VISHNU INSTITUTE OF TECHNOLOGY:: BHIMAVARAM
(Autonomous)
Approved by AICTE, Accredited by NBA, NAAC & Affiliated to JNTUK, Kakinada

MECHANICAL ENGINEERING DEPARTMENT

SUBJECTS FOR B. Tech. (MINOR) in MECHANICAL ENGINEERING

B. Tech. (GENERAL MINOR) in MECHANICAL ENGINEERING (Offered to Other Branches)		
S.No	**Course Title**	**Pre- requisites**
1	Applied Mechanics	NIL
2	Engineering Materials	NIL
3	Basic Thermal Engineering	NIL
4	Manufacturing Processes	Engineering Materials
5	Basics of Engineering Design	Applied Mechanics
6	Product Design	Basics of Engineering Design

B.Tech MINOR
in
Mechanical Engineering
Syllabus
(Offered to Other Branches)

APPLIED MECHANICS
(Minors)

L	T	P	C
4	0	0	4

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- Understand particle, body, rigid body, concept of force, analysis of forces acting on a rigid body.
- Understand moment and the principle of moments.
- Understand the laws of friction and its applications.
- Analyzing trusses for its member forces.
- Understand the concept of centre of gravity and area moment of inertia.
- Understanding principles of kinematics and kinetics applied to rigid bodies.

UNIT I

Force: Different force systems, principle of transmissibility of forces, law of superposition. Composition and resolution of coplanar concurrent forces, resultant force, method of composition of forces, triangle law of forces, polygon law of forces, resolution of forces, resolving a force into two rectangular components, Free body diagram, Lami's theorem, Type of Load, supports, Beams, analysis for simply supported, cantilever beams.

UNIT II

Moment: Moment of a force, Varignon's theorem, Principle of moment and its applications (Levers, simple and compound), Parallel forces (like and unlike parallel forces), calculating their resultant, Concept of couple, its properties and effects, General conditions of equilibrium of bodies under coplanar forces, Position of resultant force by moment.

UNIT III

Friction: force of friction, limiting frictional force, coefficient of friction, angle of friction, angle of repose, relation between angle of friction, angle of repose and coefficient of friction. Cone of friction, types of friction, laws of friction, advantages and disadvantages of friction. Equilibrium of bodies on level plane, external force applied horizontal and inclined up and down. Equilibrium of bodies on inclined plane, external forces is applied parallel to the plane, horizontal and incline to inclined plane.

UNIT IV

Centre of Gravity: Concept, definition of centroid of plain figures and centre of gravity of symmetrical solid bodies, Determination of centroid of plain and composite lamina using moment method only, centroid of bodies with removed portion, Determination of center of gravity of solid bodies, cone, cylinder and sphere; composite bodies.

U**NIT V**

Simple Machines: Definition of effort, velocity ratio, mechanical advantage and efficiency of a machine and their relationship, law of machines, Simple and compound machine, Definition of ideal machine, reversible and self, locking machine, Effort lost in friction, Load lost in friction, System of pulleys, simple screw jack, worm and worm wheel, single and double winch crab.

COURSE OUTCOMES:

After undergoing this course, the students will be able to

1. Understand and analyse the various types of forces acting on a body, their unit's conversion from one to another and draw free body diagrams.
2. Calculate resultant force and moment to maintain equilibrium.
3. Calculate the co-efficient of friction for different types of surfaces.
4. Determine the centroid/centre of gravity of plain and composite laminar and solid bodies.
5. Determine velocity ratio, mechanical advantage and efficiency of simple machines.

TEXT BOOKS:

1. S Ramamurtham, Engineering Mechanics, DhanpatRai Publishing Co. Ltd., Rev. Edition, 2016.
2. RK Rajput, Applied Mechanics, Laxmi Publications, 3rd Edition, 2016.

REFERENCE BOOKS:

1. RS Khurmi, A Text Book of Engineering Mechanics, S Chand and Co. Ltd., Rev. Edition, 2010.
2. AK Upadhya, Applied Mechanics, SK Kataria & Sons, 5th Edition, 2013.

