Semester: III		
Transforms and Statistical Methods (Theory)		
Course Code	MVJ21MME31	CIE Marks: 50
Credits	L:T:P:: 3:2:0	SEE Marks: 50
Hours	30L+20T	SEE Duration: 3 Hrs.
Course Learning Objectives: The students will be able to		
1	Comprehend and use of analytical and numerical methods in different engineering fields.	
2	Apprehend and apply Fourier Series.	
3	Realize and use of Fourier transforms.	
4	Realize and use of Z-Transforms.	
5	Use of statistical methods in curve fitting applications.	

UNIT-I	
Laplace Transform: Definition and Laplace transforms of elementary functions. Laplace transforms of Periodic functions and unit-step function and problems. **Inverse Laplace Transform**: Definition and problems, Convolution theorem to find the inverse Laplace transforms and problems. **Applications**: Solution of linear differential equations using Laplace transforms. Self study topic: Derivations of Laplace transforms of elementary functions, Unit impulse function-problems. **Web Link and Video Lectures**: https://nptel.ac.in/courses/111106139	10 Hrs
UNIT-II	
Fourier series: Recapitulation of Series, Continuous and Discontinuous functions, Periodic functions, Dirichlet's condition, Fourier series of periodic functions of period 2π and arbitrary period $2l$, Half-range Fourier sine and cosine series, Practical Harmonic Analysis and Problems. **Web Link and Video Lectures**: https://nptel.ac.in/courses/111106111/	10 Hrs
UNIT-III	
Fourier transforms: Infinite Fourier transform, Infinite Fourier sine and cosine transforms, Inverse Fourier transforms, Inverse Fourier sine and cosine transforms, Convolution theorem. **Web Link and Video Lectures**: https://nptel.ac.in/courses/111105123	10 Hrs
UNIT-IV	
Z-Transforms: Difference equations, basic definition, Z-transform -definition,	10 Hrs

Properties of Z-transforms, Standard Z-transforms, damping rule, Shifting rule, Initial value and final value theorems - problems, Inverse Z-transform. **Applications**: Application of Z- transforms to solve difference equations. Self study topic: Proof of Initial value and final value theorems. **Web Link and Video Lectures**: https://nptel.ac.in/courses/108104100	
UNIT-V	
Curve Fitting: Curve fitting by the method of least squares. Fitting of the curves of the form $y = ax + b$, $y = ax^2 + bx + c$, $y = ae^{bx}$. **Statistical Methods**: Introduction, Correlation and coefficient of correlation, Regression, lines of regression and problems. Self study topic: Fitting of the curves of the form $\boldsymbol{y = ax^b}$. **Web Link and Video Lectures**: https://nptel.ac.in/courses/111105042	10 Hrs

Course Outcomes: After completing the course, the students will be able to	
CO1	Use Laplace transform and inverse transforms techniques in solving differential equations.
CO2	Communications, Know the use of periodic signals and Fourier series to analyze circuits and system.
CO3	Demonstrate Fourier Transform as a tool for solving Integral equations.
CO4	Apply Z Transform to solve Difference Equation.Use Method of Least Square for appropriate Curves.
CO5	Fit a suitable curve by the method of least squares and determine the lines of regression for a set of statistical data.

Reference Books	
1.	B.S. Grewal, "Higher Engineering Mathematics" Khanna Publishers, 43rd Edition, 2013.
2.	Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley-India publishers, 10th edition,2014.
3.	Ramana B. V., "Higher Engineering Mathematics", Tata Mc Graw-Hill, 2006.
4.	Bali N. P. & Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 8th Edition.

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	3	0	3	0	0	0	0	0	0	1	0
CO2	3	3	0	3	0	0	0	0	0	0	0	1
CO3	2	3	0	3	0	0	0	0	0	0	1	0
CO4	3	3	0	3	0	0	0	0	0	0	0	0
CO5	3	3	0	2	0	0	0	0	0	0	0	1

High-3, Medium-2, Low-1

Semester: III		
ENGINEERING THERMODYNAMICS (Theory)		
Course Code: MVJ21ME32		CIE Marks:50
Credits: L:T:P:S: 4:0:0		SEE Marks: 50
Hours: 50L		SEE Duration: 3 Hrs

Course Learning Objectives: The students will be able to	
1	To be able to learn and understand basic concepts & definitions of thermodynamics
2	To be able to use the First and Second Law of Thermodynamics to estimate thermo-mechanical energy conversion and performance parameters
3	To be able to apply thermodynamics principles to air standard cycles with the help of PV and Ts diagrams
4	To be able to apply thermodynamics principles to vapor power cycles
5	To be able to make performance analysis of reciprocating air compressors and optimization of compression

