316E3.5	3	2	1	-	1	-	-	-	-	-	3	2	2	1	-
C316E3.6	3	2	1	-	-	-	-	-	-	-	-	2	2	1	-

VERTICAL – III : CLEAN ENERGY TECHNOLOGIES

20MEV13 COMPRESSIBLE FLOW AND TURBO – MACHINERY

L	T	P	C
3	0	0	3

(Use of approved gas tables, standard Steam Tables, Mollier diagram and Psychrometric chart permitted)

OBJECTIVES

- To understand the basic difference between incompressible and compressible flow.
- To understand the Flows through constant area ducts with and without Heat transfer.
- To understand the phenomenon of shock waves and its effect of flow on variable area of ducts.
- To understand the basic concepts of steam turbine and different types of gas turbines.
- To understanding the basic concepts and operating principles of Rotary compressors.

PREREQUISITE:

Course Code: 20ME302, 20ME304
Course Name: Fluid Mechanics and Machinery, Engineering Thermodynamics

UNIT - I BASIC CONCEPTS AND ISENTROPIC FLOWS 9

Energy and momentum equations of compressible fluid flows – Stagnation states, Mach waves and Mach cone – Effect of Mach number on compressibility – Isentropic flow through variable ducts – Nozzle and Diffusers.

UNIT – II COMPRESSIBLE FLOW THROUGH DUCTS 9

Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) – variation of flow properties.

UNIT - III NORMAL AND OBLIQUE SHOCKS 9

Governing equations – Variation of flow parameters across the normal and oblique shocks – Prandtl – Meyer relations.

UNIT – IV STEAM TURBINES AND GAS TURBINES 9

Impulse and reaction principles, Velocity diagrams for simple impulse turbine, Work done and efficiency – optimal operating conditions. Compounding and governing.

Gas turbine cycle analysis – open and closed cycle. Performance and its improvement - Regenerative, Intercooled, Reheated cycles and their combinations.

UNIT - V ROTARY COMPRESSOR 9

Classifications, Root blower, Vane type compressor, Centrifugal and Axial flow compressor Construction and working, velocity triangle, degree of reaction, polytropic efficiency, coefficients, losses and Characteristic curve of axial flow compressor.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Yahya S M, 'Fundamentals of Compressible Flow with Aircraft and Rocket Propulsions, New Age International Publishers, 5th Edition (2016).
2. Kothandaraman.C.P., Domkundwar. S, Domkundwar. A.V., "A course in thermal Engineering", 5th Edition, "Dhanpat Rai & sons, 2016.
3. Oosthuizen, P.H. and Carscallen, W.E., Compressible Fluid Flow, McGraw-Hill, 1997.

REFERENCES:

1. Anderson, J.D., "Modern Compressible flow", 4th Edition, McGraw Hill, 2021.
2. Ganesan. V., "Gas Turbines", Tata McGraw Hill Publishing Co., New Delhi, 2010.
3. Yahya, S.M., 'Turbines, Compressor and Fans', McGraw Hill Education Publishing Company, 4th edition, 2017.
4. Dixon, S.L., "Fluid Mechanics and Thermodynamics of Turbomachinery", Pergamon Press, 2014.
5. Gopalakrishnan .G and Prithvi Raj .D, "A Treatise on Turbo machines", Scifech Publications (India) Pvt. Ltd., 2010.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: COMPRESSIBLE FLOW AND TURBOMACHINERY												**Course Code : 20MEV13**			
CO	**Course Outcomes**											**Unit**	**K–CO**	**POs**	**PSOs**
C314.1	Apply the concepts of compressible flow behaviour in isentropic flow in variable area ducts.											I	K3	1,2,3,4	1,2
C314.2	Apply the concepts of compressible flow behaviour in constant area ducts with and without heat transfer.											II	K3	1,2,3,4	1,2
C314.3	Calculate the changes in physical properties when a normal shock occurs in One-dimensional constant area or variable area ducts.											III	K3	1,2,3,4	1,2
C314.4	Determine the performance of steam turbine.											IV	K3	1,2,3,4	1,2
C314.5	Determine the performance of gas turbine											IV	K3	1,2,3,4	1,2
C314.6	Explain the working and performance of Rotary compressor.											V	K2	1,2,3,4	1,2
CO-PO Mapping															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C314.1	3	3	2	1	-	-	-	-	-	-	-	-	3	2	3
C314.2	3	3	2	1	-	-	-	-	-	-	-	-	3	2	3
C314.3	3	3	2	1	-	-	-	-	-	-	-	-	3	2	3
C314.4	3	3	2	1	-	-	-	-	-	-	-	-	3	2	3
C314.5	3	3	2	1	-	-	-	-	-	-	-	-	3	2	3
C314.6	3	3	2	1	-	-	-	-	-	-	-	-	3	2	3

20MEV23	POWER PLANT ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To provide an overview of Power Plants.
- To understand the operation and maintenance of coal based thermal power plants.
- To understand different types of Gas Turbine power plants.
- To understand different types of renewable energy power plants
- To analyze and solve energy and economic related issues in power sectors.

PREREQUISITE:

20ME304 Engineering Thermodynamics
20ME403 Thermal Engineering

UNIT - I COAL BASED THERMAL POWER PLANTS 9

Rankine cycle - improvisations, Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants – Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration systems.

UNIT – II DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS 9

Otto, Diesel, Dual &Brayton Cycle - Analysis &Optimisation. Components of Diesel and Gas Turbine power plants. Combined Cycle Power Plants. Integrated Gasifier based Combined Cycle systems.

UNIT – III NUCLEAR POWER PLANTS 9

Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors: Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANada Deuterium- Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants.

UNIT – IV 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.

UNIT - V ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS 9

Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria, relative merits & demerits, Capital & Operating Cost of different power plants. Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Nag. P.K., "Power Plant Engineering", Third Edition, Tata McGraw – Hill Publishing Company Ltd., 4th Edition 2018.
2. A.K. Raja, AmitPrakashSrivastava, Manish Dwivedi. Power Plant Engineering, New Age International (P) Ltd., Publishers, 2019.
3. Bedalov, Zark, “Practical power plant engineering : a guide for early career engineers” Wiley, 2020.

REFERENCES:

1. El-Wakil. M.M., "Power Plant Technology", Tata McGraw – Hill Publishing Company Ltd.,
2. 2010.
3. Black & Veatch, Springer, "Power Plant Engineering", 2021.
4. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, "Power Plant Engineering", Standard Handbook of McGraw – Hill, 2nd Edition, 2021.
5. Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2019.
6. R. K. Hedge, Power Plant Engineering, Pearson Education, 2020.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: POWER PLANT ENGINEERING											**Course Code : 20MEV23**				
CO	**Course Outcomes**										**Unit**	**K–CO**	**POs**	**PSOs**	
C405E4.1	Calculate the efficiency of Rankine cycle.										I	K3	1,2,3	1,2,3	
C405E4.2	Explain the functioning of combined power plants.										II	K2	1,2,3	1,2,3	
C405E4.3	Calculate the efficiency of Various types of gas power cycles										II	K3	1,2,3	1,2,3	
C405E4.4	Explain the working of various types of nuclear power plant										III	K2	1,2,3	1,2,3	
C405E4.5	Explain the working principle of various renewable energy power plants.										IV	K2	1,2,3	1,2,3	
C405E4.6	Explain the different tariff procedures for energy consumption										V	K2	1,2,3, 11	1,2,3	
CO-PO Mapping															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C405E4.1	3	2	1	-	-	-	-	-	-	-	-	-	3	2	1
C405E4.2	2	1	1	-	-	-	-	-	-	-	-	-	2	2	1
C405E4.3	3	2	1	-	-	-	-	-	-	-	-	-	3	2	1
C405E4.4	2	1	1	-	-	-	-	-	-	-	-	-	2	2	1
C405E4.5	2	1	1	-	-	-	-	-	-	-	-	-	2	2	1
C405E4.6	2	1	1	-	-	-	-	-	-	-	1	-	2	2	1

20MEV33 **ENGINE POLLUTION AND CONTROL**

L	T	P	C
3	0	0	3

OBJECTIVES

- To provide an insight about effect of engine out emissions on human health and environment
- To impart the knowledge on various pollutant species formations in SI and CI engine
- To divulge about various emission measurement techniques in engines and its significance
- To provide a discernment about various emission control methods
- To impart the knowledge about international and national driving cycles and emission standards

PREREQUISITE: NIL

UNIT - I AIR POLLUTION – ENGINES 8

Atmospheric pollution from automotive, stationary engines and gas turbines, Global warming – Green-house effect, Effects of engine pollution on human health and environment

UNIT – II POLLUTANT FORMATION 9

Formation of Oxides of nitrogen, Carbon monoxide, Hydrocarbon, Aldehydes, Smoke and Particulate matter emissions. Effects of Engine design and operating variables on emission formation, Noise pollution.

UNIT - III EMISSION MEASUREMENT TECHNIQUES 9

CO, CO2 - Non dispersive infrared gas analyzer, NOx - Chemiluminescent analyzer, HC - Flame
ionization detector, Smoke – Opacity and filter paper measurements, Particulate Matter – Full flow
and Partial flow dilution tunnel, Gas chromatography, Noise measurement.

UNIT – IV EMISSION CONTROL TECHNIQUES 10

Engine design modifications, Fuel modification, Evaporative emission control, EGR, Air injection, Thermal reactors, Water injection, Common rail direct injection and Gasoline direct injection system, After treatment systems - Catalytic converters, Diesel oxidation catalyst, Particulate traps, De-NOx catalysts, SCR systems. Low temperature combustion concepts

UNIT - V DRIVING CYCLES AND EMISSION STANDARDS 9

Transient dynamometer, Test cells, Driving cycles for emission measurement, chassis dynamometer, CVS system, National and International emission standards.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Ganesan V., “Internal Combustion Engines”, V Edition, Tata McGraw Hill, 2012.
2. John. B. Heywood, “Internal Combustion engine fundamentals” McGraw – Hill, 1988.
3. Amba Prasad Rao .G, KarthikeyaSharma.T, “Engine Emission Control Technologies Design Modifications and Pollution Mitigation Techniques” Apple Academic Press, 2021

REFERENCES:

1. Ernest, S., Starkman, Combustion Generated Air Pollutions, Plenum Press, 2012.
2. George Springer and Donald J Patterson, Engine emissions, Pollutant Formation and Measurement, Plenum press, 2012.
3. Obert, E.F., Internal Combustion Engines and Air Pollution, Intext Educational Publishers, 3rd Edition, 2020.

4. Pundir B. P., “IC Engines Combustion and Emission” Narosa publishing house, 2010.
5. Crouse William, Automotive Emission Control, Gregg Division /McGraw-Hill, 1971

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: ENGINE POLLUTION AND CONTROL													**Course Code : 20MEV33**		
CO	**Course Outcomes**										**Unit**	**K–CO**	**POs**		**PSOs**
C405E8.1	Explain the impact of pollution from engines on human health and environment.										I	K2	1,2,3,8		1,2,3
C405E8.2	Describe the formation of different pollutants										II	K2	1,2,3		1,2,3
C405E8.3	Discuss the effect of engine design and operating variables on emission formation.										II	K2	1,2,3,5		1,2,3
C405E8.4	Explain the various measurement techniques used for the measurement of pollutants in engine emissions.										III	K2	1,2,3,7		1,2,3
C405E8.5	Describe the various techniques used in IC engine to control the engine emissions										IV	K2	1,2,3,7		1,2,3
C405E8.6	Discuss the international and national driving cycles and emission standards										V	K2	1,2,3,6,7		1,2,3
CO-PO Mapping															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C405E8.1	3	2	1	-	-	-	-	1	-	-	-	-	3	2	1
C405E8.2	2	1	1	-	-	-	-	-	-	-	-	-	2	2	1
C405E8.3	3	2	1	-	1	-	-	-	-	-	-	-	3	2	1
C405E8.4	2	1	1	-	-	-	1	-	-	-	-	-	2	2	1
C405E8.5	2	1	1	-	-	-	1	-	-	-	-	-	2	2	1
C405E8.6	2	1	1	-	-	-	1	-	-	-	1	-	2	2	1

20MEV43 ENERGY CONSERVATION AND MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVES

- To explain basics of Energy scenario.
- To explain basics of Investment and Financial analysis techniques.
- To explain basics of energy management and audit.
- To explain basics of thermal systems energy efficiency.
- To know in depth of Clean Development Mechanism.

PREREQUISITE:

20ME304 Engineering Thermodynamics
20HS401 Environmental Science and Engineering

UNIT - I ENERGY SCENARIO 9

Classification of Energy, Indian energy scenario, Sectorial energy consumption (domestic, industrial and other sectors), energy needs of growing economy, energy intensity, long term energy scenario, energy pricing, energy security, energy conservation and its importance, energy strategy for the future.

UNIT – II FINANCIAL MANAGEMENT, ENERGY MONITORING AND TARGETING 9

Investment-need, financial analysis techniques simple payback period, return on investment, net present value, internal rate of return, cash flows, risk and sensitivity analysis; financing options, energy performance contracts and role of Energy Service Companies (ESCOs).

UNIT – III ENERGY MANAGEMENT & AUDIT 9

Definition, energy audit, need, types of energy audit. Energy management (audit) approach-understanding energy costs, Bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel and energy substitution, energy audit instruments and metering.

UNIT – IV ENERGY EFFICIENCY IN THERMAL UTILITIES AND SYSTEMS 9

Boilers: Types, combustion in boilers, performances evaluation, analysis of losses, feed water treatment, blow down, energy conservation opportunities. Boiler efficiency calculation, evaporation ratio and efficiency for coal, oil and gas. Soot blowing and soot deposit reduction, reasons for boiler tube failures, start up, shut down and preservation.
Furnaces: Classification, general fuel economy measures in furnaces, excess air, heat distribution, temperature control, draft control, waste heat recovery. Forging furnace heat balance, Cupola, non-ferrous melting, Induction furnace, performance evaluation of a furnace.
Waste Heat Recovery: Classification, advantages and applications, commercially viable waste heat recovery devices, saving potential.

UNIT - V ENERGY AND ENVIRONMENT, AIR POLLUTION, CLIMATE CHANGE 9

United Nations Framework Convention on Climate Change (UNFCC), sustainable development, Kyoto Protocol, Conference of Parties (COP), Clean Development Mechanism (CDM), CDM Procedures case of CDM – Bachat Lamp Yojna and industry; Prototype Carbon Fund (PCF).

TOTAL : 45 PERIODS

TEXT BOOKS:

1. AmlanChakrabarti, “Energy Engineering and Management” Prentice Hall India Pvt., Limited, 2019

2. Energy Conservation Guidebook, Dale R Patrick, Stephen W Fardo, 2nd Edition, CRC Press, 2016.
3. Handbook of Energy Audits, Albert Thumann, 6th Edition, The Fairmont Press, 2020.

REFERENCES:

1. Rai G. D., Non-conventional Energy Sources, Khanna Publishers, 2016.
2. Energy Management Handbook, W.C. Turner, John Wiley and Sons, A Wiley Inter science publication,2015.
3. Carbon Capture and Sequestration: Integrating Technology, Monitoring, and Regulation edited by E J Wilson and D Gerard, Blackwell Publishing,2014.
4. Heating and Cooling of Buildings - Design for Efficiency, J. Krieder and A. Rabl, McGraw Hill Publication, 2016.
5. Bureau of Energy Efficiency Reference book: No.1, 2, 3, 4, 2015

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: ENERGY CONSERVATION AND MANAGEMENT												**Course Code : 20MEV43**			
CO	**Course Outcomes**											**Unit**	**K–CO**	**POs**	**PSOs**
C405E5.1	Summarize the energy conservation scenario, energy and environment, air pollution, climate change, and various acts and policy for the energy conservation											I	K2	1,2,3,4	1,2,3
C405E5.2	Infer the concept of financial management, energy monitoring and targeting											II	K2	1, 2, 3, 4,11,12	1,2,3
C405E5.3	Explain energy audit for the energy management and operation of energy audit instruments.											III	K2	1, 2, 3, 4, 12	1,2,3
C405E5.4	Determine energy efficiency in various thermal utilities and systems											IV	K3	1,2,3	1,2,3
C405E5.5	Explain working of waste hear recovery systems											IV	K2	1,2,3	1,2,3
C405E5.6	Summarize the Convention on Climate Change and Clean Development Mechanism											V	K2	1, 2, 3, 7, 12	1,2,3
CO-PO Mapping															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C405E5.1	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
C405E5.2	2	1	1	-	-	-	-	-	-	-	1	1	2	1	1
C405E5.3	2	1	1	-	-	-	-	-	-	-	-	1	2	1	1
C405E5.4	3	2	1	-	-	-	-	-	-	-	-	-	2	1	1
C405E5.5	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
C405E5.6	2	1	1	-	-	-	1	-	-	-	-	1	2	1	1

20MEV53 **RENEWABLE ENERGY SOURCES**

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the importance of renewable energy
- To understand the functioning of solar power plant
- To understand the functioning of wind power plant
- To understand the mechanism of conversion of biomass into power
- To understand the principle of producing power from wave, tidal and fuel cells

PREREQUISITE: NIL

UNIT - I INTRODUCTION **9**

World Energy Use – Reserves of Energy Resources – Environmental Aspects of Energy Utilisation – Renewable Energy Scenario in Tamilnadu, Present renewable energy status in India and around the World – Potentials - Achievements / Applications – Economics of renewable energy systems.

UNIT – II SOLAR ENERGY **9**

Solar Radiation – Measurements of Solar Radiation - Flat Plate and Concentrating Collectors – Solar direct Thermal Applications – Solar thermal Power Generation - Solar thermal energy storage -Fundamentals of Solar Photo Voltaic Conversion – Solar Cells -– Solar PV Power Generation – Solar PV Applications

UNIT - III WIND ENERGY **9**

Wind Data and Energy Estimation – Types of Wind Energy Systems – Performance – Site Selection – Details of Wind Turbine Generator – Safety and Environmental issues - Applications

UNIT – IV BIO - ENERGY **9**

Biomass direct combustion – Biomass gasifiers – Biogas plants – Digesters – Ethanol production – Bio diesel – Cogeneration - Carbonization – Pyrolysis -Biomass Applications

UNIT - V OTHER RENEWABLE ENERGY SOURCES **9**

Tidal energy – Wave Energy – Open and Closed OTEC Cycles – Small Hydro-Geothermal Energy – Hydrogen production and Storage - Transport and utilization - Safety issues. Fuel Cell Systems – Hybrid Systems.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Rai. G.D., "Non Conventional Energy Sources", 6th edition, Khanna Publishers, New Delhi, 2017.
2. Twidell, J.W. & Weir, A., "Renewable Energy Sources", 3rd edition, EFN Spon Ltd., UK, 2015.
3. Qiuye Sun, “Energy Internet and We energy”, Springer Nature Singapore Pvt. Ltd., 2018

REFERENCES:

1. Chetan Singh Solanki, Solar Photovoltaics, "Fundamentals, Technologies and Applications", PHI Learning Private Limited, New Delhi, 2015.
2. David M. Mousdale – "Introduction to Biofuels", CRC Press, Taylor & Francis Group, USA 2017
3. Freris. L.L., "Wind Energy Conversion Systems", Prentice Hall, UK, 1990.
4. S. Rao& Dr. B.B.Parulekar. "Energy Technology Nonconventional, Renewable & Conventional", Khanna Publishers, New Delhi , 2015
5. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, U.K., 2012.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: RENEWABLE ENERGY SOURCES											Course Code : 20MEV53				
CO	**Course Outcomes**										**Unit**	**K–CO**	**POs**	**PSOs**	
C316E5.1	Explain the importance and Economics of renewable Energy										I	K2	1,2,3,4, 6,711	1,2,3	
C316E5.2	Explain the method of power generation from Solar Energy										II	K2	1,2,3,4, 6,7	1,2,3	
C316E5.3	Explain the method of power generation from Wind Energy										III	K2	1,2,3,4, 6,7	1,2,3	
C316E5.4	Explain the method of power generation from Bio Energy										IV	K2	1,2,3,4, 6,7	1,2,3	
C316E5.5	Explain the power generation method from the newer renewable energy source										V	K2	1,2,3,4, 6,7	1,2,3	
C316E5.6	Choose the appropriate power plant by applying the knowledge of characteristics of different power plant and explain its function										II,III IV,V	K3	1,2,3,4, 6,7,11, 12	1,2,3	
CO-PO Mapping															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C316E5.1	2	1	1	1	-	1	2	-	-	-	1	-	2	1	1
C316E5.2	2	1	1	1	-	1	2	-	-	-	-	-	2	1	1
C316E5.3	2	1	1	1	-	1	2	-	-	-	-	-	2	1	1
C316E5.4	2	1	1	1	-	1	2	-	-	-	-	-	2	1	1
C316E5.5	2	1	1	1	-	1	2	-	-	-	-	-	2	1	1
C316E5.6	3	2	1	1	-	1	2	-	-	-	1	1	2	1	1

20MEV63 **FUNDAMENTALS OF HVAC SYSTEMS**

L	T	P	C
3	0	0	3

OBJECTIVES

- To learn climate variation and its effects on the building heat load.
- To learn building material characteristics and their influence on building heating / cooling load for all weather conditions.
- To study various conversation techniques related to build environment and codes for the same.
- To study various basic concepts related to Duct Installation, Duct Design, Zone Control Systems
- To study various basic concepts related Chilled Water Systems, Cooling Towers, Commercial Refrigeration Systems

PREREQUISITE:

Course Code: 20ME302, 20ME304
Course Name: Fluid Mechanics and Machinery, Engineering Thermodynamics

UNIT - I REFRIGERATION CYCLE **9**

Unit of refrigeration, Refrigerating effect, Carnot COP - Refrigerator & heat pumps, Limitations of Carnot cycle
Refrigerants - Definition, Nomenclature, Classification, Essential and Desirable Properties, ODP, GWP & TEWI – and other Environmental issues
Refrigeration cycle - Simple vapour compression – P-h diagram, T-S diagram, COP, Heat rejection ratio, different processes, Effect of sub cooling and super heating, Effect of suction and discharge pressures on the cycle performance, Actual compression cycle – use of P-h charts and Tables.
Vapour absorption and adsorption systems, steam jet, Thermoelectric etc.- concepts only

UNIT – II MAIN COMPONENTS OF HVAC **9**

Compressor : Types, classification, Constructional details, working, Selection, capacity control and performance comparison. Condenser: Types, working , Heat transfer estimation, Selection and application , factors affecting condenser performance. Evaporators : Types , heat transfer estimation, selection and application, factors affecting evaporator performance Expansion Devices: Types, Selection and application, Performance

UNIT - III PSYCHROMETRY & HEAT LOAD **9**

Psychrometry: Psychrometric terms, Use of Psychrometric Chart, Various Psychrometric processes –Determination of ADP, Enthalpy Calculations , Plotting of air conditioning processes in chart. Factors affecting human comfort, Comfort parameters, Comfort chart. Heat Load Estimation Air Conditioning,
Data collection for Heat load, Study of Drawings, Procedure for heating and cooling load estimation: Interpretation of heat load estimations, Heat load estimation Refrigeration: Product storage temperatures, Design input data, Procedures for estimation of cooling load.

