**R. V. COLLEGE OF ENGINEERING, BENGALURU – 59**

*(An Autonomous Institution affiliated to VTU, Belagavi)*

# DEPARTMENT OF MECHANICAL ENGINEERING

## SCHEME OF TEACHING AND EXAMINATION

| THIRD SEMESTER | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Sl. No.** | **Course Code** | **Course Title** | **BoS** | **Credit Allocation** | | | | **Total Credits** |
| | | | | **Lecture** | **Tutorial** | **Practical** | **SS (EL)** | |
| 1 | 16MA31C | Applied Mathematics-III | Maths | 3 | 1 | 0 | 0 | 4 |
| 2 | 16EM32B | Engineering Materials[#] | ME | 2 | 0 | 0 | 0 | 2 |
| 3 | 16ME33 | Mechanics of Materials | ME | 3 | 0 | 1 | 1 | 5 |
| 4 | 16ME34 | Thermal Engineering I | ME | 3 | 1 | 0 | 1 | 5 |
| 5 | 16ME35 | Fluid Mechanics | ME | 3 | 0 | 0 | 1 | 4 |
| 6 | 16ME36 | Manufacturing Processes - I | ME | 3 | 0 | 1 | 1 | 5 |
| 7 | 16DMA37 | Bridge Course Mathematics* | Maths | 2 | 0 | 0 | 0 | 0 |
| | | Total No. of Credits | | | | | | **25** |
| | | No. of Hrs. | | **19** | **2** | **4** | **16**** | **42** |

*Mandatory Audit course for lateral entry diploma students

**Non-contact hours

**#ME/IM/AS Common #EC/TC/EE/EI Common ## CS/IS/BT Common**

**1Hr. Theory = 1 credit 2Hrs. Practical = 1credit 2 Hrs. Tutorial = 1 credit 4 Hrs. SS (EL) = 1 Credit**

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# DEPARTMENT OF MECHANICAL ENGINEERING

## SCHEME OF TEACHING AND EXAMINATION

| FOURTH SEMESTER | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Sl. No | Course Code | Course Title | BOS | Credit Allocation | | | | Total Credits |
| | | | | Lecture | Tutorial | Practical | SS (EL) | |
| 1 | 16MA41C | Applied Mathematics - IV | Maths | 3 | 1 | 0 | 0 | 4 |
| 2 | 16ET42 | Environmental Technology# | BT | 2 | 0 | 0 | 0 | 2 |
| 3 | 16ME43 | Metrology and Measurements | ME | 3 | 0 | 1 | 1 | 5 |
| 4 | 16ME44 | Kinematics of Machines | ME | 3 | 0 | 0 | 1 | 4 |
| 5 | 16ME45 | Thermal Engineering II | ME | 3 | 1 | 1 | 0 | 5 |
| 6 | 16ME46 | Manufacturing Processes II | ME | 3 | 0 | 1 | 1 | 5 |
| 7 | 16HS47 | Professional Practice-II (Team Work & Professional Ethics)$ | HSS | 0 | 0 | 0 | 0 | 1 |
| 8 | 16DCS48 | Bridge Course C Programming* | CSE | 2 | 0 | 0 | 0 | 0 |
| | | Total No. of Credits | | | | | | **26** |
| | | No. Of Hrs. | | **19** | **2** | **6** | **12**** | **39** |

*Mandatory Audit course for lateral entry diploma students **Non contact hours

$ 3 days (18 Hrs) in 3rd semester and 3 days (18 Hrs) in 4th semester, in the event of student not able to take the regular allotment, may have to complete this credit by attending other branch program.

# BT, CV, CH, Chemistry will handle classes

**1 Hr. Theory = 1 credit** **2 Hrs. Practical = 1credit** **2 Hrs. Tutorial = 1 credit** **4 Hrs. SS (EL) = 1 Credit**

| Semester: III | | |
|---|---|---|
| **Course Title: APPLIED MATHEMATICS – III** | | |
| **Course Code:** | **16MA31** | **CIE Marks: 100** |
| **Hrs/Week: L:T:P:S:** | **3:1:0:0** | **SEE Marks: 100** |
| **Credits:** | **4** | **SEE Duration: 3Hrs** |

| **Course Learning Objectives: The students should be able to:** | |
|---|---|
| **1** | Identify and solve initial value problems, physically interpret the solution, using Laplace Transforms and Inverse Laplace transforms |
| **2** | Evaluate extremal of integrals involving functionals with applications to physical situations |
| **3** | Understand the basics of Matrix theory, Eigen values and Eigen vectors, its applications for finding solution of system of linear equations |
| **4** | Analyze the given set of experimental data and fit suitable approximating curves |

| **UNIT-I** | |
|---|---|
| **LAPLACE TRANSFORM**<br>Existence and uniqueness of Laplace Transform (LT), Transform of elementary functions, RoC. Properties of LT: Linearity, change of scale and first shifting. Transform of function multiplied by $t^n$, division by t, derivatives and integral. LT of periodic function, Heaviside unit step function, Unit impulse function. Heaviside shift (second shift) theorem | **08 Hrs** |
| **UNIT-II** | |
| **INVERSE LAPLACE TRANSFORM**<br>Definition, properties of inverse Laplace transform, evaluation using different methods. Convolution theorem, problems. Application to solve ordinary linear differential equations and simultaneous differential equations | **08 Hrs** |
| **UNIT-III** | |
| **CALCULUS OF VARIATION**<br>Introduction of variation of functions, extremal of a functional, Euler's equation-special cases-problems. Geodesics-problems, Hanging cable problem, Brachistochrome problem | **08 Hrs** |
| **UNIT-IV** | |
| **LINEAR ALGEBRA**<br>Rank of matrices-rank of matrix by Echelon form, consistency of system of linear equations- homogeneous and non-homogeneous equations, Gauss elimination, Gauss Jordan, Gauss Seidel methods, Eigen values and Eigen vectors-properties, largest Eigen value by Power method | **08 Hrs** |
| **UNIT-V** | |
| **STATISTICS**<br>Curve fitting by method of least squares, fitting of curves-linear, parabolic, exponential, power functions, correlation, and Regression analysis – problems | **08 Hrs** |

| **Course Outcomes: After completing the course, the students will be able to** | |
|---|---|
| 1 | Understand the fundamental concepts of Laplace and inverse Laplace transforms, variation of functions, elementary transformation of matrices, method of least squares |
| 2 | Demonstrate the properties of Laplace and inverse Laplace transforms, knowledge of extremal of functional, Eigen values, Eigen vectors and correlation |
| 3 | Apply Laplace and inverse Laplace transform technique to solve differential equations, Euler's equation to solve variational problems, matrix methods to solve system of linear equations, regression analysis for curve fitting |