UNIT-I	
Fundamental Concepts & Definitions: Introduction to Thermodynamics; definitions thermodynamics, concepts of thermodynamics, Thermodynamic equilibrium; definition, mechanical equilibrium; diathermic wall, thermal equilibrium, chemical equilibrium- Zeroth law of thermodynamics, Temperature; concepts, scales, measurement *Work & Heat:* Definition of work and its limitations. Thermodynamic definition of work; examples, sign convention. Displacement work; expressions for displacement work in various processes through p-v diagrams. Shaft work; Electrical work. Other types of work. Heat; definition, units, and sign convention. **Experiential Learning**: IC Engines, Thermometers, Dynamometer, Compressors etc. **Video Links/Any other special information:** 1. https://www.youtube.com/watch?v=WFMIzS2jQQg&t=48s 2. https://nptel.ac.in/courses/112105123	10 Hrs
UNIT-II	
Pure substances: Definition, phase change of a pure substance, Phase change terminology & definitions, Important terms relating to steam formation. p-V, T-s and h-s diagrams. (No numerical examples) **Ideal & Real Gases**: Introduction and definition of ideal gas, The equation of state of a perfect gas, Specific heat capacities. Introduction and definition of real gases, Van der Waal's equation, Reduced properties, Law of corresponding states, Compressibility charts. (No numerical examples) **Experiential Learning:** Steam formation experimentation in lab. **Video link / Additional online information:** 1. https://youtu.be/wjvIZDwIKaE 2. https://youtu.be/HoodenvNcTc 3. https://youtu.be/tlaKcBB_C9E 4. https://youtu.be/BKLW0MyoyAg 5. https://www.youtube.com/watch?v=HoodenvNcTc	10 Hrs

UNIT-III	
First Law of Thermodynamics: Statement of the First law of thermodynamics, energy, energy as a property, modes of energy, Specific heat at constant volume, enthalpy, specific heat constant pressure. steady state-steady flow energy equation, important applications. *Second Law of Thermodynamics:* Thermal reservoir. Direct heat engine; schematic representation and efficiency. Reserved heat engine, coefficients of performance. Kelvin - Planck statement of the Second law of Thermodynamic; PMM I & PMM II Clausius's statement of Second law of Reversible and irreversible processes; Introduction to Entropy, its importance and definition (No derivations) **Experiential Learning**: Compressors, Turbines, IC engines, Refrigerator, Heat Pump etc **Video Links/Any other special information**: 1. https://www.youtube.com/watch?v=10FlW80XN64 2. https://nptel.ac.in/courses/112104113/ 3. https://www.youtube.com/watch?v=cobFAMZDS0o 4. 2. https://nptel.ac.in/courses/112108148/	10 Hrs
UNIT-IV	
Air Standard and Gas power cycles: Carnot cycle, Air standard Otto, Diesel, and Dual cycles, efficiency derivation. Ideal Brayton cycle, effect of reheat, regeneration and Intercooling- (Simple numerical problems on Otto, Diesel, Dual and ideal Brayton cycle only.). **Vapor Power Cycle**: Steam power plant, Ideal and actual Rankine Cycles. Effect of pressure and temperature on Rankine cycle performance. Reheat Cycle, Ideal Regenerative Cycle, Regenerative Cycle with feed water heaters. Binary Vapor Cycle. Problems. **Experiential Learning**: Heat engines of all types form a very important and commercially used application based on thermodynamic principles. **Video link / Additional online information**: 1. https://youtu.be/LDXLOCTeJQE, 2. https://youtu.be/b5SPb6NHna4, 3. https://youtu.be/PB7n8Y74890 4. https://youtu.be/4-BI22Wx4Pc, 5. https://youtu.be/vt1_7f5l3hI, 6. https://youtu.be/NtoTpeWAAWc	10 Hrs
UNIT-V	
Reciprocating Compressors: Operation of a single stage reciprocating compressors. Work input through p-v diagram and steady state steady flow analysis. Effect of Clearance and Volumetric efficiency. Adiabatic, Isothermal and Mechanical efficiencies. Multi-stage compressor, saving in work, Optimum intermediate pressure, Inter-cooling, Minimum work for compression. **Experiential learning**: • Performance analysis of air compressor will be analyzed by conducting the experiment related to air compressor available in Fluid mechanics and machines laboratory. **Video link / Additional online information**: 1. https://youtu.be/zX8PnPCGRLE	10 Hrs

Course Outcomes: After completing the course, the students will be able to	
CO1	Define the basic concepts of thermodynamics like systems, equilibrium, process etc. Identify different work n heat interactions
CO2	Understand pure substance, real and ideal gases and its use in thermodynamics
CO3	Understand first & second laws of TD, Entropy and its applications
CO4	Application of TD to air standard. And Vapor power cycles,
CO5	Application of TD to reciprocating air compressors

Reference Books	
1.	B K Venkanna & Swati B V, Basic & Applied Thermodynamics, PHI Learning, 2011
2.	P K Nag, Engineering Thermodynamics, Tata McGraw-Hill Education, 2005
3.	R K Rajput, "Engineering Thermodynamics", Laxmi Publications Pvt. Ltd., Sixth Edition, 2023
4.	Yunus A Cengel; Michael A Boles, Thermodynamics: An Engineering Approach (SIE) Paperback – 1 July 2017, McGraw Hill Education, ISBN-13: 978-9339221652

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	3	3	3	2	0	0	0	0	0	1	0
CO2	3	3	2	3	0	2	0	0	0	0	0	1
CO3	2	3	3	3	2	0	0	0	0	0	1	0
CO4	3	3	2	3	0	0	0	0	0	0	0	0
CO5	3	3	3	2	0	1	0	0	0	0	0	1

High-3, Medium-2, Low-1

Semester: III		
Mechanics of Materials (Theory)		
Course Code: MVJ21ME33		CIE Marks:50
Credits: L:T:P:S: 2:2:0:0		SEE Marks: 50
Hours: 20L+20T		SEE Duration: 3 Hrs
Course Learning Objectives: The students will be able to		
1	To study the distribution of various stresses in mechanical elements that deform under various loads.	
2	To study the distribution of various stresses in mechanical elements that deform under various loads.	