UNIT – IV AIR CONDITIONING SYSTEMS **9**

Selection of systems for different Applications: Residential, Commercial – Hotels, Mall, Hospitals, Industrial etc. Window, Ductless split ACs, Package and Ductable units, VRFs/VRV, large DX systems with AHUs, Air cooled and water cooled condensing units. Chilled water systems: Air and water cooled chillers – compressors, types and capacities range and applications, AHUs, Pumps, Fans, Cooling towers and other allied components..

UNIT - V AIR DISTRIBUTION & CONTROL SYSTEMS 9

Duct design methodologies, Different types of duct design, Selection of air terminals, dampers, filters etc. Pressure drop estimation, Constant volume systems, variable air volume systems, VAV boxes, Single duct cooling and heating, VAV with parallel and series fan powered, induction VAVs , accessories, Types of Room air Distribution Systems.

Fan: Law, Types including ventilation, Selection of fan for various applications, Piping design, Pump and Pumping systems Chilled and cooling water – Types, Selection, Head Requirement, Motor sizing, Electrical Fundamentals, Electrical Control and BMS: Fundaments of Control, Types of controllers, Control systems applicable to Chillers, VRF etc., BMS, Introduction to BAC net.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. James E. BrumbaughAudel, Fundamentals of HVAC Systems Wiley Publications. 4th Edition,2004
2. Roy J. Dossat, Principles of Refrigeration, Pearson, 5th Edition, 2007
3. Richard C. Jordon and Gayle B.Priester, Refrigeration and Air Conditioning Prentice Hall India, 15th Edition, 2000

REFERENCES:

1. Hand book of heating, ventilation and Air-conditioning, Jan. F. Kreider, CRC press. 2000
2. Mike Stubblefield John Harold Haynes - Automotive Heating & Air Conditioning Systems Manual, Haynes Manuals, 2000
3. John W. Mitchell, James E. Braun, Principles of Heating, Ventilation, and Air Conditioning in Buildings, Wiley Publications, 2013.
4. Roger W. Haines, Control Systems for Heating, Ventilating and Air Conditioning, Springer US, 2000
5. Arthur A. Bell Jr., PE, HVAC Equations, Data and Rules of Thumb-McGraw-Hill Professional, 2000

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: FUNDAMENTALS OF HVAC SYST													**Course Code : 20MEV63**		
CO	**Course Outcomes**										**Unit**	**K–CO**	**POs**	**PSOs**	
C316E4.1	Estimate heating loads, space heat gains and space cooling loads using accepted engineering methods.										1	K2	1,2,3,4, 5,6,7,8	1,2,3	
C316E4.2	Explain the phenomena of various heating systems, like gas and oil furnace also understand the concept of Troubleshooting of heating systems										2	K2	1,2,3,4, 6,7,	1,2,3	
C316E4.3	Explain the Fundamentals of Heat Pumps and its Applications										2	K2	1,2,3,4	1,2,3	
C316E4.4	Determine the coil loads for cooling and heating systems										3	K3	1,2,3,4	1,2,3	
C316E4.5	Select equipment and design systems to provide comfort conditions within the building.										4	K3	1,2,3,4	1,2,3	
C316E4.6	Explain the working principle of chillers used in Commercial Refrigeration Systems										5	K2	1,2,3,4	1,2,3	
CO-PO Mapping															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C316E4.1	3	3	2	2	1	2	1	1	-	-	-	-	3	2	1
C316E4.2	3	2	2	2	-	2	1	-	-	-	-	-	3	2	1
C316E4.3	3	2	2	1	-	-	-	-	-	-	-	-	3	2	1
C316E4.4	3	3	2	2	-	-	-	-	-	-	-	-	3	2	1
C316E4.5	3	3	2	2	-	-	-	-	-	-	-	-	3	2	1
C316E4.6	3	2	1	1	-	-	-	-	-	-	-	-	3	2	1

20MEV73 **ENERGY EFFICIENT BUILDINGS**

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the conventional connections energy efficient buildings and developing proficiency in energy conservation building codes.
- To understand the energy efficient landscape system.
- To understand the different solutions for HVAC in buildings
- To understand the heat transmission in buildings.
- To understand the integration of renewable energy in buildings.

PREREQUISITE: NIL

UNIT - I INTRODUCTION 9

Conventional versus energy efficient BUILDINGS – Historical perspective – Water – Energy – IAQ requirement analysis – Future building design aspects – critically of resources and needs of modern living – Building assessment and green building processes - Energy conservation building codes.

UNIT – II LANDSCAPE AND BUILDING ENVELOPES 9

Energy efficient landscape – Micro climates – various methods – Shading, water bodies – Building envelope: Building materials, Envelope heat loss and heat gain and its evaluation, paints, insulation

UNIT - III HEATING, VENTILATION AND AIR CONDITIONING 9

Natural Ventilation, Passive cooling and heating: Thermal mass effects – Application of wind, water and earth for cooling, evaporative cooling, radiant cooling – Hybrid methods – energy conservation measures, thermal storage integration in buildings

UNIT – IV 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. Thermal load estimation: Heat balance method. Degree day method for seasonal energy consumption.

UNIT - V BUILDING COOLING AND RENEWABLE ENERGY IN BUILDINGS 9

Passive cooling concepts, Application of wind, water and earth cooling; shading, paints and cavity walls for cooling; roof radiation traps, Earth air tunnel. Solar absorption cooling and solar vapour compression cooling for buildings – Solar water heating systems in buildings – Small wind turbines, standalone PV, Hybrid systems for residential buildings with economics.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Krieder. J., and Rabi. A., Heating and cooling of buildings: design for efficiency, McGraw Hill, 3rd edition 2016.
2. Charles. J. Kibert, Sustainable Construction: Green Building Design and Deliver, John Wiley & Sons, 2016.
3. Duffie, A and Beckmann, W. A., Solar Engineering of Thermal Processes, John Wiley, 2019.

REFERENCES:

1. R. Velraj, 'Sensible heat Storage for solar heating and cooling systems' in the book titled "Advances in Solar Heating and Cooling" – Pages 399 - 428 Elsevier Publication, 2016.
2. Energy Efficiency in Buildings Both New and Rehabilitated Edited by José Manuel Andújar and Sergio Gómez Melgar, Printed Edition of the Special Issue Published in Energies'2020.
3. Sukhatme, S.P., Solar Energy, Tata McGraw Hill, 2014.
4. UrsalaEicker, "Solar Technologies for buildings", Wiley Publications, 2013.Guide book for national certification examination for energy managers and energy auditors (downloaded from www.energymanagertraining.com).
5. Michael Bauer, Peter Mosle and Michael Schwarz, Green Building - Guidebook for Sustainable Architecture, 2009.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: ENERGY EFFICIENT BUILDINGS		**Course Code : 20MEV73**			
CO	**Course Outcomes**	**Unit**	**K–CO**	**POs**	**PSOs**
C316E8.1	Compare conventional connections in energy efficient buildings and versatile with energy conservation building codes.	I	K2	1,2,3	1,2
C316E8.2	Explain an energy efficient landscape system.	II	K2	1,2,3	1,2
	Discuss different cooling methods of HVAC in buildings.	III	K2	1,2,3	1,2
C316E8.3	Explain the heat transmission in buildings due to ventilation / infiltration.	IV	K2	1,2,3	1,2
	Describe different methods for estimation of building loads.	IV	K2	1,2,3	1,2
C316E8.4	Explain Passive cooling concepts of renewable energy in buildings	V	K2	1,2,3	1,2

CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C316E8.1	3	2	1	-	-	-	-	-	-	-	-	-	3	2	1
C316E8.2	3	2	1	-	-	-	-	-	-	-	-	-	3	2	1
	3	2	1	-	-	-	-	-	-	-	-	-	3	2	1
C316E8.3	3	2	1	-	-	-	-	-	-	-	-	-	3	2	1
	3	2	1	-	-	-	-	-	-	-	-	-	3	2	1
C316E8.4	3	2	1	-	-	-	-	-	-	-	-	-	3	2	1

VERTICAL – IV : ROBOTICS AND AUTOMATION

20MEV14 **APPLIED HYDRAULICS AND PNEUMATICS**

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the basic concepts of fluid power system.
- To know about the utilization of cylinders, accumulators, valves and various electrical and electronic control components.
- To gain knowledge in design, construction and operation of fluid power circuits.
- To develop the skills in trouble shooting the hydraulic and pneumatic circuits.
- To understand the applications of hydraulic and pneumatic circuits in modern manufacturing industries.

PREREQUISITE:

Course Code: 20ME302
Course Name: Fluid mechanics and Machinery

UNIT - I INTRODUCTION TO FLUID POWER AND HYDRAULIC POWER DRIVES **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.
Hydraulic power drives: Pumping Theory – Pump Classification – Construction, Working, Design, Performance, Selection criteria of Linear and Rotary – Fixed and Variable displacement pumps and motors.

UNIT – II HYDRAULIC ACTUATORS AND CONTROL COMPONENTS **9**

Hydraulic Actuators: Cylinders – Types and construction, Application, Hydraulic cushioning – Control Components : Direction Control, Flow control and pressure control valves – Types, Construction and Operation – Servo and Proportional valves – Applications- Fluid Power ANSI Symbols.

UNIT - III HYDRAULIC CIRCUITS AND SYSTEMS **9**

Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Hydrostatic transmission. Electro hydraulic circuits, Mechanical hydraulic servo systems.

UNIT – IV PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS **9**

Basic principles of Pneumatics, 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 for sequencing – Electro Pneumatic System – Elements – Programmable Logic Controllers - Ladder diagram, Timers and Counters.

UNIT - V TROUBLE SHOOTING AND APPLICATIONS **9**

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.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Anthony Esposito, "Fluid power with Applications," Pearson Education, 7th Edition, 2009.

2. Majumdar S.R., “Oil Hydrualics Systems- Principles and Maintenance”, Tata McGraw- Hill, July 2017.
3. James L. Johnson “Introduction to Fluid Power” Delmar Thomson Learning Publishers 2002.

REFERENCES:

1. W.Bolton, Mechatronics, Electronic control systems in Mechanical and Electrical Engineering Pearson Education, 2015.
2. Peter Rohner, Fluid Power Logic Circuit Design, Macmillan Publishers, 1994.
3. Eaton Hydraulics Training Services (Vickers), Industrial Hydraulics Manual 6th Edition. 2015.
4. Frank Yeaple, Fluid Power Design Handbook, 3rd Edition, CRC Press, October 24, 1995.
5. James R. Daines -Fluid Power: Hydraulics and Pneumatics 2nd Edition, Textbook Edition, GW publisher 2009.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: APPLIED HYDRAULICS AND PNEUMATICS		**Course Code : 20MEV14**			
CO	**Course Outcomes**	**Unit**	**K–CO**	**POs**	**PSOs**
C316E6.1	Discuss the function of different types of hydraulic pumps and motors.	I	K2	1,2,3,4	1,2,3
C316E6.2	Describe the features and functions of hydraulic actuators, Direction and Flow control valves.	II	K2	1,2,3,4	1,2,3
C316E6.3	Develop fluid power multi actuation circuits for various purposes in industry.	III	K3	1,2,3, 4,5,6	1,2,3
C316E6.4	Discuss the working of different pneumatic and electro pneumatic components, circuits and systems.	IV	K2	1,2,3, 4,5,6	1,2,3
C316E6.5	Construct the cascaded electro pneumatic circuits for requiring cylinder sequences.	IV	K3	1,2,3, 4,5,6	1,2,3
C316E6.6	Summarize the various trouble shooting methods and applications of hydraulic and pneumatic systems.	V	K2	1,2,3, 4,6	1,2,3

CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C316E6.1	2	2	1	1	-	-	-	-	-	-	-	-	2	2	1
C316E6.2	2	2	1	1	-	-	-	-	-	-	-	-	2	2	1
C316E6.3	3	2	1	1	3	1	-	-	-	-	-	-	2	2	1
C316E6.4	2	2	1	1	3	1	-	-	-	-	-	-	2	2	1
C316E6.5	3	2	1	1	3	1	-	-	-	-	-	-	2	2	1
C316E6.6	2	2	1	1	-	1	-	-	-	-	-	-	2	2	1

20MEV24 **INDUSTRIAL ROBOTICS**

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the functions of the basic components and coordinate system of a Robot.
- To understand the working principle of various robot drive system.
- To study the use of various types of Sensors and End Effectors.
- To impart knowledge in Robot Kinematics and Programming.
- To learn Robot implementation and safety issues.

PREREQUISITE:
Course Code: 20GE203
Course Name: Basic Electrical, Electronics and Instrumentation Engineering

UNIT - I FUNDAMENTALS OF ROBOT AND ROBOT DRIVE SYTEMS 9

Robot - Definition - Robot Anatomy - Coordinate 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.
Robot Drive Systems - 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.

UNIT – II SENSORS AND END EFFECTORS 9

Requirements of a sensor, Principles and Applications of the following types of sensors-Pneumatic Position Sensors, Range Sensors, Triangulations Principles, Lighting Approach, Time of Flight, Range Finders, Laser Range Meters, Touch Sensors ,binary Sensors., Analog Sensors, Wrist Sensors, Compliance Sensors, Slip Sensors.
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.

UNIT – III MACHINE VISION 9

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.

UNIT – IV ROBOT KINEMATICS 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.

UNIT - V ROBOT PROGRAMMING AND IMPLEMENTATION 9

Lead through Programming, Robot programming Languages-VAL Programming-Motion Commands, Sensor Commands, End Effector commands and simple Programs. RGV, AGV; Implementation of Robots in Industries - Various Steps; Safety Considerations for Robot Operations.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Klafter R.D., Chmielewski T.A and Negin M., “Robotic Engineering - An Integrated Approach”, Prentice Hall, 2010.

2. Groover M.P., “Industrial Robotics -Technology Programming and Applications”, McGraw Hill, 2017.
3. Deb S.R., “Robotics Technology and Flexible Automation” Tata McGraw Hill Book Co., 2009.

REFERENCES:

1. Craig J.J., “Introduction to Robotics Mechanics and Control”, Pearson Education, 3rd Edition 2014.
2. Koren Y., “Robotics for Engineers", McGraw Hill Book Co., 1992.
3. Fu.K.S.,Gonzalz R.C. and Lee C.S.G., “Robotics Control, Sensing, Vision and Intelligence”, McGraw Hill Book Co., 1987.
4. Janakiraman P.A., “Robotics and Image Processing”, Tata McGraw Hill, 1995.
5. Rajput R.K., “Robotics and Industrial Automation”, S.Chand and Company, 2nd Edition, 2014.
6. Surender Kumar, “Industrial Robots and Computer Integrated Manufacturing”, Oxford and IBH Publishing Co. Pvt. Ltd., 1993.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: INDUSTRIAL ROBOTICS											**Course Code : 20MEV24**				
CO	**Course Outcomes**										**Unit**	**K–CO**	**POs**	**PSOs**	
C405E6.1	Explain about the robot parts, specifications, coordinates and robot drive system.										1	K2	1,2	1,2,3	
C405E6.2	Discuss the working principle of robot sensors and types of end effectors.										2	K2	1,2	1,2,3	
C405E6.3	Explain the Image processing techniques to analyze the real images.										3	K2	1,2,3, 4,5	1,2,3	
C405E6.4	Explain the forward and reverse kinematics of manipulators with two, three and four degrees of freedom.										4	K2	1,2,3, 4,5	1,2,3	
C405E6.5	Discuss the commands to control the motion of sensor and end effectors in robot programming languages.										5	K2	1,2,3, 4,5	1,2,3	
C405E6.6	Describe the steps for implementation of robots in industries and safety considerations for robot operations.										5	K2	1,2,3,4	1,2,3	
CO-PO Mapping															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C405E6.1	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
C405E6.2	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
C405E6.3	2	2	2	1	2	-	-	-	-	-	-	-	2	1	1
C405E6.4	2	2	1	2	1	-	-	-	-	-	-	-	2	1	1
C405E6.5	2	2	1	1	2	-	-	-	-	-	-	-	2	1	1
C405E6.6	2	2	1	1	-	-	-	-	-	-	-	-	2	1	1
C405E6.1	2	2	1	1	1	-	-	-	-	-	-	-	2	1	1

20MEV34 **SENSORS AND ACTUATORS**

L	T	P	C
3	0	0	3

OBJECTIVES

- To enable the students to understand the working principle of various sensors and actuators.
- To teach students about the working principle and applications of Inductive and Capacitive sensors.
- To develop the skills of students in selecting the suitable sensors for the required applications.
- To enable the students understand the applications of hydraulic, pneumatic and electrical actuators in modern manufacturing industries.
- To enable the students to understand processing techniques of micro sensors and actuators.

PREREQUISITE:
Course Code: 20GE203
Course Name: Basic Electrical, Electronics and Instrumentation Engineering

UNIT - I INTRODUCTION TO SENSORS AND SIGNAL TRANSMISSION 9

Difference between sensor, transmitter and transducer - Primary measuring elements - Signal transmission - Types of signal: Pneumatic signal; Hydraulic signal; Electronic Signal. Principle of operation, construction details, characteristics and applications of potentiometer, Proving Rings, Strain Gauges, Resistance thermometer, thermistor, Hot-wire anemometer, Resistance Hygrometer, Photo-resistive sensor, Optical encoders.

UNIT – II INDUCTIVE & CAPACITIVE SENSORS 9

Inductive transducers: - Principle of operation, construction details, characteristics and applications of LVDT, Induction potentiometer, variable reluctance transducer, synchros, microsyn. Capacitive transducers: - Principle of operation, construction details, characteristics of Capacitive transducers – different types & signal conditioning- Applications: capacitor microphone, capacitive pressure sensor, proximity sensor.

UNIT - III ACTUATORS 9

Definition, types and selection of Actuators; linear; rotary; Logical and Continuous Actuators, Pneumatic actuator- Electro-Pneumatic actuator; cylinder, rotary actuators, Mechanical actuating system: Hydraulic actuator - Control valves; Construction, Characteristics and Types, Selection criteria. Electrical actuating systems: Solid-state switches, Solenoids, Electric Motors- Principle of operation and its application: D.C motors - AC motors - Single phase & 3 Phase Induction Motor; Synchronous Motor; Stepper motors - Piezoelectric Actuator.

UNIT – IV MICRO SENSORS AND MICRO ACTUATORS 9

Micro Sensors: Principles and examples, Force and pressure micro sensors, position and speed micro sensors, acceleration micro sensors, chemical sensors, biosensors, temperature micro sensors and flow micro sensors. Micro Actuators: Actuation principle, shape memory effects-one way, two way and pseudo elasticity. Types of micro actuators- Electrostatic, Magnetic, Fluidic, Inverse piezo effect, other principles.

UNIT - V SENSOR MATERIALS AND PROCESSING TECHNIQUES 9

Materials for sensors: Silicon, Plastics, metals, ceramics, glasses, nano materials Processing techniques: Vacuum deposition, sputtering, chemical vapour deposition, electro plating, photolithography, silicon micro machining, Bulk silicon micro machining, Surface silicon micro machining, LIGA process.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Patranabis.D, “Sensors and Transducers”, Wheeler publisher. 2nd edition 2003.
2. SergejFatikow and Ulrich Rembold, “ Microsystem Technology and Microbotics”, 1st edition, Springer –VerlagNewyork, Inc, 1997.
3. Jacob Fraden, “Hand Book of Modern Sensors: Physics, Designs and Application” 4th edition, Springer, 2014.

REFERENCES:

1. Robert H Bishop, “The Mechatronics Hand Book”, CRC Press, 2007.
2. Thomas. G. Bekwith and Lewis Buck.N, Mechanical Measurements, Oxford and IBH publishing Co. Pvt. Ltd.,1982.
3. MassoodTabib and Azar, “Microactuators Electrical, Magnetic, thermal, optical, mechanical, chemical and smart structures”, 1st edition, Kluwer academic publishers, Springer, 1997.
4. Manfred Kohl, “Shape Memory Actuators”, 1st edition, Springer.
5. W.Bolton, Mechatronics, Electronic control systems in Mechanical and Electrical Engineering Pearson Education, 2015.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: SENSORS AND ACTUATORS													**Course Code : 20MEV34**		
CO	**Course Outcomes**												**Unit**	**K–CO**	**POs**	**PSOs**
C406E2.1	Discuss the functions of different types of Sensors and Signal transmission.												1	K2	1,2	1
C406E2.2	Explain the working principle of Inductive, Capacitive type of sensors and applications.												2	K2	1,2	1
C406E2.3	Describe the working principle and applications of various actuators.												3	K2	1,2	1
C406E2.4	Explain the working principle of various types of micro sensors.												4	K2	1,2	1
C406E2.5	Discuss the working principle of various types of micro actuators.												4	K2	1,2	1
C406E2.6	Explain about the sensor materials and processing techniques for micro sensor and actuator.												5	K2	1,2	1
CO-PO Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	
C406E2.1	3	1	-	-	-	-	-	-	-	-	-	-	2	-	-	
C406E2.2	3	1	-	-	-	-	-	-	-	-	-	-	2	-	-	
C406E2.3	3	1	-	-	-	-	-	-	-	-	-	-	2	-	-	
C406E2.4	3	1	-	-	1	-	-	-	-	-	-	-	2	-	-	
C406E2.5	3	1	-	-	1	-	-	-	-	-	-	-	2	-	-	
C406E2.6	3	1	-	-	1	-	-	-	-	-	-	-	2	-	-	
C406E2.1	3	1	-	-	1	-	-	-	-	-	-	-	2	-	-	

20MEV44	AUTOMATION IN MANUFACTURING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To enable the students to understand building blocks of an automation system.
- To enable the students to understand types of automation and Mechanisms.
- To develop the programming skills of students in Microprocessor and PLC.
- To teach the students about Computer Numerical Control technology and programming.
- To develop the skills of students in applying IoT technology in manufacturing

PREREQUISITE:
Course Code: 20GE203
Course Name: Basic Electrical, Electronics and Instrumentation Engineering

UNIT - I INTRODUCTION 9

Introduction: Importance of automation in the manufacturing industry. Use of Mechatronics based systems. Design of an automated system: Building blocks of an automated system, working principle and examples, Introduction to Computer Aided Design (CAD) processes.