| | |
|---|---|
| 4 | Analyse and interpret- solution of IVP and BVP, solution of functionals, solution of linear systems, and statistical dataoccurring in Engineering problems |

| **Reference Books** | |
|---|---|
| **1.** | B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 40th Edition, 2007, ISBN: 81-7409-195-5 |
| **2.** | B. V. Ramana, Higher Engineering Mathematics, Tata McGraw-Hill, 2008, ISBN: 13-978-07-063419-0; ISBN: 10-0-07-063419-X |
| **3.** | Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 9th Edition, 2007, ISBN: 978-81-265-3135-6 |
| **4.** | Introduction to Probability and Statistics by Lipshutz and Schiller(Schaum's outline series), ISBN:0-07-038084-8 |

| **Continuous Internal Evaluation (CIE)<br>( Theory – 100 Marks)** | |
|---|---|
| Evaluation method | Course with Assignment/ Self-study |
| Quiz -1 | 10 |
| Test -1 | 30 |
| Quiz -2 | 10 |
| Quiz -3 | 10 |
| Test -2 | 30 |
| Assignments | 10 |
| Total | **100** |

| **Semester End Evaluation<br>Theory (100)** | |
|---|---|
| **Part- –A**<br>**Objective type questions** | **20** |
| **Part –B**<br>There should be five questions from five units. Each question should be for maximum of 16 Marks.<br><br>The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice.<br><br>The **UNIT-2 and UNIT-3** should have an internal choice.<br>Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level. | **80** |
| **Total** | **100** |

| | What | | To whom | Frequency of conduction | Max Marks | Evidence | Contribution to Course Outcome | | |
|---|---|---|---|---|---|---|---|---|---|
| **Direct Assessment Methods** | CIE | Quiz | Students | Three | 30 | Answer Scripts | 80% | 100% | 90% |
| | | Test | | Two | 60/50 | | | | |
| | | Assignment/Self-study | | 2 phases | 10/20 | Reports / Record Books | | | |
| | SEE | Semester End Examination | | End of every semester Consisting of Part-A and Part-B | 100 | Answer Scripts | 20% | | |
| **Indirect Assessment methods** | Course End Survey | | Students | End of course | | Questionnaire Based on COs | 10% | | |

| CO-PO Mapping | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO/PO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | **H** | **M** | | | | | | | | | | **L** |
| **CO2** | **H** | **M** | | | | | | | | | | **L** |
| **CO3** | **L** | **M** | **M** | | | | | | | | | **L** |
| **CO4** | | **L** | **L** | **H** | | | | | | | | **L** |

**Low-1 Medium-2 High-3**

| Semester: III | | |
|---|---|---|
| **Course Title: ENGINEERING MATERIALS** | | |
| **Course Code:** | **16EM32B** | **CIE Marks: 50** |
| **Hrs/Week: L:T:P:S:** | **2:0:0:0** | **SEE Marks: 50** |
| **Credits:** | **2** | **SEE Duration: 2 Hrs** |

**Course Learning Objectives: The students should be able to**

| | |
|---|---|
| **1** | Familiarize with atomic structure of metals, imperfections, diffusion mechanisms and theories of plastic deformation |
| **2** | Construct phase diagram of different alloy system |
| **3** | Differentiate between steel and cast iron with the help of Iron carbon Diagram |
| **4** | Explain Time Temperature Transformation diagram and different types of heat treatment processes |
| **5** | Explain composition, properties and application of ferrous and non-ferrous materials |
| **6** | Explain concept of corrosion in materials and their prevention |
| **7** | Select materials for automotive, aerospace, marine and domestic applications |

| **UNIT-I** | |
|---|---|
| **Crystallography, defects in materials and deformation:**<br>Crystal structure - BCC, FCC and HCP structures - Unit cell - Crystallographic planes and directions, Miller indices. Crystal imperfections, point, line, planar and volume defects - Grain size, ASTM grain size number. Frank Reed source of dislocation, Elastic and Plastic deformation, Slip and Twinning, strain hardening and Bauschinger effect | **06 Hrs** |
| **UNIT-II** | |
| **Alloys and Phase Diagrams:** Constitution of alloys - solid solutions - Substitutional and Interstitial<br>Phase diagrams - construction of isomorphus phase diagram, Lever rule, Iron-Iron carbide equilibrium diagram, different types of invariant reactions, slow cooling of steels | **04 Hrs** |
| **UNIT-III** | |
| **Heat Treatment:**Full annealing, Stress relief annealing, Normalizing, Hardening and Tempering of steel. Isothermal transformation diagram of eutectoid steel - cooling curves imposed on I.T diagram, Critical cooling rate, Hardenability, Jomminy end quench test - austempering, martempering, case hardening, carburising, nitriding, cyaniding. Flame and Induction hardening. | **06 Hrs** |
| **UNIT-IV** | |
| **Ferrous and Non Ferrous Metals:** Alloying of steel (Mn, Si, Cr, Mo, V, Ti and W) - stainless steels and tool steels - High Speed Low alloy (HSLA). Cast Iron-Gray, white, malleable, spheroidal, graphite cast iron.<br>Composition, Properties and applications of Copper and Copper alloys-Brass and Bronze, Aluminium and Aluminium alloys, Titanium and Titanium alloys. | **04 Hrs** |
| **UNIT-V** | |
| **Corrosion:** Types of corrosion- Galvanic corrosion, Pitting corrosion, Erosion corrosion, Crevice corrosion; intergranular and transgranular corrosion, hydrogen cracking and embrittlement, corrosion prevention.<br>Materials for Automotive, aerospace, marine and domestic applications. | **04 Hrs** |

