Y25 Machine Design Handbook

Category: Engineering Science Courses (ESC)

Program Structure

S#	Cat	Sub-Cat	CourseCode	Course Title	Mode	Acrym	L	T	P	S	CR	CH	Pre-req
1	ESC	ESC-CORE	25MT5102	COMPUTATIONAL TECHNIQUES IN ENGINEERING OPTIMIZATION	R	CTEO	2	2	0	0	4	4	
2	PCC	PCC-CORE	25ME5102	MODELLING AND ANALYSIS OF MECHANICAL ELEMENTS	R	MAME	2	0	2	4	4	8	
3	PCC	PCC-CORE	25MD5102	ROBOTICS MANIPULATOR DESIGN AND ANALYSIS	R	RMDA	3	0	2	0	4	5	
4	PCC	PCC-CORE	25MD5103	MECHANICAL BEHAVIOUR OF MATERIALS	R	MBM	3	1	0	0	4	4	
5	PCC	PCC-CORE	25MD5204	ADVANCED STRENGTH OF MATERIALS	R	ASM	3	0	2	0	4	5	
6	PCC	PCC-CORE	25MD5205	MECHANICAL VIBRATIONS	R	MV	2	0	2	0	3	4	
	PCC	PCC-CORE	25MD5206	DESIGN OF PRESSURE VESSELS AND PLATES	R	DPVP	3	0	2	4	5	9	
7	PEC	PE-1	25MD51A1	LEAN MANUFACTURING	R	LM	3	0	2	0	3	0	
8	PEC	PE-1	25MD51A2	PRECISION AND QUALITY ENGINEERING	R	PQE	3	0	2	0	3	0	
9	PEC	PE-1	25MD51A3	MECHANICS OF COMPOSITE MATERIALS	R	BCM	3	0	2	0	3	0	
10	PEC	PE-2	25MD52B1	FINITE ELEMENT ANALYSIS	R	DFS	2	0	2	0	2	0	
11	PEC	PE-2	25MD52B2	DESIGN FOR SUSTAINABILITY	R	CM	2	0	2	0	2	0	
12	PEC	PE-2	25MD52B3	CONCURRENT MANUFACTURING			2	0	2	0	2	0	
13	PEC	PE-3	25MD52C1	DESIGN FOR MANUFACTURING	R	FM	3	0	2	0	3	0	
14	PEC	PE-3	25MD52C2	FRACTURE MECHANICS	R	TSD	3	0	2	0	3	0	
15	PEC	PE-3	25MD52C3	TRIBOLOGICAL SYSTEM DESIGN	R	AFEA	3	0	2	0	3	0	
16	PRI	PRI-CORE	25IE5149	TERM PAPER	R	TP	0	0	8	0	4	8	
17	PRI	PRI-CORE	25IE5201	ESSENTIALS OF RESEARCH DESIGN	R	ERD	1	1	0	0	2	2	
18	PRI	PRI-CORE	25IE6150	DISSERTATION (PART-1)	R	DIS	0	0	32	0	16	32	
19	PRI	PRI-CORE	25IE6250	DISSERTATION (PART-2)	R	DIS	0	0	32	0	16	32	
20	OEC	OE-1	25OEIN01	FUNDAMENTALS OF IOT	R	FIOT	4	0	0	0	4	4	OEC
21	OEC	OE-1	25OEEE01	RENEWABLE ENERGY RESOURCES	R	RER	4	0	0	0	4	4	OEC
22	VAC	VAC-CERT	25CC3071	PROGRAMMING USING PYTHON	R	PUP	0	0	0	8	0	8	VAC
23	VAC	VAC-CERT		PYTHON PROGRAMMING CERTIFIED BY IBM	R	PP	0	0	0	4	0	4	

S#	Cat	Sub-Cat	CourseCode	Course Title	Mode	Acrym	L	T	P	S	CR	CH	Pre-req
26	VAC	VAC-CERT		CATIA / HYPERMESH CERTIFICATION	R	CATA	0	0	0	4	0	4	
27	AUC	AUC-CORE	25UC5201	PROFESSIONAL COMMUNICATION SKILLS	R	PCS	0	0	4	0	0	4	
28	AUC	AUC-CAREER	CRTVQRL1V1	CAMPUS RECRUITMENT: VERBAL APTITUDE TRAINING	R	CRT: VAT	0	0	0	8	0	8	
29	AUC	AUC-CAREER	CRTVQRL2V2	CAMPUS RECRUITMENT: QUANTITATIVE APTITUDE TRAINING	R	CRT: QAT	0	0	0	8	0	8	
30	AUC	AUC-CAREER	CRTVQRL3V3	CAMPUS RECRUITMENT: REASONING APTITUDE TRAINING	R	CRT: RAT	0	0	0	8	0	8	
31	AUC	AUC-CAREER	CRTCSSL1V1	CAMPUS RECRUITMENT: COMMUNICATION SKILLS TRAINING	R	CRT: CST	0	0	0	8	0	8	
32	AUC	AUC-CAREER	CRTCSSL2V2	CAMPUS RECRUITMENT: SOFT SKILLS TRAINING	R	CRT: SST	0	0	0	8	0	8	
33	AUC	AUC-CAREER	CADCORL1V1	CAREER ADVANCEMENT: TRAINING IN CORE DOMAIN	R	CAD: TICD	0	0	0	8	0	8	
34	AUC	AUC-CAREER	CADUPSL1V1	CAREER ADVANCEMENT: UPSC-CIVIL SERVICES EXAM TRAINING	R	CAD: UPSC	0	0	0	8	0	8	
35	AUC	AUC-CAREER	CADENTL1V1	CAREER ADVANCEMENT:ENTREPRENEURIAL CAREER PATHWAY TRAINING	R	CAD: ECPT	0	0	0	8	0	8	
36	AUC	AUC-CAREER	CRTCODL1V1	CAMPUS RECRUITMENT: LOGIC BUILDING SKILLS TRAINING	R	CRT: LBST	0	0	0	8	0	8	
37	AUC	AUC-CAREER	CADCOML1V1	CAREER ADVANCEMENT:COMPETITIVE EXAM TRAINING	R	CAD: COM	0	0	0	8	0	8	

Y25: M.Tech. - Machine Design

Category: Engineering Science Courses (ESC)

25MT5102 - COMPUTATIONAL TECHNIQUES IN ENGINEERING OPTIMIZATION (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
25MT5102	COMPUTATIONAL TECHNIQUES IN ENGINEERING OPTIMIZATION	CTEO	R	2	2	0	0	4

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Understand the fundamental concepts of optimization, including types of problems, mathematical formulation, and programming implementation.	2	PO1, PO2
CO2	Apply mathematical optimization techniques, both unconstrained and constrained, to solve engineering problems using programming languages like Matlab or Python or R programming.	3	PO1, PO5
CO3	Analyze and solve multi-objective optimization problems, considering trade-offs and conflicting objectives, using appropriate algorithms and methodologies.	4	PO1, PO5
CO4	Apply optimization techniques to solve application-specific problems in Machine Design and Thermal Engineering domains, demonstrating domain-specific knowledge and skills.	3	PO1, PO5

Syllabus

Introduction to Engineering Optimization: Basics of optimization, mathematical formulations, and algorithms. Applications in mechanical and machine design.

Unconstrained Optimization Techniques: Newton\'s method, gradient descent, conjugate gradient. Implementation in MATLAB or Python.

Constrained Optimization Techniques: Linear and nonlinear constraints, Lagrange multipliers, penalty and barrier methods. Application in mechanical design.

Multi objective Optimization: Pareto optimality, weighted sum, epsilon-constraint methods. Implementing multi-objective optimization using Python.

Reference Books

1. "Engineering Optimization: Methods and Applications", Ravindran, R., Ragsdell, K. M., & Reklaitis, G. V., 2006, Wiley.
2. "Introduction to Optimization", Chong, E. K. P., & Zak, S. H., 2013, Wiley.
3. "Optimization Concepts and Applications in Engineering", Belegundu, A. D., & Chandrupatla, T. R., 2011, Pearson.
4. "Optimization in Practice with MATLAB For Engineering Students and Professionals", Achanta, S., & Darby-Dowman, K., 2015, Cambridge University Press.
5. "Applied Optimization: Formulation and Algorithms for Engineering Systems", Ross, I. J., 1999, Cambridge University Press.