UNIT – II INDUSTRIAL AUTOMATION AND MECHANISMS 9

Types of Industrial Automation – Fixed automation, Programmable automation, Flexible automation, Mechanisms: Types of Ball screws, linear motion bearings, Cams, Systems controlled by camshafts. Electronic Cams, Indexing Mechanisms,Tool Magazines and Automatic Material handling system.

UNIT - III SIGNAL CONDITIONING AND CONTROLLERS 9

Signal Conditioning: Amplification, Filtering, Wheatstone bridge, Pulse Modulation, Signal Conversion, Microprcessor Technology - Architecture, Addressing modes and Programming. PLC- Architecture, I/O processing, Ladder Logic Programming, Analog and Digital data handling, Timers, Counters and Industrial applications.

UNIT – IV CNC TECHNOLOGY 9

Flexible Manufacturing System, CNC technology in manufacturing, vertical milling process. CNC Machine Tools- Tool Magazines, Automatic Palleting, Tool wear monitoring system. Computer Aided manufacturing and Process Planning- Group Technology, Part families, Manual Visual Inpection, Production Flow Analysis, Classification and Coding. CNC machines and Interplotation , Applications, CNC programming.

UNIT - V IoT IN MANUFACTURING 9

Introduction to Human Computer Interaction(HCI) and Internet of Things (IoT) world - Multilingual interactions Robotics and Autonomous Vehicles Sensing and data processing- Simultaneous mapping and localization-Levels of autonomy, Smart factories.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Boltan, W., Mechatronics: electronic control systems in mechanical and electrical engineering, Longman, Singapore, 2015.
2. Groover, M. P., Automation, Production Systems, and Computer-Integrated Manufacturing, Prentice Hall, 2016.
3. Vijay Madisetti, ArshdeepBahga “Internet of Things: A Hands-On Approach “,1st edition, 2015.

REFERENCES:

1. Bradley, D. A., Dawson D., Burd, N. C. and Loader A. J.,Mechatronics: Electronics in products and processes, CRC Press, Florida, USA, 2010.
2. Gaonkar, R. S., Microprocessor architecture, programming,and applications with the 8085, Penram International Publishing (India), Delhi, 2013.
3. Rao, P. N., CAD/CAM Principles and Applications, Tata McGraw Hill, New Delhi, 2010.
4. Smid, P., CNC Programming Handbook, IndustrualPress,New York, USA, 2008.
5. Adrian McEwan and Hakim Cassimally, “Designing the internet of things”, Wiley, 2013.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: AUTOMATION IN MANUFACTURING													**Course Code : 20MEV44**		
CO	**Course Outcomes**												**Unit**	**K–CO**	**POs**	**PSOs**
C406E3.1	Explain the building blocks of automation system.												1	K2	1,2	1
C406E3.2	Describe the various types of automation system and Mechanisms.												2	K2	1,2	1
C406E3.3	Explain about the signal conditioning processes.												3	K2	1,2,3	1,2
C406E3.4	Develop the Microprocessor and PLC programming codes.												3	K3	1,2,3,4,5	1,2
C406E3.5	Describe about the CNC technology in manufacturing.												4	K2	1,2,3,5	1,2
C406E3.6	Apply IoT concept in advanced manufacturing machines .												5	K3	1,2,3,4,5	1,2
CO-PO Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	
C406E3.1	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-	
C406E3.2	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-	
C406E3.3	3	2	1	-	-	-	-	-	-	-	-	-	2	1	-	
C406E3.4	3	2	2	1	2	-	-	-	-	-	-	-	2	1	-	
C406E3.5	3	2	1	-	2	-	-	-	-	-	-	-	2	1	-	
C406E3.6	3	2	2	1	2	-	-	-	-	-	-	-	2	1	-	
	3	2	1	-	1	-	-	-	-	-	-	-	2	1	-	

20MEV54	VIRTUAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

OBJECTIVES

- To enable the students to understand the concept of Virtual Instrumentation (VI) and Programming techniques.
- To teach students about basic building blocks and Data Acquisition in Virtual Instrumentation.
- To develop the programming skills of students in LabVIEW software.
- To enable the students understand the function of VI toolsets and Distributed I/O modules.
- To develop the skills of students in image processing techniques and motion control in VI.

PREREQUISITE:

Course Code: 20GE203, 20ME404
Course Name: Basic Electrical, Electronics and Instrumentation Engineering, Metrology and Measurement Practices

UNIT - I INTRODUCTION **9**

Virtual Instrumentation – Definition, flexibility - Block diagram and Architecture for Virtual Instruments versus Traditional Instruments Instrumentation -VI Programming techniques - VI, sub VI, Loop and Charts, Arrays, Clusters and Graphs, Case and Sequence Structures, Formula nodes, String and File Input / Output.

UNIT – II DATA ACQUISTITION IN VI **9**

A/D and D/A converters, Plug-in Analog Input / Output cards – Digital Input and Output Cards, Organization of the DAQ VI system – Opto-isolation – Performing analog input and analog output – Scanning multiple analog channels – Issues involved in selection of Data acquisition cards – Data acquisition modules with serial communication – Design of digital voltmeter with transducer input –Timers and Counters.

UNIT - III APPLICATION OF VIRTUAL INSTRUMENTATION **9**

Instrument Control using RS-232C and IEEE488, Development of Virtual Instrument using GUI, Real-time systems, Embedded Controller, OPC, Active X programming, Publishing measurement data in the web.

UNIT – IV REAL TIME CONTROL IN VI **9**

Designs using VI Software - ON/OFF controller – Proportional controller – Modeling and basic control of level and reactor processes – Case studies on development of HMI, SCADA in VI.

UNIT - V OPERATING SYSTEM AND I/O MODULES **9**

Operating system requirements, Current trends on PC based instrumentation, analog and digital interfaces, Modular Instruments, VI toolsets Distributed I/O modules, Control Design and Simulation, Digital Signal processing tool kit, Image acquisition and processing, Motion control.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Gary W. Johnson, Richard Jennings, “LabVIEW Graphical Programming”, 3rd edition , McGraw-Hill Professional Publishing, 2006.
2. S. Gupta and J. John ,"Virtual Instrumentation using LabVIEW", Tata McGraw-Hill Publishing Company Limited, New Delhi, 2010.
3. Jovitha Jerome, Virtual Instrumentation using LabVIEW, 1st Edition, PHI, 2010.

REFERENCES:

1. Barry Paton, “Sensor, transducers and Labview”, Prentice Hall of India 2000.
2. R. H. Bishop, "Learning with LabVIEW", 1st edition, Pearson Publishing, 2020.
3. Kevin James, PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control, Newnes, 2000.
4. Rick Bitter, LabVIEW advanced programming technique, 2nd Edition, CRC Press, 2006.
5. Skolkoff, “Basic concepts of LABVIEW 4”, PHI, 1998.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: VIRTUAL INSTRUMENTATION													**Course Code : 20MEV54**		
CO	**Course Outcomes**												**Unit**	**K–CO**	**POs**	**PSOs**
C406E4.1	Define Virtual Instrumentation Concepts.												1	K2	1,2	1
C406E4.2	Describe the building blocks and VI programming techniques.												1	K2	1,2,3,5	1,2
C406E4.3	Describe the Data Acquisition (DAQ) methodologies in VI.												2	K2	1,2,3,5	1,2
C406E4.4	Discuss about the applications of Virtual Instrumentation.												3	K2	1,2,3,5	1,2
C406E4.5	Describe about the real time control and interfacing methods in VI.												4	K2	1,2,3,5	1,2
C406E4.6	Discuss operating systems required for Virtual Instrumentation.												5	K2	1,2,3,5	1,2
CO-PO Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	
C406E4.1	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-	
C406E4.2	3	2	1	-	2	-	-	-	-	-	-	-	2	1	-	
C406E4.3	3	2	1	-	2	-	-	-	-	-	-	-	2	1	-	
C406E4.4	3	2	1	-	2	-	-	-	-	-	-	-	2	1	-	
C406E4.5	3	2	1	-	2	-	-	-	-	-	-	-	2	1	-	
C406E4.6	3	2	1	-	2	-	-	-	-	-	-	-	2	1	-	

20MEV64 DATA ANALYTICS FOR MECHANICAL ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the various methods of data collection.
- To gain knowledge about the data processing and data handling methods.
- To know about the streaming of data analytics and data security.
- To apply the concepts of data analytics in manufacturing sector.
- To understand the applications of data analysis in energy management and safety systems.

PREREQUISITE: NIL

UNIT - I DATA COLLECTION 9

Sensing: Sensors, transducers, sensor resolution, types of sensors; Actuation: Actuator, types of actuators; Communication protocols: 802.15.4, ZigBee, 6lowpan, RFID, NFC, Bluetooth, Z-wave; Embedded systems - Arduino, Raspberry Pi.

UNIT – II DATA PROCESSING AND DATA HANDLING 9

Data processing: MQTT, MQTT components and methods;
Data handling: Big data, types of data, flow of data; Cloud computing: Recent trends, service models, managing data in cloud.

UNIT – III DATA ANALYTICS AND DATA SECURITY 9

Data analytics: Types, lifecycle, discovery, preparation, model planning, model building; Data collection, Streaming data analytics: hadoop, hive, hbase; Data security: Data protection, challenges.

UNIT – IV APPLICATIONS IN MANUFACTURING 9

Manufacturing: Machine diagnostics and prognosis, robotics and autonomous vehicles and part tracing; Inventory and logistics: Route generation and scheduling, fleet tracking, shipment monitoring, remote vehicle diagnostics;

UNIT - V APPLICATIONS IN ENERGY, SAFETY 9

Energy: Smart grids, waste management; Safety and security: Indoor air quality monitoring, noise level monitoring, smoke/gas detections, structural health monitoring.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", Apress, 1st Edition, 2016.
2. Ulrich Sendler, "The Internet of Things: Industrie 4.0 Unleashed", Springer, 1st Edition, 2019.
3. Sabina Jeschke, Christian Brecher, Houbing Song, Dana B. Rawat, "Industrial Internet of Things: Cyber- manufacturing Systems", Springer, 2016.

REFERENCES:

1. Dieter Uckelmann, Mark Harrison, Florian Michahelles, "Architecting the Internet of Things", Springer, 2011.
2. Adrian McEwen, Hakim Cassimally , "Designing the Internet of Things", John Wiley and Sons Ltd, 2014.
3. Thomas Er, Dr. ZaighamMahmood, Professor Ricardo Puttini, "Cloud Computing: Concepts, Technology & Architecture", PHI, 2013.
4. Daniel Minoli, “Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications”, Wiley Publications, 2013.
5. Peter Waher “Learning Internet of Things”,Packt Publishing, 2015.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: DATA ANALYTICS FOR MECHANICAL ENGINEERING												**Course Code : 20MEV64**			
CO	**Course Outcomes**											**Unit**	**K–CO**	**POs**	**PSOs**
C404E1.1	Explain the data collection systems using sensors.											I	K2	1,2,3	1,2,3
C404E1.2	Describe the data processing and handling methods.											II	K2	1,2,3	1,2,3
C404E1.3	Explain the data security systems.											III	K2	1,2,3	1,2,3
C404E1.4	Describe the applications of data analytics in manufacturing sector.											IV	K2	1,2,3	1,2,3
C404E1.5	Describe the applications of data analytics in inventory and shipment.											IV	K2	1,2,3	1,2,3
C404E1.6	Describe the applications of data analytics in energy and safety management.											V	K2	1,2,3,12	1,2,3
CO-PO Mapping															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C404E1.1	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
C404E1.2	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
C404E1.3	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
C404E1.4	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
C404E1.5	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
C404E1.6	2	1	1	-	-	-	-	-	-	-	-	1	2	1	1

20MEV74 **MICRO ELECTRO MECHANICAL SYSTEMS**

L	T	P	C
3	0	0	3

OBJECTIVES

- To provide knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
- To educate on the rudiments of Micro fabrication techniques.
- To introduce various sensors and actuators
- To introduce different materials used for MEMS
- To educate on the applications of MEMS to disciplines beyond Electrical and Mechanical engineering.

PREREQUISITE: NIL

UNIT - I INTRODUCTION **9**

Intrinsic Characteristics of MEMS – Energy Domains and Transducers- Sensors and Actuators – Introduction to Micro fabrication - Silicon based MEMS processes – New Materials – Review of Electrical and Mechanical concepts in MEMS – Semiconductor devices – Stress and strain analysis – Flexural beam bending- Torsional deflection.

UNIT – II SENSORS AND ACTUATORS-I **9**

Electrostatic sensors – Parallel plate capacitors – Applications – Interdigitated Finger capacitor – Comb drive devices – Micro Grippers – Micro Motors - Thermal Sensing and Actuation – Thermal expansion – Thermal couples – Thermal resistors – Thermal Bimorph - Applications – Magnetic Actuators – Micromagnetic components – Case studies of MEMS in magnetic actuators- Actuation using Shape Memory Alloys

UNIT – III SENSORS AND ACTUATORS-II **9**

Piezoresistive sensors – Piezoresistive sensor materials - Stress analysis of mechanical elements – Applications to Inertia, Pressure, Tactile and Flow sensors – Piezoelectric sensors and actuators – piezoelectric effects – piezoelectric materials – Applications to Inertia , Acoustic, Tactile and Flowsensors.

UNIT – IV MICROMACHINING **9**

Silicon Anisotropic Etching – Anisotrophic Wet Etching – Dry Etching of Silicon – Plasma Etching – Deep Reaction Ion Etching (DRIE) – Isotropic Wet Etching – Gas Phase Etchants – Case studies - Basic surface micro machining processes – Structural and Sacrificial Materials – Acceleration of sacrificial Etch – Striction and Antistriction methods – LIGA Process - Assembly of 3D MEMS – Foundry process.

UNIT - V POLYMER AND OPTICAL MEMS **9**

Polymers in MEMS– Polimide - SU-8 - Liquid Crystal Polymer (LCP) – PDMS – PMMA – Parylene – Fluorocarbon - Application to Acceleration, Pressure, Flow and Tactile sensors- Optical MEMS – Lenses and Mirrors – Actuators for Active Optical MEMS.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Chang Liu, "Foundations of MEMS", Pearson Education Inc., 2006.
2. Stephen D Senturia, "Microsystem Design", Springer Publication, 2000.
3. Tai Ran Hsu, “MEMS & Micro systems Design and Manufacture” Tata McGraw Hill, New Delhi, 2002.

REFERENCES:

1. Nadim Maluf,“ An Introduction to Micro Electro Mechanical System Design”, Artech House, 2000.
2. Mohamed Gad-el-Hak, editor, “ The MEMS Handbook”, CRC press Baco Raton, 2000
3. Julian w. Gardner, Vijay K. Varadan, Osama O. Awadelkarim, "Micro Sensors MEMS and Smart Devices", John Wiley & Son LTD,2002
4. James J.Allen, "Micro Electro Mechanical System Design", CRC Press Publisher, 2010
5. Thomas M.Adams and Richard A.Layton, “Introduction MEMS, Fabrication and Application,” Springer 2012.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: MICRO ELECTRO MECHANICAL SYSTEMS													**Course Code : 20MEV74**		
CO	**Course Outcomes**												**Unit**	**K–CO**	**POs**	**PSOs**
C406E5.1	Explain about micro fabrication												I	K2	1,2,3	1,2,3
C406E5.2	Explain about electrical sensors												II	K2	1,2,3	1,2,3
C406E5.3	Explain about thermal sensors for a particular application												III	K2	1,2,3	1,2,3
C406E5.4	Describe about Piezo resistive sensors												IV	K2	1,2,3	1,2,3
C406E5.5	Describe about various micro machining processes												IV	K2	1,2,3	1,2,3
C406E5.6	Describe the application of polymers in MEMS												V	K2	1,2,3,12	1,2,3
CO-PO Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	
C406E5.1	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1	
C406E5.2	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1	
C406E5.3	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1	
C406E5.4	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1	
C406E5.5	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1	
C406E5.6	2	1	1	-	-	-	-	-	-	-	-	1	2	1	1	

VERTICAL – V : INDUSTRIAL ENGINEERING

20MEV15 STATISTICAL QUALITY CONTROL

L	T	P	C
3	0	0	3

Use of Statistical quality control table is permitted

OBJECTIVES

- To develop the basic concepts of quality control procedures.
- To impart knowledge about designing and implementation of Statistical Process control in any industry.
- To design and implement acceptance sampling inspection methods in industry.
- To study the process and machine capability.
- To develop the applications of various charts.

PREREQUISITE:

Course Code: 20BS401
Course Name: Statistics and Numerical Methods

UNIT - I QUALITY FUNDAMENTALS 9

Quality – Importance, evolution, definitions, dimensions of quality. Quality control, quality assurance, areas of quality, quality planning, quality objectives and policies, quality costs, economics of quality, Quality loss function, quality Vs productivity, Quality Vs reliability.

UNIT – II CONTROL CHARTS FOR VARIABLES 9

Control Charts for Variables: Control Charts for X bar and R (statistical basis, development and use, estimating process capability; interpretation, the effect of non- normality on the chart, the OC function, average run length); Control Charts for X bar and S; Control Chart for Individual Measurements; Applications of Variables Control Charts

UNIT - III CONTROL CHARTS FOR ATTRIBUTES 9

Control Chart for Fraction-Nonconforming (OC curve of the control chart, variable sample size, nonmanufacturing application, the OC function and ARL calculation); Control Charts for Nonconformities or Defects; Choices Between Attribute and Variable Control Charts, Guideline for Implementing Control charts.

UNIT – IV STATISTICAL PROCESS CONTROL 9

Process stability- process capability study using control charts, capability indices, capability analysis using histogram and normal probability plot, machine capability study, gauge capability study- setting statistical tolerances for components and assemblies. Natural Tolerance Limits of a Process - Based on the Normal Distribution, Nonparametric Tolerance Limits, Predictive model for SQC

UNIT - V ACCEPTANCE SAMPLING 9

Lot-By-Lot Acceptance Sampling For Attributes - The accepting sampling problem, single sampling plan for attributes, Double, Multiple, and sequential sampling, Dodge-Roming sampling plans (AOQL and LTPD plans).

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Douglus C. Montgomery, “Introduction to Statistical Quality Control”, Wiley-India, 7th Edition, 2015.
2. Krishnaiah K.,” Applied Statistical Quality Control and Improvement”, PHI, 2017.
3. Dale H. Besterfield, Quality Control, Pearson Education Asia, 8th Edition, 2018.

REFERENCES:

1. Amitava Mitra, "Fundamentals of Quality Control and Improvement", Wiley, 3rd Edition, 2018.
2. Eugene L. Grant and Richard S. Leaven Worth, "Statistical Quality Control", McGraw-Hill Education, 7th Edition, 2018.
3. Monohar Mahajan, "Statistical Quality Control", Dhanpat Rai & Sons, 2017.
4. Statistical Quality Control, R C Gupta, Khanna Publishers, New Delhi, 2015.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: STATISTICAL QUALITY CONTROL												**Course Code : 20MEV15**			
CO	**Course Outcomes**											**Unit**	**K–CO**	**POs**	**PSOs**
C316E7.1	Explain the basic Concepts of Quality and its tools.											I	K3	1,2,3, 8,10	1,2,3
C316E7.2	Construct the X bar, R & σ charts from the available data.											II	K3	1,2,3, 9,10	1,2,3
C316E7.3	Construct the p, np, c & u charts from the available data											II	K3	1,2,3, 8,10	1,2,3
C316E7.4	Control the occurrence of defects in product or service industries.											III	K3	1,2,3	1,2,3
C316E7.5	Select and apply appropriate quality control technique for given application.											IV	K3	1,2,3,8	1,2,3
C316E7.6	Measure the performance of the sampling plans											V	K3	1,2,3,8, 9,10	1,2,3
CO-PO Mapping															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C316E7.1	3	2	1	-	-	-	-	2	-	2	-	2	3	2	1
C316E7.2	3	2	1	-	-	-	-	-	2	2	-	2	3	2	1
C316E7.3	3	2	1	-	-	-	-	2	-	2	-	2	3	2	1
C316E7.4	3	2	1	-	-	-	-	-	-	-	-	2	3	2	1
C316E7.5	3	2	1	-	-	-	-	2	-	-	-	2	3	2	1
C316E7.6	3	2	1	-	-	-	-	1	2	2	-	2	3	2	1

20MEV25 PROCESS PLANNING AND COST ESTIMATION

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand about work study concepts.
- To link design and manufacturing.
- To determine the process and sequence of operations to obtain a useful final product.
- To introduce the process planning concepts to make cost estimation for various products after process planning.
- To forecast the expenses and prepare a budget for producing various products.

PREREQUISITE: NIL

UNIT - I INTRODUCTION TO WORK STUDY AND PROCESS PLANNING 9

Introduction - Method study – Basic Procedure – Tools and Techniques – Work Measurements – Stop Watch Time study - Methods of process planning - Drawing interpretation - Material evaluation – Steps in process selection - Production equipment and tooling selection.

