

KLNCE UG MECH R2020 (AY 2021-2022)

# **K.L.N. COLLEGE OF ENGINEERING**

**Pottapalayam-630612, Sivagangai District**

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



**Estd: 1994**

## **THIRD YEAR CURRICULUM AND SYLLABUS**

**REGULATIONS 2020**

**For Under Graduate Program**

**B.E. – MECHANICAL ENGINEERING**

**CHOICE BASED CREDIT SYSTEM**

**(For the students admitted from the academic year 2021-2022 onwards)**



**K.L.N. COLLEGE OF ENGINEERING, POTTAPALAYAM**  
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### **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.



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### **PROGRAM EDUCATIONAL OBJECTIVES (PEOs)**

- PEO 1** Graduates will have successful career in Mechanical Engineering and service industries.
- PEO 2** Graduates will contribute towards technological development through academic research and industrial practices.
- PEO 3** Graduates will practice their profession with good communication, leadership, ethics and social responsibility.
- PEO 4** Graduates will adapt to evolving technologies through life-long learning.

### **PROGRAM SPECIFIC OUTCOMES (PSOs)**

- PSO 1** 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.
- PSO 2** 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.
- PSO 3** 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.



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**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

**KLNCE UG MECH R2020 (AY 2021-2022)**

**SEMESTER V**

S. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1	20ME501	<u>Design of Machine Elements</u>	PC	4	3	1	0	4
2	20ME506	<u>Dynamics of Machines</u>	PC	4	3	1	0	4
3	20ME503	<u>CAD / CAM</u>	PC	3	3	0	0	3
4	20ME507	<u>Heat and Mass Transfer</u>	PC	4	3	1	0	4
5	20ME603	<u>Lean Manufacturing</u>	PC	3	3	0	0	3
6		Professional Elective - I	PE	3	3	0	0	3
7	20MC501	<u>Constitution of India</u>	MC	1	1	0	0	0
<b>PRACTICAL</b>								
8	20ME5L1	<u>Dynamics Laboratory</u>	PC	3	0	0	3	1.5
9	20ME5L2	<u>CAD / CAM Laboratory</u>	PC	4	0	0	4	2
10	20ME5L3	<u>Heat and Mass Transfer Laboratory</u>	PC	3	0	0	3	1.5
<b>TOTAL</b>				<b>32</b>	<b>19</b>	<b>3</b>	<b>10</b>	<b>26</b>

**SEMESTER VI**

S. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1	20ME605	<u>Design of Transmission Systems</u>	PC	4	3	1	0	4
2	20ME606	<u>Finite Element Analysis</u>	PC	4	3	1	0	4
3		<u>Open Elective - I</u>	OE	3	3	0	0	3
4		<u>Management Elective</u>	HS	3	3	0	0	3
5		Professional Elective - II	PE	3	3	0	0	3
6		Professional Elective – III	PE	3	3	0	0	3
<b>PRACTICAL</b>								
7	20ME6L3	<u>Computer Aided Simulation and Analysis Laboratory</u>	PC	4	0	0	4	2
8	20ME6L4	<u>Design and Fabrication Project</u>	EEC	4	0	0	4	2
<b>TOTAL</b>				<b>28</b>	<b>18</b>	<b>2</b>	<b>8</b>	<b>24</b>

**MANAGEMENT ELECTIVE COURSES**

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

**OPEN ELECTIVES (OE)**

**SEMESTER VI**

**ELECTIVE I**

SI. 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



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**Professional Elective Courses – Verticals**

Vertical 1	Vertical 2	Vertical 3	Vertical 4	Vertical 5	Vertical 6
<b>Design and Development</b>	<b>Modern Manufacturing</b>	<b>Clean Energy Technologies</b>	<b>Robotics and Automation</b>	<b>Industrial Engineering</b>	<b>Modern Mobility Systems</b>
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 systems
		Energy efficient Buildings	Micro Electro Mechanical Systems	Operations Research	

**Registration of Professional Elective Courses from Verticals:**

Professional Elective Courses will be registered in Semesters V to VII. These courses are listed in groups called verticals that represent a particular area of specialisation / diversified group. Students are permitted to choose all the Professional Electives from a particular vertical or from different verticals. Further, only one Professional Elective course shall be chosen in a semester horizontally (row-wise). The registration of courses for B.E./B.Tech (Honours) or Minor degree shall be done from Semester V to VIII. For more details on B.E./B.Tech (Honours) or Minor degree refer to the Regulations 2020 (Amendments), Clause 4 & Clause 16.



**Vertical 1: Design and Development**

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

**Vertical 2: Modern Manufacturing**

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

**Vertical 3: Clean Energy Technologies**

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

**Vertical 4: Robotics and Automation**

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

**Vertical 5: Industrial Engineering**

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

**Vertical 6: Modern Mobility Systems**

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

**KLNCE UG MECH R2020 (AY 2021-2022)****Enrollment for B.E. / B. Tech. Minor degree (Optional)**

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E./B.Tech Minor degree. For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes, Moreover, for minor degree the student can register for courses from any one of the following verticals also. Complete details are available in clause 4.10 (Amendments) of Regulations 2020.

**VERTICALS FOR MINOR DEGREE (In addition to all the verticals of other degree programmes)****VERTICAL 1: FINTECH AND BLOCK CHAIN**

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1.	20MGV11	Financial Management	HS	3	3	0	0	3
2.	20MGV21	Fundamentals of Investment	HS	3	3	0	0	3
3.	20MGV31	Banking, Financial Services and Insurance	HS	3	3	0	0	3
4.	20MGV41	Introduction to Blockchain and its Applications	HS	3	3	0	0	3
5.	20MGV51	Fintech Personal Finance and Payments	HS	3	3	0	0	3
6.	20MGV61	Introduction to Fintech	HS	3	3	0	0	3

**VERTICAL 2: ENTREPRENEURSHIP**

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1.	20MGV12	Foundations of Entrepreneurship	HS	3	3	0	0	3
2.	20MGV22	Team Building & Leadership Management for Business	HS	3	3	0	0	3
3.	20MGV32	Creativity & Innovation in Entrepreneurship	HS	3	3	0	0	3
4.	20MGV42	Principles of Marketing Management For Business	HS	3	3	0	0	3
5.	20MGV52	Human Resource Management for Entrepreneurs	HS	3	3	0	0	3
6.	20MGV62	Financing New Business Ventures	HS	3	3	0	0	3

<b>20ME501</b>	<b>DESIGN OF MACHINE ELEMENTS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		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** 15

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** 11

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** 11

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** 11

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, 5<sup>th</sup> Edition, 2020.
2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett “Mechanical Engineering Design”, 11<sup>th</sup> Edition, Tata McGraw-Hill, 2020.
3. Robert C. Juvinal 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., 3<sup>rd</sup> Edition, 2013.
4. AnselUgural, “Mechanical Design – An Integral Approach”, Tata McGraw-Hill Book Co, 1<sup>st</sup>Edition, 2003.
5. Ganesh Babu, Sridhar, “Machine Design” Tata McGraw-Hill Education, 2<sup>nd</sup> 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 MACHINERY

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", 3<sup>rd</sup> 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", 5<sup>th</sup> Edition, Oxford University Press, New Delhi, 2017.
2. Khurmi, R.S., "Theory of Machines", S Chand Publications, 14<sup>th</sup> Edition, 2020.
3. Ballaney P L, "Theory of Machines and Mechanisms", Khanna Publishers, 25<sup>th</sup> 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 MACHINERY		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

**20ME503**

**CAD / CAM**

L	T	P	C
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, 4<sup>th</sup> Edition 2016.
3. Dr. Sadhu Singh, “Computer Aided Design & Manufacturing, Khanna Publishers 5<sup>th</sup> Edition 2018.



**REFERENCES:**

1. Chris McMahon and Jimmie Browne "CAD/CAM Principles", "Practice and Manufacturing management " 2<sup>nd</sup> Edition, Pearson Education, 2001
2. M.S.Sehrawat and J.S.Narang "CNC Machines Computer Numerical Control" Dhanpat rai & Co Publishers, 2<sup>nd</sup> 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

<b>20ME507</b>	<b>HEAT AND MASS TRANSFER</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		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, 10<sup>th</sup> Edition 2010
- 2.Yunus A. Cengel, "Heat Transfer A Practical Approach", Tata McGraw Hill, 5<sup>th</sup> Edition 2015
- 3.Nag, P.K., "Heat Transfer", Tata McGraw Hill, New Delhi, 3<sup>rd</sup> edition 2011

**REFERENCES:**

- 1.Bergman T.L., Lavine A.S., Incropera, F.P. and Dewitt, D.P., Fundamentals of Heat and Mass Transfer, 7<sup>th</sup> 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

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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 : 20ME507					
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**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
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, 3<sup>rd</sup> 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, 2<sup>nd</sup> 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, 4<sup>th</sup> 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 Graw Hill, 2<sup>nd</sup> Edition,2021
5. Prof. Kate & Prof. Phadke: Toyota Production System - Elementary Concepts, Everest publishing house, 1<sup>st</sup> 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

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', 4<sup>th</sup> 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	-	-	-	-	-
C307.1	-	-	-	-	-	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**



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**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										EXP	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	PSO 1	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**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
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.
  - (ii) Part Programming - CNC Machining Centre
    - Linear Cutting.
    - Circular cutting.
    - 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**

**KLNCE UG MECH R2020 (AY 2021-2022)**

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

<b>HARDWARE</b>		
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
<b>SOFTWARE</b>		
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										EXP	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 wirecut EDM.										14	K3	1,2,3,5,8,9,12	1,2,3	
<b>CO-PO Mapping</b>															
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

<b>20ME5L3</b>	<b>HEAT AND MASS TRANSFER LABORATORY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		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**

<b>S.No.</b>	<b>NAME OF THE EQUIPMENT</b>	<b>Qty.</b>
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										EXP	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

<b>20ME605</b>	<b>DESIGN OF TRANSMISSION SYSTEMS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		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, 5<sup>th</sup> Edition, 2020.
2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett “Mechanical Engineering Design”, 11<sup>th</sup> 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., 3<sup>rd</sup> Edition, 2013.
4. AnselUgural, “Mechanical Design – An Integral Approach”, Tata McGraw-Hill Book Co, 1<sup>st</sup>Edition,2003.
5. Ganesh Babu, Sridhar, “Machine Design” Tata McGraw-Hill Education, 2<sup>nd</sup> Edition 2010.

**OUTCOMES:**

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

Course Name : DESIGN OF TRANSMISSION SYSTEMS											Course Code : 20ME605				
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

<b>20ME606</b>	<b>FINITE ELEMENT ANALYSIS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		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", 3<sup>rd</sup> 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 : 20ME606				
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

<b>20ME6L3</b>	<b>COMPUTER AIDED SIMULATION AND ANALYSIS LABORATORY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		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.

**TOTAL: 60 PERIODS**

**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 : 20ME6L3			
CO	Course Outcomes										EXP	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**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
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 : 20ME6L4					
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	1,2,3,4,5,6,7,8,9,10,11,12	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

**MANAGEMENT ELECTIVE COURSES**

<b>20HS7A2</b>	<b>TOTAL QUALITY MANAGEMENT</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**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. Besterfield, et al., "Total quality Management", Pearson Education Asia, 5<sup>th</sup> 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., 2<sup>nd</sup> Edition, 2006.

