

<b>Semester: V</b>		
<b>Technical Management and Entrepreneurship Theory - HSMC</b>		
Course Code: MVJ21ME51		CIE Marks: 50
Credits: L:T:P: 3:0:0		SEE Marks: 50
Hours: 40L		SEE Duration: 3 Hrs.
<b>Course Learning Objectives: The students will be able to</b>		
1	Understand the fundamental concepts and principles of management and to help the students gain understanding of the functions and responsibilities of managers.	
2	Understand the concepts of project management and collaborative project teams.	
3	Understand the Traditional Project Management and launch and execute to TPM.	
4	Understand the process of Workplace and Organizational vision	
5	knowledge, with respect to concepts, principles and practical applications of technical innovations and Entrepreneurship	

<b>UNIT-I</b>	
<p>Management: Introduction - Meaning - nature and characteristics of Management, Scope and Functional areas of management - Management as a science, art of profession - Management &amp; 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 - Decision making Importance of planning - steps in planning &amp; planning premises - Hierarchy of plans.</p> <p>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 &amp; Recruitment. Directing &amp; 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.</p> <p><u>Laboratory Sessions/ Experimental learning:</u>  Case-Study Self Study For Leaders: A case-study type of self-study, with your leadership issue at the center, followed by discussion and debriefing are the closest thing to a real-life experience during the class. This helps student absorb concepts better and have practical discussions around their learning using the characters in the case study or their real-life situations.  Application: Management of organizations, institutions and industries.  Video link / Additional online information:</p>	<b>8 Hrs</b>

<ul style="list-style-type: none"> <li>• <a href="https://www.youtube.com/watch?v=d1jOwD-CTLI">https://www.youtube.com/watch?v=d1jOwD-CTLI</a></li> <li>• <a href="https://www.youtube.com/watch?v=CxAzZRnJo2o">https://www.youtube.com/watch?v=CxAzZRnJo2o</a></li> <li>• <a href="https://www.youtube.com/watch?v=nASV5I_WG3k">https://www.youtube.com/watch?v=nASV5I_WG3k</a></li> </ul>	
UNIT-II	
<p>Understanding the Project Management Landscape : Defining a Project, Defining a Program, Defining a Portfolio, Understanding the Scope Triangle, The Importance of Classifying Projects, Understanding the Fundamentals of Project Management, Challenges to Effective Project Management, Managing the Creeps, Introducing Project Management Life Cycles, Agile Project Management Approaches, Extreme Project Management Approach, Hybrid Project Management Approach, Choosing the Best-Fit PMLC Model, Definition of Strategic Project Management, The Business Environment: Business Climate, Market Opportunities , Enterprise Capacity, SWOT, Value Chain Analysis.</p> <p>Collaborative Project Team and PM Process Groups : The Complex Project Team, Project Executive, Core Team, Using the Co-Manager Model, Establishing Meaningful Client Involvement, The Challenges to Meaningful Client Involvement, Project Management Process Groups : Project Integration Management, Project Scope Management, Project Schedule Management, Project Cost Management, Project Quality Management. Project Resource Management, Project Communications Management, Project Risk Management, Project Procurement Management, Overview of the Process Groups, Mapping Knowledge Areas to Process Groups.</p> <p>Laboratory Sessions/ Experimental learning:</p> <ul style="list-style-type: none"> <li>• Role-Play Exercises : The best way to learn so-called "soft skills" is to practice them one-on-one opposite professional actors in customized, controlled and safe "role play" exercises. This ensures that learners get the experience they need to use those skills effectively in the real world.</li> <li>• Demonstration to students on the Organization behavioural skills will be given through case studies.</li> <li>• Applications-Organizing, Staffing and Coordinating in an organization</li> </ul> <p>Video link / Additional online information:</p> <ul style="list-style-type: none"> <li>• <a href="https://www.youtube.com/watch?v=dt_mMi5My14">https://www.youtube.com/watch?v=dt_mMi5My14</a></li> <li>• <a href="https://www.youtube.com/watch?v=BepKLu1mx4U">https://www.youtube.com/watch?v=BepKLu1mx4U</a></li> </ul>	<b>8 Hrs</b>
UNIT-III	
<p><u>Traditional Project Management (TPM):</u> Using Tools, Templates, and Processes to Scope a Project, Managing Client Expectations, The Project Scoping Meeting, Project Scoping Meeting Deliverables. How to Plan a TPM Project: Using Tools, Templates, and Processes to Plan a Project, The Importance of Planning, Using Application Software Packages to Plan a Project, Planning and Conducting Joint Project Planning Sessions, Constructing the Project Network Diagram, Writing an Effective Project Proposal, Gaining Approval to Launch the Project.</p> <p><u>Launch and Execute a TPM Project:</u> Using the Tools, Templates, and Processes to Launch a Project, Recruiting the Project Team, Developing a Team Deployment Strategy, Conducting the Project Kick-Off Meeting, Establishing Team Operating</p>	<b>8 Hrs</b>

<p>Rules, Managing Scope Changes, Managing Team Communications, Assigning Resources, Resource Leveling Strategies, Finalizing the Project Schedule, Writing Work Packages. Execute a TPM Project: Using Tools, Templates, and Processes to Monitor and Control, Establishing Your Progress Reporting System, Applying Graphical Reporting Tools, Managing the Scope Bank, Managing Project Status Meetings, Defining a Problem Escalation Strategy, Gaining Approval to Close the Project.</p> <p><u>Laboratory Sessions/ Experimental learning:</u></p> <ul style="list-style-type: none"> <li>• Demonstration to students on the Directing and Controlling will be given through case studies.</li> <li>• Buddy Programs And Peer Group Learning Experiences: Buddy programs and peer group learning experiences in the workplace, as well as open groups outside the workplace, are wonderful ways to practice learning in safe environments. Peers can share their personal experiences, and knowledge is exchanged and grows among peer group members.</li> <li>• Applications-Directing, Controlling the activities of an organization.</li> </ul> <p>Video link / Additional online information:</p> <ul style="list-style-type: none"> <li>• <a href="https://www.youtube.com/watch?v=vMJxNKpG0TA">https://www.youtube.com/watch?v=vMJxNKpG0TA</a></li> <li>• <a href="https://www.youtube.com/watch?v=TNEYDBKmTNU">https://www.youtube.com/watch?v=TNEYDBKmTNU</a></li> </ul>	
UNIT-IV	
<p><b>Understanding the Workplace:</b> Defining Organizational Behaviour, Perception, Personality, and Emotions, Values, Attitudes, and Diversity in the Workplace, Groups and Teamwork: From Individual to Team Member, Stages of Group and Team Development, Creating Effective Teams, Interacting Effectively, The Communication Process, Barriers to Effective Communication, Organizational Communication, Power and Politics at the workplace, Conflict and Negotiation at workplace.</p> <p><b>Sharing the Organizational Vision:</b> Organizational Culture: Definition of Organizational Culture, Creating and Sustaining an Organization's Culture, Changing Organizational Culture, Leadership: Leadership as Supervision, Inspirational Leadership, Contemporary Leadership Roles, Contemporary Issues in Leadership, Decision Making, Creativity, and Ethics: Individual and Group Decision Making, Creativity and Ethics in Organizational Decision Making. An introduction to organizational structure and change.</p> <p><u>Laboratory Sessions/ Experimental learning:</u></p> <ul style="list-style-type: none"> <li>• Stretch Assignments: Things such as leading a task force or leading a group on a topic where the person has no expertise, but the others are experts, can be invaluable.</li> <li>• Entrepreneurship development programs will be conducted to simulate and motivate the interests of students to become entrepreneurs.</li> </ul>	<b>8 Hrs</b>

<ul style="list-style-type: none"> <li>• Applications-Appling the concepts of entrepreneurship to become successful entrepreneurs and establish enterprises.</li> </ul> <p><u>Video link / Additional online information:</u></p> <ul style="list-style-type: none"> <li>• <a href="https://www.youtube.com/watch?v=lqC2cfwllLg&amp;list=PLF1DBCAC25C2BC963&amp;index=9">https://www.youtube.com/watch?v=lqC2cfwllLg&amp;list=PLF1DBCAC25C2BC963&amp;index=9</a></li> <li>• <a href="https://www.youtube.com/watch?v=0wNuyNZIzrQ&amp;list=PLF1DBCAC25C2BC963&amp;index=26">https://www.youtube.com/watch?v=0wNuyNZIzrQ&amp;list=PLF1DBCAC25C2BC963&amp;index=26</a></li> </ul>	
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UNIT-V

<p><b>Introduction to Technological Innovation :</b> Innovation Systems, The Concept of Innovation Systems, Difference Between Innovation–Invention, Types and Characteristics of Innovation, Technological Innovation Management, Challenges in Technological Innovation Management, Basic Principles of Innovation Systems, Innovation Systems and Simulation Systems, System Dynamics as a Concept, Tool, and Process, Innovation Management Through Management of Knowledge and Education. Introduction to Intellectual property: Protecting your ideas.</p> <p><b>Introduction to Technological Entrepreneurship:</b> Introduction, Definitions, Types of Entrepreneurship, Sustainable Entrepreneurship, Business Incubator, Technology Management and Transfer: Technology Technology Transfer, Technology Transfer Mechanisms, Technology Transfer Models, The Vicious Circle of Underdevelopment Versus Technology Transfer, Technology Transfer Obstacles, Success Factors for Technology Transfer, Cooperative Research and Development Agreements,</p> <p><u>Laboratory Sessions/ Experimental learning:</u></p> <ul style="list-style-type: none"> <li>• Students will be given an assignment for preparation of a project report for establishing a Small Scale Industry</li> <li>• Applications- Establishment and successful implementation of the concepts for running Industries.</li> </ul> <p><u>Video link / Additional online information:</u></p> <ul style="list-style-type: none"> <li>• <a href="https://www.youtube.com/watch?v=bXbOoobVN30">https://www.youtube.com/watch?v=bXbOoobVN30</a></li> <li>• <a href="https://www.youtube.com/watch?v=nITjNZb7_WM">https://www.youtube.com/watch?v=nITjNZb7_WM</a></li> </ul>	<b>8 Hrs</b>
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<b>Course Outcomes: After completing the course, the students will be able to</b>	
CO1	Discuss Decision making, Organizing, Staffing, Directing and Controlling.
CO2	Correlate concepts of Traditional Project Management and launch and execute TPM projects.
CO3	Plan and reframe the project management Landscape and Process Groups
CO4	Design and modify the organizational vision and workplace culture.
CO5	Plan and collaborate the concepts of Innovation and Entrepreneurship.

Reference Books	
1.	Principles of Management Tripathy and Reddy Tata McGraw Hill 3rd edition 2006.
2.	Organisational Behaviour by - Stephen Robbins - Pearson Education/PHI - 17th Edition, 2003
3.	Dynamics of Entrepreneurial Development & Management Vasant Desai - Himalaya Publishing House
4.	Entrepreneurship Development – Poornima. M. Charantimath Small Business Enterprises - Pearson Education - 2006 (2 & 4).

