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||Jai Sri Gurudev||

Sri Adichunchanagiri Shikshana Trust (R.)

SJC INSTITUTE OF TECHNOLOGY

An Autonomous Institution under VTU from 2024-25

AICTE Approved, Accredited by NAAC with A+ Grade & NBA (CSE, ISE, ECE, ME & CV), NIRF(151-300) in 2023,Gold Rated by QS I-Gauge

P.B. No.20, B.B Road, Chikkaballapur - 562 101, Karnataka

Estd : 1986

IV Semester
Scheme & Syllabus of B.E. Programme
Aerospace Engineering
(2025 Scheme)

Core Values

Spiritual, Judicious, Commitment, Integrity, Trustworthy



AICTE | NATIONAL INSTITUTIONAL RANKING FRAMEWORK 151-300 | NBA | NAAC A+ | QS I-GAUGE GOLD | INSTITUTION'S INNOVATION COUNCIL (Ministry of HRD Initiative) 4-Star Rating

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Sri Adichunchanagiri Shikshana Trust (R.)

SJC INSTITUTE OF TECHNOLOGY

(An Autonomus Institute Under VTU Belagavi & Approved by AICTE, New Delhi)
Accredited by NAAC with A+ Grade & NBA (CSE, ISE, ECE, ME & CV), NIRF (151-300), QS-I Gauge GOLD Rated
Post Box #20, B.B. Road, Chikkaballapur - 562 101, Karnataka
Estd.:1986

B.E. in Aerospace Engineering ,
Scheme of Teaching and Examinations 2025

Outcome-Based Education (OBE) and Choice-Based Credit System (CBCS) (Effective from the academic year 2025-26)

IV SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching and Learning Scheme					Examination				Credits
					CI		LI	TW & SL	Total Hours per sem	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	SL						
1	PCC	1BAS401	Introduction to Drone Technology	AS	42	0	0	48	90	3	50	50	100	3
2	IPCC	1BAS402	Air Breathing Propulsion	AS	42	0	28	50	120	3	50	50	100	4
3	PCC	1BAS403	Low Speed Aerodynamics	AS	42	28	0	50	120	3	50	50	100	4
4	IPCC	1BAS/AE404	Mechanics of Materials	AS	42	0	28	50	120	3	50	50	100	4
5	PCCL	1BASL405	Aerodynamics Lab	AS	0	0	28	02	30	3	50	50	100	1
6	AEC	1BASL406	**Ability Enhancement Course Laboratory****	AS	0	0	28	02	30	2	50	50	100	1
7	BSC	1BAS407	Programme Specific Biology (ME and CV Streams)	PHY/CHEM/BIO	14	0	0	16	30	2	50	50	100	1
8	SDC	1BEP408	Environmental Science Project	AS	0	0	0	30	30	2	50	50	100	1
9	HSSM	1BMP409	Metaphysical Science	AS	14	0	0	16	30	2	50	50	100	1

10	NCMC	1BNS410	National Service Scheme	Campus	NSS coordinator	0	0	0	28	28	--	100	---	100	PP
		1BPE410	Physical Education		Physical Education Director										
		1BYO410	Yoga		Yoga Teacher										
		1BMU410	Music		Music Teacher										
		1BNC410	National Cadet Corps-2		NCC coordinator										
11	NCMC	1BCE411	Competency Enhancement Course-2	CDCAC		14	0	0	14	28	--	100	---	100	PP
12	NCMC	1BMATDIP412	Additional Mathematics -II	Maths Dept.		14	0	0	14	28	3	100	---	100	PP
Total												**750**	**450**	**1200**	**20**

Ability Enhancement Course (Laboratory) 1BASL406x			
1BASL406A	Drone Development and Operations	**1BASL406C**	Mat lab and Simulink
1BASL406B	VR and AR in Aerospace Engineering	**1BASL406D**	Smart Manufacturing and Robotics

Semester: IV					
Introduction to Drone Technology					
Course Code	**:**	1BAS401	**Credits**	**:**	3
Hours/Semester (L:T:P:SL)	**:**	42:0:0:48	**CIE**	**:**	50 Marks
Total Hours	**:**	90	**SEE**	**:**	50 Marks
Course Type	**:**	PCC	**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Elements of Aeronautical Engineering
Knowledge on Fundamental Concepts	Basic Electrical and Electronics
Knowledge on Connected Tools (If any)	

Course Learning Objectives: This course will enable the students to	
CLO1	Comprehend the fundamental classifications and aerodynamic principles of unmanned aerial platforms.
CLO2	Evaluate and select appropriate airframe materials and propulsion components based on mission requirements.
CLO3	Analyze the electronic architecture and communication links of modern flight control systems.
CLO4	Develop technical proficiency in the assembly, programming, and sensor calibration of multi-rotor systems.
CLO5	Implement safety standards, maintenance routines, and troubleshooting techniques for diverse industrial applications.

Module – 1	**08 Hrs**
Introduction to Aerial Platforms and Flight Principles Definitions of Drone, UAV, RPA, and Quadcopters. Classification of UAVs based on weight, range, and endurance. Basic components and categories of aerial vehicles. Comparison with traditional manned aircraft. Fundamental principles of flight including lift, weight, thrust, and drag. Introduction to flight dynamics and 6-DOF movement. Understanding basic flight maneuvers: Pitch, Roll, Yaw, and Throttle control.	
Module – 2	**08 Hrs**
Airframe Design and Propulsion Power Train Aerial vehicle airframes and structural requirements. Study of materials including Carbon Fiber, Aluminum, and Composites. Analysis of different frame shapes and their aerodynamic impacts. Propulsion system anatomy. Selection and specifications of Brushless DC (BLDC) motors and KV ratings. Propeller theory including pitch and diameter relationship. Calculation of total lift and thrust-to-weight ratio.	
Module – 3	**08 Hrs**
Electronic Systems and Flight Control Electronic Speed Controllers (ESC) and their role in motor speed regulation. Flight battery technology focusing on Lithium Polymer (Li-Po) cells, C-ratings, and safety. Architecture of the Flight Control Board (FCB). Functions of internal sensors including Gyroscope, Accelerometer, and Magnetometer. Radio transmitter and receiver communication protocols. Integration of GPS, Compass, and Telemetry modules.	
Module – 4	**08 Hrs**
Assembly, Configuration, and Programming Hardware assembly of a Quadcopter including connector soldering and component mounting. Interconnectivity of peripherals with the FCB. Establishing connections between FCB, ESC, motors, and sensors. Writing and uploading computer code to the flight controller for sensor testing. Programming and configuring the flight control board using ground station software. Calibration procedures for IMU, Compass, and Lidar sensors.	

Module – 5	08 Hrs
Testing, Maintenance, and Real-World Applications Pre-flight safety rules and checklist preparation. Flight log information and basic flight instructions. Maintenance and repair techniques including crash analysis and common issue identification. Troubleshooting the FCB and ESC through voltage testing and signal flow analysis. Drone leveling and battery level monitoring with Return to Home (RTH) operations. Case studies in Aerial Photography, Precision Agriculture, and Infrastructure Inspection.	

Topics for Self learning	
Module – 1	Evolution of UAVs: Historical development, classifications, and future trends in unmanned aerial platforms.
	Flight Stability and Dynamics: Static and dynamic stability, 6-DOF motion, and control maneuvers.
Module – 2	Advanced Materials in UAV Structures: Carbon fiber, composites, and nanomaterials for lightweight strength.
	Propulsion Innovations: Hybrid, solar, and fuel-cell propulsion systems with efficiency analysis.
Module – 3	Sensor Fusion Techniques: Integration of IMU, GPS, and vision sensors for autonomous navigation.
	Cyber security in UAV Communication: Secure protocols, encryption, and resilience against hacking.
Module – 4	Open-Source Flight Controllers: PX4, Ard pilot, and customization for mission-specific UAVs.
	Drone Simulation Platforms: Air Sim, Gazebo, and MATLAB for virtual UAV performance testing
Module – 5	Drone Swarm Operations: Cooperative UAV missions in agriculture, defense, and disaster relief.
	Ethical and Legal Challenges: Privacy, safety, and airspace regulations in UAV deployment.

Course Outcomes: After completing the course, the students will be able to	
CO1	Apply the concept of Flight dynamics for building Quadcopter
CO2	Assemble the Quadcopter
CO3	Program the Quadcopter
CO4	Perform Testing and Control operations on the Quadcopter
CO5	Implement Quadcopter for real world applications

Text Books	
1	Unmanned Aircraft Systems UAV design, development and deployment, Reg Austin, Wiley, 2010.

Reference Books	
1	Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy, Kimon P. Valavanis, Springer, 2007
2	Introduction to UAV Systems, Paul G Fahlstrom, Thomas J Gleason, UAV Systems Inc, 1998
3	Design of Unmanned Air Vehicle Systems, Dr. Armand J. Chaput, Lockheed Martin Aeronautics

4	Flight Stability and Automatic Control, Robert C. Nelson, McGraw-Hill, Inc, 1998

Web links and Video Lectures (e – Resources)	
1	https://www.youtube.com/watch?v=LePUzKzl9c0&source_ve_path=OTY3MTQ&embeds_referring_euri=https%3A%2F%2Fonlinecourses.nptel.ac.in%2F

CO – PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	1										3	2
CO2	3	2										3	3
CO3	3	2	2		2							3	3
CO4	2		2	2	3				3	1	1	3	3
CO5	2	2	3	2	2	3	2	1	2	2	2	3	3

Semester: IV					
Air Breathing Propulsion					
Course Code	**:**	1BAS402	**Credits**	**:**	4
Hours/Semester (L:T:P:SL)	**:**	42:0:28:50	**CIE**	**:**	50 Marks
Total Hours	**:**	120	**SEE**	**:**	50 Marks
Course Type	**:**	IPCC	**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Fluid Mechanics, Thermodynamics
Knowledge on Fundamental Concepts	Thermodynamic Cycles (P-V, T-S diagrams)
Knowledge on Connected Tools (If any)	-

Course Learning Objectives: This course will enable the students to	
CLO1	Develop understanding of the first law and second law of thermodynamics as applied to rotating machines.
CLO2	Build analytical skills for evaluating combined cycles such as reheat with regeneration.
CLO3	Familiarize students with the working of subsonic inlets and diffusers in propulsion systems.
CLO4	Enhance problem-solving skills related to compressor analysis and performance evaluation.
CLO5	Analyze different types of losses in turbines and their impact on overall performance.