UNIT – II PROCESS PLANNING ACTIVITIES 9

Process parameters calculation for various production processes-Selection jigs and fixtures Selection of quality assurance methods - Set of documents for process planning-Economics of process planning - case studies

UNIT – III INTRODUCTION TO COST ESTIMATION 9

Importance of costing and estimation –methods of costing-elements of cost estimation – Types of estimates – Estimating procedure- Estimation labor cost, material cost- allocation of over head charges- Calculation of depreciation cost.

UNIT – IV PRODUCTION COST ESTIMATION 9

Estimation of Different Types of Jobs - Estimation of Forging Shop, Estimation of Welding Shop, Estimation of Foundry Shop.

UNIT - V MACHINING TIME CALCULATION 9

Estimation of Machining Time - Importance of Machine Time Calculation- Calculation of Machining Time for Different Lathe Operations ,Drilling and Boring - Machining Time Calculation for Milling, Shaping and Planning -Machining Time Calculation for Grinding.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Peter scalon, “Process planning, Design/Manufacture Interface”, Butterworth-Heinemann, 2003.
2. Sinha B.P, “Mechanical Estimating and Costing”, Tata-McGraw Hill publishing co, 1995.
3. M. Adithan, “Process Planning and Cost Estimation”, New Age International (P) Limited, 2015.

REFERENCES:

1. Chitale A.V. and Gupta R.C., “Product Design and Manufacturing”, Prentice Hall India, 6th Edition, 2011.
2. Ostwalal P.F. and Munoz J., “Manufacturing Processes and systems”, John Wiley, 9th Edition, 2008.
3. Russell R.S and Tailor B.W, “Operations Management”, Prentice Hall India, 7th Edition, 2010.

4. Mikell P. Groover, “Automation, Production, Systems and Computer Integrated Manufacturing”, Pearson, 5th Edition, 2019.
5. K.C. Jain & L.N. Aggarwal, “Production Planning Control and Industrial Management”, Khanna Publishers, 2002.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: PROCESS PLANNING AND COST ESTIMATION													**Course Code : 20MEV25**		
CO	**Course Outcomes**												**Unit**	**K–CO**	**POs**	**PSOs**
C405E3.1	Explain about method study procedure & its techniques and work measurement.												I	K2	1,2,8, 10	1,2,3
C405E3.2	Select material, process, production equipment, tooling and process parameters for the given product.												I	K3	1,2,3, 8,10	1,2,3
C405E3.3	Prepare a process planning sheet from a design drawing considering various production and design parameters.												II	K3	1,2,3, 8,10	1,2,3
C405E3.4	Apply the step by step procedure for estimating the cost of any product.												III	K3	1,2,3, 8,10	1,2,3
C405E3.5	Express the different elements of cost of a product and compute the total cost of a given product.												IV	K3	1,2,3, 8,10	1,2,3
C405E3.6	Calculate machining time for different lathe operations, drilling, boring, milling, shaping, planning and grinding												V	K3	1,2,3, 8,9,10	1,2,3
CO-PO Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	
C405E3.1	2	1	-	-	-	-	-	1	-	1	-	-	2	1	1	
C405E3.2	3	2	1	-	-	-	-	1	-	1	-	-	2	1	1	
C405E3.3	3	2	1	-	-	-	-	1	-	1	-	-	2	1	1	
C405E3.4	3	2	1	-	-	-	-	1	-	1	-	-	2	1	1	
C405E3.5	3	2	1	-	-	-	-	1	-	1	-	-	2	1	1	
C405E3.6	3	2	1	-	-	-	-	1	2	1	-	-	2	1	1	

20MEV35 **PRODUCTION PLANNING AND CONTROL**

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the various components and functions of production planning and control
- To gain knowledge about method study, motion study and work study,
- To understand the product planning, process planning, production scheduling, Inventory Control.
- To know the recent trends like manufacturing requirement Planning (MRP II)
- To gain knowledge in Enterprise Resource Planning (ERP).

PREREQUISITE: NIL

UNIT - I INTRODUCTION **9**

Production planning and control – Objectives, benefits, Functions. Types of production, Product development and design - Marketing, Functional, Operational, Durability and dependability, aesthetic aspect. Profit consideration- Standardization, Simplification & specialization

UNIT – II WORK STUDY **9**

Method study, basic procedure, Selection, Recording of process, Micro motion and memo motion study, work measurement techniques, Time study, Work sampling, Synthesis from standard data, Predetermined motion time standards.

UNIT – III PRODUCT PLANNING AND PROCESS PLANNING **9**

Value analysis, Problems in lack of product planning, Process planning and routing-Prerequisites, Steps in process planning, Quantity determination in batch production-Machine capacity, balancing, Analysis of process capabilities in a multi-product system.

UNIT – IV PRODUCTION SCHEDULING **9**

Master Scheduling, Scheduling rules, Gantt charts, Basic scheduling problems, Line of balance, Flow and batch production scheduling, Product sequencing, Production Control systems-Periodic batch control, Material requirement planning, kanban. Manufacturing lead time, Techniques for aligning completion times and due dates.

UNIT - V RECENT TRENDS IN PPC **9**

Introduction to computer integrated production planning systems, elements of JUST IN TIME SYSTEMS, Fundamentals of MRP II and ERP.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. MartandTelsang, “Industrial Engineering and Production Management”, S. Chand and Company, Reprint, 2006.
2. James.B.Dilworth, “Operations management – Design, Planning and Control for manufacturing and services” McGraw Hill International edition, 1992.
3. Samson Eilon, “Elements of Production Planning and Control”, Universal Book Corporation,2015

REFERENCES:

1. Elwood S.Buffa, and RakeshK.Sarin, “Modern Production / Operations Management”, John Wiley and Sons, 8th Edition, 2000.
2. KanishkaBedi, “Production and Operations management”, Oxford university press, 3rd Edition, 2013.
3. Melynk, Denzler, “Operations management – A value driven approach” Irwin Mcgraw hill, 1995.

4. Norman Gaither, G. Frazier, “Operations Management”, Thomson learning IE, 9th edition, 2007
5. Jain. K.C & L.N. Aggarwal, “Production Planning Control and Industrial Management”, Khanna Publishers, 8th Edition, 1999.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : PRODUCTION PLANNING AND CONTROL											**Course Code : 20MEV35**				
CO	**Course Outcomes**										**Unit**	**K–CO**	**POs**		**PSOs**
C408E3.1	Explain various aspects of product development.										I	K3	1,2,3, 11		1,2,3
C408E3.2	Describe work sampling techniques.										II	K3	1,2,3, 8,11		1,2,3
C408E3.3	Determine the quantity in batch production system.										III	K3	1,2,3,4, 5,11,12		1,2,3
C408E3.4	Explain scheduling rules										IV	K3	1,2,3,4, 5,7,11		1,2,3
C408E3.5	Determine manufacturing lead time for the given production system.										IV	K3	1,2,3,5, 11,12		1,2,3
C408E3.6	Explain MRP and ERP.										V	K3	1,2,3,5, 11,12		1,2,3
CO-PO Mapping															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C408E3.1	3	2	1	-	-	-	-	-	-	-	2	-	3	2	1
C408E3.2	3	2	1	-	-	-	-	1	-	-	2	-	3	2	1
C408E3.3	3	2	1	1	2	-	-	-	-	-	2	1	3	2	1
C408E3.4	3	2	1	2	2	-	1	-	-	-	2	-	3	2	1
C408E3.5	3	2	1	-	1	-	-	-	-	-	2	1	2	2	1
C408E3.6	3	2	1	-	1	-	-	-	-	-	2	1	2	2	1

20MEV45 SUPPLY CHAIN AND LOGISTIC MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the scope of Supply Chain Management and the Drivers of Supply Chain performance.
- To design suitable Supply Chain network for a given situation.
- To solve the issues related to Logistics in Supply Chain Management.
- To understand Sourcing, Coordination and current issues in Supply Chain Management.
- To appraise about the applications of IT in Supply Chain Management and apply Supply Chain Management concepts in selected enterprise.

PREREQUISITE: NIL

UNIT - I INTRODUCTION 9

Role of Logistics and Supply chain Management: Scope and Importance - Evolution of Supply Chain – Examples of supply Chains - Decision Phases in Supply Chain - Competitive and Supply chain Strategies – Drivers of Supply Chain Performance and Obstacles.

UNIT – II SUPPLY CHAIN NETWORK DESIGN 9

Role of Distribution in Supply Chain – Factors influencing Distribution network design – Design options for Distribution Network- Distribution Network in Practice - Role of network Design in Supply Chain – Framework for network Decisions.

UNIT – III LOGISTICS IN SUPPLY CHAIN 9

Role of transportation in supply chain – Factors affecting transportations decision – Design option for transportation network – Tailored transportation – Routing and scheduling in transportation - 3PL- 4PL- Global Logistics - Reverse Logistics; Reasons, Activities and issues.

UNIT – IV SOURCING AND COORDINATION IN SUPPLY CHAIN 9

Role of Sourcing in supply chain - Supplier selection - Contracts - Design Collaboration - Sourcing planning and analysis - Supply chain co-ordination - Bull whip effect – Effect of lack of co-ordination in supply chain and obstacles – Building strategic partnerships and trust within a supply chain.

UNIT - V IT AND EMERGING CONCEPTS IN SUPPLY CHAIN 9

The role IT in supply chain-The supply chain IT framework - Customer Relationship Management – Internal supply chain management – supplier relationship management – future of IT in supply chain – E-Business in supply chain- Introduction to Warehouse Management, Risks in Supply Chain, Lean supply Chains, Sustainable supply Chains.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Sunil Chopra, Peter Meindl and D.V. Kalra, “Supply Chain Management: Strategy, Planning, and Operation", Pearson Education, 6th Edition, 2016.
2. Ravi Ravindran A, Donald P. Warsing, Jr, “Supply Chain Engineering: Models and Applications”, CRC Press, 2012.
3. Srinivasan G.S, “Quantitative models in Operations and Supply Chain Management”, PHI, 2010.

REFERENCES:

1. Simchi – Levi Davi, Kaminsky Philip "Designing and Managing the Supply Chain Concepts Strategies and Case Studies", McGraw-Hill Education, 3rd Edition, 2017.
2. Erik Hofmann, Nicola Bosia and Urs Magnus Strewe, "Supply Chain Finance and Blockchain Technology -The Case of Reverse Securitisation", Springer International Publishing AG, 2018.
3. Roberta S Russell, Bernard W Taylor III, "Operations and Supply Chain Management", Wiley India, 10th Edition, 2019.
4. Jay Heizer, Barry Render, Chuck Munson, "Operations Management: Sustainability and Supply Chain Management", Pearson, 12th Edition, 2017.
5. Hsiao Fan Wang, Surendra M Gupta, "Green Supply Chain Management: Product Life Cycle Approach", McGraw Hill, 2011.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: SUPPLY CHAIN AND LOGISTIC MANAGEMENT		**Course Code : 20MEV45**			
CO	**Course Outcomes**	**Unit**	**K–CO**	**POs**	**PSOs**
C404E6.1	Describe the role and drivers of and supply chain management in achieving competitiveness.	I	K3	1,2,3,11	1,2,3
C404E6.2	Explain about Supply Chain Network Design.	II	K3	1,2,3,8, 11	1,2,3
C404E6.3	Illustrate about the issues related to Logistics in Supply Chain.	III	K3	1,2,3,4, 5,11,12	1,2,3
C404E6.4	Appraise about Sourcing and Coordination in Supply Chain.	IV	K3	1,2,3,4, 5,7,11	1,2,3
C404E6.5	Explain about the application of Information Technology and Emerging Concepts in Supply Chain.	V	K2	1,2,3,4, 5,11,12	1,2,3
C404E6.6	Describe about warehouse management.	V	K2	1,2,3,5, 11,12	1,2,3

CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C404E6.1	3	2	1	-	-	-	-	-	-	-	2	-	3	2	1
C404E6.2	3	2	1	-	-	-	-	1	-	-	2	-	3	2	1
C404E6.3	3	2	1	1	2	-	-	-	-	-	2	1	3	2	1
C404E6.4	3	2	1	2	2	-	1	-	-	-	2	-	3	2	1
C404E6.5	3	2	1	-	1	-	-	-	-	-	2	1	2	2	1
C404E6.6	3	2	1	-	1	-	-	-	-	-	2	1	2	2	1

20MEV55	ENGINEERING ECONOMICS AND COST ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To gain knowledge about the fundamental economic concepts applicable to engineering.
- To learn the time value of money and calculation of interest.
- To understand the various methods of comparison of alternatives.
- To gain knowledge in replacement policies.
- To understand the importance of cost analysis in economic decision making.

PREREQUISITE: NIL

UNIT - I INTRODUCTION 9

Law of supply and demand, Engineering efficiency, Economic efficiency, Scope of engineering economics. Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis, Material selection for product Design, Process planning.

UNIT – II VALUE ENGINEERING 9

Reasons for interest, simple interest, compound interest, time-value equivalence, compound interest factors, nominal and effective interest rates, use of interest tables, continuous compounding, calculation of time-value equivalents for single and multiple-payment cash flows involving uniform continuous payment and uniform gradient.

UNIT – III CASH FLOW 9

Methods of comparison of alternatives – present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), Annual equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), rate of return method

UNIT – IV REPLACEMENT ANALYSIS 9

Items deteriorating with time and items that fail completely, replacement with and without time value of money, replacement policy for new and old machines with infinite horizon, group replacement.

UNIT - V COST ANALYSIS 9

Cost concepts, Determinants of cost, Short-run cost-output Relationship, Long-run cost output relationship, Economies and Diseconomies of scale and Estimating cost-Output Relationship.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. James L Riggs, David D Bedworth, Sabah U Randhawa , "Engineering Economics", Tata McGraw Hill, 4th Edition, 2017.
2. Prasanna Chandra, "Projects Planning and Analysis", Tata McGraw Hill, 9th Edition, 2009.
3. Chan S Park, "Contemporary Engineering Economics", Pearson, 6th Edition, 2015.

REFERENCES:

1. Leland Blank, Anthony Tarquin, "Engineering Economy", Tata McGraw Hill, 7th Edition, 2013.
2. William G Sullivan, Elin M Wicks, Patrick Koelling C, "Engineering Economy", Pearson, 14th Edition, 2011.
3. Gerald Thuesen J, Fabrycky W J, "Engineering Economy", Prentice Hall, 9th Edition, 2002.
4. PanneerSelvam, R, “Engineering Economics”, Prentice Hall of India Ltd, 2001.
5. Zahid A khan, "Engineering Economy", Pearson, 2012

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: ENGINEERING ECONOMICS AND COST ANALYSIS											**Course Code : 20MEV55**				
CO	**Course Outcomes**										**Unit**	**K–CO**	**POs**		**PSOs**
C405E7.1	Determine the break-even point for a given production system.										I	K3	1,2,3, 11		1,2,3
C405E7.2	Compute time value equivalent for various cash flow.										II	K3	1,2,3, 8,11		1,2,3
C405E7.3	Describe various methods of comparison of alternatives.										III	K3	1,2,3,4, 5,11,12		1,2,3
C405E7.4	Choose a suitable replacement policy for items deteriorating with time.										IV	K3	1,2,3,4, 5,7,11		1,2,3
C405E7.5	Choose a suitable replacement policy for machines with infinite horizon.										IV	K3	1,2,3,5, 11,12		1,2,3
C405E7.6	Explain various determinants of cost.										V	K3	1,2,3,5, 11,12		1,2,3
CO-PO Mapping															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C405E7.1	3	2	1	-	-	-	-	-	-	-	2	-	3	2	1
C405E7.2	3	2	1	-	-	-	-	1	-	-	2	-	3	2	1
C405E7.3	3	2	1	1	2	-	-	-	-	-	2	1	3	2	1
C405E7.4	3	2	1	2	2	-	1	-	-	-	2	-	3	2	1
C405E7.5	3	2	1	-	1	-	-	-	-	-	2	1	2	2	1
C405E7.6	3	2	1	-	1	-	-	-	-	-	2	1	2	2	1

20MEV65	MAINTENANCE ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the principles, functions of maintenance activities
- To understand the practices adapted in industry for the successful management of maintenance activities.
- To explain the different maintenance categories like Preventive maintenance, condition monitoring.
- To know about the repair methods of machine elements and material handling equipment.
- To illustrate some of the simple instruments used for condition monitoring in industry.

PREREQUISITE: NIL

UNIT - I PRINCIPLES AND PRACTICES OF MAINTENANCE PLANNING 9

Basic Principles of maintenance planning – Objectives and principles of planned maintenance activity – Importance and benefits of sound Maintenance systems – Reliability and machine availability – MTBF, MTTR and MWT – Factors of availability – Maintenance organization – Maintenance economics.

UNIT – II MAINTENANCE POLICIES – PREVENTIVE MAINTENANCE 9

Maintenance categories – Comparative merits of each category – Preventive maintenance, maintenance schedules, repair cycle - Principles and methods of lubrication – TPM.

UNIT – III CONDITION MONITORING 9

Condition Monitoring – Cost comparison with and without CM – On-load testing and offload testing – Methods and instruments for CM – Temperature sensitive tapes – Pistol thermometers – wear-debris analysis

UNIT – IV REPAIR METHODS FOR BASIC MACHINE ELEMENTS 9

Repair methods for beds, slide ways, spindles, gears, lead screws and bearings – Failure analysis – Failures and their development – Logical fault location methods – Sequential fault location.

UNIT - V REPAIR METHODS FOR MATERIAL HANDLING EQUIPMENT 9

Repair methods for Material handling equipment - Equipment records –Job order systems - Use of computers in maintenance.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Srivastava S.K., “Industrial Maintenance Management”, S. Chand and Co., 2002
2. Venkataraman .K “Maintenance Engineering and Management”, PHI Learning, Pvt. Ltd., 4th Edition, 2010.
3. Bhattacharya S.N., “Installation, Servicing and Maintenance”, S. Chand and Co., 2013.

REFERENCES:

1. Mishra R C and Pathak K., “Maintenance Engineering and Management”, PHI, 2nd Edition, 2012.
2. Andrew K.S. Jardine, Albert H.C. Tsang, “Maintenance, Replacement and Reliability” Taylor and Francis, 2006

3. BikasBadhury,Basu. S.K., “Tero Technology: Reliability Engineering and Maintenance Management”, Asian Books, 2003.
4. Seichi Nakajima, “Total Productive Maintenance”, Productivity Press, 2000.
5. Davies, “Handbook of Condition Monitoring”, Chapman & Hall, 1996.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: MAINTENANCE ENGINEERING											**Course Code : 20MEV65**				
CO	**Course Outcomes**										**Unit**	**K–CO**	**POs**	**PSOs**	
C404E7.1	Explain the principles, functions of maintenance activities.										I	K3	1,2,3,11	1,2,3	
C404E7.2	Describe the different maintenance categories.										II	K3	1,2,3, 8,11	1,2,3	
C404E7.3	Describe the principles and methods of lubrication.										II	K3	1,2,3, 4,5,11,12	1,2,3	
C404E7.4	Explain about condition monitoring and instruments used in industry.										III	K3	1,2,3,4, 5,7,11	1,2,3	
C404E7.5	Describe the repair methods used for basic machine elements like bed, slide ways.										IV	K3	1,2,3,5, 11,12	1,2,3	
C404E7.6	Describe the repair methods used for material handling equipment.										V	K3	1,2,3,5, 11,12	1,2,3	
CO-PO Mapping															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C404E7.1	3	2	1	-	-	-	-	-	-	-	2	-	3	2	1
C404E7.2	3	2	1	-	-	-	-	1	-	-	2	-	3	2	1
C404E7.3	3	2	1	1	2	-	-	-	-	-	2	1	3	2	1
C404E7.4	3	2	1	2	2	-	1	-	-	-	2	-	3	2	1
C404E7.5	3	2	1	-	1	-	-	-	-	-	2	1	2	2	1
C404E7.6	3	2	1	-	1	-	-	-	-	-	2	1	2	2	1

20MEV75 **OPERATIONS RESEARCH**

L	T	P	C
3	0	0	3

OBJECTIVES

- To provide knowledge about optimization techniques and approaches.
- To formulate a real time problem as a mathematical programming model.
- To gain mathematical, computational and communication skills for solving problems.
- To gain knowledge to solve networking and inventory problems.
- To gain knowledge on solving different waiting line models

UNIT - I LINEAR PROGRAMMING 9

Introduction to Operations Research, Linear programming (LP) – assumptions, **properties of LP solutions**, Formulations of linear programming problem – Graphical method. Solutions to LPP – simplex, Big M method.

UNIT – II TRANSPORTATION AND ASSIGNMENT MODELS 9

Transportation Problem - Mathematical Model, Types – Balanced and Unbalanced, Solution to Transportation Problem - Finding the initial basic solution, **Optimizing the basic feasible solution applying U–V Method (Modi method)**
Assignment problem –Hungarian method, Travelling salesman problem - Branch and Bound technique.

UNIT - III NETWORK MODELS 9

Network problem: shortest path – Systematic method, Dijkstra's algorithm, Floyd's algorithm
Minimal spanning tree – PRIM and Kruskal's algorithm, Maximum flow models – linear programming models, maximal flow problem algorithm
Project network representation, Critical Path Method computations, construction of time schedule, linear programming formulation of CPM, PERT networks.

UNIT – IV INVENTORY MODELS 9

Inventory models, Quantity Discount, Purchase Inventory Model - Q System, P System, Multiple-item Model - Shortage Limitation, Inventory Carrying CostConstraint, EOQ Model - Multi-item Joint Replenishment with and without Shortages, Space Constraint.

UNIT - V QUEUEING MODELS 9

Queuing models - Queuing systems and structures – Notation parameter – Single server and multi server models – Poisson input – Exponential service – Constant rate service – Infinite population.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. HamdyA.Taha "Operations Research – An Introduction", MacMillan India Ltd., 10th Edition,2017.
2. Panneerselvam R, "Operations Research", Prentice Hall India, 2016.
3. Hira.DGupta.P.K, "Operations Research",S.Chand Publications, 1st Edition, Reprint 2016

REFERENCES:

1. G.Srinivasan, "Operations Research: Principles and Applications", PHI Ltd., 2016.
2. KantiswarupGupta.P.K, Man Muhan" „Operations Research: Sultan Chand & Sons India Ltd., 12th Edition,New Delhi 2016.
3. Philips, Ravindran and Solberg, "Operations Research principle and practise", John Wiley, 2016.