**Course Outcomes: After completing the course, the students will be able to**

| | |
|---|---|
| 1 | Understand the concepts of crystal structure, microstructure and deformation. (L1- L2) |
| 2 | Construct phase diagram of alloy systems and Iron Carbon phase diagram. (L3) |

| | |
|---|---|
| 3 | Develop TTT diagram (L4) |
| 4 | Select ferrous and Non-ferrous materials and their alloys for different application. (L5) |

| **Reference Books** | |
|---|---|
| **1.** | William F Smith., 'Material Science and Engineering', Tata McGraw Hill, 4th Edition, 2008, ISBN-(13 digits ): 978-0-07-066717-4; ISBN-(10 digits):0-07-066717-9 |
| **2.** | Sidney H Avner., 'Introduction to Physical Metallurgy', Tata McGraw Hill, 1997, ISBN-(13 digits ): 978-0-07-463006-8; ISBN-(10 digits): 0-07-463006-7 |
| **3.** | William D. Callister, Jr., 'Materials Science and Engineering An Introduction', John Wiley and Sons, Inc., 6th Edition, 2004, ISBN: 9812-53-052-5 |

| **Continuous Internal Evaluation (CIE)<br>( Theory – 50 Marks)** | |
|---|---|
| Evaluation method | Course with Assignment/ Self-study |
| Quiz -1 | 5 |
| Test -1 | 20 |
| Quiz -2 | 5 |
| Test -2 | 20 |
| Total | **50** |

| **Semester End Evaluation<br>Theory (50)** | |
|---|---|
| **Part- –A<br>Objective type questions** | **10** |
| **Part –B**<br>There should be five questions from five units. Each question should be for maximum of Marks.<br><br>The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice.<br><br>The **UNIT-2 and UNIT-3** should have an internal choice.<br>Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level. | **40** |
| **Total** | **50** |

| | What | | To whom | Frequency of conduction | Max Marks | Evidence | Contribution to Course Outcome | | |
|---|---|---|---|---|---|---|---|---|---|
| **Direct Assessment Methods** | CIE | Quiz | Students | Two | 20 | Answer Scripts | 80% | 100% | 90% |
| | | Test | | Two | 30/20 | | | | |
| | SEE | Semester End Exam | | Consisting of Part-A and Part-B | 50 | Answer Scripts | 20% | | |
| **Indirect Assessment methods** | Course End Survey | | Students | End of course | | Questionnaire Based on Cos | 10% | | |

| CO-PO Mapping | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO/PO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | | **H** | **L** | | | | **M** | | | | | **L** |
| **CO2** | **H** | **H** | **L** | | | | | | | **L** | | |
| **CO3** | **M** | **H** | | | **M** | | | | | | | |
| **CO4** | | **H** | **L** | | | **M** | | | | | | **L** |

**Low-1 Medium-2 High-3**

| Semester: III | | |
|---|---|---|
| **Course Title: MECHANICS OF MATERIALS** | | |
| **Course Code:** | **16ME33** | **CIE Marks: 100 + 50** |
| **Hrs/Week: L:T:P:S:** | **3:0:2:4** | **SEE Marks: 100 + 50** |
| **Credits:** | **5** | **SEE Duration: 3+ 3 Hrs** |

| **Course Learning Objectives: The students should be able to** | |
|---|---|
| **1** | Understand mechanics of deformable bodies and apply them in analysis and design problems |
| **2** | Analyze bodies subjected to two dimensional stress systems. |
| **3** | Understand behaviorof structural members in flexure and Torsion. |
| **4** | Evaluate slope and deflection in beams subjected to loading. |
| **5** | Understand stability of columns and struts. |
| **6** | Predict the stress distribution in beams, pressure vessels and shafts |

| **PART A** | |
|---|---|
| **UNIT-I** | |
| **Review of stress, strain & Elastic Constants:** Stress, Strain, relationship among elastic constants, Volumetric strain. (No questions to be set on these topics)<br>**Thermal stresses and strains** (compound bars not included). Numerical problems<br>**Two Dimensional Stress System:** Introduction, Stress components on inclined planes, Principal Stresses, Principal planes, Mohr's circle of stress Numerical problems | **05 Hrs** |
| **UNIT-II** | |
| **Bending moment and shear force in beams :** Introduction, Types of beams, Loads and Reactions, Shear forces and bending moments, Rate of loading, Sign conventions, Relationship between shear force and bending moments, Shear force and bending moment diagrams subjected to concentrated loads, uniform distributed load (UDL) for different types of beams.(UVL not included)<br>**Bending stress in beams:** Introduction, Assumptions in simple bending theory, Derivation of Bernoulli's equation, Modulus of rupture, Section modulus, Flexural rigidity, Bending stress distribution in beams of various sections, Beam of uniform strength (No numerical on beam of uniform strength)<br>**Shear stresses in beams**: Expression for horizontal shear stress in beam, Shear stress diagram for simple rectangular and I section and T sections only. Numerical problems. | **10 Hrs** |
| **UNIT-III** | |
| **Deflection of determinate Beams:** Introduction, Definitions of slope, Deflection, Elastic curve, Derivation of differential equation of flexure, Sign convention, Double integration method, Slope and deflection using Macaulay's method for prismatic beams and overhanging beams subjected to point loads, UDL and couple. Numerical problems.<br>**Thick and thin cylinders:** Stresses in thin cylinders, Changes in dimensions of cylinder(diameter, length and volume), Thick cylinders subjected to internal and external pressures (Lame's equation), (Compound cylinders not included). | **10 Hrs** |
| **UNIT-IV** | |
| **Torsion of shafts**: Assumptions in theory of pure torsion, Torsion equations, Torsional rigidity and modulus of rupture, Power transmitted, Comparison of solid and hollow circular shafts. Numerical problems. | **04 Hrs** |
| **UNIT-V** | |

| | |
|---|---|
| **Analysis of columns and struts**: Introduction, Euler's theory on columns, Effective length, Slenderness ratio, Short and long columns, Radius of gyration, Buckling load, Assumptions, Derivation of Euler's Buckling load for different end conditions, Limitations of Euler's theory, Rankine's formula. Numerical problems. | **04 Hrs** |

| **PART – B** | |
|---|---|
| **MECHANICS OF MATERIALS LABORATORY** | |
| **Section I** | **12Hrs** |
| 1. Hardness Tests (Brinell, Rockwell, Vicker) | |
| 2. Tension test on Mild steel and HYSD (High Yield Strength Deformed) bars | |
| 3. Compression test of Mild Steel, HYSD, Cast iron. | |
| 4. Torsion test on Mild Steel circular sections. | |
| 5. Bending Test on Wood Under two point loading. | |
| 6. Shear Test on Mild steel. | |
| 7. Impact test on Mild Steel (Charpy & Izod) | |
| 8. Wear Test using Pin on disc Tribometer | |
| **Section – II (Non-destructive testing)** | **4Hrs** |
| 1. Magnetic Particle Test | |
| 2. Ultrasonic Test | |
| 3. Dye Penetrant Test | |
| 4. Eddy current inspection for metals | |

| **Course Outcomes: After completing the course, the students will be able to** | |
|---|---|
| 1 | Identify the different engineering materials, describe their properties and predict their behaviour under different types of loading |
| 2 | Compute the stresses, strains, moments, deflections, etc. and derive the expressions used from the fundamentals. |
| 3 | Select materials, sizes and sections for various applications such as beams, shafts, pressure vessels, columns, etc. and justify the selection |
| 4 | Determine mechanical properties by destructive and non-destructive methods |