Module – 1	**08 Hrs**
Introduction: Prime Movers, simple gas turbines, Application of first law and second law of thermodynamics in rotating machines, static and stagnation states. Open cycle, closed cycle arrangements, comparison of gas turbine with reciprocating engines. **Energy Exchange in Rotating Machines:** Euler's turbine equation, Alternate form of Euler's turbine equation, Velocity triangles for different values of degree of reaction, Components of energy transfer, Degree of Reaction, utilization factor, Relation between degree of reaction and Utilization factor, Problems	
Module – 2	**08 Hrs**
Ideal cycle and their analysis: Assumption in Ideal cycle analysis, simple gas turbine cycle, heat exchange cycle, reheat cycle, reheat and heat exchange cycle, intercooled cycle, problems. **Practical cycle and their analysis**: Assumptions, stagnation properties, compressor and turbine efficiency, pressure or flow losses, Effect of varying mass flow and specific heat, mechanical losses, problems.	
Module – 3	**08 Hrs**
Jet propulsion cycle and their analysis: Ram jet Engine, Pulse jet Engine, turbo prop engine, turbojet engine, thrust and thrust equation, efficiencies, parameters affecting flight performance, thrust augmentation, problems, Types of propellers, Propeller thrust: momentum theory, Blade element theories, propeller blade design, propeller selection **Inlets and combustion systems:** subsonic inlets, diffuser, combustion theory, factors affecting combustion chamber design, factors affecting combustion chamber performance, forms of combustion system, requirements of combustion chamber, process of combustion, combustion chamber geometry and arrangement.	
Module – 4	**08 Hrs**

Centrifugal Compressor: Essential parts of centrifugal compressor, principle of operation, ideal energy transfer, blade shapes and velocity triangle, analysis of flow through compressor, compressor characteristics, surging and chocking, problems **Axial flow compressor:** Geometry and working principle, stage velocity triangle, work done factor, enthalpy -entropy diagram, compressor stage efficiencies, degree of reaction, characteristics, problems
Module – 5 **08 Hrs**
Turbine: A single impulse and reaction stage, velocity triangle for a single stage machine, expression for work output, blade loading and coefficients, blade and stage efficiencies, reaction turbine, blade to gas speed ratio, losses and efficiencies, performance graphs, problems **Supersonic inlets and exhaust nozzles:** Supersonic inlets, starting problem in supersonic inlets, Shock swallowing by area variation, External deceleration. Modes of inlet operation. Theory of flow in isentropic nozzles, Convergent nozzles and nozzle choking, Nozzle throat conditions. Nozzle efficiency, Losses in nozzles. Over-expanded and under-expanded nozzles, Ejector and variable area nozzles, Thrust reversal.

Practical component	
Module – 1	Study of forced convective heat transfer over a flat plate.
	Determination of heat of combustion of aviation fuel.
Module – 2	Measurement of burning velocity of a premixed flame.
	Combustion performance studies in a jet engine combustion chamber.
Module – 3	Study of Free Jet
	Study of Wall jet
Module – 4	Preparation of Propellant
	Computation of burning rate of the propellant.
Module – 5	Estimate the Calorific value of propellant
	Measurement of Ignition delay of a single propellant with different shapes.

Topics for Self learning	
Module – 1	Evolution of Gas Turbine Engines.
	Modern Applications of Gas Turbines in Aircraft, Marine and Power Plants.
Module – 2	Performance Analysis of Combined Cycle Power Plants.
	Regenerative Gas Turbine Systems in Industrial Applications.
Module – 3	Working Principle of Scramjet Engines.
	Hybrid Rocket Propulsion Systems.
Module – 4	3D Blade Design of Axial Compressors.

	Additive Manufacturing of Compressor Components.
Module – 5	Performance Analysis of a Turbojet Engine Using MATLAB/Python.
	CFD Analysis of Flow Through a Convergent-Divergent Nozzle.

Course Outcomes: After completing the course, the students will be able to	
CO1	Interpret the concept of static, stagnation states, degree of reaction and utilization factor**.**
CO2	Apply the assumptions of ideal cycle analysis to evaluate the performance of a simple gas turbine cycle.
CO3	Solve numerical problems related to jet propulsion cycles and performance analysis
CO4	Evaluate the flow behavior through a centrifugal and axial compressor, and its impact on efficiency.
CO5	Construct and use velocity triangles to determine work output in turbine stages.

Text Books	
1	Gas Turbine, V. Ganesan, Tata McGraw Hill Pub. Co. Ltd.3rd edition,2010, ISBN-13: 978-0-07-068192-1
2	Turbomachines, M. S. Govinde Gowda, Iterative International Publishers ,1st edition,2024, ISBN-13: 978-93-6252-884-1

Reference Books	
1	Gas Turbine Theory, Cohen, H. Rogers, G.F.C. and Saravanamuttoo, H.I.H. Pearson Education,7th edition,2017, ISBN-13: 978-1292093093

Web links and Video Lectures (e – Resources)	
1	https://nptel.ac.in/courses/101105091
2	https://onlinecourses.nptel.ac.in/noc21_me69/preview

CO – PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2		2							2	2	
CO2	3	2	2	2	3				2	2	2	2	3
CO3	3	2	3	3	3				2	2	2	3	3
CO4	2	2	3	3	3				2	2	2	2	
CO5	2	2	3	3	3				2	2	2	2	

Semester: IV					
Low Speed Aerodynamics					
Course Code	**:**	1BAS403	**Credits**	**:**	4
Hours/Semester (L:T:P:SL)	**:**	42:28:00:50	**CIE**	**:**	50 Marks
Total Hours	**:**	120	**SEE**	**:**	50 Marks
Course Type	**:**	PCC	**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Fluid Mechanics, Thermodynamics
Knowledge on Fundamental Concepts	Bernoulli's Principle, Forces-Weight, lift, drag and thrust
Knowledge on Connected Tools (If any)	-

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the basics of fluid mechanics for prerequisite to Aerodynamics
CLO2	Apply Kutta–Joukowski Theorem to explain the generation of aerodynamic lift on bodies immersed in a fluid flow.
CLO3	Estimate laminar and turbulent skin-friction drag on aerodynamic surfaces using empirical and analytical relations.
CLO4	Acquire knowledge on typical air foil characteristics and two-dimensional flows over air foil and study the incompressible flow over finite wings
CLO5	Apply potential flow theory and panel techniques for solving complex three-dimensional aerodynamic flow problems.

Module – 1	**08 Hrs**
Models of Fluid: Control volume and fluid elements, finite control volume approach, Infinitesimal fluid element approach, molecular approach, physical meaning of divergence of velocity, specification of flow field **Governing Equations Conservative and Non-Conservative:** Continuity equations, momentum equation, Energy Equation, substantial derivative, Fundamental equations in terms of substantial derivative. Application of Momentum equation: Drag of a two-dimensional body	
Module – 2	**08 Hrs**
Inviscid, Incompressible Flow: Bernoulli's Equation, Incompressible Flow in a Duct: The Venturi and Low-Speed Wind, Pitot Tube: Measurement of Airspeed Tunnel, Governing Equation for Irrotational, Incompressible Flow: Laplace's Equation **Elementary flows:** Uniform flow, Source flow, Sink flow, Combination of a uniform flow with source and sink. Doublet flow. Non-lifting flow over a circular cylinder. Vortex flow. Lifting flow over a circular cylinder. Kutta-Joukowski theorem and generation of Lift.	
Module – 3	**08 Hrs**
Incompressible Flow Over Airfoils: Airfoil Nomenclature, Air foil Characteristics, Philosophy of Theoretical Solutions for Low-Speed Flow over Airfoils: The Vortex Sheet, Kutta condition, Kelvin's circulation theorem and the starting vortex, Classical Thin Airfoil Theory: The Symmetric Airfoil, The Cambered Airfoil, Lifting Flows over Arbitrary Bodies: The Vortex Panel Numerical Method **Viscous Flow:** Airfoil Drag, Estimating Skin-Friction Drag: Laminar Flow, Estimating Skin-	

Friction Drag: Turbulent Flow, Transition, Flow Separation, The Flow over an Airfoil—The Real Case	
Module – 4	**08 Hrs**
Incompressible Flow Over Finite Wings: Biot-Savart law and Helmholtz's theorems, Vortex filament: Infinite and semi-infinite vortex filament, Induced velocity. Prandtl's classical lifting line theory: Downwash and induced drag. Elliptical and modified elliptical lift distribution. Lift distribution on wings. Limitations of Prandtl are lifting line theory. Extended lifting line theory- lifting surface theory, vortex lattice method for wings. Lift, drag and moment characteristics of complete airplane.	
Module – 5	**08 Hrs**
Three-Dimensional Incompressible Flow: Three-Dimensional Source, Three-Dimensional Doublet, General Three-Dimensional Flows: Panel Techniques, Applied Aerodynamics: The Flow over a Sphere—The Real Case, Applied Aerodynamics: Airplane Lift and Drag, Airplane Lift, Airplane Drag, Application of Computational Fluid Dynamics for the Calculation of Lift and Drag.	

