Scheme for V Semester B.E. (Mechanical Engineering)												
S No	Course		Course Title	Teaching Department	Teaching hours/week			Examination				Credits
					Theory Lecture	Tutorial	Practical/Drawing	Duration in Hours	CIE Marks	SEE Marks	Total marks	
	Type	Code			L	T	P					
1	HSMC	MVJ19TEM51	Technical Management & Entrepreneurship	Humanities	3	0	0	3	50	50	100	3
2	PCC	MVJ19ME52	Design of Machine Elements-I	ME	3	2	0	3	50	50	100	4
3	PCC	MVJ19ME53	Turbo Machinery	ME	3	2	0	3	50	50	100	4
4	PCC	MVJ19ME54	Dynamics of Machines	ME	2	2	0	3	50	50	100	3
5	PE	MVJ19ME55X	Professional Elective - 1	ME	3	0	0	3	50	50	100	3
6	PCC	MVJ19MEL56	Fluid Mechanics and Fluid Machinery-Lab	ME	0	1	3	3	50	50	100	2
7	PCC	MVJ19MEL57	Energy conversion-Lab	ME	0	1	3	3	50	50	100	2
8	PCC	MVJ19MEL58	Computational Techniques Lab	ME	0	1	3	3	50	50	100	2
9	HSMC	MVJ19ENV59	Environmental Studies	Humanities	1	0	0	3	50	50	100	1
				Total	15	9	9	27	450	450	900	24

Note: 1. PCC: Professional Core Course , PE: Professional Elective, HSMC: Humanity and Social Science
2. Audit Course of Application development using Python to be taught in V Semester.
3. Students can take up Certification Course of 45 (30+15) hours duration on HVAC for 2 credits in the V Semester to be offered in association with the Alpine Coach Tree - HVAC Training Institute.

Professional Elective - 1:

1. MVJ19ME551: Industrial Internet of Things
2. MVJ19ME552: Advanced Manufacturing Technology,
3. MVJ19ME553: Composite Materials,
4. MVJ19ME554: Total Quality Management

Course Title	TECHNICAL MANAGEMENT & ENTREPRENEURSHIP	Semester	V
Course Code	MVJ19TEM51	CIE	50
Total No. of Contact Hours	40 L: T: P: 3:0:0	SEE	50
No. of Contact Hours/week	04	Total	100
Credits	03	Exam. Duration	3 hrs.

Course objective is to:

- To help the students to understand the fundamental concepts and principles of management; the basic roles, skills, functions of management, various organizational structures and basic knowledge of marketing.
- To impart knowledge, with respect to concepts, principles, and practical applications of Economics, which govern the functioning of a firm/organization under different market conditions

Module-1	RBT Level L1,L2	8 Hrs

Management: Introduction - Meaning - nature and characteristics of Management, Scope and Functional areas of management - Management as a science, art of profession - Management & Administration - Roles of Management, Levels of Management, Development of Management Thought- early management approaches – Modern management approaches. Planning: Nature, importance, and purpose of planning process Objectives - Types of plans (Meaning Only) - Decision making Importance of planning - steps in planning & planning premises - Hierarchy of plans.

Laboratory Sessions/ Experimental learning:
Students will understand the key roles and implementation characteristics of management skills through case studies.

Application: Management of organizations, institutions, and industries.

Video link / Additional online information:

https://nptel.ac.in/courses/122/106/122106031/

https://nptel.ac.in/courses/110/105/110105067/

https://nptel.ac.in/courses/110/106/110106141/

https://nptel.ac.in/courses/110/106/110106141/

Module-2	RBT Level L1,L2	8 Hrs.

Organizing and Staffing: Nature and purpose of organization Principles of organization - Types of organization - Departmental Committees, Centralization Vs Decentralization of authority and responsibility - Span of control - MBO and MBE Nature and importance of staffing--Process of Selection & Recruitment.

Laboratory Sessions/ Experimental learning:
Demonstration to students on the Organization behavioural skills will be given through case studies.

Applications-Organizing, Staffing and Coordinating in an organization

Video link / Additional online information:

https://nptel.ac.in/courses/122/106/122106031/

https://nptel.ac.in/courses/110/105/110105067/

https://nptel.ac.in/courses/110/106/110106141/

https://nptel.ac.in/courses/110/106/110106141/

Module-3	RBT Level L1,L2	8 Hrs

Directing & controlling: Meaning and nature of directing - Leadership styles, Motivation Theories, Communication - Meaning and importance - coordination, meaning and importance and Techniques of Co - Ordination. Meaning and steps in controlling - Essentials of a sound control system - Methods of establishing control.

Laboratory Sessions/ Experimental learning:
Demonstration to students on the Directing and Controlling will be given through case studies.

Applications-Directing, Controlling the activities of an organization.

Video link / Additional online information:

https://nptel.ac.in/courses/122/106/122106031/

https://nptel.ac.in/courses/110/105/110105067/

https://nptel.ac.in/courses/110/106/110106141/

https://nptel.ac.in/courses/110/106/110106141/

Module-4	RBT Level L1,L2	8 Hrs.

Entrepreneur: Meaning of Entrepreneur; Evolution of the Concept; Functions of an Entrepreneur, Types of Entrepreneur, Entrepreneur - an emerging. Class. Concept of Entrepreneurship - Evolution of Entrepreneurship, Development of Entrepreneurship; Stages in entrepreneurial process; Role of entrepreneurs in Economic Development; Entrepreneurship in India; Entrepreneurship - its Barriers.

Laboratory Sessions/ Experimental learning:
Entrepreneurship development programs will be conducted to simulate and motivate the interests of students to become entrepreneurs.

Applications-Applying the concepts of entrepreneurship to become successful entrepreneurs and establish enterprises.

Video link / Additional online information:

https://nptel.ac.in/courses/122/106/122106031/

https://nptel.ac.in/courses/110/105/110105067/

https://nptel.ac.in/courses/110/106/110106141/

https://nptel.ac.in/courses/110/106/110106141/

Module-5	RBT Level L1,L2	8 Hrs

Small scale industries: Definition; Characteristics; Need and rationale; Objectives; Scope; role of SSI in Economic Development. Advantages of SSI Steps to start and SSI - Government policy towards SSI; Different Policies of SSI; Government Support for SSI during 5-year plans.

Preparation of project: Meaning of Project; Project Identification; Project Selection; Project Report; Need and Significance of Report; Contents; Formulation; Guidelines by Planning Commission for Project report; Network Analysis; Errors of Project Report; Project Appraisal. Identification of business opportunities: Market Feasibility Study; Technical Feasibility Study; Financial Feasibility Study & Social Feasibility Study.

Laboratory Sessions/ Experimental learning:

Students will be given an assignment for preparation of a project report for establishing a Small Scale Industry

Applications- Establishment and successful implementation of the concepts for running Industries.

Video link / Additional online information:

https://nptel.ac.in/courses/122/106/122106031/

https://nptel.ac.in/courses/110/105/110105067/

https://nptel.ac.in/courses/110/106/110106141/

https://nptel.ac.in/courses/110/106/110106141/

Course outcomes:

CO1	Understand needs, functions, roles, scope and evolution of Management
CO2	Understand importance, purpose of Planning and hierarchy of planning and also analyse its types.
CO3	Discuss Decision making, Organizing, Staffing, Directing and Controlling.
CO4	Students are able to understand the meaning of Entrepreneur, Role of entrepreneurs in Economic Development.
CO5	Students are able to Prepare the project reports effectively.

Text Books:

1.	Principles of Management Tripathy and Reddy Tata McGraw Hill 3rd edition 2006.
2.	Management Fundamentals - Concepts, Application, Skill Development - Robers Lusier - Thomson
3.	Entrepreneurship Development - S.S.Khanka - S.Chand & Co.

Reference Books:	
1.	Management - Stephen Robbins - Pearson Education/PHI - 17th Edition, 2003
2.	Dynamics of Entrepreneurial Development & Management Vasant Desai - Himalaya Publishing House
3.	Entrepreneurship Development – Poornima. M. Charantimath Small Business Enterprises - Pearson Education - 2006 (2 & 4).

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests

- Quizzes/mini tests (4 marks)
- Mini Project / Case Studies (8 Marks)
- Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.

ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.

iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	1	-	-	-	-	-	-	-	2	2	1	3	2	2
CO2	1	-	-	-	-	-	-	-	2	2	1	3	2	2
CO3	1	-	-	-	-	-	-	-	2	2	1	3	2	2
CO4	1	-	-	-	-	-	-	-	2	2	1	3	2	2
CO5	1	-	-	-	-	-	-	-	2	2	1	3	2	2

High-3, Medium-2, Low-1

Course Title	DESIGN OF MACHINE ELEMENTS-I	Semester	V
Course Code	MVJ19ME52	CIE	50
Total No. of Contact Hours	50 L : T : P :: 3 : 2:0	SEE	50
No. of Contact Hours/week	05	Total	100
Credits	04	Exam. Duration	3 Hrs.

Course objective is:

- To design simple machine elements subjected to static and dynamic loads using the concepts of stress analysis and theories of failure.
- To study the material behaviour in the presence of crack.
- To effectively understand the fracture behaviour of materials.
- To design the riveted and welded joints.
- To design joints and couplings.

Module-1	RBT Level L1,L2,L3	10 Hrs

Stress Analysis: Types of stresses, stress-strain diagram in tension, mechanical properties of materials, static stress equation in axial, bending and torsional loading, criteria for failure, factor of safety.

Combined Stresses: Combination of normal stresses, eccentric loading of members, combination of normal and shear stresses, principal stresses.

