VEERMATA JIJABAI TECHNOLOGICAL INSTITUTE

(VJTI)

MATUNGA, MUMBAI 400 019

(Autonomous Institute affiliated to University of Mumbai)

Curriculum

(Scheme of Instruction & Evaluation and Course contents)

For

First Year

of

Four Year Undergraduate Programme

Leading to

Bachelor of Technology (B Tech) Degree in Mechanical Engineering

Implemented from the batch admitted in Academic Year 2023-24

B. Tech. Mechanical Engineering

Program Educational Objectives (PEOs)

1. To attain Analytical, Experimental and Computational expertise in Mathematics, Applied Sciences and Core Engineering subject domain.
2. To discharge responsibilities towards society by achieving high standards of professionalism, leadership and ethical behavior.
3. To comprehend the need for higher studies and lifelong learning so as to remain in competitive and sustainable environment.

Program Outcomes (POs)

PO1: Apply knowledge of mathematics, science and engineering to design, analyze and evaluate mechanical components & complex systems.

PO2: Analyze problems of mechanical engineering including design thermal and manufacturing industrial systems.

PO3: Design, implement, and evaluate mechanical systems and processes considering public health, safety, cultural, societal and environmental issues.

PO4: Design and conduct experiments using domain knowledge and analyze data to arrive at valid conclusions.

PO5: Apply recent techniques, skills, knowledge and computer based methods & tools to solve mechanical problems.

PO6: Analyze the local and global impact of modern technologies on individual organizations, society and culture.

PO7: Apply knowledge of contemporary issues to investigate and solve problems with a concern for sustainability and eco-friendly environment.

PO8: Exhibit responsibility in professional, ethical, legal and social issues.

PO9: Function effectively in teams, in diverse and multidisciplinary areas to accomplish common goal.

PO10: Effective written and verbal communication on complex engineering activities and exhibit leadership qualities.

PO11: Apply management principles to manage projects in multidisciplinary environment.

PO12: Pursue life-long and independent learning as a means to enhance knowledge and skills.

Program Specific Outcomes (PSOs)

Our Graduate should be able to apply principles of Mechanical Engineering to:

1. Specify, manufacture, test, operate and document basic mechanical systems and processes.
2. Analyse, design, develop and implement advanced mechanical systems and processes.
3. Select solutions to the mechanical engineering problems based on ethics, sustainability and long term benefits to society.

V J T I Veermata Jijabai Technological Institute
(Central Technological Institute, Maharashtra State, INDIA)
H. R. Mahajani Marg, Matunga, Mumbai 400019
Tel.No. +91 22 24198101-02 Fax +91 22 24102874
www.vjti.ac.in

(Autonomous Institute affiliated to University of Mumbai)

Curriculum

(Scheme of Instruction & Evaluation and Course contents)

For

First Year

of

Four Year Undergraduate Programme

Leading to

Bachelor of Technology (B Tech) Degree in Mechanical Engineering

V J T I Veermata Jijabai Technological Institute
(Central Technological Institute, Maharashtra State, INDIA)
H. R. Mahajani Marg, Matunga, Mumbai 400019
Tel.No. +91 22 24198101-02 Fax +91 22 24102874
www.vjti.ac.in

Credit Framework for UG Programme in Mechanical Engineering (Level 4.5- UG Certificate) - Semester - I

Sr.	Course Type	Course Code	Course Name	L	T	P	Hr	Cr	Examination Weightage in %		
									TA	MST	ESE
1	BSC	R5PH1011T	Physics	2	1	0	3	3	20	30	50
2	BSC	R5PH1011L	Physics Laboratory	0	0	2	2	1	ISCE :60		40
3	BSC	R5MA1002T	Mathematics-I	2	1	0	3	3	20	30	50
4	ESC	R5ME1001T	Engineering Graphics	2	0	0	2	2	20	30	50
5	ESC	R5ME1001L	Engineering Graphics Laboratory	0	0	2	2	1	ISCE: 60		40
6	ESC	R5EE1021T	Basic Electrical & Electronics Engineering	2	0	0	2	2	20	30	50
7	ESC	R5EE1021L	Basic Electrical & Electronics Engineering Laboratory	0	0	2	2	1	ISCE: 60		40
8	ESC	R5ME1022T	Engineering Materials & Applications	3	0	0	3	3	20	30	50
9	ESC	R5ME1023L	Engineering Materials & Applications Laboratory	0	0	2	2	1	ISCE :60		40
10	VSEC	R5ME1024L	Design Thinking and Idea Lab	0	0	3	3	1.5	ISCE :60		40
11	AEC	R5HS1001L	Business & Technical Communication	1	0	2	3	2	ISCE :60		40
12	CC1	R5ME1025L	From Basket	0	0	3	3	1.5	ISCE:100		
			Total	12	2	16	30	22			

abbreviations **L** Lecture, **T** Tutorial, **P** Practical, **TA** Teacher Assessment / Term work Assessment, **MST** Mid Semester Test, **ESE** End Semester Written Examination, **ISCE** In-semester Continuous Evaluation, **BSC** Basic Science Course, **ESC** Engineering Science Course, **VSEC** Vocational and Skill Enhancement Course, **AEC** Ability Enhancement Course, **CC** Co-curricular Course

V J T I Veermata Jijabai Technological Institute
(Central Technological Institute, Maharashtra State, INDIA)
H. R. Mahajani Marg, Matunga, Mumbai 400019
Tel.No. +91 22 24198101-02 Fax +91 22 24102874
www.vjti.ac.in

Credit Framework for UG Programme in Mechanical Engineering (Level 4.5- UG Certificate) - Semester - II

Sr.	Course Type	Course Code	Course Name	L	T	P	Hr	Cr	Examination Weightage in %		
									TA	MST	ESE
1	BSC	R5CH1012T	Chemistry	2	1	0	2	3	20	30	50
2	BSC	R5CH1012L	Chemistry – Laboratory	0	0	2	2	1	ISCE :60		40
3	BSC	R5MA1012T	Mathematics-II	2	1	0	3	3	20	30	50
4	BSC	R5ME1026T	Engineering Thermodynamics	2	0	0	2	2	20	30	50
5	ESC	R5SE1002T	Engineering Mechanics	2	0	0	2	2	20	30	50
6	ESC	R5SE1002L	Engineering Mechanics Laboratory	0	0	2	2	1	ISCE: 60		40
7	ESC	R5CO1012T	Programming for Problem Solving	2	0	0	2	2	20	30	50
8	ESC	R5CO1012L	Programming for Problem Solving Laboratory	0	0	2	2	1	ISCE :60		40
9	PCC	R5ME1027T	Manufacturing Processes	2	0	0	2	2	20	30	50
10	VSEC	R5ME1028L	Manufacturing Practice	0	0	3	3	1.5	ISCE :100		
11	IKS	R5ME1029T	Introduction to Ancient Indian Science and Technology	2	0	0	2	2	20	30	50
									Or Credit Transfer		
12	CC2	R5ME1030L	From Basket	0	0	3	3	1.5	ISCE:100		
			Total	14	2	12	28	22			

abbreviations **L** Lecture, **T** Tutorial, **P** Practical, **TA** Teacher Assessment / Term work Assessment, **MST** Mid Semester Test, **ESE** End Semester Written Examination, **ISCE** In-semester Continuous Evaluation, **BSC** Basic Science Course, **ESC** Engineering Science Course, PCC Program Core, **VSEC** Vocational and Skill Enhancement Course, IKS Indian Knowledge System, **CC** Co-curricular Course

V J T I Veermata Jijabai Technological Institute
(Central Technological Institute, Maharashtra State, INDIA)
H. R. Mahajani Marg, Matunga, Mumbai 400019
Tel.No. +91 22 24198101-02 Fax +91 22 24102874
www.vjti.ac.in

List of Exit Courses after completion of Semester I and II

1. Exit option is available for students those who have earned the total 44 credits at the End of Second Semester.
2. Student who wants to avail the exit option after first year have to earn additional 6-8 credits from the list of courses shown below.
3. These courses student have to complete within summer vacation after 1st Year.
4. After fulfillment as mentioned in 1 to 3 above, Students can earn U.G Certificate and same will be issued by the Institute.