Topics for Self learning	
Module – 1	Applications of Control Volume Analysis in Aerospace Engineering
	Physical Interpretation of Divergence and Curl in Fluid Flow.
Module – 2	Working Principle of Pitot-Static Tubes in Aircraft.
	Wind Tunnel Testing Techniques for Low-Speed Aerodynamics
Module – 3	Evolution of NACA Airfoil Series.
	Modern Airfoil Design Techniques.
Module – 4	Aerodynamic Characteristics of UAV Wings.
	Lift Distribution on Swept and Delta Wings.
Module – 5	CFD Applications in Aircraft Design.
	CFD Analysis of NACA 0012 Airfoil at Different Angles of Attack.

Course Outcomes: After completing the course, the students will be able to	
CO1	Identify and specify different types of flow fields based on velocity components.
CO2	Interpret the formation and significance of vortex flow and its influence on pressure distribution
CO3	Analyze symmetric and cambered airfoils using Thin Airfoil Theory for determining aerodynamic performance parameters.
CO4	Evaluate elliptical and modified elliptical lift distributions and their influence on aerodynamic efficiency
CO5	Evaluate different components of airplane drag including induced drag, pressure drag, and skin-friction drag.

Text Books	
1	"Fundamental of Aerodynamics", Anderson J.D, 5thedition, McGraw-IL, International Edition, New York (2011), ISBN-13: 978-0073398105.

2	"Aerodynamics for Engineering Students", E.L. Houghton, P.W. Carpenter, 5th edition, Elsevier, New York. (2010), ISBN-13:9780080966328.
3	"Gas Dynamics" Radhakrishnan, E, 8th edition Prentice Hall of India.2026, ISBN-13: 978-9354438400.

Reference Books	
1	"Aerodynamics" Clancy L.J Sterling book house, New Delhi. (2006), ISBN13:9780582988804
2	"Theoretical Aerodynamics" Thomson, Imported Edition, Dover Publications, USA (2011), ISBN 9780486619804.

Web links and Video Lectures (e – Resources)	
1	http://www.digimat.in/nptel/courses/video/101101001/101101001.html
2	http://nptel.ac.in/syllabus/101105059/
3	http://nptel.ac.in/courses/112105171/1
4	http://nptel.ac.in/courses/112104118/

CO – PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2		2							2	2	2
CO2	3	2	2	2	3				2	2	2	3	2
CO3	3	2	3	3	3				2	2	2	3	2
CO4	2	2	3	3	3				2	2	2	3	2
CO5	2	2	3	3	3				2	2	2	2	2

Semester: IV					
Mechanics of Materials **(Common to the Branches: AE &AS)**					
Course Code	**:**	1BAS404	**Credits**	**:**	4
Hours/Semester (L:T:P:SL)	**:**	42:0:28:50	**CIE**	**:**	50 Marks
Total Hours	**:**	40L+12P	**SEE**	**:**	50 Marks
Course Type	**:**	IPCC	**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	• Aircraft Materials & Processes • Introduction to Artificial intelligence
Knowledge on Fundamental Concepts	Basics of Materials, Engineering Materials and its properties. etc.
Knowledge on Connected Tools (If any)	

Course Learning Objectives: This course will enable the students to	
CLO1	Understand basic concepts of strength of materials and Determine the stresses, strains produced by the application of loads.
CLO2	Acquire knowledge of shear force, bending moment diagrams and Shear Stresses for beams subjected to various types of loads.
CLO3	Apply deflection & Slope equations to determine circumferential and hoop stresses in cylinders.
CLO4	Analyze the concepts of torsion of Circular Shafts and Columns subjected to varies forces.
CLO5	Learn Failure theories for different materials and understand fatigue, fracture and creep loads.

Module – 1	**08 Hrs**
Simple Stress & Strain: The concept of stress & strain, state of Stress & Strain at a point, Stress-strain curves for brittle and ductile materials, Allowable stress, and Material selection for structural performance. Extension / Shortening of a bar, bars with cross sections varying in steps, bars with continuously varying cross sections. Elongation due to self-weight. **Elastic Constants:** Volumetric strain, expression for volumetric strain, elastic constants, simple shear stress, shear strain, temperature stresses.	
Module – 2	**08 Hrs**
Shear Force and Bending Moment: Type of beams, Loads and reactions, Relationship between loads, shear forces and bending moments, Shear force and bending moments of cantilever beams, UVL, UDL, couple Pin support and roller supported beams subjected to concentrated loads, uniformly distributed constant / varying loads. **Bending and Shear Stresses in Beams:** The Euler-Bernoulli theory derivation, assumptions, bending stress equation, moment carrying capacity of section, Bending and shear stress distribution in rectangular, I and T section beams.	
Module – 3	**08 Hrs**
Deflection of Beams: Introduction, Differential equation for deflection. Equations for deflection, slope and bending moment. Double integration method for cantilever and simply supported beams for point load, UDL, UVL and Couple. Macaulay's method.	

Cylinders: Stresses in thin cylinders, Lame's equation for thick cylinders subjected to internal and external pressures, Changes in dimensions of cylinder (diameter, length and volume), and simple numerical.
Module – 4 **08 Hrs**
Torsion of Circular shafts: Circular solid and hallow shafts, Torsional moment of resistance, Power transmission of straight and stepped shafts, Twist in shaft sections, Thin tubular sections, Thin-walled sections. **Stability of Columns:** Buckling and stability, Critical load, Columns with pinned ends, Columns with other support conditions, Effective length of columns, Secant formula for columns.
Module – 5 **08 Hrs**
Theories of Failure : Maximum Principal Stress Theory (Rankine's Theory), Maximum Shear Stress Theory (Tresca or Guest's Theory), Maximum Principal Strain Theory (St.Venant's Theory), Maximum Distortion Energy Theory (Von Mises or Hencky's Theory)(No Numericals) **Failure of Materials:** Fracture: Type-I, II, III, Creep: Stages, properties stress relaxation, Fatigue: fatigue types, S-N diagram, mechanism, properties, testing

Practical component	
Module – 1	To determine the hardness values of different materials by Brinell hardness/Rockwell hardness (MS,CI,CU,AL & Brass
	Tensile and compression tests of metallic specimens using Universal Testing Machine
Module – 2	Shear tests of metallic specimens using Universal Testing Machine
	Bending test
Module – 3	Impact test: Izod and Charpy Tests on M.S, C.I Specimen
	Liquid Dye penetration testing. To study the defects of Cast and Welded specimens
Module – 4	Torsion Testing
	To conduct a wear test on Mild steel/ Cast Iron/Aluminium/ Copper to findThe volumetric wear rate and coefficient of friction
Module – 5	Magnetic crack detection
	Ultrasonic flaw detection (Demonstration)

Topics for Self learning	
Module – 1	Material selection for structural performance.
	Simple shear stress
Module – 2	Type of beams.
	Type of Loads.
Module – 3	Macaulay’s method for deflection of beams
	Stresses in thin cylinders

Module – 4	Thin-walled sections
	Critical load
Module – 5	Fatigue types
	Properties stress relaxation

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the mechanical behavior and elastic constants of materials, and stress-strain relationships.
CO2	Determine the simple, compound, thermal stresses and strains induced on various Mechanical elements
CO3	Draw SFD and BMD for different types of beams subjected to different loads and shear stresses in beams.
CO4	Evaluate the torsional equation to find power transmitted by circular shafts under various loading conditions to estimate stability.
CO5	Apply Failure theories for different types of materials and Mechanical properties of materials.

Text Books	
1	Mechanics of Materials, S.I. Units, Ferdinand Beer & Russell Johnston, 7th Ed, TATA McGraw Hill-2014.
2	Mechanics of Materials, K. V. Rao, G. C. Raju, Subhash Stores, 2012 Edition

Reference Books	
1	Strength of Materials, S. S. Bhavikatti, Vikas Publishing House-Pvt. Ltd., 4th Ed. 2013.
2	A Text book of Strength of Materials, R. K. Bansal, Laxmi Publications, 2010
3	Structural Analysis, O.A. Bauchau and J.I. Craig, Springer Dordrecht Heidelberg London New York,ISBN978-90-481-2515-9, e-ISBN 978-90-481-2516-6

Web links and Video Lectures (e – Resources)	
1	https://onlinecourses.nptel.ac.in/noc23_me140/preview
2	https://www.youtube.com/supported_browsers?next_url=https%3A%2F%2Fwww.youtube.com%2Fwatch%3Fv%3DuA_HqCGo8Pg

CO – PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	2	-	-	-	-	2	3	2	2	2	1
CO2	3	2	2	2	-	2	-	2	3	2	2	2	1
CO3	3	2	2	-	2	-	1	2	3	2	2	2	1
CO4	3	2	2	2			1	2	3	2	2	2	1
CO5	3	2	2	-	-	-	-	2	3	2	2	2	1

Semester: IV					
Aerodynamics Lab					
Course Code	:	1BASL405	**Credit**	:	1
Hours/Semester (L:T:P:SL)	:	0:0:28:02	**CIE**	:	50 Marks
Total Hours	:	30	**SEE**	:	50 Marks
Course Type	:	PCCL	**SEE Duration**	:	2 Hours

Prerequisites:	
Courses	Aerodynamics
Knowledge on Fundamental Concepts	Fluid Mechanics
Knowledge on Connected Tools (If any)	

Course Learning Objectives: This course will enable the students to	
CLO1	Familiarize with subsonic wind tunnel calibration procedures and flow characteristics.
CLO2	Understand and apply visualization techniques (smoke and tuft) to analyze flow around aerodynamic bodies
CLO3	Measure surface pressure distributions and calculate aerodynamic forces
CLO4	Perform wake survey using Pitot-static probes for drag estimation
CLO5	Study and analyze boundary layer properties including velocity profile, displacement and momentum thickness.