UNIT-I	
Stresses and Strains: Stress and strain due to axial force, elastic limit, Hooke's law-factor of safety - stepped bars, uniformly varying sections, stresses in composite bar due to axial force and temperature. Strain Energy due to axial force- proof resilience, stresses due to gradual load, sudden load and impact load. **Experiential Learning:** The material property like modulus of elasticity can also be found for different engineering materials like copper, bronze, aluminium apart from mild steel (Material testing lab can be used). **Applications**: The students will be asked to find stresses and strains induced in various applications like, chair/bench where the students are sitting, strain in the shoe while jogging, in the concrete building etc **Video link**: https://www.mtu.edu/materials/k12/experiments/tensile/.	8 Hrs
UNIT-II	
Changes in Dimensions and Volume: Lateral strain - Poisson's ratio, volumetric strain, changes in dimensions and volume, shear stress, shear strain, relationship between elastic constants. Hoop and Longitudinal stresses in thin cylindrical and spherical shells under internal pressure-changes in dimensions and volume. **Experiential Learning:** A practical observation of strain gauges will be given, one of the most important sensors of the electrical measurement technique applied to the measurement of mechanical quantities like forces, pressure etc (metrology and measurement lab can be used). **Applications**: Change in dimensions in all three directions for different geometrical cross sections like square, rectangle can be found for a minimum two different materials. **Video link**: https://www.youtube.com/watch?v=qHi8FPnWP6E	8 Hrs
UNIT-III	
Principal Stresses and Strains: (Two dimensional only) State of stress at	Hrs

a point - normal and tangential stresses on a given plane, principal stresses and their planes, plane of maximum shear stress, analytical method, Mohr's circle method, application to simple problems, Strain Rosettes. **Experiential Learning:** Material subjected to 2D state of stress (wood and ply wood) and its analysis can be thought using Ansys software under static condition (Computer Aided Modelling and Analysis lab can be used). **Applications:** Mohr's circle can be used to find the principal plane in wood materials. **Videolink:** https://www.youtube.com/watch?v=wbkvJmUEKHY	
UNIT-IV	
Bending Moment and Shear Force: Relationship between load, shear force and bending moment -shear force and bending moment diagrams for cantilever, simply supported and overhanging beams under concentrated loads, uniformly distributed loads,uniformly varying loads, concentrated moments, maximum bending moment and point of contra flexure. *Flexure in Beams:* Theory of simple bending and assumptions - derivation of equation, section modulus, normal stresses due to flexure. **Experiential Learning:** A cantilever and simply supported beam subjected to different types of loads like point load, UDL, UVL couple can be thought using Ansys software under static condition (Computer Aided Modelling and Analysis lab can be used). **Applications:** The importance of the beam cross section for a particular loading. **Video link:** https://www.youtube.com/watch?v=-9DYHrqq51E	Hrs
UNIT-V	
Deflection of Determinate Beams: Governing differential equation - Macaulay's method-moment area method, application to simple problems; Bending moment and shear force diagram of a typical shaft, elastic instability, Euler Formula. *Torsion:* Theory of torsion and assumptions-derivation of the equation, polar modulus, stresses in solid and hollow circular shafts, power transmitted by a shaft, close coiled helical spring with axial load. **Experiential Learning:** Dynamic analysis of a shaft subjected to torque can be thought using Ansys software (Computer Aided Modelling and Analysis lab can be used). **Applications:** A propeller shaft of an automobile which transmits power and motion from engine to the wheels. **Video link:** https://www.youtube.com/watch?v=cZwg6XYpzRw	Hrs

Course Outcomes: After completing the course, the students will be able to	
CO1	Apply mathematical knowledge to Calculate the deformation behavior of simple structures.
CO2	Critically analyze problem and solve the problems related to mechanical elements and analyze the deformation behavior for different types of loads.

CO3	Analyze the deflection in beams.
CO4	Analyze buckling and bending phenomenon in columns, struts and beams.
CO5	Analysis of shaft for various cross sections.