Laboratory Sessions/ Experimental learning:

1. Stress and Strains: Stress strain plots for different materials like Al, Zinc.

Applications:

1. Study of materialistic properties, related to static analysis.

Video link / Additional online information:

https://nptel.ac.in/courses/112105125/

https://nptel.ac.in/courses/112/106/112106247/

https://nptel.ac.in/content/storage2/courses/112105125/pdf/Module-2_Lesson-2.pdf

https://nptel.ac.in/courses/112/107/112107146/

Module-2	RBT Level L1,L2,L3	10 Hrs.

Variable Loads: Mechanism of fatigue failure (in brief)-fatigue limit and fatigue strength, S-N curves, types of stress variations, terminology, Soderberg, Goodman and Gerber equations, stress raisers, stress concentration factor, notch sensitivity factor, factors affecting fatigue limit, finite life, equivalent stress, combined variable stress. Stresses due to impact loading.

Laboratory Sessions/ Experimental learning:

1. Impact load: Experiment on impact loading.
2. Fatigue: Demonstration with model.

Applications:

1. Study the effect of different loads under design considerations.
2. Failure analysis of different materials.

Video link / Additional online information:

https://nptel.ac.in/courses/112105125/

https://nptel.ac.in/content/storage2/courses/112105125/pdf/Module-3_lesson-4.pdf

https://nptel.ac.in/course.html

https://nptel.ac.in/courses/111/104/111104095/

Module-3	RBT Level L2,L3, L4	10 Hrs

An Overview of Fracture Mechanics Design: Three modes of crack opening, stress intensity factor, significance of fracture mechanics in design

Design of Shafts and Couplings: Forces on shafts due to gears, belts and chains, estimation of shaft size based on strength and critical speed. Couplings-types and applications, Design of square keys-use of standards, rigid couplings, flexible flange couplings - selection.

Laboratory Sessions/ Experimental learning:

1. Couplings: Model making and demonstration on couplings.

Applications:

1. Practical application of different couplings usages.

Video link / Additional online information:

https://nptel.ac.in/courses/112105125/

https://nptel.ac.in/courses/112/106/112106065/

https://nptel.ac.in/noc/courses/noc17/SEM2/noc17-me23/

https://onlinecourses.nptel.ac.in/noc19_me42/preview

Module-4	RBT Level L3,L4,L5	10 Hrs.

Riveted and Welded Joints: Strength equations, efficiency, design of riveted joints lap joint,butt joint,-joints of uniform strength, eccentrically loaded riveted joints. Types of welded joints-weld symbols, strength of welds, centrally loaded, unsymmetrical sections, axially loaded, eccentrically loaded joints.

Laboratory Sessions/ Experimental learning:

1. Riveting: To do a tank by riveting.

Applications:

1. Design of rivets on requirement view.

Video link / Additional online information:

https://nptel.ac.in/courses/112105125/

http://www.nptelvideos.in/2012/12/design-of-machine-elements.html

https://www.yumpu.com/en/document/view/11310280/design-of-eccentrically-loaded-bolted-riveted-joints-nptel

https://nptel.ac.in/courses/112/105/112105124/

Module-5	RBT Level L3,L4,L5	10 Hrs

Design of Bolted Joints, Cotter and Knuckle joints, Couplings.

Design of threaded fasteners.

Design of Power Screws: Types of power screws, efficiency and self-locking, Design of power screw, Design of screw jack: (Complete Design).

Laboratory Sessions/ Experimental learning:

1. Bolts: Loading and testing bolts.
2. Model on mounting and lifting mechanism.

Applications:

1. Study of various stresses in bolts design and design considerations.
2. Comparative study of hydraulic jack and screw jack.

Video link / Additional online information:

https://nptel.ac.in/courses/112105125/

https://nptel.ac.in/courses/112/105/112105124/

http://www.nptelvideos.in/2012/12/design-of-machine-elements.html

https://nptel.ac.in/courses/112/104/112104228/

Course outcomes:

CO1	Students are able to apply basic stress-strain analysis and failure theories to design machine elements.
CO2	Students are capable of analyzing and solving problems on machine elements subjected to dynamic Loads.
CO3	Students can able to Design shaft and couplings.
CO4	Students are able to Design of threaded fasteners, welded and riveted joints.
CO5	Students are able to perform design of Bearings.

Text Books:

1.	Shigley and Mischke, "*Mechanical Engineering Design*", McGraw Hill Publishers Co. Ltd., New Delhi, 2000.
2.	Faculty of Mechanical Engineering, PSG College of Technology, "*Design Data Book*", M/s. DPV Printers, Coimbatore, 2000.

3.	John M Barson and Stanely T Rolfe, "*Fracture and Fatigue Control in Structures*", Prentice-Hall Inc., New Jersey, 1987.
Reference Books:	
1.	Jacobson B O, Bernard J Hamrock and Steven R Schmid, "*Fundamentals of Machine Elements*", Mcgraw Hill, Inc., Second Edition, 2006.
2.	Machine Design Data hand book Vol 1, Vol 2 by K Lingaiah, Suma Publishers.
3.	Bandari V B, "*Design of Machine Elements* ", Tata McGraw Hill Publishers Co. Ltd., New Delhi, 2003.

CIE Assessment:
CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests - Quizzes/mini tests (4 marks) - Mini Project / Case Studies (8 Marks) - Activities/Experimentations related to courses (8 Marks)
SEE Assessment:
i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus. ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions. iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	-	2	-	-	-	-	-
CO2	3	3	2	2	-	-	2	-	-	-	-	-
CO3	3	3	2	2	-	-	2	-	-	-	-	-
CO4	3	3	2	2	-	-	2	-	-	-	-	-
CO5	3	3	2	2	-	-	2	-	-	-	-	-

High-3, Medium-2, Low-1

Course Title	TURBO MACHINERY	Semester	V
Course Code	MVJ19ME53	CIE	50
Total No. of Contact Hours	50 L: T : P :: 3: 2 : 0	SEE	50
No. of Contact Hours/week	05	Total	100
Credits	04	Exam. Duration	3 hrs

Course objective is to:

- Enhance knowledge about working of Turbo machines like power absorbing and power generating machines and recognize typical designs of Turbo Machines.
- Application of working principles of general Turbo Machines to specific types of machines.
- Understand the concept of ideal velocity triangles in Turbo machinery stages operating at design and off design conditions.
- Apply the concepts of ideal velocity triangles to various kinds of Turbo machines to design and estimate performance parameters.
- Recognize and discuss today's and tomorrow's use of Turbo machines for enabling a sustainable society.

Module-1	RBT Level L1,L2,L3	10 Hrs.

Basics of Fluid Machines:

Prerequisites: Basics of fluid mechanics and dimensional analysis.

Definition of Turbo machine, parts of Turbo machines, Comparison with positive displacement machines, Classification, Dimensionless parameters and their significance, Effect of Reynold's number, Unit and specific quantities. Application of first and second law's of thermodynamics to Turbo machines, Efficiencies of Turbo machines. Similarity, Model-Prototype concept and relation, latest trends in Turbo Machines. Numerical Examples.

Laboratory Sessions/ Experimental learning:

- Find specific speed of all Turbo machines available in Fluid Machinery lab based on speed and head conditions and compare them for performance.

Applications: Recognize and analyze typical designs of Turbo Machines in Industry.

Self-learning component: Classification of Aero-Foil section Blade terminology.

Video link / Additional online information:

https://youtu.be/TiJZp-KB6h8, https://youtu.be/1ggnDwCrhe8

https://nptel.ac.in/courses/112/106/112106303/

https://www.youtube.com/watch?v=wlPXZrP9vR8&list=PLCoE5wxWtHFYiVGswvsWRaHjv18vxZzE2

https://www.youtube.com/watch?v=C2sX9Wg6twI&list=PLbMVogVj5nJSurQymuzzJM9MwLpEb75lq

Module-2	RBT Level L1,L2,L3	10 Hrs.

General Analysis of Turbines: Euler's turbine equation, Alternate form of Euler's turbine equation, Velocity triangles for different values of degree of reaction, Components of energy transfer, Degree of Reaction, utilization factor, Relation between degree of reaction and Utilization factor, Numericals.

Laboratory Sessions/ Experimental learning:

- Apply Euler's Turbine equation to Turbines available in Turbo Machinery lab to know the practical application of the equation.
- Validation of Euler's turbine equation by the use of software tool.

Applications: Hydro, thermal and nuclear power stations.

Self-learning component: Basic parameters applied to Aero-Foil section blade terminology

Video link / Additional online information:

https://youtu.be/6Opq1_RfsOo

https://www.youtube.com/watch?v=VxqHj_JBG2M

https://www.youtube.com/watch?v=fDC0aNTsdHk

https://www.youtube.com/watch?v=9M4peF-_Bv8

https://www.youtube.com/watch?v=tIvs30Gi8XI

Module-3	RBT Level L1,L2,L3	10 Hrs.

Radial and axial flow compressors and pumps: need for radial flow compressors and pumps. Types of compressors and pumps, Expression for degree of reaction, velocity triangles, Effect of blade discharge angle on energy transfer, degree of reaction and performance. Theoretical head – capacity relationship,

Axial flow compressors and pumps, degree of reaction, velocity triangles, Problems.

Laboratory Sessions/ Experimental learning:

- Find degree of reaction of centrifugal compressor.

Applications: Gas turbines and Jet propulsion systems.

Self-learning component: Effects of Cavitation and Prevention of Cavitation.