Experiments	
Sl. No.	**List of problems for which student should Develop C program and execute in the Laboratory**
1.	Calibration of a subsonic wind tunnel: test section static pressure and total head distributions.
2.	Smoke flow visualization studies on a two-dimensional circular cylinder at low speeds.
3.	Smoke flow visualization studies on a two dimensional airfoil at different angles of incidence at low speeds.
4.	Smoke flow visualization studies on a two dimensional multi element airfoil with flaps and slats at different angles of incidence at low speeds.
5.	Tuft flow visualization on a wing model at different angles of incidence at low speeds: identify zones of attached and separated flows.
6.	Surface pressure distributions on a two-dimensional smooth circular cylinder at low speeds and calculation of pressure drag.
7.	Surface pressure distributions on a two-dimensional symmetric airfoil at Zero angles of incidence and calculation of lift and pressure drag.
8.	Surface pressure distributions on a two-dimensional cambered airfoil at Zero angles of incidence and calculation of lift and pressure drag.
9.	Calculation of total drag of a two-dimensional Symmetric airfoil at low speeds using pitot-static probe wake survey.
10.	Calculation of total drag of a two-dimensional cambered airfoil at low speeds using pitot-static probe wake survey.
11.	Measurement of a typical boundary layer velocity profile on the tunnel wall (at low speeds) using a pitot probe and calculation of boundary layer displacement and momentum thickness

12.	Calculation of aerodynamic coefficients and forces acting on a model aircraft at various AOA and speeds using wind tunnel balance (With and Without Yaw).

Open Ended Experiments	
1	Surface pressure distributions on a two-dimensional rough circular cylinder at low speeds and calculation of pressure drag.
2	Surface pressure distributions on a two-dimensional symmetric and cambered airfoil at different angles of incidence and calculation of lift and pressure drag
3	Pressure measurements on airfoil for a case of reverse flow

Course Outcomes: After completing the course, the students will be able to	
CO1	Calibrate a subsonic wind tunnel and analyze static and total pressure distributions in the test section.
CO2	Conduct smoke and tuft flow visualization studies to identify flow attachment, separation, and wake behavior
CO3	Measure surface pressure distributions on symmetric and cambered airfoils/cylinders and calculate lift and pressure drag
CO4	Estimate total drag using wake survey methods involving Pitot-static probe measurements.
CO5	Measure boundary layer velocity profiles and compute displacement and momentum thickness

Text Books	
1	Pope A and Goin L, "Low-Speed Wind Tunnel Testing", Wiley-Interscience, 2nd Edition, 1985, ISBN: 9780471862101
2	J.P. Holman, "Experimental Methods for Engineers", McGraw-Hill Education, 8th Edition, 2011, ISBN: 9780073529301

Reference Books	
1	Robert J Goldstein, "Fluid Mechanics Measurements", CRC Press / Taylor & Francis, 2nd Edition, 1996, ISBN: 9781560323027.

Web links and Video Lectures (e – Resources)	
1	https://youtu.be/u1NNVQbPuxg?si=HKIfRfQNph5O9kd4

CO – PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	2	2	1						1	3	2
CO2	3	2	2	2	2				1		1	3	2
CO3	3	2	3	3	1						2	3	2
CO4	3	2	3	3	2						2	3	2
CO5	3	2	2	3	2						2	3	2

Semester: IV						
Drone Development and Operations						
Course Code	**:**	**1BASL406A**		**Credits**	**:**	1
Hours/Week(L:T:P)	**:**	0:0:28:02		**CIE**	**:**	50 Marks
Total Hours	**:**	30		**SEE**	**:**	50 Marks
Course Type	**:**	AEC		**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Elements of Aeronautical Engineering
Knowledge on Fundamental Concepts	Basic Electrical and Electronics
Knowledge on Connected Tools (If any)	

Course Learning Objectives: This course will enable the students to	
CLO1	**Understand** the regulatory framework, safety guidelines, and the fundamental hardware architecture of Unmanned Aerial Vehicles (UAVs).
CLO2	**Develop** hands-on skills in the mechanical assembly, power distribution, and electronic interfacing of multirotor systems.
CLO3	**Master** the configuration of flight control systems, including firmware management and precise sensor calibration.
CLO4	**Analyse** flight stability and autonomous operations through simulation and PID control tuning.
CLO5	**Evaluate** flight performance through telemetry data analysis, mission planning, and data logging.

Sl. No	**Experiments**
1	Study of Drone Regulations and Safety Protocols
2	Identification and Characterization of Drone Components
3	Mechanical Assembly of a Multirotor Frame
4	Power Distribution and Soldering Practice
5	Propulsion System Interfacing and ESC Calibration
6	Radio Control (RC) Transmitter and Receiver Binding
7	Flight Controller Configuration and Firmware Flashing
8	Sensor Calibration (IMU, Magnetometer, and GPS)
9	Software-in-the-Loop (SITL) Flight Simulation
10	PID Controller Tuning and Stability Analysis
11	Autonomous Mission Planning with Waypoints
12	Telemetry Analysis and Flight Data Logging

Open End Experiments	
1.	Compare the performance of two different propeller sizes (using manufacturer data or simulation) and discuss their effect on thrust and flight time.
2.	Plan an autonomous waypoint mission for a small area (e.g., college playground or campus) using Mission Planner/Q Ground Control.

3.	Analyse a sample drone flight log and identify parameters such as altitude, battery voltage, GPS satellites, and flight mode changes.
Course Outcomes: After completing the course, the students will be able to	
CO1	Identify drone components and apply safety protocols and government regulations for legal and safe aerial operations.
CO2	Perform mechanical assembly and electrical soldering of a multirotor frame, ensuring robust power distribution and propulsion interfacing.
CO3	Execute firmware flashing and calibrate internal sensors (IMU, Magnetometer, GPS) to ensure accurate flight controller orientation.
CO4	Design and tune PID control parameters in a simulated environment to achieve flight stability and system responsiveness.
CO5	Plan autonomous waypoint missions and analyze telemetry logs to troubleshoot flight performance and mission accuracy.
Text Books:	
1.	Unmanned Aircraft Systems UAV design, development and deployment, Reg Austin, Wiley, 2010.
2.	Flight Stability and Automatic Control, Robert C. Nelson, McGraw-Hill, Inc, 1998.
Reference Books:	
1.	Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy, Kimon P. Valavanis, Springer, 2007
2.	Introduction to UAV Systems, Paul G Fahlstrom, Thomas J Gleason, UAV Systems Inc, 1998
3.	Design of Unmanned Air Vehicle Systems, Dr. Armand J. Chaput, Lockheed Martin Aeronautics
Web links and Video Lectures (e – Resources):	
1.	https://ardupilot.org/copter/docs/esc-calibration.html
2.	https://ardupilot.org/planner

CO – PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	1					3	2	3				2	2
CO2	3		2		1				3		1	3	2
CO3	3	2		1	3				2			3	3
CO4	3	3	2	2	3					1		3	3
CO5	2	3	1	3	3				2	3	2	3	3

Semester: IV					
VR and AR in Aerospace Engineering					
Course Code	**:**	1BASL406B	**Credit**	**:**	1
Hours/Semester (L:T:P:SL)	**:**	0:0:28:02	**CIE**	**:**	50 Marks
Total Hours	**:**	30	**SEE**	**:**	50 Marks
Course Type	**:**	AEC	**SEE Duration**	**:**	2 Hours

Prerequisites:	
Courses	Engineering Mechanics, Fluid Mechanics
Knowledge on Fundamental Concepts	Aerodynamics, Aircraft Performance and Flight Mechanics, Aircraft Stability and Control
Knowledge on Connected Tools (If any)	Aerospace Engineering, Aerodynamics, Flight Mechanics, Aircraft Propulsion, and basic computer applications.

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the fundamentals of aerospace systems, aircraft performance, stability, control, and navigation through simulation-based learning.
CLO2	Develop proficiency in the use of modern aerospace simulation tools and software for modeling, visualization, and analysis of aerospace systems.
CLO3	Analyze aerodynamic characteristics, flight dynamics, propulsion systems, and mission profiles using virtual simulation environments.
CLO4	Interpret simulation data and evaluate the performance of aircraft and space systems under various operating conditions.
CL05	Design and conduct open-ended simulation studies to solve aerospace engineering problems and effectively communicate the results through technical reports and presentations.