Y25: M.Tech. - Machine Design

Category: Professional Core Courses (PCC)

25MD5102 - ROBOTICS MANIPULATOR DESIGN AND ANALYSIS (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
25MD5102	ROBOTICS MANIPULATOR DESIGN AND ANALYSIS	RMDA	R	3	0	2	0	4

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Apply homogeneous transformations and DH parameters	3	PO1, PO3, PO4
CO2	Apply forward and inverse kinematics to Robots	3	PO2, PO3, PO4
CO3	Apply rigid body dynamics and dynamic modelling to Robots	3	PO2, PO3, PO4
CO4	Design mechanical systems for robot manipulators	4	PO2, PO3, PO4
CO5	Apply configuration space and motion planning	3	PO2, PO3, PO4

Syllabus

Introduction to Robotics: Definition of Robotics, Classification of Robots, Robot Components and Architecture :Robot Kinematics - Homogeneous Transformations, Denavit-Hartenberg (DH) Parameters

Forward Kinematics, Inverse Kinematics: Robot Dynamics - Rigid Body Dynamics, Lagrange\'s Equation, Newton-Euler Equations,

Dynamic Modeling of Manipulators; Robot Motion Planning - Configuration Space, Path Planning, Motion Planning Algorithms; Robot Control -Proportional-Integral-Derivative (PID) Control, Computed-Torque Control

Robot Manipulator Design- Mechanical Design Considerations, Actuators and Drive Systems; Robot Sensors and Perception -Sensor Types and Selection, Sensing Techniques for Robotics

Reference Books

1 Robotics: Modelling, Planning and Control, Bruno Siciliano, Lorenzo Sciavicco, Luigi Villani, Giuseppe Oriolo, 1, 2010, Springer.

2 Introduction to Robotics: Mechanics and Control, John J. Craig, 1, 2017, Pearson.

3 Robot Dynamics and Control, Mark W. Spong, Seth Hutchinson, M. Vidyasagar , 2, 2020, Wiley.

4 Mechanical Vibrations and Noise Engineering, A. G. Ambekar, 1st Edition, 2011, Pearson.

25MD5103 - MECHANICAL BEHAVIOUR OF MATERIALS (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
25MD5103	MECHANICAL BEHAVIOUR OF MATERIALS	MBM	R	3	1	0	0	4

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Analyze the structural deformation of solid bodies in multi-axial stress state to assess the safety factor against yielding	4	PO1, PO3
CO2	Solve 2-D elasticity problems in Cartesian and Polar coordinate systems	4	PO2, PO3
CO3	Analyze the bending of cantilever beams having rectangular and circular cross-sections; Axisymmetric stress and deformation in a solid of revolution ; and simple 3D stress analysis problems	4	PO1, PO3
CO4	Analyze the plastic deformation of solid bodies using the method of characteristics and engineering methods	4	PO1, PO3
CO5	Analyze the complex structural deformation problems relevant to CO1, CO2, CO3 and CO4	4	PO2, PO3

Syllabus

ELASTICITY: Two dimensional stress analysis - Plane stress - Plane strain Equations of compatibility Stress function Boundary conditions. PROBLEMS IN RECTANGULAR COORDINATES Solution by polynomials Saint Venents principles Determination of displacement Simple beam problems.

PROBLEMS IN POLAR COORDINATES General equations in polar coordinates Stress distribution symmetrical about axis Strain components in polar coordinates Simple and symmetric problems.

ANALYSIS OF STRESS AND STRAIN IN THREE DIMENSIONS: Principle stresses Homogeneous deformations Strain spherical and deviatoric stress Hydrostatic strain. General theorems Differential equations of equilibrium and compatibility Displacement Uniqueness of solution Reciprocal theorem.

BENDING OF PRISMATIC BARS Stress function Bending of cantilever beam Beam of rectangular cross section Beams of circular cross section. PLASTICITY Plastic deformation of metals Structure of metals Deformation Creep stress relaxation of deformation Strain rate condition of constant maximum shear stress Condition of constant strain energy Approximate equation of plasticity. METHODS OF SOLVING PRACTICAL PROBLEMS The characteristic method Engineering method Compression of metal under press Theoretical and experimental data drawing.

Solving problems relevant to modules 1 to 4

Reference Books

1 Theory of Elasticity, Timoshenko S.P. and Goodier J.N., 1970, McGraw-Hill Education.

2 An Engineering Theory of Plasticity, E.P. Unksov, 1961, Butterworths.

3 Applied Elasticity, C.T. Wang, 1953, McGraw-Hill.

4 Theory of Plasticity for Engineers, Hoffman and Sacks, 1953, McGraw-Hill.

5 Theory of Elasticity and Plasticity, Sadhu Singh, 1988, Khanna Publishers.

6 Theory of Elasticity and Plasticity, Harold Malcolm Westergaard, 1964, Dover Publications.

25ME5102 - MODELLING AND ANALYSIS OF MECHANICAL ELEMENTS (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
25ME5106	MODELLING AND ANALYSIS OF MECHANICAL ELEMENTS	MAME	R	2	0	2	4	4

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Understand various CAD tools and peripherals required to create models.	2	PO1, PO2, PO4
CO2	Represent different curves and surfaces of geometric models.	3	PO1, PO2, PO4
CO3	Represent solid models using different solid represent schemes	3	PO1, PO2, PO4
CO4	Apply various data exchange formats in geometric modeling and also will be able to apply finite element modeling and mechanical assembly concepts in design applications	3	PO1, PO2, PO4
CO5	Analyze various mechanical elements models using modeling software	4	PO1, PO2, PO4
CO6	Design and develop mechanical components for selected applications	5	PO1, PO2, PO4

Syllabus

CADTOOLS:Definition of CAD Tools, Types of System, CAD/CAM system evaluation criteria, brief treatment of input an output devices. Graphics standards, functional areas of CAD, Modeling and Viewing, Software documentation efficient use of CAD Software.GEOMETRIC MODELING:Types of Mathematical representation of curves, wire frame models, wire frame entities, parametric representation of synthetic curves hermit cubic splines, Bezier curves, B-Splines rational curves.

SURFACE MODELING:Mathematical representation surfaces, surface model, surface entities, surface representation,parametric representation of surfaces,plane surface,rule surface, surface of revolution,tabular cylinder.PARAMETRIC REPRESENTATION OF SYNTHETICSURFACES:Hermit Bi Cubic surface, Bezier curve surface, B-Spline surface, COONs, Blending Surface,Sculptured surface, Surface Manipulation- Displaying, segmentation, trimming, intersection, Transformations (2D and3D).

GEOMETRIC MODELING 3D:Solid modeling, solid representation, Boundary Representation (B-Rep), Constructive Solid Geometry. CAD/CAM DATA EXCHANGE: Evaluation of data Exchange format, IGES Data representation sand structure, STEP Architecture, Implementation, ACIS and DXF.

DESIGN APPLICATIONS: Finite Element Modeling and Analysis and Mechanical Assembly. COLLABORATIVE ENGINEERING: Collaborative Design, Principles, Approaches, tools, designs system.

Reference Books

1 CAD/CAM: Principles and Applications, P.N.Rao, 3rd Edition, Tata Mc Graw hill.

2 CAD/CAM: Theory and Practice, Ibrahim Zeid, 2nd Edition, Tata Mc Graw hill.

3 CAD/CAM: Computer Aided Design and Manufacturing, M.Groover, E.Gimmers, 3rd Edition, Pearson.

4 CAD/CAM: Concepts and Applications, Chennakeava R. Alavala, 3rd Edition, Prentice Hall India Learning Private Limited.

25MD5204 - ADVANCED STRENGTH OF MATERIALS (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
25MD5204	ADVANCED STRENGTH OF MATERIALS	ASM	R	3	0	2	0	4

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Analyze the stresses and deflections in the beams under unsymmetrical bending and determination of shear centre.	4	PO2
CO2	Analyze the stresses induced in curved beams subjected to loading.	4	PO1, PO2
CO3	Analyze the torsional stresses in beams and determine the contact stresses.	4	PO1, PO2
CO4	Apply principles of elasticity to determine stresses in two dimensional and three dimensional problems.	3	PO2
CO5	Simulate the structural members using ANSYS software and validate the results with analytical methods	4	PO1, PO2

Syllabus

UNSYMMETRICAL BENDING: Bending stress in beams subjected to non-symmetrical bending, deflection of straight beams due to non symmetrical bending. SHEARCENTER: Bending axis and shear center-shear center of axisymmetric and unsymmetrical sections.

CURVED BEAM THEORY: Winkler Bach formula, correct factors, radial stress in curved beams, closed ring subjected to concentrated and uniform loads, stress in chain links. Torsion: Linear elastic solution, Pradtl elastic membrane (Soap-Film) Analogue, Narrow rectangular cross-section, Hollow thin wall torsion members, multiply connected cross-section.

CONTACT STRESS: Introduction, problem of determining contact stresses, assumptions on which a solution for contact stresses is based, expression for principle stresses, method of computing contact stresses, deflections of bodies in point contact, stresses for two bodies in contact over narrow rectangular area (Line of contact). Loads normal to area, stressed for two bodies in line contact normal and tangent to contacts area.

TWO DIMENSIONAL ELASTICITY PROBLEMS: Plane stress and plain strain, problems in rectangular Coordinates bending of cantilever beam loaded at the end, bending of a beam by uniform load. In polar coordinates, general equations in polar coordinates, stress distribution symmetrical about the axis, pure bending of curved bars, and displacements for symmetrical stress distributions, rotating discs. INTRODUCTION TO THREE DIMENSIONAL PROBLEMS: Uniform stress stretching of a prismatic bar by its own weight, twist of circular shafts of constant cross section, pure bending of plates.