Video link / Additional online information:

https://nptel.ac.in/courses/112/106/112106200/

https://nptel.ac.in/courses/112/105/112105182/

https://www.youtube.com/watch?v=b1dyUVA19kQ

https://www.youtube.com/watch?v=NBY9oqAX-rY

https://www.youtube.com/watch?v=kHHTaHvo1LQ

Module-4	RBT Level L1,L2,L3	10 Hrs.

Hydraulic Turbines: Classification, Pelton turbine –velocity triangles, design parameters, different efficiencies and Maximum efficiency. Francis turbine - velocity triangles, design parameters, runner shapes for different blade speeds. Draft tubes- Types and functions. Kaplan and Propeller turbines - velocity triangles, design parameters. Problems.

Centrifugal pumps: Classification and parts of centrifugal pump, different heads and efficiencies of centrifugal pump, Minimum speed for starting the flow, Maximum suction lift, Net positive suction head, Cavitation, Need for priming, Pumps in series and parallel. Problems.

Laboratory Sessions/ Experimental learning:

- Find operating parameters of hydraulic turbines like efficiency and specific speed at different preset conditions.
- Performance analysis of Pelton, Francis and Kaplan turbine in fluid mechanics lab.

Applications: Hydro-electric power plants.

Self-learning component: Basis for selection of Hydraulic turbine.

Video link / Additional online information:

https://youtu.be/9jAZ2eWy-Q4, https://youtu.be/JB_VwxhAeGU

https://www.youtube.com/watch?v=9jAZ2eWy-Q4

https://www.youtube.com/watch?v=GQHCnWl2U6I

https://www.youtube.com/watch?v=Dao9V8YsSB8

Module-5	RBT Level L1,L2,L3	10 Hrs.

Centrifugal Compressors: Stage velocity triangles, slip factor, power input factor, Stage work, Pressure developed, stage efficiency and surging and problems. Axial flow Compressors: Expression for pressure ratio developed in a stage, work done factor, efficiencies and stalling. Problems.

Steam turbines Steam Turbines: Classification, Single stage impulse turbine, condition for maximum blade efficiency, stage efficiency, Need and methods of compounding, Multi-stage impulse turbine, expression for maximum utilization factor, Numerical Problems.

Laboratory Sessions/ Experimental learning:

- Programming of velocity triangle profile for compressors using software tool.

Applications:.Steam power plants.

Self-learning: Classification of Compressors.

Video link / Additional online information:

https://youtu.be/T3PYZsQevHU, https://youtu.be/6aCKxtHqH-s

https://nptel.ac.in/courses/112/106/112106061/

https://www.youtube.com/watch?v=ELQDTKrioX8

https://www.youtube.com/watch?v=UYMDm4yB1QA

https://www.youtube.com/watch?v=fNPPwmfE-SY&list=PL6Qggk0O9yRItYPKm51jEnZoM-mSOM4XA

Course outcomes:	
CO1	Understand and analyse model studies of turbomachines.
CO2	Study and analyse the performance of turbines.
CO3	Construct velocity diagrams and analyse their applicability
CO4	Analyse various kinds of Turbo machines to estimate performance parameters.
CO5	Analyse and understand various type of compressors and steam turbine.

Text Books:	
1.	R.K.Turton, *"Principles of Turbomachinery"*, E & F N Spon Publishers, London & New York.
2.	Gopalakrishnan G, Prithvi Raj D, "*A treatise on Turbomachines*", Scitec Publications, Chennai, 2002.
3.	S.M. Yahya, "*Turbines, Compressors and Fans"*, Tata McGraw Hill.
Reference Books:	
1.	V. Kadambi and Monohar Prasad, "An introduction to energy conversion: Volume III –Turbomachinery," New Age International Private Limited, 2011, ISBN: 978-8122431896.
2	D. G. Shepherd, "Principles of Turbo Machinery," Macmillan Company, 1964
3.	A Valan Arasu, "Turbomachines," Vikas Publishing House Pvt Ltd, 2009, ISBN: 9788125908401.
4.	B K Venkanna, "Fundamentals of Turbomachinery," PHI Learning Pvt Limited, 2009, ISBN: 978-8120337756.

CIE Assessment:
CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests - Quizzes/mini tests (4 marks) - Mini Project / Case Studies (8 Marks) - Activities/Experimentations related to courses (8 Marks)

SEE Assessment:
i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus. ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions. iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping												
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CO2	3	2	1	2	2	1	-	-	1	1	1	1
CO3	3	3	2	2	2	1	-	-	2	1	2	1
CO4	3	3	2	3	3	1	1	-	2	1	2	2
CO5	3	3	3	3	2	2	2	-	3	2	3	3

High-3, Medium-2, Low-1

Course Title	DYNAMICS OF MACHINES	Semester	V
Course Code	MVJ19ME54	CIE	50
Total No. of Contact Hours	40 L: T : P :: 2 : 2 : 0	SEE	50
No. of Contact Hours/week	04	Total	100
Credits	03	Exam. Duration	3 Hrs

Course objective is to:

- Gain the knowledge of static and dynamic equilibrium conditions of mechanisms subjected forces and couple with and without friction.
- Understand and analyse the balancing principles of rotating and reciprocating masses.
- Comprehend the working principles of governors and gyroscopes.
- Understand the friction concept and flat belt drives.
- Understand the concept of energy storage in flywheel and its energy fluctuation.

Module-1	RBT Level L1, L2, L3	08 Hrs.

Static force Analysis:

Prerequisites: Four bar mechanism, slider crank mechanism and velocity triangles

Static equilibrium. Equilibrium of two and three force members. Members with two forces and torque, Free body diagrams, Static force analysis of four bar mechanism and Slider-crank mechanism with and without friction.

Dynamic force Analysis: D'Alembert's principle, Inertia force, Inertia torque. Dynamic force analysis of four-bar mechanism and Slider crank mechanism without friction.

Laboratory Sessions/ Experimental learning:

- Study of static and dynamic force analyses of mechanisms other than four bar mechanism and slider crank mechanism.

Applications: I C Engines, Reciprocating Compressors, Whitworth quick return mechanism, Rotary engines, etc.

Video link / Additional online information :

1. https://www.youtube.com/watch?v=fEdz91oWrts&list=PL46AAEDA6ABAFCA78&index=4&t=0s
2. https://nptel.ac.in/courses/112/104/112104114/
3. https://nptel.ac.in/courses/112/101/112101096/
4. http://www.nptelvideos.in/2012/12/dynamics-of-machines.html

Module-2	RBT Level L1, L2, L3	08 Hrs.

Balancing of Rotating Masses: Static and dynamic balancing, balancing of single rotating mass by balancing masses in same plane and in different planes. Balancing of several rotating masses by balancing masses in same plane and in different planes.

Balancing of Reciprocating Masses: Inertia effect of crank and connecting rod, Single cylinder engine, balancing in multi cylinder-inline engine (primary and secondary forces).

Laboratory Sessions/ Experimental learning:

- Study of balancing of two stroke and four stroke in line engine and balancing of V engines.

Applications: In-line engine, V-engines, Radial engines, etc.

Video link / Additional online information:

1. https://www.youtube.com/watch?v=p1JDMvWGdsk
2. https://www.youtube.com/watch?v=aRulDXMuNDc&list=PL46AAEDA6ABAFCA78&index=9&t=0s
3. https://www.youtube.com/watch?v=HKVvJWArgg8&list=PL46AAEDA6ABAFCA78&index=10&t=0s
4. https://www.youtube.com/watch?v=GPDZ4izcS2M&list=PL46AAEDA6ABAFCA78&index=15&t=0s

Module-3	RBT Level L1, L2, L3	08Hrs.

Governors: Types of governors, force analysis of Porter and Hartnell governors. Controlling force, Stability, Sensitiveness, Isochronism, Effort and Power.

Laboratory Sessions/ Experimental learning:

- Study of Watt Governor, Proell Governor and Wilson-Hartnell Governor.

Applications: Automotive vehicles

Video link / Additional online information :

1. https://www.youtube.com/watch?v=ANl8Sai7Lqg
2. https://www.youtube.com/watch?v=L8wSm_WrGK8
3. https://www.youtube.com/watch?v=n8ObpsDfdTE

Module-4	RBT Level L1, L2, L3	08 Hrs.

Gyroscope: Vectorial representation of angular motion, Gyroscopic couple. Effect of gyroscopic couple on plane disc, aeroplane, ship, stability of two wheelers and four wheelers

Laboratory Sessions/ Experimental learning:

- Experimental study of Gyroscope.
- Study of Gyroscopic analysis of a disc fixed rigidly to a rotating shaft at certain angle.

- Study of Gyroscopic analysis of Grinding Mill.

Applications: Airplanes, Ships, Ground vehicles.

Video link / Additional online information :

1. https://www.youtube.com/watch?v=FydJu1A1oeM&list=PL46AAEDA6ABAFCA78&index=8&t=0s
2. https://www.youtube.com/watch?v=T1Zc0gJw9fU
3. https://www.youtube.com/watch?v=XPUuF_dECVI
4. https://www.youtube.com/watch?v=ZAkYYjYSCQ4

Module-5	RBT Level L2, L3, L4	08Hrs.

Friction and Belt Drives: Definitions: Types of friction: laws of friction, Belt drives: Flat belt drives, ratio of belt tensions, centrifugal tension power transmitted.

Flywheel: Turning moment diagrams Fluctuation of Energy. Determination of size of flywheels.

Laboratory Sessions/ Experimental learning:

- Analysis of friction of Nutt and Screw.
- Study of maximum effective tension and H. P. Transmitted of belt drive.
- Study of flywheel for punching press.