**REFERENCES:**

1. Joel.E. Ross, "Total Quality Management – Text and Cases", CRC Press, 5<sup>th</sup> Edition, 2017.
2. Kiran.D.R, "Total Quality Management: Key concepts and case studies, Butterworth – Heinemann Ltd, 1<sup>st</sup> Edition, 2016.
3. Oakland, J.S. "TQM – Text with Cases", Butterworth – Heinemann Ltd., Oxford, 3<sup>rd</sup> Edition, 2012.
4. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 1<sup>st</sup> Edition, 2006.
5. Brue G, "Six Sigma for Managers", Tata-McGraw Hill, 2<sup>nd</sup> 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
C403E1.1	Explain basic concepts, TQM framework, Barriers and Benefits of TQM.										I	K3	1,2,11	-
C403E1.2	Explain the TQM Principles for application.										II	K3	1,2,8,11	-
C403E1.3	Discuss the basics of Six Sigma and Traditional tools, New tools, Benchmarking and FMEA.										III	K2	1,2,4,11,12	-
C403E1.4	Describe Taguchi's Quality Loss Function, Performance Measures and apply Techniques like QFD, TPM, COQ and BPR.										IV	K3	1,2,3,4,7,11	-
C403E1.5	Illustrate and apply QMS and EMS in any organization.										V	K3	1,2,11,12	-
C403E1.6	Explain the process of implementation of ISO 9000/9001-2008/14000 for given manufacturing, service sector.										V	K3	1,2,11,12	-
CO-PO Mapping														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C403E1.1	2	1	-	-	-	-	-	-	-	-	2	-	-	-
C403E1.2	2	1	-	-	-	-	-	1	-	-	2	-	-	-
C403E1.3	2	1	-	1	-	-	-	-	-	-	2	1	-	-
C403E1.4	2	1	-	2	-	-	1	-	-	-	2	-	-	-
C403E1.5	2	1	-	-	-	-	-	-	-	-	2	1	-	-
C403E1.6	2	1	-	-	-	-	-	-	-	-	2	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 a career option.
  - R & D IP Counsel
  - Government Jobs – Patent Examiner
  - Private Jobs
  - Patent agent and Trademark agent
  - Entrepreneur

**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										
C403E2.1	Explain the fundamental aspects of Intellectual property Rights which plays a major role in development and management of innovative	1	K2	6,7,8,10,11,12											
C403E2.2	Describe the patents, patent regime in India and abroad and registration aspects.	2	K2	6,7,8,10,11,12											
C403E2.3	Describe the copyrights and its related rights and registration aspects.	3	K2	6,7,8,10,11,12											
C403E2.4	Explain the trademarks and registration aspects.	4	K2	6,7,8,10,11,12											
C403E2.5	Explain the Design, Geographical Indication (GI), Plant Variety and Layout Design Protection and their registration aspects.	5	K2	6,7,8,10,11,12											
C403E2.6	Analyze the current trends in IPR and Government steps in fostering IPR.	5	K2	6,7,8,10,11,12											
CO-PO Mapping															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C403E2.1						1	1	1		1	1	1			
C403E2.2						1	1	1		1	1	1			
C03E2.3						1	1	1		1	1	1			
C403E2.4						1	1	1		1	1	1			
C403E2.5						1	1	1		1	1	1			
C403E2.6						1	1	1		1	1	1			



<b>20HS6B1</b>	<b>PROJECT MANAGEMENT AND ENTREPRENEURSHIP</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		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**

Project management: meaning, scope & importance, role of project manager - Project life-cycle and Project appraisal - project feasibility report- Technical appraisal, Environmental appraisal, Market appraisal and Managerial appraisal.

**UNIT - II PROJECT FINANCING 9**

Project cost estimation & working capital requirements - sources of funds - capital budgeting - Risk & uncertainty in project evaluation - preparation of projected financial statements viz. Projected balance sheet - projected income statement - projected funds & cash flow statements - Preparation of detailed project report - Project finance.

**UNIT - III ENTREPRENEURSHIP 9**

Entrepreneurship need and scope - Entrepreneurial competencies and traits - Factors affecting entrepreneurial development - Entrepreneurial motivation (Mc Clelland's Achievement motivation theory) - conceptual model of entrepreneurship - entrepreneur vs. intrapreneur - Classification of entrepreneurs - Entrepreneurial Development Programmes.

**UNIT - IV ENTREPRENEURIAL IDEA AND INNOVATION 9**

Introduction to Innovation - Entrepreneurial Idea Generation and Identifying Business Opportunities - Management skills for Entrepreneurs and managing for Value Creation - Creating and Sustaining Enterprising Model - Organizational Effectiveness.

**UNIT - V SOCIAL ENTREPRENEURSHIP 9**

Social Sector Perspectives and Social Entrepreneurship - Social Entrepreneurship Opportunities and Successful Models - Social Innovations and Sustainability - Marketing Management for Social Ventures - Risk Management in Social Enterprises - Legal Framework for Social Ventures.

**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:**

<b>Course Name : Project Management and Entrepreneurship</b>		<b>Course Code : 20HS6B1</b>													
<b>CO</b>	<b>Course Outcomes</b>	<b>Unit</b>	<b>K-CO</b>	<b>POs</b>	<b>PSOs</b>										
C403E3.1	Conclude the project characteristics and various stages of a project.	1	K6	8,9,10,11											
C403E3.2	Compile the conceptual clarity about project organization and feasibility.	2	K5	8,9,10,11											
C403E3.3	Apply the risk management plan and analyze the role of stakeholders.	3	K3	8,9,10,11											
C403E3.4	Analyze the social responsibility for an entrepreneurship.	4	K4	7,8,9,10,11											
C403E3.5	Interpret the gain knowledge to overcome the factors affecting small-scale business.	4	K3	8,9,10,11											
C403E3.6	Formulate a new small-scale business.	5	K6	7,8,9,10,11											
<b>CO-PO Mapping</b>															
<b>COs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>
C403E3.1	-	-	-	-	-	-	-	2	2	2	3	-	-	-	-
C403E3.2	-	-	-	-	-	-	-	2	2	2	3	-	-	-	-
C403E3.3	-	-	-	-	-	-	-	2	2	2	3	-	-	-	-
C403E3.4	-	-	-	-	-	-	3	2	2	2	3	-	-	-	-
C403E3.5	-	-	-	-	-	-	-	2	2	2	3	-	-	-	-
C403E3.6	-	-	-	-	-	-	3	2	2	2	3	-	-	-	-

20HS8A1	<b>HUMAN RELATIONS AT WORK</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		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			
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			
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			
C403E4.4	Identify various Yoga Postures.									3	K3	6,8,9,10			
C403E4.5	Develop an action plan to increase personal motivation in a personal and or workplace situation.									4	K3	6,8,9,10			
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			
CO-PO Mapping															
COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO3
C403E4.1	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
C403E4.2	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
C403E4.3	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
C403E4.4	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
C403E4.5	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
C403E4.6	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-

<b>20HS8B2</b>	<b>ECONOMICS FOR ENGINEERS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To understand the fundamental economic concepts
- To understand cost estimation concepts
- To understand value engineering
- To understand project appraisal and methods of analysis
- 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, "ContemporaryEngineeringEconomics", 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:EngineeringEconomy,"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
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

<b>20HS5A1</b>	<b>MANAGEMENT CONCEPTS &amp; ORGANIZATIONAL BEHAVIOR</b>	<b>L</b> <b>3</b>	<b>T</b> <b>0</b>	<b>P</b> <b>0</b>	<b>C</b> <b>3</b>
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**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**

**OUTCOMES:**

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

On the successful completion of the course, student will be able to:

1. 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.
2. Understand and explain all the managerial functions.
3. 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.
4. Analyze the complexities associated with management of the group behavior in the organization.
5. Demonstrate how the organizational behavior can integrate in understanding the motivation (why) behind behavior of people in the organization.
6. 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.

**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,



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.
- Develop Negotiation and buying techniques for industrial products .
- Formulate strategic plan and implementation methods.
- Develop techniques of Logistics, Marketing Control and Channel Optimization
- Identify Pricing tactics and Sales Force Planning techniques
- Manage the entire industrial marketing process.

**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. Havaladar, 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

**Vertical 1: Design and Development**

<b>20MEV11</b>	<b>PRODUCT DESIGN AND DEVELOPEMENT</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		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, 4<sup>th</sup>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, 5<sup>th</sup> 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, 7<sup>th</sup>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		
	Explain the basic concepts of product design and development									I	K2	1,2,3,6,9,10	1,2,3		
	Describe the basic concepts of concurrent Engineering									I	K2	1,2,3,6,9,10	1,2,3		
	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		
	Discuss the concepts and importance of product architecture									III	K2	1,2,3,6,9,10	1,2,3		
	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		
	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
	3	2	1	-	-	1	-	-	1	1	-	-	2	1	1
	3	2	1	-	-	1	-	-	1	1	-	-	2	1	1
	3	2	1	1	-	1	-	-	1	1	-	-	2	1	1
	3	2	1	-	-	1	-	-	1	1	-	-	2	1	1
	3	2	1	-	-	1	-	-	1	1	-	-	2	1	1
	3	2	1	1	-	1	-	-	1	1	-	-	2	1	1

<b>20MEV21</b>	<b>PRODUCT LIFE CYCLE MANAGEMENT</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		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 Anselmilmmonen, “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

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**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	
	Explain the history, concepts and terminology of PLM										I	K2	1, 2, 3	1, 2, 3	
	Describe the functions of PLM/PDM										II	K2	1, 2, 3	1, 2, 3	
	Explain the features of PLM/ PDM										III	K2	1, 2, 3	1, 2, 3	
	Classify the different modules offered in commercial PLM/PDM tools.										IV	K2	1, 2, 3	1, 2, 3	
	Predict PLM/PDM approach techniques for industrial applications.										IV	K2	1, 2, 3	1, 2, 3	
	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
	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
	3	2	1	-	-	-	-	-	-	-	-	-	3	1	1
	3	2	1	-	-	-	-	-	-	-	-	-	3	1	1
	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1

<b>20MEV31</b>	<b>DESIGN OF JIGS, FIXTURES AND PRESS TOOLS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		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., 2<sup>nd</sup> 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, 5<sup>th</sup> Edition, 2017.
4. Hoffman “Jigs and Fixture Design”, Thomson Delmar Learning, Singapore, 2004.
5. Kempster, “Jigs and Fixture Design”, Hoddes and Stoughton, 3<sup>rd</sup> 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	
	Summarize the different methods of Locating Jigs and Fixtures and Clamping principles										I	K2	1, 2, 3	1, 2, 3	
	Design and develop jigs and fixtures for given component										I	K3	1, 2, 3	1, 2, 3	
	Discuss the press working terminologies and elements of cutting dies										II	K2	1, 2, 3	1, 2, 3	
	Distinguish between Bending and Drawing dies.										III	K2	1, 2, 3	1, 2, 3	
	Discuss the different types of forming techniques										IV	K2	1, 2, 3	1, 2, 3	
	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
	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
	3	2	1	-	-	-	-	-	-	-	-	-	3	1	1
	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
	3	2	1	-	-	-	-	-	-	-	-	-	3	1	1



<b>20MEV41</b>	<b>PIPING DESIGN ENGINEERING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		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, 7<sup>th</sup> Edition, 2000.
2. George A Antaki, "Piping and Pipeline Engineering: Design, Construction, Maintenance Integrity and Repair", CRC Press, 2003.
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-ChuanPeng and Tsen-LoongPeng, "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		
	Explain the various piping components and process diagrams									1	K2	1,2,3,8,9,10,12	2		
	Apply various codes and standards for piping systems									1	K3	1,2,3,8,9,10	1		
	Calculate the piping wall thickness and branch reinforcement									2	K3	1,2,3,9	1		
	Draw the layout for piping systems and equipment									3	K2	1,2,3,8	1		
	Determine the stresses induced in the pipes under various loadings									4	K3	1,2,3,8,9,10	1		
	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
	3	2	1	-	-	-	-	1	1	1	-	1	-	1	-
	3	2	1	-	-	-	-	2	2	1	-	-	1	-	-
	3	2	1	-	3	-	-	1	-	-	-	-	1	-	-
	3	2	1	-	-	-	-	1	-	-	-	-	1	-	-
	3	2	1	-	-	-	-	1	1	1	-	-	1	-	-
	3	2	1	-	-	-	-	2	2	1	-	-	1	-	-

<b>20MEV51</b>	<b>COMPUTATIONAL FLUID DYNAMICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		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 convection 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:**

20BS401 Statistics 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-ε) – 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, 2<sup>nd</sup> 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.