Experiments	
Sl. No.	**EXPERIMENT NAME**
1.	Visualization of Aircraft Types (Passenger, Fighter, Cargo Aircraft) in VR
2.	Study of Aircraft Control Surfaces Using AR
3.	Virtual Study of Aircraft Engines (Turbojet and Turbofan)
4.	Identification of Aircraft Instruments Using AR
5.	Aircraft Stability and Control Demonstration
6.	Basic Flight Simulation: Take-off, Cruise and Landing
7.	Study of Aircraft Cockpit Instruments and Avionics
8.	Aircraft Navigation Using GPS, VOR and ILS Simulation
9.	Jet Engine Component Visualization and Performance Study
10.	Satellite Orbit Visualization and Mission Simulation

11.	Airport Layout, Runway and Air Traffic Operations Simulation
12.	Effect of Angle of Attack on Lift and Drag

Open Ended Experiments	
1	Airfoil Performance Optimization Using Simulation
2	Aircraft Stability Analysis Under Different Flight Conditions
3	Flight Path Planning and Fuel Efficiency Assessment
4	Comparative Study of Aircraft Performance
5	Navigation and Landing System Design Challenge
6	Satellite Mission Planning and Orbit Analysis

Course Outcomes: After completing the course, the students will be able to	
CO1	Demonstrate the use of aerospace simulation tools for modeling and visualization of aircraft, propulsion, and space systems.
CO2	Analyze aerodynamic characteristics, flight performance, and stability parameters using simulation software.
CO3	Perform virtual flight operations, navigation, and mission planning through aerospace simulation environments.
CO4	Investigate and interpret simulation results to evaluate the performance of aerospace systems under varying operating conditions.
CO5	Design and execute open-ended simulation studies using modern engineering tools and effectively communicate the findings through technical reports and presentations.

Text Books	
1	Aircraft Performance and Design,John D. Anderson Jr.,1st Edition,I SBN-13: 9780070019713
2	Introduction to Flight,John D. Anderson Jr.,9th Edition, ISBN-13: 978-1260570991

Reference Books	
1	Flight Stability and Automatic Control, Robert C. Nelson,2nd Edition,ISBN-13: 978-0070462182
2	Aircraft Control and Simulation,Brian L. Stevens, Frank L. Lewis, Eric N. Johnson 3rd Edition,ISBN-13: 978-1118870983

Web links and Video Lectures (e – Resources)	
1	https://www.flightgear.org/](https://www.flightgear.org
2	https://www.grc.nasa.gov/www/k-12/airplane/

CO – PO MAPPING

COs /POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	2	3	-	-	-	-	1	-	1	1
CO2	3	3	2	3	3	-	-	-	-	1	-	1	1
CO3	2	3	2	2	3	-	-	-	1	1	-	1	1
CO4	2	3	2	3	3	-	-	-	1	2	-	1	1
CO5	2	3	3	3	3	-	-	-	2	2	1	2	2

Semester: III					
Matlab and Simulink					
Course Code	:	1BASL406C	**Credit**	:	1
Hours/Semester (L:T:P:SL)	:	0:0:28:02	**CIE**	:	50 Marks
Total Hours	:	30	**SEE**	:	50 Marks
Course Type	:	AEC	**SEE Duration**	:	2 Hours

Prerequisites:	
Courses	C, C++
Knowledge on Fundamental Concepts	Mathematics
Knowledge on Connected Tools (If any)	

Course Learning Objectives: This course will enable the students to	
CLO1	Understand MATLAB fundamentals including expressions, data types, operators, arrays, vectors, matrices, and matrix operations for engineering computations.
CLO2	Develop MATLAB scripts and user-defined functions using input-output arguments, different function types, polynomial and recursive functions for solving engineering problems.
CLO3	Analyze and visualize engineering data using MATLAB graphics, including two-dimensional plots, plot customization, multiple plots, and subplot techniques.
CLO4	Implement MATLAB programming concepts such as conditional statements, loops, nested loops, loop control statements, and file handling methods for engineering applications.
CLO5	Apply MATLAB and Simulink tools for modeling, simulation, and analysis of aerospace engineering problems related to aerodynamics, fluid mechanics, and aerothermodynamics.

Experiments	
Sl. No.	**List of problems for which student should Develop Matlab program and execute in the Laboratory**
1.	To perform basic mathematical computations by writing simple MATLAB expressions and using different data types and operators.
2.	To create MATLAB arrays, vectors, and matrices and perform matrix operations using built-in functions.
3.	To determine the properties of matrices and generate matrices by replicating data using MATLAB commands.
4.	To create and customize two-dimensional plots of engineering data using MATLAB plotting commands.
5.	To compare multiple engineering datasets by generating multiple plots and subplot layouts.
6.	To create MATLAB scripts and user-defined function files using appropriate input and output arguments.
7.	To implement different types of functions, including polynomial and recursive functions, for solving engineering problems.
8.	To demonstrate the use of global and persistent variables and identify common errors encountered while using MATLAB functions.
9.	To develop MATLAB programs using conditional statements for decision-making applications.

10.	To implement iterative algorithms using loops, nested loops, and loop control statements (break and continue).
11.	To create MATLAB programs for reading, writing, and processing different external file types.
12.	To model and simulate a dynamic engineering system using Simulink by creating subsystems, utilizing blocksets, and developing a simple graphical user interface.

Open Ended Experiments	
1	To determine lift and drag characteristics of an airfoil using MATLAB.
2	To simulate the variation of thermodynamic properties of an ideal gas using MATLAB.
3	To develop a MATLAB program for determining velocity distribution in laminar flow.
4	To determine variation of pressure, velocity, and Mach number through a convergent or convergent-divergent nozzle.

Course Outcomes: After completing the course, the students will be able to	
CO1	Perform MATLAB-based mathematical computations using expressions, data types, operators, arrays, vectors, matrices, matrix properties, and data replication techniques.
CO2	Create MATLAB scripts and user-defined functions using input-output arguments, different function types, polynomial and recursive functions for solving engineering problems.
CO3	Generate, customize, and interpret two-dimensional graphical representations using MATLAB plotting commands, multiple plots, and subplot techniques.
CO4	Develop MATLAB programs using decision-making statements, looping structures, loop control statements, and file handling methods for engineering applications.
CO5	Develop and simulate aerospace engineering models using MATLAB Simulink and utilize MATLAB programming tools to analyze and interpret problems related to fluid mechanics, aerodynamics, and aerothermodynamics.

Text Books	
1	"Programming in MATLAB: a problem - solving approach", Ram N Patel & Ankush Mittal, Z_Bookswagon, 2018, ISBN-10 9332524815. Chapters:1,2,3,4,5
2	"MATLAB Programming for Engineers", Stephen Chapman, 6th Edition, CL Engineering, 2019, ISBN-10:0357030397. Chapters:1,2,3,4,5

Reference Books	
1	"System Simulation Techniques with MATLAB and Simulink", Dingy Xue & Yang Chen, 1st Edition, Wiley, 2013, ISBN-10: 11 18647920.
2	"Introduction to MATLAB for Engineers", William J. Palm III, 4th Edition, McGraw-Hill Education, 2020, ISBN: 978-1260570798.
3	"Introduction to Simulink with Engineering Applications", Steven T. Karris, Orchard Publications, 2018, ISBN: 978-1934404275.

Web links and Video Lectures (e – Resources)	
1	https://www.youtube.com/watch?v=OHxR8iMHDWw&list=PL7CAABC40B2825C8B
2	https://www.youtube.com/watch?v=iOmqgewj5XI&list=PL484BA2AD3AE4C2D0
3	https://www.youtube.com/@MATLAB?utm_source=chatgpt.com

CO – PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2			3							2	3
CO2	3	3	2		3					1		2	3
CO3	2	3	2	2	3							2	3
CO4	3	3	2	2	3					1		2	3
CO5	3	3	3	3	3					1	2	3	3

Semester: IV						
Smart Manufacturing and Robotics						
Course Code	:	1BASL406D		**Credits**	:	1
Hours/Week(L:T:P)	:	0:0:28:02		**CIE**	:	50 Marks
Total Hours	:	30		**SEE**	:	50 Marks
Course Type	:	AEC		**SEE Duration**	:	2 Hours

Prerequisites:	
Courses	Introduction to Drone Technology
Knowledge on Fundamental Concepts	CAD/CAM
Knowledge on Connected Tools	**Soild Edge**

Course Learning Objectives: This course will enable the students to	
CLO1	**Understand Robotic Fundamentals & Kinematics:** Grasp the core concepts of robotic anatomy, degrees of freedom (DOF), coordinate transformations, forward/inverse kinematics, and actuator/end-effector selection for industrial manipulators.
CLO2	**Comprehend Smart Manufacturing & IIoT Frameworks:** Explore the principles of Cyber-Physical Systems (CPS), Industrial Internet of Things (IIoT), real-time sensor data acquisition, and Digital Twin simulations for automated shop floors.
CLO3	**Develop Trajectory Planning & Motion Control:** Formulate Cartesian and joint-space trajectory algorithms, offline programming routines, and collision-avoidance strategies for automated robotic work cells.
CLO4	**Apply Additive Manufacturing & Machine Vision:** Study 3D printing techniques, AI-driven machine vision systems for automated quality inspection, and the integration of Collaborative Robots (Cobots) and Autonomous Mobile Robots (AMRs).
CLO5	**Master CNC Programming & Modern Field Robotics:** Write manual and computer-assisted G-code and M-code programs for CNC machining operations, and evaluate specialized field robotics (UAVs, space manipulators, swarm robotics) in aerospace manufacturing.

Module – 1	**8 Hrs**
Fundamentals of Industrial Robotics & Spatial Kinematics **Robotic Anatomy & Architecture:** Degrees of Freedom (DOF), arm configurations (Cartesian, Cylindrical, Spherical, Articulated/Jointed-arm, SCARA, Delta). **Kinematic Modeling:** Introduction to Forward and Inverse Kinematics, Denavit-Hartenberg (D-H) parameters, and transformation matrices. **Actuators & End Effectors:** Electric (Servo/Stepper), Pneumatic, and Hydraulic drives; Mechanical, Vacuum, Magnetic grippers, and specialized end-effectors for aerospace assembly (e.g., automated riveting and drilling heads).	
Module – 2	**8 Hrs**
Smart Manufacturing & Industry 4.0 Integration **Concepts of Smart Manufacturing:** Principles of Cyber-Physical Systems (CPS), Industrial Internet of Things (IIoT), and cloud-connected factory floors. **Sensors & Data Acquisition:** Vibration, ultrasonic, tactile, and thermal sensor integration for real-time machine health and predictive maintenance. **Digital Twins & Simulation:** Modeling physical aerospace manufacturing lines, robotic cells, and workflow simulations using tools like RoboDK, Gazebo, or ROS.	