| **Reference Books** | |
|---|---|
| **1.** | S.S. Bhavikatti, Strength of Materials, Vikas Publications House Pvt. Ltd. New Delhi,2012, ISBN 9788125927914 |
| **2.** | Timoshenko and Young "Elements of Strength of Materials", Affliated East-West Press, 1976 Edition, ISBN-10: 0442085478, ISBN-13: 978-0442085476. |
| **3.** | F.P. Beer and R. Johnston, "Mechanics of Materials", McGraw-Hill Publishers,2006 ISBN 9780073529387 |
| **4.** | S. Ramamrutham, R. Narayanan, "Strength of Materials", Dhanapath Rai Publishing Company, New Delhi, 2012, ISBN: 818743354X |

| Continuous Internal Evaluation (CIE) | | | | |
|---|---|---|---|---|
| **( Theory – 100 Marks)** | | **(Laboratory- 50 Marks)** | | **Total (150)** |
| **Evaluation method** | **Course with assignment** | | | |
| Quiz -1 | 10 | Performance of the student in the laboratory, every week | 40 | |
| Test -1 | 30 | | | |
| Quiz -2 | 10 | | | |
| Quiz -3 | 10 | Test at the end of the semester | 10 | |
| Test -2 | 30 | | | |
| Assignments | 10 | | | |
| Total | **100** | **Total** | **50** | **150** |

| Semester End Evaluation (SEE) | | | | |
|---|---|---|---|---|
| **Theory (100 Marks)** | | **Laboratory(50 Marks)** | | **Total (150)** |
| **Part- –A**<br>**Objective type questions** | **20** | **Experiment Conduction with proper results** | 40 | |
| **Part –B**<br>There should be five questions from five units. Each question should be for maximum of 16 Marks.<br><br>The **UNIT-1, UNIT-4 and UNIT-5** should not have any choice.<br><br>The **UNIT-2 and UNIT-3** should have an internal choice.<br>Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level. | **80** | **Viva** | 10 | |
| **Total** | **100** | **Total** | **50** | **150** |

| | What | | To whom | Frequency of conduction | Max Marks | Evidence | Contribution to Course Outcome | | |
|---|---|---|---|---|---|---|---|---|---|
| **Direct Assessment Methods** | CIE | Quiz | Students | Three | 30 | Answer Scripts | 80 % | 100 % | 90 % |
| | | Test | | Two | 60/50 | | | | |
| | | Assignment/Self-study | | 2 phases | 10/20 | Reports / Record Books | | | |
| | | Laboratory | | Weekly | 50 | | | | |
| | SEE | Semester End Examination | | Consisting of Part-A and Part-B | 100 | Answer Scripts | 20 % | | |
| | | Semester End Laboratory | | End of every semester laboratory | 50 | | | | |
| **Indirect Assessment methods** | Course End Survey | | Students | End of course | | Questionnaire Based on COs | 10% | | |

| CO-PO Mapping | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO/PO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | **L** | **H** | **M** | | | | | | | | | |
| **CO2** | | | **H** | | | | | | | | | |
| **CO3** | | **M** | | | **H** | | | | | **L** | | |
| **CO4** | | | **H** | | | | | | **M** | | | |

**Low-1 Medium-2 High-3**

| Semester: III | | |
|---|---|---|
| **Course Title: THERMAL ENGINEERING – I** | | |
| **Course Code:** | **16ME34** | **CIE Marks: 100** |
| **Hrs/Week: L:T:P:S:** | **3:1:0:4** | **SEE Marks: 100** |
| **Credits:** | **5** | **SEE Duration: 3Hrs** |

| **Course Learning Objectives: The students should be able to:** | |
|---|---|
| **1** | Familiarize with various definitions involved in thermodynamics. |
| **2** | Define and differentiate between thermodynamic work and heat. |
| **3** | Apply first law of thermodynamics to various processes. |
| **4** | Demonstrate the skills to explain corollaries of second Law of thermodynamics. |
| **5** | Explain the concept of Entropy and the principle of increase of Entropy. |
| **6** | Apply thermodynamic laws to steam processes. |
| **7** | Understand the behavior of pure substances with the help of property diagrams |
| **8** | Differentiate between real and ideal gases |

| **UNIT-I** | |
|---|---|
| **Fundamental Concepts and Definitions:** Macroscopic and Microscopic point of view -Thermodynamic systems, surroundings and boundary – Thermodynamic property, Intensive and Extensive properties - Thermodynamic state, process, cycle, path and point functions –Quasi-static process, Thermodynamic equilibrium – adiabatic and diathermic walls<br>**Temperature:** Equality of temperature – Zeroth law of thermodynamics-thermometry -Temperature scales-International temperature scale | **06 Hrs** |
| **UNIT-II** | |
| **Thermodynamic Work and Heat:** Thermodynamic work, work done in a frictionless quasi-equilibrium process – *pdv* work in various quasi-static processes - other types of work transfer – Heat, comparison of heat and work.<br>**First Law of Thermodynamics:** First law of thermodynamics for a system undergoing thermodynamic cycle – First law of thermodynamics for closed system – Perpetual Motion Machine of kind I – Internal energy - property of the system – Enthalpy –Application of first law of thermodynamics to steady flow processes, Steady flow energy equation applied to different flow systems | **07 Hrs** |
| **UNIT-III** | |
| **Second Law of Thermodynamics:** Limitations of first law of thermodynamics – Thermal reservoirs – Heat engines, Refrigerator and Heat pump – Statements of second law of thermodynamics – Equivalence of Kelvin Planck and Clausius statements – Perpetual Motion Machine of kind II<br>**Reversible and Irreversible Processes** – Carnot cycle – Corollaries of Second law of thermodynamics, Absolute thermodynamic temperature scale | **07 Hrs** |
| **UNIT-IV** | |
| **Entropy:** Clausius Inequality, Entropy - a property of a system, Principle of increase of entropy – The combined first and second law (T-ds equations) – Change of entropy for different processes of Ideal gas<br>**Available and Unavailable energy:** Available energy referred to a cycle, Decrease in available energy when heat is transferred through a finite temperature difference, Availability in non-flow systems, Availability in steady flow systems, Helmholtz and Gibb's functions, Maximum work in a reversible process, Useful work, Dead state, Gouy-Stodola theorem, Second law efficiency | **06 Hrs** |
| **UNIT-V** | |
| **Pure Substance:** Steam and its properties –Gibbs phase rule, Two property | **07 Hrs** |