ENGINEERING MATERIALS

(Minors)

L	T	P	C
4	0	0	4

Pre-requisites: NIL

COURSE OBJECTIVES:

- To acquire the knowledge of different crystal structures and constitution of alloys.
- To understand rules to form solid solution and different reactions in a phase diagram.
- To understand the microstructure and properties of cast irons and non-ferrous alloys.
- To be able to correlate the concepts of phase structures and properties of different types of steels and their heat treatment methods.
- To exemplify different types of destructive and non-destructive testing of materials.

UNIT I

Crystal Structure: Space Lattice and Unit Cells, Crystallography, Crystal Structure of Common Metallic Materials – BCC, FCC and HCP. Miller Indices for Directions and Planes, Atomic Packing Efficiency for Cubic and HCP Structures, Necessity of Alloying, Types of Solid Solutions.

UNIT II

Phase Diagrams: Construction and Interpretation of Phase Diagrams, Phase Rule, Lever Rule, Binary Phase Diagrams, Isomorphous, Eutectic and Eutectoid Transformations with examples, Study of Fe-Fe_3C Phase Diagram.

UNIT III

Engineering Materials–I (Steels): Classification of Steels, Structure, Properties & Applications of - Plain Carbon Steels, Low Alloy Steels, Hadfield Manganese Steels, Tool and Die Steels.

Engineering Materials–II (**Cast Irons):** Classification of Cast Irons, Structure, Properties & Applications of White Cast Iron, Malleable Cast Iron, Grey Cast Iron and Nodular Cast Iron.

UNIT IV

Engineering Materials-III (Non-Ferrous Metals and Alloys): Structure, Properties and Applications of - Copper and its Alloys, Aluminum and its Alloys, Titanium and its Alloys. Al-Cu Phase Diagram.

Heat Treatment: Annealing, Normalizing, Hardening and Tempering of Steels, Construction of TTT Diagrams, Hardenability, Surface-Hardening Methods.

UNIT V

Testing of Engineering Materials: Tensile and Compressive Testing, Hardness – Brinell, Rockwell and Vickers Tests, Impact Testing, Ductile Fracture and Brittle Fracture.

Non-Destructive Testing: Fluorescent Inspection, Radiography, Magnetic Particle Inspection and Ultrasonic Inspection.

COURSE OUTCOMES:

Students will be able to:

1. Know different crystal structures and the importance of alloying.
2. Construct different phase diagrams, understand microstructures and reactions with examples.
3. Acquire the knowledge of engineering materials – steels, cast irons.
4. Analyze various heat treatment processes, non-ferrous metals & alloys and their properties.
5. Characterize different destructive and non-destructive testing of engineering materials.

TEXT BOOKS:

1. V. D. Kodgire, Material Science and Metallurgy for Engineers, Everest Publishing House, 39th Edition, 2017.
2. Sidney H. Avner, Introduction to Physical Metallurgy, McGraw Hill, 2nd Edition, 2017.

REFERENCE BOOKS:

1. William D Callister & R. Balasubramaniam, Materials Science & Engineering, Wiley Publishing, 2nd Edition, 2014.
2. Donald R. Askeland and Pradeep P Fulay, Essentials of Materials Science and Engineering, Cengage Learning, 2nd Edition, 2013.
3. V. Raghavan, Materials Science & Engineering, Eastern Economy Edition, 6th Edition, 2015.

BASIC THERMAL ENGINEERING
(Minors)

L	T	P	C
4	0	0	4

Pre-requisites: NIL

COURSE OBJECTIVES:

- To understand the basic concepts of thermodynamics, heat and work interactions between system and its surroundings.
- To learn the applications of first and second law of thermodynamics to thermal engineering devices.
- To learn about the working of thermal power plants.
- To study the working of IC engines and refrigerators.
- To understand different modes of heat transfer.

UNIT I

Basic Concepts: System, boundary, Surrounding, Universe, Types of Systems, Properties, Thermodynamic Equilibrium, State, Process - Reversible, Quasi static & Irreversible Processes, cycle, Causes of Irreversibility. Energy in State and in Transition - Types, Work and Heat, Point and Path function, Zeroth Law of Thermodynamics.

Joule‘s Experiment, Statement of first law of thermodynamics, First law applied to a flow system: general energy equation, steady flow energy equation and important applications (boiler, turbine and heat exchangers).