Reference Books

1 Advanced Mechanics of materials, A.P.Boresi and O.M.Side bottom, 4th Edition, Wiely International.

2 Theory of Elasticity, Timoschenko S.P. and Goodier J.N, 2nd Edition, Mc Graw hill Publishers.

3 Advanced strength of materials, Den Hortog J.P., 3rd Edition, Dover Publications.

4 Theory of plates and shells, S.Timoshenko, 3rd Edition, McGraw Hill.

5 Strength of Materials and Theory of Structures, B.C Punmai, 2nd Edition, Laxmi Publications Pvt Ltd.

25MD5205 - MECHANICAL VIBRATIONS (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
25MD5205	MECHANICAL VIBRATIONS	MV	R	2	0	2	0	3

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Analyse free vibrations of single degree freedom systems	4	PO1, PO3, PO4
CO2	Analyse harmonically excited vibrations of single degree freedom systems	4	PO1, PO3, PO4
CO3	Analyse the mode shapes of two degree and multi degree vibration systems	4	PO1, PO3, PO4
CO4	Identify the means to control and measure the vibration response of the system	4	PO1, PO3, PO4
CO5	Analyse the vibrations of the system using analysis software	5	PO1, PO3, PO4

Syllabus

Classification of vibrations, Vibration analysis procedure, spring elements, damping elements, Inertia elements, harmonic motion and analysis, free vibration of undamped and damped translational and torsional systems.

Response of an undamped and damped systems under harmonic excitation, Response of damped system under harmonic force of the base, Response of damped system under rotating unbalance, Transfer function approach, solution using frequency transfer function.

Free vibration analysis of undamped 2DOF systems, coordinate coupling and Principal coordinates, forced vibration analysis, semidefinite system, solutions using Laplace Transform, Modelling of continuous system as multi degree of freedom systems

Vibration control and Isolation, Vibration measurement: Transducers, Vibration pickups, frequency measuring instruments, vibration exciters, signal analysis, dynamic testing of machinery and structures, machine condition monitoring and diagnosis.

Reference Books

1 Mechanical vibrations, S.S.Rao, 6th edition 2018, Pearson.

2 Vibration Analysis and Control in Mechanical Systems, C. M. Harris, 2nd Edition, 2001, CRC Press.

3 Mechanical Vibrations: Theory and Applications, S. Graham Kelly, 1st Edition, 2012, Cengage Learning.

4 Mechanical Vibrations and Noise Engineering, A. G. Ambekar, 1st Edition, 2011, Pearson.

25MD5206 - DESIGN OF PRESSURE VESSELS AND PLATES (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
25MD5206	DESIGN OF PRESSURE VESSELS AND PLATES	DPVP	R	3	0	2	4	5

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Apply the methods to determine stresses in cylindrical shells	3	PO1, PO2
CO2	Analyze the stresses in pressure vessel with various closure heads	3	PO1, PO2
CO3	Formulate basic equations for bending of rectangular plate	3	PO1, PO2
CO4	Analyze bending stresses in circular plate	3	PO1, PO2

Syllabus

Methods for determining stresses, Factors affecting the design of vessels, Design approach, Terminology and ligament efficiency.Problems on strins,stresses and Ligament efficiency.

General theory of Membrane stresses in vessels under internal pressure, Torus under Internal pressure, Thick cylinder ,Thermal stresses and their significance, Graphical determination of thermal stress in a cylindrical vessel for any thermal gradient. Bending of a pate in one and two perpendicular directions.

Introduction-assumptions-slopes and curvatures of bent plate-strain curvature relations- moment curvature relations-equilibrium equations-rectangular plate, - rectangular plate, circular plate-summery of basic equations-basic equations in Cartesian coordinate system Method of superposition for the analysis of rectangular plates with arbitrary boundary conditions.

Basic equations in polar co-ordinate system. Pure bending and cylindrical bending of rectangular plates Navier solution for an all-round simply supported rectangular plate-levy solution for rectangular plates-. Circular plates subjected to an arbitrary load- Symmetric bending of circular plates, circular plate subjected to asymmetric load. circular plate-boundary conditions

Reference Books

1 Theory and Design of Pressure Vessels, John F. Harvey, 1987, CBS Publishers and Distributors.

2 Theory of plates, K Chandrashekara, 2001, University Press.

3 Approximate Methods in the Design and Analysis of Pressure Vessels and Piping, Stanley, M. Wales,, 1997, Pre ASME Pressure Vessels and Piping Conference.

4 Theory of elasticity, Timoshenko S.P. and Goodier J.N, 1987, McGraw-Hill Publishers.

Y25: M.Tech. - Machine Design

Category: Professional Elective Courses (PEC)

25MD51A1 - LEAN MANUFACTURING (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
25MD51A1	LEAN MANUFACTURING	LM	R	3	0	2	0	3

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Understand Lean principles and tools for waste reduction, enhancing efficiency, and fostering a culture of continuous improvement in manufacturing environments.	2	PO1, PO2
CO2	Understand Lean methodologies like 5S, Kaizen, and Value Stream Mapping to optimize processes, reduce lead times, and improve overall productivity.	2	PO3, PO5
CO3	Understand leadership skills to champion Lean initiatives, cultivate a culture of employee engagement, and drive sustainable organizational improvement.	2	PO6
CO4	Apply practical knowledge of Lean implementation strategies to streamline operations, minimize costs, and maximize value for stakeholders and customers.	3	PO2
CO5	Apply practical skills in applying lean manufacturing principles and tools to improve efficiency, reduce waste, and optimize processes through hands-on lab activities.	3	PO1, PO2

Syllabus

An overview of Lean principles and philosophy, highlighting key concepts like waste reduction, value stream mapping, and continuous improvement. It covers strategies for boosting efficiency, optimizing processes, and fostering a culture of ongoing improvement.

Explore 5S methodology, Kaizen events, and Poka-yoke techniques. Understand Kanban systems for effective inventory management, focusing on organizational practices, continuous improvement, error-proofing processes, and visual workflow management to enhance operational efficiency.

Examine process flow, compare current and future state mapping, and apply VSM. Focus on improving process efficiency and eliminating waste through detailed analysis and strategic implementation of value stream mapping techniques.

Explore the essential role of leadership in implementing Lean methodologies, emphasizing the cultivation of a culture centered on continual improvement and the empowerment of employees to actively participate and contribute to Lean initiatives.

Reference Books

1 Lean Thinking: Banish Waste and Create Wealth in Your Corporation, James P. Womack, Daniel T. Jones , 2003, Free Press.

2 The Machine That Changed the World: The Story of Lean Production, Daniel T. Jones, Daniel Roos , 1990, Free Press.

3 Lean Production Simplified: A Plain-Language Guide to the World's Most Powerful Production System, Pascal Dennis , 2015, Productivity Press.

4 Lean Thinking: Banish Waste and Create Wealth in Your Corporation, James P. Womack and Daniel T. Jones , 2003, Free Press.

25MD51A2 - PRECISION AND QUALITY ENGINEERING (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
25MD51A2	PRECISION AND QUALITY ENGINEERING	PQE	R	3	0	2	0	3

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Understand and apply the measuring tools to machines and instruments.	2	PO3
CO2	Understand the different methods and solve the problems of Quality control.	2	PO3
CO3	Relate the Quality and Reliability and its associated failure modes.	2	PO3
CO4	Understand and implement the ISO 9000 series of total quality management.	2	PO3
CO5	Applying Precision Engineering concepts, Statistical Quality Control, and TQM principles for effective manufacturing processes.	3	PO3

Syllabus

INTRODUCTION: Importance of Precision Engineering, Tolerance and Technology, Definition of Tolerance, Impact of specifying Tolerance. MEASUREMENT OF PRECISION: Application of displacement transducers to machines and instruments, introduction to Precision Machine Design, Principles of Precision of Machine Design, Principle of Accuracy, Repeatability and resolution.

INTRODUCTION TO QUALITY: Quality of design, Quality of Conformance to Design, Quality of Performance, Growth of Quality Control, Process Monitoring, Acceptance Sampling, Quality of Performance Reliability, Management of Quality, Quality and Productivity.FUNDAMENTALS OF STATISTICS AND PROBABILITY IN QUALITY CONTROL

STATISTICAL QUALITY CONTROL: Variability in Materials, Machines and people, Statistical Understanding of Variability, Basic form of control chart, use of Control charts, Development of a Control Chart, Control charts for Variable and attributes. BASIC CONCEPT OF RELIABILITY: Introduction, Reliability and Quality, Failures and Failure Modes, Causes of Failures and Unreliability, maintainability and Availability, History of Reliability, Reliability literature.