### Continuous Internal Evaluation (CIE):

#### Theory for 50 Marks

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. Test portion is evaluated for 50 marks and quiz is evaluated for 10 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three (conduct additional quizzes and take best three). The three tests are conducted for 50 marks each and the average of all the tests are calculated for 50. The marks for the assignments are 20 (2 assignments for 10 marks each). The marks obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

### Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three sub divisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom’s taxonomy level.

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

<b>Semester: VII</b>		
<b>MECHANICAL VIBRATIONS (Theory)</b>		
Course Code: MVJ21ME52		CIE Marks: 50
Credits: L:T:P: 3:0:0		SEE Marks: 50
Hours: 40L		SEE Duration: 3 Hrs.
<b>Course Learning Objectives: The students will be able to</b>		
1	Gain the knowledge of static and dynamic equilibrium conditions of mechanisms subjected forces and couple with and without friction.	
2	Understand vibrations characteristics of single degree of freedom systems	
3	Characterise the single degree freedom systems subjected to free and forced vibrations with and without damping.	
4	Analyze the forced vibration with constant harmonic excitation.	
5	Carryout the Numerical Calculations for Multi-degree freedom systems	

<b>UNIT-I</b>	
<p><b>Introduction:</b> Definitions, Types of vibrations, Simple Harmonic Motion (SHM), Work done by harmonic force, Principle of super position applied to SHM, Beats, Fourier theorem, Numerical on Fourier theorem, Components of vibratory systems.</p> <p><b>Laboratory Sessions/ Experimental learning:</b></p> <ul style="list-style-type: none"> <li>Study of Numerical models and analysis of Fourier theorems and beats using MATLAB.</li> </ul> <p><b>Applications:</b> Machine Tools, and Musical instruments, etc.</p> <p><b>Video link / Additional online information:</b></p> <ol style="list-style-type: none"> <li><a href="https://www.youtube.com/watch?v=yddIT1GnIfE">https://www.youtube.com/watch?v=yddIT1GnIfE</a></li> <li><a href="https://www.youtube.com/watch?v=KKel19UfNno">https://www.youtube.com/watch?v=KKel19UfNno</a></li> <li><a href="https://www.youtube.com/playlist?list=PL46AAEDA6ABAFCA78">https://www.youtube.com/playlist?list=PL46AAEDA6ABAFCA78</a></li> </ol> <p><a href="https://www.youtube.com/watch?v=9_d8CQrCYUw">https://www.youtube.com/watch?v=9_d8CQrCYUw</a></p>	<b>8 Hrs</b>
<b>UNIT-II</b>	
<p><b>Un damped free Vibrations (Single Degree of Freedom):</b> Methods of analysis – (Newton's, Energy &amp; Rayleigh's methods). Derivations for spring mass systems, Natural frequencies of simple systems, Springs in series and parallel, Torsional and transverse vibrations, Effect of mass of spring and problems.</p> <p><b>Laboratory Sessions/ Experimental learning:</b></p> <ul style="list-style-type: none"> <li>Study of Numerical models and analysis of vibratory systems using MATLAB.</li> </ul> <p><b>Video link / Additional online information:</b></p> <ol style="list-style-type: none"> <li><a href="https://www.youtube.com/watch?v=QIdIcCn6YGc">https://www.youtube.com/watch?v=QIdIcCn6YGc</a></li> <li><a href="https://www.youtube.com/watch?v=4DF5qCxhxpM">https://www.youtube.com/watch?v=4DF5qCxhxpM</a></li> <li><a href="https://www.youtube.com/watch?v=BkgzEdDIU78">https://www.youtube.com/watch?v=BkgzEdDIU78</a></li> <li><a href="https://www.youtube.com/watch?v=QIdIcCn6YGc">https://www.youtube.com/watch?v=QIdIcCn6YGc</a></li> </ol>	<b>8 Hrs</b>
<b>UNIT-III</b>	

<p><b>Damped Free Vibrations:</b> Introduction, Types of damping, and Vibrations with viscous damping, under damped, over-damped and critically-damped systems, logarithmic decrement.</p> <p><b>Modal analysis and condition monitoring:</b> Signal analysis, dynamic testing of machines and structures, Experimental modal analysis, Machine condition monitoring and diagnosis.</p> <p><b>Laboratory Sessions/ Experimental learning:</b></p> <ul style="list-style-type: none"> <li>• Study of Numerical models and analysis of Damped vibratory systems using MATLAB.</li> </ul> <p><b>Applications:</b> Bridges, Buildings, etc.</p> <p><b>Video link / Additional online information:</b></p> <ol style="list-style-type: none"> <li>1. <a href="https://www.youtube.com/watch?v=YpiSZxDj7ws">https://www.youtube.com/watch?v=YpiSZxDj7ws</a></li> <li>2. <a href="https://www.youtube.com/watch?v=USa0VYAEzug">https://www.youtube.com/watch?v=USa0VYAEzug</a></li> <li>3. <a href="https://www.youtube.com/watch?v=YpiSZxDj7ws">https://www.youtube.com/watch?v=YpiSZxDj7ws</a></li> <li>4. <a href="https://www.youtube.com/watch?v=iNuV8Q0ZaPk">https://www.youtube.com/watch?v=iNuV8Q0ZaPk</a></li> </ol>	<b>8 Hrs</b>
<b>UNIT-IV</b>	
<p><b>Forced Vibrations (Single Degree of Freedom):</b></p> <p>Analysis of forced vibration with constant harmonic excitation, Magnification factor (M.F.), Vibration isolation - Transmissibility ratio, Excitation of support (absolute and relative), Numerical problems.</p> <p><b>Vibration Measuring Instruments &amp; Whirling of Shafts:</b> Vibrometer and accelerometer. Whirling of shafts with and without air damping, discussion of speeds above and below critical speeds.</p> <p><b>Laboratory Sessions/ Experimental learning:</b></p> <ul style="list-style-type: none"> <li>• Study of Two Degree Freedom systems like vehicle suspension and dynamic vibration absorber.</li> </ul> <p><b>Video link / Additional online information:</b></p> <ol style="list-style-type: none"> <li>1. <a href="https://www.youtube.com/watch?v=LbVL5O_bG9w">https://www.youtube.com/watch?v=LbVL5O_bG9w</a></li> <li>2. <a href="https://www.youtube.com/watch?v=4h5NOWTCVWM">https://www.youtube.com/watch?v=4h5NOWTCVWM</a></li> <li>3. <a href="https://www.youtube.com/watch?v=ETG6krVhN8w">https://www.youtube.com/watch?v=ETG6krVhN8w</a></li> <li>4. <a href="https://nptel.ac.in/courses/112/103/112103111/">https://nptel.ac.in/courses/112/103/112103111/</a></li> </ol>	<b>8 Hrs</b>
<b>UNIT-V</b>	
<p><b>Numerical Methods For Multi Degree Freedom Systems:</b> Introduction, Influence coefficients, Maxwell reciprocal theorem, Dunkerley's equation. Orthogonality of principal modes, method of matrix iteration - Method of determination of all the natural frequencies using sweeping matrix and Orthogonality principle. Holzer's method, Stodola method.</p> <p><b>Laboratory Sessions/ Experimental learning:</b></p> <ul style="list-style-type: none"> <li>• Study of vibration analysis of real time application problems.</li> </ul> <p><b>Video link / Additional online information:</b></p> <ol style="list-style-type: none"> <li>1. <a href="https://www.youtube.com/watch?v=TydULVPaFek">https://www.youtube.com/watch?v=TydULVPaFek</a></li> <li>2. <a href="https://www.youtube.com/watch?v=M8bjJQFYMHU">https://www.youtube.com/watch?v=M8bjJQFYMHU</a></li> <li>3. <a href="https://nptel.ac.in/content/storage2/courses/112101096/download/lecture-29.pdf">https://nptel.ac.in/content/storage2/courses/112101096/download/lecture-29.pdf</a></li> <li>4. <a href="https://www.youtube.com/watch?v=kT1c0iyFZmM">https://www.youtube.com/watch?v=kT1c0iyFZmM</a></li> </ol>	<b>8 Hrs</b>

<b>Course Outcomes: After completing the course, the students will be able to</b>	
CO1	Understand types of vibration, SHM and methods of finding natural frequencies of simple mechanical systems.
CO2	Determine equation of motion, natural frequency, damping factor, logarithmic decrement of damped free vibration (SDOF) systems.
CO3	Determine the natural frequency, force and motion transmissibility of single degree freedom systems.
CO4	Determine equation of motion of rotating and reciprocating unbalance systems, magnification factor, and transmissibility of forced vibration (SDOF) systems.
CO5	Determine the equation of motion and degrees of freedom of multi-degree freedom system.

<b>Reference Books</b>	
10.	Leonard Meirovitch, 'Elements of Vibrations Analysis', TMH, Special Indian edition, 2007, ISBN-81-7700-047-0.
11.	S.Graham Kelly, 'Mechanical Vibrations', Schaum's outline series, TMH, Special Indian Edition, 2007, ISBN-14-09780070616790.
3.	S.S. Rao, 'Mechanical Vibrations', Pearson Education Inc, 6th Edition, 2017. ISBN9780134361307.
4.	Mechanical Vibrations, J. B. K. Das , Dr. P. L. Srinivasa Murthy, Sapna Publishers, ISBN-13: 9788128003714

### **Continuous Internal Evaluation (CIE):**

#### **Theory for 50 Marks**

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. Test portion is evaluated for 50 marks and quiz is evaluated for 10 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three (conduct additional quizzes and take best three). The three tests are conducted for 50 marks each and the average of all the tests are calculated for 50. The marks for the assignments are 20 (2 assignments for 10 marks each). The marks obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

### **Semester End Examination (SEE):**

**Total marks: 50+50=100**

SEE for 50 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three sub divisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.



**CO-PO Mapping**

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

<b>Semester: V</b>		
<b>Fluid Mechanics &amp; Machinery (Theory and Practice)</b>		
Course Code: MVJ21ME53		CIE Marks:50+50
Credits: L:T:P: 3:0:2		SEE Marks: 50 +50
Hours:40 L+ 26 P		SEE Duration: 03+03 Hours
<b>Course Learning Objectives: The students will be able to</b>		
1	Understand the properties of fluids and concept of control volume are studied.	
2	Enumerate the applications of the conservation laws to flow through pipe.	
3	Enumerate the applications of the conservation laws to flow through pipe.	
4	Elucidate the importance of various types of flow in pumps.	
5	Elucidate the importance of various types of flow in turbine.	