List of Exit Courses after completion of Semester I and II: Mechanical Engineering

Sr.	Course Type	Course Name	L	T	P	Hr	Cr	Examination Weightage in %		
								TA	MST	ESE
1	EC	Internship (6-8 weeks)					6	ISCE :60		40
2	PCC	Welding	0	0	4	4	2	ISCE :60		40
3	PCC	Carpentry	0	0	4	4	2	ISCE :60		40
4	PCC	Turning	0	0	4	4	2	ISCE :60		40
5	PCC	Material Characterization	0	0	4	4	2	ISCE :60		40
6	PCC	Fitting	0	0	4	4	2	ISCE :60		40

SEMESTER-I

Programme Name	*Bachelor of Technology in Mechanical Engineering*
Course Code	**R5PH1011T**
Course Title	**Physics**

Course Outcomes

After completion of course, students would be able to

1. Classify, draw, describe, and distinguish crystal structures and crystallographic planes.
2. Analyze crystal structures by X-Ray diffraction.
3. Describe properties of light using interference, diffraction, polarization, and its applications.
4. Identify and summarize properties and applications of dielectric materials.
5. Classify and analyze magnetic materials.

Course Contents

Crystal Structure of solids

Single crystal, polycrystalline, amorphous solids; Concepts of space lattice, atomic basis, unit cell & its characteristics; Monoatomic and diatomic Crystal, ligancy, imperfection

Crystallographic Planes and Direction

Concept of Miller indices and its determination for Crystallographic planes and their direction, examples, Interplanar spacing in terms of miller indices

Determination of crystal structure using X-rays

Bragg's law of X-ray diffraction, Bragg's spectrometer, X-ray diffraction methods: - Laue, Powder, Rotating Crystal

Interference

Temporal and spatial coherence, interference in parallel thin films, wedge shaped film, Michelson interferometer, antireflection coating

Diffraction

Fresnel and Fraunhofer diffraction, Fraunhofer diffraction at single slit, double slits and circular aperture, diffraction grating

Polarization

Polarization types, theory of production of Plane, circularly and elliptically polarized light, double refraction, uniaxial and biaxial crystals, Nicole prism, Dichroism, retardation plates: quarter wave and half wave, polarimeter

Dielectric properties

Capacitance, Permittivity & dielectric constant; Polarizability-polar and nonpolar, dielectric susceptibility, Polarizations: - electronics, ionic, orientation interface, internal fields in solids, Dielectrics in alternating fields, ferroelectricity, piezoelectricity

Magnetic properties

Basic concepts, classification of magnetic materials, Domain theory of Ferromagnetism, Hysteresis Curve, Magnetostriction, magnetic materials.

Reference Books

1. Modern Physics, 3rd edition, R Serway, C Moses and C Moyer, Thomson Learning inc,
2. Material Science and Engineering: An Introduction, 6th edition., Callister W.C. Jr., John Wiley & Sons
3. Applied Physics I for Science and Engineering, Dattatray Wavhal, ISBN 978-93-5267-180-9, 2016
4. Applied Physics II for Science and Engineering, Dattatray Wavhal, ISBN 978-93-5268-289-8, 2017
5. A textbook of Engineering Physics, M N Avadhanulu and P. G. Kshirsagar

Programme Name	***Bachelor of Technology in Mechanical Engineering***
Course Code	**R5PH1011L**
Course Title	**Physics Laboratory**

COURSE OUTCOMES:

The student should be able to

1. Draw and analyze unit cells, Miller planes and Miller directions.
2. Calculate radius of curvature of lens, wavelength and small thickness, velocity of sound waves using Interference.
3. Finding energy of spectral lines and grating element using diffraction phenomena.
4. Determine optical activity by polarimeter and verification of Malus Law
5. Study of magnetic properties using hysteresis/curie temperature/ susceptibility

Course Contents **(Any 10)**

1. Crystal Structure (Unit Cells)
2. Crystal Structure (Miller planes)
3. Newton's Ring Experiment
4. Wedge shape Method
5. Michelson Interferometer
6. Ultrasonic Interferometer
7. Wavelength and energy measurement of spectral lines using spectrometer.
8. Laser diffraction method
9. Specific rotation of Cane sugar solution using polarimeter.
10. Polarization of light and verification of Malus law
11. Hysteresis of a ferromagnetic material
12. Curie temperature by two probe method
13. Susceptibility of solids by Gouy's method

Programme Name	*Bachelor of Technology in Mechanical Engineering*
Course Code	**R5MA1002T**
Course Title	**Mathematics-I**

COURSE OUTCOMES:

The student should be able to

1. Characterize a linear system in terms of number of solutions, whether it is consistent or not.
2. Compute eigenvalues and eigenvectors of a square Matrix and determine if it is diagonalizable
3. Calculate functional value of some point in a neighborhood using Taylor's series expansion and find the limit of a function at a point or at infinity using L'Hospital's rule.
4. Determine if an infinite series is convergent or not using suitable test.
5. Be familiar with the theorems of differentiability such as mean value theorem and interpret it geometrically.
6. Evaluate partial derivatives and implement/ apply it to find minima and maxima of a multivariate function. Also Find directional derivatives and gradient and illustrate geometric meaning with the help of sketches.
7. Apply definite integration to evaluate surface areas and volumes of revolution and evaluate improper integrals.
8. Evaluate multiple integrals for regions in a plane and find volume, area bounded by the curves, mass, center of gravity of solid geometric figures.
9. Characterize complex variables in terms of analyticity, find harmonic conjugates and study geometric properties of conformal mappings.

Course Contents

Linear Algebra

Rank of a matrix, System of linear equations- check for consistency, Eigenvalues & eigenvectors of a matrix, Diagonalization, Cayley-Hamilton theorem, Minimal polynomial, Finding Inverse and Powers of a matrix.

Differential Calculus

Mean value theorem, Rolle's theorem, Indeterminate form, L'Hospital's rule, Taylor's theorem and Truncation error, Partial Derivatives, Chain rule, Total Derivative, Differentiation of an implicit function, Directional Derivative, Gradient, maxima, minima and saddle points of a multivariable function, Lagrange's multipliers method, tangent plane and normal line, Convergence of sequence and series, Tests for convergence -ratio test, root test, p-series test, comparison test, alternating series test, absolute convergence test.

Integral Calculus

Evaluation of definite integration to find surface areas and volumes of revolution, Introduction to Improper Integrals and Gamma functions and its properties, Multiple integrals, change of order of integration in double integrals, Change of variables (Cartesian to polar), Triple integrals

(Cartesian, cylindrical and spherical co-ordinates). Applications: areas and volumes, Center of mass and Gravity (constant and variable densities);

Complex Variables: Differentiation

Complex Functions- Limits, Continuity and differentiability, Analytic functions, Cauchy Riemann equations, Harmonic conjugates, Conformal mappings, Linear fractional transformations and their properties.

References

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & sons, 2006.
3. Ramana B. V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
4. Veerarajan T., Engineering Mathematics for first year, Tata McGraw Hill, New Delhi 2008.
5. N. P. Bali and Manish Goyal, A textbook of Engineering Mathematics, Laxmi Publications, Reprint 2008.
6. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
7. Susan Jane Colley, Vector Calculus, 4th Edition,2012
8. David Poole , Linear Algebra A Modern Introduction, Third Edition
9. S. Kumareson, Linear Algebra A Geometric Approach
10. John H. Matthews and Russell W. Howell, Complex Analysis for Mathematics and Engineering, Third Edition

Programme Name	*Bachelor of Technology in Mechanical Engineering*
Course Code	**R5ME1001T**
Course Title	**Engineering Graphics**

Course Outcomes

The student should be able to –

1. Represent projections of lines and solids.
2. Draw projections of solids cut by section planes.
3. Convert the pictorial view into orthographic projections.
4. Convert the orthographic projections into isometric view.