Applications: All mating surfaces, power transmission systems, IC engines, etc.

Video link / Additional online information :

1. https://www.youtube.com/watch?v=qPtpsARSZIs
2. https://www.youtube.com/watch?v=oZhR1HPdvR4&list=PL46AAEDA6ABAFCA78&index=18&t=0s
3. https://www.youtube.com/watch?v=oQURLrZFU2k
4. https://www.youtube.com/watch?v=outh87jHrl8

Course outcomes:

CO1	Determine the forces and couples for static and dynamic conditions of four bar and slider crank mechanisms to keep the system in equilibrium.
CO2	Determine magnitude and angular position of balancing masses under static and dynamic condition of rotating masses in same and different planes.
CO3	Determine sensitiveness, isochronism, effort and power of porter and hartnell governors.
CO4	Determine gyroscopic couple and effects related to 2, 4 wheeler, plane disc, ship and aeroplanes.
CO5	Determine the coefficient of friction between belt and the pulley and fluctuation in energy of flywheel.

Text Books:	
1	**Theory of Machines: Kinematics and Dynamics**, Sadhu Singh Pearson Third edition 2019.
2	**A. G. Ambedkar, *"Mechanism and Machine Theory"***, PHI, 2007.
Reference Books	
1.	**Rattan S.S., *"Theory of Machines"***, Tata McGraw Hill Publishing Company Ltd., New Delhi, 3rd Edition, 2009.
2.	**Mechanisms and Machines Kinematics,** Dynamics and Synthesis Michael M Stanisic Cengage Learning 2016

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests

- Quizzes/mini tests (4 marks)
- Mini Project / Case Studies (8 Marks)
- Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.

ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.

iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	2	2	1	1	1	1	1
CO2	3	3	3	2	2	2	1	1	1	1	1	1
CO3	3	3	3	3	3	1	1	1	1	1	1	1
CO4	3	3	3	3	3	2	2	1	1	1	1	1
CO5	3	3	3	3	2	2	1	2	1	1	1	1

High-3, Medium-2, Low-1

Course Title	INDUSTRIAL INTERNET OF THINGS (IIoT)	Semester	V
Course Code	MVJ19ME551	CIE	50
Total No. of Contact Hours	40 L : T : P :: 3 : 0 : 0	SEE	50
No. of Contact Hours/week	04	Total	100
Credits	03	Exam. Duration	03 Hrs

Course objective is to:

- Explore the basic components of IIoT.
- Study the principles of IIoT and its controlling factors.
- Extend experience in IIoT to understand about drives and control.
- Identify design parameters for a typical IIoT architecture.

Module-1	RBT Level L1, L2	8 Hrs.

Introduction to IoT - The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization, Recommendations on Research Topics.

Laboratory Sessions/ Experimental learning:

- Demonstration of IoT in Data Management and Security.

Applications: IoT for Industrial Automation.

NPTEL/Additional Videos Link:

https://www.youtube.com/watch?v=AQdLQV6vhbk

Module-2	RBT Level L1, L2,L3	8 Hrs.

Industrial IoT: Introduction to Industrial IoT, Business Model and Reference Architecture, IIoT-Business Models, Industrial IoT- Layers: IIoT Sensing, IIoT Processing, IIoT Communication, IIoT Networking.

Laboratory Sessions/ Experimental learning:

- Demonstration of Application of IIoT in a production facility.

Applications: Airbus: Factory of the Future

NPTEL/Additional Videos Link:

https://www.youtube.com/watch?v=Qs7bs2g7Usc

https://www.youtube.com/watch?v=9Wh4PUN-viE

Module-3	RBT Level L2, L3	8 Hrs.

Industry 4.0: Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artificial Intelligence, Big Data and Advanced Analysis.

Laboratory Sessions/ Experimental learning:

- Demonstration of the some basic exercises related to sensors.

Applications: ABB: Smart robotics

NPTEL/Additional Videos Link:

https://www.youtube.com/watch?v=wgWRLu8p90M

Module-4	RBT Level L1, L2, L3	8 Hrs.

Developing IoT: Introduction to different IoT tools, Introduction to Arduino and Raspberry Pi, Implementation of IoT with Arduino and Raspberry, CloudComputing, Fog Computing, Connected Vehicles, Data Aggregation for the IoT in Smart Cities, Privacy and Security Issues in IoT.

Laboratory Sessions/ Experimental learning:

- Demonstration of functioning of different IoT tools

Applications: IoT for Smart Cities and Smart Vehicles

NPTEL/Additional Video Links:

https://www.youtube.com/watch?v=wgWRLu8p90M

Module-5	RBT Level L2, L3	8 Hrs.

Intelligent Manufacturing for Industry 4.0: Introduction to Intelligent Manufacturing, Three Dimensions of Intelligent Manufacturing - (1) Demand Driven and Integrated Supply Chains;(2) Dynamically Optimized Manufacturing Enterprises (plant + enterprise operations); (3) Real Time, Sustainable Resource Management, intelligent energy demand management, production energy optimization, Monitoring and Intelligent Control of Machining/Manufacturing and Logistics/Supply Chain Processes.

Laboratory Sessions/ Experimental learning:

Case Studies on the application of IIoT in Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Real case studies : Milk Processing and Packaging Industries, Manufacturing Industries

Applications: Smart Factories, Smart Products and Smart Services

NPTEL/Additional Video Links:

https://www.youtube.com/watch?v=gq0VWSXvG0s

Course outcomes:	
CO1	Understand general concepts of Internet of Things (IoT) (Understand)
CO2	Recognize various devices, sensors and applications (Knowledge)
CO3	Apply design concept to IoT solutions (Apply)
CO4	Analyse and Evaluate design issues in IoT applications (Analyse and Evaluate).
CO5	Create IoT solutions using sensors, actuators and Devices (Create).

Text Books:	
1.	The Internet of Things in the Industrial Sector, Mahmood, Zaigham (Ed.) (Springer Publication).
2.	Industrial Internet of Things: Cybermanufacturing System, Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat (Springer Publication).
Reference Books	
1.	Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key Applications and Protocols, ISBN: 978-1-119-99435-0, 2nd Edition, Wiley Publications.
2.	Arsheep Bahga, Vijay Madisetti, Internet Of Things: A Hands-On Approach Paperback – Universities Press Publication, January 2015 Edition.
3.	Raj Kamal, Internet of Things: Architecture and Design Principles, Tata McGraw Hill, 2017 Edition, ISBN-13: 9789352605224.

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests

- Quizzes/mini tests (4 marks)
- Mini Project / Case Studies (8 Marks)
- Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.

ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.

iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	-	-	2	2	-	-	-	-	2
CO2	3	3	2	-	-	2	2	-	-	-	-	2
CO3	3	3	2	-	-	2	2	-	-	-	-	2
CO4	3	3	2	-	-	2	2	-	-	-	-	2
CO5	3	3	2	-	-	2	2	-	-	-	-	2

High-3, Medium-2, Low-1

Course Title	ADVANCED MANUFACTURING TECHNOLOGY	Semester	V
Course Code	MVJ19ME552	CIE	50
Total No. of Contact Hours	40 L : T : P :: 3 : 0: 0	SEE	50
No. of Contact Hours/week	04	Total	100
Credits	03	Exam. Duration	3 Hrs

Course objective is to:

- To analyze and determine material fabrication processes.
- To understand and analyse various science and technologies involved in the production of integrated circuits.
- To introduce students the basics of additive manufacturing/rapid prototyping and its applications in various fields, reverse engineering techniques.
- To understand and identify fundamentals of metallic and non-metallic materials with special emphasis on applications.

Module-1	RBT Level L1,L2,L4	08 Hrs.

Manufacturing Of Composites:

Manufacturing of Polymer Matrix Composites (PMCs)-hand lay-up, spray technique, filament winding, Pultrusion, Resin Transfer Moulding (RTM)-, bag moulding, injection moulding, Sandwich Mould Composites (SMC) - Manufacturing of Metal Matrix Composites (MMCs) - Solid state, liquid state, vapour state processing, Manufacturing of Ceramic Matrix Composites (CMCs) –hot pressing-reaction bonding process-infiltration technique, direct oxidation- interfaces.

Laboratory Sessions/ Experimental learning: Case Studies/ Brain storming for selection criteria for different manufacturing processes

Video link / Additional online information:

https://www.youtube.com/watch?v=uO8EMAUh1po

Module-2	RBT Level L1,L3, L4	08 Hrs.

Processing Of Ceramics: Applications, characteristics, classification. Processing of particulate ceramics, Powder preparations, consolidation, Drying, sintering, Hot compaction, Area of application, finishing of ceramics. Processing of Composites: Composite Layers, Particulate and fibre reinforced composites, Elastomers, Reinforced plastics, MMC, CMC, Polymer matrix composites.

Laboratory Sessions/ Experimental learning: Case studies for cost estimation of various advanced manufacturing processes.