<b>UNIT-I</b>	
<b>Fluid Properties and Flow Characteristics:</b> Dimensions and units: physical properties of fluids- specific gravity, viscosity and its significance, surface tension, capillarity, vapour pressure. Atmospheric gauge and vacuum pressure –measurement of pressure. Manometers Piezometer, U-tube, inverted and differential manometers. Pascal's law, hydrostatic law. <b>Buoyancy and floatation:</b> Meta center, stability of floating body. Submerged bodies. Calculation of metacenter height. Stability analysis and applications.	<b>08</b>
<b>UNIT-II</b>	
<b>Fluid Dynamics:</b> Forces acting on fluid in motion, Linear momentum equation, Impact of jets, Moment of momentum equation, Euler's equation of motion along a streamline, Bernoulli's equation – assumptions and limitations. Introduction to Navier-Stokes equation, Venturi-meters, orificemeters, rectangular and triangular notches, pitot tubes, Rota-meter, electromagnetic flow meter <b>Boundary Layer Theory:</b> Introduction, momentum integral equation, displacement, momentum and energy thickness, separation of boundary layer, control of flow separation, Stream lined body, Bluff body and its applications, basic concepts of velocity profiles	<b>08</b>
<b>UNIT-III</b>	
<b>Fluid kinematics:</b> Introduction, flow types. Equation of continuity for one dimensional flow, circulation and vorticity, Stream line, path line and streak lines and stream tube. Stream function and velocity potential function, differences and relation between them. Condition for irrotational flow, flow net, source and sink, doublet and vortex flow. <b>Dimensional Analysis:</b> Similitude and modelling – Dimensionless numbers <b>Closed conduit flow:</b> Reynold's experiment- Darcy Weisbach equation- Minor losses in pipes- pipes in series and pipes in parallel- total energy line-hydraulic gradient line.	<b>08</b>
<b>UNIT-IV</b>	
<b>Basics of turbo machinery:</b> Hydrodynamic force of jets on stationary and moving flat, inclined, and curved vanes, jet striking centrally and at tip, velocity	<b>08</b>

<p>diagrams, work done and efficiency, flow over radial vanes, hydrodynamic force of jets on stationary and moving flat, inclined, and curved vanes, jet striking centrally and at tip, velocity diagrams, work done and efficiency, flow over radial vanes.</p> <p><b>Centrifugal pumps:</b> classification, working, work done – manometric head-losses and efficiencies- specific speed- pumps in series and parallel-performance characteristic curves, cavitation &amp; NPSH, Reciprocating pumps: Working, Discharge, slip, indicator diagrams.</p>	
<b>UNIT-V</b>	
<p><b>Hydraulic Turbines:</b> Classification of turbines, Impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine-working proportions, work done, efficiencies, hydraulic design –draft tube- theory functions and efficiency. Performance of hydraulic turbines: Geometric similarity, Unit and specific quantities, characteristic curves, governing of turbines, selection of type of turbine, cavitation, surge tank, water hammer. Hydraulic systems hydraulic ram, hydraulic lift, hydraulic coupling. Fluidics – amplifiers, sensors and oscillators. Advantages, limitations and applications.</p>	<b>08</b>
<b>LABORATORY EXPERIMENTS</b>	
<ol style="list-style-type: none"> <li>1. Determination of coefficient of friction of flow in a pipe.</li> <li>2. Determination of minor losses in flow through pipes.</li> <li>3. Application of momentum equation for determination of coefficient of impact of jets on flat and curved blades.</li> <li>4. Determination of coefficient of discharge of various flow measuring devices.</li> <li>5. Performance studies on Pelton, Francis, and Kaplan wheel turbines.</li> <li>6. Performance of Single and Multistage Centrifugal Pump.</li> <li>7. Performance test on Reciprocating Pump.</li> <li>8. Performance test on a two stage Reciprocating Air Compressor.</li> <li>9. Performance test on an Air Blower.</li> </ol> <p><b>Any 10 experiments to be conducted</b></p>	

<b>Course Outcomes: After completing the course, the students will be able to</b>	
CO1	Acquire the knowledge of the basic principles of fluid mechanics and fluid kinematics.
CO2	Acquire the basic knowledge of fluid dynamics and flow measuring instruments.
CO3	Acquire the knowledge on the nature of flow and flow over bodies and the dimensionless analysis.
CO4	Elucidate the concepts of the turbomachinery and their applications.
CO5	Conduct basic experiments of fluid mechanics and hydraulic machinery and understand the working principles.

<b>Reference Books</b>	
	Modi P.N. and Seth, S.M. "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi, 2013. ISBN 13: 9788189401269
	Kumar K. L., "Engineering Fluid Mechanics", Eurasia Publishing House(p) Ltd., New Delhi, 2016. ISBN 13: 9788121901000

3.	A text book of Fluid Mechanics and Hydraulic Machines, Dr. R K Bansal, Laxmi publishers. ISBN 13: 9788131808153
4.	P. C. Angelo and R. Subramanian: Powder Metallurgy- Science, Technology and Applications, PHI, New Delhi, 2008. ISBN : 9788120332812

### Continuous Internal Evaluation (CIE):

#### Theory for 50 Marks

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. Test portion is evaluated for 50 marks and quiz is evaluated for 10 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three (conduct additional quizzes and take best three). The three tests are conducted for 50 marks each and the average of all the tests are calculated for 50. The marks for the assignments are 20 (2 assignments for 10 marks each). The marks obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

#### Laboratory- 50 Marks

The laboratory session is held every week as per the time table and the performance of the student is evaluated in every session. The average of the marks over number of weeks is considered for 30 marks. At the end of the semester a test is conducted for 10 marks. The students are encouraged to implement additional innovative experiments in the lab and are awarded 10 marks. Total marks for the laboratory is 50.

### Semester End Examination (SEE):

**Total marks: 50+50=100**

SEE for 50 marks are executed by means of an examination.

The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three sub divisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

#### Laboratory- 50 Marks

Experiment Conduction with proper results is evaluated for 40 marks and Viva is for 10 marks. Total SEE for laboratory is 50 marks.



Semester: V		
DESIGN OF MACHINE ELEMENTS (Theory and Practice)		
Course Code: MVJ21ME54		CIE Marks:50+50
Credits: L:T:P: 3:0:2		SEE Marks: 50 +50
Hours:40 L+ 26 P		SEE Duration: 03+03 Hours
<b>Course Learning Objectives: The students will be able to</b>		
1	To explain the principles involved in design of machine elements, subjected to different kinds of forces, from the considerations of strength, rigidity.	
2	To understand and interpret different failure modes and application of appropriate criteria for design of machine elements.	
3	Develop the capability to design elements like shafts, couplings and springs, welded joints, screwed joints.	
4	To learn transmission elements like gears, belts, pulleys, bearings from the manufacturers' catalogue	
5	To produce assembly and working drawings of various mechanical systems involving machine elements like clutches and brakes	

UNIT-I	
<p><b>Introduction and Review:</b> Review of engineering materials and their properties and manufacturing processes; use of codes and standards, selection of preferred sizes. Review of axial, bending, shear and torsion loading on machine components, combined loading, two- and three dimensional stresses, principal stresses, stress tensors, Mohr's circles.</p> <p><b>Design for static strength:</b> Factor of safety and service factor. Failure mode: definition and types. , Failure of brittle and ductile materials; even and uneven materials; Theories of failure: maximum normal stress theory, maximum shear stress theory, distortion energy theory, strain energy theory, Columba –Mohr theory and modified Mohr's theory. Stress concentration, stress concentration factor</p> <p><b>Impact Strength:</b> Introduction, Impact stresses due to axial, bending and torsion loads.</p> <p><b>Fatigue loading:</b> Introduction to fatigue failure, Mechanism of fatigue failure, types of fatigue loading, S-N Diagram, Low cycle fatigue, High cycle fatigue, Endurance limit.</p> <p><b>Laboratory Sessions/ Experimental learning:</b></p> <ol style="list-style-type: none"> <li>1. Impact load: Experiment on impact loading.</li> <li>2. Fatigue: Demonstration with model.</li> </ol> <p><b>Applications:</b></p> <ol style="list-style-type: none"> <li>1. Study the effect of different loads under design considerations.</li> <li>2. Failure analysis of different materials.</li> </ol> <p><b>Video link / Additional online information:</b>  <a href="https://nptel.ac.in/courses/112105125/">https://nptel.ac.in/courses/112105125/</a></p>	8 Hrs

<a href="https://nptel.ac.in/content/storage2/courses/112105125/pdf/Module-3_lesson-4.pdf">https://nptel.ac.in/content/storage2/courses/112105125/pdf/Module-3_lesson-4.pdf</a> <a href="https://nptel.ac.in/course.html">https://nptel.ac.in/course.html</a> <a href="https://nptel.ac.in/courses/111/104/111104095/">https://nptel.ac.in/courses/111/104/111104095/</a>	
<b>UNIT-II</b>	
<p>Introduction and Review: Review of engineering materials and their properties and manufacturing processes; use of codes and standards, selection of preferred sizes. Review of axial, bending, shear and torsion loading on machine components, combined loading, two- and three dimensional stresses, principal stresses, stress tensors, Mohr's circles.</p> <p><b>Design for static strength:</b> Factor of safety and service factor. Failure mode: definition and types. , Failure of brittle and ductile materials; even and uneven materials; Theories of failure: maximum normal stress theory, maximum shear stress theory, distortion energy theory, strain energy theory, Columba –Mohr theory and modified Mohr's theory. Stress concentration, stress concentration factor</p> <p><b>Impact Strength:</b> Introduction, Impact stresses due to axial, bending and torsion loads.</p> <p><b>Fatigue loading:</b> Introduction to fatigue failure, Mechanism of fatigue failure, types of fatigue loading, S-N Diagram, Low cycle fatigue, High cycle fatigue, Endurance limit.</p> <p><b>Laboratory Sessions/ Experimental learning:</b></p> <ol style="list-style-type: none"> <li>1. Impact load: Experiment on impact loading.</li> <li>2. Fatigue: Demonstration with model.</li> </ol> <p><b>Applications:</b></p> <ol style="list-style-type: none"> <li>1. Study the effect of different loads under design considerations.</li> <li>2. Failure analysis of different materials.</li> </ol> <p><b>Video link / Additional online information:</b>  <a href="https://nptel.ac.in/courses/112105125/">https://nptel.ac.in/courses/112105125/</a>  <a href="https://nptel.ac.in/content/storage2/courses/112105125/pdf/Module-3_lesson-4.pdf">https://nptel.ac.in/content/storage2/courses/112105125/pdf/Module-3_lesson-4.pdf</a>  <a href="https://nptel.ac.in/course.html">https://nptel.ac.in/course.html</a>  <a href="https://nptel.ac.in/courses/111/104/111104095/">https://nptel.ac.in/courses/111/104/111104095/</a></p>	<b>8 Hrs</b>
<b>UNIT-III</b>	
<p><b>Riveted joints:</b> Types of rivets, rivet materials, Caulking and fullering, analysis of riveted joints, joint efficiency, failures of riveted joints, boiler joints, riveted brackets, Discussion on engineering applications.</p> <p><b>Welded joints:</b> Types, strength of butt and fillet welds, eccentrically loaded welded joints, Discussion on engineering applications.</p>	<b>Hrs</b>