Course Contents

Introduction to Drawing & Geometrical Contraction

Introduction: Introduction and importance of engineering drawing, Drawing Instruments and their use, Drawing layout, types of lines, lettering and Dimensioning

Engineering Curves: Cycloid, Epicycloid, and Hypocycloid; Involutes.

Projection of Points and Lines

Introduction: Method of projections, Orthographic projection, Reference planes, Quadrants, Reference line etc. Projection of Points.

Projections of lines: Line inclined to both the reference planes (excluding the traces), True/Apparent lengths & inclinations.

Projection Solids, Sections of Solids

Projections of Solids: Solids (Prism, Pyramid, Cylinder, Tetrahedron, Hexahedron and cone only with their axis inclined to HP or VP only (Excluding Spheres, Composite and Hollow solids) Use change of position or Auxiliary Plane method.

Section of Solids: Section of Prism, Pyramid, Cylinder, Tetrahedron, Hexahedron & cone cut by plane. Use change of Position or Auxiliary plane method.

Orthographic Projections

Multi View Orthographic projections of simple machine parts by first angle method, Sectional views of simple machine parts (full & Half Section only)

Isomeric Projection

Isomeric scale, isometric view/Drawing of simple blocks with plain and cylindrical surfaces. (excluding spherical surface)

Note: Only FIRST ANGLE Method of projections must be used throughout the course.

Text books

1. N. D. Bhatt, Engineering Drawing, Charotar publishing house, 53rd Edition, 2014
2. N. H. Dubey, Engineering Drawing Nandu Publishers & printers, 15th Edition, 2015

Programme Name	***Bachelor of Technology in Mechanical Engineering***
Course Code	**R5ME1001L**
Course Title	**Engineering Graphics Laboratory**

Course Outcomes

The student should be able to –

1. Draft various Geometrical Elements used in Engineering Practice using CAD software.
2. Draft projections of various objects and their representation and dimensioning using CAD software.
3. Represent objects through isometric projections. Interpret drawings of engineering parts and objects.
4. Acquire drawing skills pertaining to various topics like projection of points, lines and solids.

Course Contents

Introduction to Computer Aided sketching

Computer screen, layout of the software, standard tool bar/menus and description of most commonly used tools bars, navigational tools. Co-ordinate system and reference planes. Definitions of HP, VP. Creation of 2D/3D environment. Selection of drawing size and scale. Commands and creation of co-ordinate points, lines, axes, polylines, square, rectangle, polygons, splines, circles, ellipse, text, move, copy, offset, mirror, rotate, trim, extend, break, chamfer, fillet, curves, constraints viz. tangency, parallelism, inclination and perpendicularity. Dimensioning, line conventions material conventions and lettering

Minimum 10 Exercises based on above mentioned topics with minimum two problems in each Exercise.

Programme Name	*Bachelor of Technology in Mechanical Engineering*
Course Code	**R5EE1021T**
Course Title	**Basic Electrical & Electronics Engineering**

COURSE OUTCOMES:

The student should be able to

1. Provide working knowledge for the analysis of basic DC and AC circuits used in electrical and electronic devices.
2. Develop selection skill to identify the type of generators or motors required for particular application.
3. Highlight the importance of transformers in transmission and distribution of electric power.
4. Learn different applications of commonly used electrical machinery and electronics devices

Course Contents

DC Circuits

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems.

AC Circuits

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three-phase balanced circuits, voltage and current relations in star and delta connections.

Transformers

Ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

Electrical Machine

Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators.

Electrical Installations/wiring

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup

Diodes

Semiconductor Diode Characteristics, Modeling the Semiconductor Diode, Diode circuits: Clipper; Clamper circuits

DC power supply
Rectifier; Half wave, Full wave (center-tapped, bridge)

Recommended Reading

1. D. P. Kothari and I. J. Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, 2010.
2. D. C. Kulshreshtha, “Basic Electrical Engineering”, McGraw Hill, 2009.
3. L. S. Bobrow, “Fundamentals of Electrical Engineering”, Oxford University Press, 2011.
4. E. Hughes, “Electrical and Electronics Technology”, Pearson, 2010.
5. V. D. Toro, “Electrical Engineering Fundamentals”, Prentice Hall India, 1989.
6. Robert Boylestad and Louis Nashelsky, “Electronic Devices and Circuit Theory” PHI; 8th Edition.200
7. Thomas L. Floyd, “Electronic Devices” 8th Edition, Pearson Education, Inc., 2007
8. A.S. Sedra and K.C. Smith, “Microelectronic Circuits”, 6th Edition, Oxford University Press, 2006

Programme Name	***Bachelor of Technology in Mechanical Engineering***
Course Code	**R5EE1021L**
Course Title	**Basic Electrical & Electronics Engineering Laboratory**

COURSE OUTCOMES:

Students will able to

1. Handle basic electrical equipment
2. Understand domestic wiring procedures practically.
3. Assemble electronic systems.
4. Understand all the fundamental concepts involving electrical & electronics engineering

Course Contents

Basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.

Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification. Observation of phase differences between current and voltage. Resonance in R-L-C circuits.

Transformers: Loading of a transformer: measurement of primary and secondary voltages and currents, and power.

Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line-line voltage, phase-to-neutral voltage, line and phase currents).

Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase induction machine.

Torque Speed Characteristic of induction motor.

Diode characteristics, rectifiers, Zener diodes

Programme Name	*Bachelor of Technology in Mechanical Engineering*
Course Code	**R5ME1022T**
Course Title	**Engineering Materials & Applications**

COURSE OUTCOMES:

The student should be able to –

1. Apply concepts in materials science to solve engineering problems.
2. Interpret Iron-Iron carbide diagram, TTT diagram & their significance
3. Compare various material used for engineering application

Course Contents

Solid Crystalline Structure

Crystallization of liquid into solid state, Nucleation and growth in metals and alloys, Formation of polycrystalline and single crystals, Classification of crystal structure, FCC, BCC and HCP lattice, Lattice structure, unit cell, packing density and co-ordination number, their importance, Crystallographic notations – Methods for planes and directions.

Lattice Imperfections

Definition, classification and significance of imperfections, Point defects, vacancy, interstitially and impurity atom defects, their formation and effects, Dislocations: Edge and screw dislocations Burger's reactor, Motion of dislocations and their significance, Surface defects, Grain boundary, sub- angle grain boundary and stacking faults, their significance Generation of dislocation, Frank Reed source, conditions of multiplications and significance. Dislocation interactions, Elimination, multi-component dislocation, Dislocation pile up. Dislocation jog, dislocation climb.

Deformation

Definition, elastic and plastic deformation and their significance in design and shaping, Deformation in single crystal and polycrystalline materials, Mechanisms of deformation, Critical stress for deformation. Deformability of FCC, HCP and BCC lattice, slip systems.

Strain Hardening

Definition and importance of strain hardening, Dislocation theory of strain hardening, effects of strain hardening on engineering behavior of materials Recrystalization Annealing, Theory and stages of recovery, Recrystalization and grain growth, Factors affecting recrystallation, Recrystalization temperature, Hot and cold working theory, Their advantages, limitation and applications.

Constitution of Alloys

Introduction, classification, pure metal, interstitial and intermetallic compounds, Solid solution and its types, phase rule, cooling curves for pure metals and alloys, Phase diagrams: Equilibrium diagram of a binary system in which the components from eutectic In solid state (Lead-Antimony phase diagram), Equilibrium diagram of a binary system in which there is a complete solubility, In liquid and solid state (copper-nickel phase diagram), Equilibrium diagram of a

system in which components have completed Mutual, Solubility in liquid state and limited solubility in solid state and solid solubility, Decrease with the temperature (Lead-tin phase diagram)

Iron-Carbon Equilibrium Diagram

Allotropy of iron, study of transformation in iron-carbon equilibrium diagram, Definition of structures, study of microstructures, effect of carbon content on Structure and properties of plain carbon steels, critical temperature lines, and effect of Minor constitutes and curves.