Reference Books	
1.	Bedi D S, "*Strength of Materials*", S Chand and Co. Ltd., New Delhi, 2019.
2.	Ramamrutham S and Narayan R, "*Strength of Materials*", Dhanpat Rai and Sons, New Delhi, 1997.
3.	Popov E P, "*Mechanics of Materials*", Prentice Hall Inc., Englewood Cliffs, New Jersey, 2015.
4.	S S Bhavikatti Strength of Materials Paperback – 1 Vikas Publishing House Pvt Ltd. ISBN: 9788125927914, 9788125927914

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

Semester: III		
Materials Engineering (Theory and Practice)		
Course Code: MVJ21ME34		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

Course Learning Objectives: The students will be able to	
1	Provide basic background for selection of materials for a wide range of products in engineering applications.
2	Introduce the concept of crystal structure, atomic planes and directions and identify imperfections in solids.
3	Elucidate phase stabilities and phase diagrams and identify the mechanism of phase transformations.
4	Enumerate different metals and alloys and elucidate various heat treatment and power metallurgy techniques.
5	Elucidate the corrosion and failure mechanisms in metals and alloys, and introduce composite materials.

UNIT-I	
Introduction: Basics of Engineering Materials, their Classifications and Application, Basics of Advance Engineering Materials, Engineering requirements of materials, Properties of engineering materials, Criteria for selection of materials for engineering Applications. **Crystal Structure**: Crystal Lattice, Unit Cell, Planes and directions in a lattice, Planar Atomic Density, packing of atoms and packing fraction, Classification and Coordination of voids, Bragg's Law. Imperfections in Solids: Types of imperfections, Point defects: vacancies, interstitials, line defects, 2-D and 3D-defects, Diffusion-Fick's laws, role of imperfections in diffusion.	8 Hrs
UNIT-II	
Solidification and Theory of Alloys: Solidification of metals and an alloy, Nucleation and Growth during freezing of pure metal and alloy ingot/a casting Resultant macrostructures; Effects of Structure on Mechanical Properties. **Phase and Phase equilibrium**: Unary and Binary equilibrium phase diagrams, Hume- Rothery Rules, Gibbs Phase Rule, Lever Rule, Fe-C equilibrium diagram, Different reactions like eutectic, eutectoid, peritectic and peritectoid; Non-equilibrium cooling.	8 Hrs
UNIT-III	
Heat treatment: Annealing, Normalizing, hardening, Tempering, Nitriding, Cyaniding, Induction Hardening and Flame Hardening, Recent advances in heat treat technology. TTT diagram, microstructural effects brought about by these processes and their influence on mechanical properties. **Powder metallurgy**: Introduction, Powder Production Techniques: Different Mechanical and Chemical methods, Characterization of powders (Particle Size & Shape Distribution), Powder Shaping: Particle Packing Modifications,	8 Hrs

Lubricants & Binders, Powder Compaction & Process, Sintering and Application of Powder Metallurgy.	
UNIT-IV	
Corrosion and surface coating: Introduction to corrosion, types of corrosion, mechanism of corrosion, corrosion prevention techniques coating materials, coating technologies, types of coating, advantages and limitations. **Failure of Materials**: Ductile and brittle failure mechanisms, Tresca, Von-mises, Maximum normal stress, Mohr-Coulomb and Modified Mohr-Coulomb theories, yield locus plots, fatigue failure, SN curve, endurance and fatigue limits, modified goodman diagram, creep failure, fracture mechanics, Griffith criterion.	8 Hrs
UNIT-V	
Metals and Alloys: Carbon and alloy steels-stainless steel and tool steel, maraging steel, cast iron-grey, white, malleable and spheroidal cast iron; Copper and Copper alloys-Brass, Bronze and Cupro-Nickel alloys; Aluminium Alloys, Magnesium Alloys, Nickel based super alloys and Titanium alloys. **Composite Materials**: Introduction, Classification, Metal Matrix Composites, Ceramic Matrix Composites, Polymer Matrix Composites, Natural fiber reinforced composites, Advantages, Limitations, Properties and Applications.	8 Hrs
LABORATORY EXPERIMENTS	
1. To determine the hardness values of different metal specimens by Rockwell/Vickers hardness testing machine. 2. To determine the hardness values of different metal specimens by Brinell hardness testing machine. 3. To determine the tensile strength, modulus of elasticity, yield stress, % of elongation and % of reduction in area of the metal specimen and to observe the necking. 4. To carry out the compression test on universal testing machine and determine the change in length/area and compression strength for the give specimen. 5. Carryout the Bending test/Single Shear/Double Shear test on the given specimens and to plot the stress strain graphs. 6. Determining the impact strength of a given material using Charpy/IZOD tests. 7. Carryout the Torsion test on the given specimen and to tabulate the readings and find the torsion values. 8. Demonstration of pin on disc wear test. 9. Demonstration of any two Nondestructive tests. 10. Preparation of the specimen and microstructure observation for different metals and alloys. 11. Demonstration of Fatigue test for the given specimen.	

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the atomic arrangement in crystalline materials and describe the periodic arrangement of atoms in terms of unit cell parameters.
CO2	Understand the importance of phase diagrams and the phase transformations.
CO3	Know various heat treatment methods for controlling the microstructure.
CO4	Correlate between metals, alloys, material properties with component design and identify various kinds of failure mechanisms.
CO5	Understand the application of the different types of composite materials.

Reference Books

3.	W. D. Callister, "Materials Science and Engineering-An Introduction", Wiley India, 6th Edition, 2006.
4.	Kenneth G. Budinski and Michael K. Budinski, Engineering Materials, Prentice Hall India, 4th Edition, 2002.
3.	V. Raghavan, "Material Science and Engineering", Prentice Hall India, 5th Edition, 2004.
4.	P. C. Angelo and R. Subramanian: Powder Metallurgy- Science, Technology and Applications, PHI, New Delhi, 2008.