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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 : COMPRESSIBLE FLOW AND TURBOMACHINERY										Course Code : 20MEV51					
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
	Apply the concepts of compressible flow behaviour in isentropic flow in variable area ducts.										I	K3	1,2,3,4	1,2	
	Apply the concepts of compressible flow behaviour in constant area ducts with and without heat transfer.										II	K3	1,2,3,4	1,2	
	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	
	Determine the performance of steam turbine.										IV	K3	1,2,3,4	1,2	
	Determine the performance of gas turbine										IV	K3	1,2,3,4	1,2	
	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
	3	3	2	1	-	-	-	-	-	-	-	-	3	2	3
	3	3	2	1	-	-	-	-	-	-	-	-	3	2	3
	3	3	2	1	-	-	-	-	-	-	-	-	3	2	3
	3	3	2	1	-	-	-	-	-	-	-	-	3	2	3
	3	3	2	1	-	-	-	-	-	-	-	-	3	2	3
	3	3	2	1	-	-	-	-	-	-	-	-	3	2	3

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 Papadacos, 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

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**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	
	Explain seven concerns in design thinking.										I	K2	1, 2, 3	1, 2, 3	
	Describe new needs to context with example.										II	K3	1, 2, 3	1, 2, 3	
	Describe the constraints and technologies for comprehension.										III	K2	1, 2, 3	1, 2, 3	
	Identify the crucial steps missed in check										IV	K3	1, 2, 3	1, 2, 3	
	Identify the manufacturing challenges in crafting.										V	K3	1, 2, 3	1, 2, 3	
	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
	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
	3	2	1	-	-	-	-	-	-	-	-	-	3	1	1
	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
	3	2	1	-	-	-	-	-	-	-	-	-	3	1	1
	3	2	1	-	-	-	-	-	-	-	-	-	3	1	1
	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1

**VERTICAL 2: 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 non-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 rheological 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., 1<sup>st</sup> Edition 2013
2. Pandey P.C. and Shan H.S. “Modern Machining Processes” Tata McGraw-Hill,1<sup>st</sup> 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., 8<sup>th</sup> Edition, New Delhi, 2001.
3. Bhattacherya A, “New Technology”, The Institute for Engineers, 1<sup>st</sup> Edition, 2000.

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4. C. Elanchezian, B. VijayaRamnath, M. Vijayan, “Unconventional Machining processes”, Anuradha Publication, 1<sup>st</sup> Edition, 2005.

5. M. K. Singh, “Unconventional Machining processes”, New Age International Publishers, 1<sup>st</sup> 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			PSO		
	Explain the need for unconventional machining processes and its classification.							I	K2	1,2,8,10			1,3		
	Explain various mechanical energy based unconventional machining processes.							I	K2	1,2,8,10			1,3		
	Compare various thermal energy and electrical energy based unconventional machining processes.							II	K2	1,2,8,9,10			1,3		
	Summarize various chemical and electro-chemical energy based unconventional machining processes.							III	K2	1,2,8,10			1,3		
	Explain various nono abrasives based unconventional machining processes.							IV	K2	1,2,8,10			1,3		
	Distinguish various recent trends based unconventional machining processes.							V	K2	1,2,8,10			1,3		
CO-PO Mapping															
CO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
	2	1	-	-	-	-	-	1	-	1	-	-	2	-	1
	2	1	-	-	-	-	-	1	-	1	-	-	2	-	1
	2	1	-	-	-	-	-	1	2	1	-	-	2	-	1
	2	1	-	-	-	-	-	1	-	1	-	-	2	-	1
	2	1	-	-	-	-	-	1	-	1	-	-	2	-	1
	2	1	-	-	-	-	-	1	-	1	-	-	2	-	1



<b>20MEV22</b>	<b>COMPUTER INTEGRATED MANUFACTURING SYSTEMS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		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, 5<sup>th</sup> Edition, 2019.
2. Radhakrishnan P, SubramanyanS.andRaju V., “CAD/CAM/CIM”, New Age, International (P) Ltd, 4<sup>th</sup> Edition, 2016.
3. James A. Rehg, and Henry W Kraebber, ‘Computer-Integrated Manufacturing’, Pearson Education Limited, 2<sup>nd</sup> 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, 5<sup>th</sup> 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 SYSTEMS										Course Code : 20MEV22					
CO	Course Outcomes										Unit	K –CO	POs	PSO	
	Explain the knowledge about role of computer and automation in manufacturing.										I	K2	1,2,8,10	1,2,3	
	Explain the concept of group technology and formation of parts – machine cell.										II	K3	1,2,3,8,10	1,2,3	
	Explain the concept of FMS, and sizing of FMS systems.										III	K2	1,2,8,10	1,2,3	
	Describe the automation, types of automation and automation strategies.										IV	K2	1,2,8,10	1,2,3	
	Describe Automated Guided Vehicle System and its application.										IV	K2	1,2,8,10	1,2,3	
	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	PO1 2	PSO1	PSO 2	PSO3
	2	1	-	-	-	-	-	1	-	1	-	-	2	1	1
	3	2	1	-	-	-	-	1	2	1	-	-	2	1	1
	2	1	-	-	-	-	-	1	-	1	-	-	2	1	1
	2	1	-	-	-	-	-	1	-	1	-	-	2	1	1
	2	1	-	-	-	-	-	1	-	1	-	-	2	1	1

<b>20MEV32</b>	<b>COMPOSITE MATERIALS AND MECHANICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		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", 1<sup>st</sup> 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	PSO		
	Explain the different types of the composite materials and its applications.									I	K2	1,2,8,10	1,2,3		
	Explain the various processing techniques for polymer composites manufacturing.									II	K2	1,2,8,10	1,2,3		
	Explain the different types of processing techniques for metal matrix composites manufacturing.									III	K2	1,2,8,9,10	1,2,3		
	Determine the stress strain and strain displacement relationship matrix for polymer composites.									IV	K3	1,2,3,8,10	1,2,3		
	Determine the buckling, and bending behaviours of polymer composites.									V	K3	1,2,3,8,10	1,2,3		
	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
	2	1	-	-	-	-	-	1	-	1	-	-	2	1	1
	2	1	-	-	-	-	-	1	-	1	-	-	2	1	1
	2	1	-	-	-	-	-	1	2	1	-	-	2	1	1
	3	2	1	-	-	-	-	1	-	1	-	-	2	1	1
	3	2	1	-	-	-	-	1	-	1	-	-	2	1	1

20MEV42

**ADDITIVE MANUFACTURING**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
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., 1<sup>st</sup> 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		
	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		
	Explain data processing for Additive Manufacturing Technology.									II	K2	1,2,3,4,5,8,10	1,2,3		
	Differentiate MIMICS and MAGICS software’s used in AM process.									II	K2	1,2,5,8,10	1,2,3		
	Explain the principle, Processes, applications of SLA, SGC, FDM and LOM processes.									III	K2	1,2,5,7,8,9,10	1,2,3		
	Explain the principle, Processes, applications of SLS and LENS.									IV	K2	1,2,5,7,8,10	1,2,3		
	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
	2	1	-	-	-	-	-	1	-	1	-	-	3	2	2
	2	1	-	-	-	-	-	1	-	1	-	-	3	2	2
	2	1	-	-	2	-	-	1	-	1	-	-	3	2	2
	2	1	-	-	-	-	-	1	2	1	-	-	3	2	2
	2	1	-	-	-	-	-	1	-	1	-	-	3	2	2
	2	1	-	-	-	-	-	1	-	1	-	-	3	2	2

<b>20MEV52</b>	<b>TESTING OF MATERIALS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		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, 9<sup>th</sup> 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., 3<sup>rd</sup> 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, 7<sup>th</sup> 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

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**OUTCOMES:**

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

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



<b>20MEV62</b>	<b>DIGITAL MANUFACTURING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		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 4<sup>th</sup> 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	
	Describe the basic components of Digital manufacturing										I	K2	1,2	1,2	
	Implement digital thread components in Manufacturing enterprise										II	K3	1,2,3,5	1,2	
	Perform virtual commissioning of Digital Twin in Smart Factory										III	K3	1,2,3,5	1,2	
	Perform advanced manufacturing process analysis in digital manufacturing enterprise										IV	K3	1,2,3,5,7,10	1,2	
	Design intelligent manufacturing operations in manufacturing enterprise.										V	K3	1,2,3,5,11,12	1,2	
	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
	2	1	-	-	-	-	-	-	-	-	-	-	2	1	-
	3	2	1	-	2	-	-	-	-	-	-	-	2	1	-
	3	2	1	-	3	-	-	-	-	-	-	-	2	1	-
	3	2	1	-	1	-	2	-	-	2	-	-	2	1	-
	3	2	1	-	1	-	-	-	-	-	3	2	2	1	-
	3	2	1	-	-	-	-	-	-	-	-	2	2	1	-

**VERTICAL 3: CLEAN ENERGY TECHNOLOGIES**

<b>20MEV13</b>	<b>COMPRESSIBLE FLOW AND TURBO-MACHINERY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		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, 5<sup>th</sup> Edition (2016).
2. Kothandaraman.C.P., Domkundwar. S, Domkundwar. A.V., "A course in thermal Engineering", 5<sup>th</sup> 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", 4<sup>th</sup> 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, 4<sup>th</sup> 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", Scitech 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	
	Apply the concepts of compressible flow behaviour in isentropic flow in variable area ducts.										I	K3	1,2,3,4	1,2	
	Apply the concepts of compressible flow behaviour in constant area ducts with and without heat transfer.										II	K3	1,2,3,4	1,2	
	Calculate the changes in physical properties when a normal shock occurs in One-dimensional constant area or variable area										III	K3	1,2,3,4	1,2	
	Determine the performance of steam turbine.										IV	K3	1,2,3,4	1,2	
	Determine the performance of gas turbine										IV	K3	1,2,3,4	1,2	
	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
	3	3	2	1	-	-	-	-	-	-	-	-	3	2	3
	3	3	2	1	-	-	-	-	-	-	-	-	3	2	3
	3	3	2	1	-	-	-	-	-	-	-	-	3	2	3
	3	3	2	1	-	-	-	-	-	-	-	-	3	2	3
	3	3	2	1	-	-	-	-	-	-	-	-	3	2	3



**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	
	Calculate the efficiency of Rankine cycle.										I	K3	1, 2, 3	1, 2, 3	
	Explain the functioning of combined power plants.										II	K2	1, 2, 3	1, 2, 3	
	Calculate the efficiency of Various types of gas power cycles										II	K3	1, 2, 3	1, 2, 3	
	Explain the working of various types of nuclear power plant										III	K2	1, 2, 3	1, 2, 3	
	Explain the working principle of various renewable energy power plants.										IV	K2	1, 2, 3	1, 2, 3	
	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
	3	2	1	-	-	-	-	-	-	-	-	-	3	2	1
	2	1	1	-	-	-	-	-	-	-	-	-	2	2	1
	3	2	1	-	-	-	-	-	-	-	-	-	3	2	1
	2	1	1	-	-	-	-	-	-	-	-	-	2	2	1
	2	1	1	-	-	-	-	-	-	-	-	-	2	2	1
	2	1	1	-	-	-	-	-	-	-	1	-	2	2	1

**20MEV33**

**ENGINE POLLUTION AND CONTROL**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
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, CO<sub>2</sub> - Non dispersive infrared gas analyzer, NO<sub>x</sub> - 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-NO<sub>x</sub> 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, 3<sup>rd</sup> 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	
	Explain the impact of pollution from engines on human health and environment.										I	K2	1,2,3,8	1,2,3	
	Describe the formation of different pollutants										II	K2	1,2,3	1,2,3	
	Discuss the effect of engine design and operating variables on emission formation.										II	K2	1,2,3,5	1,2,3	
	Explain the various measurement techniques used for the measurement of pollutants in engine emissions.										III	K2	1,2,3,7	1,2,3	
	Describe the various techniques used in IC engine to control the engine emissions										IV	K2	1,2,3,7	1,2,3	
	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
	3	2	1	-	-	-	-	1	-	-	-	-	3	2	1
	2	1	1	-	-	-	-	-	-	-	-	-	2	2	1
	3	2	1	-	1	-	-	-	-	-	-	-	3	2	1
	2	1	1	-	-	-	1	-	-	-	-	-	2	2	1
	2	1	1	-	-	-	1	-	-	-	-	-	2	2	1
	2	1	1	-	-	-	1	-	-	-	1	-	2	2	1