4. Hiller and Liberman, Introduction to Operations Research, McGraw Hill, 2015.
5. Ramamurthy P, “Operations Research”, New age International Publishers, 2nd edition, 2007.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: OPERATIONS RESEARCH												**Course Code : 20MEV75**			
CO	**Course Outcomes**											**Unit**	**K–CO**	**POs**	**PSOs**
C315.1	Solve Linear Programming Problems by appropriate technique.											I	K3	1,2,3,8, 10	1,2,3
C315.2	Determine the performance characteristics such as time and cost in solving shortest route, transportation problems with an appropriate model.											II	K3	1,2,3,9, 10	1,2,3
C315.3	Solve the given assignment problem with an appropriate method.											II	K3	1,2,3,8, 10	1,2,3
C315.4	Determine the optimal solution for a project scheduling problem.											III	K3	1,2,3	1,2,3
C315.5	Determine the order quantity of goods under different constraints.											IV	K3	1,2,3,8	1,2,3
C315.6	Determine the solutions to single and multi channel queuing problems.											V	K3	1,2,3,8, 9,10	1,2,3
CO-PO Mapping															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C315.1	3	2	1	-	-	-	-	2	-	2	-	2	3	2	1
C315.2	3	2	1	-	-	-	-	-	2	2	-	2	3	2	1
C315.3	3	2	1	-	-	-	-	2	-	2	-	2	3	2	1
C315.4	3	2	1	-	-	-	-	-	-	-	-	2	3	2	1
C315.5	3	2	1	-	-	-	-	2	-	-	-	2	3	2	1
C315.6	3	2	1	-	-	-	-	1	2	2	-	2	3	2	1

VERTICAL – VI : MODERN MOBILITY SYSTEMS

20MEV16	AUTOMOBILE ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the construction and working principle of various parts of an automobile.
- To acquire the fundamental knowledge of the various systems of an automobile.
- To have the practice for assembling and dismantling of engine parts and transmission system
- To associate the functions of each system with its design and layout and depict the various systems using simple schematics.
- To understand the emerging trends of electric vehicles and hybrid vehicle.

PREREQUISITE:
Course Code :20ME403
Course Name: Thermal Engineering

UNIT - I AUTOMOTIVE ENGINE AUXILIARY SYSTEMS 9

Automotive engines – External combustion engines – Internal combustion engines – classification of engines – SI Engines – CI Engines – two stroke engines – four stroke engines – construction and working principles – IC engine components – functions and materials – valve timing – port timing diagram – Injection system – Unit injector system – Rotary distributor type – Electronically controlled injection system for SI engines – CI engines – Ignition system – Electronic ignition system – Transistorized ignition system, capacitive discharge ignition system.

UNIT – II VEHICLE FRAMES AND STEERING SYSTEM 9

Vehicle construction and different Chassis layouts – classifications of chassis – types of frames – frameless chassis construction – articulated vehicles – vehicle body – vehicle aerodynamics – various resistances and its effects – steering system – conventional – sophisticated vehicle – and types of steering gear box – power steering – Steering geometry – condition for true rolling motion – Ackermann's – Devi's steering system – types of stub axle – Types of rear axles.

UNIT – III TRANSMISSION SYSTEMS 9

Clutch – types and construction, gear boxes – manual and automatic, gear shift mechanisms, Over drive, transfer box, fluid flywheel, torque converter, propeller shaft, slip joints, universal joints – Hotchkiss Drive and Torque Tube Drive – rear axle – Differential – wheels and tyres.

UNIT – IV SUSPENSION AND BRAKES SYSTEMS 9

Suspension systems – conventional suspension systems – independent suspension systems – leaf spring – coil spring – taper lite – eligos spring Types of brakes – Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS), electronic brake force distribution (EBD) and Traction Control. Derive the equation of Forces acting while applying a brake on plain surface – inclined road – gradient.

UNIT - V ALTERNATIVE ENERGY SOURCES 9

Use of Natural Gas, Liquefied Petroleum Gas, Bio-diesel, Bio-ethanol, Gasohol and Hydrogen in Automobiles – Engine modifications required – Performance, Combustion and Emission Characteristics of SI and CI engines with these alternate fuels – Electric and Hybrid Vehicles, Fuel Cell. Turbo chargers – Engine emission control by three way catalytic converter system.
Note: Practical Training in dismantling and assembling of Engine parts and Transmission Systems should be given to the students.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Ganesan V. “Internal Combustion Engines”, Fourth Edition, Tata McGraw-Hill, 2012.
2. Jain K.K. and Asthana R.B., “Automobile Engineering” Tata McGraw Hill Publishers, 2015.
3. Kirpal Singh, “Automobile Engineering”, Vol. 1 & 2, Standard Publishers, 7th Edition, 2020.

REFERENCES:

1. D. Crolla, D. E. Foster, T. Kobayashi and N. Vaughan, “Encyclopedia of Automotive Engineering, Parts 1-6, Wiley, 2015.
2. Joseph Heitner, “Automotive Mechanics Principles & Practices”, East-West Press Pvt. Ltd., 2nd Edition, 2006.
3. M. Ehsani, Y. Gao and A. Emadi, “ Modern Electric, Hybrid electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2nd Edition, 2010
4. R. Stone and J. K. Ball, “Automotive Engineering Fundamentals”, SAE International, 2004.
5. T. K. Garrett, K. Newton and W. Steeds, “The Motor Vehicle”, SAE International, 13th Edition, 2001.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: AUTOMOBILE ENGINEERING											**Course Code : 20MEV16**				
CO	**Course Outcomes**										**Unit**	**K–CO**	**POs**	**PSOs**	
C404E4.1	Explain the various types of engines and components.										I	K2	1,2,3	1,2,3	
C404E4.2	Explain the various types of injection and ignition systems.										I	K2	1,2,3	1,2,3	
C404E4.3	Describe the various types of chassis, frame and steering systems.										II	K2	1,2,3	1,2,3	
C404E4.4	Distinguish between the manual transmissions systems with automatic transmission systems.										III	K2	1,2,3	1,2,3	
C404E4.5	Describe the operation of the brakes and the suspension systems.										IV	K2	1,2,3	1,2,3	
C404E4.6	Describe the importance of alternate fuels for IC engines.										V	K2	1,2,3,12	1,2,3	
CO-PO Mapping															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C404E4.1	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
C404E4.2	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
C404E4.3	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
C404E4.4	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
C404E4.5	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
C404E4.6	2	1	1	-	-	-	-	-	-	-	-	1	2	1	1

20MEV26 ADVANCED INTERNAL COMBUSTION ENGINES

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the underlying principles of operation of different IC Engines and components.
- To compare the operations of different IC Engine and components.
- To understand the various alternative fuels.
- To provide knowledge on pollutant formation, control, alternate fuel etc.
- To provide knowledge on Hybrid Electric Vehicles.

PREREQUISITE: 20ME304 Engineering Thermodynamics

UNIT - I SPARK IGNITION ENGINES 9

Mixture requirements – Fuel injection systems – Monopoint, Multipoint & Direct injection - Stages of combustion – Normal and Abnormal combustion – Knock - Factors affecting knock Combustion chambers.

UNIT – II COMPRESSION IGNITION ENGINES 9

Diesel Fuel Injection Systems - Stages of combustion – Knocking – Factors affecting knock – Direct and Indirect injection systems – Combustion chambers – Fuel Spray behaviour – Spray structure and spray penetration – Air motion - Introduction to Turbo charging.

UNIT – III POLLUTANT FORMATION AND CONTROL 9

Pollutant – Sources – Formation of Carbon Monoxide, Unburnt hydrocarbon, Oxides of Nitrogen, Smoke and Particulate matter – Methods of controlling Emissions – Catalytic converters, Selective Catalytic Reduction and Particulate Traps – Methods of measurement – Emission norms and Driving cycles.

UNIT – IV ALTERNATIVE FUELS 9

Alcohol, Hydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel - Properties, Suitability, Merits and Demerits - Engine Modifications.

UNIT - V RECENT TRENDS 9

Air assisted Combustion, Homogeneous charge compression ignition engines – Variable Geometry turbochargers – Common Rail Direct Injection Systems - Hybrid Electric Vehicles – NoxAdsorbers - Onboard Diagnostics.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Ramalingam. K.K., "Internal Combustion Engine Fundamentals", Scitech Publications, 2018.
2. H.N. Gupta, Fundamentals of Internal Combustion Engines, Prentice-Hall of India Pvt. Ltd, 2020.
3. Ganesan. V, Internal combustion engines, McGraw-Hill Education, 2017.

REFERENCES:

1. Mathur. R.B. and R.P. Sharma, "Internal Combustion Engines", DhanpatRai& Sons 2010.
2. Auto fuel and emission control systems : technology, South Holland, Ill. : Goodheart-Willcox ,2018
3. Eric Chowenitz, "Automobile Electronics", SAE Publications, 2019
4. K.A. Subramanian , Bio-fuelled Reciprocating Internal Combustion Engines, CRC Press, 2018

5. S.K.Gupta "A Text book of Automobile Engineering", S Chand and Company Limited 2020.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : ADVANCED INTERNAL COMBUSTION ENGINES		**Course Code : 20MEV26**			
CO	**Course Outcomes**	**Unit**	**K–CO**	**POs**	**PSOs**
C409E5.1	Explain fuel injection systems in SI engine, types of combustion chamber and combustion process.	I	K2	1,2,3	1,2,3
C409E5.2	Explain different types of fuel injection system and combustion chambers of CI engine.	I	K2	1,2,3	1,2,3
C409E5.3	Explain different types of air motion, and Turbo charging of IC Engine.	II	K2	1,2,3	1,2,3
C409E5.4	Explain the mechanism of pollution formation and the evolution of emission norms.	III	K2	1,2,3	1,2,3
C409E5.5	Describe the properties of various alternative fuels, engine modification required and emission characteristic of alternative fuels.	IV	K2	1,2,3	1,2,3
C409E5.6	Discuss various ignition methods used in I.C engine and electronic engine management system	V	K2	1,2,3	1,2,3

CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C409E5.1	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
C409E5.2	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
C409E5.3	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
C409E5.4	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
C409E5.5	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
C409E5.6	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1

20MEV36 TWO WHEELER AND FOUR WHEELER OVERHAULING

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the constructional details operating characteristics and vehicle design aspects.
- To understand the various subsystems of two and four wheeler.
- To develop the skills of the students in the operating principles.
- To understand the knowledge about recent development of two and four wheelers.
- To understand the cooling and lubrication systems.

PREREQUISITE: 20ME403 Thermal Engineering

UNIT - I POWER UNIT **9**

Two stroke and four stroke SI & CI engine Construction and Working, merits and demerits, Symmetrical and unsymmetrical valve & port timing diagrams. Scavenging process.

UNIT – II FUEL AND IGNITION SYSTEMS **9**

Fuel system – Different circuits in two wheeler fuel systems, fuel injection system. Ignition systems - Magneto coil and battery coil spark ignition system, Electronic ignition System, Starting system - Kick starter system – Self-starter system. Recent technologies.

UNIT – III CHASSIS AND SUSPENSION SYSTEMS **9**

Main frame for two and four wheelers, its types, Chassis and different drive systems for two wheelers, Single, multiple plates and centrifugal clutches, Gear box and its and various gear controls in two wheelers. Two wheeler suspension systems, Front and rear suspension systems. Shock absorbers. Four wheeler suspension systems, conventional suspension systems, independent suspension systems, leaf spring, coil spring.

UNIT – IV BRAKES AND WHEELS **9**

Two wheeler Brake system - Drum brakes & Disc brakes Construction and Working and its Types, Front and Rear brake links layouts for two wheeler. Brake actuation mechanism. Four wheeler brake system – Pneumatic and Hydraulic braking systems, Antilock braking system (ABS), Steering geometry, Construction and working of four wheeler power steering. Spoked wheel, cast wheel, Disc wheel & its merits and demerits. Tyres and tubes Construction & its Types.

UNIT - V COOLING AND LUBRICATIONS SYSTEMS **9**

Need for cooling, types of cooling systems, air and liquid cooling systems. Thermo syphon and forced circulation and pressurized cooling systems, properties of coolants, Requirements of lubrication systems, types – mist, pressure feed, dry and wet sump systems, properties of lubricants.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Kirpalsingh, “Automobile Engineering”, Vol. 1 & 2, Standard Publishers Distributors, 2020.
2. R. K. Rajput, “A text book of Automobile Engineering”, Laxmi Publications, 2015.
3. Irving, P.E.,'' Motor cycle Engineering'', Temple Press Book, London, 1992.

REFERENCES:

1. K. K. Ramalingam, “Automobile Engineering”, Scitech publication, Chennai, 2014.
2. James E Duffy, “Modern Automotive Technology”, Goodheart-Willcox Pub; Work book edition, 2016.
3. Ganesan V. “Internal Combustion Engines”, Tata McGraw-Hill, 3rd Edition, 2007
4. Roland Brown, The Encyclopedia of Motor cycles, Lorenz Books, 2016.

5. Ramalingam. K. K., "Two Wheelers", Scitech publications, Chennai,2009

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : TWO WHEELER AND FOUR WHEELER OVERHAULING													**Course Code : 20MEV36**		
CO	**Course Outcomes**												**Unit**	**K–CO**	**POs**	**PSOs**
C409E1.1	Explain two stroke and four stroke SI and CI engines and valve & port timing diagrams.												I	K2	1,2,3	1,2,3
C409E1.2	Explain the different circuits in two wheeler fuel systems and ignition system.												II	K2	1,2,3	1,2,3
C409E1.3	Describe the main frame for two and four wheelers, chassis and drive systems for two wheelers.												III	K2	1,2,3	1,2,3
C409E1.4	Describe the different types of clutches, gear box and suspension systems.												III	K2	1,2,3	1,2,3
C409E1.5	Describe the different types of brake system for two wheeler and four wheeler, wheels and tyres.												IV	K2	1,2,3	1,2,3
C409E1.6	Explain the different types of cooling systems and lubrication systems.												V	K2	1,2,3	1,2,3
CO-PO Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	
C409E1.1	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1	
C409E1.2	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1	
C409E1.3	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1	
C409E1.4	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1	
C409E1.5	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1	
C409E1.6	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1	

20MEV46 BATTERY TECHNOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the working principle of automotive batteries.
- To gain knowledge in energy storage systems.
- To understand about the battery performance
- To understand the battery management system
- To understand the requirement of batteries for automotive applications

PREREQUISITE:NIL

UNIT - I INTRODUCTION TO BATTERIES 9

Classification of batteries, Automotive Batteries - Principle, construction and working of lead acid battery, advanced lead-acid batteries horizontal plate Pb-acid batteries for transportation, cylindrical Pb-acid battery vs. flat plate system, maintenance free batteries.

UNIT – II ENERGY STORAGE SYSTEMS 9

Advanced Li-ion batteries - principle of operation, battery components and design, electrode, cell and battery fabrications, Li-polymer batteries and applications, Li-S battery, Li-Air battery, Sodium battery, Magnesium battery, Aluminum battery, Advanced Ni-MH batteries for transportation, future prospects of Ni-MH batteries, super capacitors

UNIT – III BATTERY TESTING AND EVALUATION 9

Battery performance evaluation- Primary battery - Service time- Voltage data- Service life – ohmic load curve- Effect of operating temperature on service life. Secondary batteries- Discharge curves-Terminal voltages- Plateau voltage, Maintenance of batteries.

UNIT – IV BATTERY PACK AND BATTERY MANAGEMENT SYSTEM 9

Selection of battery for EVs & HEVs, Traction Battery Pack design, Requirement of Battery Monitoring, Battery State of Charge Estimation methods, Battery Cell equalization problem, thermal control, protection interface, SOC Estimation, Energy & Power estimation, Battery thermal management system, Battery Management System: Definition, Parts: Power Module, Battery, DC/DC Converter, load, communication channel, Battery Pack Safety, Battery Standards & Tests.

UNIT - V BATTERIES FOR AUTOMOTIVES – FUTURE PROSPECTS 9

Degrees of vehicle electrification – Battery size vs. application -USABC and DOE targets for vehicular energy storage systems – Analysis and Simulation of batteries - Equivalent circuit and life modeling – Environmental concerns in battery production – Disposal and recycling of batteries

TOTAL : 45 PERIODS

TEXT BOOKS:

1. David Linden, Thomas Reddy, Hand book of batteries, MC Graw Hill Professional, Third Edition 2002
2. T.Minami, M.Tatsumisago,M.Wakihara,C. Iwakura,S. Kohijiya, Solid state ionics for batteries, Springer Publication, 2009
3. SandeepDhameja, Electric Vehicle Battery Systems, Newnes publication, 2001.

REFERENCES:

1. MasatakaWakihara and Osamu Yamamoto, Lithium ion Batteries Fundamental and
2. Performance,Wiley–VCH, Verlag GmbH, 2008.
3. Robert A.Huggins, Advanced Batteries – Materials science aspects,Springer, 2009.
4. Ibrahim Dinçer, Halil S. Hamut and Nader Javani, “Thermal Management of Electric Vehicle Battery Systems”, JohnWiley& Sons Ltd., 2016.

5. Albert N. Link, Alan C. O' Connor and Troy J. Scot, Battery technology for Electric vehicles, Routledge,2015
6. G.Pistoia, J.P. Wiaux, S.P. Wolksy, Used Battery Collection and Recycling, Elsevier, 2001

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : BATTERY TECHNOLOGY												**Course Code : 20MEV46**			
CO	**Course Outcomes**											**Unit**	**K–CO**	**POs**	**PSOs**
C408E4.1	Describe the construction and working of lead acid batteries.											I	K2	1,2,3,4, 6,7	1,2,3
C408E4.2	Explain the construction and working of lithium ion batteries.											II	K2	1,2,3,4, 6,7	1,2,3
C408E4.3	Discuss about the testing of batteries.											III	K2	1,2,3,4, 6,7	1,2,3
C408E4.4	Explain the battery pack system.											IV	K2	1,2,3,4, 6,7	1,2,3
C408E4.5	Discuss about the battery management system.											IV	K2	1,2,3,4, 6,7	1,2,3
C408E4.6	Discuss the environmental aspects, energy consumption, reuse and recycling of batteries.											V	K2	1,2,3,4, 6,7,12	1,2,3
CO-PO Mapping															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C408E4.1	2	1	1	1	-	1	2	-	-	-	-	-	2	1	1
C408E4.2	2	1	1	1	-	1	2	-	-	-	-	-	2	1	1
C408E4.3	2	1	1	1	-	1	2	-	-	-	-	-	2	1	1
C408E4.4	2	1	1	1	-	1	2	-	-	-	-	-	2	1	1
C408E4.5	2	1	1	1	-	1	2	-	-	-	-	-	2	1	1
C408E4.6	2	1	1	1	-	1	2	-	-	-	-	1	2	1	1

20MEV56 ALTERNATE FUELS FOR IC ENGINES

L	T	P	C
3	0	0	3

OBJECTIVES

- To expose potential alternate fuels and their characteristics
- To use appropriate synthetic fuels and fuel additives for better combustion characteristics
- To utilize alcohol fuels effectively for lower emissions
- To elaborate on the utilization of Bio-Diesel and its types as a suitable fuel in CI engines
- To utilize different gaseous fuels and predict their performance and combustion characteristics

PREREQUISITE: NIL

UNIT - I INTRODUCTION 9

Availability, Suitability, Properties, Merits and Demerits of Potential Alternative Fuels – Alcohols, Bio-Diesel, Hydrogen, Liquefied Petroleum Gas, Natural Gas, Biogas, Fuel standards – ASTM & EN.

UNIT – II SPECIAL AND SYNTHETIC FUELS 9

Different synthetic fuels, Merits and demerits, Dual, Bi-fuel and Pilot injected fuel systems, Fuel additives – types and their effect on performance and emission characteristics of engines, Flexi fuel systems, Ethers - as fuel and fuel additives, properties and characteristics.

UNIT - III ALCOHOL FUELS 9

Alcohols – Properties, Production methods and usage in engines. Blending, dual fuel operation, surface ignition, spark ignition and oxygenated additives. Performance, combustion and emission Characteristics in engines. Issues & limitation in alcohols

UNIT – IV BIO-DIESEL FUELS 9

Vegetable oils and their important properties. Fuel properties characterization. Methods of using vegetable oils – Blending, preheating, Transesterification and emulsification – Performance, combustion and emission Characteristics in diesel engines. Third generation biofuels, Ternary and Quaternary fuels, Issues & limitation of using vegetable oils in IC engines

UNIT - V GASEOUS FUELS 9

Biogas, Natural gas, LPG, Hydrogen – Properties, problems, storage and safety aspects. Methods of utilization in engines. Performance, combustion and emission Characteristics in engines. Issues & limitation in Gaseous fuels

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Ramachandran S., Rapid Thermodynamic Simulation Model of an Internal Combustion Engine on Alternate Fuels,2014
2. Singh A.P. ,Alternative Fuels And Advanced Combustion Techniques As Sustainable Solutions For Internal Combustion Engines, Springer,2021
3. Biernat K, Alternative Fuels Technical and Environmental Conditions, INTECH, 2017

REFERENCES:

1. Keith Owen and Trevor Eoley, Automotive Fuels Reference Book , SAE Publications, 2014
2. PundirB.P , I.C. Engines Combustion and Emission, Narosa Publishing House. 2010

3. Pundir B.P , Engine Combustion and Emission, , Narosa Publishing House 2011
4. Richard L. Bechtold, Automotive Fuels Guide Book, SAE Publications, 2014.
5. S M AshrafurRahman, Alternative Fuels and Their Application to Combustion Engines, MDPI, 2021

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: ALTERNATE FUELS FOR IC ENGINES													**Course Code : 20MEV56**		
CO	**Course Outcomes**												**Unit**	**K–CO**	**POs**	**PSOs**
C406E6.1	Explain various properties of Alternative Fuels and their merits demerits												I	K2	1,2,3	1,2
C406E6.2	Describe various properties of Different Synthetic fuels and their merits demerits												II	K2	1,2,3	1,2
C406E6.3	Discuss the performance and emission characteristics of engines using additives.												II	K2	1,2,3	1,2
C406E6.4	Explain Properties, Production methods and usage of Alcohol fuels in I.C Engines.												III	K2	1,2,3	1,2
C406E6.5	Describe various properties and production methods of BIO-Diesel fuels.												IV	K2	1,2,3	1,2
C406E6.6	Discuss different types utilization of Gaseous Fuels												V	K2	1,2,3	1,2
CO-PO Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	
C406E6.1	2	1	1	1	-	-	-	-	-	-	-	-	2	1	1	
C406E6.2	2	1	1	1	-	-	-	-	-	-	-	-	2	1	1	
C406E6.3	2	1	1	1	-	-	-	-	-	-	-	-	2	1	1	
C406E6.4	2	1	1	1	-	-	-	-	-	-	-	-	2	1	1	
C406E6.5	2	1	1	1	-	-	-	-	-	-	-	-	2	1	1	
C406E6.6	2	1	1	1	-	-	-	-	-	-	-	1	2	1	1	

20MEV66 INTELLIGENT TRANSPORTATION SYSTEM

L	T	P	C
3	0	0	3

OBJECTIVES

- To enable the students to study about the functional areas of Intelligent Transportation System. (ITS)
- To teach students about the architecture of Intelligent Transportation System. (ITS)
- To enable the students to know the strategies and algorithms of advanced Transport Management System.
- To teach students about the concepts of Advanced Traveller and Information System (ATIS)
- To develop the skills of the students to implement ITS in developed and developing countries.