| | |
|---|---|
| rule, Formation of steam, p-v, p-T, T-s and h-s diagrams for a pure substance, Introduction to steam tables and charts– Measurement of dryness fraction, Throttling and combined calorimeters<br>**Ideal Gases:** Mixture of ideal gases and real gases – Ideal gas equation, Relation between properties of an Ideal gas – mixture – *pvt* behaviour of an Ideal gas – Deviation of Ideal gas – Real gases– Vander waal's equation of state – compressibility factor, Use of compressibility charts | |
| **Experiential Learning (Suggestive):**<br>Modeling (Prototyping) of thermodynamic systems, Industry based case studies, Internship, Survey of Areas pertaining to thermal systems, innovative projects related to energy, state-of-the-art in emerging areas related to thermal engineering | **4**<br>Hrs/Week |

| **Course Outcomes: After completing the course, the students will be able to** | |
|---|---|
| 1 | Define and Explain basic concepts, properties of substances and Laws of thermodynamics (L1- L2) |
| 2 | Apply the Laws of Thermodynamics for analyzing thermodynamic processes / cycles (L3) |
| 3 | Analyse thermodynamic processes for heat and work transfer (L4) |
| 4 | Adapt knowledge of thermodynamics to suggest solutions for thermodynamic problems (L6) |

| **Reference Books** | |
|---|---|
| **1.** | Nag P. K., 'Engineering Thermodynamics', Tata McGraw Hill, 4th Edition, 2011, ISBN-13:978-0-07-026062-7: ISBN-10:0-07-026062-1 |
| **2.** | Yunus A Cengel and Boles M.A., 'Thermodynamics', 7th Edition, Tata McGraw Hill, 2009, ISBN-13:978-0-07-107254-0; ISBN-10:0-07-107254-3 |
| **3.** | R.E Sonntag , C. Borgnakke and G.J. Van Wylen, 'Fundamentals of Thermodynamics', John Wiley, 2003; ISBN:0-471-15232-3 |
| **4.** | Rajput, R.K., 'Engineering Thermodynamics', Laxmi Publications Pvt. Ltd., 3rd Edition, 2007; ISBN: 978-0-7637-8272-6 |

| **Continuous Internal Evaluation (CIE)<br>( Theory – 100 Marks)** | |
|---|---|
| Evaluation method | Course with Assignment/ Self-study |
| Quiz -1 | 10 |
| Test -1 | 25 |
| Quiz -2 | 10 |
| Quiz -3 | 10 |
| Test -2 | 25 |
| Self-study (EL) | 20 |
| Total | **100** |

| Semester End Evaluation<br>Theory (100) | |
|---|---|
| **Part –A**<br>**Objective type questions** | **20** |
| **Part –B**<br>There should be five questions from five units. Each question should be for maximum of 16 Marks.<br><br>The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice.<br><br>The **UNIT-2 and UNIT-3** should have an internal choice.<br>Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level. | **80** |
| **Total** | **100** |

| | **What** | | **To whom** | **Frequency of conduction** | **Max Marks** | **Evidence** | **Contribution to Course Outcome** | | |
|---|---|---|---|---|---|---|---|---|---|
| **Direct Assessment Methods** | CIE | Quiz | Students | Three | 30 | Answer Scripts | 80% | 100% | 90% |
| | | Test | | Two | 60/50 | | | | |
| | | Assignment/Self-study | | 2 phases | 10/20 | Reports / Record Books | | | |
| | SEE | Semester End Examination | | End of every semester Consisting of Part-A and Part-B | 100 | Answer Scripts | 20% | | |
| **Indirect Assessment methods** | Course End Survey | | Students | End of course | | Questionnaire Based on COs | 10% | | |

| **CO-PO Mapping** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO/PO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | **H** | **M** | | **L** | **M** | | | | | | | |
| **CO2** | **H** | **M** | | **L** | **M** | | | | | | | |
| **CO3** | **H** | **L** | | **M** | **L** | | | | | | | |
| **CO4** | **H** | **M** | | **M** | **L** | | | | | | | |

**Low-1 Medium-2 High-3**

| Semester: III | | |
|---|---|---|
| **Course Title: FLUID MECHANICS** | | |
| **Course Code:** | **16ME35** | **CIE Marks: 100** |
| **Hrs/Week: L:T:P:S:** | **3:0:0:4** | **SEE Marks: 100** |
| **Credits:** | **4** | **SEE Duration: 3Hrs** |

| **Course Learning Objectives: The students will be able to** | |
|---|---|
| **1** | Understand fundamentals of fluid mechanics |
| **2** | Measure pressure and determine hydrostatic forces |
| **3** | Apply laws of conservation of momentum, mass and energy to fluid flow systems and explain the measurement of fluid flow parameters |
| **4** | Investigate the characteristics of flow though pipes |
| **5** | Interpret compressibility of gases in terms of Mach number |
| **6** | Apply dimensional analysis and similarity laws for conducting model tests |

| **UNIT-I** | |
|---|---|
| **Basic Concepts and Fluid Properties:** Definition of a fluid; Classification of fluid flows; No slip condition; System and control volume; Continuum. Density, Specific gravity, Vapour pressure, Viscosity, Surface Tension; Coefficient of compression, Effects of Cavitation and Capillarity<br>**Review of Vector Relations:** Dot product, Cross product, Gradient, Divergence, Curl and their physical significance from fluid mechanics point of view. Line Integrals, Surface Integrals and Volume Integrals<br>**Dimensional Analysis and Modeling:** Similitude; Geometric, Kinematic and Dynamic similarities; Buckingham pi theorem and its application to fluid mechanics problems; Dimensionless numbers; Model studies | **05 Hrs** |
| **UNIT-II** | |
| **Pressure and Fluid Statics:** Pressure at a point; Pressure variation with depth; Manometer and other pressure measuring devices; Barometer and atmospheric pressures; Hydrostatic forces on submerged plane and curved surfaces<br>**Buoyancy and Stability:** Stability of floating bodies, Meta centre and Meta centric height; experimental and analytical determination of meta centric height; stability of submerged bodies | **08 Hrs** |
| **UNIT-III** | |
| **Fluid Kinematics:** Lagrangian and Eulerian descriptions; Fundamentals of flow visualization; Stream line, Stream tube, Path line and Streak line; Stream function, Velocity potential, Circulation, Vorticity and Rotationality<br>**Potential Flows:** Uniform flow, Source flow, Sink flow, Combination of uniform flow with a source and sink, Doublet flow, Non-lifting flow over a circular cylinder and vortex flow | **06 Hrs** |
| **UNIT-IV** | |
| **Fluid Dynamics:** General continuity equation in Cartesian coordinates; Euler's equation; Bernoulli's equation, Limitations of Bernoulli's equation, Applications of Bernoulli's equation; Venturimeter, Orifice Meter, Notches - V notch, Rectangular notch, Pitot tube and Pitot Static tube. Static, Dynamic and Stagnation pressures<br>**Flow through Pipes:** Darcy-Weisbach equation; Chezy's formula; Laminar flow through pipes; Hagen-Poiseulle equation; Friction factor, Minor losses.<br>**Turbulent Flow through Pipes:** Characteristics of turbulent flow; Turbulent velocity profile; Turbulent shear stress; Moody's chart | **08 Hrs** |
| **UNIT-V** | |