<b>20MEV43</b>	<b>ENERGY CONSERVATION AND MANAGEMENT</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		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		
	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		
	Infer the concept of financial management, energy monitoring and targeting									II	K2	1, 2, 3, 4, 11, 12	1, 2, 3		
	Explain energy audit for the energy management and operation of energy audit instruments.									III	K2	1, 2, 3, 4, 12	1, 2, 3		
	Determine energy efficiency in various thermal utilities and systems									IV	K3	1, 2, 3	1, 2, 3		
	Explain working of waste heat recovery systems									IV	K2	1, 2, 3	1, 2, 3		
	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
	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
	2	1	1	-	-	-	-	-	-	-	1	1	2	1	1
	2	1	1	-	-	-	-	-	-	-	-	1	2	1	1
	3	2	1	-	-	-	-	-	-	-	-	-	2	1	1
	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
	2	1	1	-	-	-	1	-	-	-	-	1	2	1	1

<b>20MEV53</b>	<b>RENEWABLE SOURCES OF ENERGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		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", 6<sup>th</sup> edition, Khanna Publishers, New Delhi, 2017.
2. Twidell, J.W. & Weir, A., "Renewable Energy Sources", 3<sup>rd</sup> 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	
	Explain the importance and Economics of renewable Energy										I	K2	1,2,3,4,6,7,11	1,2,3	
	Explain the method of power generation from Solar Energy										II	K2	1,2,3,4,6,7	1,2,3	
	Explain the method of power generation from Wind Energy										III	K2	1,2,3,4,6,7	1,2,3	
	Explain the method of power generation from Bio Energy										IV	K2	1,2,3,4,6,7	1,2,3	
	Explain the power generation method from the newer renewable energy source										V	K2	1,2,3,4,6,7	1,2,3	
	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
	2	1	1	1	-	1	2	-	-	-	1	-	2	1	1
	2	1	1	1	-	1	2	-	-	-	-	-	2	1	1
	2	1	1	1	-	1	2	-	-	-	-	-	2	1	1
	2	1	1	1	-	1	2	-	-	-	-	-	2	1	1
	3	2	1	1	-	1	2	-	-	-	1	1	2	1	1

<b>20MEV63</b>	<b>FUNDAMENTALS OF HVAC SYSTEMS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		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

**KLNCE UG MECH R2020 (AY 2021-2022)**

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: Fundamentals 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. Brumbaugh Audel, Fundamentals of HVAC Systems Wiley Publications. 4<sup>th</sup> Edition, 2004
2. Roy J. Dossat, Principles of Refrigeration, Pearson, 5<sup>th</sup> Edition, 2007
3. Richard C. Jordon and Gayle B. Priester, Refrigeration and Air Conditioning Prentice Hall India, 15<sup>th</sup> 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 SYSTEMS											Course Code : 20MEV63				
CO	Course Outcomes										Unit	K-CO	POs	PSOs	
	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	
	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	
	Explain the Fundamentals of Heat Pumps and its Applications										2	K2	1,2,3,4	1,2,3	
	Determine the coil loads for cooling and heating systems										3	K3	1,2,3,4	1,2,3	
	Select equipment and design systems to provide comfort conditions within the building.										4	K3	1,2,3,4	1,2,3	
	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
	3	3	2	2	1	2	1	1	-	-	-	-	3	2	1
	3	2	2	2	-	2	1	-	-	-	-	-	3	2	1
	3	2	2	1	-	-	-	-	-	-	-	-	3	2	1
	3	3	2	2	-	-	-	-	-	-	-	-	3	2	1
	3	3	2	2	-	-	-	-	-	-	-	-	3	2	1
	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. UrsulaEicker, “Solar Technologies for buildings”, Wiley Publications, 2013. Guide book for national certification examination for energy managers and energy auditors (downloaded from [www.energymanagertraining.com](http://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		
	Compare conventional connections in energy efficient buildings and versatile with energy conservation building codes.									I	K2	1,2,3	1,2		
	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		
	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		
	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
	3	2	1	-	-	-	-	-	-	-	-	-	3	2	1
	3	2	1	-	-	-	-	-	-	-	-	-	3	2	1
	3	2	1	-	-	-	-	-	-	-	-	-	3	2	1
	3	2	1	-	-	-	-	-	-	-	-	-	3	2	1
	3	2	1	-	-	-	-	-	-	-	-	-	3	2	1



**VERTICAL 4: ROBOTICS AND AUTOMATION**

<b>20MEV14</b>	<b>APPLIED HYDRAULICS AND PNEUMATICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		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, 7<sup>th</sup> Edition, 2009.
2. Majumdar S.R., “Oil Hydraulics 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 6<sup>th</sup> Edition. 2015.
4. Frank Yeaple, Fluid Power Design Handbook, 3<sup>rd</sup> Edition, CRC Press, October 24, 1995.
5. James R. Daines -Fluid Power: Hydraulics and Pneumatics 2<sup>nd</sup> 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		
	Discuss the function of different types of hydraulic pumps and motors.									I	K2	1,2,3,4	1,2,3		
	Describe the features and functions of hydraulic actuators, Direction and Flow control valves.									II	K2	1,2,3,4	1,2,3		
	Develop fluid power multi actuation circuits for various purposes in industry.									III	K3	1,2,3,4,5,6	1,2,3		
	Discuss the working of different pneumatic and electro pneumatic components, circuits and systems.									IV	K2	1,2,3,4,5,6	1,2,3		
	Construct the cascaded electro pneumatic circuits for requiring cylinder sequences.									IV	K3	1,2,3,4,5,6	1,2,3		
	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	PO 1	PO 2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO1 1	PO1 2	PSO 1	PSO 2	PSO3
	2	2	1	1	-	-	-	-	-	-	-	-	2	2	1
	2	2	1	1	-	-	-	-	-	-	-	-	2	2	1
	3	2	1	1	3	1	-	-	-	-	-	-	2	2	1
	2	2	1	1	3	1	-	-	-	-	-	-	2	2	1
	3	2	1	1	3	1	-	-	-	-	-	-	2	2	1
	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. Klaffer 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, 3<sup>rd</sup> 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, 2<sup>nd</sup> 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:**

<b>Course Name: INDUSTRIAL ROBOTICS</b>							<b>Course Code: 20MEV24</b>								
<b>CO</b>	<b>Course Outcomes</b>						<b>Unit</b>	<b>K –CO</b>	<b>POs</b>			<b>PSO</b>			
	Explain about the robot parts, specifications, coordinates and robot drive system.						1	K2	1,2			1,2,3			
	Discuss the working principle of robot sensors and types of end effectors.						2	K2	1,2			1,2,3			
	Explain the Image processing techniques to analyze the real images.						3	K2	1,2,3,4,5			1,2,3			
	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			
	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			
	Describe the steps for implementation of robots in industries and safety considerations for robot operations.						5	K2	1,2,3,4			1,2,3			
<b>CO-PO Mapping</b>															
<b>CO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>
	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
	2	2	2	1	2	-	-	-	-	-	-	-	2	1	1
	2	2	1	2	1	-	-	-	-	-	-	-	2	1	1
	2	2	1	1	2	-	-	-	-	-	-	-	2	1	1
	2	2	1	1	1	-	-	-	-	-	-	-	2	1	1

20MEV34	<b>SENSORS AND ACTUATORS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		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”, 1<sup>st</sup> edition, Springer –VerlagNewyork, Inc, 1997.
3. Jacob Fraden, “Hand Book of Modern Sensors: Physics, Designs and Application” 4<sup>th</sup> 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”, 1<sup>st</sup> edition, Kluwer academic publishers, Springer, 1997.
4. Manfred Kohl, “Shape Memory Actuators”, 1<sup>st</sup> edition, Springer.
5. W.Bolton, Mechatronics, Electronic control systems in Mechanical and Electrical Engineering Pearson Education, 2015.

<b>Course Name: SENSORS AND ACTUATORS</b>											<b>Course Code: 20MEV34</b>				
<b>CO</b>	<b>Course Outcomes</b>										<b>Unit</b>	<b>K –CO</b>	<b>POs</b>	<b>PSO</b>	
	Discuss the functions of different types of Sensors and Signal transmission.										1	K2	1,2	1	
	Explain the working principle of Inductive, Capacitive type of sensors and applications.										2	K2	1,2	1	
	Describe the working principle and applications of various actuators.										3	K2	1,2	1	
	Explain the working principle of various types of micro sensors.										4	K2	1,2	1	
	Discuss the working principle of various types of micro actuators.										4	K2	1,2	1	
	Explain about the sensor materials and processing techniques for micro sensor and actuator.										5	K2	1,2	1	
<b>CO-PO Mapping</b>															
<b>CO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>
	3	1	-	-	-	-	-	-	-	-	-	-	2	-	-
	3	1	-	-	-	-	-	-	-	-	-	-	2	-	-
	3	1	-	-	-	-	-	-	-	-	-	-	2	-	-
	3	1	-	-	1	-	-	-	-	-	-	-	2	-	-
	3	1	-	-	1	-	-	-	-	-	-	-	2	-	-
	3	1	-	-	1	-	-	-	-	-	-	-	2	-	-

<b>20MEV44</b>	<b>AUTOMATION IN MANUFACTURING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		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, Microprocessor 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 Inspection, 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 Madiseti, ArshdeepBahga “Internet of Things: A Hands-On Approach “,1<sup>st</sup> 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, Industrial Press, 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	PSO		
	Explain the building blocks of automation system.									1	K2	1,2	1		
	Describe the various types of automation system and Mechanisms.									2	K2	1,2	1		
	Explain about the signal conditioning processes.									3	K2	1,2,3	1,2		
	Develop the Microprocessor and PLC programming codes.									3	K3	1,2,3,4,5	1,2		
	Describe about the CNC technology in manufacturing.									4	K2	1,2,3,5	1,2		
	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	PO 10	PO 11	PO12	PSO1	PSO2	PSO3
	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
	3	2	1	-	-	-	-	-	-	-	-	-	2	1	-
	3	2	2	1	2	-	-	-	-	-	-	-	2	1	-
	3	2	1	-	2	-	-	-	-	-	-	-	2	1	-
	3	2	2	1	2	-	-	-	-	-	-	-	2	1	-
	3	2	1	-	1	-	-	-	-	-	-	-	2	1	-



20MEV54

**VIRTUAL INSTRUMENTATION**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
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 ACQUISITION 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", 3<sup>rd</sup> 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, 1<sup>st</sup> Edition, PHI, 2010.