PREREQUISITE:

Course Code: 20GE203
Course Name: Basic Electrical, Electronics and Instrumentation Engineering

UNIT - I INTRODUCTION TO INTELLIGENT TRANSPORT SYSTEM 9

Introduction to Intelligent Transportation Systems (ITS) -Definition – Role and Responsibilities – Advanced Traveller Information System – Fleet Oriented ITS Services – Electronic Toll Collection – Critical issues – Security – Safety.

UNIT – II ITS ARCHITECTURE AND HARDWARE 9

Architecture –ITS Architecture Framework – Hardware Sensors –Vehicle Detection – Techniques – Dynamic Message Sign – GPRS – GPS – Toll Collection.

UNIT - III ADVANCED TRANSPORT MANAGEMENT SYSTEM 9

Video Detection – Virtual Loop - Cameras - ANPR – IR Lighting – Integrated Traffic Management – Control Centre – Junction Management Strategies- ATMS – Advanced Traveler Information Systems (ATIS)- Route Guidance – Issues -– Historical – Current – Predictive Guidance – Data Collection – Analysis – Dynamic Traffic Assignment (DTA) – Components – Algorithm.

UNIT – IV ADVANCED TRAVELLER AND INFORMATION SYSTEM 9

Travel Information – Pre Trip and Enroute Methods- Basic ATIS Concepts – Smart Route System – Data Collection – Process – Dissemination to Travelers – Evaluation of Information – Value of Information – Business Opportunities.

UNIT - V CASE STUDIES 9

Automated Highway Systems -Vehicles in Platoons–Integration of Automated Highway Systems. ITS Programs in the World – Overview of ITS implementations in developed countries, ITS in developing countries.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Choudury M A and Sadek A, “Fundamentals of Intelligent Transportation Systems Planning” Artech House, 2003.
2. Pradip Kumar Sarkar, Amit Kumar Jain, “Intelligent Transport Systems”, PHI Learning Publishers, 2018.
3. Turban E.,”Decision Support and Export Systems Management Support Systems", Maxwell Macmillan, 1998.

REFERENCES:

1. Cycle W.Halsapple and Andrew B.Winston, "Decision Support Systems – Theory and Application", Springer Verlog, New York, 1987.
2. Sitausu S. Mittra, "Decision Support Systems – Tools and Techniques", John Wiley, New York, 1986.
3. Henry F.Korth, and Abraham Siberschatz, Data Base System Concepts, 7th edition, McGraw Hill, 2019.
4. Sussman, J. M., “Perspective on ITS”, Artech House Publishers, 2005.
5. Turban. E and Aronson. J. E, “Decision Support Systems and Intelligent Systems”, Prentice Hall, 2005.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: INTELLIGENT TRANSPORTATION SYSTEM													**Course Code : 20MEV66**		
CO	**Course Outcomes**												**Unit**	**K–CO**	**POs**	**PSOs**
	Describe the role and Responsibilities of Advanced Transportation System (ATS).												1	K2	1,2	1
	Explain the Architecture and Hardware of ATS.												2	K2	1,2	1
	Describe the strategies used in Advanced Transport Management System.												3	K2	1,2,3	1,2
	Discuss about the algorithms used in Dynamic Traffic Assignment System.												3	K2	1,2,3	1,2
	Describe about the data collection and evaluation process used in Advanced Traveller and Information System.												4	K2	1,2,3	1,2
	Discuss about the implementation of ITS in developed and developing countries.												5	K2	1,2,3	1,2
CO-PO Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	
	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-	
	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-	
	3	2	1	-	-	-	-	-	-	-	-	-	2	1	-	
	3	2	1	-	-	-	-	-	-	-	-	-	2	1	-	
	3	2	1	-	-	-	-	-	-	-	-	-	2	1	-	
	3	2	1	-	-	-	-	-	-	-	-	-	2	1	-	
	3	2	1	-	-	-	-	-	-	-	-	-	2	1	-	

MANAGEMENT ELECTIVE COURSES

		L	T	P	C
20HS5A1	**MANAGEMENT CONCEPTS & ORGANIZATIONAL BEHAVIOR**	**3**	**0**	**0**	**3**

OBJECTIVES:

To enable the students to study the evolution of Management, to study the functions and principles of management and to learn the application of the principles in an organization with a perspective to diagnose and effectively handle human behavior**.**

PRE-REQUISITE:NIL

UNIT-I INTRODUCTION TO MANAGEMENT 9

Origin - Definition of management -Nature & Characteristics of management - Scope of management - Importance of Management - Difference between administration & management- Levels of management -Functions of Management - Principles of management - Management by objectives - Management by exception .

UNIT-II PLANNINGAND ORGANIZING 9

Definitions of planning -Nature of planning - Importance of planning - Limitations of planning - Process / steps of planning -Elements of planning - Decision making - Characteristics of decision making - Process / steps of decision making-Nature of Organisation-Principles of Organisation - Advantages of Organisation - Process / steps of Organisation - Formal & Informal Organisation - Organisational Structure (Types) - Organisation chart - delegation - Process / steps of delegation - Centralisation - De-Centralisation

UNIT - III CO-ORDINATION AND CONTROLLING 9

Definition of Co-ordination - characteristics of Co-ordination - Benefits of Co-ordination - Problems in Coordination -Techniques of Co-ordination - Defintion of controlling - characteristics of control function – Control process –Communication - Characteristics of Communication - Process of Communication - Formal &Informal Communication - Upward & Downward Communication - Sideward Communication – Written Communication - Barriers in Communication - Measures to overcome communication barriers

UNIT - IV INDIVIDUAL BEHAVIOUR 9

Meaning of Organizational behavior, contributing disciplines, importance of organizational behavior, Perception and Learning - Personality and Individual Differences - Motivation theories and Job Performance - Values, Attitudes and Beliefs - Communication Types-Process - Barriers - Making Communication Effective.

UNIT - V GROUP BEHAVIOUR 9

Groups and Teams: Definition, Difference between groups and teams, Stages of Group Development, Group Cohesiveness, Types of teams, Group Dynamics - Leadership - Styles - Approaches - Power and Politics.

TOTAL: 45 PERIODS

REFERENCES:

1. Stephen P. Robins, Organizational Behavior, Pearson Education, Edition 16, 2022.
2. Steven L. Mc Shane, Mary Ann Von Glinow, et al. Organizational Behavior, Edition 9, 2022.
3. PC Tripathi, PN Reddy, AshishBajpai, Principles of Management, Tata McGraw Hill,

TOTAL: 45 PERIODS

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

- Explain Management principles into management practices and Managers manage business in global context with different strategies and to determine the effective ways of controlling, and decision making. [K2]
- Understand and explain all the managerial functions. [K2]
- Demonstrate the applicability of the concept of organizational behavior to understand the behavior of people in the organization and management of individual behavior in the organization. [K3]
- Analyze the complexities associated with management of the group behavior in the organization. [K3]
- Demonstrate how the organizational behavior can integrate in understanding the motivation (why) behind behavior of people in the organization. [K3]
  Managerial functions like planning, organizing, staffing, leading & controlling and have same basic knowledge on international aspect of management and the degree to which one can make an individual to think beyond self. [K3]

20HS5A2	INDUSTRIAL MARKETING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the basics of Industrial Marketing.
- To know about the Management of Industrial Marketing
- To understand the methods of Strategic Planning and Implementation process.
- To learn the process of Logistics, Marketing Control and Channel Optimization
- To understand the techniques of Pricing and Sales Force Planning

PRE-REQUISITE:NIL

UNIT-I Basics of Industrial Marketing 9

Introduction to Industrial Marketing- Industrial versus Consumer Marketing- Economics of Industrial Demand Classification of Industrial Customers- Unique Characteristics of Organizational Procurement-Purchasing in Government Units

UNIT-II Management of Industrial Marketing 9

Industrial Buying Behaviour in Indian context- Conceptualization of Buying Behavior-Stages in Buying Uncertainty Management in Industrial Marketing- Purchasing Agents in Industrial Buying-Negotiation in Industrial Marketing

UNIT - III Strategic Planning and Implementation 9

Process of Strategic Planning-Macro and Micro Variables Used to Segment Industrial Marketing- Managing the Development of Strategic Planning- Understanding Strategy Formulation and Strategy Implementation Industrial Marketing Strategy Components - Industrial Marketing Research for New Product Development Industrial Marketing Strategy in India.

UNIT - IV Logistics, Marketing Control and Channel Optimization 9

Marketing Logistics- Physical Distribution and Customer Services- Marketing Control Channel Participants-Channel Functions and Dual Channels-Choosing the Right Distributor-Distribution and Manufacturers' Representatives

UNIT - V Pricing and Sales Force Planning 9

Price: A Crucial Element in Product Strategy- The nature of Derived Demand- Segregation of New Product Cost- Pricing in Industrial Marketing- Segregation of New Product Cost - Industrial Product Pricing in India Development of Industrial Sales Force-Motivation of Sales Force- Effective Use of Sales Compensation

TOTAL: 45 PERIODS

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

- Compare industrial vs consumer marketing and the classifications of industrial customers. [K3]
- Develop Negotiation and buying techniques for industrial products. [K3]
- Formulate strategic plan and implementation methods. [K3]
- Develop techniques of Logistics, Marketing Control and Channel Optimization [K3]
- Identify Pricing tactics and Sales Force Planning techniques [K3]
- Manage the entire industrial marketing process. [K3]

REFERENCES:

1. Industrial Marketing: A Process of Creating and Maintaining Exchange by krishnamacharyulu Csg,Lalitha R, Publisher: Jaico Book House,
2. Industrial Marketing by Ghosh, Publisher: Oxford University Press,2019
3. Industrial Marketing 2e by K. K. Havaldar, Publisher: Tata McGraw-Hill Publishing Company limited,2016
4. Industrial Marketing Management by Govindarajan, Vikas Publishing House.2018
5. Industrial Marketing by Phadtare -M. T, Prentice Hall of India Private Limited ,2020

20HS6B1 PROJECT MANAGEMENT AND ENTREPRENEURSHIP

L	T	P	C
3	0	0	3

OBJECTIVES:

- To make them understand the concepts of project management for planning to execution of projects.
- To develop and strengthen entrepreneurial quality and motivation in students and to impart basic entrepreneurial skills and understanding to run a business efficiently and effectively.

PRE-REQUISITE:NIL

UNIT- I PROJECT MANAGEMENT **9**

Introduction to Industrial Marketing- Industrial versus Consumer Marketing- Economics of Industrial DemandClassification of Industrial Customers- Unique Characteristics of Organizational Procurement-Purchasing in Government Units

UNIT-II PROJECT FINANCING **9**

Industrial Buying Behaviour in Indian context- Conceptualization of Buying Behavior-Stages in Buying Uncertainty Management in Industrial Marketing- Purchasing Agents in Industrial Buying-Negotiation in Industrial Marketing

UNIT - III ENTREPRENEURSHIP **9**

Process of Strategic Planning-Macro and Micro Variables Used to Segment Industrial Marketing- Managing the Development of Strategic Planning- Understanding Strategy Formulation and Strategy Implementation Industrial Marketing Strategy Components - Industrial Marketing Research for New Product Development Industrial Marketing Strategy in India.

UNIT - IV ENTREPRENEURIAL IDEA AND INNOVATION **9**

Marketing Logistics- Physical Distribution and Customer Services- Marketing ControlChannel Participants-Channel Functions and Dual Channels-Choosing the Right Distributor- Distribution and Manufacturers' Representatives

UNIT - V SOCIAL ENTREPRENEURSHIP **9**

Price: A Crucial Element in Product Strategy- The nature of Derived Demand- Segregation of New Product Cost- Pricing in Industrial Marketing- Segregation of New Product Cost - Industrial Product Pricing in IndiaDevelopment of Industrial Sales Force-Motivation of Sales Force- Effective Use of Sales Compensation

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Robert D. Hisrich, Michael P. Peters and Dean A. Shepherd, "Entrepreneurship", McGraw Hill Education, Tenth Edition, 2018.
2. Peter F. Drucker, "Innovation and Entrepreneurship", Harper Business, 2006.

REFERENCES:

1. Anil K. Gupta, "Grassroots Innovation: Minds on the Margin Are Not Marginal Minds", Random House, 2016.
2. V.S.P.Rao, "Business, Entrepreneurship and Management", Vikas Publishing, 2014.
3. Rajeev Roy, "Entrepreneurship", Oxford University Press, 2011.
4. Roman Pichler, "Agile Product Management with Scrum Creating Products That Customers Love", Pearson India, 2013.
5. John M. Nicholas and Herman Steyn, "Project Management for Engineering,

Business and Technology", A Butterworth-Heinemann Title, Fourth Edition, 2011.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: PROJECT MANAGEMENT AND ENTREPRENEURSHIP		**Course Code : 20HS6B1**			
CO	**Course Outcomes**	**Unit**	**K–CO**	**POs**	**PSOs**
C403E3.1	Conclude the project characteristics and various stages of a project.	1	K6	8,9,10, 11	3
C403E3.2	Compile the conceptual clarity about project organization and feasibility.	2	K5	8,9,10, 11	3
C403E3.3	Apply the risk management plan and analyze the role of stakeholders.	3	K3	8,9,10, 11	3
C403E3.4	Analyze the social responsibility for an entrepreneurship.	4	K4	7,8,9, 10,11	3
C403E3.5	Interpret the gain knowledge to overcome the factors affecting small-scale business.	4	K3	8,9,10, 11	3
C403E3.6	Formulate a new small-scale business.	5	K6	7,8,9,10, 11	3

CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C403E3.1	-	-	-	-	-	-	-	2	2	2	3	-	-	-	1
C403E3.2	-	-	-	-	-	-	-	2	2	2	3	-	-	-	1
C403E3.3	-	-	-	-	-	-	-	2	2	2	3	-	-	-	1
C403E3.4	-	-	-	-	-	-	3	2	2	2	3	-	-	-	1
C403E3.5	-	-	-	-	-	-	-	2	2	2	3	-	-	-	1
C403E3.6	-	-	-	-	-	-	3	2	2	2	3	-	-	-	1

20HS6A1	INTELLECTUAL PROPERTY RIGHTS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To get an adequate knowledge on patent and copyright for their innovative research works.
- To use in their career, information in patent documents provide useful insight on novelty of their idea from state-of-the art search. This provide further way for developing their idea or innovations.
- To pave the way to catch up Intellectual Property (IP) as an career option.
  - R & D IP Counsel
  - Government Jobs – Patent Examiner
  - Private Jobs

PRE-REQUISITE: NIL

UNIT - I OVERVIEW OF INTELLECTUAL PROPERTY 9

Introduction and the need for intellectual property right (IPR) - Kinds of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design - Genetic Resources and Traditional Knowledge - Trade Secret - IPR in India: Genesis and development - IPR in abroad - Major International Instruments concerning Intellectual Property Rights: Paris Convention - 1883, the Berne Convention - 1886, the Universal Copyright Convention - 1952, the WIPO Convention - 1967, the Patent Co-operation Treaty - 1970, the TRIPS Agreement - 1994.

UNIT - II PATENTS 9

Patents - Elements of Patentability: Novelty, Non Obviousness (Inventive Steps), Industrial Application - Non-Patentable Subject Matter - Registration Procedure - Rights and Duties of Patentee - Assignment and license - Restoration of lapsed Patents - Surrender and Revocation of Patents - Infringement - Remedies & Penalties - Patent office and Appellate Board.

UNIT - III COPYRIGHTS 9

Nature of Copyright - Subject matter of copyright: original literary, dramatic, musical, artistic works - cinematograph films and sound recordings - Registration Procedure - Term of protection - Ownership of copyright - Assignment and license of copyright - Infringement - Remedies & Penalties - Related Rights - Distinction between related rights and copyrights.

UNIT - IV TRADEMARKS 9

Concept of Trademarks - Different kinds of marks (brand names, logos, signatures, symbols, well known marks, certification marks and service marks) - Non Registrable Trademarks - Registration of Trademarks - Rights of holder and assignment and licensing of marks - Infringement, Remedies & Penalties - Trademarks registry and appellate board.

UNIT - V OTHER FORMS OF IP & REGISTRATION PROCESS 9

Design: meaning and concept of novel and original - Procedure for registration, effect of registration and term of protection. Geographical Indication (GI): meaning, and difference between GI and trademarks - Procedure for registration, effect of registration and term of protection. IPR registration process through government website-modalities and publications. Plant Variety Protection: meaning and benefit sharing and farmers' rights – Procedure for registration, effect of registration and term of protection. Layout Design Protection: meaning – Procedure for registration, effect of registration and term of protection.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. K.V.Nithyananda, “Intellectual Property Rights: Protection and Management”, Cengage Learning India Pvt. Ltd., 2019.
2. P.Neeraj and D.Khusdeep, “Intellectual Property Rights”, PHI Learning Pvt. Ltd., 2014.

REFERENCES:

1. V.K.Ahuja, “Law Relating to Intellectual Property Rights”, Lexis Nexis, Third Edition, 2017.
2. Journal of Intellectual Property Rights (JIPR): NISCAIR
3. Cell for IPR Promotion and Management (http://cipam.gov.in/)
4. World Intellectual Property Organization (https://www.wipo.int/about-ip/en/)
5. Office of the Controller General of Patents, Designs & Trademarks (http://www.ipindia.nic.in/)

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : INTELLECTUAL PROPERTY RIGHTS																**Course Code : 20HS6A1**	
CO	**Course Outcomes**															**Unit**	**K–CO**	**POs**	**PSOs**
C408E6.1	Explain the fundamental aspects of Intellectual property Rights which plays a major role in development and management of innovative projects in industries.															1	K2	1,2,8	1,2
C408E6.2	D Describe the patents, patent regime in India and abroad and registration aspects.															2	K2	1,2,8	1,2
C408E6.3	Describe the copyrights and its related rights and registration aspects.															3	K2	1,2,8	1,2
C408E6.4	Explain the trademarks and registration aspects.															4	K2	1,2,8	1,2
C408E6.5	Explain the Design, Geographical Indication (GI), Plant Variety and Layout Design Protection and their registration aspects.															5	K2	1,2,8	1,2
C408E6.6	Analyze the current trends in IPR and Government steps in fostering IPR															5	K3	1,2,3,8	1,2
CO-PO Mapping																			
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**				
C408E6.1	2	1	-	-	-	-	-	1	-	-	-	-	1	1	-				
C408E6.2	2	1	-	-	-	-	-	1	-	-	-	-	1	1	-				
C408E6.3	2	1	-	-	-	-	-	1	-	-	-	-	1	1	-				
C408E6.4	2	1	-	-	-	-	-	1	-	-	-	-	1	1	-				
C408E6.5	2	1	-	-	-	-	-	1	-	-	-	-	1	1	-				
C408E6.6	2	1	-	-	-	-	-	1	-	-	-	-	1	1	-				

20HS7A2	TOTAL QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand TQM concepts.
- To know about TQM principles.
- To understand Six Sigma, Traditional tools, New tools, Benchmarking and FMEA.
- To understand Taguchi's Quality Loss Function, Performance Measures and apply QFD, TPM, COQ and BPR.
- To apply QMS and EMS in any organization.

PRE-REQUISITE: NIL

UNIT - I INTRODUCTION 9

Quality – Need, Evolution, Definitions, Dimensions of product and service quality. TQM - Basic concepts, Framework, Contributions of Deming, Juran and Crosby, Barriers. Quality statements, Customer satisfaction, Customer complaints, Customer retention, Costs of quality.

UNIT – II TQM PRINCIPLES 9

Strategic quality planning, Quality Councils, Employee involvement, Motivation, Empowerment, Teamwork, Quality circles, Recognition and Reward, Performance appraisal, Continuous process improvement - PDCA cycle, 5S, Kaizen, Supplier partnership, Supplier selection, Supplier Rating.

UNIT – III TQM TOOLS AND TECHNIQUES I 9

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.

UNIT – IV TQM TOOLS AND TECHNIQUES II 9

Control Charts, Process Capability, Quality Function Development (QFD), Taguchi quality loss function, TPM - Concepts, improvement needs, Performance measures.

UNIT - V QUALITY SYSTEMS 9

Need for ISO 9000, ISO 9001-2008 Quality System, Elements, Documentation, Quality Auditing, QS 9000 - ISO 14000, Concepts, Requirements and Benefits, TQM Implementation in manufacturing and service sectors.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Dale H. Besterfiled, et at., "Total quality Management", Pearson Education Asia, 5th Edition, 2018.
2. James R. Evans and William M. Lindsay, "The Management and Control of Quality", Cengage Learning, 8th Edition, 2012.
3. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2nd Edition, 2006.