| | |
|---|---|
| **Introduction to Compressible Flow:** Propagation of pressure waves in a compressible medium; Velocity of sound, Mach number, Mach cone; Stagnation properties; Bernoulli's equation for isothermal and adiabatic flows<br>**Introduction to Boundary Layer Theory**: Flow over a flat plate: Boundary layer thickness, Displacement, Momentum and Energy thickness<br>**Flow over submerged bodies:** Introduction**,** Lift and Drag forces with their expression, Coefficient of lift and Coefficient of drag | **06 Hrs** |
| **Experiential Learning:**<br>Case studies, Design and Emerging technologies to be discussed pertaining to the course | **4** Hrs/week |

| **Course Outcomes: After completing the course, the students will be able to:** | |
|---|---|
| 1 | Describe properties of fluids for analysing fluid flow applications |
| 2 | Analyse effect of fluid properties on static and dynamics of fluid flow |
| 3 | Analyze hydrostatic and dynamic solutions for fluid flow applications |
| 4 | Derive appropriate formulae for specific industrial fluid problems |

| **Reference Books** | |
|---|---|
| **1.** | Yunus A. Cengel and John M. Cimbala, Fluid Mechanics, Tata Mc-Graw Hill, 2006; ISBN: 9780071284219 |
| **2.** | Modi and Seth, Fluid Mechanics and Hydraulic Machines, Standard Book House, 2007; ISBN -81-7867-023-2 |
| **3.** | K. Subramanya, Theory and Application of Fluid Mechanics, TMH Outline Series, 1993; ISBN-13: 978-0-07-460369-7, ISBN: 0-07-460369-8 |
| **4.** | R. K. Bansal, A Textbook of Fluid Mechanics and Hydraulic Machines, Laxmi Publications Pvt. Ltd., 2009; ISBN-13: 978-81-318-0661-6 |

| **Continuous Internal Evaluation (CIE)<br>( Theory – 100 Marks)** | |
|---|---|
| Evaluation method | Course with Assignment / Self-study |
| Quiz -1 | 10 |
| Test -1 | 25 |
| Quiz -2 | 10 |
| Quiz -3 | 10 |
| Test -2 | 25 |
| Self-study (EL) | 20 |
| Total | **100** |

| Semester End Evaluation<br>Theory (100) | |
|---|---|
| **Part –A**<br>**Objective type questions** | **20** |
| **Part –B**<br>There should be five questions from five units. Each question should be for maximum of 16 Marks.<br><br>The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice.<br><br>The **UNIT-2 and UNIT-3** should have an internal choice.<br>Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level. | **80** |
| **Total** | **100** |

| | **What** | | **To whom** | **Frequency of conduction** | **Max Marks** | **Evidence** | **Contribution to Course Outcome** | | |
|---|---|---|---|---|---|---|---|---|---|
| **Direct Assessment Methods** | CIE | Quiz | Students | Three | 30 | Answer Scripts | 80% | 100% | 90% |
| | | Test | | Two | 60/50 | | | | |
| | | Assignment/Self-study | | 2 phases | 10/20 | Reports / Record Books | | | |
| | SEE | Semester End Examination | | End of every semester Consisting of Part-A and Part-B | 100 | Answer Scripts | 20% | | |
| **Indirect Assessment methods** | Course End Survey | | Students | End of course | | Questionnaire Based on COs | 10% | | |

| **CO-PO Mapping** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO/PO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | **H** | **H** | | **M** | | | | | | | | |
| **CO2** | **H** | **H** | **M** | **M** | **L** | | | | | | | |
| **CO3** | **H** | **H** | **M** | **L** | **L** | | | | | | | |
| **CO4** | **H** | **H** | **M** | **L** | | | | | | | | **M** |

**Low-1 Medium-2 High-3**

| Semester: III | | |
|---|---|---|
| **Course Title: MANUFACTURING PROCESSES – I** | | |
| **Course Code:** | **16ME36** | **CIE Marks: 100 + 50** |
| **Hrs/Week: L:T:P:S:** | **3:0:2:4** | **SEE Marks: 100 + 50** |
| **Credits:** | **5** | **SEE Duration: 3 + 3 Hrs** |

| **Course Learning Objectives: The students should be able to** | |
|---|---|
| **1** | Classify manufacturing processes; understand the significance and steps involved in metal casting processes |
| **2** | Design, analyze gating systems for casting and explain different special casting processes |
| **3** | Understand and apply principles concerned with metal forming processes to solve real time forming problems. |
| **4** | Identify, evaluate different sheet metal forming operations, sheet metal dies, arc welding processes and welding defects. |