**REFERENCES:**

1. Barry Paton, "Sensor, transducers and Labview", Prentice Hall of India 2000.
2. R. H. Bishop, "Learning with LabVIEW", 1<sup>st</sup> 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, 2<sup>nd</sup> 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	PSO		
	Define Virtual Instrumentation Concepts.									1	K2	1,2	1		
	Describe the building blocks and VI programming techniques.									1	K2	1,2,3,5	1,2		
	Describe the Data Acquisition (DAQ) methodologies in VI.									2	K2	1,2,3,5	1,2		
	Discuss about the applications of Virtual Instrumentation.									3	K2	1,2,3,5	1,2		
	Describe about the real time control and interfacing methods in VI.									4	K2	1,2,3,5	1,2		
	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
	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
	3	2	1	-	2	-	-	-	-	-	-	-	2	1	-
	3	2	1	-	2	-	-	-	-	-	-	-	2	1	-
	3	2	1	-	2	-	-	-	-	-	-	-	2	1	-
	3	2	1	-	2	-	-	-	-	-	-	-	2	1	-

<b>20MEV64</b>	<b>DATA ANALYTICS FOR MECHANICAL ENGINEERING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		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, 1<sup>st</sup> Edition, 2016.
2. Ulrich Sendler, "The Internet of Things: Industrie 4.0 Unleashed", Springer, 1<sup>st</sup> 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:**

<b>Course Name : DATA ANALYTICS FOR MECHANICAL ENGINEERING</b>		<b>Course Code : 20MEV64</b>													
<b>CO</b>	<b>Course Outcomes</b>	<b>Unit</b>	<b>K –CO</b>	<b>POs</b>	<b>PSO</b>										
	Explain the data collection systems using sensors.	I	K2	1, 2, 3	1, 2, 3										
	Describe the data processing and handling methods.	II	K2	1, 2, 3	1, 2, 3										
	Explain the data security systems.	III	K2	1, 2, 3	1, 2, 3										
	Describe the applications of data analytics in manufacturing sector.	IV	K2	1, 2, 3	1, 2, 3										
	Describe the applications of data analytics in inventory and shipment.	IV	K2	1, 2, 3	1, 2, 3										
	Describe the applications of data analytics in energy and safety management.	V	K2	1, 2, 3, 12	1, 2, 3										
<b>CO-PO Mapping</b>															
<b>CO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>
	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
	2	1	1	-	-	-	-	-	-	-	-	1	2	1	1

<b>20MEV74</b>	<b>MICRO ELECTRO MECHANICAL SYSTEMS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		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 – Anisotropic 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	PSO
	Explain about micro fabrication	I	K2	1, 2, 3	1, 2, 3
	Explain about electrical sensors	II	K2	1, 2, 3	1, 2, 3
	Explain about thermal sensors for a particular application	III	K2	1, 2, 3	1, 2, 3
	Describe about Piezo resistive sensors	IV	K2	1, 2, 3	1, 2, 3
	Describe about various micro machining processes	IV	K2	1, 2, 3	1, 2, 3
	Describe the application of polymers in MEMS	V	K2	1, 2, 3, 12	1, 2, 3

**CO-PO Mapping**

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO 2	PSO3
	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
	2	1	1	-	-	-	-	-	-	-	-	1	2	1	1

**Vertical - 5: Industrial Engineering**

<b>20MEV15</b>	<b>STATISTICAL QUALITY CONTROL</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		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-Romig sampling plans (AOQL and LTPD plans).

**TOTAL : 45 PERIODS**

**TEXT BOOKS:**

1. Douglas C. Montgomery, "Introduction to Statistical Quality Control", Wiley-India, 7<sup>th</sup> Edition, 2015.
2. Krishnaiah K., "Applied Statistical Quality Control and Improvement", PHI, 2017.
3. Dale H. Besterfield, Quality Control, Pearson Education Asia, 8<sup>th</sup> Edition, 2018.

**REFERENCES:**

1. Amitava Mitra, "Fundamentals of Quality Control and Improvement", Wiley, 3<sup>rd</sup> Edition, 2018.
2. Eugene L. Grant and Richard S. Leaven Worth, "Statistical Quality Control", McGraw-Hill Education, 7<sup>th</sup> Edition, 2018.
3. Monohar Mahajan, "Statistical Quality Control", Dhanpat Rai & Sons, 2017.
5. Statistical Quality Control, R C Gupta, Khanna Publishers, New Delhi, 2015

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**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		
	Explain the basic Concepts of Quality and its tools.								I	K3	1,2,3,8,10			1,2,3		
	Construct the X bar, R & $\sigma$ charts from the available data.								II	K3	1,2,3,9,10			1,2,3		
	Construct the p, np, c & u charts from the available data								II	K3	1,2,3,8,10			1,2,3		
	Control the occurrence of defects in product or service industries.								III	K3	1,2,3			1,2,3		
	Select and apply appropriate quality control technique for given application.								IV	K3	1,2,3,8			1,2,3		
	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	
	3	2	1	-	-	-	-	2	-	2	-	2	3	2	1	
	3	2	1	-	-	-	-	-	2	2	-	2	3	2	1	
	3	2	1	-	-	-	-	2	-	2	-	2	3	2	1	
	3	2	1	-	-	-	-	-	-	-	-	2	3	2	1	
	3	2	1	-	-	-	-	2	-	-	-	2	3	2	1	
	3	2	1	-	-	-	-	1	2	2	-	2	3	2	1	



<b>20MEV25</b>	<b>PROCESS PLANNING AND COST ESTIMATION</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		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, 6<sup>th</sup> Edition, 2011.
2. Ostwalal P.F. and Munoz J., “Manufacturing Processes and systems”, John Wiley, 9<sup>th</sup> Edition, 2008.
3. Russell R.S and Tailor B.W, “Operations Management”, Prentice Hall India, 7<sup>th</sup> Edition, 2010.
4. Mikell P. Groover, “Automation, Production, Systems and Computer Integrated Manufacturing”, Pearson, 5<sup>th</sup> Edition, 2019.
5. K.C. Jain & L.N. Aggarwal, “Production Planning Control and Industrial Management”, Khanna Publishers, 2002.

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**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	PSO		
	Explain about method study procedure & its techniques and work measurement.									I	K2	1,2,8,10	1,2,3		
	Select material, process, production equipment, tooling and process parameters for the given product.									I	K3	1,2,3,8,10	1,2,3		
	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		
	Apply the step by step procedure for estimating the cost of any product.									III	K3	1,2,3,8,10	1,2,3		
	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		
	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
	2	1	-	-	-	-	-	1	-	1	-	-	2	1	1
	3	2	1	-	-	-	-	1	-	1	-	-	2	1	1
	3	2	1	-	-	-	-	1	-	1	-	-	2	1	1
	3	2	1	-	-	-	-	1	-	1	-	-	2	1	1
	3	2	1	-	-	-	-	1	2	1	-	-	2	1	1

<b>20MEV35</b>	<b>PRODUCTION PLANNING AND CONTROL</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		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, 8<sup>th</sup> Edition, 2000.
2. KanishkaBedi, “Production and Operations management”, Oxford university press, 3<sup>rd</sup> 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, 9<sup>th</sup> edition, 2007
5. Jain. K.C & L.N. Aggarwal, “Production Planning Control and Industrial Management”, Khanna Publishers, 8<sup>th</sup> Edition, 1999.

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**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		
	Explain various aspects of product development.										I	K3	1,2,3,11	1, 2,3		
	Describe work sampling techniques.										II	K3	1,2,3,8,11	1, 2,3		
	Determine the quantity in batch production system.										III	K3	1,2,3,4,5,11,12	1, 2,3		
	Explain scheduling rules										IV	K3	1,2,3,4,5,7,11	1, 2,3		
	Determine manufacturing lead time for the given production system.										IV	K3	1,2,3,5,11,12	1, 2,3		
	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	
	3	2	1	-	-	-	-	-	-	-	2	-	3	2	1	
	3	2	1	-	-	-	-	1	-	-	2	-	3	2	1	
	3	2	1	1	2	-	-	-	-	-	2	1	3	2	1	
	3	2	1	2	2	-	1	-	-	-	2	-	3	2	1	
	3	2	1	-	1	-	-	-	-	-	2	1	2	2	1	
	3	2	1	-	1	-	-	-	-	-	2	1	2	2	1	

<b>20MEV45</b>	<b>SUPPLY CHAIN AND LOGISTIC MANAGEMENT</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		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, 6<sup>th</sup> 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, 3<sup>rd</sup> 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, 10<sup>th</sup> Edition, 2019.
4. Jay Heizer, Barry Render, Chuck Munson, "Operations Management: Sustainability and Supply Chain Management", Pearson, 12<sup>th</sup> Edition, 2017.

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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	
	Describe the role and drivers of and supply chain management in achieving competitiveness.										I	K3	1,2,3,11	1, 2, 3	
	Explain about Supply Chain Network Design.										II	K3	1,2,3,8,11	1, 2, 3	
	Illustrate about the issues related to Logistics in Supply Chain.										III	K3	1,2,3,4,5,11,12	1, 2, 3	
	Appraise about Sourcing and Coordination in Supply Chain.										IV	K3	1,2,3,4,5,7,11	1, 2, 3	
	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	
	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
	3	2	1	-	-	-	-	-	-	-	2	-	3	2	1
	3	2	1	-	-	-	-	1	-	-	2	-	3	2	1
	3	2	1	1	2	-	-	-	-	-	2	1	3	2	1
	3	2	1	2	2	-	1	-	-	-	2	-	3	2	1
	3	2	1	-	1	-	-	-	-	-	2	1	2	2	1
	3	2	1	-	1	-	-	-	-	-	2	1	2	2	1

<b>20MEV55</b>	<b>ENGINEERING ECONOMICS AND COST ANALYSIS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		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, 4<sup>th</sup> Edition, 2017.
2. Prasanna Chandra, "Projects Planning and Analysis", Tata McGraw Hill, 9<sup>th</sup> Edition, 2009.
3. Chan S Park, "Contemporary Engineering Economics", Pearson, 6<sup>th</sup> Edition, 2015.

**REFERENCES:**

**KLNCE UG MECH R2020 (AY 2021-2022)**

1. Leland Blank, Anthony Tarquin, "Engineering Economy", Tata McGraw Hill, 7<sup>th</sup> Edition, 2013.
2. William G Sullivan, Elin M Wicks, Patrick Koelling C, "Engineering Economy", Pearson, 14<sup>th</sup> Edition, 2011.
3. Gerald Thuesen J, Fabrycky W J, "Engineering Economy", Prentice Hall, 9<sup>th</sup> 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		
	Determine the break-even point for a given production system.									I	K3	1,2,3,11	1, 2, 3		
	Compute time value equivalent for various cash flow.									II	K3	1,2,3,8,11	1, 2, 3		
	Describe various methods of comparison of alternatives.									III	K3	1,2,3,4,5,11,12	1, 2, 3		
	Choose a suitable replacement policy for items deteriorating with time.									IV	K3	1,2,3,4,5,7,11	1, 2, 3		
	Choose a suitable replacement policy for machines with infinite horizon.									IV	K3	1,2,3,5,11,12	1, 2, 3		
	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
	3	2	1	-	-	-	-	-	-	-	2	-	3	2	1
	3	2	1	-	-	-	-	1	-	-	2	-	3	2	1
	3	2	1	1	2	-	-	-	-	-	2	1	3	2	1
	3	2	1	2	2	-	1	-	-	-	2	-	3	2	1
	3	2	1	-	1	-	-	-	-	-	2	1	2	2	1
	3	2	1	-	1	-	-	-	-	-	2	1	2	2	1



<b>20MEV65</b>	<b>MAINTENANCE ENGINEERING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		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., 4<sup>th</sup> 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, 2<sup>nd</sup> 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	
	Explain the principles, functions of maintenance activities.										I	K3	1,2,3,11	1, 2, 3	
	Describe the different maintenance categories.										II	K3	1,2,3,8,11	1, 2, 3	
	Describe the principles and methods of lubrication.										II	K3	1,2,3,4,5,11,12	1, 2, 3	
	Explain about condition monitoring and instruments used in industry.										III	K3	1,2,3,4,5,7,11	1, 2, 3	
	Describe the repair methods used for basic machine elements like bed, slide ways.										IV	K3	1,2,3,5,11,12	1, 2, 3	
	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
	3	2	1	-	-	-	-	-	-	-	2	-	3	2	1
	3	2	1	-	-	-	-	1	-	-	2	-	3	2	1
	3	2	1	1	2	-	-	-	-	-	2	1	3	2	1
	3	2	1	2	2	-	1	-	-	-	2	-	3	2	1
	3	2	1	-	1	-	-	-	-	-	2	1	2	2	1
	3	2	1	-	1	-	-	-	-	-	2	1	2	2	1

<b>20MEV75</b>	<b>OPERATIONS RESEARCH</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		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., 10<sup>th</sup>Edition,2017.
2. Panneerselvam R, “Operations Research”, Prentice Hall India, 2016.
3. Hira.DGupta.P.K, ”Operations Research”,S.Chand Publications, 1<sup>st</sup> 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., 12<sup>th</sup>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, 2<sup>nd</sup> 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		
	Solve Linear Programming Problems by appropriate technique.									I	K3	1,2,3,8,10	1,2,3		
	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		
	Solve the given assignment problem with an appropriate method.									II	K3	1,2,3,8,10	1,2,3		
	Determine the optimal solution for a project scheduling problem.									III	K3	1,2,3	1,2,3		
	Determine the order quantity of goods under different constraints.									IV	K3	1,2,3,8	1,2,3		
	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
	3	2	1	-	-	-	-	2	-	2	-	2	3	2	1
	3	2	1	-	-	-	-	-	2	2	-	2	3	2	1
	3	2	1	-	-	-	-	2	-	2	-	2	3	2	1
	3	2	1	-	-	-	-	-	-	-	-	2	3	2	1
	3	2	1	-	-	-	-	2	-	-	-	2	3	2	1
	3	2	1	-	-	-	-	1	2	2	-	2	3	2	1