REFERENCES:

1. Joel.E. Ross, “Total Quality Management – Text and Cases”, CRC Press, 5th Edition, 2017.
2. Kiran.D.R, “Total Quality Management: Key concepts and case studies, Butterworth – Heinemann Ltd, 1st Edition, 2016.

3. Oakland, J.S. “TQM – Text with Cases”, Butterworth – Heinemann Ltd., Oxford, 3rd Edition, 2012.
4. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 1st Edition, 2006.
5. Brue G, "Six Sigma for Managers”, Tata-McGraw Hill, 2nd Edition, 2002.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : TOTAL QUALITY MANAGEMENT											**Course Code : 20HS7A2**				
CO	**Course Outcomes**										**Unit**	**K–CO**	**POs**	**PSOs**	
C409E6.1	Explain basic concepts, TQM framework, Barriers Benefits of TQM and importance of customers										I	K2	1,2,3,11	1,2,3	
C409E6.2	Explain the TQM Principles, understand the importance of employee involvement and supplier partnership										II	K2	1,2,3, 8,11	1,2,3	
C409E6.3	Explain the basics of Six Sigma, Traditional tools, New tools										III	K2	1,2,3,4, 5,11,12	1,2,3	
C409E6.4	Explain the process of Benchmarking and FMEA										IV	K2	1,2,3,4, 5,7,11	1,2,3	
C409E6.5	Explain process capability, QFD, TPM, Taguchi quality loss function and performance measures										IV	K2	1,2,3,4, 11,12	1,2,3	
C409E6.6	Explain the Quality system ISO 9000, ISO 14000, Audit, Certification process and implementation of TQM in manufacturing and service sectors										V	K2	1,2,3,5, 11,12	1,2,3	
CO-PO Mapping															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C409E6.1	3	2	1	-	-	-	-	-	-	-	2	-	3	2	1
C409E6.2	3	2	1	-	-	-	-	1	-	-	2	-	3	2	1
C409E6.3	3	2	1	1	2	-	-	-	-	-	2	1	3	2	1
C409E6.4	3	2	1	2	2	-	1	-	-	-	2	-	3	2	1
C409E6.5	3	2	1	-	-	-	-	-	-	-	2	1	2	2	1
C409E6.6	3	2	1	-	1	-	-	-	-	-	2	1	2	2	1

20HS8A1 HUMAN RELATIONS AT WORK

L	T	P	C
3	0	0	3

OBJECTIVES:

- To create awareness of human relations at work its relationship with self.
- To create awareness about the processes involved in interaction with people at work.
- To understand the importance of psychological and physical health in maintaining human relations at work and progressing in career.

PRE – REQUISITE : NIL

UNIT – I INTRODUCTION TO HUMAN RELATIONS 9

Understanding and Managing Yourself – Human Relations and You – Self-Esteem and Self –Confidence – Self-Motivation and Goal Setting – Emotional Intelligence – Attitudes and Happiness – Values and Ethics – Problem Solving and Creativity.

UNIT- II HUMAN RELATIONS AT WORK 9

Dealing Effectively with People – Communication in the Workplace – Specialized Tactics for Getting Along with Others in the Workplace – Managing Conflict – Becoming an Effective
Leader – Motivating Others and Developing Teamwork – Diversity and Cross-Cultural Competence.

UNIT - III STAYING PHYSICALLY HEALTHY 9

Yoga: Ashtanga, Yam and Niyam, Asan – Pranayam – Exercise: Aerobic and anaerobic.

UNIT - IV STAYING PSYCHOLOGICALLY HEALTHY 9

Managing Stress and Personal Problems – Meditation – Cognitive, behavioural and emotional well-being.

UNIT - V DEVELOPING CAREER THRUST 9

Getting Ahead in Your Career – Learning Strategies – Perception – Life Span Changes – Developing Good Work Habits.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Andrew DuBrin, “Human Relations for Career and Personal Success: Concepts, Applications, and Skills”, Pearson Education, Eleventh Edition, 2016.
2. Swami Vivekananda, “Raja-Yoga or Conquering the Internal Nature”, Vedanta Press,1998.

REFERENCES:

1. Jerrold S. Greenberg, “Comprehensive Stress Management”, McGraw-Hill Humanities Social, Thirteenth Edition, 2012.
2. Y.Udai, “Yogasan aur pranayama”, N.S. Publications, New Delhi, 2015.
3. Janardan Swami Yogabhyasi Mandal, “Yogic Asanas for Group Training - Part-I”, Nagpur.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: HUMAN RELATIONS AT WORK		**Course Code : 20HS8A1**			
CO	**Course Outcomes**	**Unit**	**K–CO**	**POs**	**PSOs**
C403E4.1	Implement the elements of Emotional Intelligence and create a plan for continual improvement.	1	K3	6,8,9,10	3
C403E4.2	Demonstrate the elements of teamwork such as team development stages, leadership skills, team dynamics, problems solving and decision making approaches, and team building.	2	K3	6,8,9,10	3
C403E4.3	Employ active listening skills including paraphrasing, questioning, empathetic listening, analytic listening, responding and communicating non-verbally while respecting individual differences.	2	K3	6,8,9,10	3
C403E4.4	Identify various Yoga Postures.	3	K3	6,8,9,10	3
C403E4.5	Develop an action plan to increase personal motivation in a personal and or workplace situation.	4	K3	6,8,9,10	3
C403E4.6	Identify different elements of organizational behavior and change including organizational climate, culture, power, ethics, and organizational development techniques to develop a change model for an aspect of their personal and or professional life.	5	K3	6,8,9,10	3

CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C403E4.1	3	3	3	3	-	-	-	-	-	-	-	-	-	-	1
C403E4.2	3	3	3	3	-	-	-	-	-	-	-	-	-	-	1
C403E4.3	3	3	3	3	-	-	-	-	-	-	-	-	-	-	1
C403E4.4	3	3	3	3	-	-	-	-	-	-	-	-	-	-	1
C403E4.5	3	3	3	3	-	-	-	-	-	-	-	-	-	-	1
C403E4.6	3	3	3	3	-	-	-	-	-	-	-	-	-	-	1

20HS8B2 ECONOMICS FOR ENGINEERS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the fundamental economic concepts
- To understand cost estimation concepts
- To understand value engineering
- To understand project appraisal and methods of anlaysis
- To understand the methods of depreciation

PRE-REQUISITE: NIL

UNIT - I INTRODUCTION TO ECONOMICS 9

Introduction to Economics- Flow in an economy, Law of supply and demand, Concept of Engineering Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics – Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis - V ratio, Elementary economic Analysis – Material selection for product Design selection of a product, Process planning.

UNIT - II COST ESTIMATION AND MACRO ECONOMICS 9

Cost and revenue concepts- Determination of equilibrium price under perfect competition - Banking – Inflation - National Income

UNIT - III VALUE ENGINEERING 9

Make or buy decision, Value engineering – Function, aims, Value engineering procedure: Interest formulae and their applications –Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series payment Present worth factor- equal payment series capital recovery factor - Uniform gradient series annual equivalent factor, Effective interest rate, Examples in all the methods.

UNIT - IV PROJECT APPRAISAL AND ANALYSIS 9

Methods of comparison of alternatives – present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), Annual equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram),rate of return method, Examples in all the methods.

UNIT - V DEPRECIATION 9

Depreciation- Introduction, Straight line method of depreciation, declining balance method of depreciation-Sum of the years digits method of depreciation, sinking fund method of depreciation/ Annuity method of depreciation, service output method of depreciation-Evaluation of public alternatives- introduction, Examples, Inflation adjusted decisions – procedure to adjust inflation, Examples on comparison of alternatives and determination of economic life of asset.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Panneer Selvam, R, “Engineering Economics”, Prentice Hall of India Ltd, New Delhi,2001.

REFERENCES:

1. ChanS.Park,“Contemporary Engineering Economics”, PrenticeHallofIndia,2011.
2. Donald.G. Newman, Jerome.P.Lavelle, “Engineering Economics and analysis” Engg.Press,Texas,2010.
3. Degarmo, E.P., Sullivan, W.G and Canada, J.R, “Engineering Economy”, Macmillan, NewYork,2011.
4. ZahidAkhan: Engineering Economy,"EngineeringEconomy", DorlingKindersley,2012

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: ECONOMICS FOR ENGINEERS		**Course Code : 20HS8B2**			
CO	**Course Outcomes**	**Unit**	**K–CO**	**POs**	**PSOs**
C403E5.1	Describe the concept of engineering economics	1	K2	1,2,8	1,2
C403E5.2	Comprehend macroeconomic principles	2	K2	1,2,8	1,2
C403E5.3	Decision making in diverse business set up	3	K2	1,2,8	1,2
C403E5.4	Explain the Inflation & Price Change	3	K2	1,2,8	1,2
C403E5.5	Explain Present Worth Analysis	4	K2	1,2,8	1,2
C403E5.6	Apply the principles of economics through various case studies	5	K3	1,2,3,8	1,2

CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C403E5.1	2	1	-	-	-	1	1	2	2	2	-	-	1	1	-
C403E5.2	2	1	-	-	-	1	1	2	2	2	-	-	1	1	-
C403E5.3	2	1	-	-	-	1	1	2	2	2	-	-	1	1	-
C403E5.4	2	1	-	-	-	1	1	2	2	2	-	-	1	1	-
C403E5.5	2	1	-	-	-	1	1	2	2	2	-	-	1	1	-
C403E5.6	2	1	-	-	-	1	1	2	2	2	2	-	1	1	-

OPEN ELECTIVE - I (VI SEMESTER)

		L	T	P	C
20OE101	**MECHATRONICS AND APPLICATIONS**	3	0	0	3

OBJECTIVES

- To enable the students understand the basic concepts of mechatronics and measurement systems.
- To teach students about the various types of sensors and transducers.
- To enable the students understand the functions of various Signal Conditioning devices and Data Acquisition system.
- To develop the skills of students in describing the functions and applications of PLC and SCADA system.
- To enable the students understand the applications of Mechatronics system.

PREREQUISITE: NIL

UNIT - I INTRODUCTION TO MECHATRONICS AND MEASUREMENT SYSTEM 9

Introduction to Mechatronics – Systems – Concepts of Mechatronics approach – key elements of mechatronics system - Need for Mechatronics – Emerging areas of Mechatronics – Classification of Mechatronics. Generalized Measurement System – Performance Characteristics: Static and Dynamic Characteristics – Errors in Measurements – Statistical Analysis of errors - Calibration and Standards.

UNIT – II SENSORS AND TRANSDUCERS 9

Static and dynamic Characteristics of Sensor - Potentiometers – LVDT – Capacitance sensors – Strain gauges – Piezoelectric sensor - Eddy current sensor – Hall effect sensor – Temperature sensors – Light sensors- optical encoders – proximity sensors -Ultrasonic sensor.

UNIT - III SIGNAL CONDITIONING AND DATA ACQUISITION 9

Amplification, Filtering – Level conversion – Linearization - Buffering – Sample and Hold circuit – Quantization – Multiplexer / Demultiplexer – Analog to Digital converter – Digital to Analog converter I/P and P/I converter - Instrumentation Amplifier-V/F and F/V converter-Data Acquisition -Data Logging – Data conversion –Introduction to virtual instrumentation.

UNIT – IV PROGRAMMABLE LOGIC CONTROLLER AND SCADA SYSTEM 9

Introduction – Basic structure – Input and output processing – Programming – Mnemonics – Timers, counters and internal relays – Data handling – Selection of PLC.

Introduction to SCADA – Typical SCADA System Architecture – Communication Requirements – Desirable properties of SCADA system – Applications of SCADA

UNIT - V APPLICATIONS OF MECHATRONICS SYSTEM 9

Traditional and Mechatronics design concepts – Case studies of Mechatronics systems – Pick and place Robot – Engine Management system – Automatic car park barrier – Washing machine system – Automatic camera.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Ernest O Doebelin, “Measurement Systems – Applications and Design”, Tata McGraw-Hill, 2009.
2. W.Bolton, “Mechatronics, Electronic control systems in Mechanical and Electrical Engineering”, Pearson Education, 2015.
3. Sawney A K and Puneet Sawney, “A Course in Mechanical Measurements and Instrumentation and Control”, 12th edition, Dhanpat Rai & Co, New Delhi, 2013.

REFERENCES:

1. Michael B.Histand and Davis G.Alciatore, “Introduction to Mechatronics and Measurement systems”, McGraw Hill International 4th Edition, 2011.
2. Bradley D.A, Dawson D, Buru N.C and Loader A.J, “Mechatronics”, Chapman and Hall, 1993.
3. Smaili.A and Mrad.F, “Mechatronics Integrated Technologies for Intelligent Machines”, Oxford University Press, 2008.
4. Devadas Shetty and Richard A. Kolk, “Mechatronics Systems Design”, PWS publishing company, 2007.
5. John Turner and Martyn Hill, “Instrumentation for Engineers and Scientists”, Oxford Science Publications, 2009.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: MECHATRONICS AND APPLICATIONS		**Course Code : 20OE101**			
CO	**Course Outcomes**	**Unit**	**K–CO**	**POs**	**PSOs**
C305E1.1	Describe the key elements, functions of mechatronics and measurement systems.	I	K3	1,2,3,4, 10,12	1,2,3
C305E1.2	Describe the working principles and characteristics of various types of sensors.	II	K3	1,2,3,4, 10,12	1,2,3
C305E1.3	Discuss about the functions of Signal Conditioning devices and Data Acquisition system.	III	K3	1,2,3,4,5 , 10,12	1,2,3
C305E1.4	Develop the ladder logic diagram for various automatic control operations with PLC.	IV	K3	1,2,3,4,5 10,12	1,2,3
C305E1.5	Describe the architecture, desirable properties and applications of SCADA system.	IV	K3	1,2,3,4,5 , 10,12	1,2,3
C305E1.6	Describe the industrial and domestics applications of various mechatronics system.	V	K3	1,2,3,4, 10,12	1,2,3

CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C305E1.1	3	3	1	1	-	-	-	-	-	1	-	1	3	2	1
C305E1.2	3	3	1	1	-	-	-	-	-	1	-	1	3	2	1
C305E1.3	3	3	1	1	-	-	-	-	-	1	-	1	3	2	1
C305E1.4	3	3	1	1	1	-	-	-	-	1	-	1	3	2	1
C305E1.5	3	3	1	1	1	-	-	-	-	1	-	1	3	2	1
C305E1.6	3	3	1	1	-	-	-	-	-	1	-	1	3	2	1

20OE102	SOLID FREE FORM MANUFACTURING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the evolution of Solid Freeform Manufacturing proliferation into various fields.
- To gain knowledge on Design for Additive Manufacturing and its importance in quality improvement of fabricated parts.
- To impart knowledge in polymerization and sheet lamination processes and their applications.
- To know about material extrusion and powder bed fusion processes.
- To gain knowledge on jetting and direct energy deposition processes and their applications.

PREREQUISITE: NIL

UNIT - I INTRODUCTION 9

Need - Development of SFM systems – Hierarchical structure of SFM - SFM process chain – Classification – Applications. Case studies: Bio printing- Food Printing- Electronics printing – Rapid Tooling - Building printing. AM Supply chain. Economics aspect: Strategic aspect- Operative aspect.

UNIT – II DESIGN FOR ADDITIVE MANUFACTURING 9

Concepts and Objectives - AM Unique Capabilities - Part Consolidation - Topology Optimization - Lightweight Structures - DFAM for Part Quality Improvement - CAD Modeling - Model Reconstruction - Data Processing for AM - Data Formats - Data Interfacing - Part Orientation - Support Structure Design and Support Structure Generation - Model Slicing - Tool Path Generation. Design Requirements of Additive Manufacturing: For Part Production, For Mass Production, For Series Production. Case Studies.

UNIT - III VAT POLYMERIZATION AND SHEET LAMINATION PROCESSES 9

Stereo lithography Apparatus (SLA): Principles – Photo Polymerization of SL Resins - Pre Build Process – Part-Building and Post-Build Processes - Part Quality and Process Planning, Recoating Issues - Materials - Advantages - Limitations and Applications. Digital Light Processing (DLP) - Materials - Process - Advantages and Applications. Laminated Object Manufacturing (LOM): Working Principles - Process - Materials, Advantages, Limitations and Applications. Ultrasonic Additive Manufacturing (UAM) - Process - Parameters - Applications. Case Studies.

UNIT – IV MATERIAL EXTRUSION AND POWDER BED FUSION PROCESSES 9

Fused deposition Modeling (FDM): Working Principles - Process - Materials and Applications. Design Rules for FDM. Selective Laser Sintering (SLS): Principles - Process - Indirect and Direct SLS - Powder Structure – Materials - Surface Deviation and Accuracy - Applications. Multijet Fusion. Selective Laser Melting (SLM) and Electron Beam Melting (EBM): Principles – Processes – Materials – Advantages - Limitations and Applications. Case Studies.

UNIT - V JETTING AND DIRECT ENERGY DEPOSITION PROCESSES 9

Binder Jetting: Three dimensional Printing (3DP): Principles – Process - Physics of 3DP - Types of printing: Continuous mode – Drop on Demand mode - Process – Materials - Advantages - Limitations - Applications. Material Jetting: Multi Jet Modelling (MJM) - Principles - Process - Materials - Advantages and Limitations. Laser Engineered Net Shaping (LENS): Processes- Materials- Advantages - Limitations and Applications. Case Studies.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Ernest O Doebelin, “Measurement Systems – Applications and Design”, Tata McGraw-Hill, 2009.
2. W.Bolton, “Mechatronics, Electronic control systems in Mechanical and Electrical Engineering”, Pearson Education, 2015.
3. Sawney A K and Puneet Sawney, “A Course in Mechanical Measurements and Instrumentation and Control”, 12th edition, Dhanpat Rai & Co, New Delhi, 2013.

REFERENCES:

1. Michael B.Histand and Davis G.Alciatore, “Introduction to Mechatronics and Measurement systems”, McGraw Hill International 4th Edition, 2011.
2. Bradley D.A, Dawson D, Buru N.C and Loader A.J, “Mechatronics”, Chapman and Hall, 1993.
3. Smaili.A and Mrad.F, “Mechatronics Integrated Technologies for Intelligent Machines”, Oxford University Press, 2008.
4. Devadas Shetty and Richard A. Kolk, “Mechatronics Systems Design”, PWS publishing company, 2007.
5. John Turner and Martyn Hill, “Instrumentation for Engineers and Scientists”, Oxford Science Publications, 2009.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: SOLID FREE FORM MANUFACTURING		**Course Code : 20OE102**			
CO	**Course Outcomes**	**Unit**	**K–CO**	**POs**	**PSOs**
C305E2.1	Recognize the importance in the evolution of SFM, proliferation into the various fields and its effects on supply chain.	I	K3	1,2,3,4, 10,12	1,2,3
C305E2.2	Evaluate the design for AM and its importance in the quality of fabricated parts.	II	K3	1,2,3,4, 10,12	1,2,3
C305E2.3	Describe the principles and applications of polymerization and sheet lamination processes with case studies.	III	K3	1,2,3,4,5 10,12	1,2,3
C305E2.4	Explain principles of material extrusion and powder bed fusion processes and design guidelines.	IV	K3	1,2,3,4,5 10,12	1,2,3
C305E2.5	Perceive jetting and direct energy deposition processes and their applications.	IV	K3	1,2,3,4,5 10,12	1,2,3
C305E2.6	Recognize the importance in the evolution of SFM, proliferation into the various fields and its effects on supply chain.	V	K3	1,2,3,4, 10,12	1,2,3

CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C305E2.1	3	3	1	1	-	-	-	-	-	1	-	1	3	2	1
C305E2.2	3	3	1	1	-	-	-	-	-	1	-	1	3	2	1
C305E2.3	3	3	1	1	-	-	-	-	-	1	-	1	3	2	1
C305E2.4	3	3	1	1	1	-	-	-	-	1	-	1	3	2	1
C305E2.5	3	3	1	1	1	-	-	-	-	1	-	1	3	2	1
C305E2.6	3	3	1	1	-	-	-	-	-	1	-	1	3	2	1

20OE103 REFRIGERATION AND AIR CONDITIONING

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the properties .Classification and Nomenclature of different Refrigerant.
- To understand the underlying principles of operations in different Refrigeration & Air Conditioning systems and components.
- To provide knowledge on design aspects of Refrigeration.
- To understand the psychrometric properties and processes.
- To provide knowledge on Air Conditioning Systems with Controls

PREREQUISITE: NIL

UNIT - I INTRODUCTION 9

Introduction to Refrigeration - Unit of Refrigeration and C.O.P.– Ideal cycles- Refrigerants Desirable properties – Classification - Nomenclature - ODP & GWP.

UNIT – II VAPOUR COMPRESSION REFRIGERATION SYSTEM 9

Vapor compression cycle: p-h and T-s diagrams - deviations from theoretical cycle sub cooling and super heating- effects of condenser and evaporator pressure on COP- multipressure system – low temperature refrigeration - Cascade systems – problems. Equipments: Type of Compressors, Condensers, Expansion devices, Evaporators.

UNIT – III OTHER REFRIGERATION SYSTEMS 9

Working principles of Vapour absorption systems and adsorption cooling systems – Steam jet refrigeration- Ejector refrigeration systems- Thermoelectric refrigeration- Air refrigeration - Magnetic - Vortex and Pulse tube refrigeration systems.

UNIT – IV PSYCHROMETRIC PROPERTIES AND PROCESSES 9

Properties of moist Air-Gibbs Dalton law, Specific humidity, Dew point temperature, Degree of saturation, Relative humidity, Enthalpy, Humid specific heat, Wet bulb temperature Thermodynamic wet bulb temperature, Psychrometric chart; Psychrometric of air conditioning processes, mixing of air streams.

UNIT - V AIR CONDITIONING SYSTEMS AND LOAD ESTIMATION 9

Air conditioning loads: Outside and inside design conditions; Heat transfer through structure, Solar radiation, Electrical appliances, Infiltration and ventilation, internal heat load; Apparatus selection; fresh air load, human comfort & IAQ principles, effective temperature & chart, calculation of summer & winter air conditioning load; Classifications, Layout of plants; Air distribution system; Filters; Air Conditioning Systems with Controls: Temperature, Pressure and Humidity sensors, Actuators & Safety controls.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Arora, C.P., "Refrigeration and Air Conditioning", McGraw Hill, 3rd edition, 2020.
2. R. S. Khurmi, J. K. Gupta, “A Text Book of Refrigeration and Air-conditioning”, Eurasia Publishing House, 2019.
3. W F Stoecker, Refrigeration and Air Conditioning, Mcgraw Hill Higher Education, 2019.