Video link / Additional online information: https://www.youtube.com/watch?v=3pAajeRKufc		
Module-3	**RBT Level** L1,L2, L3	08 Hrs.
Fabrication Of Microelectronic Devices: Crystal growth and wafer preparation, Film Deposition oxidation, lithography, bonding and packaging, reliability and yield, Printed Circuit boards, computer aided design in microelectronics, surface mount technology, Integrated circuit economics. **Laboratory Sessions/ Experimental learning**: Case study of design for advance machining processes. **Video link / Additional online information:** https://www.youtube.com/watch?v=-M-941EcjC8		
Module-4	**RBT Level** L1,L2,L3	08Hrs.
Rapid Prototyping: Introduction to RP and advantages and limitations, Applications, Stereo lithography Apparatus (SLA), Fused Deposition Modelling, Laminated Object Manufacturing, Selective Laser Sintering, Laser Engineered Net Shaping (LENS). **Laboratory Sessions/ Experimental learning**: Case study of 3D Printing **Video link / Additional online information:** https://www.youtube.com/watch?v=sM67ict7TVM		
Module-5	**RBT Level** L2,L3,L4	08 Hrs.
Modern Metallic Materials: Dual Steels, Micro alloyed, High Strength Low alloy (HSLA) Steel, Transformation induced plasticity (TRIP) Steel, Managing Steel, Inter metallic, Ni and Ti Aluminides, Smart Materials, Shape Memory alloys, Metallic Glass Quasi Crystal and Nano Crystalline Materials. *Nonmetallic Materials:* Polymeric materials and their molecular structures, Production Techniques for Fibers, Foams, Adhesives and Coatings, structure, Properties and Applications of Engineering Polymers, Advanced Structural Ceramics WC, TiC, TaC, A12 O3, SiC, Si3 N4, CBN and Diamond – properties, Processing and applications. **Laboratory Sessions/ Experimental learning**: Case study of applications of modern materials in aerospace and aircraft industry. **Video link / Additional online information:** https://onlinecourses.nptel.ac.in/noc21_mm14/preview		

Course Outcomes:	
CO1	Ability to manufacture components of composite materials
CO2	Ability to manufacture components of ceramics

CO3	Ability to manufacture components of Electromechanical devices
CO4	Knowledge of Rapid prototyping
CO5	Knowledge of modern metallic and non-metallic materials

Text Books:	
1.	Gibson, R.F., *"Principles of Composite Material Mechanics"*, McGraw-Hill, 1994, Second Edition - CRC press in progress.
2.	*Manufacturing Engineering and Technology* IKalpakijian / Adisson Wesley, 1995.
Reference Books:	
1	Hyer, M.W., "*Stress Analysis of Fiber-Reinforced Composite Materials*", McGraw-Hill, 1998
2	*Process and Materials of Manufacturing* / R. A. Lindburg / 1th edition, PHI 1990.
3	*Microelectronic packaging* handbook / Rao. R. Thummala and Eugene, J. Rymaszewski / Van Nostr and Renihold,
4	*MEMS & Micro Systems Design and manufacture* / Tai — Run Hsu / TMGH

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests

- Quizzes/mini tests (4 marks)
- Mini Project / Case Studies (8 Marks)
- Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.

ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.

iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	-	-	-	-	-	-	-	-	-	3
CO2	3	2	-	-	3	-	-	-	-	-	-	2
CO3	2	2	-	-	2	-	-	-	-	-	-	2
CO4	2	2	-	-	2	-	-	-	-	2	-	2
CO5	2	-	-	-	3	-	-	-	-	-	-	2

High-3, Medium-2, Low-1

Course Title	COMPOSITE MATERIALS	Semester	V
Course Code	MVJ19ME553	CIE	50
Total No. of Contact Hours	40 L: T:: P: 3: 0:0	SEE	50
No. of Contact Hours/week	04	Total	100
Credits	03	Exam. Duration	03 Hrs

Course objective is to:

- To obtain knowledge on classification, processing, characterization and applications of composite materials.
- To obtain knowledge on mechanical properties and failure mechanisms of composites under loading conditions for engineering applications.

Module-1	RBT Level L1 L2	08 Hrs.

Introduction To Composite Materials: Definition, history and classification of composite materials. Advantages and limitations, industrial scenario and applications. Materials - fibrous composites, laminated composites, particulate composites.

Fibre Reinforced Plastic (FRP) Processing: Layup and curing, fabricating process, open and closed mould process, Hand layup techniques, structural laminate bag moulding, production procedures for bag moulding, filament winding, pultrusion, pulforming, thermo-forming, injection moulding, blow moulding.

Laboratory / Experimental Sessions: Hand Layup Technique, Compression Moulding Technique, Bag Moulding.

Applications: Wind turbine, Aerospace Industries, Military Industries.

Video link / additional online information:

https://www.youtube.com/watch?v=kC5VRV8vWkM. MOOC & Open courseware.

Module-2	RBT Level L2 L3 L4	08 Hrs.

Characteristics of Fibre Reinforced Lamina: Unidirectional fibre composites: Fibre characteristics. Longitudinal strength and modulus of composites, minimum and critical fibre volume fractions, factors affecting strength, Transverse strength and modulus.

Introduction to Properties of Laminate and Failure Theories: Failure modes, Single and multiple fractures. Short-fibre composites: Stress transfer, critical fibre length. Modulus and strength. Whiskers and whisker reinforced composites.

Laboratory / Experimental Sessions: Fiber characteristics – Unidirectional fibre, Bidirectional fibre, Multidimensional fibre, minimum and critical fibre for finding out Longitudinal & Transverse strength and modulus, failure modes.

Applications: Fibre Reinforced Plastics in Industries, Plastic industries, Manufacturing industries. **Video link / additional online information**: https://www.youtube.com/watch?v=S_hJw7ai76A, https://www.youtube.com/watch?v=R4SkUOzVDJA, MOOC & Open courseware.		
Module-3	RBT Level L1 L2 L3	08 Hrs.
Metal Matrix Composites: Reinforcement materials, types, characteristics and selection base metals selection. Need for production MMC's and its application. **Fabrication Process for MMC's**: Powder metallurgy technique, liquid metallurgy technique and secondary processing, special fabrication techniques. **Laboratory / Experimental Sessions**: Analysis of Mechanical Properties using Stir Casting, Characterization analysis using optical microscope. **Applications:** Aeronautical and Aerospace Industries, Automobile Industries. **Video link / additional online information**: https://www.youtube.com/watch?v=RihoVfzEfWI, MOOC & Open courseware.		
Module-4	RBT Level L1 L2 L4	08 Hrs.
Ceramic Matrix Composites: Engineering ceramic materials, properties, advantages, limitations, Monolithic ceramics, Need for CMC, Ceramic matrix, Various types of Ceramic Matrix composites, oxide ceramics, non-oxide ceramics, aluminium oxide, silicon nitride reinforcements, particles, fibres, whiskers. Sintering, Hot pressing, Cold isostatic pressing (CIPing), Hot isostatic pressing (HIPing). **Advanced Composites**: Nano composites, hybrid composites, sandwich composites, in-situ composites, smart composites, self-healing composites, and carbon - carbon composites. **Laboratory / Experimental Sessions**: Analysis of Mechanical Properties using Powder Metallurgy, Ceramic shell casting, Slip casting. **Applications**: Glass industries, Ceramic Industries. **Video link / additional online information**: https://youtu.be/ACPDEy3evqE, MOOC & Open courseware.		
Module-5	RBT Level L2 L3 L4	08 Hrs.
Testing and Characterization: Different tests tensile, compression, shear, fatigue, pull-out test, fracture toughness, metallographic preparation with special emphasis to metal matrix composites, XRD and SEM. **Secondary Processes and Applications**: Secondary processing like machining, joining, extrusion of composites - Application and case studies. **Laboratory / Experimental Sessions:** Different types of tests on finding out mechanical properties and fracture analysis, Characterization analysis using optical microscope.		

Applications: Wind turbine, Aerospace Industries, Military Industries, Glass industries, Ceramic Industries. **Video link / additional online information:** https://www.youtube.com/watch?v=ZMJ7O4vs-Q8, MOOC & Open courseware.	
Course outcomes:	
CO1	Knowledge on classification, processing, characterization and applications of various composite materials.
CO2	Ability to arrive at different deformation and failure mechanisms of composite materials under different loading conditions in engineering applications.
CO3	Ability to decide the manufacturing methods for producing different types of MMC's.
CO4	Ability to understand the properties, manufacturing methods of CMC's and to differentiate various types of advanced composite materials.
CO5	Select suitable testing procedures, characterization of composite materials and knowledge of secondary processing of composites.

Text Books:	
1.	Madhijit Mukhopadhay, Mechanics of Composite Materials & Structures, Universities Press, 2004.
2.	Michael W Hyer, Stress analysis of fibre Reinforced Composite Materials, Mc-Graw Hill International, 2009.
Reference Books:	
1.	Fibre Reinforced Composites, P C Mallik, Marcel Decker, 1993.
2.	Composite Materials: Science and Engineering, Krishan K Chawla, Springer.
3.	Autar K Kaw, Mechanics of Composite materials, CRC Taylor & Francis, 2nd Ed, 2005.
4.	Robert M Jones, Mechanics of Composite Materials, Taylor & Francis, 1999

CIE Assessment:
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SEE Assessment:
i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus. ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions. iii. One question must be set from each unit. The duration of examination is 3 hours.

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CO2	3	3	2	1	2	1	1	1	1	2	1	1
CO3	3	3	3	1	2	1	1	1	1	2	1	1
CO4	3	3	2	1	2	1	1	1	1	2	1	1
CO5	3	3	3	1	3	1	1	1	1	3	1	1

High-3, Medium-2, Low-1

Course Title	TOTAL QUALITY MANAGEMENT	Semester	V
Course Code	MVJ19ME554	CIE	50
Total No. of Contact Hours	40 L : T : P :: 3 : 0 : 0	SEE	50
No. of Contact Hours/week	04	Total	100
Credits	03	Exam. Duration	3 Hrs

Course objective is to:

- To understand the concept of Total Quality Management.
- To Know the Customer, his Quality perception and his demands.
- To identify useful quality improvement techniques.
- To know the need of Leadership qualities and Team development in TQM
- To understand the need of Quality, ISO Certification and its procedure.