| **PART A** | |
|---|---|
| **UNIT-I** | |
| **Manufacturing processes:** Classification of Manufacturing Processes<br>**Metal-Casting Processes:** Advantages, Limitations and Applications. **Patterns –**Pattern allowances, Core prints, Types of patterns. **Types of moulding sands** - Properties of moulding sands. **Types of Sand Moulds -**Green-sand, Dry-sand and Skin-dried moulds<br>**Moulding Machines:** Jolting, Squeezing, Jolt & Squeezing and Sand Slinging. **Cores –**Functions and Desired Characteristics of Cores, Core sands, Types of Cores, Core Prints and Chaplets | **06 Hrs** |
| **UNIT-II** | |
| **Gating and Riser Design for Casting:** Elements of Gating System, Types of Gates and gating systems. **Gating – System Design:** Pouring time calculations – Top Gating, Bottom Gating and Relation (condition) to Avoid Aspiration Effect (Derivations and Numericals)<br>**Design of Risers:** Types of Risers, Directional Solidification<br>**Solidification Time of Casting** – Chvorinov's Rule and Caine's method (Numericals)<br>**Special Casting Processes:**$CO_2$Moulding, Shell Moulding, Investment Casting, Die Casting – Hot and Cold Chamber Processes; Centrifugal casting; Continuous Casting<br>**Casting Defects –** Types, Causes and Remedies | **07 Hrs** |
| **UNIT-III** | |
| **Metal Forming:** Classification of Metal Forming Operations.<br>**Forging:** Processes and operations**,** Lubrication in Metal Forming Operations.<br>**Forces and Stresses during Forging–** Analysis of Pressure distribution in Rectangular Block under Sticking, Sliding and Mixed Friction Condition. (Simple Numericals)<br>**Extrusion:** Direct and Indirect Extrusion, Impact Extrusion, Hydrostatic Extrusion, Defects in Extruded Products.<br>**Drawing:** Wire drawing, Rod and Tube Drawing. | **07 Hrs** |
| **UNIT-IV** | |
| **Rolling:** Types of Rolling mills and Defects in Rolling.<br>**Flat Rolling and Terminology –** Draft (Reduction), Forward and Backward Slip, Roll strip contact length, Bite angle, Ragging, Neutral Plane and Angle of | **06 Hrs** |

| | |
|---|---|
| Nip (Simple Numericals)<br>**Sheet Metal Forming:** Classification of press tool operations; Punch and Die Clearances, Ironing, Coining and Embossing, Lancing, Twisting, Spinning, Stretch forming<br>**Sheet Metal Drawing –** Drawing, Cupping and Deep drawing<br>**Draw Die Design –**Factors considered for designing a Draw Die (Simple Numericals). Defects in drawing.<br>**Sheet Metal Dies –** Progressive, Compound and Combination Dies. Bending and Bending Allowance, Rubber Forming. | |
| **UNIT-V** | |
| **Electric Arc Welding:** Introduction, Characteristic curves of constant-current and constant voltage, arc welding transformer (Simple Numericals);<br>**Electrodes –** consumable and non-consumable electrodes, Functions of coatings on the electrodes, Arc blow.<br>**Arc Welding Processes –** Shielded metal arc welding (SMAW), Inert Gas Arc Welding – Tungsten Inert Gas (TIG) welding and Metal Inert Gas (MIG) arc welding, Submerged arc welding (SAW), Atomic Hydrogen welding (AHW), Plasma arc welding (PAW).<br>**Resistance welding:** Principle and types of resistance welding.<br>**Metallurgy of Arc welding:** Principal zones in the joint and typical grain structure, Welding defects. | **07 Hrs** |
| **Experiential Learning component:**<br>Prototyping of metal casting, forming and welding systems, Industry based cases studies, survey of areas pertaining to manufacturing, Innovative projects related to manufacturing processes. | **4** Hrs/Week |

| | |
|---|---|
| **PART – B** | |
| **MACHINE SHOP I** | |
| **PART I** | **12Hrs** |
| **Foundry Practice:** | |
| 1. Use of foundry tools and other equipment. | |
| 2. Preparation of sand moulds using two moulding boxes – with patterns and without patterns (Split pattern, Match plate patter and Core boxes). | |
| 3. Demonstration of casting process (Aluminium or Cast iron). | |
| **PART – II** | **08Hrs** |
| **Testing of Moulding Sand and Core Sand:** | |
| Preparation of Moulding sand and performing following tests: | |
| • Compression and Shear Tests using Sand Testing Machine | |
| • Permeability Test | |
| • Grain Fineness number test (Sieve Analysis Test). | |
| • Clay content Test. | |
| • Moisture content test. | |
| **Welding Practice:** | |
| 1. Butt Joint | |
| 2. Lap Joint | |
| 3. Corner Joint | |
| **Forging:** | |
| Demonstration of Forging process using Power Hammer – Making Square Rod from a Round Rod. | |

| Course Outcomes: After completing the course, the students will be able to | |
|---|---|
| 1 | Define the terms related to metal casting, metal Forming, Welding and summarize various processes. (L1&L2) |
| 2 | Analyse and Apply Principles of Casting, Forming and Welding to specific applications. (L3&L4) |
| 3 | Assess, Compare and Select appropriate Manufacturing Processes (L5) |
| 4 | Adapt the Principles of Casting, Forming, Welding and Develop the Mechanical Components (L6) |

| Reference Books | |
|---|---|
| **1.** | P N Rao, Manufacturing Technology – Foundry, Forming, and Welding, 4th edition, McGraw Hill Education (India) Private Limited, 2013, ISBN-13: 978-1-25-9606257-5 and ISBN-10: 1-25-906257-0 |
| **2.** | Mikell P. Groover, "Fundamentals of modern manufacturing: materials, processes and systems", JOHN WILEY & SONS, INC., 4th Edition, 2010, ISBN: 978-0470-467002 |
| **3.** | Swadesh Kumar Singh, "A Text Book on Production Engineering", 3rd edition, Made Easy Publication, 2016, ISBN– 978-93-5147-217-9 |
| **4.** | G.S Sawhney, "Manufacturing Science – I, Forming, Casting and Welding", 2015, I.K. International Publishing House Pvt. Ltd. ISBN: 978-93-82332-53-4. |

| **Continuous Internal Evaluation (CIE)** | | | | |
|---|---|---|---|---|
| **( Theory – 100 Marks)** | | **(Laboratory- 50 Marks)** | | **Total (150)** |
| **Evaluation method** | **Course with assignment** | | | |
| Quiz -1 | 10 | Performance of the student in the laboratory, every week | 40 | |
| Test -1 | 30 | | | |
| Quiz -2 | 10 | | | |
| Quiz -3 | 10 | Test at the end of the semester | 10 | |
| Test -2 | 30 | | | |
| Assignments | 10 | | | |
| Total | **100** | **Total** | **50** | **150** |

| **Semester End Evaluation (SEE)** | | | | |
|---|---|---|---|---|
| **Theory (100 Marks)** | | **Laboratory(50 Marks)** | | **Total (150)** |
| **Part- –A**<br>**Objective type questions** | **20** | **Experiment Conduction with proper results** | 40 | |
| **Part –B**<br>There should be five questions from five units. Each question should be for maximum of 16 Marks.<br><br>The **UNIT-1, UNIT-4 and UNIT-5** should not have any choice.<br><br>The **UNIT-2 and UNIT-3** should have an internal choice. | **80** | **Viva** | 10 | |

| | | | | | |
|---|---|---|---|---|---|
| Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level. | | | | | |
| **Total** | **100** | **Total** | **50** | **150** | |