TOTAL QUALITY MANAGEMENT: Objectives of TQM, Management in TQM, Implementation of TQM. I.S.O.9000 Series. Introduction Characteristics, Area covered in ISO 9000

Reference Books

1 Precision Engineering in Manufacturing, Murthy R. L., 1996, New Age International (P) limited.

2 Geometric Dimensioning and Tolerancing, James D. Meadows, 1995, Marcel Dekker inc..

3 Precision Engineering, VC Venkatesh& S Izman, --, TMH.

4 Introduction to Statistical Quality Control, Douglas C Montgomery, 2012, John Wiley.

5 Statistical Quality Control, Grant E.L. and Leavensworth, 2000, TMH.

25MD51A3 - BEHAVIOUR OF COMPOSITE MATERIALS (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
25MD51A3	MECHANICS OF COMPOSITE MATERIALS	BCM	R	3	0	2	0	3

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Understand the concept of Composite materials, Classifications and Manufacturing Processes	2	PO1, PO6
CO2	Apply the micro-mechanics concept to study the structural behavior of composite Lamina	3	PO1, PO2, PO6
CO3	Apply the macro-mechanics concept to study the structural behavior of composite Lamina	3	PO1, PO2, PO6
CO4	Apply Failure theories to calculate stresses in composite materials	3	PO1, PO2, PO6
CO5	Apply and analyze the theoretical concepts to conduct various experiments on composite materials through modeling.	4	PO2, PO6

Syllabus

Introduction to composite materials, Geometric definitions, Classification of composites, Types of fibers, Types of the matrix, Hybrid composite, Scale of analysismicro and macro mechanics approaches, Degree of Anisotropy. Manufacturing methods of the composites, Autoclave molding, Filament winding, and Resin transfer molding.

Elastic behavior of composite lamina (Micro-mechanics), Micro-mechanics methods, Geometric aspects and elastic symmetry, Longitudinal elastic properties (Continuous fibers), Transverse elastic properties, In-plane shear properties (Continuous fibers), Longitudinal properties (short fibers)

Elastic behavior of composite lamina (Macro mechanics approach), Stress-Strain relations: General anisotropic material, Specially orthotropic material, Transversely isotropic material, Orthotropic material under plane stress, Isotropic material.

Standard sizes of the specimen for tensile and compressive, Fatigue tests, and Impact tests of uni-directional composites. Experimental methods for characterization and testing of composite materials. Failure of the composite materials: fiber failures, matrix failure, interface failure. Failure Theories: Tsai-Wu, Tsai-Hill, Puck criterion, Maximum stress, maximum strain.

Reference Books

1 Engineering Mechanics of Composite Materials , Issac Daniel & Ori Ishai, 2nd; 2005, OU Publisher, USA.

2 Mechanics of Composite Materials , Autar K. Kaw , 2nd; 2005, Taylor & Francis.

3 Mechanics of Composite Materials , R.M.Jones , 2nd; 1998, Taylor & Francis .

4 Composite Materials , N. Chawla and K.K. Chawla, 3rd; 2006, Springer .

5 Mechanics of Composite Materials & Structures, Madhujit Mukhopadhyay, 1st; 2022, University Press.

25MD52C1 - DESIGN FOR MANUFACTURING (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
25MD52C1	DESIGN FOR MANUFACTURING	DFM	R	3	0	2	0	3

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Identify the principles and methodologies of Design for Manufacturing (DFM) and its impact on manufacturing processes	3	PO1, PO2, PO3
CO2	Apply design techniques for optimizing part geometry, tolerances, and surface finish to improve manufacturability in machining processes	3	PO2, PO3, PO4
CO3	Develop and incorporate design considerations for casting, forging and sheet metal forming processes	3	PO2, PO3, PO4
CO4	Make use of the design constraints and opportunities of Additive Manufacturing (AM) techniques in product development	3	PO1, PO2, PO3
CO5	Apply DFM principles through case studies, hands-on exercises and software simulations to optimize manufacturing processes	3	PO2, PO4, PO5

Syllabus

Introduction to Design for Manufacturing (DFM) principles and methodologies. Understanding the impact of design decisions on manufacturing processes

Design for Machining: Optimizing part geometry, tolerances, and surface finish requirements to improve manufacturability using machining processes

Design for Casting and Forming: Considerations for designing parts for casting, forging, and sheet metal forming processes

Design for Additive Manufacturing (AM): Exploring the design constraints and opportunities for utilizing AM techniques in product development

Practical Component: Application of DFM principles through case studies, hands-on exercises, and software simulations for manufacturing process optimization

Reference Books

1 Design for Manufacturability Handbook , James G. Bralla , Revised, McGraw-Hill Education.

2 Design for Manufacturability and Statistical Design , Scott K. Johnson, 2019, CRC Press .

3 Design for Manufacturing and Assembly, Geoffrey Boothroyd, Peter Dewhurst, Winston A. Knight, Revised, Marcel Dekker Inc. .

4 Design for Manufacturing: A Structured Approach, Corrado Poli , Revised, Springer.

5 Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Ian Gibson, David W. Rosen, Brent Stucker, 2014, Springer.

25MD52B2 - DESIGN FOR SUSTAINABILITY (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
25MD52B2	DESIGN FOR SUSTAINABILITY	DFS	R	2	0	2	0	3

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Understanding the Principles and Importance of Sustainability	2	PO5, PO6
CO2	Applying Life Cycle Assessment and Environmental Impact Assessment in Design	3	PO1, PO2
CO3	Implementing Sustainable Design Strategies and Principles	3	PO1, PO2
CO4	apply Sustainable Manufacturing, Supply Chain, and Assessment Tools	3	PO5, PO6, PO7
CO5	apply principles of sustainability in engineering design and develop sustainable solutions	3	PO5, PO6, PO7

Syllabus

Introduction to Sustainability: Definition and Principles of Sustainability, Importance of Sustainable Design, Environmental, Social, and Economic Dimensions Life Cycle Assessment: Introduction to Life Cycle Assessment (LCA), Life Cycle Thinking and Stages of LCA, Environmental Impact Assessment in Design, Interpretation and Limitations of LCA Results.

Sustainable Design Strategies: Design for Disassembly and End-of-Life Management, Material Selection and Substitution, Energy Efficiency and Renewable Energy Integration, Water Conservation and Waste Reduction, Design for Recyclability and Upcycling Sustainable Product Design: Design Principles for Sustainable Products, Eco-design and Design Guidelines, Cradle-to-Cradle Design Concepts, Sustainable Packaging Design.

Sustainable Manufacturing and Supply Chain Lean Manufacturing and Waste Reduction, Green Supply Chain Management, Closed-Loop Systems and Circular Economy, Social and Ethical Considerations in Manufacturing

Sustainable Design Assessment Tools Sustainable Design Standards and Certifications (e.g., LEED, BREEAM), Environmental Product Declarations (EPDs), Carbon Footprint Analysis, Social Life Cycle Assessment

Reference Books

1 Sustainable Design: A Critical Guide, David Bergman, 1, Bloomsbury.

2 Cradle to Cradle: Remaking the Way We Make Things, William McDonough, Michael Braungart, 2022, North Point Press.

3 Sustainability in Engineering Design, Ramachandran S., 2019, CRC Press.

4 Design for Sustainable Change, Stephen Lehmann, Roberta Tassi, 2019, Bloomsbury.

25MD52B3 - CONCURRENT MANUFACTURING (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
25MD52B3	CONCURRENT MANUFACTURING	CM	R	2	0	2	0	3

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Understand the integration of design and production activities to streamline workflows, enhance collaboration, and reduce time-to-market for products.	2	PO1, PO5
CO2	Apply concurrent engineering techniques in the product development process by engaging cross-functional teams to work simultaneously on design and production aspects.	3	PO1, PO5
CO3	Analyze the benefits of concurrent manufacturing, such as improved efficiency and reduced time-to-market, while also identifying potential challenges like increased complexity .	4	PO1, PO5
CO4	Analyze and optimize Implement strategies and techniques to optimize these processes, enhancing productivity, reducing costs, and improving overall operational efficiency..	4	PO1, PO5
CO5	Demonstrate and show a high level of skill and competence in utilizing concurrent engineering tools, including software and methodologies designed to integrate and streamline the design and production processes.	4	PO1, PO5

Syllabus

Introduction to concurrent manufacturing: principles and concepts - Overview of concurrent engineering and its importance in product development - Role of concurrent manufacturing in reducing time-to-market and enhancing product quality - Integration of design, manufacturing, and other functions for concurrent manufacturing

- Concurrent engineering techniques in product development - Simultaneous engineering and its application in concurrent manufacturing - Design for manufacturability and design for assembly principles - Use of computer-aided design (CAD) and computer-aided engineering (CAE) tools for concurrent design

Collaboration in cross-functional teams for concurrent manufacturing - Team dynamics and communication strategies for effective collaboration - Cross-functional team roles and responsibilities in concurrent manufacturing - Conflict resolution techniques and decision-making in cross-functional teams

Analysis of manufacturing processes for efficiency - Value stream mapping and process flow analysis - Identification of bottlenecks and waste in manufacturing processes - Lean manufacturing principles and their application in concurrent manufacturing