Heat-Treatment of Steels

Annealing, normalizing, hardening, and tempering of steels, Surface heat treatments (case hardening), Chemical heat treatments such as carburizing, nit riding, cyaniding, Flame hardening and Induction hardening.

Cast Irons

White, gray, malleable, chilled, S.G. Mechanize Cast iron, alloy cast irons, Effect of Constituents, such as silicon, sulfur, Manganese, phosphorous on cast iron, Mechanical properties and uses of different cast iron.

Alloy Steels

Effect of alloying elements on the structures, properties and applications of steels, such as manganese, nickel, chromium, tungsten, molybdenum and silicon steels. Effect of alloying elements in steels: Limitations of plain carbon steels, significance of alloying elements, Effects of major and minor constituents, Effect of alloying elements on ferrite, carbide, austenite, effect of alloying elements on phase transformation, decomposition, hardening and tempering, Classification of tool steels and metallurgy of tool steels and special steels.

Non-Ferrous Metals and Alloys

Copper and its alloys, Aluminum and its alloys, Nickel and its alloys, Zinc and its alloys and Lead and its alloys.

Fatigue Failure

Definition of fatigue and significance of cyclic stress, Mechanism of fatigue and theories of fatigue failure, Fatigue testing, Test data presentation and statistical evaluation, S. N. Curve and it interpretation, Influence of important factors on fatigue, Notch effect surface effect, Effect of pre-stressing, corrosion fatigue and thermal fatigue.

Creep Failure

Effect of temperature on mechanical behavior of materials, Definition and signification of creep Creep testing and data presentation, Mechanisms and types of creep, Analysis of classical creep curve and Creep Resistant materials.

Powder Metallurgy

Powder making methods, Powder compaction, Sintering, sintering mechanism, Applications of power metallurgy.

Introduction to New Materials

Composites: Basic concepts of composites, Processing of composites, advantages over metallic materials, various types of composites and their applications.

Nano-Materials: Introduction, Concepts, synthesis of nano-materials, examples, applications and nano-composites.

Polymers : Basic concepts, Processing methods, advantages and disadvantages over metallic materials, examples and applications.

Introduction to International Standards/ Codes

BIS Publications, IS, AISI, ASME section 8, div II, AWS (American Welding Society) Hand Book, ASME section 5 for NDT. Materials specifications commonly used materials for different engineering components parts.

Text Books

1 Y. Lakhtin, Engineering Physical Metallurgy, Mir publishers, Moscow, 1st Indian edition, 1998

2 S.H.Avner, Introduction to Physical Metallurgy, McGraw-Hill Inc., 1st edition, 1974

3 William D. Callister, Materials Science and Engineering an Introduction, Jr. sixth edition, (2003) John Wiley & Sons (ASIA) Pte Ltd. Singapore.

Reference Books:

1 G. E. Dieter, Mechanical metallurgy, McGraw Hill International, (1988) metric edition, New Delhi.

2 Metallurgy for Engineers, E. C. Rollason, English Language Book Society & Edward Arnold Publisher Ltd.

3 Introduction to Engineering Materials, B. K. Agrawal, Tata McGraw Hill Publications Co. Ltd.

4 Structure and Properties of Engineering Alloys, W. F. Smith, McGraw Hill International New Delhi

5 Physical Metallurgy for Engineers, Donald S. Clarke and Wibur R. Varney, D. Van Nostrand Co. INC

Programme Name	***Bachelor of Technology in Mechanical Engineering***
Course Code	**R5ME1022L**
Course Title	**Engineering Materials & Applications Laboratory**

COURSE OUTCOMES

The student should be able to –

1. Identify various defects and failure mechanisms.
2. Compare various material based on their microscopic structure
3. Select appropriate heat treatment process for specific requirements.

List of Experiments [Any 8]

1. Preparation of specimens for microscopic examination – steels, copper alloys and aluminium alloys; hot mounting and cold mounting and mechanical fixtures.
2. Microstructural study by etching of specimens of steel, copper alloys and aluminium alloys and cast iron.
3. Microstructures of plain carbon steels.
4. Microstructures of cast irons.
5. Observation and drawing of different morphologies of grains – equiaxed dendrites, columnar dendrites, cellular structure, equiaxed grains, polygonal grains, elongated grains.
6. Observation of microstructures using image analyzer, Quantitative Metallography software, models and tools for grain size, shape, phases distribution and porosity.
7. Estimation of phases and drawing of cooling curves for transformation of plain carbon steels with varying carbon contents using Fe-C diagram. Observation and description of microstructures of annealed plain carbon steels.
8. Observations and description of microstructures belonging to various cast irons, brasses, bronzes, wrought and cast aluminium alloys; measurement of their hardness.
9. Annealing, Normalising, Hardening and tempering of medium carbon steel and observation of microstructures.
10. Determination of hardenability of steel using Jominy end Quench Test.
11. Fatigue test – To determine number of cycles to failure of a given material at a given stress.
12. Corrosion rate test
13. Student will bring unknown metallic sample; prepare it for metallographic observation; observe and describe the microstructure with identification of phases present in it.

Programme Name	*Bachelor of Technology in Mechanical Engineering*
Course Code	**R5ME1024L**
Course Title	**Design Thinking and Idea Laboratory**

COURSE OUTCOMES:

The student should be able to

1. Understand how to apply Design Thinking methods to understand what your users need, and how to meet those needs.
2. Learn how to solicit input from users in creative ways and generate new ideas quickly.
3. Learn how to test your ideas and develop prototypes.

Course Contents

Introduction to Design Thinking

Introduction to elements and principles of Design, basics of design-dot, line, shape, form as fundamental design components. Principles of design. Introduction to design thinking, history of Design Thinking, New materials in Industry.

Design Thinking Process

Design thinking process (empathize, analyze, idea & prototype), implementing the process in driving inventions, design thinking in social innovations. Tools of design thinking -person, costumer, journey map, brain storming, product development

Activity: Every student presents their idea in three minutes, Every student can present design process in the form of flow diagram or flow chart etc. Every student should explain about product development.

Innovation

Art of innovation, Difference between innovation and creativity, role of creativity and innovation in organizations. Creativity to Innovation. Teams for innovation, Measuring the impact and value of creativity.

Activity: Debate on innovation and creativity, Flow and planning from idea to innovation, Debate on value-based innovation.

Product Design

Problem formation, introduction to product design, Product strategies, Product value, Product planning, product specifications. Innovation towards product design Case studies.

Activity: Importance of modelling, how to set specifications, Explaining their own product design.

Design Thinking in Business Processes

Design Thinking applied in Business & Strategic Innovation, Design Thinking principles that redefine business –Business challenges: Growth, Predictability, Change, Maintaining Relevance, Extreme competition, Standardization. Design thinking to meet corporate needs. Design thinking for Startups. Defining and testing Business Models and Business Cases. Developing & testing prototypes.

Activity: How to market our own product, About maintenance, Reliability and plan for startup.

Text Book

Karmic Design Thinking by Prof. Bala Ramadurai

References:

1. Design: Creation of Artifacts in Society by Prof. Karl Ulrich, U. Penn
2. Change by Design by Tim Brown.

Programme Name	*Bachelor of Technology in Mechanical Engineering*
Course Code	**R5HS1001L**
Course Title	**Business & Technical Communication**

Course Outcomes

After completion of course, students would be able to

1. Apply the principles and practices of business communication for communicating in a professional environment.
2. Design a technical document with correctness of language, appropriate vocabulary and style.
3. Display competence in oral and visual communication.
4. Demonstrate capabilities for self -assessment and development.

Course Contents

Foundations of Business English

● Introduction to Business English and its importance in the professional world.
● Business Vocabulary and commonly used expressions.
● Business Idioms at the workplace.