<p><b>Threaded Fasteners:</b> Stresses in threaded fasteners, effect of initial tension, design of threaded fasteners under static, dynamic and impact loads, design of eccentrically loaded bolted joints, Discussion on engineering applications.</p> <p><b>Laboratory Sessions/ Experimental learning:</b></p> <ol style="list-style-type: none"> <li>1. Riveting: To do a tank by riveting.</li> <li>2. Bolts: Loading and testing bolts.</li> <li>3. Model on mounting and lifting mechanism.</li> </ol> <p><b>Applications:</b></p> <ol style="list-style-type: none"> <li>1. Design of rivets on requirement view.</li> <li>2. Study of various stresses in bolts design and design considerations.</li> <li>3. Comparative study of hydraulic jack and screw jack.</li> </ol> <p><b>Video link / Additional online information:</b>  <a href="https://nptel.ac.in/courses/112105125/">https://nptel.ac.in/courses/112105125/</a>  <a href="http://www.nptelvideos.in/2012/12/design-of-machine-elements.html">http://www.nptelvideos.in/2012/12/design-of-machine-elements.html</a>  <a href="https://www.yumpu.com/en/document/view/11310280/design-of-eccentrically-loaded-bolted-riveted-joints-nptel">https://www.yumpu.com/en/document/view/11310280/design-of-eccentrically-loaded-bolted-riveted-joints-nptel</a>  <a href="https://nptel.ac.in/courses/112/105/112105124/">https://nptel.ac.in/courses/112/105/112105124/</a></p>	
<b>UNIT-IV</b>	
<p><b>Spur Gears:</b> Definitions, stresses in gear tooth: Lewis equation and form factor, design for strength, dynamic load and wear.</p> <p><b>Helical Gears:</b> Definitions, transverse and normal module, formative number of teeth, design based on strength, dynamic load and wear.</p> <p><b>Bevel Gears:</b> Definitions, formative number of teeth, design based on strength, dynamic load and wear.</p> <p><b>Worm Gears:</b> Definitions, types of worm and worm gears, and materials for worm and worm wheel. Design based on strength, dynamic, wear loads and efficiency of worm gear drives.</p> <p><b>Applications:</b> Automobiles, Engines and Machineries</p> <p><b>Video link/Additional online information: MOOC and Open courseware:</b>  <a href="https://www.youtube.com/watch?v=AS0zQhMfJUw&amp;list=PLSGws_74K01_e499POG3gczxcnIJEHMWE">https://www.youtube.com/watch?v=AS0zQhMfJUw&amp;list=PLSGws_74K01_e499POG3gczxcnIJEHMWE</a>  <a href="https://www.youtube.com/watch?v=i788-2pq1HA">https://www.youtube.com/watch?v=i788-2pq1HA</a>,<a href="https://www.youtube.com/watch?v=9XYeur-iVAs">https://www.youtube.com/watch?v=9XYeur-iVAs</a>  <a href="https://www.youtube.com/watch?v=oiBU7yxkpzc">https://www.youtube.com/watch?v=oiBU7yxkpzc</a>,<a href="https://www.youtube.com/watch?v=0rnTh6c19HM">https://www.youtube.com/watch?v=0rnTh6c19HM</a>  <a href="https://www.youtube.com/watch?v=a5A4LegPtyg">https://www.youtube.com/watch?v=a5A4LegPtyg</a>  <a href="https://www.youtube.com/watch?v=L7i_QDehseg">https://www.youtube.com/watch?v=L7i_QDehseg</a>  <a href="https://www.youtube.com/watch?v=gj2szHk0OCU">https://www.youtube.com/watch?v=gj2szHk0OCU</a>  <a href="https://www.youtube.com/watch?v=K5_ivdkRXp0">https://www.youtube.com/watch?v=K5_ivdkRXp0</a></p>	<b>Hrs</b>



**UNIT-V**

**Design of Clutches and Brakes:** Design of single plate, multi-plate and cone clutches based on uniform pressure and uniform wear theories. Design of band brakes, block brakes and internal expanding brakes

**Lubrication and Bearings:** Lubricants and their properties, bearing materials and properties; mechanisms of lubrication, hydrodynamic lubrication, pressure development in oil film, bearing modulus, coefficient of friction, minimum oil film thickness, heat generated, and heat dissipated.

**Antifriction bearings:** Types of rolling contact bearings and their applications, static and dynamic load carrying capacities, equivalent bearing load, load life relationship, Discussion on engineering applications.

**Video link/Additional online information: MOOC and Open courseware:**

<https://www.youtube.com/watch?v=gOuLq2haqLY>,<https://www.youtube.com/watch?v=wCu9W9xNwtI>

<https://www.youtube.com/watch?v=pgF-aBtTBnY>,[https://www.youtube.com/watch?v=bMg\\_j5\\_AGMg](https://www.youtube.com/watch?v=bMg_j5_AGMg)

<https://www.youtube.com/watch?v=g5n8OqS1Fow>,<https://www.youtube.com/watch?v=wCu9W9xNwtI>

<https://www.youtube.com/watch?v=wCu9W9xNwtI>

<https://www.youtube.com/watch?v=SOgovejzF8c>,<https://www.youtube.com/watch?v=8Jr44ybyS7U>

<https://www.youtube.com/watch?v=devo3kdSPQY>,<https://www.youtube.com/watch?v=rOT4O-lwzu8>

<https://www.youtube.com/watch?v=98DXe3uKwfc>,<https://www.youtube.com/watch?v=6c4deRAhqcA>

<https://www.youtube.com/watch?v=grfLkzjyc-o>,<https://www.youtube.com/watch?v=TsXQsw8EVgA>

<https://www.youtube.com/watch?v=TsXQsw8EVgA>

<https://www.youtube.com/watch?v=gxFRIkZMcJY>,<https://www.youtube.com/watch?v=VwgBSQ5tF3Y>

<https://www.youtube.com/watch?v=VwgBSQ5tF3Y>,<https://www.youtube.com/watch?v=wpretUMnW9g>,<https://www.youtube.com/watch?v=tP8nzvnrPY>

Hrs

**LABORATORY EXPERIMENTS**

1. Experimental studies of Single Degree of Freedom Vibrating systems.
2. Experiment on Governors – Porter/Proell/Hartnell to find the equilibrium speed, sensitiveness, power and effort.
3. Experiment on the balancing of rotating masses.
4. Experiment on rotating shafts to find the critical speed.
5. Experiment on Photo-elastic materials for the determination of the fringe constant using.
  - a) Circular disc subjected to diametral compression.
  - b) Pure bending specimen.

6.	Determination of stress concentration using Photo-elasticity for simple components like plate with a hole under tension or bending, circular disk with circular hole under compression, 2D Crane hook
7.	Experiment on Journal bearing to find the pressure distribution.
8.	Determination of Principal Stresses and strains in a member subjected to combined loading using Strain gauges
9.	Determination of stresses in Curved beam using strain gauge.
10.	Write codes in MATLAB/PYTHON to design a machine element.
11.	Demonstration of Design and Analysis of a Welded Joint using appropriate modeling and analysis softwares.

<b>Course Outcomes: After completing the course, the students will be able to</b>	
CO1	Apply codes and standards in the design of machine elements and select an element based on the Manufacturer's catalogue.
CO2	Analyze the performance and failure modes of mechanical components subjected to combined loading and fatigue loading using the concepts of theories of failure.
CO3	Demonstrate the application of engineering design tools to the design of machine components like shafts, springs, couplings, fasteners, welded and riveted joints, brakes and clutches
CO4	Design different types of gears and simple gear boxes for relevant applications.
CO5	Apply design concepts of hydrodynamic bearings for different applications and select Anti friction bearings for different applications using the manufacturers, catalogue.

<b>Reference Books</b>	
1.	Shigley's Mechanical Engineering Design Richard G. Budynas, and J. Keith Nisbett McGraw-Hill Education 10th Edition, 2015
2.	Design of Machine Elements V. B. Bhandari Tata McGraw Hill 4th Ed 2016.
3.	Machine Design- an integrated approach Robert L. Norton Pearson Education 2nd edition
4.	Design Data Hand Book, K.Lingaiah, McGraw Hill, 2nd edition, 2003.

### **Continuous Internal Evaluation (CIE):**

#### **Theory for 50 Marks**

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. Test portion is evaluated for 50 marks and quiz is evaluated for 10 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three (conduct additional quizzes and take best three). The three tests are conducted for 50 marks each and the average of all the tests are calculated for 50. The marks for the assignments are 20 (2 assignments for 10 marks each). The marks obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

#### **Laboratory- 50 Marks**

The laboratory session is held every week as per the time table and the performance of the student is evaluated in every session. The average of the marks over number of weeks is

considered for 30 marks. At the end of the semester a test is conducted for 10 marks. The students are encouraged to implement additional innovative experiments in the lab and are awarded 10 marks. Total marks for the laboratory is 50.

**Semester End Examination (SEE):**

**Total marks: 50+50=100**

SEE for 50 marks are executed by means of an examination.

The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three sub divisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

**Laboratory- 50 Marks**

Experiment Conduction with proper results is evaluated for 40 marks and Viva is for 10 marks. Total SEE for laboratory is 50 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	1	-	-	-	2	-	1	-	2
CO3	3	3	3	1	-	-	-	2	-	1	-	2
CO4	3	3	3	1	-	-	-	2	-	2	-	2
CO5	2	3	3	2	-	-	-	2	-	1	-	2

Semester: V		
COMPUTER INTEGRATED MANUFACTURING (Theory)		
Course Code: MVJ21ME551		CIE Marks:100
Credits: L: T:P:S: 3:1:0:0		SEE Marks: 100
Hours: 40L+26T		SEE Duration: 3 Hrs
<b>Course Learning Objectives: The students will be able to</b>		
1	To impart knowledge of CIM and Automation and different concepts of automation by developing mathematical models.	
2	The students will get the knowledge of high-quality production, the manufacturing and assembly line balancing and computerized manufacturing planning system.	
3	To expose the students to CNC Machine Tools, CNC part programming	
4	To impart the knowledge of computer aided quality control and shop floor control will help the students to compete with the present technology.	
5	To impart knowledge of CIM and Automation and different concepts of automation by developing mathematical models.	