- Concurrent engineering tools and software - Overview of concurrent engineering software tools and their functionalities - CAD/CAM integration and data exchange for concurrent manufacturing - Simulation tools for process optimization and validation - Hands-on practice with concurrent engineering software tools

Reference Books

1 Concurrent Engineering: Contemporary Issues and Modern Design, Fathi, Madjid, 2nd Edition, 2021, CRC Press.

2 Concurrent Engineering: Automation, Tools, and Techniques, William D. Herrold, 1st Edition, 2018, Wiley-IEEE Press.

3 Design for Manufacturability and Concurrent Engineering, David M. Anderson, 1st Edition, 2014, CRC Press.

4 Collaboration Engineering: Designing Concurrent Systems, B. Sena, R. De Guio, et al., 1st Edition, 2013, Springer.

5 Lean Manufacturing: Tools, Techniques, and How to Use Them, William M. Feld, 2nd Edition, 2017, CRC Press.

25MD52B1 - FINITE ELEMENT ANALYSIS (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
25MD52B1	ADVANCED FINITE ELEMENT ANALYSIS	AFEA	R	2	0	2	0	4

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Apply finite element method to solve two dimensional structural problems	3	PO3
CO2	Apply finite element method to solve problems in Bending of plates and shells and Conforming and Non-Conforming elements.	3	PO3, PO4
CO3	Formulate and solve the non linear problems in Elasto Plasticity.	4	PO3, PO4
CO4	Formulate the dynamic problems in free, transient and forced vibration	4	PO1
CO5	Gain hands on experience in converting a given structure into desired shape and size and to perform the suitable analysis using ANSYS software	4	PO3

Syllabus

Two Dimensional Problems: Basic concepts of plane stress and plane strain, stiffness matrix of CST element, finite element solution of plane stress problems

BENDING OF PLATES AND SHELLS: Review of Elasticity equation, Bending of plates and shells, Finite Element formulation of plates and shell elements, Conforming and Non-Conforming elements, C0 and C1 Continuity elements, application and examples.

NON-LINEAR PROBLEM: Introduction, Iterative Techniques, Material Non-Linearity, Elasto Plasticity, Plasticity, Viscos Plasticity, Geometric Non linearity, Large displacement formulation, application in metal forming process and contact problems.

DYNAMIC PROBLEMS: Direct formulation-free, transient and forced response, Solution procedures, Subspace iterative Techniques, Houbot, Wilson, Newmark, Methods, Examples.

Reference Books

1 The Finite Element Method, Zienkiewicz,O.C. and Taylor,R.L, 5th Edition, Mc Graw Hill International Edition.

2 Concept and Applications of Finite Element Analysis, Cook R.D, 3rd Edition, John Wiely and Sons Inc.

3 Finite Element Procedure in Engineering Analysis, Bathe K.J, 3rd Edition, Prentice Hall.

4 Introduction to Non Linear Finite Element Analysis, Nam-Ho Kin, 1st Edition, Springer.

25MD52C2 - FRACTURE MECHANICS (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
25MD52C2	FRACTURE MECHANICS	FM	R	3	0	2	0	4

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Analyze the crack growth behavior in failed mechanical components	4	PO2, PO3
CO2	Analyze the stress field equations in flawed mechanical components	4	PO1, PO3
CO3	Determine the stress intensity factors of flawed mechanical components adopting different method of approaches	4	PO1, PO3
CO4	Evaluate the fracture toughness of the materials and develop the crack growth rate equations	4	PO2, PO3
CO5	Assess the fracture behavior of flawed mechanical components	4	PO2

Syllabus

ELEMENTS OF SOLID MECHANICS The geometry of stress and strain, elastic deformation, plastic and elastoplastic deformation limit analysis. STATIONARY CRACK UNDER STATIC LOADING Two dimensional elastic fields Analytical solutions yielding near a crack front Irwins approximation plastic zone size Dugdale model J integral and its relation to crack opening displacement.

ENERGY BALANCE AND CRACK GROWTH Griffith analysis Linear Fracture Mechanics Crack Opening displacement Dynamic energy balance crack arrest.

FATIGUE CRACK GROWTH CURVE Empirical Relation describing crack growth by fatigue Life calculations for a given load amplitude effects of changing the load spectrum Effects of Environment.

ELEMENTS OF APPLIED FRACTURE MECHANICS Examples of crackgrowth Analysis for cyclic loading leak before break crack Initiation under large scale yielding Thickness as a Design parameter crack instability in Thermal or Residual stress fields.

EVALUATION OF BEHAVIOUR OF FRACTURE Crack initiation, Crack growth, Fatigue lifecycle measurement.

Reference Books

1 Elementary Engineering Fracture Mechanics, David Broek, 1978, Fifthoff and Noerdhoff International Publisher.

2 Introduction of Fracture Mechanics, Kare Hellan, 1985, McGraw-Hill Book Company.

3 Elements of Fracture Mechanics, Preshant Kumar, 1999, Wheeler Publishing.

4 Mechanical Metallurgy , George E. Dieter , 1986, McGraw-Hill International.

5 Mechanical Behaviorof Materials , Norman E. Dowling, 2013, Prentice Hall .

25MD52C3 - TRIBOLOGICAL SYSTEM DESIGN (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
25MD52C3	TRIBOLOGICAL SYSTEM DESIGN	TSD	R	3	0	2	0	4

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Understand the surface wear and its treatment.	2	PO1, PO2
CO2	Apply the lubricant flow and delivery in different bearings	3	PO1, PO2
CO3	Apply the mechanism of rolling bearings and its failure criterion	3	PO1, PO2
CO4	Apply the tools to measure the bearing performance.	3	PO1, PO2
CO5	Analyze the tribological mechanism with experimental tools	4	PO2

Syllabus

Topography of surfaces, Surface features, interaction, theory of friction, sliding and rolling friction, Wear-mechanism of wear, wear resistant materials, surface treatment, Surface modification, coatings

Lubricants reduce friction, varying by composition and conditions. Standards guide usage across multiple lubrication regimes and dynamic effects.

Design and performance analysis of thrust and journal bearing, Hydrostatic journal bearing, Rolling element bearing, Bearing life capacity, ISO standard, Oil films and their effects, Rolling bearing failure

Tribomeasurement instruments assess surface topography via electron microscopy, friction, wear with lasers, adhering to international standards for bearing performance and vibration.

Reference Books

1 Tribology: Friction and Wear of Engineering Materials, Ian M. Hutchings, 2017, Butterworth-Heinemann.

2 Fundamentals of Tribology, Basim Al-Najjar, 2019, CRC Press.

3 Introduction to Tribology, J Halling, 2016, Wykeham Publications.

4 Introduction to Tribology, B.C. Majumdar, 2006, New Age .

5 Tribology: Principles and Design Applications, P Sahoo, 2012, PHI.

Y25: M.Tech. - Machine Design

Category: Project Research And Internship (PRI)

25IE5149 - TERM PAPER (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
25IE5149	TERM PAPER	TP	R	0	0	8	0	4

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Understand Literature Review and Problem Identification	2	PO1, PO2, PO4
CO2	Understand Methodology and Implementation	2	PO1, PO2, PO4

Syllabus

Literature Review and Problem Identification

Methodology and Implementation

Reference Books

1 Research methodology, C R Kothari, Ist Edition, New Age International Publishers.

2 Research Methodology, Panneerselvam R, Ist Edition, PHI.

3 Research Methodology: A Step-by-Step Guide for Beginners, Ranjit Kumar, Ist Edition, SAGE Publications Ltd.

4 Researching Lived Experience Human Science for an Action Sensitive Pedagogy, Max Van Manen, Ist Edition, State Univ of New York Pr.

25IE5201 - ESSENTIALS OF RESEARCH DESIGN (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
25IE5201	ESSENTIALS OF RESEARCH DESIGN	ERD	R	1	1	0	0	2

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Analyze existing research to identify a focused and answerable research question or develop a well-defined hypothesis	4	PO1, PO2
CO2	Evaluate different research designs based on their strengths and weaknesses in relation to the chosen research question and data needs.	4	PO2, PO7
CO3	Apply appropriate data collection methods considering the chosen research design and data characteristics.	3	PO1, PO3
CO4	Analyze and interpret data using relevant data analysis methods to address the research question	4	PO3, PO7

Syllabus

Definition and objectives of Research Types of research, Various Steps in Research process, Applied Mathematical tools for analysis, developing a research question- Choice of a problem, Literature review, Surveying, Synthesizing, critical analysis, reading materials, reviewing, rethinking, critical evaluation, interpretation, Research Purposes, Ethics in research APA Ethics code.

Literature Review (LR) Meaning and its Types-Narrative and Systematic, LR using Web of Science, Google and Google Scholar, Citations-Types, referencing in academic writing, Citation vs Referencing Vs Bibliography, Citation tools Zotero, Qualitative Research and its methods, Quantitative Research, and its Methods. Data Collection-Primary data collection using Questionnaire, Google forms, survey monkey, Testing the validity and Reliability of Questionnaire using Factor Analysis and Cronbach\'s Alpha

Diagrammatic and graphical presentation of data: Diagrams and Graphs of frequency data of one variable- histogram, bar charts simple, sub divided and multiple; line charts, Diagrams and Graphs of frequency data of two variables scatter plot, preparing data for analysis. Concepts of Correlation and Regression, Fundamentals of Time Series Analysis and Error Analysis. Analysing data using one dimensional statistics, two-dimensional statistics and multidimensional statistics.