Module-3	8 Hrs

Robotic Path Planning & Simulation

Motion & Trajectory Planning: Joint-space and Cartesian-space trajectory generation (cubic and polynomial path planning).

Robotic Offline Programming (OLP): Simulation of automated pick-and-place, arc/spot welding, laser cutting, and composite material layup.
Collision Avoidance: Obstacle detection and real-time path correction algorithms in automated work cells.

Module-4	8 Hrs

Additive Manufacturing & Automated Quality Inspection

3D Printing in Robotics: Prototyping lightweight robotic components, end-effectors, and aerospace brackets using FDM, SLA, and Metal Additive Manufacturing.
Machine Vision Systems: Image processing, edge detection, and AI-assisted defect detection for precision aerospace component inspection.
Cobots & Autonomous Material Handling: Use of Collaborative Robots (Cobots), Automated Guided Vehicles (AGVs), and Autonomous Mobile Robots (AMRs) in aerospace hangar and factory transport.

Module-5	8 Hrs

CNC Programming, Machining and Advanced Robotic Applications

CAD/CAM Fundamentals: Principles of Computer-Aided Design (CAD) and Computer-Aided Manufacturing (CAM) integration in modern smart factories.
Material Handling: Automated pick-and-place operations, palletizing, and depalletizing in manufacturing lines.
Machine Tending & Assembly: Automated loading and unloading of CNC machines, robotic arc/spot welding, riveting, and component assembly.
Computer Integrated Manufacturing (CIM): Role of industrial manipulators and automated work cells in CIM and flexible manufacturing systems (FMS).

Course Outcomes: After completing the course, the students will be able to	
CO1	**Explain** the fundamental configuration, degrees of freedom (DOF), kinematic parameters, and actuator mechanisms of industrial robotic manipulators.
CO2	**Apply** principles of Cyber-Physical Systems (CPS), IIoT sensor architecture, and digital twin simulations to enable real-time process monitoring in smart factory environments
CO3	**Analyze** trajectory generation algorithms and path planning techniques in joint and Cartesian spaces for collision-free robotic operations.
CO4	**Evaluate** the implementation of additive manufacturing, AI-based machine vision systems, and collaborative robots (Cobots/AMRs) for quality inspection and component assembly.
CO5	**Develop** manual G-code and M-code programs for CNC machining and **assess** specialized field robotics (UAVs, space manipulators, swarm platforms) for aerospace applications.

Text Books	
1	Mikell P. Groover et. al., "Industrial Robots - Technology, Programming andApplications", McGraw Hill, Special Edition, (2012).
2	**Manufacturing & Smart Systems:** Manufacturing Engineering and Technology – Serope Kalpakjian & Steven R. Schmid.
3	**Industry 4.0:** Smart Manufacturing: Technologies and Applications – Anthony Tarantino.

Reference Books	
1	Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering – AnIntegrated Approach", Eastern Economy Edition, Prentice Hall of India Pvt. Ltd., 2006.
2	**Logical Reasoning and Data Interpretation for the CAT**, Nishit K. Sinha, 7th Edition, Pearson Education -2020, (ISBN: 978-9353946616)

Web links and Video Lectures (e –Resources)	
1	https://nptel.ac.in/courses/112108093
2	https://onlinecourses.nptel.ac.in/e-learning
3	https://elearning.vtu.ac.in/
4	https://www.vlab.co.in/

CO – PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	1		2				1	2	1	1	1
CO2	3	2	2		2					2	2	2	2
CO3	3	3	2	1	1					1	2	2	3
CO4	3	2	3	1	2					1	1	2	2
CO5	3	2	3	2	3					2	2	2	2

Semester: IV					
Programme Specific Biology (ME and CV Streams)					
Course Code	:	1BAS407	**Credit**	:	1
Hours/Semester (L:T:P:SL)	:	14:0:0:16	**CIE**	:	50 Marks
Total Hours	:	30	**SEE**	:	50 Marks
Course Type	:	BSC	**SEE Duration**	:	1 Hour

Prerequisites:	
Courses	Biology and Chemistry
Knowledge on Fundamental Concepts	-
Knowledge on Connected Tools (If any)	NA

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the structure and functions of cells, biomolecules, stem cells, enzymes, vitamins, and hormones, and their significance in engineering.
CLO2	Relate human organ systems to engineered devices such as prosthetics, bionic eyes, pacemakers, ventilators, and dialysis systems.
CLO3	Understand bio-inspired designs and emerging bioengineering technologies, including tissue engineering, bioprinting, self-healing materials, and bioremediation.

Module – 1	**05 Hrs**
Fundamentals of Biology and Biomolecules - Cell structure and functions, Plant and Animal cells, Prokaryotic and Eukaryotic cells, Stem cells and applications, Biomolecules: Carbohydrates, Proteins, Lipids and Nucleic acids, Enzymes, Vitamins and Hormones.	
Module – 2	**05 Hrs**
Human Organ Systems and Engineering Designs - Brain as CPU and prosthetic devices, Eye as camera and bionic eye, Heart as pump: ECG, pacemakers and stents, Lungs as purification system: Ventilators and spirometer, Kidney as filtration system: Dialysis technologies. G-Forces, Effects of Positive and Negative G-forces, Microgravity Effects on Bones, Muscles and Blood Circulation.	
Module – 3	**04 Hrs**
Nature-Inspired Engineering and Bioengineering Trends - Echolocation and Sonar, Photosynthesis and Solar Cells, Lotus Leaf Effect and Self-cleaning Surfaces, Bird Flight and Aircraft Design, Velcro inspired by Plant Burrs, Kingfisher Beak and Bullet Train Design, Tissue Engineering and Bio printing, Self-healing Bio concrete and Bioremediation. Applications of Bio mimic in UAVs and Modern Aircraft.	

Topics for Self-learning	
Module – 1	Stem Cells and Their Applications in Regenerative Medicine
	Role of Biomolecules in Healthcare and Industrial Applications
Module – 2	Prosthetic Devices and Recent Advances in Bionic Organs
	Bionic Eye and Advanced Vision Restoration Technologies
Module – 3	Tissue Engineering and Bio printing
	Self-Healing Bio concrete

Course Outcomes: After completing the course, the students will be able to	
CO1	Interpret the fundamental concepts of biology, biomolecules, and their engineering applications.
CO2	Relate the structure and functions of human organ systems to biomedical devices and engineering solutions.
CO3	Apply bio-inspired principles and discuss emerging bioengineering technologies for sustainable and innovative engineering applications.

Text Books	
1	**Biology for Engineers** – Rajendra Singh C. and Rathnakar Rao N., Rajendra Singh C and Rathnakar Rao N Publishing, Bengaluru, 2023.
2	**Biology for Engineers** – S. Thyagarajan, N. Selvamurugan, M.P. Rajesh, R.A. Nazeer, W. Thilagaraj, S. Barathi and M.K. Jaganathan, Tata McGraw-Hill Education, New Delhi, 2012.

Reference Books	
1	**Biology for Engineers** – Arthur T. Johnson, CRC Press, Taylor & Francis Group, 2011.
2	**Biomimetics: Nature-Based Innovation** – Yoseph Bar-Cohen, CRC Press, 2012.

Web links and Video Lectures (e – Resources)	
1	https://nptel.ac.in/courses/121106008?utm_source=chatgpt.com
2	https://ocw.mit.edu/courses/20-020-introduction-to-biological-engineering-design-spring-2009/?utm_source=chatgpt.com
3	https://onlinecourses.nptel.ac.in/noc22_bt18/preview?utm_source=chatgpt.com

CO – PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	**3**				**1**	**2**					**1**
CO2	**3**				**3**	**3**	**2**				**2**
CO3	**3**				**3**	**3**					**3**

Semester: IV					
Environmental Science Project					
Course Code	:	1BEP408	**Credit**	:	1
Hours/Semester (L:T:P:SL)	:	0:0:0:30	**CIE**	:	50 Marks
Total Hours	:	30	**SEE**	:	50 Marks
Course Type	:	SDC	**SEE Duration**	:	2 Hours

Course Learning Objectives: This course will enable the students to	
CLO1	Understand complex, real-world environmental issues, including climate change, biodiversity loss, and pollution dynamics.
CLO2	Apply scientific, technological, and engineering principles to analyze structural environmental problems.
CLO3	Train in field-based methodologies, including site surveys, environmental auditing, and data collection protocols.
CLO4	Instill critical thinking and interdisciplinary problem-solving skills required to design sustainable, preventive, or remedial solutions.
CLO5	Develop professional competencies in teamwork, collaborative project management, and effective communication of environmental findings.

Restrictions and professional conduct:
Environmental Science Projects should be academic, socially responsible, technically focused, and politically neutral. Students and faculty must maintain professionalism, ethical conduct, and respect while working with communities and stakeholders, and avoid any political, ideological, commercial, or disruptive activities. Projects should also consider practical constraints such as cost, resources, safety, environmental impact, and stakeholder cooperation.