Web links and Video Lectures (e-Resources):

1. Bhattacharya,B., Materials Selection and Design, NPTEL Course Material, Department of Mechanical Engineering, Indian Institute of Technology Kanpur, http://nptel.ac.in/courses/112104122/

2. Prasad, R., Introduction to Materials Science and Engineering, NPTEL Course Material, Department of Materials 27 27 Science and Engineering, Indian Institute of Technology Delhi, http://nptel.ac.in/courses/113102080/

3. Subramaniam, A., Structure of Materials, NPTEL Course Material, Department of Material Science and Engineering, Indian Institute of Technology Kanpur, https://nptel.ac.in/courses/113104014/

4. Schuh, C., 3.40J Physical Metallurgy. Fall 2009. Massachusetts Institute of Technology: MIT Open Course Ware, https://ocw.mit.edu. License: Creative Commons BY-NC-SA.

5. Ghosh, R.N., Principles of Physical Metallurgy, IIT Kharagpur, http://nptel.ac.in/syllabus/113105024/

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 be held for 10 marks each). The marks obtained in test, quiz and self -studies 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 complete 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
CO2	3	2	2	2			1		2	1	2	
CO3	3								2		2	
CO4	3	2	2			2			2			2
CO5	2										2	

Semester: III			
Manufacturing Technology-Theory and Practice (Theory and Practice)			
Course Code: MVJ21ME35			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
Course Learning Objectives: The students will be able to			
1	Recognize the various manufacturing principles and techniques. To gain theoretical and practical knowledge in material casting processes and develop an understanding of the dependent and independent variables which control materials casting in a production setting.		
2	Describe moulding, patterns, and furnaces. Determine the appropriate parameters for different manufacturing processes. Justify the most appropriate manufacturing process for a given product.		
3	Recognize the importance of metal joining processes in fabrication and categorize different processes.		
4	Acquire a fundamental knowledge on metal forming technology which is necessary for an understanding of industrial processes and to introduce students to the wide range of materials and processes in plastic region, which are currently used in manufacturing industry.		
5	Categorize and describe various sheet metal operations and their advantages and limitations.		

UNIT-I	
Manufacturing Process: Introduction to basic manufacturing, Classification of manufacturing process, Primary and Secondary Manufacturing process classification and Applications, Primary manufacturing process of Iron and Aluminium, Introduction about metal casting. **Pattern Making:** Functions of pattern, Classification of pattern, Different pattern materials, various pattern allowances in design of pattern, Simple problems in design of pattern.	8 Hrs
UNIT-II	
Mould Making: Moulding sand ingredients, Desirable properties of Sand Mould, cores and functions of cores, types of Moulds, Mould making, moulding machines. Concept of gating system, different types of gating systems, gating system design, risering design. **Special casting processes:** Shell moulding, investment casting, Gravity die casting, Pressure die casting, Centrifugal casting, Continuous casting, Injection moulding, Blow Moulding, Defects in casting, Causes, features and remedies.	8 Hrs
UNIT-III	
Metal Joining (Welding): Survey of welding and allied processes. Gas welding and cutting, process and equipment. Arc welding: Power sources and consumables. TIG & MIG processes and their parameters. Resistance welding-spot, seam projection, Other welding processes such as atomic hydrogen, submerged arc, electroslag, friction welding. **Other types of Metal Joining and Welding defects:** Soldering & Brazing. Adhesive bonding, Riveting and Bolting.	8 Hrs

Heat Affected Zone, Weld decay in HAZ, Defects in welding, causes features and remedies, Welding Inspection - Visual, Magnetic particle, Fluorescent particle, Ultrasonic, Radiography, Eddy current, Holography methods of Inspection.	
UNIT-IV	
Metal Forming Processes: Advantages of Mechanical Working Processes, Difference Between Hot and Cold Working, Advantages and Disadvantages of Cold and Hot Working Processes, Classification of Metal Forming Processes. **Forging**: Introduction, Classification of Forging, Die Forging with Power Hammers, Open Die Forging, Impression Die Forging, Closed Die Forging, Forging Defects. **Rolling**: Introduction, Nomenclature of Rolled Products, Mechanism of Rolling, and Types of Rolling Mill, Rolls and Roll Pass Design, Ring Rolling, Cold Rolling.	8 Hrs
UNIT-V	
Drawing: Drawing equipment & dies, expression for drawing load by slab analysis, power requirement. Redundant work and its estimation, optimal cone angle & dead zone formation, drawing variables, Tube drawing, classification of tube drawing, simple problems. **Extrusion**: Types of extrusion processes, extrusion equipment & dies, deformation, lubrication & defects in extrusion. Extrusion dies, Extrusion of seamless tubes. Extrusion variables, simple problem. **Sheet Metal Forming**: Introduction, Dies & punches, Types of presses, piercing, blanking, bending, deep drawing, LDR in drawing, Forming limit criterion, defects of drawn products, stretch forming. Roll bending & contouring, Simple problems	8 Hrs
LABORATORY EXPERIMENTS	
1. Compression strength test of Moulding Sand 2. Shear strength test of Moulding Sand 3. Tensile strength test of Moulding Sand 4. Permeability test of Moulding Sand 5. Clay content test of Moulding Sand 6. Grain fineness test by Sieve Analysis. 7. Making a mould cavity using two hand cut molds 8. Making a mould cavity using single piece pattern and split pattern 9. Calculation of length of the raw material required to prepare the model considering scale loss, preparation of square shaped and bend 10. Calculation of length of the raw material required to prepare the model considering scale loss and preparation of square headed stud 11. L joint, T joint and Butt joint preparation using arc welding equipment on M.S. flats 12. V joint and Lap joint welded joints using arc welding equipment on M.S. flats	