Technical Writing and Publishing, Conference presentations, Poster Presentations, Plagiarism check and tools, Self Plagiarism. Structure and Components of Research Report, Types of Report, Layout of Research Report, Mechanism of writing a research report, Design Thinking for Contextualized Problem Solving and Empathetic Research.

Reference Books

1 Business Research Methods , Donald R.Cooper, Pamela S. Schhindler, 12th , McGraw-Hill.

2 Research Methods, Nicholas Walliman,Routledge, 3rd, The Taylor & Francis Group.

3 Essentials of Research Design and Methodology, David DeMatteo,Geoffrey R. Marczyk, 4th, wiley .

4 Research Design: Qualitative, Quantitative, and Mixed Methods Approaches , J. David Creswell, 6th, wiley.

25IE6150 - DISSERTATION (PART-1) (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
25IE6150	DISSERTATION (PART-1)	DIS	R	0	0	32	0	16

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Identify and articulate research problems within their field of study, demonstrating an understanding of current research gaps.	4	PO1, PO3
CO2	Design and execute research methodologies, employing relevant techniques for data collection, analysis, and interpretation.	5	PO4, PO6
CO3	Demonstrate advanced critical thinking skills, analyzing research findings within the context of existing literature to draw meaningful conclusions.	5	PO1, PO3

Syllabus

Identify and articulate research problems within their field of study, demonstrating an understanding of current research gaps.

Design and execute research methodologies, employing relevant techniques for data collection, analysis, and interpretation.

Demonstrate advanced critical thinking skills, analyzing research findings within the context of existing literature to draw meaningful conclusions.

Reference Books

1 Research Design: Qualitative, Quantitative, and Mixed Methods Approaches, John W. Creswell and J. David Creswell, 2018, SAGE Publications.

2 Engineering Research Methodology: A Practical Insight for Researchers, Dipankar Deb, Brojo Kishore Mishra, and Jayanta Bhattacharya, 2019, Springer.

3 Essentials of Research Methodology for Engineers, Pradip Kumar Sahu, 2020, Springer.

4 Advanced Research Methods for Engineers, Ali Salehnia and Ebrahim Pouresmaeil, 2018, Elsevier.

25IE6250 - DISSERTATION (PART-2) (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
25IE6250	DISSERTATION (PART-2)	DIS	R	0	0	32	0	16

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Demonstrate a comprehensive understanding of a chosen research topic and its significance in the broader field.	4	PO1, PO6
CO2	Apply appropriate research methodologies to address research questions	3	PO2, PO5
CO3	Analyze and interpret data effectively, drawing meaningful conclusions	4	PO1, PO6

Syllabus

Demonstrate a comprehensive understanding of a chosen research topic and its significance in the broader field.

Apply appropriate research methodologies to address research questions

Analyze and interpret data effectively, drawing meaningful conclusions

Reference Books

1 Research Design: Qualitative, Quantitative, and Mixed Methods Approaches, John W. Creswell and J. David Creswell, 2018, SAGE Publications.

2 Engineering Research Methodology: A Practical Insight for Researchers, Dipankar Deb, Brojo Kishore Mishra, and Jayanta Bhattacharya, 2019, Springer.

3 Essentials of Research Methodology for Engineers, Pradip Kumar Sahu, 2020, Springer.

4 Advanced Research Methods for Engineers, Ali Salehnia and Ebrahim Pouresmaeil, 2018, Elsevier.

Y25: M.Tech. - Machine Design

Category: Open Elective Courses (OEC)

25OEEE01 - RENEWABLE ENERGY RESOURCES (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
25OEEE01	RENEWABLE ENERGY RESOURCES	RER	R	4	0	0	0	4

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Demonstrate the different types of solar thermal applications and solar photovoltaic cells	3	PO3
CO2	Identify different types of wind turbines and wave energy conversion for generation of power	3	PO3
CO3	Apply various energy conversion techniques of Tidal, ocean thermal and geo thermal power plants	3	PO3
CO4	Explore different types of Bio energy conversion methods and applications in bio gas plants	3	PO3

Syllabus

Solar Radiation,Extraterrestrial solar radiation, terrestrial solar radiation, solar thermal conversion, solar ponds, solar heating/cooling technique, solar distillation, photovoltaic energy conversion, solar cells, 4 model

Wind Energy,Planetary and local winds, vertical axis and horizontal axis wind mills, principles of wind power, maximum power, actual power, wind turbine operation

Energy from Oceans,Ocean temperature differences, principles of OTEC plant operations, wave energy, devices for energy extraction, tides, simple single pool tidal system.

Geothermal Energy,Origin and types Energy from Bio mass: Bio fuels, classification, direct combustion for heat and electricity generator, anaerobic digestion for biogas, biogas digester, and power generation. Biomass energy conversion technologies, Biogas generation, classification of Biogas plants

Reference Books

1 Renewable Energy Sources, John Twidell & Toney Weir: E&F.N. Spon,, 2021, Taylor &Francis New York.

2 Wind Energy Technology, John F.Walker & N.Jenkins, 2011, John Willey and Sons Chichester.

3 Ocean Energy- Tide and Tidal Power, Roger H.Charlier, Charles W, 2014, ISBN: Library of Congress Control Number: 2008929624_c Springer-Verlag Brerlin Heidelberg 2009.

4 Renewable Energy, Godfrey Boyle, 2022, Oxford Publications.

25OEIN01 - FUNDAMENTALS OF IOT (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
25OEIN01	FUNDAMENTALS OF IOT	FIOT	R	4	0	0	0	4

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Apply the basic concepts of IoT and its implementation using the Development Hardware.	3	PO5
CO2	Apply the different sensors interfacing with Development Hardware.	3	PO5
CO3	Apply the different actuators interfacing with Development Hardware.	3	PO5
CO4	Analyze the IoT concepts to solve real time insights using Arduino / ESP32.	4	PO5

Syllabus

This module covers digital components (multiplexer, de-multiplexer, encoder, decoder), the ATMEGA328P microcontroller, and Arduino (types, features, pin descriptions, IDE, applications, GPIO programming).

It covers sensor basics, types, and classifications, focusing on temperature sensors (thermistors, LM35), LDR, IR, PIR, ultrasonic, and gas sensors, along with their interfacing and application implementations.

This module introduces actuators and their interfacing, covering types of DC motors, servo motors, and stepper motors along with their applications. It also includes motor driver circuits, relays, and optocouplers.

It covers IoT case studies on home automation, smart irrigation, and healthcare, with self-learning topics like smart lighting, intrusion detection, and air pollution monitoring.

Reference Books

1 Internet of Things (A-Hand-on-Approach), Arshdeep Bahga and Vijay Madisetti, 1st edition, 2015, Universities Press.

2 Internet of Things, Rajkamal, 2012, Tata McGraw Hill.

3 Internet of Things Architectures, Protocols and Standards, Simone Cirani, Gianluigi Ferrari, Marco Picone, Luca Veltri, 1st edition, 2019, Wiley.

4 The Internet of Things: Key applications and Protocols , Olivier Hersent, David Boswarthick, Omar Elloumi , 2012, Wiley.

5 The Internet of Things: Connecting Objects, Hakima Chaouchi, 2013, Wiley.

Y25: M.Tech. - Machine Design

Category: Value Added Courses (VAC)

25CC3071 - PROGRAMMING USING PYTHON (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
25CC3071	PROGRAMMING USING PYTHON	PUP	R	0	0	0	8	0

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Understand Python Modules and Packages	2	PO3
CO2	Apply Exception handling and string methods in Python	3	PO3
CO3	Apply object-oriented programming in python	3	PO3
CO4	Apply functions and Input/Output operations in python	3	PO3

Syllabus

Modules and Packages: Import and use modules and packages, Perform evaluations using the math module, Generate random values using the random module, Discover host platform properties using the platform module, Create and use user-defined modules and packages.

Exceptions: Handle errors using Python-defined exceptions, Extend the Python exceptions hierarchy with self-defined exceptions. Strings: Understand machine representation of characters, Operate on strings, Employ built-in string methods.

Object-Oriented Programming: Understand the Object-Oriented approach, Employ class and object properties, Equip a class with methods, Discover the class structure, Build a class hierarchy using inheritance, Construct and initialize objects.

Miscellaneous: Build complex lists using list comprehension, Embed lambda functions into the code, Define and use closures, Understand basic Input/Output terminology, Perform Input/Output operations.