Module-1	RBT Level L1, L2	08 Hrs

Introduction: Definition, Quality Dimensions, Quality aspects – Quality of Design, Quality of Conformance and Quality of Performance, TQM Cultural change, Historical Review, Discussion on Benefits of TQM, Quality, Garvin's Nine dimensions of Quality, TQM frame work, Contribution of Quality Gurus-Juran (Quality Triology), Discussion on Deming's (14 Principles of Management), Contribution of Crosby, Ishikawa and Taguchi.

Laboratory Sessions/ Experimental learning:

- The impact of total quality management (TQM) on productivity-A case study

Applications: It guides to know about quality-based production.

Video link / Additional online information:

1. https://nptel.ac.in/courses/110104080/
2. https://studentsfocus.com/ge6757-tqm-notes-total-quality-management
3. https://pec.ac.in/programmes/pg/structure/tqm
4. https://www.scribd.com/document/354054705/Total-Quality-Management

Module-2	RBT Level L1, L2	08 Hrs

Customer Orientation-Customer Focus, Customer satisfaction model Quality Function Deployment (QFD), Customer Satisfaction Measurement, Kano Model.

Problem Solving Tools-Problem Solving Process, Seven QC Tools, Seven Management tool.

Laboratory Sessions/ Experimental learning:

- Customer Satisfaction through TQM Approach: A case study

Applications: It helps in reaching the customer related to queries of the product. **Video link / Additional online information:** https://studentsfocus.com/ge6757-tqm-notes-total-quality-management		
Module-3	**RBT Level** L2, L3	08 Hrs
Continuous Improvement Strategies-Deming Wheel, Zero Defect Concept, Benchmarking, Six sigma, *Preventive Techniques*-Failure Mode Effect Analysis, Poke Yoke. *Quality Ambience*- Five S for Quality Ambience, Time Management. *Quality Control* – Offline quality control, statistical quality control Statistical Quality Control – Causes of Variation in Quality, Central limit Theorem, Control charts for variables and attribute (simple problems only), Process capability studies (theory only) & Z-Score. Laboratory Sessions/ Experimental learning: • A case study on Continuous Improvement Process **Applications**: It is used in quality control of the product to improve the productivity. **Video link / Additional online information**: https://nptel.ac.in/courses/110104080/		
Module-4	**RBT Level** L2, L3	08 Hrs
LEAN Six Sigma-Mapping; Kanban; team management; Process Improvement; process; six sigma; Leadership and Management; Lean Methods; lean six sigma; Trigonometric Integral. Laboratory Sessions/ Experimental learning: • Exercises related to Six Sigma in daily life **Applications**: It guides to learn more skills related to leadership qualities. **Video link / Additional online information**: https://www.youtube.com/watch?v=jHe5sezJ0cY		
Module-5	**RBT Level** L2, L3	08 Hrs
Quality Certification-ISO 9000 series Certification ISO 9001: 2008 Certification, ISO 14000 Series Certification, Quality auditing, Quality Awards. *TQM Road Map*: Measurement of Quality, TQM Road Map, TQM Implementation Strategy, When TQM Fails. Laboratory Sessions/ Experimental learning: • Importance of TQM in engineering projects **Applications**: Applied to companies to get the standards of the product. **Video link / Additional online information:** https://studentsfocus.com/ge6757-tqm-notes-total-quality-management		

Course outcomes:	
CO1	Understand the philosophy and core value to TQM
CO2	To determine the voice of customers and its impact on quality.
CO3	Apply and evaluate Various strategies, best practices for attainment of total quality.
CO4	Come to know the need of Leadership qualities and Team development in TQM
CO5	To do the ISO Certification and explain about its procedure

Text Books:	
1	Dale H Besterfield *"Total Quality Management"*, Pearson Education,3rd Edition
2	L. Suganthi & Anand, "*Total Quality Management*", PHI-2004.
Reference Books:	
1.	Amitava Mitra *"Fundamentals of Quality Control and Improvement"*, Third Edition, John Wiley & Sons publication
2	Poornima M Charanthimath *"Total Quality Management"*, Pearson Education
3	Juran J.M, "*A History For Managing For Quality"*, ASQC Quality Press, 1995
4	A Mahajan *"Statistical Quality Control"*, Dhanapat Rai & Co. (P) Ltd.

CIE Assessment:
CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests - Quizzes/mini tests (4 marks) - Mini Project / Case Studies (8 Marks) - Activities/Experimentations related to courses (8 Marks)
SEE Assessment:
i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus. ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions. iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	-	-	1	-	3	-	2	-	3
CO2	3	1	1	-	-	2	2	-	2	3	-	3
CO3	3	1	3	1	2	1	-	-	-	-	-	3
CO4	3	1	1	-	-	1	-	3	3	3	-	3
CO5	3	1	1	-	-	3	3	3	2	1	-	2

High-3, Medium-2, Low-1

Course Title	FLUID MECHANICS AND FLUID MACHINERY-LAB	Semester	V
Course Code	MVJ19MEL56	CIE	50
Total No. of Contact Hours	20 L: T: P: 0: 1: 3	SEE	50
No. of Contact Hours/week	02	Total	100
Credits	02	Exam. Duration	03 Hrs

Course Learning Objectives:

- To provide a basic understanding of the flow characteristics.
- To provide a basic understanding of the energy conversion principles.
- To provide an understanding of the significance of hydraulic machines and performance analysis.
- To provide an insight into the characteristic curves for flow through different equipment.

Sl. No	Experiments
	PART A
1	Determination of coefficient of friction of flow in a pipe.
2	Determination of minor losses in flow through pipes.
3	Application of momentum equation for determination of coefficient of impact of jets on flat and curved blades.
4	Determination of coefficient of discharge of various flow measuring devices.
	PART B
5	Performance studies on Pelton. Francis and Kaplan wheel turbines.
6	Performance of Single and Multistage Centrifugal Pump.
7	Performance test on Reciprocating Pump.
8	Performance test on a two stage Reciprocating Air Compressor.
9	Performance test on an Air Blower.
Course outcomes:	
CO1	Perform experiments to determine the coefficient of friction of flow in a pipe.
CO2	Conduct experiments to determine minor losses in flow through pipes.
CO3	Determine coefficient of discharge of various flow measuring devices.
CO4	Conduct performance studies on Pelton, Francis and Kaplan wheel turbines.
CO5	Conduct performance test on pumps and compressors.

Reference Books:	
1.	Munson, Young, Okiishi & Huebsch, "*Fundamentals of Fluid Mechanics*", John Wiley Publications7th edition.

Scheme of Examination: As per the MVJCE Autonomous Regulations, Semester End Examination (SEE) is to be conducted and evaluated for 100 marks which will be proportionately reduced and considered for 50 marks by the Grading authority.	
1.	One question is to be set from Part-A: 20 marks
2.	One question is to be set from Part-B: 20 marks
3.	Viva – Voce: 10 marks

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	-	-	-	2	-	1	-	1
CO2	3	3	3	2	-	-	-	2	-	2	-	2
CO3	3	2	3	1	-	-	-	2	-	1	-	2
CO4	3	3	3	2	-	-	-	2	-	2	-	2
CO5	3	2	1	1	-	-	-	2	-	1	-	1

High-3, Medium-2, Low-1

Course Title	ENERGY CONVERSION-LAB	Semester	V
Course Code	MVJ19MEL57	CIE	50
Total No. of Contact Hours	20L: T: P: 0: 1: 3	SEE	50
No. of Contact Hours/week	02	Total	100
Credits	02	Exam. Duration	03 Hrs

Course Learning Objectives:

- To provide basic understanding of the fuel properties to students.
- To provide insight into the Energy conversion principles, analysis and understanding of I C Engines.
- To provide insight into the application of the energy conversion principles.
- To carryout basic experiments on the performance characteristics of the IC Engines.
- To provide an insight into the Exhaust emissions of I C Engines and various emission standards.

Sl. No	Experiments
	PART A
1	Determination of Calorific value of fuel.
2	Determination of Flash point and Fire point of lubricating oil using Abel Pensky and Marten's (closed) / Cleveland's (Open Cup) Apparatus.
3	Determination of Viscosity of lubricating oil using Redwoods, Saybolt and Torsion Viscometers.
4	Valve Timing Diagram of an I.C. Engine.
5	Use of a Planimeter
	PART B
5.	Performance Tests on Two stroke Petrol Engine, Four Stroke Petrol Engine, Four Stroke Diesel Engines with different loading.
6.	Performance test on 4-Stroke VCR(Variable Compression Ratio) Petrol Engine test rig
7.	Performance test on 4-Stroke Petrol Engine with Morse test rig
8.	Measurements of Exhaust Emissions of Petrol engine.
9.	Measurements of Exhaust Emissions of Diesel engine.
10.	Demonstration of measurements of P-θ, PV plots using IC Engine test rig.
Course outcomes:	
CO1	Perform experiments to determine the properties of fuels and oils.
CO2	Conduct performance tests on IC Engines and draw the characteristic graphs.

CO3	Test basic performance parameters of I.C. Engine and implement the knowledge in industry.
CO4	Measure the Exhaust emissions of petrol and diesel engines.