REFERENCES:

1. Roy J. Dossat, "Principles of Refrigeration", Pearson Education Asia, 4th edition, 2019.
2. Stoecker, W.F. and Jones J. W., "Refrigeration and Air Conditioning", McGraw Hill, New Delhi, 2021.
3. ASHRAE Hand book, Fundamentals, 2010
4. Jones W.P., "Air conditioning engineering", Elsevier Butterworth-Heinemann, 5th edition, 2018
5. A. R. Trott, T C Welch , Refrigeration and air-conditioning, Butterworth Heinemann, 2018

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: REFRIGERATION AND AIR CONDITIONING												**Course Code : 20OE103**			
CO	**Course Outcomes**											**Unit**	**K–CO**	**POs**	**PSOs**
C305E3.1	Explain the principle of refrigeration, cycles, properties and its environment effects.											I	K2	1,2,3	1,2,3
C305E3.2	Calculate COP of vapor compression Cycle for different processes.											II	K3	1,2,3	1,2,3
C305E3.3	Explain the different types and working principle of refrigeration Equipment's.											II	K2	1,2,3	1,2,3
C305E3.4	Describe the working principle of various types of refrigeration systems.											III	K2	1,2,3	1,2,3
C305E3.5	Discuss psychrometric properties and processes, and air conditioning process											IV	K2	1,2,3	1,2,3
C305E3.6	Estimate cooling load factor, winter and summer air conditioning load and human comfort condition.											V	K3	1,2,3	1,2,3
CO-PO Mapping															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C305E3.1	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
C305E3.2	3	2	1	-	-	-	-	-	-	-	-	-	3	2	1
C305E3.3	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
C305E3.4	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
C305E3.5	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
C305E3.6	3	2	1	-	-	-	-	-	-	-	-	-	3	2	1

20OE104 PRODUCTION AND OPERATIONS MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the concept of Production and Operations Management in creating and enhancing a firm's competitive advantages.
- To gain knowledge about forecasting techniques in both manufacturing and service industry.
- To know about the inputs, strategies and models for aggregate planning.
- To understand the concepts of MRP and ERP.
- To know about the tools for capacity planning.

PREREQUISITE: NIL

UNIT - I INTRODUCTION 9

Objectives of Operations Management, Scope of Operations Management, Relationship of Operations with other Functional areas, Manufacturing Vs Service sector, Operations Decision making, Phases in Product Design and Development, Product Life Cycle, Process Selection.

UNIT – II FORECASTING 9

Need, Determinants of Demand, Demand Patterns, Qualitative Forecasting Methods-Delphi techniques. Market Research, Nominal Group Technique. Quantitative Forecasting methods – Moving Average Methods, Exponential Smoothing Methods, Regression methods, Monitoring and Control of Forecasts, Requirements and Selection of Good forecasting methods.

UNIT - III AGGREGATE PLANNING 9

Role of aggregate Product planning, Managerial inputs to Aggregate planning, Pure and Mixed strategies, Mathematical Models for Aggregate planning – Transportation Method, Linear programming Formulation, Linear Decision Rues, Master Production Schedule(MPS), Procedure for developing MPS.

UNIT – IV MRP AND ERP 9

MRP -Lot sizing methods – Implementation issues, MRP – II.
ERP – evolution, comparison of ERP with traditional systems, benefits, need for ERP, overview of modules in ERP. ERP implementation: Requirement analysis, alternatives, life cycle, implementation methodology.

UNIT - V CAPACITY MANAGEMENT 9

Measures of capacity, Factors affecting capacity, Capacity Planning, Systematic approach to capacity planning, Long-term and short-term capacity decisions, Tools for capacity planning, Capacity Requirement Planning- Business Process Outsourcing.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Chase R.B, Nicholas J. Aquilano, F.and Jacobs R, "Production and Operations Management: Manufacturing and Services, Irwin/McGraw-Hill, 2010.
2. Panneerselvam. R, "Production and operations Management", PHI, 3rd Edition, 2012.
3. Mary Sumner, "Enterprise Resource Planning", 2nd Edition, Pearson Education, 2007.

REFERENCES:

1. Lee J. Krajewski, Manoj K. Malhotra, Larry P. Ritzman, “Operations Management: Processes and Supply Chains”, Pearson Education,11th Edition,2015
2. Norman Gaither, Greg Frazier, “Operations Management”, Thomson Learning, 9th Edition, 2002.
3. William J Stevenson, “Operations Management”, McGraw Hill, 13th Edition, 2018.
4. Hiller and Liberman, “Introduction to Operations Research”, McGraw Hill, 2015.
5. Jay Heizer, Barry Render, Chuck Munson, "Operations Management: Sustainability and Supply Chain Management", Pearson, 2017.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: PRODUCTION AND OPERATIONS MANAGEMENT												**Course Code : 20OE104**			
CO	**Course Outcomes**											**Unit**	**K–CO**	**POs**	**PSOs**
C305E4.1	Explain the different phases in product design and development.											I	K3	1,2,3,4, 10,12	1,2
C305E4.2	Forecast demand for Production and Service Systems.											II	K3	1,2,3,4, 10,12	1,2
C305E4.3	Formulate and Assess Aggregate Planning strategies and Material Requirement Plan.											III	K3	1,2,3,4, 5,10,12	1,2
C305E4.4	Determine the lot size of a product for the given conditions in an industry.											IV	K3	1,2,3,4, 5,10,12	1,2
C305E4.5	Describe the ERP implementation methodology with an example.											IV	K3	1,2,3,4, 5,10,12	1,2
C305E4.6	Calculate capacity requirements and developing capacity alternatives.											V	K3	1,2,3,4, 10,12	1,2
CO-PO Mapping															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C305E4.1	3	2	1	1	-	-	-	-	-	1	-	1	2	1	-
C305E4.2	3	2	1	1	-	-	-	-	-	1	-	1	2	1	-
C305E4.3	3	2	1	1	-	-	-	-	-	1	-	1	2	1	-
C305E4.4	3	2	1	1	1	-	-	-	-	1	-	1	2	1	-
C305E4.5	3	2	1	1	1	-	-	-	-	1	-	1	2	1	-
C305E4.6	3	2	1	1	-	-	-	-	-	1	-	1	2	1	-

OPEN ELECTIVE - II (VII SEMESTER)

20OE105	SOLAR PHOTOVOLTAIC FUNDAMENTALS AND APPLICATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To explain basics of solar photovoltaic.
- To explain basics of PV Systems.
- To explain basics of PV System grid connections.
- To explain basics of Hybrid systems
- To know in depth of its types and design of various PV-interconnected systems

PREREQUISITE: NIL

UNIT - I PHOTOVOLTAIC BASICS **9**

Structure and working of Solar Cells - Types, Electrical properties and Behavior of Solar Cells – Cell properties and design - PV Cell Interconnection and Module Fabrication – PV Modules and arrays - Basics of Load Estimation.

UNIT – II STAND ALONE PV SYSTEMS **9**

Schematics, Components, Batteries, Charge Conditioners - Balance of system components for DC and/or AC Applications - Typical applications for lighting, water pumping etc.

UNIT – III GRID CONNECTED PV SYSTEMS **9**

Schematics, Components, Charge Conditioners, Interface Components - Balance of system Components - PV System in Buildings.

UNIT – IV HYBRID SYSTEMS **9**

Solar, Biomass, Wind, Diesel Hybrid systems - Comparison and selection criteria for a given application.

UNIT - V DESIGN OF PV SYSTEMS **9**

Radiation and load data - Design of System Components for different PV Applications – Sizing and Reliability - Simple Case Studies

TOTAL : 45 PERIODS

TEXT BOOKS:

1. CS Solanki: Solar Photovotaics – Fundamentals, Technologies and Applications, PHI Learning Pvt. Ltd., 2015.
2. Martin A. Green, Solar Cells Operating Principles, Technology, and System Applications Prentice- Hall, 2008
3. Nelson, J the Physics of Solar Cells. Imperial College Press, 2017.

REFERENCES:

1. Thomas Markvart, Solar Electricit, John Wiley and Sons, 2015.
2. Stuart R. Wenham, Martin A. Green, Muriel E. Watt, Richard Corkish (Editors), Applied Photovoltaics, Earthscan, 2014.
3. Michael Boxwell, the Solar Electricity Handbook, Code Green Publishing, UK, 2015.
4. Rik DeGunther, Solar Power Your Home for Dummies, Wiley Publishing Inc, 2016.
5. Chetan Singh Solanki, Renewable Energy Technologies; A Practical Guide for Beginners, PHI School Books, 2014.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: SOLAR PHOTOVOLTAIC FUNDAMENTALS AND APPLICATIONS		**Course Code : 20OE105**			
CO	**Course Outcomes**	**Unit**	**K–CO**	**POs**	**PSOs**
C409E7.1	Summarize the basics of Photovoltaic systems.	I	K2	1,2 3	1,2,3
C409E7.2	Explain the component of stand- alone photovoltaic systems	II	K2	1,2 3	1,2,3
C409E7.3	Explain the component of grid connected photovoltaic systems	III	K2	1,2 3	1,2,3
C409E7.4	Summarize the basics of Hybrid systems.	IV	K2	1,2 3	1,2,3
C409E7.5	Explain the selection criteria for a given Photovoltaic application.	V	K2	1,2 3	1,2,3
C409E7.6	Design of various components of solar PV systems.	V	K3	1,2 3	1,2,3

CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C409E7.1	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
C409E7.2	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
C409E7.3	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
C409E7.4	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
C409E7.5	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
C409E7.6	3	2	1	-	-	-	-	-	-	-	-	-	3	2	1

20OE106 FUNDAMENTALS OF PRODUCT DESIGN

L	T	P	C
3	0	0	3

OBJECTIVES:

- To Understand various global trends and identify the scope of a new product design
- To translate conceptual idea into detailed design
- To understand the concept of new product design.
- To understand various Quality Concepts in product design
- To impart knowledge on various industrial design process

PREREQUISITE: NIL

UNIT - I PRODUCT PLANNING 9

Product Planning Process - Identify Opportunities - Evaluating and Prioritizing Projects - Allocating Resources and Timing - Identifying Customer Needs - Raw Data from Customers - Interpreting Raw Data in Terms of Customer Needs - Organizing the Needs into a Hierarchy - Establishing the Relative Importance of the Needs - Case study for motor driven nailer - Reflecting on the Results and the Process

UNIT – II CONCEPT GENERATION AND SELECTION 9

Task – Structured approaches – clarification – search – externally and internally – explore systematically – reflect on the solutions and processes – concept selection – methodology –benefits.

UNIT – III PRODUCT ARCHITECTURE 9

Implications – Product change – variety – component standardization – product performance –manufacturability – product development management – establishing the architecture – creation –clustering – geometric layout development – fundamental and incidental interactions – related system level design issues.

UNIT – IV QUALITY CONCEPTS 9

Design For Quality - Quality Function Deployment - Design Of Experiments - Failure Modes & Effect Analysis - TQM - Design For Six Sigma - Brain Storming Techniques - Design For Manufacturing - Design Ethics - Safety and Environmental Considerations in Product Design

UNIT - V INDUSTRIAL DESIGN 9

Integrate process design – Managing costs – Robust design – Need for industrial design – impact – design process – investigation of for industrial design – impact – design process– conceptualization – refinement – management of the industrial design process – technology driven products – user – driven products – assessing the quality of industrial design.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Anita Goyal, Karl T Ulrich, Steven D Eppinger, “Product Design and Development”, Tata McGraw Hill Education, 4th Edition, 2009.
2. Kevin Otto, Kristin Wood, “Product Design”, Indian Reprint 2004, Pearson Education
3. George E Dieter, Linda C Schmidt, “Engineering Design”, Mc-Graw Hill International Edition, 5th Edition, 2012

REFERENCES:

1. David G.Ullman, “The Mechanical Design Process”, Tata McGraw Hill , 2011
2. Stephen Rosenthal, Effective Product Design and Development, Business One Orwin, 1992,
3. Staurt Pugh, Tool Design -Integrated Methods for Successful Product Engineering, Addison Wesley Publishing, 1991.
4. Chitale A K and Gupta R C, “Product Design and Manufacturing”, PHI 2007.
5. Yousef Haik, T. M. M. Shahin, “Engineering Design Process”, Cengage Learning, 2nd Edition Reprint, 2010.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: FUNDAMENTALS OF PRODUCT DESIGN											**Course Code : 20OE106**				
CO	**Course Outcomes**										**Unit**	**K–CO**	**POs**	**PSOs**	
C409E8.1	Explain the basic concepts of product design										I	K3	1,2,3,6, 9,10	1,2,3	
C409E8.2	Describe the basic concepts of concurrent Engineering										I	K3	1,2,3,6, 9,10	1,2,3	
C409E8.3	Generate various concepts for a product design and to select the best concept										II	K3	1,2,3,4, 6,9,10	1,2,3	
C409E8.4	Discuss the concepts and importance of product architecture										III	K3	1,2,3,6, 9,10	1,2,3	
C409E8.5	Apply the quality concepts to develop robust product										IV	K3	1,2,3,6, 9,10	1,2,3	
C409E8.6	Illustrate the importance of industrial design in view of aesthetics factors and ergonomic factors										V	K3	1,2,3,4, 6,9,10	1,2,3	
CO-PO Mapping															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C409E8.1	3	2	1	-	-	1	-	-	1	1	-	-	2	1	1
C409E8.2	3	2	1	-	-	1	-	-	1	1	-	-	2	1	1
C409E8.3	3	2	1	1	-	1	-	-	1	1	-	-	2	1	1
C409E8.4	3	2	1	-	-	1	-	-	1	1	-	-	2	1	1
C409E8.5	3	2	1	-	-	1	-	-	1	1	-	-	2	1	1
C409E8.6	3	2	1	1	-	1	-	-	1	1	-	-	2	1	1

20OE107 AUTONOMOUS AND ELECTRIC VEHICLES

L	T	P	C
3	0	0	3

OBJECTIVES

- To Understand the technologies used in autonomous system
- To understand the perception, prediction and routing of autonomous driving
- To understand the planning and control of autonomous driving
- To understand the architecture of electric vehicle and energy storage device
- To understand the architecture of hybrid electric vehicle

PREREQUISITE: NIL

UNIT - I AUTONOMOUS DRIVING TECHNOLOGIES 9

Autonomous driving Technologies overview- Autonomous driving algorithms-Autonomous driving client system- Autonomous driving cloud platform

UNIT – II PERCEPTION, PREDICTION AND ROUTING 9

Perception in Autonomous Driving – Detection – Segmentation – Stereo, optical flow and scene flow – Tracking. Prediction and Routing – Planning and control – Traffic Prediction-Lane level Routing.

UNIT – III DECISION AND PLANNING 9

Decision, planning and control – Behavioral Decisions – Motion Planning – Feedback control.

UNIT – IV ELECTRIC VEHICLE AND ENERGY STORAGE 9

Basics of Vehicle mechanisms, history of Electric vehicles (EV), Electric vehicle Architecture: Major components of electric vehicle. Energy storage-Battery, fuel cell and ultra capacitor.

UNIT - V HYBRID ELECTRIC VEHICLE 9

Introduction to hybrid electric vehicle, Types- series, parallel and complex configuration-Architecture of hybrid electric vehicle-drive train-sizing of components.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Shaoshan Liu; Liyun Li; Jie Tang; Shuang Wu; Jean-Luc Gaudiot, “Creating Autonomous Vehicle Systems”, Morgan & Claypool, 2018.
2. A.Perallos, U. Hernandez-jayo, E. Onieva and I. Garcia-Zuazola (Eds.), Intelligent Transport Systems: Technologies and Applications, Wiley publications, 2015.
3. Iqbal Hussain, Electric & Hybrid Vehicles – Design Fundamentals, CRC Press, New York, 2003.

REFERENCES:

1. Danil Prokhorov, “Computational Intelligence in Automotive Applications”, Studies in Computational Intelligence book series, Springer, 2008.
2. H. Cheng, Autonomous Intelligent Vehicles: Theory, Algorithms, and Implementation, Berlin:Springer, 2011.
3. Andreas Herrmann, Walter Brenner, Rupert Stadler, Autonomous Driving: How the Driverless Revolution will Change the World Emerald Publishing, 2018
4. Michael E. McGrath, Autonomous Vehicles: Opportunities, Strategies, and Disruptions, Amazon, 2018.
5. Tom Denton, Electric and Hybrid Vehicles,1st edition, Routledge Publishers,2017

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: AUTONOMOUS AND ELECTRIC VEHICLE												**Course Code : 20OE107**			
CO	**Course Outcomes**											**Unit**	**K–CO**	**POs**	**PSOs**
C409E9.1	Discuss the latest technologies in the design of autonomous systems.											I	K2	1,2,3,4, 5,6,7	1,2,3
C409E9.2	Explain the perception of autonomous system.											II	K2	1,2,3,4, 6,7	1,2,3
C409E9.3	Explain the prediction and routing of autonomous system.											II	K2	1,2,3,4, 6,7	1,2,3
C409E9.4	Explain the planning and control of autonomous driving.											III	K2	1,2,3,4, 6,7	1,2,3
C409E9.5	Explain the importance of electric vehicle and energy storage system.											IV	K2	1,2,3,4, 6,7	1,2,3
C409E9.6	Discuss about the hybrid electric vehicles.											V	K2	1,2,3,4, 6,7	1,2,3
CO-PO Mapping															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C409E9.1	2	1	1	1	1	1	2	-	-	-	-	-	2	1	1
C409E9.2	2	1	1	1	-	1	2	-	-	-	-	-	2	1	1
C409E9.3	2	1	1	1	-	1	2	-	-	-	-	-	2	1	1
C409E9.4	2	1	1	1	-	1	2	-	-	-	-	-	2	1	1
C409E9.5	2	1	1	1	-	1	2	-	-	-	-	-	2	1	1
C409E9.6	2	1	1	1	-	1	2	-	-	-	-	-	2	1	1

20OE108 INDUSTRIAL SAFETY PRACTICES

L	T	P	C
3	0	0	3

OBJECTIVES

- To impart knowledge on safety engineering fundamentals.
- To gain knowledge on safety management practices.
- To understand about the chemical, fire, mechanical hazards.
- To understand about noise and vibration control.
- To gain knowledge in Factories Act.

PREREQUISITE: NIL

UNIT - I INTRODUCTION **9**

Evolution of modern safety concepts – Fire prevention – Mechanical hazards – Boilers, Pressure vessels, Electrical Exposure.

UNIT – II CHEMICAL HAZARDS **9**

Chemical exposure – Toxic materials – Radiation Ionizing and Non-ionizing Radiation - Industrial Hygiene – Industrial Toxicology.

UNIT - III ENVIRONMENTAL CONTROL **9**

Industrial Health Hazards – Environmental Control – Industrial Noise - Noise measuring instruments, Control of Noise, Vibration, - Personal Protection.

UNIT – IV HAZARD ANALYSIS **9**

System Safety Analysis –Techniques – Fault Tree Analysis (FTA), Failure Modes and Effects Analysis (FMEA), HAZOP analysis and Risk Assessment.

UNIT - V SAFETY REGULATIONS **9**

Explosions – Disaster management – catastrophe control, hazard control, Factories Act, Safety regulations, Product safety – case studies.

TEXT BOOKS:

1. John V.Grimaldi, “Safety Management”, AITB S Publishers, 2003.
2. David L. Goetsch, “Occupational Safety and Health for Technologists”, Engineers and Managers, Pearson Education Ltd. 5th Edition, 2005.
3. Deshmukh L M, “Industrial Safety Management”, Tata McGraw-Hill Publishing Company Ltd.,2005

REFERENCES:

1. Safety Manual, “EDEL Engineering Consultancy”, 2000.
2. Charles D. Reese, “Occupational Health and Safety Management”, CRC Press, 2003.
3. Philip E. Hagan, John Franklin Montgomery, James T. O'Reilly, “Accident Prevention Manual – NSC”, Chicago, 2009.
4. John Davies, Alastair Ross, Brendan Wallace, “Safety Management: A Qualitative Systems Approach”, CRC Press, 2003.
5. Anil Mital, “Advances in Industrial Ergonomics and Safety”, Taylor and Francis Ltd, London, 1989

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: INDUSTRIAL SAFETY PRACTICES															**Course Code : 20OE103**	
CO	**Course Outcomes**														**Unit**	**K–CO**	**POs**	**PSOs**
C409E10.1	Illustrate the importance of safety in Boilers and Pressure vessels.														I	K3	1,2,3,4, 6,10,12	1,2
C409E10.2	Identify and prevent chemical, environmental mechanical, fire hazard.														II	K3	1,2,3,4, 6,10,12	1,2
C409E10.3	Collect, analyze and interpret the accidents data based on various safety techniques.														III	K3	1,2,3,4, 5,6,10,12	1,2
C409E10.4	Apply proper safety techniques on safety engineering and management.														IV	K3	1,2,3,4, 5,6,10,12	1,2
C409E10.5	Perform hazard analysis.														V	K3	1,2,3,4, 5,6,10,12	1,2
C409E10.6	Design the system with environmental consciousness by implementing safety regulation.														V	K3	1,2,3,4, 6,10,12	1,2
CO-PO Mapping																		
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**			
C409E10.1	3	3	1	1	-	2	-	-	-	1	-	1	2	1	-			
C409E10.2	3	3	1	1	-	2	-	-	-	1	-	1	2	1	-			
C409E10.3	3	3	1	1	-	2	-	-	-	1	-	1	2	1	-			
C409E10.4	3	3	1	1	1	2	-	-	-	1	-	1	2	1	-			
C409E10.5	3	3	1	1	1	2	-	-	-	1	-	1	2	1	-			
C409E10.6	3	3	1	1	-	2	-	-	-	1	-	1	2	1	-			