Reference Books

1 Programming Python, Mark Lutz, 2001, O'Reilly Media.

2 Learning Python: Powerful Object-Oriented Programming, Mark Lutz, 2013, O'Reilly Media.

3 Python for Everyone, Cay Horstmann and Rance Necaise, 2016, John Wiley & Sons, Inc..

4 Programming and Problem Solving with Python , Ashok Namdev Kamthane and Amit Ashok Kamthane, 2018, McGraw Hill Education (India) Private Limited.

5 Starting Out with Python , Tony Gaddis, 2019, Pearson Education Limited.

25CC3085 - STATIC AND DYNAMIC ANALYSIS USING ALTAIR HYPERWORKS (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
25CC3085	STATIC AND DYNAMIC ANALYSIS USING ALTAIR HYPERWORKS	SDAU AHW	R	0	0	0	8	0

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	create high-quality meshes for complex geometries efficiently.	3	PO4
CO2	clean up and prepare CAD geometry for meshing and analysis.	3	PO4
CO3	set up and modify finite element models for various types of analyses.	3	PO4
CO4	perform and interpret structural analysis simulations, including static and dynamic analyses, using RADIOSS/ optistruct.	4	PO4

Syllabus

Introduction to HyperMesh- Overview of HyperMesh Interface:-Introduction to the HyperMesh environment Navigation and customization of the interface Basic operations and commands; Geometry Import and Cleanup - Importing CAD geometry, Geometry cleanup tools and techniques,Repairing and simplifying geometry for meshing.

Mesh Generation Techniques Introduction to meshing principles Creating 1D, 2D, and 3D meshes Mesh quality criteria and improvement methods

Advanced Meshing Strategies -Tetrahedral and hexahedral meshing Shell and solid meshing for complex geometries Mesh refinement and adaptation techniques

Introduction to RADIOSS Overview of RADIOSS capabilities and applications Setting up RADIOSS simulations in HyperMesh Running basic static and dynamic analyses Linear and Non-Linear Analysis Understanding linear static analysis Introduction to non-linear analysis concepts Solving non-linear problems using RADIOSS

Reference Books

1 Altair HyperMesh Tutorials, Altair, 1st, 2021, Altair.

2 Altair HyperMesh user guide, Altair, 1st, 2021, Altair.

3 Altair optistruct user guide, Altair, 1st, 2021, Altair.

4 Altair optistruct turorials, Altair, 1st, 2021, Altair.

Y25: M.Tech. - Machine Design

Category: Audit Courses (AUC)

25UC5201 - PROFESSIONAL COMMUNICATION SKILLS (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
25UC5201	PROFESSIONAL COMMUNICATION SKILLS	PCS	R	0	0	4	0	0

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Develop the skill of contextual Vocabulary and Critical Reading	3	PO7
CO2	Demonstrate different types of personal and professional skills and apply them for growth in professional zone.	3	PO7
CO3	Apply the concepts of Mathematical Principles to solve problems on Arithmetic , Algebra & Geometry to improve problem solving ability.	3	PO3
CO4	Apply the concepts and using Logical thinking to solve problems on verbal & Non-Verbal Reasoning to develop Logical thinking skills.	3	PO3

Syllabus

Vocabulary: Synonyms, Antonyms and One-word substitutes, (B)Reading comprehension, Critical reading, (C) Writing skills: Email writing, report writing and paragraph writing (D) Listening/Speaking Skills: listen & speak, Functional grammar

- A)Personal Skills: Intra & Interpersonal skills (B) Assertiveness (C) Group Discussion (D) Resume writing (E) Video resumes (F) Interview skills

Simple Equations, Ratio & Partnership, Averages, Percentages, Profit & Loss, Simple & Compound Interest, Numbers, Quadratic Equations & Inequalities, Time & Work, Time, Speed & Distance, Permutations & Combinations, Probability, Mensuration, Data Interpretation.

Syllogism, Logical Venn Diagrams, Cubes & Dice, Number& letter series, Number, letter & word Analogy, Odd Man Out, Coding & Decoding, Blood Relations, Directions, clocks, calendars, Number, ranking & Time sequence test, Seating Arrangements, Data Sufficiency.

Reference Books

1 OBJECTIVE ENGLISH FOR COMPETITIVE EXAMINATION, HARI MOHAN PRASAD AND UMA SINHA, 2017, MC GRAW HILL.

2 55 ESSENTIAL TOOL FOR EVERY WRITER, ROY PETER CLARK, 2006, LITTLE BROWN AND COMPANY.

3 QUANTTAITIVE APTITUDE, ABHJITH GUPTA, 2017, MC GRAW HILL.

4 LOGICAL REASONING , ARUN SHARMA, 2006, MC GRAW HILL.

5 LOGICAL REASONING, PIYUSH BAHRADWAJ, 2006, ARIHANT PUBLICATIONS.

CADCOML1V1 - CAREER ADVANCEMENT:COMPETITIVE EXAM TRAINING (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
CADCOML1V1	CAREER ADVANCEMENT:COMPETITIVE EXAM TRAINING	CAD: COM	R	0	0	0	8	0

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Enhance critical thinking and problem-solving skills to analyze and solve complex problems effectively.	3	PO7
CO2	Apply strategic test-taking techniques to improve performance and manage exam-related stress.	3	PO7

Syllabus

Introduction to Critical Thinking: covering the definition, importance, and key components; Logical Reasoning: focusing on types of reasoning (deductive and inductive) and common logical fallacies; Data Interpretation: analyzing graphs, charts, and statistical information; and Problem-Solving Techniques: emphasizing creative problem-solving methods and structured frameworks.

Practice Sessions through case studies and group discussions. It also explores Understanding Exam Formats, providing an overview of common competitive exams such as GRE, GMAT, and UPSC, along with types of questions encountered. Students will learn Time Management Techniques for prioritizing questions and allocating time efficiently, alongside Effective Study Habits to create study schedules and utilize resources. The syllabus includes Stress Management Strategies, focusing on mindfulness and relaxation techniques, and concludes with Mock Exams and Feedback to assess performance and identify areas for improvement.

Reference Books

1 Critical Thinking: A Beginner's Guide, Gail McDonald, Springer, 2018.

2 The 7 Habits of Highly Effective People, Stephen R. Covey, Free Press, 2020.

CADCORL1V1 - CAREER ADVANCEMENT: TRAINING IN CORE DOMAIN (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
CADCORL1V1	CAREER ADVANCEMENT: TRAINING IN CORE DOMAIN	CAD: TICD	R	0	0	0	8	0

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Apply advanced domain-specific concepts and emerging trends to address industry challenges and innovations.	3	PO1, PO2
CO2	Apply advanced problem-solving and strategic decision-making techniques to manage complex projects within the core domain.	3	PO1, PO2

Syllabus

Core Concepts, theories, and frameworks of the specific domain (e.g., finance, IT, healthcare, engineering), Advanced Domain-Specific Tools, innovations and their impact on the core domain, Real-world examples of how new trends are being applied within the domain

Domain specific challenges, Practical exercises to resolve complex issues in the domain, best practices for managing projects within the domain, Case Studies and Simulations.

CADENTL1V1 - CAREER ADVANCEMENT:ENTREPRENEURIAL CAREER PATHWAY TRAINING (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
CADENTL1V1	CAREER ADVANCEMENT:ENTREPRENEURIAL CAREER PATHWAY TRAINING	CAD: ECPT	R	0	0	0	8	0

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	apply essential entrepreneurial qualities such as resilience, innovation, and risk-taking, enabling them to pursue entrepreneurial career paths in various contexts, including startups, corporate roles, and freelancing.	3	PO6, PO7
CO2	Develop the skills to recognize potential business opportunities, conduct thorough market research, and validate ideas by addressing customer needs and evaluating feasibility, preparing them to create sustainable business solutions.	3	PO6, PO7

Syllabus

Defining entrepreneurship: What it means to be an entrepreneur; The distinction between entrepreneurial and traditional career paths; The entrepreneurial mindset: resilience, risk-taking, innovation, and adaptability; Exploring entrepreneurial career pathways in startups, corporate environments, freelancing, and social ventures.

Spotting opportunities: How to find unmet needs and gaps in the market; Market research: Tools and techniques for understanding trends and customer needs; Idea validation: Testing the feasibility of your business idea; Problem-solving for innovation: Leveraging customer pain points and inefficiencies.

Reference Books

1 The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses, Eric Ries, 1st (2011), Crown Business.

2 The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company, Steve Blank, Bob Dorf, 2nd (2020), K&S Ranch Press.

3 Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers, Alexander Osterwalder, Yves Pigneur, 1st (2010), Wiley.

4 The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail, Clayton M. Christensen, 1st (1997), Harvard Business Review.

CADUPSL1V1 - CAREER ADVANCEMENT: UPSC-CIVIL SERVICES EXAM TRAINING (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
CADUPSL1V1	CAREER ADVANCEMENT: UPSC-CIVIL SERVICES EXAM TRAINING	CAD: UPSC	R	0	0	0	8	0

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Understanding the basics of Indian History and it\'s evolution	2	PO7
CO2	Understanding the basics of Indian Geography	2	PO7
CO3	Understanding the Evolution of Indian Constitution.	2	PO7
CO4	Understanding the evolution of Indian Economy	2	PO7

Syllabus

Ancient Indian History- IVC,Rig Vedic, Later Vedic, Buddhism, Jainism, Mahajanapadas, Mouryan Empire, Guptan Empire, Harshavardhana empire, Sangam Age.