UNIT II

Limitations of the First Law of Thermodynamics, PMM 1.Statement of the second law of thermodynamics (Kelvin plancks & Clausius), Thermal reservoir, Heat Engine, Heat pump, refrigerator, Parameters of performance (thermal efficiency and the coefficient of performance), equivalence of two statements. PMM2.

UNIT III

Properties of steam: Properties of steam, Use of property diagram, Steam tables.

Thermal Power plant Cycles: Simple Ranking cycle, Steam power plant layout. Brayton cycle, Open and closed Gas turbine power plant principle, Methods to improve cycle performance: Regeneration Cycle, Reheat Cycle, Inter cooling Cycle.

UNIT IV

Introduction to I.C. Engines: Working principles of 4-Stroke and 2-Stroke Spark Ignition and Compression Ignition Engines, Differences between 2-s and 4-s cycle engines, Differences between SI and CI engines.

Refrigeration: Need of refrigeration**,** working principle of Simple vapour compression refrigeration cycle (Dry saturated vapour refrigerant at compressor inlet), COP.

UNIT V

Heat Transfer: Introduction, modes of heat transfer, Conduction Heat Transfer: General heat conduction equation in Cartesian co-ordinates, Boundary conditions, 1-D Heat transfer with internal heat generation.

Convective Heat Transfer: Classification of Convective Heat Transfer, Buckingham Pi Theorem for forced and Natural convection.

Radiation Heat Transfer: Basic concepts, concept of black body, laws of black-body radiation - Planck's law, Wien's displacement law, Stefan Boltzmann law.

COURSE OUTCOMES:

Students will be able to

1. Apply first law of thermodynamics to energy conversion devices.
2. Apply second law of thermodynamics to energy conversion devices.
3. Analyze the performance of thermal power plant.
4. Understand the working of IC engines and refrigerators.
5. Understand the modes of heat transfer and apply these basics in the design of thermal systems.

TEXT BOOK:

1. R.K. Rajput, Thermal Engineering, Lakshmi Publications, 10th Edition, 2020.
2. PK Nag, Engineering Thermodynamics, McGraw Hill, 6th Edition, 2017.

REFERENCE BOOKS:

1. Mahesh M. Rathore, Thermal Engineering, McGraw Hill, 1st Edition, 2010.
2. V Ganesan, Internal Combustion Engines, McGraw Hill, 4th Edition, 2017.

MANUFACTURING PROCESSES

(Minors)

L	T	P	C
4	0	0	4

PRE-REQUISITES: Engineering Materials

COURSE OBJECTIVES:

- To understand casting principles and different tools used for creating a sound casting.
- To specify various casting processes and gating systems.
- To demonstrate different types welding principles, welding defects - causes and remedies, testing of welds.
- To state various metal working and rolling processes.
- To study various metal forming processes such as forging, extrusion and drawing.
- To get familiarize with the sheet metal working, processing of plastics by injection molding and blow moulding.

UNIT I

Casting: Steps involved in making a casting, Types of Patterns**,** Materials used for Patterns, Pattern Allowances and their Construction, Cores: Types of Cores, Merits, Demerits & Applications of Casting, Casting Defects.

Gating System: Elements of Gating System, Principles of Gating, Gating Ratio, Design of Gating Systems, Risers, Function, Types and Design, Special Casting Processes, Die Casting, Centrifugal Casting and Investment Casting.

UNIT II

Welding: Classification of Welding Processes, Types of Welds and Welded Joints, Their Characteristics, Edge Preparation, Gas Welding, Arc Welding, Submerged Arc Welding, Inert Gas Welding, TIG & MIG Welding, Thermit Welding, Resistance Welding, Friction Welding, Friction Stir Welding, Explosive Welding, Laser Welding, Welding Defects, Causes and Remedies, Oxy – Acetylene Gas Cutting, Soldering & Brazing.

UNIT III

Bulk Deformation Processes - I:Fundamentals on Metal Forming Processes, Hot Working, Warm Working and Cold Working, Strain Hardening, Recovery, Recrystallization and Grain Growth, Comparison of Properties of Cold and Hot

Worked Parts. Rolling: Fundamentals, Theory of Rolling, Types of Rolling Mills and Products, Rolling Defects.