Course Outcomes: After completing the course, the students will be able to	
CO1	Identify and explain all the steps involved in basic casting processes.
CO2	Categorize and explain all the special casting processes and Press and Die punch assembly
CO3	Understand the principles of metal joining processes and the constructional features of the equipment.
CO4	Identify and explain the principle behind metal forming process and detail all the forging and rolling process.
CO5	Carryout sand tests, simple moulding and forging operations.

Reference Books	
1.	O.P Khanna, "Foundry Technology", Dhanpat rai publications-2003 reprint ISBN-10 8189928341
2.	R.K Jain , Production Technology Vol. 1, Khanna Publishers, ISBN 9788174090991
3.	P N Rao, "Manufacturing Technology: Foundry, Forming and Welding", 2nd Edition Tata Mc Graw-Hill Publication. ISBN:9789383286621, 9383286628

Web links and Video Lectures (e-Resources):

1. Principles of Metal Forming Technology, Mechanical Engineering. Dr. Pradeep K. Jha IIT Roorkee, Video Lecture. https://nptel.ac.in/courses/112/107/112107250/

2. Metal Casting, Dr. Pradeep Kumar, Dr. D. B. Karunakar, IIT Roorkee, https://archive.nptel.ac.in/courses/112/107/112107083/

3. Joining Technologies for metals, Prof. Dheerendra Kumar Dwivedi, IIT Roorkee, https://nptel.ac.in/courses/112107213

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 be held for 10 marks each). The marks obtained in test, quiz and self -studies 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 complete 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	3										
CO2	2		2	2			1				2	2
CO3	3	2								2	1	
CO4	3	2		2		2						2
CO5	2		2									

Semester: III		
SAMSKRUTHIKA KANNADA (Theory)		
Course Code: MVJ21KAN36		CIE Marks: 50
Credits: L:T:P: 1:0:0		SEE Marks: 50
Hours: 15L		SEE Duration: 02 Hrs.
Course Learning Objectives: This course will enable students to understand Kannada and communicate in Kannada language		

UNIT-I	
೧. ಕನ್ನಡ ಭಾಷೆ-ಸಂಕ್ಷಿಪ್ತ ವಿವರಣೆ. ೨. ಭಾಷಾ ಪ್ರಯೋಗಲ್ಲಾಗುವ ಲೋಪದೋಷಗಳು ಮತ್ತು ಅವುಗಳ ನಿವಾರಣೆ	3 Hrs
UNIT-II	
೧. ಲೇಖನ ಚಿಹ್ನೆಗಳು ಮತ್ತು ಅವುಗಳ ಉಪಯೋಗ ೨. ಪತ್ರ ವ್ಯವಹಾರ.	3 Hrs.
UNIT-III	
೧. ಆಡಳಿತ ಪತ್ರಗಳು. ೨. ಸರ್ಕಾರದಆದೇಶ ಪತ್ರಗಳು	3 Hrs.
UNIT-IV	
೧. ಸಂಕೀಪ್ತ ಪ್ರಬಂಧರಚನೆ, ಪ್ರಬಂಧ ಮತ್ತು ಭಾಷಾಂತರ ೨. ಕನ್ನಡ ಶಬ್ದಸಂಗ್ರಹ	3 Hrs.
UNIT-V	
೧. ಕಂಪ್ಯೂಟರ್ ಹಾಗೂ ಮಾಹಿತಿತಂತ್ರಜ್ಞಾನ ೨. ಪಾರಿಭಾಷಿಕ ಆಡಳಿತ ಕನ್ನಡ ಪದಗಳು ಮತ್ತು ತಾಂತ್ರಿಕ/ಕಂಪ್ಯೂಟರ್ ಪಾರಿಭಾಷಿಕ ಪದಗಳು.	3 Hrs.

Reference Books	
5.	Adalitha Kannada – Dr. L Thimmesh, Prof. V Keshav Murthy

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 50 marks covering the entire syllabus having same complexity in terms of COs and Bloom's taxonomy level.