Exploring The Physical and Social Geography of India: The Universe, Big Bang Theory, Solar system, Geological Time Scale, Earth\'s Interior, Earth\'s Magnetic Feild.

Indian Polity and Constitution: Sailent featuresof Indian constitution, Preamble, Fundamental RIghts, Directrive Principles of State Policy, Fundamental Duties , Indian Parliament.

Understanding India\'s Economy - Indian Economic Development, National Income, Public Finance, Indian Budget.

Reference Books

1 Indian Polity, M. Laxmikanth, 7, Tata Mc Graw Hill.

2 Indian Economy, Nitin Singhania, 5, Mc Graw Hill.

3 Ancient and Medieval India, Poonam Dalal Dahiya, 3, Mc Graw Hill.

4 Fundamentals of Physical Geography, Husain Majid, 5, Mc Graw Hill.

CRTCODL1V1 - CAMPUS RECRUITMENT: LOGIC BUILDING SKILLS TRAINING (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
CRTCODL1V1	CAMPUS RECRUITMENT: LOGIC BUILDING SKILLS TRAINING	CRT: LBST	R	0	0	0	8	0

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Apply logical principles and critical thinking skills to analyze and evaluate arguments, solve problems, and make informed decisions.	3	PO1
CO2	Identify various logical reasoning techniques to solve complex problems, identify patterns, and draw valid conclusions	3	PO1

Syllabus

Introduction to Logic and Critical Thinking: fundamentals of logic, including the concepts of statements, propositions, truth values, logical connectives (AND, OR, NOT, IF-THEN, IF-AND-ONLY-IF), truth tables, and logical equivalence. Students will learn to identify and analyze different types of arguments, including deductive and inductive reasoning. They will also develop critical thinking skills, such as evaluating evidence, identifying assumptions, and recognizing fallacies

Logical Reasoning and Problem-Solving: applying logical reasoning techniques to solve various types of problems. Students will learn about different problem-solving strategies, including problem decomposition, pattern recognition, working backward, and using analogies. They will practice solving logic puzzles, brain teasers, and real-world problems that require logical thinking. Additionally, students will explore the concepts of syllogisms, Venn diagrams, and conditional reasoning to enhance their problem-solving abilities

Reference Books

1 Introduction to Logic, Irving M. Copi, Carl Cohen, Victor Rodych, 2014, Routledge.

2 Critical Thinking, Richard Paul, Linda Elder, 2019, Pearson.

3 The Art of Logical Thinking; Or, The Laws of Reasoning, William Walker Atkinson, 2013, Public domain in the

4 Symbolic logic and The game of logic, Carroll, Lewis, 1958, Dover Publications.

CRTCSSL1V1 - CAMPUS RECRUITMENT: COMMUNICATION SKILLS TRAINING (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
CRTCSSL1V1	CAMPUS RECRUITMENT: COMMUNICATION SKILLS TRAINING	CRT: CST	R	0	0	0	8	0

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	apply knowledge of communication of different types and techniques while analyzing body language and tone to enhance overall communication effectiveness.	3	PO7
CO2	apply active listening and feedback techniques, and analyzing effective participation in group discussions, while exploring roles in teamwork and strategies for managing conflicts, alongside professional communication practices such as writing emails and conducting meetings.	3	PO7

Syllabus

Communication: Basics, significance, types, verbal & non-verbal communication techniques, effective speaking and presentation skills tone and pacing in verbal interactions

Interpersonal skills, listening skills, feedback techniques, group communication and dynamics, group discussion, conflict management in professional communication, E-mail writing, report writing, presentations, interview skills.

Reference Books

1 Business Communication: A Problem-Solving Approach, Louis E. Boone & David L. Kurtz, 3rd Edition, McGraw Hill Education.

2 The Complete Guide to Business School Presentations", Jennifer D. D. McDonald, 2nd Edition, Pearson.

3 Listening: The Forgotten Skill", Geoffrey M. Cohen, 1st Edition, University Press of America.

4 Business Communication: Process and Product", Mary Ellen Guffey & Dana Loewy, 8th Edition, Cengage Learning.

5 Effective Communication Skills" Author, John Adair, 2nd Edition, Pan Macmillan.

CRTCSSL2V2 - CAMPUS RECRUITMENT: SOFT SKILLS TRAINING (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
CRTCSSL2V2	CAMPUS RECRUITMENT: SOFT SKILLS TRAINING	CRT: SST	R	0	0	0	8	0

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Apply and practice empathy, critical thinking, problem-solving, decision-making, effective communication, and interpersonal skills through real-life scenarios and interactive activities.	3	PO7
CO2	Apply group discussion techniques, interview skills, and mock interviews through practical exercises, encouraging learners to practice and refine these skills in realistic settings.	3	PO7

Syllabus

Critical thinking, problem soving, decision making, communication skills, interpersonal skills

Grooming, group discussions, story narrations, interview skills, mock interviews

Reference Books

1 Personality Development and Soft Skills", Barun K. Mitra, 2nd Edition, Oxford University Press.

2 Communication Skills for Engineers", C. Muralikrishna & Sunita Mishra, 1st Edition, Pearson Education.

3 Developing Soft Skills", Robert L. Katz, 1st Edition, McGraw Hill Education.

CRTVQRL1V1 - CAMPUS RECRUITMENT: VERBAL APTITUDE TRAINING (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
CRTVQRL1V1	CAMPUS RECRUITMENT: VERBAL APTITUDE TRAINING	CRT: VAT	R	0	0	0	8	0

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	apply and practice grammatical concepts like sentence formation, identifying odd words, using one-word substitutions, while enhancing understanding of idioms, phrases, spellings, and structures.	3	PO7
CO2	apply concepts like paragraph formation, sentence completion, reading comprehension, sentence correction, and correcting jumbled sentences, while enhancing word selection and sentence structure accuracy.	3	PO7

Syllabus

Synonyms, Antonyms, odd words, parts of speech, idioms and phrases, one word substitutions, odd words, formation of sentences

sentence completion, sentence correction, jumbled sentences, paragraph formation, reading comprehension, and sentence selection

Reference Books

1 The Pearson Guide to Verbal Ability and Logical Reasoning for the CAT", Nishit K. Sinha, 2nd Edition, Pearson.

2 Objective General English", S.P. Bakshi, 3rd Edition, Arihant Publications.

3 English Grammar in Use", Raymond Murphy, 5th Edition, Cambridge University Press.

CRTVQRL2V2 - CAMPUS RECRUITMENT: QUANTITATIVE APTITUDE TRAINING (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
CRTVQRL2V2	CAMPUS RECRUITMENT: QUANTITATIVE APTITUDE TRAINING	CRT: QAT	R	0	0	0	8	0

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Apply principles of quantitative techniques to solve problems on Simple Equations, Simple & Compound Interest etc	3	PO7
CO2	Apply principles of quantitative techniques to solve problems on Divisibility, Functions, Surds & Indices etc	3	PO7

Syllabus

Simple Equations, Problem on Ages, Ratio & Proportion, Variation& Partnership, Percentages, Profit, Loss& Discounts, Simple & Compound Interest, Averages & Allegations or Mixtures

Numbers, Divisibility, Decimal Fractions, LCM & HCF, Simplification, Sequence, Series & Progressions, Linear Algebra, Quadratic Equations & Inequalities, Theory of Equations. Sets, Relations & Functions, Surds & Indices, Logarithms

Reference Books

1 Quantitative Aptitude by R.S. Agarwal, SCHAND Publications, R.S. Agarwal, 2021, SCHAND Publications.

2 A Modern Approach to Verbal Reasoning by R.S. Agarwal, SCHAND Publications, R.S. Agarwal, 2021, SCHAND Publications.

CRTVQRL3V3 - CAMPUS RECRUITMENT: REASONING APTITUDE TRAINING (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
CRTVQRL3V3	CAMPUS RECRUITMENT: REASONING APTITUDE TRAINING	CRT: RAT	R	0	0	0	8	0

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Apply principles of deductive logic to solve problems on syllogisms, Venn diagrams, etc	3	PO7
CO2	Apply principles of inductive logic to solve problems on assumptions and conclusions	3	PO7

Syllabus

Syllogism, Number& letter series, Number, letter & word Analogy, Odd man out, coding & decoding, Cubes & Dice, Logical Venn Diagrams

Statements & conclusions, statements & Arguments (Critical Reasoning), statements & Assumptions, logical connectives, Binary logic

Reference Books

1 A Modern Approach to Verbal Reasoning, R.S. Agarwal, 2022, SCHAND Publications.

2 Logical Reasoning for CAT, Arun Sharma, 2021, McGraw Hills.