Business and Technical Writing

● Understanding Business writing language, style and tone.
● Crafting clear and concise business documents: Instruction Manuals/Brochures.
● Developing Email Etiquette.

Business Grammar and Language Usage

● Review of essential English grammar rules.
● Identifying commonly made errors in Indian English.

Group Discussion

● Basics of a Group Discussion.
● Understanding the different types of Group Discussions.
● Practical tips and suggestions for a GD.

Presentation Skills

● Structuring a compelling business presentation.
● Engaging an audience and using visual aids effectively.

Introduction to Public Speaking for Engineers

● Techniques to manage and reduce public speaking anxiety.
● Crafting a clear and concise speech outline.
● Tailoring the message for different audiences.

Critical Thinking Skills

● Introduction to the processes of logical reasoning to interpret arguments
● Evaluating information from a lens of fact checking, evidentiary support, confirmation bias and language analysis.

Text Books

1. H. S. Mukherjee, Business Communication: Connecting at Work, Oxford University Press; Pap/Cdr edition (26 November 2012), (ISBN: 9780198073475)
2. A. Rizvi, Effective Technical Communication, McGraw Hill Education; 1 edition (27 June 2005), (ISBN: 0070599521)
3. M. Raman, P. Singh, Business Communication, Oxford; Second edition (6 August 2012), (ISBN: 9780198077053)

Recommended Reading:

1. E. H. Mcgrath, Basic Managerial Skills for All, Prentice Hall India Learning Private Limited; 9 edition (2011), (ISBN: 9788120343146)
2. R. Subramanian, Professional Ethics, Oxford University Press; Second edition (17 April 2017), (ISBN: 0199475075)

SEMESTER-II

Programme Name	*Bachelor of Technology in Mechanical Engineering*
Course Code	**R5CH1012T**
Course Title	**Chemistry**

COURSE OUTCOMES:

The student should be able to

1. Correlate the different chemical reaction mechanisms with rate of reaction that are used in the industrial synthesis of organic molecules and drugs.
2. Rating the chemical fuels based on their chemical composition, and properties. Choosing the alternate energy sources.
3. Analyze the basic cause of corrosion, its reactions & corrective preventive measure to reduce the rate and adopt suitable method of treatment suitable for various industrial applications.
4. Analyse functional material based on their structure, and performance. Rationalize the concept Sustainability and adopt green chemistry approach
5. Select appropriate separation methods required in manufacturing industries by understanding the basic concept of chromatographic techniques. Choose the spectroscopic techniques for characterization of materials.

Course Contents

Reactions, Mechanisms & Kinetics

Introduction to Chemical reactions, Material balance for organic reactions, Mass balance and stoichiometry, SN1, SN2 Reactions, Chemical Kinetics, Energy profile diagram, Synthesis of drug molecule.

Energy Source:

Types of Chemical fuels, Calorific value, Determination of calorific value, combustion calculations, Analysis of coal, proximate and ultimate analysis, Fuels for IC engines, Effect of Chemical composition of fuel on knocking, anti knocking agents. Limitations of fossil fuels, Alternative fuels: Power alcohol, biomass, biogas,
biodiesel, Green hydrogen.

Science of Corrosion

Direct chemical corrosion, Electrochemical corrosion and its reactionmechanisms, Types of electrochemical corrosion, (differential aeration, galvanic, concentration cell), Electrochemical corrosion like Pitting, Intergranular, Soil, Waterline. Factors affecting corrosion, Protection of corrosion, Applications with few practical problems of corrosion.

Functional Materials for Engineers

Plastic, Elastomeric, & Fiber forming polymers, structural requirement, molecular weight determination, effect of structure, bonding, molecular weight, degree of polymerization on the performance of the polymers. Glass transition temperature, Structure property relationship.

Lubricants: Types of lubricants, Mechanism of lubrication, Physical and Chemical properties of lubricants, selection of lubricants.

Cementations Materials: Chemical composition of cement, Admixtures used in concrete, Chemical reactions involved, bitumen emulsions.

Identification, Separation & Purification

Types of Separation techniques: Column Chromatography, Thin layer chromatography, Paper chromatography. Spectroscopic principles and its applications, U.V. Spectroscopy, Fourier Transform Infra-Red Spectroscopy, Flame photometry. Determination of hardness of water by EDTA method and removal of hardness by ion exchange and zeolite method

Sustainable Engineering Chemistry

Concept of sustainability and its significance, Waste minimization, Atom Economy, Reduction of Materials and Energy requirement, Green Chemistry approach, Industrial applications of green chemistry.

Textbooks

1. Engineering Chemistry by Jain and Jain, Danpatrai publications;16th edn. (2013)
2. Engineering Chemistry by Dr.S.S.Dara, Dr.S.S.Umare, S.Chand & CompanyLtd,12th ed.
3. A Text Book of Engineering Chemistry by Shashi Chawla, Dhanpatrai publications; 4th edn;(2010)

Reference Books

1. Polymer Science-Billmayer, F.John Willey&Sons, N.Y.; 3rd edn(1984)
2. Introduction to Material Science William Callister, John Willey & Sons, N.Y.; 9th edn;(2013)
3. Engineering .Chemistry- NPTEL web- book, by T.L. Tembe, Kamaluddin and M.S.Krishnan
4. Fundamentals of Molecular spectroscopy: Colin N.Banwell & Elaine M. McCash, Tata McGraw- Hill 4th edn.
5. Fundamentals of Electrochemistry, Second Edition, V. S. Bagotsky, Wiley Interscience (2006).

Programme Name	*Bachelor of Technology in Mechanical Engineering*
Course Code	**R5CH1012L**
Course Title	**Chemistry Laboratory**

COURSE OUTCOMES:

The student should be able to

1. Determine the quality of water suitable for different sectors.
2. Determine physical and chemical characteristics of lubricating oils.
3. Synthesis of Biodiesel, Chalcones and calculating atom economy..
4. Analysis of coal by proximate method.
5. Separate and analyze by Chromatographic techniques

Course Contents

Title of the Experiment: (Any 10 experiments)

1. Saponification value of oils
2. Acid value of an Oil
3. Viscosity &Viscosity Index by Redwood Viscometer
4. Flash Point by Abel's & Pensky-Marten's Apparatus
5. Conductometric titrations
6. Analysis Of fuel: Proximate analysis of coal sample
7. Determination of adulteration in transport fuels
8. Separation by TLC & Paper chromatography
9. Determination of alkali metals by Flame photometry
10. Synthesis of Biodiesel to find out Atom Economy.
11. Synthesis of drug molecule
12. Determination of hardness of water by EDTA method.

Reference

1. Lab. Manual for Engineering Chemistry - Dr.S.K.Basin & Dr. S.K. Rani, Dhanapat Rai Publishing Company; (2009)
2. Practical Manual for Chemistry of Engineering Materials - D.D. Shah, Nandu Publication, Mumbai
3. Post Graduate Practical Chemistry - H.N. Patel, S.P. Turakhia, S.S. Kelkar, S.R. Puniyani, Himalaya Publishing House, 5th edn; (2008)
4. A Manual of Practical Engineering Chemistry Sudha Jain & Shradha Sinha, S.Chand Company Ltd 1st edn (2002)

Programme Name	*Bachelor of Technology in Mechanical Engineering*
Course Code	**R5MA1012T**
Course Title	**Mathematics-II**

COURSE OUTCOMES

The student should be able to –

1. Formulate Differential equations from the given physical problems and solve first order Differential equations using different techniques.
2. Find the complete solution of a differential equation with constant coefficients in terms of complementary function and particular integral.
3. Study complex power series, classify singularities of a function, evaluate line integrals and apply residue theorem to evaluate real integrals.
4. Develop better understanding of scalar and vector fields and apply gradient to solve problems involving normal vectors to level surfaces.
5. Apply the integral theorems such as Stoke's theorem, Green's theorem and Gauss divergence theorem to evaluate line, surface and volume integrals and give physical interpretation of curl and divergence of a vector field.
6. Model physical phenomena using partial differential equations such as heat and wave equation and solve them using separation of variables method.