**VERTICAL - 6: MODERN MOBILITY SYSTEMS**

<b>20MEV16</b>	<b>AUTOMOBILE ENGINEERING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		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, 7<sup>th</sup> 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., 2<sup>nd</sup> Edition, 2006.
3. M. Ehsani, Y. Gao and A. Emadi, "Modern Electric, Hybrid electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2<sup>nd</sup> 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, 13<sup>th</sup> 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		
	Explain the various types of engines and components.									I	K2	1, 2, 3	1, 2, 3		
	Explain the various types of injection and ignition systems.									I	K2	1, 2, 3	1, 2, 3		
	Describe the various types of chassis, frame and steering systems.									II	K2	1, 2, 3	1, 2, 3		
	Distinguish between the manual transmissions systems with automatic transmission systems.									III	K2	1, 2, 3	1, 2, 3		
	Describe the operation of the brakes and the suspension systems.									IV	K2	1, 2, 3	1, 2, 3		
	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
	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
	2	1	1	-	-	-	-	-	-	-	-	1	2	1	1

<b>20MEV26</b>	<b>ADVANCED INTERNAL COMBUSTION ENGINES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		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





**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	
	Explain two stroke and four stroke SI and CI engines and valve & port timing diagrams.										I	K2	1, 2, 3	1, 2, 3	
	Explain the different circuits in two wheeler fuel systems and ignition system.										II	K2	1, 2, 3	1, 2, 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	
	Describe the different types of clutches, gear box and suspension systems.										III	K2	1, 2, 3	1, 2, 3	
	Describe the different types of brake system for two wheeler and four wheeler, wheels and tyres.										IV	K2	1, 2, 3	1, 2, 3	
	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
	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
	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 Performance,Wiley–VCH, Verlag GmbH, 2008.
2. Robert A.Huggins, Advanced Batteries – Materials science aspects,Springer, 2009.
3. Ibrahim Dinçer, Halil S. Hamut and Nader Javani, “Thermal Management of Electric Vehicle Battery Systems”, JohnWiley& Sons Ltd., 2016.
4. Albert N. Link, Alan C. O’ Connor and Troy J. Scot, Battery technology for Electric vehicles, Routledge,2015
5. 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	
	Describe the construction and working of lead acid batteries.										I	K2	1, 2, 3, 4, 6, 7	1, 2, 3	
	Explain the construction and working of lithium ion batteries.										II	K2	1, 2, 3, 4, 6, 7	1, 2, 3	
	Discuss about the testing of batteries.										III	K2	1, 2, 3, 4, 6, 7	1, 2, 3	
	Explain the battery pack system.										IV	K2	1, 2, 3, 4, 6, 7	1, 2, 3	
	Discuss about the battery management system.										IV	K2	1, 2, 3, 4, 6, 7	1, 2, 3	
	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
	2	1	1	1	-	1	2	-	-	-	-	-	2	1	1
	2	1	1	1	-	1	2	-	-	-	-	-	2	1	1
	2	1	1	1	-	1	2	-	-	-	-	-	2	1	1
	2	1	1	1	-	1	2	-	-	-	-	-	2	1	1
	2	1	1	1	-	1	2	-	-	-	-	1	2	1	1

<b>20MEV56</b>	<b>ALTERNATE FUELS FOR IC ENGINES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		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	
	Explain various properties of Alternative Fuels and their merits demerits										I	K2	1,2,3	1,2	
	Describe various properties of Different Synthetic fuels and their merits demerits										II	K2	1,2,3	1,2	
	Discuss the performance and emission characteristics of engines using additives.										II	K2	1,2,3	1,2	
	Explain Properties, Production methods and usage of Alcohol fuels in I.C Engines.										III	K2	1,2,3	1,2	
	Describe various properties and production methods of BIO-Diesel fuels.										IV	K2	1,2,3	1,2	
	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
	2	1	1	1	-	-	-	-	-	-	-	-	2	1	1
	2	1	1	1	-	-	-	-	-	-	-	-	2	1	1
	2	1	1	1	-	-	-	-	-	-	-	-	2	1	1
	2	1	1	1	-	-	-	-	-	-	-	-	2	1	1
	2	1	1	1	-	-	-	-	-	-	-	1	2	1	1

<b>20MEV66</b>	<b>INTELLIGENT TRANSPORTATION SYSTEM</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		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 Expert Systems Management Support Systems”, Maxwell Macmillan, 1998.

**REFERENCES:**

1. Cycle W.Halsapple and Andrew B.Winston, "Decision Support Systems – Theory and Application", Springer Verlag, New York, 1987.
2. Sitau S. Mitra, "Decision Support Systems – Tools and Techniques", John Wiley, New York, 1986.
3. Henry F.Korth, and Abraham Siberschatz, Data Base System Concepts, 7<sup>th</sup> 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:**

<b>Course Name: INTELLIGENT TRANSPORTATION SYSTEM</b>											<b>Course Code: 20MEV66</b>				
<b>CO</b>	<b>Course Outcomes</b>										<b>Unit</b>	<b>K –CO</b>	<b>POs</b>	<b>PSO</b>	
	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	
<b>CO-PO Mapping</b>															
<b>CO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>
	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	-



**VERTICAL 1: FINTECH AND BLOCK CHAIN**

<b>20MGV11</b>	<b>FINANCIAL MANAGEMENT</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To acquire the knowledge of the decision areas in finance.
- To learn the various sources of Finance
- To describe about capital budgeting and cost of capital.
- To discuss on how to construct a robust capital structure and dividend policy
- To develop an understanding of tools on Working Capital Management

**PRE-REQUISITE: NIL**

**UNIT - I THE INVESTMENT ENVIRONMENT 9**

Definition and Scope of Finance Functions - Objectives of Financial Management - Profit Maximization and Wealth Maximization- Time Value of money- Risk and return concepts.

**UNIT – II SOURCES OF FINANCE 9**

Long term sources of Finance -Equity Shares – Debentures - Preferred Stock – Features – Merits and Demerits. Short term sources - Bank Sources, Trade Credit, Overdrafts, Commercial Papers, Certificate of Deposits, Money market mutual funds etc

**UNIT – III INVESTMENT DECISIONS 9**

Investment Decisions: capital budgeting – Need and Importance – Techniques of Capital Budgeting– Payback -ARR – NPV – IRR –Profitability Index.

Cost of Capital - Cost of Specific Sources of Capital - Equity -Preferred Stock- Debt - Reserves - Concept and measurement of cost of capital - Weighted Average Cost of Capital.

**UNIT – IV FINANCING AND DIVIDEND DECISION 9**

Operating Leverage and Financial Leverage- EBIT-EPS analysis. Capital Structure – determinantsof Capital structure- Designing an Optimum capital structure .

Dividend policy - Aspects of dividend policy - practical consideration - forms of dividend policy - Determinants of Dividend Policy

**UNIT - V WORKING CAPITAL DECISION 9**

Working Capital Management: Working Capital Management - concepts - importance -Determinantsof Working capital. Cash Management: Motives for holding cash – Objectives and Strategies of Cash Management. Receivables Management: Objectives - Credit policies.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. M.Y. Khan and P.K.Jain Financial management, Text, Tata McGraw Hill
2. M. Pandey Financial Management, Vikas Publishing House Pvt. Ltd

**REFERENCES:**

1. James C. Vanhorne –Fundamentals of Financial Management– PHI Learning
2. Prasanna Chandra, Financial Management
3. Srivatsava, Financial Management, Oxford University Press, 2011

<b>20MGV21</b>	<b>FUNDAMENTALS OF INVESTMENT</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- Describe the investment environment in which investment decisions are taken.
- Explain how to Value bonds and equities
- Explain the various approaches to value securities
- Describe how to create efficient portfolios through diversification
- Discuss the mechanism of investor protection in India.

**PRE-REQUISITE: NIL**

**UNIT - I THE INVESTMENT ENVIRONMENT 9**

The investment decision process, Types of Investments – Commodities, Real Estate and Financial Assets, the Indian securities market, the market participants and trading of securities, security market indices, sources of financial information, Concept of return and risk, Impact of Taxes and Inflation on return

**UNIT – II FIXED INCOME SECURITIES 9**

Bond features, types of bonds, estimating bond yields, Bond Valuation types of bond risks, default risk and credit rating.

**UNIT – III APPROACHES TO EQUITY ANALYSIS 9**

Introduction to Fundamental Analysis, Technical Analysis and Efficient Market Hypothesis, dividend capitalisation models, and price-earnings multiple approach to equity valuation

**UNIT – IV PORTFOLIO ANALYSIS AND FINANCIAL DERIVATIVES 9**

Portfolio and Diversification, Portfolio Risk and Return; Mutual Funds; Introduction to Financial Derivatives; Financial Derivatives Markets in India

**UNIT - V INVESTOR PROTECTION 9**

Role of SEBI and stock exchanges in investor protection; Investor grievances and their redressal system, insider trading, investors' awareness and activism

**TOTAL: 45 PERIODS**

**REFERENCES:**

1. Charles P. Jones, Gerald R. Jensen. Investments: analysis and management. Wiley, 14<sup>TH</sup> Edition, 2019.
2. Chandra, Prasanna. Investment analysis and portfolio management. McGraw-hill education, 5<sup>th</sup>, Edition, 2017.
3. Rustagi, R. P. Investment Management Theory and Practice. Sultan Chand & Sons, 2021.
4. ZviBodie, Alex Kane, Alan J Marcus, PitabusMohanty, Investments, McGraw Hill Education(India), 11 Edition(SIE), 2019

<b>20MGV31</b>	<b>BANKING, FINANCIAL SERVICES AND INSURANCE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- Understand the Banking system in India
- Grasp how banks raise their sources and how they deploy it
- Understand the development in banking technology
- Understand the financial services in India
- Understand the insurance Industry in India

**PRE-REQUISITE: NIL**

**UNIT - I INTRODUCTION TO INDIAN BANKING SYSTEM 9**

Overview of Banking system – Structure – Functions –Banking system in India - Key Regulations in Indian Banking sector –RBI. Relationship between Banker and Customer - Retail & Wholesale Banking – types of Accounts - Opening and operation of Accounts.

**UNIT – II MANAGING BANK FUNDS/ PRODUCTS 9**

Liquid Assets - Investment in securities - Advances - Loans.Negotiable Instruments – Cheques, Bills of Exchange & Promissory Notes.Designing deposit schemes– Asset and Liability Management – NPA’s – Current issues on NPA’s – M&A’s of banks into securities market

**UNIT – III DEVELOPMENT IN BANKING TECHNOLOGY 9**

Payment system in India – paper based – e payment –electronic banking –plastic money – e-money –forecasting of cash demand at ATM’s –The Information Technology Act, 2000 in India – RBI’s Financial Sector Technology vision document – security threats in e-banking & RBI’s Initiative.