UNIT-I	
<b>Computer Integrated Manufacturing System &amp; High-Volume Production System:</b> Introduction, Production concepts, Mathematical Models, Production economics, Costs in manufacturing, Break even analysis, Unit cost of production, Cost of MLT and WIP. Automated flow lines, work part Transport, Transfer Mechanism and Buffer Storage.	8 Hrs
UNIT-II	
<b>Analysis of Automated Flow line and Line Balancing:</b> Analysis of Transfer Lines without storage and with storage, Partial Automation, Manual Assembly Lines, Methods of Line balancing, Computerized Line Balancing. Automated Material Handling System, Automated guided vehicle system.	8 Hrs
UNIT-III	
<b>Computerized Manufacturing Planning System and Flexible Manufacturing Systems:</b> Computer Aided Process Planning: retrieval types, Generative type, Material Requirement Planning, Fundamental concepts of MRP, Inputs to MRP, Capacity Planning. Group technology. Flexible Manufacturing Systems, types of FMS, FMS components.	8 Hrs
UNIT-IV	
<b>CNC Machining Centers:</b> Introduction to CNC, elements of CNC, CNC machining centers, part programming, fundamental steps involved in development of part programming for milling and turning. Programming with canned cycles. Cutter radius compensations. <b>Shop Floor Control &amp; Computer Aided Quality Control:</b> Factory, Data Collection System, Automatic identification system. Inspection methods, Non-Contact inspection methods, Co-ordinate measuring machine	8 Hrs
UNIT-V	
<b>Future of Automated Factory:</b> Industry 4.0, functions, applications and benefits. Components of Industry 4.0, Internet of Things (IOT), IOT applications in manufacturing, Big-Data and Cloud Computing for IOT, IOT for smart manufacturing, influence of IOT on predictive maintenance, industrial automation,	8 Hrs

Course Outcomes: After completing the course, the students will be able to	
CO1	Able to define Automation, CIM, CAD, CAM and explain the differences between these concepts.
CO2	Explain the basics of automated manufacturing industries through mathematical models and analyse different types of automated flow lines.
CO3	Analyse the automated flow lines to reduce down time and enhance productivity.
CO4	Explain the use of different computer applications in Shop Floor Control & computer aided quality control, and able to prepare part programs for simple jobs on CNC machine tools.
CO5	Visualize and appreciate the modern trends in Manufacturing like additive manufacturing, Industry 4.0 and applications of Internet of Things leading to Smart Manufacturing.

Reference Books	
	Mikell P Groover, " <i>Automation, Production Systems and Computer-Integrated Manufacturing</i> ", 4th Edition, 2015, Pearson Learning. ISBN-10 9789332572492
	P N Rao " <i>CAD / CAM Principles and Applications</i> ", 3rd Edition, 2015, Tata McGraw-Hill. ISBN-10 9780070681934
3.	P. Radhakrishnan, " <i>CAD/CAM/CIM</i> " 3rd edition, New Age International Publishers, New Delhi. ISBN-10 8122439802
4.	Arshdeep Bahga and Vijay Madiseti, " <i>Internet of Things: A Hands-on Approach</i> ", (Universities Press) ISBN-10 8173719543
<b>Web links and Video Lectures (e-Resources):</b> <a href="https://nptel.ac.in/content/storage2/112/104/112104289/MP4/mod03lec12.mp4">https://nptel.ac.in/content/storage2/112/104/112104289/MP4/mod03lec12.mp4</a> <a href="https://nptel.ac.in/content/storage2/112/104/112104289/MP4/mod03lec13.mp4">https://nptel.ac.in/content/storage2/112/104/112104289/MP4/mod03lec13.mp4</a> <a href="https://nptel.ac.in/content/storage2/112/104/112104289/MP4/mod03lec14.mp4">https://nptel.ac.in/content/storage2/112/104/112104289/MP4/mod03lec14.mp4</a> <a href="https://nptel.ac.in/content/storage2/112/104/112104289/MP4/mod12lec49.mp4">https://nptel.ac.in/content/storage2/112/104/112104289/MP4/mod12lec49.mp4</a> <a href="https://nptel.ac.in/content/storage2/112/104/112104288/MP4/mod01lec05.mp4">https://nptel.ac.in/content/storage2/112/104/112104288/MP4/mod01lec05.mp4</a> <a href="https://nptel.ac.in/content/storage2/112/104/112104288/MP4/mod01lec04.mp4">https://nptel.ac.in/content/storage2/112/104/112104288/MP4/mod01lec04.mp4</a> <a href="https://nptel.ac.in/content/storage2/112/104/112104289/MP4/mod12lec48.mp4">https://nptel.ac.in/content/storage2/112/104/112104289/MP4/mod12lec48.mp4</a>	

### Continuous Internal Evaluation (CIE):

#### Theory for 50 Marks

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. Test portion is evaluated for 50 marks and quiz is evaluated for 10 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three (conduct additional quizzes and take best three). The three tests are conducted for 50 marks each and the average of all the tests are calculated for 50. The marks for the assignments are 20 (2 assignments for 10 marks each). The marks obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

## Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three sub divisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

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

<b>Semester: V</b>		
<b>Industrial Internet of Things (Theory) – Professional Elective I</b>		
<b>Course Code: MVJ21ME552</b>		<b>CIE Marks: 50</b>
<b>Credits: L:T:P: 3:0:0</b>		<b>SEE Marks: 50</b>
<b>Hours: 40L</b>		<b>SEE Duration: 3 Hrs.</b>
<b>Course Learning Objectives: The students will be able to</b>		
1	Understand the evolution of Industry 4.0 and the Internet of things	
2	Understand the Industrial Internet and IIOT Architecture	
3	Understand the designing of Industrial Internet and examining the access network for IIoT.	
4	Understand the Emerging Hardware Technologies for IoT Data Processing and Architecting IoT Cloud and Machine Learning.	
5	Understand the Systems Development for the Industrial IoT and Cyber Physical	

<b>UNIT-I</b>	
<p>Introducing Industry 4.0: Defining Industry 4.0, Four Main Characteristics of Industry 4.0, The Value Chain, Creating a Value Chain, Industry 4.0 Design Principles, Building Blocks of Industry 4.0, Industry 4.0 Design Principles, Building Blocks of Industry 4.0. Smart Factories: Introducing and need for Smart Factory, Digital Transformation, Transforming Operational Processes, Transforming Business Models, Increase Operational Efficiency, Adopt Smart Architectures and Technologies.</p> <p>Introduction to IoT – IoT Fundamentals: Definitions, Architectures, Challenges, and Promises : Internet of Things Terms and Acronyms, Impact and benefits of IoT, Architectures and Reference Models of IoT, Architectures and Reference Models of IoT, IoT Frameworks and Platforms, IoT Applications in Vertical Markets, IoT Business Implications and Opportunities, The Smart “Things” in IoT : Definition and Architecture of Smart Things, Engineering IoT Networks, The Simplified ISO/OSI Reference Model and IoT, IoT Network Technologies and Standards.</p> <p>Laboratory Sessions/ Experimental learning:</p> <ul style="list-style-type: none"> <li>• Demonstration of IoT in Data Management and Security.</li> </ul> <p>Applications: IoT for Industrial Automation.</p> <p>NPTEL/Additional Videos Link:</p> <p><a href="https://www.youtube.com/watch?v=AQdLQV6vhbk">https://www.youtube.com/watch?v=AQdLQV6vhbk</a></p>	<b>8Hrs</b>
<b>UNIT-II</b>	
<p>Introduction to the Industrial Internet, Catalysts and Precursors of the IIoT, Industrial Internet Use-Cases, The Technical and Business Innovators of the Industrial Internet, Network Virtualization, The Cloud and Fog, Big Data and Analytics, M2M Learning and Artificial Intelligence, Augmented Reality and Virtual Reality, People versus Automation, People versus Automation.</p>	<b>8 Hrs</b>

<p>Industrial Internet of Things (IIoT): Principles, Processes and Protocols, IIoT Reference Architecture : The IIC Industrial Internet Reference Architecture, Industrial Internet Architecture Framework (IIAF), Three Tier Topology, Key System Characteristics, Data Management, IIoT-Business Models, Industrial IoT- Layers. M2M AREA NETWORK PHYSICAL LAYERS, Power line Communication for M2M Applications. An introduction to ANSI C12 Suite, DLMS/COSEM and 6LoWPAN and RPL.</p> <p>Laboratory Sessions/ Experimental learning:</p> <ul style="list-style-type: none"> <li>Demonstration of Application of IIoT in a production facility.</li> </ul> <p>Applications: Airbus: Factory of the Future</p> <p>NPTEL/Additional Videos Link:  <a href="https://www.youtube.com/watch?v=Qs7bs2g7Usc">https://www.youtube.com/watch?v=Qs7bs2g7Usc</a>  <a href="https://www.youtube.com/watch?v=9Wh4PUN-viE">https://www.youtube.com/watch?v=9Wh4PUN-viE</a></p>	
<p>UNIT-III</p>	
<p>Designing Industrial Internet Systems: The Concept of the IIoT, The Proximity Network, WSN Edge Node, Legacy Industrial Protocols, Legacy Industrial Protocols, Wireless Communication Technologies, Proximity Network Communication Protocols, And Industrial Gateways. Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Lifecycle Management.</p> <p>Examining the Access Network Technology and Protocols : The Access Network, Access Networks Connecting Remote Edge Networks, Examining the Middleware Transport Protocols, Middleware Software Patterns, Software Design Concepts, API (Application Programming Interface), Middleware Industrial Internet of Things Platforms. IIoT WAN Technologies and Protocols: IIoT Device Low-Power WAN Optimized Technologies for M2M, Millimeter Radio, Securing the Industrial Internet, Security in Manufacturing, PLCs and DCS.</p> <p>Laboratory Sessions/ Experimental learning:</p> <ul style="list-style-type: none"> <li>Demonstration of the some basic exercises related to sensors.</li> </ul> <p>Applications: ABB: Smart robotics</p> <p>NPTEL/Additional Videos Link:  <a href="https://www.youtube.com/watch?v=wgWRLu8p90M">https://www.youtube.com/watch?v=wgWRLu8p90M</a></p> <p>Experiential Learning: (Experiments which can be conducted on the concepts of contents)</p> <ul style="list-style-type: none"> <li>Demonstration of network data transfer and protocols of various telecom companies.</li> </ul> <p>Video Links/Any other special information(Papers): (For additional study on the concepts of contents)  <a href="https://www.youtube.com/watch?v=XMAVAXj1WmQ">https://www.youtube.com/watch?v=XMAVAXj1WmQ</a></p>	<p>8Hrs</p>
<p>UNIT-IV</p>	
<p>Architecting IoT Cloud and Machine Learning: Fundamentals of Cloud Computing, Device Management Layer, Data Ingestion Layer, Data Processing</p>	