UNIT IV

Bulk Deformation Processes -II: **Forging Processes:** Principles of Forging, Tools and Dies**,** Types of Forging: Smith Forging, Drop Forging, Roll Forging, Rotary Forging, Forging Defects.

Bulk Deformation Processes - III: **Extrusion of Metals**: Basic Extrusion Process and its Characteristics, Hot Extrusion and Cold Extrusion, Forward Extrusion and Backward Extrusion, Impact Extrusion, Hydrostatic Extrusion, Extrusion Defects, Wire Drawing and Tube Drawing.

UNIT V

Sheet Metal Working &Plastics: Blanking and Piercing, Estimation of Blank Size, Deep Drawing, Stretch Forming, Bending, Coining, Spinning, Types of Presses and Press Tools.

Processing of Plastics: Injection Moulding and Blow Moulding.

COURSE OUTCOMES:

At the end of course, the students will be able to:

1. Illustrate the importance of casting and various pattern and cores used for making a sound casting, design a gating system and study various special casting processes.
2. Evaluate the role of metal joining processes, welding principles, welding defects, causes and remedies.
3. Illustrate the necessity of metal working and forming processes, rolling mills.
4. Relate the bulk deformation processes such as forging, extrusion and drawing processes on metals.
5. Infer sheet metal operations and plastic processing to develop engineering components.

TEXT BOOKS:

1. Kalpakjian Sand Steven R Schmid, Manufacturing Engineering and Technology, Pearson Publishing, 7th edition, 2018.
2. P.N. Rao, Manufacturing Technology –Vol. I, Tata McGraw Hill Publishers, 4th Edition, 2017.

REFERENCE BOOKS:

1. Philip C Rosenthal, Principles of Metal Casting, McGraw-Hill Education, 2nd Edition, 2017.
2. P. L. Jain, Principles of Foundry Technology, Tata McGraw Hill Publishers, 5th Edition, 2017.
3. Amitabha Ghosh & Asok Kumar Mallik, Manufacturing Science, East West Press Pvt. Ltd, 2nd Edition, 2010.

BASICS OF ENGINEERING DESIGN

(Minors)

L	T	P	C
4	0	0	4

PRE-REQUISITES: Applied Mechanics

- Engineering mechanics, manufacturing processes and material science.

COURSE OBJECTIVES:

- To introduce behavior of structural components under various loading conditions.
- To impart the knowledge of Shear force and Bending moment diagrams.
- To understand the general design procedures and principles in the design of machine elements.
- To study different materials of construction and their properties and factors determining the selection of material for various applications.
- To determine stresses under different loading conditions.

UNIT I

Simple Stresses & Strains: Elasticity and plasticity, Types of stresses & strains, Hooke's law, stress, strain diagram for mild steel, Working stress, Factor of safety, Lateral strain, Poisson's ratio & volumetric strain, Bars of varying section, composite bars, Complex Stresses, Stresses on an inclined plane under different uniaxial and biaxial stress conditions, Principal planes and principal stresses, Mohr's circle, Relation between elastic constants, Strain energy, Resilience, Gradual, sudden, impact and shock loadings.

UNIT II

Shear Force And Bending Moment: Definition of beam,Types of beams, Concept of shear force and bending moment, S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, UDL, uniformly varying loads and combination of these loads, Point of contra flexure, Relation between S.F., B.M and rate of loading at a section of a beam.

UNIT III

Flexural Stresses: Theory of simple bending, Assumptions, Derivation of bending equation: M/ I = f/y = E/R Neutral axis, Determination bending stresses, section modulus of rectangular and circular sections (Solid and Hollow), I, T and Channel sections, Design of simple beam sections.

Torsion: Introduction-Derivation- Torsion of Circular shafts- Pure Shear- Transmission of power by circular shafts, Shafts in series, Shafts in parallel.

UNIT IV

General Considerations: In the design of Engineering Materials and their properties, selection, manufacturing consideration in design, BIS codes of steels.

Stresses In Machine Members: Combined stresses, torsional and bending stresses, various theories of failure, factor of safety, design for strength and rigidity, preferred numbers.

UNIT V

Strength Of Machine Elements: Stress concentration, theoretical stress concentration factor, fatigue stress concentration factor notch sensitivity, design for fluctuating stresses, endurance limit, estimation of endurance strength, Goodman's line, Soderberg's line, modified Goodman's line.