**UNIT – IV FINANCIAL SERVICES 9**

Introduction – Need for Financial Services – Financial Services Market in India – NBFC — Leasing and Hire Purchase — mutual funds. Venture Capital Financing –Bill discounting –factoring – Merchant Banking

**UNIT - V INSURANCE 9**

Insurance –Concept - Need - History of Insurance industry in India. Insurance Act, 1938 –IRDA – Regulations – Life Insurance - Annuities and Unit Linked Policies - Lapse of the Policy – revival – settlement of claim

**TOTAL: 45 PERIODS**

**REFERENCES:**

1. Padmalatha Suresh and Justin Paul, “Management of Banking and Financial Services, Pearson, Delhi, 2017.
2. Meera Sharma, “Management of Financial Institutions – with emphasis on Bank and Risk Management”, PHI Learning Pvt. Ltd., New Delhi 2010
3. Peter S. Rose and Sylvia C. and Hudgins, “Bank Management and Financial Services”, Tata McGraw Hill, New Delhi, 2017

<b>20MGV41</b>	<b>INTRODUCTION TO BLOCKCHAIN AND ITS APPLICATIONS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To understand the basics of Blockchain
- To learn Different protocols and consensus algorithms in Blockchain
- To learn the fundamentals of Bitcoins and smart contracts
- To experiment the Hyperledger Fabric, Ethereum networks
- To understand the Blockchain Applications and trends

**UNIT I INTRODUCTION TO BLOCKCHAIN 9**

Blockchain: The growth of blockchain technology - Distributed systems - The history of blockchain and Bitcoin - Features of a blockchain - Types of blockchain, Consensus: Consensus mechanism - Types of consensus mechanisms - Consensus in blockchain. Decentralization: Decentralization using blockchain - Methods of decentralization - Routes to decentralization- Blockchain and full ecosystem decentralization - Smart contracts - Decentralized Organizations- Platforms for decentralization.

**UNIT II INTRODUCTION TO CRYPTOCURRENCY 9**

Bitcoin – Digital Keys and Addresses – Transactions – Mining – Bitcoin Networks and Payments – Wallets – Alternative Coins – Theoretical Limitations – Bitcoin limitations – Name coin – Prime coin – Zcash – Smart Contracts – Ricardian Contracts- Deploying smart contracts on a blockchain

**UNIT III ETHEREUM 9**

Introduction - The Ethereum network - Components of the Ethereum ecosystem - Transactions and messages - Ether cryptocurrency / tokens (ETC and ETH) - The Ethereum Virtual Machine (EVM), Ethereum Development Environment: Test networks - Setting up a private net - Starting up the private network

**UNIT IV WEB3 AND HYPERLEDGE 9**

Introduction to Web3 – Contract Deployment – POST Requests – Development Frameworks – Hyperledger as a Protocol – The Reference Architecture – Hyperledger Fabric – Distributed Ledger– Corda.

**UNIT V EMERGING TRENDS 9**

Kadena – Ripple – Rootstock – Quorum – Tendermint – Scalability – Privacy – Other Challenges – Blockchain Research – Notable Projects – Miscellaneous Tools.

**TOTAL: 45 PERIODS**

**REFERENCES:**

1. Imran. Bashir. Mastering block chain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained. Packt Publishing, 2<sup>nd</sup> Edition, 2018
2. Peter Borovykh , Blockchain Application in Finance, Blockchain Driven, 2nd Edition, 2018
3. ArshdeepBahga, Vijay Madiseti, “Blockchain Applications: A Hands On Approach”, VPT,2017.

<b>20MGV51</b>	<b>FINTECH PERSONAL FINANCE AND PAYMENTS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To understand currency exchange and digital payments.
- To acquire the knowledge of Fintech firm and their role in Market
- To learn about InsurTech model and services
- To acquire knowledge about Fintech regulations and startups
- To understand P2P lending, challenges and solutions

**UNIT I CURRENCY EXCHANGE AND PAYMENT 9**

Understand the concept of Crypto currency- Bitcoin and Applications -Cryptocurrencies and Digital Crypto Wallets -Types of Cryptocurrencies - Cryptocurrencies and Applications, block chain, Artificial Intelligence, machine learning. Fintech users, Individual Payments, RTGS Systems, Immediate Page 54 of 90 Payment Service (IMPS), Unified Payments Interface (UPI).Legal and Regulatory Implications of Crypto currencies, Payment systems and their regulations. Digital Payments Smart Cards, Stored-Value Cards, EC Micropayments, Payment Gateways, Mobile Payments, Digital andVirtual Currencies, Security, Ethical, Legal, Privacy, and Technology Issues

**UNIT II DIGITAL FINANCE AND ALTERNATIVE FINANCE 9**

A Brief History of Financial Innovation, Digitization of Financial Services, Crowd funding, Charity andEquity,. Introduction to the concept of Initial Coin Offering

**UNIT III INSURETECH 9**

InsurTech Introduction , Business model disruption AI/ML in InsurTech - IoT and InsurTech ,Risk Modeling ,Fraud Detection Processing claims and Underwriting Innovations in Insurance Services

**UNIT IV PEER TO PEER LENDING 9**

P2P and Marketplace Lending, New Models and New Products in market place lending P2P Infrastructure and technologies , Concept of Crowdfunding Crowdfunding Architecture and Technology ,P2P and Crowdfunding unicorns and business models , SME/MSME Lending: Unique opportunities and Challenges, Solutions and Innovations

**UNIT V REGULATORY ISSUES 9**

FinTech Regulations: Global Regulations and Domestic Regulations, Evolution of RegTech, RegTech Ecosystem: Financial Institutions, RegTech Ecosystem: StartupsRegTech, Startups: Challenges, RegTech Ecosystem: Regulators, Use of AI in regulation and Fraud detection

**TOTAL: 45 PERIODS**

**REFERENCES:**

1. Swanson Seth, Fintech for Beginners: Understanding and Utilizing the power of technology, Createspace Independent Publishing Platform, 2016.
2. Models AuTanda, Fintech Bigtech And Banks Digitalization and Its Impact On Banking Business, Springer, 2019
3. Henning Diedrich, Ethereum: Blockchains, Digital Assets, Smart Contracts, Decentralized Autonomous Organizations, Wildfire Publishing, 2016
4. Jacob William, FinTech: The Beginner's Guide to Financial Technology, Createspace Independent Publishing Platform, 2016
5. IIBF, Digital Banking, Taxmann Publication, 2016
6. Jacob William, Financial Technology, Create space Independent Pub, 2016
7. Luke Sutton, Financial Technology: Bitcoin & Blockchain, Createspace Independent Pub, 2016

**20MGV61**

**INTRODUCTION TO FINTECH**

L	T	P	C
3	0	0	3

**OBJECTIVES:**

- To learn about history, importance and evolution of Fintech
- To acquire the knowledge of Fintech in payment industry
- To acquire the knowledge of Fintech in insurance industry
- To learn the Fintech developments around the world
- To know about the future of Fintech

**UNIT I INTRODUCTION**

9

Fintech - Definition, History, concept, meaning, architecture, significance, Goals, key areas in Fintech, Importance of Fintech, role of Fintech in economic development, opportunities and challenges in Fintech, Evolution of Fintech in different sectors of the industry - Infrastructure, Banking Industry, Startups and Emerging Markets, recent developments in FinTech, future prospects and potential issues with Fintech.

**UNIT II PAYMENT INDUSTRY**

9

FinTech in Payment Industry-Multichannel digital wallets, applications supporting wallets, onboarding and KYC application, FinTech in Lending Industry- Formal lending, Informal lending, P2Plending, POS lending, Online lending, Payday lending, Microfinance, Crowdfunding.

**UNIT III INSURANCE INDUSTRY**

9

FinTech in Wealth Management Industry-Financial Advice, Automated investing, Socially responsible investing, Fractional Investing, Social Investing. FinTech in Insurance Industry- P2P insurance, On-Demand Insurance, On-Demand Consultation, Customer engagement through Quote to sell, policy servicing, Claims Management, Investment linked health insurance.

**UNIT IV FINTECH AROUND THE GLOBE**

9

FinTech developments - US, Europe and UK, Germany, Sweden, France, China, India, Africa, Australia, New Zealand, Brazil and Middle East, Regulatory and Policy Assessment for Growth of FinTech. FinTech as disruptors, Financial institutions collaborating with FinTech companies, The new financial world.

**UNIT V FUTURE OF FINTECH**

9

How emerging technologies will change financial services, the future of financial services, banking on innovation through data, why FinTech banks will rule the world, The FinTech Supermarket, Banks partnering with FinTech start-ups, The rise of BankTech, Fintech impact on Retail Banking, A future without money, Ethics in Fintech.

**TOTAL: 45 PERIODS**

**REFERENCES:**

- 1) Arner D., Barberis J., Buckley R, The evolution of FinTech: a new post crisis paradigm, University of New South Wales Research Series, 2015
- 2) Susanne Chishti, Janos Barberis, The FINTECH Book: The Financial Technology Handbook for Investors, Entrepreneurs and Visionaries, Wiley Publications, 2016
- 3) Richard Hayen, FinTech: The Impact and Influence of Financial Technology on Banking and the Finance Industry, 2016
- 4) Parag Y Arjunwadkar, FinTech: The Technology Driving Disruption in the financial service industry CRC Press, 2018
- 5) Sanjay Phadke, Fintech Future : The Digital DNA of Finance Paperback .Sage Publications, 2020
- 6) Pranay Gupta, T. Mandy Tham, Fintech: The New DNA of Financial Services Paperback, 2018

**VERTICAL 2: ENTREPRENEURSHIP**

<b>20MGV12</b>	<b>FOUNDATIONS OF ENTREPRENERUSHIP</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To develop and strengthen the entrepreneurial quality and motivation of learners.
- To impart the entrepreneurial skills and traits essential to become successful entrepreneurs.
- To apply the principles and theories of entrepreneurship and management in Technology oriented businesses.
- To empower the learners to run a Technology driven business efficiently and effectively

**UNIT I INTRODUCTION TO ENTREPRENEURSHIP 9**

Entrepreneurship- Definition, Need, Scope - Entrepreneurial Skill & Traits - Entrepreneur vs. Intrapreneur; Classification of entrepreneurs, Types of entrepreneurs - Factors affecting entrepreneurial development – Achievement Motivation – Contributions of Entrepreneurship to Economic Development

**UNIT II BUSINESS OWNERSHIP & ENVIRONMENT 9**

Types of Business Ownership – Business Environmental Factors – Political-Economic-Sociological-Technological-Environmental-Legal aspects – Human Resources Mobilisation-Basics of Managing Finance- Essentials of Marketing Management - Production and Operations Planning – Systems Management and Administration

**UNIT III FUNDAMENTALS OF TECHNOPRENEURSHIP 9**

Introduction to Technopreneurship - Definition, Need, Scope- Emerging Concepts- Principles - Characteristics of a technopreneur - Impacts of Technopreneurship on Society – Economy- Job Opportunities in Technopreneurship - Recent trends

**UNIT IV APPLICATIONS OF TECHNOPRENEURSHIP 9**

Technology Entrepreneurship - Local, National and Global practices - Intrapreneurship and Technology interactions, Networking of entrepreneurial activities – Launching - Managing Technology based Product / Service entrepreneurship – Success Stories of Technopreneurs - Case Studies

**UNIT V EMERGING TRENDS IN ENTREPRENEURSHIP 9**

Effective Business Management Strategies For Franchising - Sub-Contracting- Leasing- Technopreneurs – Agripreneurs - Netpreneurs- Portfolio entrepreneurship - NGO Entrepreneurship

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

- 1 S.S.Khanka, "Entrepreneurial Development" S.Chand & Co. Ltd. Ram Nagar New Delhi, 2021.
- 2 Donal F Kuratko Entrepreneurship (11th Edition) Theory, Process, Practice by Published 2019 by Cengage Learning



**REFERENCES:**

- 1 Daniel Mankani. 2003. Technopreneurship: The successful Entrepreneur in the new Economy. Prentice Hall
- 2 Edward Elgar. 2007. Entrepreneurship, Cooperation and the Firm: The Emergence and Survival of High-Technology Ventures in Europe. Ed: Jan Ulijn, Dominique Drillon, and Frank Lasch. Wiley
- 3 Lang, J. 2002, The High Tech Entrepreneur's Handbook, Ft.com.
- 4 David Sheff 2002, China Dawn: The Story of a Technology and Business Revolution,
- 5 Harper Business <https://fanny.staff.uns.ac.id/files/2013/12/Technopreneur-BASED-EDUCATION-REVOLUTION.pdf>
- 6 JumpStart: A Technopreneurship Fable, Dennis Posadas, (Singapore: Pearson Prentice Hall, 2009
- 7 Basics of Technopreneurship: Module 1.1-1.2, Frederico Gonzales, President-PESO Inc; M.Barcelon, UP
- 8 Journal articles pertaining to Entrepreneurship

<b>20MGV22</b>	<b>TEAM BUILDING &amp; LEADERSHIP MANAGEMENT FOR BUSINESS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To develop and strengthen the Leadership qualities and motivation of learners.
- To impart the Leadership skills and traits essential to become successful entrepreneurs.
- To apply the principles and theories of Team Building in managing Technology oriented businesses.
- To empower the learners to build robust teams for running and leading a business efficiently and effectively

**UNIT I INTRODUCTION TO MANAGING TEAMS 9**

Introduction to Team - Team Dynamics - Team Formation – Stages of Team Development - Enhancing teamwork within a group - Team Coaching - Team Decision Making - Virtual Teams - Self Directed Work Teams (SDWTs) -Multicultural Teams.