<p>Layer, Data Processing Layer, Application Layer, Data Visualization and Reporting Layer, Orchestration Layer, Virtualization, Scaling. Fundamental of Machine Learning: Regression Analysis, Feature Selection, Artificial Neural Networks, Clustering, Introduction to Big Data, Big Data Management and Computing Platforms. Introduction to Distributed Ledger Technology and IoT.</p> <p>Emerging Hardware Technologies for IoT Data Processing: Challenges for Data Processing in the Era of IoT, Recent Innovations for Bandwidth and Energy, Near-Memory Processing, In Situ Processing for IoT Devices, In Situ Data Clustering for IoT Servers, IoT Cyber Security: Cyber Security Controls for IoT Systems, Securing the IoT Edge, Interoperability in Smart Automation of Cyber Physical Systems, Artificial Intelligence and Data Analytics for Manufacturing, Cyber Physical Production Control.</p> <p>Laboratory Sessions/ Experimental learning:</p> <ul style="list-style-type: none"> <li>• Demonstration of functioning of different IoT tools</li> </ul> <p>Applications: IoT for Smart Cities and Smart Vehicles</p> <p>NPTEL/Additional Video Links:  <a href="https://www.youtube.com/watch?v=wgWRLu8p90M">https://www.youtube.com/watch?v=wgWRLu8p90M</a></p> <p>Experiential Learning: (Experiments which can be conducted on the concepts of contents)</p> <p>Video Links/Any other special information(Papers): (For additional study on the concepts of contents)  <a href="https://www.youtube.com/watch?v=G3z27UaiBWg">https://www.youtube.com/watch?v=G3z27UaiBWg</a></p>	8Hrs
<b>UNIT-V</b>	
<p>Systems Development for the Industrial IoT: Challenges from Industry R&amp;D, Internet of Measurement Things: Toward an Architectural Framework for the Calibration Industry, Architecture Modeling of Industrial IoT Systems Using Data Distribution Service UML Profile, Industrial IoT Projects Based on Automation Pyramid: Constraints and Minimum Requirements, Blockchain Mechanisms Security-Enabler for Industrial IoT Applications, Visible Light Communications in Industrial Internet of Things (IIoT), Implementation of Industrial Internet of Things in the Renewable Energy Sector. Internet of Things Applications and Use Cases in the Era of Industry 4.0.</p> <p>Industrial Internet of Things and Cyber Manufacturing Systems: An Application Map for Industrial Cyber-Physical Systems, Cyber-Physical Systems Engineering for Manufacturing, Model-Based Engineering of Supervisory Controllers for Cyber-Physical Systems, Evaluation Model for Assessment of Cyber-Physical Production Systems, CPS-Based Manufacturing with Semantic Object Memories and Service Orchestration for Industrie 4.0, Applications, Integration of a Knowledge Database and Machine Vision Within a Robot-Based CPS, Introduction to Cyber-Physical System Intelligence.</p>	8Hrs

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:  <a href="https://www.youtube.com/watch?v=gq0VWSXvG0s">https://www.youtube.com/watch?v=gq0VWSXvG0s</a>	
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Course Outcomes: After completing the course, the students will be able to	
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).

Reference Books	
	The Internet of Things in the Industrial Sector, Mahmood, Zaigham (Ed.), Springer Publication. ISBN-13 978-3030248918
	Industrial Internet of Things: Cyber manufacturing System, Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat (Springer Publication). ISBN:9783319425597, 3319425595
3.	Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key Applications and Protocols, ISBN: 978-1-119-99435-0, 2nd Edition, Wiley Publications.
4.	Arsheep Bahga, Vijay Madiseti, Internet Of Things: A Hands-On Approach Paperback – Universities Press Publication, January 2015 Edition. ISBN-13 978-8173719547

### Continuous Internal Evaluation (CIE):

#### Theory for 50 Marks

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. Test portion is evaluated for 50 marks and quiz is evaluated for 10 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three (conduct additional quizzes and take best three). The three tests are conducted for 50 marks each and the average of all the tests are calculated for 50. The marks for the assignments are 20 (2 assignments for 10 marks each). The marks obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

### Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three sub divisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom’s taxonomy level.

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

Semester: V		
Supply Chain Management		
Course Code: MVJ21ME553		CIE Marks: 50
Credits: L:T:P: 3:0:0		SEE Marks: 50
Hours: 40L		SEE Duration: 3 Hrs.
Course Learning Objectives: The students will be able to		
1	To acquaint with key drivers of supply chain performance and their inter-relationships with strategy	
2	To impart analytical and problem-solving skills necessary to develop solutions for a variety of supply chain management & design problems.	
3	To study the complexity of inter-firm and intra-firm coordination in implementing programs such as e-collaboration, quick response, jointly managed inventories and strategic alliances.	
4	To study the various methods of demand forecasting and the related implementation issues. The contribution of information technology in facilitating the availability of these data is also discussed.	
5	To study the Innovative supply chain strategies that enhance supply chain performance are highlighted and an introduction to SAP	

UNIT-I	
<p>The Role of Supply Chain Management in Economy and Organization, Supply Chain Strategy and Performance Measures, Customer Service and Cost Trade-offs, Supply Chain Performance Measures, Linking Supply Chain and Business Performance, Enhancing Supply Chain Performance. Outsourcing: Make Versus Buy The Strategic Approach, Identifying Core Processes, Market Versus Hierarchy, The Make-Versus-Buy Continuum.</p> <p>Supply Chain Drivers and Metrics: Drivers of Supply Chain Performance, Framework for Structuring Drivers, Facilities, Inventory, Transportation, Information, Sourcing, Pricing, Obstacles to Achieving Fit, Competitive and Supply Chain Strategies, Achieving Strategic Fit, Expanding Strategic Scope.</p> <p>Experiential Learning: (Experiments which can be conducted on the concepts of contents)</p> <p>Video Links/Any other special information(Papers): (For additional study on the concepts of contents)</p> <ul style="list-style-type: none"> <li>• <a href="https://www.youtube.com/watch?v=IMPbKVb8y8s">https://www.youtube.com/watch?v=IMPbKVb8y8s</a> (Inside Amazon's Smart Warehouse)</li> <li>• <a href="https://www.youtube.com/watch?v=8nKPC-WmLjU">https://www.youtube.com/watch?v=8nKPC-WmLjU</a> (Amazon Fulfillment Center Tour with AWS)</li> <li>• <a href="https://www.youtube.com/watch?v=6EDCnhbUpge">https://www.youtube.com/watch?v=6EDCnhbUpge</a> (Logistics of the Future)</li> </ul>	8 Hrs
UNIT-II	
Managing Material Flow in Supply Chains : Inventory Management, Introduction, Types of Inventory. Inventory-related Costs, Ordering Costs,	8 Hrs

<p>Inventory-carrying Costs, Stockout Costs, Managing Cycle Stock, Cycle Stock Inventory Model, Managing Safety Stock, Capturing Uncertainty, Impact of Service Level on Safety Stock, Managing Seasonal Stock, Planning for Seasonal Demand.</p> <p>Transportation: Introduction, Drivers of Transportation Decisions, And Modes of Transportation: Choices and Their Performance, Measures, Devising a Strategy for Transportation, Vehicle Scheduling Transportation Costs in E-Retailing. Network Design and Operations: Facility Location: Introduction, Network Operations Planning, Network Design Problem, Network Design and Operations Models: Extensions, Data for Network Design, Strategic Role of Units in the Network, Location of Service Systems</p> <p>Experiential Learning: (Experiments which can be conducted on the concepts of contents)</p> <ul style="list-style-type: none"> <li>•Study of Supply Chain Challenges for the Indian FMCG Sector</li> <li>• Video Links/Any other special information(Papers): (For additional study on the concepts of contents)</li> <li>• <a href="https://www.youtube.com/watch?v=L24q9kl6z3s">https://www.youtube.com/watch?v=L24q9kl6z3s</a> (Improve Material Flow and Value Chain Using Process Flow Insights)</li> <li>• <a href="https://www.youtube.com/watch?v=yZC4neLax5o">https://www.youtube.com/watch?v=yZC4neLax5o</a> (Walmart Supply Chain)</li> <li>• <a href="https://www.youtube.com/watch?v=VdFx2R6diMk">https://www.youtube.com/watch?v=VdFx2R6diMk</a> (Retail Digital Supply Chains: Facing an omni channel customer-driven landscape)</li> </ul>	
<p>UNIT-III</p>	
<p>Managing Information Flow in Supply Chains: Demand Forecasting: The Role of Forecasting, Qualitative Forecasting Methods, Quantitative Methods. Information Technology in Supply Chain, Management.</p> <p>Introduction Enabling Supply Chain Management Through Information Technology, IT in Supply Chain Transaction Execution, IT in Supply Chain Collaboration and Coordination, IT in Supply Chain Decision Support, IT in Supply Chain Measurement and Reporting, Strategic Management Framework for IT Adoption in Supply Chain Management, Supply Chain Management Application Marketplace, Future Trends.</p> <p>Experiential Learning: (Experiments which can be conducted on the concepts of contents)</p> <ul style="list-style-type: none"> <li>•Impact of the Internet on Sourcing Strategy</li> <li>•Video Links/Any other special information(Papers): (For additional study on the concepts of contents)</li> <li>• <a href="https://www.youtube.com/watch?v=6EDCnhbUpgE">https://www.youtube.com/watch?v=6EDCnhbUpgE</a></li> </ul>	<p>8 Hrs</p>
<p>UNIT-IV</p>	
<p>Supply Chain Innovations: Supply Chain Integration: Introduction, Internal Integration, External Integration, Building Partnership and Trust in a Supply Chain Supply Chain External Integration: Industry-level Initiatives.</p>	<p>8 Hrs</p>

<p>Supply Chain Restructuring: Introduction, Supply Chain Mapping, Supply Chain Process Restructuring, Postpone the Point of Differentiation, Changing the Shape of the Value-addition Curve, Advance the Customer Ordering Point: Move from MTS to CTO Supply Chain.</p> <p>Experiential Learning: (Experiments which can be conducted on the concepts of contents)</p> <ul style="list-style-type: none"> <li>•Incorporating Uncertainty in Network Design</li> <li>•Transportation Strategies Followed by Retail Firms</li> </ul> <p>Video Links/Any other special information(Papers): (For additional study on the concepts of contents)</p> <ul style="list-style-type: none"> <li>•<a href="https://www.youtube.com/watch?v=_wa0NCX-1kA">https://www.youtube.com/watch?v=_wa0NCX-1kA</a></li> </ul>	
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#### UNIT-V

<p>Supply Chain Contracts: Incentive Conflicts in Supply Chains, Types of Supply Chain Contracts Effectiveness of Supply Chain Mechanisms, An introduction to Agile Supply Chains, Sustainable Supply Chain Management: Green Supply Chain Management. Pricing and Revenue Management: Pricing Revenue Management for Multiple Customer Segments, Pricing Under Capacity Constraint for Multiple Segments.</p> <p>Introduction to SAP, SAP Material Management, Procurement process, Organization structure, Enterprise structure, Master data management, purchase Info record, source list, procurement cycle, purchase requisition, request for quotation, purchase order, inventory management, invoice verification, service management, transaction code.</p> <p>Experiential Learning: (Experiments which can be conducted on the concepts of contents)</p> <ul style="list-style-type: none"> <li>•Hands on experience in SAP Software with Student edition</li> </ul> <p>Video Links/Any other special information(Papers): (For additional study on the concepts of contents)</p> <ul style="list-style-type: none"> <li>•<a href="https://www.youtube.com/watch?v=K-TWZwcybLo">https://www.youtube.com/watch?v=K-TWZwcybLo</a></li> </ul>	8 Hrs
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Course Outcomes: After completing the course, the students will be able to

CO1	Describe the Supply Chain Management and a Strategic View of Supply Chains
CO2	Plan the Managing Material Flow in Supply Chains and transportation
CO3	Develop the Managing Information Flow in Supply Chains
CO4	Plan and develop supply Chain Innovations and restructuring
CO5	Connect and correlate Supply Chain contracts and functioning of SAP software