COURSE OUTCOMES:

After undergoing this course, the students will be able to:

1. Understanding of the concepts of stress and strain in mechanics of solids and apply the fundamental concepts of force-deformation, and stress-strain relationships to the solid mechanics problems.
2. Knowledge of beams and analysis of Shear Force and Bending moments.
3. Apply the basic concepts to find the bending stress distribution and torsional stresses in shafts.
4. Acquires the knowledge about the principles of design, material selection, component behaviour subjected to loads, and criteria of failure.
5. Understands the concepts of stress concentration in machine members and fatigue loading.

TEXT BOOKS:

1. RK Bansal, Strength of Materials, Lakshmi Publication, 6th Edition, 2018.
2. V. B. Bandari, Machine Design, TMH Publishers, 5th Edition, 2020.

REFERENCE BOOKS:

2. Gere and Timoshenko, Mechanics of Materials, CBS Publishers, 2nd Edition, 2004.
3. Joseph E. Shigley, Mechanical Engineering Design, McGraw Hill, 9th Edition, 2010.

PRODUCT DESIGN

(Minors)

L	T	P	C
4	0	0	4

PRE-REQUISITES: Basics of Engineering Design

COURSE OBJECTIVES:

The course should enable the students to:

- Widen student knowledge on design process.
- Enable Students to attain knowledge on tools used in Design Methods.
- Create an understanding on the process of material selection and design.
- Develop in depth knowledge on Engineering statistics and reliability.
- Create awareness on legal and ethical issues in Design and Quality Engineering.

UNIT I

Design Process: The design process, Morphology of Design, Design Drawings, Computer Aided Engineering, Designing of standards, Concurrent Engineering, Product life cycle, Technological Forecasting, Market Identification, Competition Bench marking, Systems Engineering, Life Cycle Engineering, Human Factors in Design, Industrial Design.

UNIT II

Design Methods: Creativity and Problem Solving, Product Design Specifications, Conceptual design, Decision Theory, Decision Tree, Embodiment Design, Detail Design, Mathematical Modelling, Simulation, Geometric Modelling, Finite Element Modelling, Optimization, Search Methods, Geometric Programming, Structural and Shape Optimization.

UNIT III

Material Selection Processing And Design: Material Selection Process, Economics, Cost Vs Performance, Weighted property Index, Value Analysis , Role of Processing in Design, Classification of Manufacturing Process, Design for Manufacture, Design for Assembly, Designing for castings, Forging, Metal Forming, Machining and Welding, Residual Stresses, Fatigue, Fracture and Failure.

UNIT IV

Engineering Statistics And Reliability: Probability, Distributions, Test of Hypothesis, Design of Experiments, Reliability Theory, Design for Reliability, Reliability centered Maintenance.

UNIT V

Legal And Ethical Issues In Design And Quality Engineering: Introduction, The origin of laws, Contracts, Liability, Tort law, Product liability, Protecting intellectual property, Legal and ethical domains, Codes of ethics, Solving ethical conflicts, case studies Total Quality Concept, Quality Assurance, Statistics Process Control, Taguchi Methods, Robust Design, Failure Model Effect Analysis.

COURSE OUTCOMES:

On completion of the course, student will be able to

1. Get clear understanding on CAE / concurrent engineering and systems engineering.
2. Attain problem solving skills through modelling/simulation and optimize design.
3. Ability to do material selection based on economy and value analysis. Develop understanding on DFM/DFA.
4. Have good understanding on DOE, Reliability theory and reliability cantered maintenance.
5. Exposed to laws, codes of ethics, Quality concepts and FMEA.

TEXT BOOKS:

1. Dieter, George E., Engineering Design, A Materials and Processing Approach, McGraw Hill International Editions, 3rd Edition, 2000.
2. Karl T. Ulrich and Steven D. Eppinger, Product Design and Development, McGraw Hill Edition 4th Edition, 2009.

REFERENCES:

1. Pahl, G., Beitz W., Feldhusen J., Grote K.H., Engineering Design, Spinger, 3rd Edition, 2007.
2. Ray M.S., Elements of Engineering Design: An integrated approach, Prentice Hall Inc. 1st Edition, 1985.