Course Contents

Ordinary Differential Equations

First order equations (linear and nonlinear); Bernoulli's equations, higher order linear differential equations with constant coefficients, Complementary functions and Particular integrals by operator method, method of variation of parameters, Method of Undetermined coefficients, Euler-Cauchy equation; initial and boundary value problems.

Partial Differential Equation

Classification of second order linear PDEs, Method of Separation of variables, Solutions of one-dimensional Heat equation, First and second order wave equation, Two- dimensional Laplace equation,

Vector calculus

Vector functions- Limits, continuity and differentiation, scalar and vector fields, gradient, divergence and curl, Line integrals, Surface integrals, Volume integrals, Stoke's theorem, Gauss' Divergence theorem, Green's theorem

Complex Variables: Integration

Cauchy's Integral theorem and formula, Taylor's series- radius of convergence, Laurent's series, Singularities and Poles, Residue theorem, Evaluation of real integrals using contour integration and concept of residues

References

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & sons, 2006.
3. Ramana B. V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
4. Veerarajan T., Engineering Mathematics for first year, Tata McGraw Hill, New Delhi 2008.
5. N.P.Bali and Manish Goyal, A textbook of Engineering Mathematics, Laxmi Publications, Reprint 2008.
6. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
7. Susan Jane Colley, Vector Calculus, 4th Edition, 2012.
8. John H. Matthews and Russell W. Howell, Complex Analysis for Mathematics and Engineering, Third Edition

Programme Name	*Bachelor of Technology in Mechanical Engineering*
Course Code	**R5ME1026T**
Course Title	**Engineering Thermodynamics**

COURSE OUTCOMES

The student should be able to –

1. Understand the thermodynamic properties of ideal gas and steam.
2. Apply the Laws of Thermodynamics to different steady state systems.
3. Analyse the mathematical relations between various thermodynamic properties.
4. Evaluate the performance of thermodynamic Power Cycles.

Course Contents

Thermodynamic Concepts & First Law of Thermodynamics

Intensive and Extensive Properties, Path, Process, Cycle. Thermal Equilibrium and Zeroth Law of Thermodynamics.First Law of Thermodynamics, Internal energy, Enthalpy.Throttling, Joule's porous plug experiment, Joule – Thomson coefficient, inversion curve.

Properties of Pure Substances

Introduction to steam as working substance, Dryness fraction, Use of Steam Table and Mollier Chart to find out specific volume, enthalpy, entropy and internal energy for wet, dry-saturated and superheated steam. Pressure-Volume, Temperature-Entropy and Enthalpy-Entropy diagrams.

Control Volume Analysis for steady-state steady-flow reversible processes, Application to many open systems like Compressor, Turbine, Boiler, Condenser, Nozzles, Diffusers etc.

Components of steam power plant.

Second Law of Thermodynamics

Concept of Heat Engine and its thermal efficiency, Concepts of Refrigerator & Heat Pump. Second Law Statements: Kelvin–Planck Statement, Clausius Statement, their equivalence, Thermodynamic temperature scale, Clausius Equality and Inequality, Concept of Entropy, Principle of increases of entropy.

Introducing the *TdS* Equations, Entropy Change of an Ideal Gas, Entropy Change in Internally Reversible Processes of Closed Systems, Entropy Balance for Closed Systems, Entropy Balance for Control volume, Isentropic Efficiencies of Turbines, Nozzles, Compressors and Pumps,

Maxwell Equations.

Thermodynamic Cycles

Thermodynamic analysis of Carnot, Rankine, Otto, Diesel, Brayton, Joule cycle.

Text Books

1. R. Yadav, Fundamentals of Thermodynamics & Heat Engines–Vol I, Fifth Edition,Central Publishing House, Allahabad, 2012.
2. R. Yadav, Applied Thermodynamics & Heat Engines –Vol II, Fifth Edition, 2012.
3. Domkundwar, Kothandaraman & Domkundwar, A course in Thermal Engineering, Dhanpat Rai & Co., Third Edition, 2016.
4. P. K. Nag, Basic & Applied Thermodynamics, McGraw-Hill Education, Second Edition, 2009.

Recommended Reading

1. Moran & Shapiro, Fundamentals of Engineering Thermodynamics, John Wiley & Sons Inc., Ninth Edition, 2018.
2. Yunus A. Cengel and Michael A. Boles, Thermodynamics: An Engineering Approach, McGraw-Hill Higher Edition, Eighth Edition, 2017.
3. Sonntag, Borgnakke & Van Wylen, Fundamentals of Thermodynamics, John Wiley & Sons Inc., Ninth Edition, 2017.
4. Y. V. C. Rao, Theory and Problems in Thermodynamics, Second Edition, 2012.

Programme Name	*Bachelor of Technology in Mechanical Engineering*
Course Code	**R5SE1002T**
Course Title	**Engineering Mechanics**

COURSE OUTCOMES:

The student should be able to

1. Analyse the force system and relate it to the Engineering Applications.
2. Calculate centroids and centre of gravity of plane areas and volumes.
3. Analyse the different motions of a particle and apply principles of work, energy, impulse & momentum.

Course Contents

Fundamental of Mechanics

Review of basic concepts – mass, space, time and force: Particles and rigid bodies: Scalars and vectors: Free, sliding, fixed and unit vectors: Addition, subtraction and multiplication of two vectors. Definition of a force: Classification of forces: Principles of transmissibility, etc.

Force Systems

Introduction to different force systems, Composition of forces, triangle, parallelogram and polygon law of forces, addition of two parallel forces, Resolution of forces, moment of a force, Varignon's Theorem, Couple of forces, force – couple systems, Resultant of a force system, Equilibrium conditions for a force system, Free body diagram, Different types of supports, etc.

Distributed Forces

Line, area and volume distributions of forces, Centre of gravity, Centre of mass, Centroid of plane figures, Cerntroid of composite figures, Moment of Inertia, Area and mass moments of inertia, Perpendicular and parallel axes theorems of moment of inertia, Radius of gyration, etc.

Dry Friction

Laws of dry friction, Co-efficient of friction, Angle and cone of friction, Angle of repose, Applications of friction to wedges and screw jacks, etc.

Virtual Work

Work done by forces and couples, Virtual displacement and virtual work, Principle of virtual work for equilibrium bodies in equilibrium, Active force diagram, Degree of freedom, etc.

Kinematics of Particles:

Differential equations of kinematics, plane, rectilinear and curvilinear motions, Cartesian co-ordinate system, Normal and tangent co-ordinate system, projectile motion, etc.

Kinetics of Particles:

Newton's second law of motion, Work and energy principle, Gravitational-potential energy, elastic-potential energy, kinetic energy, power, efficiency, Principle of impulse and momentum, Impact motion, Direct central impact, etc.

Recommended books

1. A textbook of Engineering Mechanics, Dr. Sadhu Singh (S. Chand publishing)
2. Tayal A.K., Mechanics for Engineering, Statics and Dynamics, Umesh Publication, N. Delhi, 2008.
3. Engineering Mechanics, K. L. Kumar, Veenu Kumar, McGrow Higher Education.

Additional Reading

1. Shames I.H, Engineering Mechanics, P.H.I. India 1980.
2. Kumar K. L., Engineering Mechanics, McGraw Hill publishing company New Delhi 2008.
3. Beer and Johnston, Mechanics for Engineers, McGraw Hill, 2009.
4. Timoshenko and Young, Mechanics for Engineers, McGraw Hill, 2010.
5. Mclean and Nelson, Mechanics for Engineers, Schaum Outline Series 2010.
6. Hibbeler R.C., Mechanics for Engineers, Pearson Education, 2012.

Programme Name	***Bachelor of Technology in Mechanical Engineering***
Course Code	**R5SE1002L**
Course Title	**Engineering Mechanics Laboratory**

Course Outcomes

Students will be able to

1. Experimentally verify the Laws of static equilibrium including friction.
2. Analyse the experimental errors and comment on possible reasons for the errors.