#### Reference Books

	Supply Chain Management : Text and Cases by Janat Shah ; Second Edition, 2016 Pearson India Education Services Pvt. Ltd, ISBN 978-93-325-4820-6, eISBN 978-93-530-6252-1
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	Supply Chain Management by Sunil Chopra and Peter Meindl Pearson India Education Services Pvt. Ltd, ISBN:9780133800203, 0133800202
3.	Logistics and Supply Chain Management by MARTIN CHRISTOPHER, Pearson India Education Services Pvt. Ltd, ISBN:9781292083797, 1292083794
4.	Global Logistics and Supply Chain Management John Mangan, Chandra Lalwani, Agustina Calatayud · 2020 Pearson India Education Services Pvt. Ltd. ISBN-13978-1119702993

#### Continuous Internal Evaluation (CIE):

Theory for 50 Marks

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. Test portion is evaluated for 50 marks and quiz is evaluated for 10 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three (conduct additional quizzes and take best three). The three tests are conducted for 50 marks each and the average of all the tests are calculated for 50. The marks for the assignments are 20 (2 assignments for 10 marks each). The marks obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

#### Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three sub divisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

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	1	-	-	-	2	-	1	-	2
CO3	3	3	3	1	-	-	-	2	-	1	-	2
CO4	3	3	3	1	-	-	-	2	-	2	-	2
CO5	2	3	3	2	-	-	-	2	-	1	-	2

Semester: V		
Smart Materials and Structures (Theory)		
Course Code: MVJ21ME554		CIE Marks: 50
Credits: L:T:P: 3:0:0		SEE Marks: 50
Hours: 40 L		SEE Duration: 03 Hours
Course Learning Objectives: The students will be able to		
1	Give an insight into the latest developments regarding smart materials and their use in structures.	
2	Introduce smart materials, piezoelectric materials structures and its characteristics.	
3	Elucidate the importance of smart fluids and fiber optics for applications in smart structures	
4	Elucidate the concept of Signal Processing, Drive and Control Techniques.	
5	Elucidate the concepts of MEMS and Microfabrication.	

UNIT-I	
<b>Overview of Smart Materials, Structures and Products Technologies:</b> Smart Structures, Smart materials (Physical Properties), Piezoelectric Materials, Electrostrictive Materials, Magnetostrictive Materials, Magneto electric Materials, Magnetorheological Fluids, Electrorheological Fluids, Shape Memory Materials. <b>Smart Sensor, Actuator and Transducer Technologies:</b> Smart Sensors, Accelerometers, Force Sensors, Load Cells, Torque Sensors, Pressure Sensors, Impact Hammers.	8 Hrs
UNIT-II	
<b>Design, Analysis, Manufacturing and Applications of Engineering Smart Structures and Products:</b> Case studies incorporating design, analysis, manufacturing and application issues involved in integrating smart materials and devices with signal processing and control capabilities to engineering smart structures and products; Emphasis on structures, automation and precision manufacturing equipment, automotives, consumer products, sporting products, computer and telecommunications products, as well as medical and dental tools and equipment.	8 Hrs
UNIT-III	
<b>Electro rheological and Magneto rheological Fluids:</b> Mechanisms and Properties, Characteristics, Fluid composition and behaviour, Discovery and Early developments, Summary of material properties. Applications of ER and MR fluids (Clutches, Dampers, others). <b>Fibre Optics:</b> Introduction, Physical Phenomenon, Characteristics, Fibre optic strain sensors, Twisted and Braided Fibre Optic sensors, Optical fibres as load bearing elements, Crack detection applications, Integration of Fibre optic sensors and shape memory elements.	8 Hrs
UNIT-IV	
<b>Measurement, Signal Processing, Drive and Control Techniques:</b> Quasi - static and Dynamic Measurement Methods; Signal conditioning devices; Constant voltage, Constant-current and Pulse drive methods; Calibration	8 Hrs



methods; Structural dynamics and Identification techniques; Passive, Semi - active and Active control; Feedback and feed forward/control strategies. <b>Data Acquisition and Processing</b> – Signal Processing and Control for Smart Structures – Sensors as Geometrical Processors – Signal Processing – Control System – Linear and Non-Linear.	
<b>UNIT-V</b>	
<b>MEMS:</b> History of MEMS, Intrinsic Characteristics, and Devices: Sensors and Actuators. Microfabrication: Photolithography, Thermal oxidation, Thin film deposition, etching types, Doping, Dicing, Bonding. Microelectronics fabrication process flow, Silicon based, Process selection and design. <b>Piezoelectric Sensing and Actuation:</b> Introduction, Cantilever Piezoelectric actuator model, Properties of Piezoelectric materials, Applications. Magnetic Actuation: Concepts and Principles.	<b>8 Hrs</b>

<b>Course Outcomes: After completing the course, the students will be able to</b>	
CO1	Define the basic concepts of smart materials, structures and products technology
CO2	Understand Design, Analysis, Manufacturing and Applications of Engineering Smart Structures and Products
CO3	Understand the application of smart fluids.
CO4	Understand the principle of Measurement, Signal Processing, Drive and Control Techniques.
CO5	Get Knowledge on MEMS and MEMS fabrication techniques.

<b>Reference Books</b>	
1.	A.V.Srinivasan, "Smart Structures –Analysis and Design", Cambridge University Press, New York, 2001, (ISBN:0521650267).
2.	V. K. Varadan, K. J. Vinoy, S. Gopalakrishnan, "Smart Material Systems and MEMS: Design and Development Methodologies", John Wiley and Sons, England, 2006.
3.	M.V.Gandhi and B.S.Thompson, "Smart Materials and Structures" Chapman & Hall, London, 1992 (ISBN:0412370107)
4.	Chang Liu "Foundation of MEMS", Pearson Education. (ISBN:9788131764756)
<b>Web links and Video Lectures (e-Resources):</b>	
1. Prof. Nachiketa Tiwari, Prof. Bishakh Bhattacharya, Smart Material, Adaptive Structures and Intelligent Mechanical Systems - IITK, IIT Kanpur, <a href="https://nptel.ac.in/courses/112104173">https://nptel.ac.in/courses/112104173</a>	

### Continuous Internal Evaluation (CIE):

#### Theory for 50 Marks

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. Test portion is evaluated for 50 marks and quiz is evaluated for 10 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three (conduct additional quizzes and take best three). The three tests are conducted for 50 marks each and the average of all the tests are calculated for 50. The marks for the self -study are 20 (2 presentations are held for 10 marks each).



Semester: V		
Theory of Elasticity (Theory)		
Course Code: MVJ21ME555		CIE Marks: 50
Credits: L:T:P: 3:0:0		SEE Marks: 50
Hours: 40 L		SEE Duration: 03 Hours
Course Learning Objectives: The students will be able to		
1	Gain knowledge of stresses and strains in 3D and their relations and thermal stresses.	
2	Understand the 2D analysis of elastic structural members.	
3	Analysis elastic members for the stresses and strains induced under direct loading conditions.	
4	Analyse the thermal stresses induced in disks and cylinders.	

<b>UNIT-I</b>	
<p>Analysis of Stress: Definition and Notation for forces and stresses. Body force, surface force Components of stresses, equations of Equilibrium, Specification of stress at a point. Principal stresses maximum and minimum shear stress. Mohr's Circle Diagram</p> <p>Mohr's diagram in three dimensions. Boundary conditions. Stress components on an arbitrary plane, Stress invariants, Octahedral stresses, Decomposition of state of stress, deviator and spherical stress tensors, Stress transformation, Numericals.</p> <p>Laboratory Sessions/ Experimental learning: conduction of Mohr's test for ductile materials.</p> <p>Video link: <a href="https://nptel.ac.in/courses/112/102/112102284/">https://nptel.ac.in/courses/112/102/112102284/</a></p>	8 Hrs
<b>UNIT-II</b>	
<p>Deformation and Strain: Deformation, Strain Displacement relations, Strain components, The state of strain at a point, Principal strain, strain invariants, Strain transformation</p> <p>Compatibility equations: Cubical dilatation, spherical and deviator strains, plane strain, Mohr's circle, and compatibility equation, Numericals.</p> <p>Laboratory Sessions/ Experimental learning: Analyzing the different materials for their yielding stresses and strains using photo elasticity.</p> <p>Video link: <a href="https://www.youtube.com/watch?v=eICv1p8WjgI&amp;list=PLbRMhDVUMngcbhsZgRWuYCi2kKQwQ0Av1">https://www.youtube.com/watch?v=eICv1p8WjgI&amp;list=PLbRMhDVUMngcbhsZgRWuYCi2kKQwQ0Av1</a></p>	8 Hrs
<b>UNIT-III</b>	
<p>Two Dimensional Problems in Cartesian Co-Ordinates: Airy's stress function, investigation of simple beam problems. Bending of a narrow cantilever beam under end load, simply supported beam with uniform load.</p>	8 Hrs

Use of Fourier series to solve two dimensional problems. Existence and uniqueness of solution, Saint -Venant's principle, Principle of super position and reciprocal theorem.	
Laboratory Sessions/ Experimental learning: Analyzing the different materials for their yielding stresses and strains using photo elasticity. Video link: <a href="https://www.youtube.com/watch?v=YpOy_z2oRDc&amp;list=PL0bRAs68fCS310qm-k2ccRa6fZTc0kxCR">https://www.youtube.com/watch?v=YpOy_z2oRDc&amp;list=PL0bRAs68fCS310qm-k2ccRa6fZTc0kxCR</a>	
<b>UNIT-IV</b>	
Two Dimensional Problems in Polar Co-Ordinates: General equations, stress distribution symmetrical about an axis, Strain components in polar co-ordinates, Rotating disk and cylinder, Concentrated force on semi-infinite plane, Stress concentration around a circular hole in an infinite plate.	8 Hrs
Laboratory Sessions/ Experimental learning: Analyzing the different materials for their yielding stresses and strains using photo elasticity. Video link: <a href="https://www.youtube.com/watch?v=YpOy_z2oRDc&amp;list=PL0bRAs68fCS310qm-k2ccRa6fZTc0kxCR">https://www.youtube.com/watch?v=YpOy_z2oRDc&amp;list=PL0bRAs68fCS310qm-k2ccRa6fZTc0kxCR</a>	
<b>UNIT-V</b>	
Relations and the General Equations of Elasticity: Generalized Hooke's law in terms of engineering constants. Formulation of elasticity Problems. Thermal Stresses: Introduction, Thermo-elastic stress -strain relations, thin circular disc, long circular cylinder.	8 Hrs
Laboratory Sessions/ Experimental learning: Analyzing the different materials for their thermal stresses and strains. Video link: <a href="https://www.youtube.com/watch?v=YpOy_z2oRDc&amp;list=PL0bRAs68fCS310qm-k2ccRa6fZTc0kxCR">https://www.youtube.com/watch?v=YpOy_z2oRDc&amp;list=PL0bRAs68fCS310qm-k2ccRa6fZTc0kxCR</a>	

<b>Course Outcomes: After completing the course, the students will be able to</b>	
CO1	Describe the state of stress and strain in 2D and 3D elastic members subjected to direct loads and thermal loads.
CO2	Analyse the structural members: beam, rotating disks, columns
CO3	Analyse the thermal stresses induced in disks and cylinders.
CO4	Describe the state of stress and strain in 2D and 3D elastic members subjected to direct loads and thermal loads.
CO5	Get Knowledge on General Equations of Elasticity

<b>Reference Books</b>	
1.	Timoshenko and Goodier, "Theory of Elasticity"-Tata McGraw Hill, New Delhi,3rd edition , 1970.
2.	L S Srinath "Advanced Mechanics of Solids"- Tata McGraw Hill, New Delhi, 3rd edition, 2010
3.	G. Thomas Mase, Ronald E. Smelser, George. E. Mase, Continuum Mechanics for



Semester: V		
ENVIRONMENTAL STUDIES		
Course Code: MVJ21CV56		CIE Marks: 50
Credits: L:T:P: 1:0:0		SEE Marks: 50
Hours: 15 L		SEE Duration: 2 Hrs.
Course Learning Objectives: The students will be able to		
1	Relate interdisciplinary approach to complex environmental problems using basic tools of the natural and social sciences including geo-systems, biology, chemistry, economics, political science and international processes	
2	Study drinking water quality standards and to illustrate qualitative analysis of water.	
3	Critically evaluate the science and policy ramifications of diverse energy portfolios on air and water quality, climate, weapons proliferation and societal stability.	