Methods for project identification:
Students may identify the project topic using one or more of the following methods: interaction with local rural or urban stakeholders such as local leaders, corporation/municipality personnel, NGOs, panchayat representatives, etc.; review of issues highlighted in print and electronic media, and social networks; and, after selecting a broad topic, collect data, conduct a feasibility survey, estimate timelines and resources, approximate expenditure, and define the problem statement and objectives clearly.

List of Project Topics and Engineering Outcomes:
The following structured sequence of activities is to be carried out during the semester:

Sl. No.	Project title	Measurable engineering outcome	Mapped POs	SDGs
1	Rural and urban water conservation and management systems	Prepare a site-specific water-saving plan, estimate water demand–supply gap, and propose a feasible conservation intervention with quantified savings.	PO1, PO2, PO3, PO4, PO10, PO11	SDG 6, SDG 11, SDG 12
2	Waste management and recycling	Conduct waste audit, classify waste streams, and design a segregation/recycling workflow with measurable reduction in mixed waste.	PO2, PO3, PO4, PO6, PO8, PO10	SDG 11, SDG 12, SDG 13

3	Afforestation	Identify a degraded area, prepare plantation layout, and demonstrate survival-rate tracking and maintenance schedule for saplings.	PO2, PO3, PO4, PO6, PO7, PO11	SDG 11, SDG 13, SDG 15
4	Biogas generation and power generation	Estimate organic waste availability, size a small biogas system, and document expected gas output or energy yield.	PO1, PO2, PO3, PO4, PO5, PO10	SDG 7, SDG 11, SDG 12
5	DPR for solar power rural plant	Prepare a DPR with load assessment, panel sizing, cost estimate, and projected energy generation and payback.	PO1, PO2, PO3, PO4, PO5, PO10	SDG 7, SDG 9, SDG 11
6	DPR for electrification of village/tribal community	Map unserved/underserved households, propose electrification layout, and estimate coverage, losses, and implementation cost.	PO1, PO2, PO3, PO4, PO10, PO11	SDG 7, SDG 9, SDG 10
7	DPR for rural drainage system	Survey drainage bottlenecks, develop a drainage layout, and estimate runoff handling capacity and flood-risk reduction.	PO1, PO2, PO3, PO4, PO6, PO10	SDG 6, SDG 9, SDG 11
8	Sustainability and environmental health projects	Assess local environmental health issues and propose interventions with measurable improvement in hygiene, safety, or resource use.	PO2, PO3, PO4, PO6, PO7, PO8	SDG 3, SDG 6, SDG 11, SDG 12
9	Plastic free campaigns	Measure plastic usage before and after awareness intervention and report percentage reduction or behavioural change.	PO2, PO3, PO6, PO7, PO8, PO10	SDG 11, SDG 12, SDG 13
10	Health and nutrition awareness	Conduct baseline and post-program awareness survey and document improvement in awareness score or adoption of healthier practices.	PO2, PO6, PO7, PO8, PO9, PO10	SDG 2, SDG 3, SDG 11
11	Societal projects involving health wellness	Identify a community health need and develop an awareness/service module with measurable participation and feedback outcomes.	PO2, PO3, PO6, PO8, PO9, PO10	SDG 3, SDG 11, SDG 17
12	Air quality monitoring system	Collect air-quality data, compare with reference limits, and present trends along with possible mitigation suggestions.	PO2, PO3, PO4, PO5, PO6, PO10	SDG 3, SDG 11, SDG 13
13	Plastic waste reduction campaign	Track collection, segregation, and replacement actions, and quantify reduction in plastic waste generation or littering.	PO2, PO3, PO6, PO7, PO8, PO10	SDG 11, SDG 12, SDG 13
		Prepare greening plan, identify	PO2, PO3,	SDG 11,

14	Urban greening projects	planting locations, and assess environmental benefits such as shade, aesthetics, or heat mitigation.	PO4, PO6, PO7, PO11	SDG 13, SDG 15
15	Smart agriculture solution	Design a low-cost monitoring or irrigation support solution and estimate improvement in water use efficiency or crop support.	PO1, PO2, PO3, PO4, PO5, PO10	SDG 2, SDG 6, SDG 9
16	Smart irrigation system	Estimate crop water requirement, propose control logic, and quantify water savings compared with conventional irrigation.	PO1, PO2, PO3, PO4, PO5, PO10	SDG 2, SDG 6, SDG 12
17	Food security initiatives / cold storage system	Estimate storage need, design a simple cold-chain concept, and document reduction in spoilage or wastage.	PO1, PO2, PO3, PO4, PO5, PO10	SDG 2, SDG 9, SDG 12

Suggested Learning Resources

Textbooks

1. Benny Joseph, Environmental Studies, Tata McGraw-Hill, 2nd Edition.
2. R. Rajagopalan, Environmental Studies: From Crisis to Cure, Oxford University Press, 2005.
3. Erach Bharucha, Textbook of Environmental Studies, University Press, latest edition as available in library.
4. M. P. Poonia and S. C. Sharma, Environmental Studies, Vikas Publishing House, latest edition as available Garg, N. R., *Project-Based Learning in Engineering Education*, Pearson India Education Services, Noida.

Reference books

1. R. Sivakumar, Principles of Environmental Science and Engineering, Cengage Learning, 2nd Edition.
2. G. Tyler Miller Jr., Environmental Science: Working with the Earth, Thomson Brooks/Cole, 11th Edition.
3. Pratibha Singh, Anoop Singh, and Piyush Malaviya, Text Book of Environmental and Ecology, Acme Learnin 1st Edition.
4. S. M. Prakash, Environmental Studies, Elite Publishing House, Mangalore, 3rd Edition, 2018.

Teaching Learning Process:

The suggested TLP for Community / Societal Project is as follows;

Week	**Teaching–Learning Activity**	**Faculty Role**	**Student Activity**	**Output / Evidence**
1	Course introduction, objectives, ethics, conduct, and assessment briefing	Explain course scope, rules, rubrics, and expected deliverables	Understand course requirements and form teams	Team list, course plan
2	Community problem identification and topic selection	Guide topic framing and feasibility	Identify local issues through discussion and observation	Shortlisted project topic

3	Stakeholder interaction and preliminary survey	Demonstrate survey methods and stakeholder engagement	Collect initial data from community/users	Survey notes, interview record
4	Problem statement and objective formulation	Review and refine problem statement	Prepare problem statement, scope, and objectives	Approved problem statement
5	Literature/case study review and baseline analysis	Suggest relevant references and examples	Study existing solutions and compare approaches	Baseline analysis summary
6	Project planning and role assignment	Help teams organize tasks, timeline, and responsibilities	Plan activities, divide roles, and prepare schedule	Work plan / Gantt chart
7	Feasibility analysis and solution brainstorming	Check technical feasibility and practicality	Generate possible engineering solutions	Solution alternatives sheet
8	Selection of final solution and design approach	Review final concept and design logic	Finalize concept, methods, and expected outcome	Concept note / design outline
9	Data processing / calculations / sizing / mapping	Support computations and technical review	Analyze data, perform calculations, prepare maps/charts	Technical analysis sheet
10	Prototype / model / audit / DPR / app development	Monitor progress and correct technical issues	Develop the selected output	Working model / draft DPR / map / app
11	Testing, refinement, and implementation planning	Evaluate technical correctness and improvements	Test prototype or validate proposal with users	Test results / revised output
12	Field implementation / demonstration / awareness activity	Facilitate community interaction and documentation	Conduct implementation or demonstration	Photos, attendance, implementation record
13	Documentation of outcomes, feedback, and impact	Review report structure and completeness	Compile findings, stakeholder feedback, and observations	Draft report
14	Presentation preparation and viva practice	Conduct mock presentation and feedback	Prepare slides/poster and rehearse	Presentation deck
15	Final presentation, submission, and reflection	Evaluate performance using	Present project, submit report, reflect on learning	Final report, presentation, viva

		rubrics		

Assessment structure:

A. Continuous Internal Evaluation (CIE) – 50 marks

- Students, in batches of 3–4, shall undertake at least one project (or a combination of two related activities) aiming, as far as possible, at a logical implemented or implementable outcome.
- CIE will be conducted by a departmental committee (HoD/nominee, guide and one senior faculty) using the following rubrics totaling 50 marks:

CIE pass requirement:

- A student shall secure a minimum of 20 marks out of 50 in CIE to become eligible to appear for SEE.
- Students who fail to earn the required CIE marks may be given additional opportunities before closure of the semester; no re-doing of CIE is permitted after the end of the semester.

B. Semester End Examination (SEE) – 100 marks (scaled to 50)

- Examination duration: 2 hours.
- Maximum examination marks: 100 (scaled to 50).
- The SEE shall be conducted batch-wise by two examiners, one faculty from the same department and one from a different department appointed by the Principal.

SEE pass requirement and overall passing rule:

- For a pass in SEE, a student shall secure minimum 35 marks out of 100.
- For declaration of a pass grade, the sum of CIE marks (out of 50) and scaled SEE marks (out of 50) shall be ≥ 40; otherwise, the student is awarded grade F (Fail).