Total marks: 50+50=100

Semester: III		
BALIKE KANNADA (Theory)		
Course Code: MVJ21KAN36		CIE Marks: 50
Credits: L:T:P: 1:0:0		SEE Marks: 50
Hours: 15L		SEE Duration: 02 Hrs.
Course Learning Objectives: This course will enable students to understand Kannada and communicate in Kannada language		

UNIT-I	
Vyavharika Kannada –Parichaya (Introduction to Vyavharika Kannada)	3 Hrs
UNIT-II	
Kannada Aksharamaale haagu uchcharane(Kannada Alphabets and Pronunciation)	3 Hrs.
UNIT-III	
Sambhashanegaagi Kannada Padagalu (Kannada Vocubulary for Communication).	3 Hrs.
UNIT-IV	
Kannada Grammar in Conversations(Sambhasaneyalli Kannada Vyakarana)	3 Hrs.
UNIT-V	
Activities in Kannada	3 Hrs.

Reference Books	
1.	Adalitha Kannada – Dr. L Thimmesh, Prof. V Keshav Murthy

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 50 marks covering the entire syllabus having same complexity in terms of COs and Bloom's taxonomy level.

Total marks: 50+50=100

Semester: III		
Spread Sheet for Engineers (AEC)		
Course Code: MVJ21MEA37		CIE Marks: 50
Credits: L: T:P: 1:0:2		SEE Marks: 50
Hours: 15 L+20 P		SEE Duration: 03 Hours

Course Learning Objectives: The students will be able to	
1	To create different plots and charts. To compute different functions, conditional functions and make regression analysis.
2	To carryout iterative solutions for roots, multiple roots, optimization and non-linear regression analysis.
3	To carryout matrix operations and athematic operations.
4	To Understand VBA and UDF and to understand VBA subroutines and Macros.
5	To carryout numerical integration and solving differential equations using different methods.

UNIT-I	
Charting: Create an XY scatter graph, XY chart with two Y-Axes, add error bars to your plot, create a combination chart. Functions: Computing Sum, Average, Count, Max and Min, Computing Weighted Average, Trigonometric Functions, Exponential Functions, Using the CONVERT Function to Convert Units. Laboratory Sessions/ Experimental learning: Plotting Stress Strain Diagrams for the given set of stress strain values. Applications: Converting the data to charts and data visualization. Video link / Additional online information: https://onlinecourses.nptel.ac.in/noc21_ge21/preview https://www.coursera.org/specializations/excel-data-analytics-visualization https://www.youtube.com/watch?v=VjQgeP6yb9A	7 Hrs
UNIT-II	
Conditional Functions: Logical Expressions, Boolean Functions, IF Function, Creating a Quadratic Equation Solver, Table VLOOKUP Function, AND, OR and XOR functions. Regression Analysis: Trendline, Slope and Intercept, Interpolation and Forecast, The LINEST Function, Multilinear Regression, Polynomial Fit Functions, Residuals Plot, Slope and Tangent, Analysis Tool Pack. Laboratory Sessions/ Experimental learning: Multilinear regression analysis for curve fitting of Load versus Displacement. Applications: Curve fitting and prediction and forecasting. Video link / Additional online information: https://onlinecourses.nptel.ac.in/noc22_mg35/preview https://nptel.ac.in/courses/111105042	7 Hrs

https://archive.nptel.ac.in/courses/110/107/110107092/ https://www.youtube.com/watch?v=0ienbLvFddQ	
UNIT-III	
Iterative Solutions Using Excel: Using Goal Seek in Excel, Using the Solver to Find Roots, Finding Multiple Roots, Optimization Using the Solver, Minimization Analysis, Non-Linear Regression Analysis. Matrix Operations Using Excel: Adding Two Matrices, multiplying a Matrix by a Scalar, Multiplying Two Matrices, transposing a Matrix, inverting a Matrix and Solving System of Linear Equations. Laboratory Sessions/ Experimental learning: Optimization of Mathematical models / Regression equations developed for a given set of load displacement values. Applications: Finding the maximum and minimum in a given set of values and optimization studies. Video link / Additional online information: https://archive.nptel.ac.in/courses/110/107/110107157/ http://www.nitttrc.edu.in/nptel/courses/video/110104119/L22.html https://freevideolectures.com/course/4743/nptel-supply-chain-analytics/27	7 Hrs
UNIT-IV	
VBA User-Defined Functions (UDF): The Visual Basic Editor (VBE), The IF Structure, The Select Case Structure, the for Next Structure, The Do Loop Structure, Declaring Variables and Data Types, An Array Function the Excel Object Model, For Each Next Structure. VBA Subroutines or Macros: Recording a Macro, coding a Macro Finding Roots by Bisection, Using Arrays, adding a Control and Creating User Forms. Laboratory Sessions/ Experimental learning: To setup the velocity of the falling parachutist. Applications: For automating using Macro fictions and automating the data sorting and other data operations. Video link / Additional online information: https://www.coursera.org/learn/excel-vba-for-creative-problem-solving-part-1 https://onlinecourses.nptel.ac.in/noc22_cs71/preview http://nptel.ac.in/courses/Webcoursecontents/IIScBANG/Operating%20Systems/New_index1.html	7 Hrs
UNIT-V	
Numerical Integration Using Excel: The Rectangle Rule, The Trapezoid Rule, The Simpson's Rule, creating a User-Defined Function Using the Simpson's Rule. Differential Equations: Euler's Method, Modified Euler's Method, The Runge Kutta Method, Solving a Second Order Differential Equation. Laboratory Sessions/ Experimental learning: Numerical Integration to find the Nusselt number.	7 Hrs