UNIT-I	
<p><b>Introduction</b> to environmental studies, Multidisciplinary nature of environmental studies; Scope and importance; Concept of sustainability and sustainable development.</p> <p><b>Ecosystems (Structure and Function):</b> Forest, Desert, Rivers, Ocean</p> <p><b>Biodiversity:</b> Types, Hot spots; Threats and Conservation of biodiversity, Deforestation.</p> <p>Video link: <a href="https://nptel.ac.in/courses/127/106/127106004/">https://nptel.ac.in/courses/127/106/127106004/</a></p>	3 Hrs
UNIT-II	
<p><b>Advances in Energy Systems</b> (Merits, Demerits, Global Status and Applications): Hydrogen, Solar, Tidal and Wind.</p> <p><b>Natural Resource Management (Concept and case-study):</b> Disaster Management, Sustainable Mining and Carbon Trading.</p> <p>Video link: <a href="https://nptel.ac.in/courses/121/106/121106014/">https://nptel.ac.in/courses/121/106/121106014/</a></p>	3 Hrs
UNIT-III	
<p><b>Environmental Pollution:</b> Surface and Ground Water Pollution, Noise pollution, Soil Pollution and Air Pollution.</p> <p><b>Waste Management &amp; Public Health Aspects:</b> Bio-medical Waste, Solid waste, Hazardous waste and E-waste.</p> <p>Video link:</p>	3 Hrs

<ul style="list-style-type: none"> <li>• <a href="https://nptel.ac.in/courses/122/106/122106030/">https://nptel.ac.in/courses/122/106/122106030/</a></li> <li>• <a href="https://nptel.ac.in/courses/105/103/105103205/">https://nptel.ac.in/courses/105/103/105103205/</a></li> <li>• <a href="https://nptel.ac.in/courses/120/108/120108005/">https://nptel.ac.in/courses/120/108/120108005/</a></li> <li>• <a href="https://nptel.ac.in/courses/105/105/105105160/">https://nptel.ac.in/courses/105/105/105105160/</a></li> </ul>	
<b>UNIT-IV</b>	
<b>Global Environmental Concerns</b> (Concept, policies, and case-studies): Global Warming, Climate Change, Acid Rain, Ozone Depletion and Fluoride problem in drinking water.  Video link: <ul style="list-style-type: none"> <li>• <a href="https://nptel.ac.in/courses/122/106/122106030/">https://nptel.ac.in/courses/122/106/122106030/</a></li> <li>• <a href="https://nptel.ac.in/courses/120108004/">https://nptel.ac.in/courses/120108004/</a></li> <li>• <a href="https://onlinecourses.nptel.ac.in/noc19_ge23/preview">https://onlinecourses.nptel.ac.in/noc19_ge23/preview</a></li> </ul>	<b>3 Hrs</b>
<b>UNIT-V</b>	
<b>Latest Developments in Environmental Pollution Mitigation Tools (Concept and Applications):</b> G.I.S. & Remote Sensing, Environment Impact Assessment, Environmental Management Systems.  Video link: <ul style="list-style-type: none"> <li>• <a href="https://nptel.ac.in/courses/105/102/105102015/">https://nptel.ac.in/courses/105/102/105102015/</a></li> <li>• <a href="https://nptel.ac.in/courses/120/108/120108004/">https://nptel.ac.in/courses/120/108/120108004/</a></li> </ul>	<b>3 Hrs</b>

<b>Course Outcomes: After completing the course, the students will be able to</b>	
CO1	Describe 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
CO5	Describe the realities that managers face when dealing with complex issues.

<b>Reference Books</b>	
1.	Principals of Environmental Science and Engineering, Raman Siva kumar, Cengage learning, Singapur, 2 <sup>nd</sup> Edition, 2005.
2.	Environmental Science – working with the Earth G.Tyler Miller Jr. Thomson Brooks /Cole, 11 <sup>th</sup> Edition, 2006
3.	Textbook of Environmental and Ecology, Pratiba Singh, Anoop Singh & Piyush Malaviya , ACME Learning Pvt. Ltd. New Delhi, 1 <sup>st</sup> Edition.

### Continuous Internal Evaluation (CIE):

#### Theory for 50 Marks

CIE for 50 marks, executed by way of tests (T) and assignments. A minimum of three quizzes are conducted along with tests. Test portion is evaluated for 40 marks and assignment is evaluated for 10 marks. The three tests are conducted for 40 marks each and the average of all the tests are calculated for 40. The marks for the assignments are 10 (2 assignments for 5 marks each). The marks obtained in test and assignment are added and report CIE for 50 marks.

### Semester End Examination (SEE):

SEE for 50 marks, executed by means of an examination. The Question paper contains objective type questions for 100 marks covering the entire syllabus having same complexity in terms of COs and Bloom's taxonomy level.

Total marks: 50+50=100

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



Semester: V		
UNIVERSAL HUMAN VALUES		
Course Code: MVJ21UHV58		CIE Marks: 50
Credits: L:T:P: 2:0:0		SEE Marks: 50
Hours: 30 L		SEE Duration: 3 Hrs.
<b>Course Learning Objectives: The students will be able to</b>		
1	Appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.	
2	Facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.	
3	Highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.	

UNIT-I	
<p><b>Introduction to Value Education:</b> Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education), Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to Fulfill the Basic Human Aspirations.</p> <p><b>Practical Sessions:</b> (1) Sharing about Oneself (2) Exploring Human Consciousness (3) Exploring Natural Acceptance</p> <p>Video link:</p> <ul style="list-style-type: none"> <li>• <a href="https://www.youtube.com/watch?v=85XCw8SU084">https://www.youtube.com/watch?v=85XCw8SU084</a></li> <li>• <a href="https://www.youtube.com/watch?v=E1STJoXCXUU&amp;list=PLWDeKF97v9SP_Kt6jqzA3p_Z3yA7g_OAQz">https://www.youtube.com/watch?v=E1STJoXCXUU&amp;list=PLWDeKF97v9SP_Kt6jqzA3p_Z3yA7g_OAQz</a></li> <li>• <a href="https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEKQw">https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEKQw</a></li> </ul>	<b>6 Hrs</b>
UNIT-II	
<p><b>Harmony in the Human Being:</b> Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health.</p> <p><b>Practical Sessions:</b> (4) Exploring the difference of Needs of Self and Body (5)</p>	<b>6 Hrs</b>

<p>Exploring Sources of Imagination in the Self (6) Exploring Harmony of Self with the Body</p> <p>Video link:</p> <ul style="list-style-type: none"> <li>• <a href="https://www.youtube.com/watch?v=GpuZo495F24">https://www.youtube.com/watch?v=GpuZo495F24</a></li> <li>• <a href="https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw">https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw</a></li> </ul>	
<b>UNIT-III</b>	
<p><b>Harmony in the Family and Society:</b> Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order.</p> <p><b>Practical Sessions:</b> (7) Exploring the Feeling of Trust (8) Exploring the Feeling of Respect (9) Exploring Systems to fulfill Human Goal</p> <p>Video link:</p> <ul style="list-style-type: none"> <li>• <a href="https://www.youtube.com/watch?v=F2KVV4WNnS">https://www.youtube.com/watch?v=F2KVV4WNnS</a></li> <li>• <a href="https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw">https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw</a></li> </ul>	<b>6 Hrs</b>
<b>UNIT-IV</b>	
<p><b>Harmony in the Nature/Existence:</b> Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfillment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence.</p> <p><b>Practical Sessions:</b> (10) Exploring the Four Orders of Nature (11) Exploring Co-existence in Existence</p> <p>Video link:</p> <ul style="list-style-type: none"> <li>• <a href="https://www.youtube.com/watch?v=1HR-QB2mCF0">https://www.youtube.com/watch?v=1HR-QB2mCF0</a></li> <li>• <a href="https://www.youtube.com/watch?v=lfN8q0xUSpw">https://www.youtube.com/watch?v=lfN8q0xUSpw</a></li> <li>• <a href="https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw">https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw</a></li> </ul>	<b>6 Hrs</b>
<b>UNIT-V</b>	
<p><b>Implications of the Holistic Understanding – a Look at Professional Ethics:</b> Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics, Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession</p> <p><b>Practical Sessions:</b> (12) Exploring Ethical Human Conduct (13) Exploring Humanistic Models in Education (14) Exploring Steps of Transition towards Universal Human Order</p> <p>Video link:</p> <ul style="list-style-type: none"> <li>• <a href="https://www.youtube.com/watch?v=BikdYub6RY0">https://www.youtube.com/watch?v=BikdYub6RY0</a></li> </ul>	<b>6 Hrs</b>

• <a href="https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEKQw">https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEKQw</a>	
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Course Outcomes: After completing the course, the students will be able to	
CO1	Explore themselves, get comfortable with each other and with the teacher
CO2	Enlist their desires and the desires are not vague.
CO3	Restate that the natural acceptance (intention) is always for living in harmony, only competence is lacking
CO4	Differentiate between the characteristics and activities of different orders and study the mutual fulfillment among them
CO5	Present sustainable solutions to the problems in society and nature

Reference Books	
1.	AICTE SIP UHV-I Teaching Material, <a href="https://fdp-si.aicte india.org/AicteSipUHV_download.php">https://fdp-si.aicte india.org/AicteSipUHV_download.php</a>
2.	A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
3.	Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2
4.	Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

#### Continuous Internal Evaluation (CIE):

CIE for 50 marks is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. Test portion is evaluated for 50 marks and quiz is evaluated for 10 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three (conduct additional quizzes and take best three). The three tests are conducted for 50 marks each and the average of all the tests are calculated for 50. The marks for the assignments are 20 (2 assignments for 10 marks each). The marks obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

#### Semester End Examination (SEE):

SEE for 50 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three sub divisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

**Total marks: 50+50=100**

CO-PO Mapping

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