**UNIT II MANAGING AND DEVELOPING EFFECTIVE TEAMS 9**

Team-based Organisations- Leadership roles in team-based organisations - Offsite training and team development - Experiential Learning - Coaching and Mentoring in team building - Building High-Performance Teams - Building Credibility and Trust - Skills for Developing Others - Team Building at the Top - Leadership in Teamwork Effectiveness.

**UNIT III INTRODUCTION TO LEADERSHIP 9**

Introduction to Leadership - Leadership Myths – Characteristics of Leader, Follower and Situation - Leadership Attributes - Personality Traits and Leadership- Intelligence Types and Leadership - Power and Leadership - Delegation and Empowerment.

**UNIT IV LEADERSHIP IN ORGANISATIONS 9**

Leadership Styles – LMX Theory- Leadership Theory and Normative Decision Model - Situational Leadership Model - Contingency Model and Path Goal Theory – Transactional and Transformational Leadership - Charismatic Leadership - Role of Ethics and Values in Organisational Leadership.

**UNIT V LEADERSHIP EFFECTIVENESS 9**

Leadership Behaviour - Assessment of Leadership Behaviors - Destructive Leadership - Motivation and Leadership - Managerial Incompetence and Derailment Conflict Management - Negotiation and Leadership - Culture and Leadership - Global Leadership – Recent Trends in Leadership.

**TOTAL: 45 PERIODS**

**REFERENCES:**

1. Hughes, R.L., Ginnett, R.C., & Curphy, G.J., Leadership: Enhancing the lessons of experience ,9th Ed, McGraw Hill Education, Chennai, India. (2019).
2. Katzenback, J.R., Smith, D.K., The Wisdom of Teams: Creating the HighPerformance Organisations, Harvard Business Review Press, (2015).
3. Haldar,U.K., Leadership and Team Building, Oxford University Press, (2010).
4. Daft, R.L., The Leadership Experience, Cengage, (2015).
5. Daniel Levi, Group Dynamics for Teams ,4th Ed, (2014), Sage Publications.
6. Dyer, W. G., Dyer, W. G., Jr., & Dyer, J. H..Team building: Proven strategies for improvingteam performance, 5thed, Jossey-Bass, (2013).

20MGV32

**CREATIVITY & INNOVATION IN  
ENTREPRENEURSHIP**

L	T	P	C
3	0	0	3

**OBJECTIVES:**

- To develop the creativity skills among the learners
- To impart the knowledge of creative intelligence essential for entrepreneurs
- To know the applications of innovation in entrepreneurship.
- To develop innovative business models for business.

**UNIT I CREATIVITY**

9

Creativity: Definition- Forms of Creativity-Essence, Elaborative and Expressive Creativities- Quality of Creativity-Existential, Entrepreneurial and Empowerment Creativities – Creative Environment-Creative Technology- - Creative Personality and Motivation.

**UNIT II CREATIVE INTELLIGENCE**

9

Creative Intelligence: Convergent thinking ability – Traits Congenial to creativity – Creativity Training- - Criteria for evaluating Creativity-Credible Evaluation- Improving the quality of our creativity – Creative Tools and Techniques - Blocks to creativity- fears and Disabilities- Strategies for Unblocking- Designing Creativity Enabling Environment.

**UNIT III INNOVATION**

9

Innovation: Definition- Levels of Innovation- Incremental Vs Radical Innovation-Product Innovation and Process- Technological, Organizational Innovation – Indicators- Characteristics of Innovation in Different Sectors. Theories in Innovation and Creativity- Design Thinking and Innovation- Innovation as Collective Change-Innovation as a system

**UNIT IV INNOVATION AND ENTREPRENEURSHIP**

9

Innovation and Entrepreneurship: Entrepreneurial Mindset , Motivations and Behaviours- Opportunity Analysis and Decision Making- Industry Understanding - Entrepreneurial Opportunities- Entrepreneurial Strategies – Technology Pull/Market Push – Product -Market fit

**UNIT V INNOVATIVE BUSINESS MODELS**

9

Innovative Business Models: Customer Discovery-Customer Segments-Prospect Theory and Developing Value Propositions- Developing Business Models: Elements of Business Models – Innovative Business Models: Elements, Designing Innovative Business Models- Responsible Innovation and Creativity.

**TOTAL: 45 PERIODS**

**REFERENCES:**

1. Creativity and Innovation in Entrepreneurship, Kankha, Sultan Chand
2. Pradip N Khandwalla, Lifelong Creativity, An Unending Quest, Tata Mc Graw Hill, 2004. Paul Trott, Innovation Management and New Product Development, 4e, Pearson, 2018.
3. Vinnie Jauhari, Sudanshu Bhushan, Innovation Management, Oxford Higher Education, 2014. Innovation Management, C.S.G. Krishnamacharyulu, R. Lalitha, Himalaya Publishing House, 2010.
4. A.Dale Timpe, Creativity, Jaico Publishing House, 2003. Brian Clegg, Paul Birch, Creativity, Kogan Page, 2009.
5. Strategic Innovation: Building and Sustaining Innovative Organizations- Course Era, Raj Echambadi.

<b>20MGV42</b>	<b>PRINCIPLES OF MARKETING MANAGEMENT FOR BUSINESS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To provide basic knowledge of concepts, principles, tools and techniques of marketing for entrepreneurs
- To provide an exposure to the students pertaining to the nature and Scope of marketing, which they are expected to possess when they enter the industry as practitioners.
- To give them an understanding of fundamental premise underlying market driven strategies and the basic philosophies and tools of marketing management for business owners.

**UNIT I INTRODUCTION TO MARKETING MANAGEMENT 9**

Introduction - Market and Marketing – Concepts- Functions of Marketing - Importance of Marketing Marketing Orientations - Marketing Mix-The Traditional 4Ps - The Modern Components of the Mix - The Additional 3Ps - Developing an Effective Marketing Mix.

**UNIT II MARKETING ENVIRONMENT 9**

Introduction - Environmental Scanning - Analysing the Organisation’s Micro Environment and Macro Environment - Differences between Micro and Macro Environment – Techniques of Environment Scanning - Marketing organization - Marketing Research and the Marketing Information System, Types and Components.

**UNIT III PRODUCT AND PRICING MANAGEMENT 9**

Product- Meaning, Classification, Levels of Products – Product Life Cycle (PLC) - Product Strategies - Product Mix - Packaging and Labelling - New Product Development - Brand and Branding - Advantages and disadvantages of branding Pricing - Factors Affecting Price Decisions - Cost Based Pricing - Value Based and Competition Based Pricing - Pricing Strategies - National and Global Pricing.

**UNIT IV PROMOTION AND DISTRIBUTION MANAGEMENT 9**

Introduction to Promotion – Marketing Channels- Integrated Marketing Communications (IMC) - Introduction to Advertising and Sales Promotion – Basics of Public Relations and Publicity - Personal Selling - Process - Direct Marketing - Segmentation, Targeting and Positioning (STP)-Logistics Management- Introduction to Retailing and Wholesaling.

**UNIT V CONTEMPORARY ISSUES IN MARKETING MANAGEMENT 9**

Introduction - Relationship Marketing Vs. Relationship Management - Customer Relationship Management (CRM) - Forms of Relationship Management - CRM practices - Managing Customer Loyalty and Development – Buyer-Seller Relationships- Buying Situations in Industrial / Business Market - Buying Roles in Industrial Marketing - Factors that Influence Business - Services Marketing E-Marketing or Online Marketing.

**TOTAL: 45 PERIODS**

**REFERENCES**

1. Marketing Management, Sherlekar S.A, Himalaya Publishing House, 2016.
2. Marketing Management , Philip Kotler and Kevin Lane Keller, PHI 15th Ed, 2015.
- 3 Marketing Management- An Indian perspective, Vijay Prakash Anand, Biztantra, 2<sup>nd</sup> /e, 2016.
4. Marketing Management Global Perspective, Indian Context, V.S.Ramaswamy & S.Namakumari, Macmillan Publishers India, 5th edition, 2015.
5. Marketing Management, S.H.H. Kazmi, 2013, Excel Books India.
6. Marketing Management- text and Cases, Dr. C.B.Gupta & Dr. N.Rajan Nair, 17th edition, 2016.

<b>20MGV52</b>	<b>HUMAN RESOURCE MANAGEMENT FOR ENTREPRENEURS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To introduce the basic concepts, structure and functions of human resource management for entrepreneurs.
- To create an awareness of the roles, functions and functioning of human resource department.
- To understand the methods and techniques followed by Human Resource Management practitioners.

**UNIT I INTRODUCTION TO HRM 9**

Concept, Definition, Objectives- Nature and Scope of HRM - Evolution of HRM - HR Manager Roles- Skills - Personnel Management Vs. HRM - Human Resource Policies - HR Accounting - HR Audit - Challenges in HRM.

**UNIT II HUMAN RESOURCE PLANNING 9**

HR Planning - Definition - Factors- Tools - Methods and Techniques - Job analysis- Job rotation- Job Description - Career Planning - Succession Planning - HRIS - Computer Applications in HR - Recent Trends.

**UNIT III RECRUITMENT AND SELECTION 9**

Sources of recruitment- Internal Vs. External - Domestic Vs. Global Sources -eRecruitment - Selection Process- Selection techniques -eSelection- Interview Types- Employee Engagement

**UNIT IV TRAINING AND EMPLOYEE DEVELOPMENT 9**

Types of Training - On-The-Job, Off-The-Job - Training Needs Analysis – Induction and Socialisation Process - Employee Compensation - Wages and Salary Administration – Health and Social Security Measures- Green HRM Practices

**UNIT V CONTROLLING HUMAN RESOURCES 9**

Performance Appraisal – Types - Methods - Collective Bargaining - Grievances Redressal Methods – Employee Discipline – Promotion – Demotion - Transfer – Dismissal - Retrenchment - Union Management Relationship - Recent Trends

**TOTAL: 45 PERIODS**

**REFERENCE**

- 1) Gary Dessler and Biju Varkkey, Human Resource Management, 14e , Pearson, 2015.
- 2) Mathis and Jackson, Human Resource Management, Cengage Learning 15e, 2017.
- 3) David A. Decenzo, Stephen.P.Robbins, and Susan L. Verhulst, Human Resource Management, Wiley, International Student Edition, 11th Edition, 2014
- 4) R. Wayne Mondy, Human Resource Management, Pearson , 2015.
- 5) Luis R.Gomez-Mejia, David B.Balkin, Robert L Cardy. Managing Human Resource. PHI Learning. 2012
- 6) John M. Ivancevich, Human Resource Management, 12e, McGraw Hill Irwin, 2013.
- 7) K. Aswathappa, Sadhna Dash , Human Resource Management - Text and Cases , 9th Edition, McGraw Hill, 2021.
- 8) Uday Kumar Haldar, Juthika Sarkar. Human Resource management. Oxford. 2012



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- Choices And Increasing Your Portfolio Returns. John Wiley & Sons, 2002.
- 9) Byers, Thomas. Technology Ventures: From Idea To Enterprise. Mcgraw-Hill HigherEducation, 2014.
  - 10) Lerner, Josh; Leamon, Ann; Hardymon, Felda. Venture Capital, Private Equity, And The Financing Of Entrepreneurship. 2012.