Applications: To find out different numerical correlational among experimental factors / variables. Video link / Additional online information: https://archive.nptel.ac.in/courses/102/106/102106051/ https://archive.nptel.ac.in/courses/103/106/103106120/ https://archive.nptel.ac.in/courses/103/103/103103162/	

Course Outcomes: After completing the course, the students will be able to	
CO1	To create different plots and charts.
CO2	To compute different functions, conditional functions and make regression analysis.
CO3	To carryout iterative solutions for roots, multiple roots, optimization and non-linear regression analysis and to carryout matrix operations.
CO4	To Understand VBA and UDF & To understand VBA subroutines and Macros.
CO5	To carryout numerical integration and solving differential equations using different methods.

Reference Books	
6.	Excel 2019 All-In-One: Master the New Features of Excel 2019 / Office 365 Paperback – 1 January 2019 by Lokesh Lalwani. ISBN: 978-9388511582.
7.	Advance Excel 2019 Training Guide: Tips and Tricks to Kick Start Your Excel Skills Paperback – 1 January 2019 by Manish Nigam, ISBN: 978-9388176675.
8.	Excel Macros for Dummies, 2nd edition, Michael Alexander, 978-8126575282
9.	MICROSOFT EXCEL 2019: DATA ANALYSIS&BUSINESS MODEL: Data Analysis and Business Modeling Paperback – 11 October 2019, L. Winston Wayne , 978-9389347180

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 be held for 10 marks each). The marks obtained in test, quiz and self -studies are added to get marks out of 100 and report CIE for 50 marks.

Semester End Examination (SEE):

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

Semester: III		
Additional Mathematics-I (Common to all branches)		
Course Code:	MVJ21MATDIP1	CIE Marks:50
Credits:	L:T:P:S: 4:0:0:0	SEE Marks: 50
Hours:	40L	SEE Duration: 3 Hrs
Course Learning Objectives: The students will be able to		
1	To familiarize the important and introductory concepts of Differential calculus	
2	Aims to provide essential concepts integral calculus	
3	To gain knowledge of vector differentiation	
4	To learn basic study of probability	
5	Ordinary differential equations of first order and analyze the engineering problems.	

UNIT-I	
Differential calculus: Recapitulation of successive differentiation -nth derivative -Leibnitz theorem (without proof) and Problems, Polar curves - angle between the radius vector and tangent, angle between two curves, pedal equation, Taylor's and Maclaurin's series expansions- Illustrative examples. **Video Link**: 1. http://nptel.ac.in/courses.php?disciplineID=111	8 Hrs
UNIT-II	
Integral Calculus: Statement of reduction formulae for the integrals of $\sin^n(x)$, $\cos^n(x)$, $\sin^n(x)\cos^n(n)$ and evaluation of these integrals with standard limits-problems. Double and triple integrals-Simple examples. **Video Link**: 1. http://nptel.ac.in/courses.php?disciplineID=111	8 Hrs
UNIT-III	
Vector Differentiation: Scalar and Vector point functions, Gradient, Divergence, Curl, Solenoidal and Irrotational vector fields. Vector identities - $div(\phi\vec{A})$, $curl(\phi\vec{A})$, $curl(grad(\phi))$, $div(curl\vec{A})$. **Video Link**: 1. http://nptel.ac.in/courses.php?disciplineID=111	8 Hrs
UNIT-IV	
Probability: Basic terminology, Sample space and events. Axioms of probability. Conditional probability – illustrative examples. Bayes theorem-examples. **Video Link**: 1. http://nptel.ac.in/courses.php?disciplineID=111	8 Hrs
UNIT-V	
Ordinary Differential Equations of First Order: Introduction – Formation of differential equation, solutions of first order and first degree differential equations: variable separable form, homogeneous, exact, linear differential equations. **Video Link**: 1. http://nptel.ac.in/courses.php?disciplineID=111	8 Hrs

Course Outcomes: After completing the course, the students will be able to	
CO1	Apply the knowledge of calculus to solve problems related to polar curves and its applications
CO2	Apply the concept of integration and variables to evaluate multiple integrals and their usage in computing the area and volumes.
CO3	Illustrate the applications of multivariate calculus to understand the solenoidal and irrotational vectors and also exhibit the inter dependence of line, surface and volume integrals.
CO4	Understand the basic Concepts of Probability
CO5	Recognize and solve first-order ordinary differential equations occurring in different branches of engineering.

Reference Books	
1.	B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 43rd Edition, 2013, .
2.	G. B. Gururajachar, Calculus and Linear Algebra, Academic Excellent Series Publicatior 2018-19
3.	Chandrashekar K. S, Engineering Mathematics-I, Sudha Publications, 2010.

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	3	0	2	0	0	0	0	0	0	1	1
CO2	3	3	0	2	0	0	0	0	0	0	1	1
CO3	3	3	0	3	0	0	0	0	0	0	1	1
CO4	2	2	0	3	0	0	0	0	0	0	1	1
CO5	2	2	0	2	0	0	0	0	0	0	0	1