Reference Books:	
1.	P. K. Nag, "*Power Plant Engineering*", Tata McGraw Hill Education Private Limited, New Delhi Third Edition, 2012.
Scheme of Examination: As per the MVJCE Autonomous Regulations, Semester End Examination (SEE) is to be conducted and evaluated for 100 marks which will be proportionately reduced and considered for 50 marks by the Grading authority.	
1.	One question is to be set from Part-A: 15 marks
2.	One question is to be set from Part-B: 25 Marks
3.	Viva – Voce: 10 marks

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	-	-	-	2	-	1	-	1
CO2	3	3	3	2	-	-	-	2	-	2	-	2
CO3	3	2	3	1	-	-	-	2	-	1	-	2
CO4	3	3	3	2	-	-	-	2	-	2	-	2
CO5	3	2	1	1	-	-	-	2	-	1	-	1

High-3, Medium-2, Low-1

Course Title	COMPUTATIONAL TECHNIQUES LAB	Semester	V
Course Code	MVJ19MEL58	CIE	50
Total No. of Contact Hours	20L: T: P: 0: 1:3	SEE	50
No. of Contact Hours/week	02	Total	100
Credits	02	Exam. Duration	03 Hrs

Course Learning Objectives:

- To understand the MATLAB/Lab View environment.
- To do basic numerical calculations using MATLAB/Lab View.
- To apply a variety of numerical techniques to solve and visualize engineering-related problems.

Sl. No	Experiments
	PART A
1	Recapitulation of numerical techniques and introduction to MATLAB software.
2	To write a script to plot the deflection and potential energy of spring subjected to different load steps
3	To create a MATLAB function to calculate the capillary rise of liquid.
4	To find the initial velocity of a projectile by solving a system of linear equations.
5	To develop a model of the effect of temperature on viscosity by the use of curve fitting.
6	To develop a model of a steady flow of water in a circular pipe by the use of multiple linear regression.
	PART B
7	To solve a differential equation to calculate the deflection of the beam.
8	To display the temperature profile on a rectangular plate using partial differential equation.
9	To write a code to plot the animation of displacement of slider crank mechanism with respect to input angle.
10	To calculate the minimum drag on an airfoil by the use of optimization technique.
	PART C (OPTIONAL)
11	To solve a system of non-linear equations using Simulink.
12	To develop a Simulink model for simulation of hybrid-driven planar five-bar parallel mechanism.
Course outcomes:	
CO1	Apply built-in functions in MATLAB to solve numerical problems

CO2	Develop code for solving problems involving different types of mathematical models and equations (ODE, PDE, Linear and nonlinear equations).
CO3	Solve simulation problems encountered in mechanical design, vibration analysis and CAD.
CO4	Model a system and develop a simulation code towards a mini project.

Reference Books:	
1.	Rudra Pratap, "*Getting started with MATLAB: A quick introduction for scientists and engineers*", Oxford University Press, Seventh Edition, 2016.
2.	Steven C. Chapra, "*Numerical Methods for Engineers*", McGraw-Hill Education, Sixth Edition, 2010.
Scheme of Examination: As per the MVJCE Autonomous Regulations, Semester End Examination (SEE) is to be conducted and evaluated for 100 marks which will be proportionately reduced and considered for 50 marks by the Grading authority.	
1.	One question is to be set from Part-A: 15 marks
2.	One question is to be set from Part-B: 25 Marks
3.	Viva – Voce: 10 marks

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	-	-	-	2	-	1	-	1
CO2	3	3	3	2	-	-	-	2	-	2	-	2
CO3	3	2	3	1	-	-	-	2	-	1	-	2
CO4	3	3	3	2	-	-	-	2	-	2	-	2
CO5	3	2	1	1	-	-	-	2	-	1	-	1

High-3, Medium-2, Low-1

Pelton Wheel Turbine test rig in Fluid Mechanics and Fluid Machinery-Lab

Computerized VCR Diesel Engine Test Rig in Energy conversion Lab

Course Title	ENVIRONMENTAL STUDIES	Semester	V
Course Code	MVJ19ENV59	CIE	50
Total No. of Contact Hours	20 L: T: P: 1: 0: 0	SEE	50
No. of Contact Hours/week	01	Total	100
Credits	01	Exam. Duration	03 Hrs

Course objective is to: This course will enable the students to

- An interdisciplinary approach to complex environmental problems using basic tools of the natural and social sciences including geosystems, biology, chemistry, economics, political science and international processes; Study drinking water quality standards and to illustrate qualitative analysis of water.
- Critically evaluate the science and policy ramifications of diverse energy portfolios on air and water quality, climate, weapons proliferation and societal stability

Module-1	**RBT Level** L2, L3	04 Hrs

Introduction to environmental studies, Multidisciplinary nature of environmental studies; Scope and importance; Concept of sustainability and sustainable development.

Ecosystems (Structure and Function): Forest, Desert, Wetlands, Rivers, Ocean and Lake.

Biodiversity: Types, Hot-spots; Threats and Conservation of biodiversity, Forest Wealth, and Deforestation.

Video link / Additional online information:

https://nptel.ac.in/courses/127/106/127106004/

https://www.youtube.com/watch?v=1TBrEVM1fXw

https://www.youtube.com/watch?v=djbcALTOyUs

Module-2	**RBT Level** L2, L3	04 Hrs

Advances in Energy Systems (Merits, Demerits, Global Status and Applications): Hydrogen, Solar, OTEC, Tidal and Wind.

Natural Resource Management (Concept and case-study): Disaster Management, Sustainable Mining, Cloud Seeding, and Carbon Trading.

Video link / Additional online information:

https://nptel.ac.in/courses/121/106/121106014/

https://www.youtube.com/watch?v=Sv-zeQ-VswI

Module-3	RBT Level L2, L3	04 Hrs
Environmental Pollution (Sources, Impacts, Corrective and Preventive measures, Relevant Environmental Acts, Case-studies): Surface and Ground Water Pollution; Noise pollution; Soil Pollution and Air Pollution. **Waste Management & Public Health Aspects**: Bio-medical Waste; Solid waste; Hazardous waste; E-waste. **Video link / Additional online information:** https://nptel.ac.in/courses/122/106/122106030/ https://nptel.ac.in/courses/105/103/105103205/ https://nptel.ac.in/courses/120/108/120108005/ https://nptel.ac.in/courses/105/105/105105160/		
Module-4	**RBT Level** L2, L3	04 Hrs
Global Environmental Concerns (Concept, policies and case-studies): Ground water depletion/recharging, Climate Change; Acid Rain; Ozone Depletion; Fluoride problem in drinking water; Environmental Toxicology. **Video link / Additional online information:** https://nptel.ac.in/courses/122/106/122106030/ https://nptel.ac.in/courses/120108004/ https://onlinecourses.nptel.ac.in/noc19_ge23/preview		
Module-5	**RBT Level** L2, L3	04 Hrs
Latest Developments in Environmental Pollution Mitigation Tools (Concept and Applications): G.I.S. & Remote Sensing, Environment Impact Assessment, Environmental Management Systems, ISO 14001. **Field work**: Visit to an Environmental Engineering Laboratory or Green Building or Water Treatment Plant or Waste water treatment Plant; Followed by understanding of process and its brief documentation. **Video link / Additional online information:** https://nptel.ac.in/courses/105/102/105102015/ https://nptel.ac.in/courses/120/108/120108004/ https://www.coursera.org/lecture/spatial-analysis-satellite-imagery-in-a-gis/what-is-remote-sensing-27nfo		
Course outcomes: On completion of the course, students would be able to		
CO1	Understand the principles of ecology and environmental issues that apply to air, land, and water issues on a global scale.	

CO2	Develop critical thinking and/or observation skills, and apply them to the analysis of a problem or question related to the environment.
CO3	Demonstrate ecology knowledge of a complex relationship between biotic and abiotic components.
CO4	Apply their ecological knowledge to illustrate and graph a problem and describe the realities that managers face when dealing with complex issues.

Text Books:	
1.	Environmental Studies Benny Joseph Tata Mc Graw – Hill. 2 nd Edition, 2012
2.	Environmental Studies S M Prakash Pristine Publishing House, Mangalore 3rd Edition, 2018.
Reference Books:	
1.	Principals of Environmental Science and Engineering, Raman Siva Kumar, Cengage learning, Singapore. 2 nd Edition, 2005
2.	Environmental Science – working with the Earth G. Tyler Miller Jr. Thomson Brooks /Cole, 11thEdition, 2006
3.	Text Book of Environmental and Ecology Pratiba Sing, Anoop Singh& Piyush Malaviya Acme Learning Pvt. Ltd. New Delhi. 1 st Edition

CIE Assessment:
CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests - Quizzes/mini tests (4 marks) - Mini Project / Case Studies (8 Marks) - Activities/Experimentations related to courses (8 Marks)
SEE Assessment:
i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus. ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions. iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	1	-	2	2	1	1	-	2	1
CO2	3	3	2	1	-	1	2	-	1	1	2	1
CO3	3	3	2	1	-	2	2	-	1	1	2	1
CO4	3	3	2	2	-	2	2	-	1	1	2	1

High-3, Medium-2, Low-1

Course Title	APPLICATION DEVELOPMENT USING PYTHON	Semester	V
Course Code	Audit Course – MVJ19MEAUD1	CIE	-
Total No. of Contact Hours	40 L: T: P :: 2 : 2 : 0	SEE	-
No. of Contact Hours/week	04	Total	-
Credits	-	Exam. Duration	-

Course objective is to:

- Learn the syntax and semantics of Python programming language.
- Illustrate the process of structuring the data using lists, tuples and dictionaries.
- Demonstrate the use of built-in functions to navigate the file system.
- Implement the Object-Oriented Programming concepts in Python.
- Appraise the need for working with various documents like Excel, PDF, Word and Others.

Module-1	RBT Level L1, L2	08 Hrs.