Course Contents

List of Practical's (Any 10)

1. **Bell Crank Lever:**

- Study the equilibrium conditions of a bell crank lever under different loads and angles.
- Calculate the mechanical advantage and efficiency of the bell crank lever.

2. **Simple Beam:**

- Determine the reactions at the supports of a simple beam loaded with various point loads and distributed loads.
- Verify the principles of equilibrium and deflection calculations for the beam.

3. **Simple Jib Crane:**

- Analyze the forces acting on a simple jib crane and calculate the reactions at its base.

4. **Link Chain:**

- Study the forces acting on a link chain when subjected to a load.
- Determine the tension in different segments of the chain and its equilibrium conditions.

5. **Screw Jack (Friction):**

- Investigate the working of a screw jack, considering frictional forces.
- Calculate the input force required to lift a given load using the screw jack.

6. **Shear Leg Apparatus:**

- Set up and analyze a shear leg apparatus to lift a load using multiple ropes and pulleys.
- Calculate the forces in the ropes and verify equilibrium conditions.

7. **'g' by Falling Weight Method:**

- Measure the acceleration due to gravity using the falling weight method.
- Analyze the motion of a freely falling weight and calculate 'g' from the recorded data.

8. **Plane Motion of Bodies:**

- Investigate the motion of bodies on inclined planes under the influence of gravity.
- Determine the acceleration, time of motion, and distance covered on the inclined plane.

9. **Moment of Inertia (M.I.) of Flywheel:**

- Determine the moment of inertia of a flywheel experimentally using rotational dynamics.
- Compare experimental results with theoretical calculations.

10. **Compound Pendulum:**

- Study the behaviour of a compound pendulum and analyze its oscillations.
- Calculate the period of oscillation and verify the principles of simple harmonic motion.

11. **Torsional Pendulum:**

- Set up a torsional pendulum and measure the torsional constant of the material.
- Calculate the moment of inertia of the pendulum and analyze its oscillations.

12. **Principle of Conservation of Energy (Connected Bodies with Flywheel):**

- Study the energy transfer and conservation principles in a system of connected bodies with a flywheel.
- Analyze the changes in potential and kinetic energy and validate the principle of conservation of energy.

13. **Stiffness of Spring:**

- Determine the stiffness (spring constant) of a spring experimentally.
- Analyze the relationship between force and displacement for the spring.

Programme Name	*Bachelor of Technology in Mechanical Engineering*
Course Code	**R5CO1012T**
Course Title	**Programming for Problem Solving**

COURSE OUTCOMES:

The student should be able to

1. Interpret the concepts of the C++ programming language.
2. Use control structures such as loops and conditional statements to control the flow of their programs.
3. Develop simple C++ programs to solve computational problems using fundamental programming constructs.
4. Use file handling to store and retrieve data efficiently from files.
5. Develop problem-solving skills by applying C++ programming techniques to real-world scenarios and challenges.

Course Contents

Introduction to Programming and C++

Elements of a computer systems, DOS Commands & Linux environment, Overview of programming languages, Introduction to C++ and its features, Setting up a C++ development environment, Language Processors, Object Oriented Programming Paradigm and benefits, Applications of Object Oriented programming.

Beginning with C++

Tokens, Expressions, Control Structures, Array, Functions, Structures, Unions and pointers, String Manipulation

C++ Programming Features

Classes, Objects, Constructors, Destructors, Inheritance and Polymorphism, Virtual Base Classes, Abstract Classes.

Working with Files

Classes for File Stream Operations and I/O stream operation, Opening and Closing a File, Detecting end-of-file, more about Open(): File Modes, Sequential Input and Output operations.

Case Studies of C++ Programming:

Number Conversions, Telecom Billing System, Logistic management of solid waste, Design of a scientific calculator

Text Books

1. How to Solve It: A New Aspect of Mathematical Method, by G. Polya, Princeton University Press, 2015
2. The C++ Programming Language, Fourth Edition by Bjarne Stroustrup, Addison-Wesley Educational Publishers Inc
3. Programming and Problem Solving with C++ by Chip Weems, Nell Dale and Tim Richards, Jones and Bartlett Publishers, Inc, 2022

4. Scientific Approach to Problem Solving: With C++ Programming by Sal Washah, Cognella, Inc, 2013.

Reference Books:

1. Effective C++, 3rd edition, by Scott Meyers, Addison-Wesley Educational Publishers Inc
2. Solving Mathematical Problems: A Personal Perspective, Illustrated Edition, by Terence Tao, Oxford University Press, 2006.
3. Object-Oriented Programming with C++, 8th edition, by E Balagurusamy, Publisher McGraw Hill

Programme Name	***Bachelor of Technology in Mechanical Engineering***
Course Code	**R5CO1012L**
Course Title	**Programming for Problem Solving Laboratory**

COURSE OUTCOMES:

The student should be able to

1. Understand Linux Environment, basic Linux commands and computer elements.
2. Demonstrate proficiency in writing basic C++ programs, including understanding data types, variables, control structures, and functions.
3. Implement classes and objects, understand inheritance and polymorphism, and apply OOP principles in their code.
4. Apply C++ knowledge to design and implement complete software solutions for specific problem domains.
5. Develop their ability to manipulate strings, including concatenation, substring extraction, and other string operations.
6. Read from and write to files in C++, enabling them to process data from external sources.

Course Contents

List of Practical

1. Study of Linux Commands, language processor and Computer Elements.
2. Study of Input and Output operations in C++ - Write a program in C++ for entering the detailed information of student and print all details of student.
3. Study of for loop in C++ - Write a program in C and C++ to print Fibonacci series of any number inputted by person.
   Additional Program for practice - Write a program in C++ to find binary values of integer using for loop.
4. Study of if-else loop in C++ - Write a program in C++ to check whether entered character is a vowel or not using if-else statement.
5. Study of if – else if - else loop in C++ - Write a C++ program to accept marks of subjects for a student. Calculate the total and percentage of marks, also decide grade of student depending on the percentage using if-else-if-else statements.
   Study of while loop and do-while in C++ - Write a C++ program to display numbers from 1 to 10 with the help of a while loop and do-while loop.
6. Study of switch case in C++ - Write a program in C++ to make a menu driven calculator.
   Additional Program for practice: Write a menu driven program in C++ to find sum of positive numbers, sum of negative numbers & avg of all numbers in an array.
7. Study of arrays and structures in C++
   a) Write a program in C++ to display the information of 10 employees using array of structure variable.
   b) Write a program in C++ to illustrate use of array within structure.
   c) Write a program in C++ to illustrate use of nested structure.

8. Study of Classes and Objects in C++ - Write a program in C++ to add two integers using classes.
   Additional Program for practice: Read and Print Student Information using class Student.
9. (a) Study of Function Overloading in C++.
   (b) Study of Operator Overloading in C++ (Overloading unary and binary operators).
10. Study of Constructors and Destructors in C++ -
    Write a program in C++ with class Rectangle with the data fields width, length, area and colour. The length, width and area are of double type and colour is of string type. The methods are get_length(), get_width(), get_colour() and find_area(). Create two objects of Rectangle and compare their area and colour. If the area and colour both are the same for the objects then display "Matching Rectangles", otherwise display "Non-matching Rectangle". Use Constructors.
    Additional Program for Practice - Write a program in C++ to implement Stack. Design the class for stack and the operations to be performed on stack. Use Constructors and destructors.
11. Study of Inheritance, virtual class and virtual function in C++ - Create a base class called shape. Use this class to store two double type values that could be used to compute the area of figures. Derive two specific classes called triangle and rectangle from the base shape. Add to the base class, a member function get_data() to initialize base class data members and another member function display_area() to compute and display the area of figures. Make display_area() as a virtual function and redefine this function in the derived classes to suit their requirements.
12. Study of friend class and friend function in C++.
13. Study of String Manipulation in C++ - Write a program in C++ to perform string operations by using predefined string functions.
14. Study of File Handling in C++ - Write a program in C++ to open, read and close a file using file stream operations.