| | **What** | | **To whom** | **Frequency of conduction** | **Max Marks** | **Evidence** | **Contribution to Course Outcome** | | |
|---|---|---|---|---|---|---|---|---|---|
| **Direct Assessment Methods** | CIE | Quiz | Students | Three | 30 | Answer Scripts | 80% | 100% | 90% |
| | | Test | | Two | 60/50 | | | | |
| | | Assignment/Self-study | | 2 phases | 10/20 | Reports / Record Books | | | |
| | | Laboratory | | Weekly | 50 | | | | |
| | SEE | Semester End Examination | | End of every semester Consisting of Part-A and Part-B | 100 | Answer Scripts | 20% | | |
| | | Semester End Laboratory | | End of every semester laboratory | 50 | | | | |
| **Indirect Assessment methods** | Course End Survey | | Students | End of course | | Questionnaire Based on COs | 10% | | |

| **CO-PO Mapping** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO/PO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | **H** | **H** | **M** | **L** | | | | | | | | |
| **CO2** | **L** | **M** | **H** | **H** | **H** | | | | | | | **H** |
| **CO3** | **L** | **L** | **M** | **M** | | **H** | | | | | | **H** |
| **CO4** | | **L** | **M** | **H** | **H** | **H** | | | | | | **H** |

**Low-1 Medium-2 High-3**

| Semester: III | | |
|---|---|---|
| **Course Title: BRIDGE COURSE MATHEMATICS** | | |
| **Course Code:** | **16DMA37** | **CIE Marks: 100** |
| **Hrs/Week: L:T:P:S** | **2:0:0:0** | **SEE Marks: 100** |
| **Credits:** | **0** | **SEE Duration: 3Hrs** |

| **Course Learning Objectives: The students will be able to** | |
|---|---|
| **1** | Acquire knowledge of multivariate functions, types of derivatives involved with these functions, Jacobian as transformation factor and applications. |
| **2** | Enhance the knowledge level to visualize integrals in higher dimensional geometry, possible representation and evaluation of geometrical and physical quantities in terms of multiple integrals. |
| **3** | Recognize and model differential equations, apply analytic techniques to compute solution for engineering problems. |
| **4** | Acquire concepts of vector function, vector field, differential calculus of vector functions in Cartesian coordinates. |
| **5** | Finding the approximate solutions using numerical methods, for problems which do not have analytical solutions. |

**Prerequisites :**

Hyperbolic functions, Trigonometric formulas, methods of differentiation, methods of integration, reduction formulae, vector algebra.

| **UNIT-I** | |
|---|---|
| **DIFFERENTIAL CALCULUS**<br>Taylor and Maclaurin's series for function of single variable.<br>Introduction-partial derivatives, simple problems. Total derivative, Composite functions, Jacobians- simple problems. | **06 Hrs** |
| **UNIT-II** | |
| **MULTIPLE INTEGRALS**<br>Evaluation of double and triple integrals – direct problems, change of order in double integral, change of variables to polar, cylindrical and spherical coordinate systems. | **06 Hrs** |
| **UNIT-III** | |
| **DIFFERENTIAL EQUATIONS**<br>Higher order linear differential equations with constant coefficients, Complementary function and Particular integral, problems. Equations with variable coefficients – Cauchy and Legendre differential equations, problems. | **06 Hrs** |
| **UNIT-IV** | |
| **VECTOR DIFFERENTIATION**<br>Introduction, simple problems in terms of velocity and acceleration. Concepts of Gradient, Divergence- solenoidal vector function, Curl- irrotational vector function and Laplacian, simple problems. | **06 Hrs** |
| **UNIT-V** | |
| **NUMERICAL METHODS**<br>Algebraic and transcendental equations – Regula-Falsi method, Newton-Raphson method.<br>Ordinary Differential Equations – Taylor's, modified Euler's and 4th order Runge-Kutta methods.<br>Numerical Integration – Simpson's $1/3^{rd}$, $3/8^{th}$and Weddle's rules. | **06 Hrs** |

| Course Outcomes: After completing the course, the students will be able to | |
|---|---|
| 1 | Understand the significance of fundamental concepts of Mathematics in various Engineering problems. |
| 2 | Interpret the concept of differentiation, integration and differential equations in Engineering and real life problems. |
| 3 | Apply effectively appropriate quantitative tools and logical modes of thinking to analyze for solving Engineering problems. |
| 4 | Justify the application of various Mathematical models and broaden the problem solving skills in a wide range of intellectual domains. |

| Reference Books | |
|---|---|
| **1.** | B.S. Grewal; Higher Engineering Mathematics; Khanna Publishers; 40$^{th}$Edition; 2007; ISBN: 81-7409-195-5 |
| **2.** | N.P Bali & Manish Goyal; A Text Book of Engineering Mathematics; Lakshmi Publications; 7$^{th}$Edition; 2010; ISBN: 978-81-7008-992-6 |
| **3.** | R.K. Jain & S.R.K. Iyengar; Advanced Engineering Mathematics; Narosa Publishing House; 2002; ISBN: 817319-420-3 |
| **4.** | Erwin Kreyszig; Advanced Engineering Mathematics; John Wiley & Sons; 9$^{th}$ Edition; 2007; ISBN: 978-81-265-3135-6 |

| **Continuous Internal Evaluation (CIE)<br>( Theory – 100 Marks)** | |
|---|---|
| Evaluation method | Course with Assignment |
| Quiz -1 | 10 |
| Test -1 | 30 |
| Quiz -2 | 10 |
| Quiz -3 | 10 |
| Test -2 | 30 |
| Assignments | 10 |
| Total | **100** |

| **Semester End Evaluation<br>Theory (100)** | |
|---|---|
| **Part- –A**<br>**Objective type questions** | **20** |
| **Part –B**<br>There should be five questions from five units. Each question should be for maximum of 16 Marks.<br><br>The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice.<br><br>The **UNIT-2 and UNIT-3** should have an internal choice.<br>Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level. | **80** |
| **Total** | **100** |

| | What | | To whom | Frequency of conduction | Max Marks | Evidence | Contribution to Course Outcome | | |
|---|---|---|---|---|---|---|---|---|---|
| **Direct Assessment Methods** | CIE | Quiz | Students | Three | 30 | Answer Scripts | 80% | 100% | 90% |
| | | Test | | Two | 60/50 | | | | |
| | SEE | Semester End Examination | | End of every semester Consisting of Part-A and Part-B | 100 | Answer Scripts | 20% | | |
| **Indirect Assessment methods** | Course End Survey | | Students | End of course | | Questionnaire Based on COs | 10% | | |