Why should you learn to write programs, Entering Expressions into the Interactive Shell, Data Types, Variables, expressions and statements, Conditional execution, if condition, Iteration, while loop, for loop, Type conversion in python.

Laboratory Sessions/ Experimental learning:

- Write and Implement Python Program on "guess the number" game

Applications:

- Data mining identify cross-sell opportunities
- Meeting software system deadlines

Video link / Additional online information:

https://automatetheboringstuff.com/

http://do1.drchuck.com/pythonlearn/EN_us/pythonlearn.pdf

http://greenteapress.com/thinkpython2/thinkpython2.pdf

Module-2	RBT Level L1, L2, L3	08 Hrs.

Local and Global scope, Data encapsulation, Importing Modules, Functions, Pure functions, Function Overloading, Program exceptions, Exception handling, Working with Strings, Operator Overloading, File Handling in Python.

Laboratory Sessions/ Experimental learning:

- Password Locker

Applications:

- Adding Bullets to Wiki Markup

Video link / Additional online information:

https://www.youtube.com/watch?v=j0cPnbtp1_w

https://www.youtube.com/watch?v=APY_pYeMRkw

https://www.youtube.com/watch?v=2IsF7DEtVjg

Module-3	RBT Level L1, L2, L3	08 Hrs.

Lists, The List Data Type, Working with Lists, Augmented Assignment Operators, Tuples, The Tuples Data Type, Working with Tuples, References, Dictionaries, The Dictionary Data Type, Working with Dictionaries, Regular Expressions.

Laboratory Sessions/ Experimental learning:

- Debugging Coin Toss

Applications:

- Date Detection
- Strong Password Detection

Video link / Additional online information (related to module if any):

https://www.youtube.com/watch?v=sa-TUpSx1JA

https://www.youtube.com/watch?v=K8L6KVGG-7o

https://www.youtube.com/watch?v=cdgV4iCDWmw

Module-4	RBT Level L1, L2, L3	08 Hrs.

Classes and objects, Programmer-defined types, Attributes, Rectangles, Instances as return values, Objects are mutable, Printing objects, Operator overloading Classes and functions, Classes and methods, Inheritance, Single inheritance, Multiple inheritance, Multilevel inheritance.

Laboratory Sessions/ Experimental learning:

- Operator Overloading

Applications:

- Polymorphism
- Inheritance

Video link / Additional online information (related to module if any):

https://www.youtube.com/watch?v=8O5kX73OkIY

https://www.youtube.com/watch?v=_uYorV9ebLg

https://www.youtube.com/watch?v=mrhccLHtyN4

Module-5	RBT Level L1, L2, L3	08Hrs.

Networked programs, Using Web Services, using databases and SQL, Data Science and Python, Understanding Python's Role in Data Science, Considering the emergence of data science Outlining the core competencies of a data scientist.

Laboratory Sessions/ Experimental learning:

- Encrypting PDFs

Applications:

- Copying Pages

Video link / Additional online information (related to module if any):
https://www.youtube.com/watch?v=ooj84UP3r6M https://www.youtube.com/watch?v=0_VZ7NpVw1Y https://www.youtube.com/watch?v=XVv6mJpFOb0

Course outcomes:	
CO1	Demonstrate proficiency in handling of loops and creation of functions.
CO2	Identify the methods to create and manipulate lists, tuples and dictionaries.
CO3	Discover the commonly used operations involving regular expressions and file system.
CO4	Interpret the concepts of Object-Oriented Programming as used in Python.
CO5	Determine the need for scraping websites and working with CSV, JSON and other file formats.

Text Books:	
1.	Gowrishankar S, Veena A, **"Introduction to Python Programming"**, 1st Edition, CRC Press/Taylor & Francis, 2018. ISBN-13: 978-0815394372
Reference Books:	
1.	Allen B. Downey, **"Think Python: How to Think Like a Computer Scientist"**, 2nd Edition, Green Tea Press, 2015. (Available under CC-BY-NC license at http://greenteapress.com/thinkpython2/thinkpython2.pdf) (Chapters 13, 15, 16, 17, 18) (Download pdf/html files from the above links)
2.	Al Sweigart,**"Automate the Boring Stuff with Python"**,1stEdition, No Starch Press, 2015. (Available under CC-BY-NC-SA license at https://automatetheboringstuff.com/), (Chapters 1 to 18)

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	-	-	-	2	-	1	-	1
CO2	3	3	3	2	-	-	-	2	-	2	-	2
CO3	3	2	3	1	-	-	-	2	-	1	-	2
CO4	3	3	3	2	-	-	-	2	-	2	-	2
CO5	3	2	1	1	-	-	-	2	-	1	-	1

High-3, Medium-2, Low-1

Course Title	HVAC	Semester	V
Course Code	CERTIFICATE COURSE	CIE	-
Total No. of Contact Hours	30 L: T : P :: 2 : 0: 0	SEE	-
No. of Contact Hours/week	03	Total	-
Credits	02	Exam. Duration	-

Course objective is to:

- Introduce the concepts of Heating Ventilation and Air-Conditioning to students.
- Expose the students to HVAC systems and air conditioners.
- Introduce the concepts of cold storage and ventilation designs.

Module-1	RBT Level L1,L2,L3	06 Hrs.

Introduction

Introduction to HVAC systems, Working of an air-conditioner, Reverse adiabatic cycle, Evaporator, Compressor, Condenser, Expansion valves and Thermostat.

Types of Compressors used in the HVAC, Reciprocating Air Conditioner Compressor, Screw AC Compressor, Rotary and Centrifugal Air conditioners.

Laboratory Sessions/ Experimental learning: Students will be exposed to various components of air conditioners through hands on experience.

Applications: Air conditioners

Video links: https://www.youtube.com/watch?v=GzEMdQk1QTk

Module-2	RBT Level L1,L2,L3	06 Hrs.

Refrigerants used in Heating and Cooling systems

Basics of Thermodynamics, Heat transfer, Sensible heat, Latent heat, Psychometric chart, Dry bulb temperature, wet bulb temperature, Relative humidity, humidity ratio, dew point.

Heating and Air Conditioning – Load Calculations

Laboratory Sessions/ Experimental learning: Students will be exposed to Heating and Air Conditioning load calculations using E-20 form and HAP software.

Applications: Design of Air Conditioning Systems based on the load conditions.

Video links: https://www.youtube.com/watch?v=9-K9Y5b8M5c

Module-3	RBT Level L1,L2,L3	06 Hrs.

Equipment Selection

Types of Heating and Air Conditioning System, DX system, VRF/VRV system, Package units, Roof top units, Chiller Systems, Air Cooled Chillers, Water Cooled Chillers.

Air Distribution System – Air terminals, Ducting, Duct types, Duct sizing criteria, Calculating the overall duct, static pressure calculation in ducting system, Duct supports and insulation. **Laboratory Sessions/ Experimental learning**: Students will be exposed to air terminals and ducting systems through real time examples. **Applications**: Air duct systems for centralized air conditioners. **Video links**: https://www.youtube.com/watch?v=5y_VBiTiuAY		
Module-4	RBT Level L1,L2,L4	06 Hrs.
Variable Refrigerant Flow – Introduction to VRF system, Difference between single and dual compressor system, Piping design for VRF system. **Hydronic heating and cooling system** – Open loop system design - water requirement, pipe sizing, finding the critical path, friction loss, pump capacity. Closed loop system design – water requirement, pipe sizing, friction loss and head loss calculation, pump capacity. **Laboratory Sessions/ Experimental learning**: Students will be exposed to hydronic heating and cooling system through real-time examples. **Applications**: Centralized heating and cooling systems. **Video links**: https://www.youtube.com/watch?v=Y-8EWK1Moh0		
Module-5	RBT Level L3,L4,L5	06 Hrs.
District heating and cooling systems – Introduction, General components, Centrifugal pumps, motors, pipes, valves and heat exchangers. **Cold storage design,** - Introduction, General components, design, and development, storage capacity, load calculations. **Ventilation design** - Toilet ventilation, Commercial ventilation design, Commercial kitchen ventilation design, car parking ventilation design, Exhaust and Fresh air calculations, ASHRAE standards, Stair case pressurization, Green HVAC, HVAC designer check list, preparing bill of quantity. **Laboratory Sessions/ Experimental learning**: Students will be exposed to ASHRAE standards, and ventilation designs through real time examples. **Applications**: Cold storage systems and Building Ventilation systems. **Video links**: https://www.youtube.com/watch?v=dO05FwVYLVM		

Course outcomes:	
CO1	Recognize the concepts of Heating, Ventilation and Air Conditioning.
CO2	Recognize the role of basic load calculations for the design of HVAC systems.
CO3	Infer the importance of equipment selection and air distribution systems.
CO4	Recognize the role of hydronic heating and cooling systems for real time applications.

CO5	Carryout the exhaust and fresh air calculations for ventilation systems.

Reference Books:	
1.	C. P. Arora, Refrigeration and Air Conditioning, Tata McGraw Hill Publications, New Delhi, 2nd edition, 2000.
2.	W.F. Stoeker, J. P. Jones, Principles of Refrigeration and Air Conditioning, Tata McGraw Hill Publications, New York, 2nd edition, 1982.
3.	McQuistion, Heating,Ventilation and Air Conditioning, Wiley Students edition,5thedition 2000.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	2	2	-	-	-	2	1	1	1
CO2	3	3	1	2	2	1	-	-	2	1	1	1
CO3	3	3	2	3	3	1	-	-	2	1	2	1
CO4	3	3	2	3	3	1	1	-	2	1	2	2
CO5	3	3	3	3	2	2	2	-	3	2	3	3

High-3, Medium-2, Low-1