Text Books:

1. The C++ Programming Language, Fourth Edition by Bjarne Stroustrup, Addison-Wesley Educational Publishers Inc

2. Object-Oriented Programming with C++, 8th edition, by E Balagurusamy, Publisher McGraw Hill

Reference Books:

1. Effective C++, 3rd edition, by Scott Meyers, Addison-Wesley Educational Publishers Inc

2. Object-Oriented Analysis and Design with Applications by Grady Booch, 3rd edition, Robert A. Maksimchuk, Michael W. Engle, Bobbi J. Young, Jim Conallen, and Kelli A. Houston, Addison Wesley publisher

Programme Name	*Bachelor of Technology in Mechanical Engineering*
Course Code	**R5ME1027T**
Course Title	**Manufacturing Processes**

COURSE OUTCOMES:

The student should be able to

1. Understand the working of conventional machining processes
2. Design a gating system to produce defect free casting
3. Illustrate suitability of different welding processes for varying requirements
4. Describe non-destructive tests and suggest suitable non-destructive test for specific
5. Evaluate different manufacturing process routes to select best manufacturing process

Course Contents

Conventional Machining Processes

Conventional, unconventional and special purpose machines. Economic criteria for selection of machines. Elements of conventional machine tools. Accuracy, precision and control of machine tools.

Lathe: Types, specifications, construction, working, operations, tools, attachments and accessories. Thread and taper turning methods. Casptan and Turret Lathes: Construction and Tool layout. Automats: general construction and tool layout.

Drilling and Boring Machines: Types, parts, tools, accessories, construction, working and operations.

Milling, Shaping and Planning Machines: Types – Horizontal, Vertical, Universal Tools, Accessories and operations. Simple and Compound Indexing on milling machine.

Grinding Machines: Parts, Types, Operations, Grinding wheel – Specifications, selection, truing and dressing.

Metal Casting

Parting line selection. Pattern making, allowances, pattern design, rapid pattern method techniques, core making. Molding and core materials: sand types, sand properties and sand testing. Gating system: design of sprue, runner and ingate. Molding methods. Molten metal preparation: furnaces, ladle metallurgy.

Die molding: construction, types of die molding. Die mold design. Defects in casting. Product design considerations.

Welding Technology

Arc welding- Theory, SMAW, GTAW, GMAW, FCAW, Submerged arc welding, Stud welding, Resistance welding- Theory, spot and seam projection welding processes. Gas welding Friction, welding, Ultrasonic welding, Thermit welding, EBW and LASER welding. Welding defects and quality. Soldering, brazing and adhesive bonding.

Hot and Cold Working of Metals

Principles of rolling, forging, drop, press, upset, roll forging, extrusion, drawing, spinning, and effect of hot working. Cold working processes, Cold rolling, swaging, forging, extrusion forward, backward and impact roll forming, tube drawing, wire drawing, spinning, shot penning. Friction and lubrication in metal forming.

Plastics & Composite Material

Forming and Shaping Engineering plastics – types, properties and uses. Molding processes – Injection, Blow, Transfer, Extrusion, Calendaring and Thermoforming. Processing Elastomer, Processing Polymer Matrix Composite, Processing Metal matrix & Ceramic matrix Composites, Design consideration, Economics of Processing Plastics and Composite Materials

Text Books

1. M.P. Groover, Fundamental of Modern Manufacturing: Materials, Processes and Systems. John Wiley and Sons, Fourth Edition, 2010.
2. Hajra Chaudhary S.K., Elements of Workshop Technology-Vol. I& II, Media Prom & Pub, Mumbai, Twelfth Edition, 2007
3. Manufacturing Engineering & Technology, S. Kalpakjian and S. R. Schmid, Fourth Edition; Prentice Hall, 2001.

Recommended Reading

1. Production Technology – HMT Handbook, Tata McGraw-Hill Education Private Limited, First Revised Edition, Twenty-eighth Reprint, 2017
2. Roy A. & Lindberg, Processes and Materials of Manufacturing, Prentice Hall of India, Delhi, Fourth Edition, 2008
3. Campbell J.S., Principles of Manufacturing Materials and Processes, McGraw-Hill, New York, First Revised, 1984
4. Begeman, Manufacturing Processes, Asia Publishing House, Bombay, Fourth Edition, 2009

Programme Name	*Bachelor of Technology in Mechanical Engineering*
Course Code	**R5ME1028L**
Course Title	**Manufacturing Practice**

Course Outcomes

The student should be able to –

1. Fabricate components with their own hands.
2. Get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.
3. Inculcate respect for physical work and hard labor.
4. Hands on experience on various manufacturing processes.

Course Contents

Fitting

Use and setting of fitting tools for chipping, cutting, filing, marking, center punching, drilling, tapping. One job involving following operations: filing to size, one simple male female joint, drilling and tapping.

Carpentry

Use and setting of hand tools like hacksaws, jack planes, chisels and gauges for construction of various joints, wood tuning and modern wood turning methods. One carpentry job involving a joint and report.

Forging (Smithy)

At least one smithy job (Lifting hook and handle)

Welding

Edge preparation for welding jobs. Arc welding for different job like, Lap welding of two plates, butt welding of plates with simple cover, arc welding to join plates at right angles.
One welding job is to be completed using any one welding processes.

Machine Shop

One machine/turning job is to be completed.

Sheet metal working

Use of sheet metal, working hand tools, cutting, bending. One sheet metal job is to be completed.

Text Books

1. Chapman W. A. J., Workshop Technology Parts 1 & 2, Viva Books P. Ltd., New Delhi, 4th Edition, 1998.
2. Welding Handbook. 8th Edition. 3 vols & 7th Edition. 5 vols, Miami, American Welding Society, 1987 & 1976 respectively.
3. Metals Handbook. 9th Edition, Vol 6, Welding, Brazing & Soldering. Metals Park, Ohio, American Society of Metals, 1983.

4. Serope Kalpakjian Manufacturing Engineering & technology Pearson Steven R. Schmid Education (Asia) Inc., Delhi, 2002

Programme Name	*Bachelor of Technology in Mechanical Engineering*
Course Code	**R5ME1029T**
Course Title	**INTRODUCTION TO ANCIENT INDIAN SCIENCE AND TECHNOLOGY**

Course Contents

Indian Knowledge System: An Introduction

Indian Knowledge System: An Overview. Why are ancient Indian science and technology relevant today? What is science? How is it different from technology? Philosophy of ancient Indian technology, how is different from modern technology? Ancient Indian Scientific methods. Glimpses of ancient Indian science and technology?

The Vedic Corpus

Philosophical Systems

Wisdom through the Ages

Foundational Concepts for Science and Technology

Linguistics.

Number System and Units of Measurement

Knowledge: Framework and Classification

Science, Engineering and Technology in IKS

Mathematics

Engineering and Technology: Metals and Metalworking. Material Technology: Mining, Metals and Metallurgy, Iron Making and craftsmanship, Wootz Steel Technology Extraction of Zinc in ancient India, Glass making, Bead making Techniques, Ceramic Technology Engineering and Technology: Other Applications

Reference

1. Mahadevan, B., Bhat, Vinayak Rajat, Nagendra Pavana R.N., Introduction To Indian Knowledge System : Concepts And Applications, PHI Learning,
2. Introduction To Ancient Indian Technology, Prof. D.P. Mishra, Department of Aerospace Engineering, IIT Kanpur, https://nptel.ac.in/courses/101104065

Programme Name	***Bachelor of Technology in Mechanical Engineering***
Course Code	
Course Title	**Internship (First Year Exit Course)**

Student will be required to earn additional 6-8 credits by completing the internship of 150-180 hrs (1-2 months) as per the discussion with allotted supervisor. Student is expected to improve skill during the internship.

The student will be evaluated on the basis of report presentation and viva.