CIE Rubric — Continuous Internal Evaluation (Total 50 marks):

Criterion	**Weight (marks)**	**Excellent (Full marks)**	**Good**	**Fair**	**Needs Improvement**
Problem identification & relevance to society/environment	8	Problem clearly identified with strong evidence of relevance and well-defined scope.	Relevant problem with clear scope and adequate evidence.	Problem defined but justification is weak.	Problem unclear or not relevant.
Formation of problem statement; engineering approach, innovation & feasibility	10	Precise statement; sound, innovative, feasible approach.	Adequate statement; feasible with minor gaps.	Partial statement; marginal feasibility.	Missing or infeasible.
Interaction with stakeholders; data collection, analysis & interpretation	8	Thorough engagement; comprehensive data and well-interpreted analysis.	Good engagement; adequate data and analysis.	Limited engagement; incomplete data and superficial analysis.	Little or no stakeholder contact; no data/analysis.
Project documentation;		Complete, well-	Complete and clear	Basic with omissions;	Missing/ poorly organized;

clarity, organization & problem-solving demonstrated	10	organized, analytical, and strong problem-solving.	with some analytical content.	problem-solving limited.	no clear problem-solving.
Communication & presentation skills	6	Confident, structured, and answers queries fully; visuals effective.	Clear and satisfactory; responds to most queries.	Acceptable but lacks clarity or confidence; weak responses.	Poor or absent; unable to respond.
Contribution & benefit to society (impact, sustainability)	8	Clear, demonstrable societal benefit and realistic sustainability path.	Benefit plausible; sustainability considered with minor gaps.	Limited or unclear benefit; sustainability weak.	No evident benefit or sustainability.

SEE Rubric — Semester End Examination (Will be conducted for 100 marks; later scaled to 50 marks):

Criterion	Weight (marks)	Excellent (Full marks)	Good	Fair	Needs Improvement
Problem identification & relevance to society/ Environment	16	Clearly articulated with strong evidence and context.	Clear with reasonable evidence.	Problem stated but evidence/context weak.	Poorly defined or irrelevant.
Formation of problem statement; engineering approach, innovation & feasibility	20	Precise; demonstrates engineering depth, novelty and feasibility.	Technically sound and feasible with minor limitations.	Basic; limited technical depth or feasibility concerns.	No viable engineering approach or infeasible plan.
Interaction with stakeholders; data collection, analysis & interpretation	16	Excellent engagement; rigorous data collection and insightful analysis.	Good engagement and acceptable analysis.	Superficial data collection and limited analysis.	Inadequate or no data; poor analysis.
Project documentation; clarity, technical rigor & problem-solving demonstrated	20	Comprehensive, technically rigorous, and systematic.	Complete and technically correct with minor gaps.	Lacks technical depth or has notable omissions.	Missing key elements or technically incorrect.
Communication, presentation & viva-voce responses	12	Presents expertly, defends work persuasively and answers all queries	Good presentation and satisfactory answers to most queries.	Adequate but fails to answer some technical questions.	Poor presentation and unable to defend work.

		correctly.			
Contribution & benefit to society; impact assessment & sustainability	16	Clear, evidence-based impact assessment with scaling recommendations.	Reasonable impact discussion and sustainability considerations.	Limited evaluation of impact or sustainability.	No coherent assessment of impact or sustainability.

Course Outcomes: After completing the course, the students will be able to	
CO1	Identify and analyse environmental problems through field interaction and technical assessment.
CO2	Develop skills in project planning, field survey, data collection, implementation, documentation, teamwork and communication.
CO3	Formulate feasible environmental problem statements and solutions considering practical constraints and sustainability aspects.
CO4	Apply principles of environmental responsibility, ethics and societal welfare in engineering practice through community-oriented interventions.
CO5	Exhibit multidisciplinary learning and problem-solving ability based on collected data, user feedback and baseline conditions.

CO – PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	2	3		3	1	2	2				
CO2				2	2				3	3	3
CO3	2	2	3			2	3				1
CO4						3	3	3			
CO5	2	3	2	2		2	2		2		

Semester: IV						
Metaphysical Science **Streams: CSE/ECE/CV/ME**						
Course Code	**:**	1BMP409		**Credits**	**:**	1
Hours/Week(L:T:P:SL)	**:**	14:0:0:16		**CIE**	**:**	50 Marks
Total Hours	**:**	30 Hrs		**SEE**	**:**	50 Marks
Course Type	**:**	HSSMC		**SEE Duration**	**:**	1 Hr.

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the basic concepts of metaphysics, ontology, and epistemology.
CLO2	Explain metaphysical perspectives on the universe, mind, and consciousness.
CLO3	Explore the relationship between quantum metaphysics, healing and modern science.

Module 1	**05 Hrs**
Foundations of Metaphysics, Ontology and Epistemology **Introduction to Metaphysics:** Definition, scope and historical roots (Aristotle, Plato, Kant). Distinction between Metaphysics, Physics and Spirituality. **Branches of Metaphysics:** Ontology, Cosmology and Epistemology. **Fundamental metaphysical questions:** Reality, existence, abstract entities, morality. **Ontology (Study of Being):** Materialism, Idealism and Dualism, Problem of Universals: Realism vs. Nominalism **Epistemology (Study of Knowledge):** Rationalism (Descartes) and Empiricism (Locke, Hume), Theories of Truth: Correspondence, Coherence and Pragmatic, Skepticism and Constructivism, Simulation Theory and Descartes' Evil Demon **Textbook2, Ch.1-5**	
Module 2	**05 Hrs**
Cosmology, Mind and Consciousness **Metaphysical Cosmology:** Philosophical and Physical Cosmology, Time, Space and Origin of the Universe, Anthropic Principle and Fine-Tuning Debate, Creation, Causality and Infinite Regress, Multiverse Theory and its Metaphysical Implications, Ancient Cosmologies: Vedic, Taoist and Indigenous Perspectives. **Mind and Consciousness:** Nature of Mind and Consciousness, Mind-Body Problem: Dualism vs. Physicalism, Theories of Consciousness: Integrated Information Theory (IIT), Global Workspace Theory and Panpsychism, Eastern and Western Perspectives on Self and Consciousness, Artificial Intelligence and Machine Consciousness, Role of Consciousness in Observation and Decision Making **Textbook1, Ch.1-2, Textbook2, Ch.6-8**	
Module 3	**05 Hrs**
Quantum Metaphysics, Healing and Engineering Perspectives Basics of quantum mechanics (superposition, entanglement, observer effect), Quantum Theory and Consciousness, Quantum Healing: Deepak Chopra's Model, Biofield Theory, Chakras and Subtle Energy Systems, Placebo Effect, Intention and Non-local Healing,	

Applications and Engineering Perspectives of Bio-resonant Technologies, Scientific evidence, limitations and ethical considerations in Quantum Healing. **Textbook1, Ch. 3-15**

Topics for Self-learning	
Module – 1	• Indian Perspectives on Metaphysics (Advaita Vedanta, Buddhism and Jainism) • Philosophy of science and scientific realism
Module – 2	• Consciousness in meditation and mindfulness practices • AI ethics and machine consciousness • Latest developments in neuroscience and consciousness research
Module – 3	• Emerging biofeedback and wearable health technologies • Engineering applications of meditation and neurotechnology

Course Outcomes: After completing the course, the students will be able to	
CO1	Interpret the fundamental concepts of metaphysics, ontology and epistemology in understanding reality and existence.
CO2	Analyze metaphysical perspectives on cosmology, consciousness and the nature of the universe.
CO3	Evaluate the relationship between quantum theory, consciousness, healing practices and their relevance to emerging engineering applications.

Text Books	
1	Quantum Metaphysics, Tarja Kallio-Tamminen, ISBN 952-10-1927-1 Otamedia, Oy 2004.
2	Metaphysics-A Very Short Introduction, Stephen Mumford, Sl. No. 20129780191640261, 0191640263, OUP Oxford, 2012

Reference Books	
1	Deepak Chopra M.D., Quantum Healing (Revised and Updated): Exploring the Frontiers of Mind/Body Medicine, 2015.
2	Deepak Chopra M.D., Quantum Body: The New Science of Living a Longer, Healthier, More Vital Life, 2023.

Weblinks	
1	https://www.yogajournal.com/meditation/
2	https://youtube.com/shorts/JgCVh6wwgNg?si=R87-PGIrUSII774w
3	https://www.youtube.com/watch?v=XvyuUqlX7fE
4	https://core.ac.uk/download/pdf/14914967.pdf
5	https://www.youtube.com/watch?v=_ba0yIAZ9ok
6	https://www.youtube.com/watch?app=desktop&v=fzxohf49loU
7	https://www.youtube.com/watch?v=SSGKowtXS3Y
8	https://www.youtube.com/watch?v=r_piRatnFlY

CO–PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2				2		2	1		3
CO2	2	3				2		2	1		3
CO3	2	2				2	2	2	1		3

Semester: IV					
NATIONAL SERVICE SCHEME (Common to the Branches)					
Course Code	**:**	**1BNS410**	**Credit**	**:**	0
Hours/Semester (L:T:P:SL)	**:**	0:0:0:28	**CIE**	**:**	100 Marks
Total Hours	**:**	28	**SEE**	**:**	-
Course Type	**:**	NCMC	**SEE Duration**	**:**	-

Prerequisites:	
Courses	**---**
Knowledge on Fundamental Concepts	Basic understanding of social responsibility, environmental awareness, community welfare, sustainable development, ethics, teamwork, and communication skills.
Knowledge on Connected Tools (If any)	Basic use of smartphones, internet, digital communication tools (email, WhatsApp, Google Forms), presentation software (PowerPoint/Canva), video recording tools, and office productivity software (MS Word/Google Docs) for documentation and report preparation.

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the community, identify its needs and problems, and apply knowledge to develop practical solutions for sustainable community development and welfare.
CLO2	Develop social and civic responsibility, leadership, teamwork, communication, and community participation skills through collaborative and service-oriented activities.
CLO3	Demonstrate ethical values, democratic attitudes, effective group-living skills, and responsible citizenship while contributing to social service and community development.

Activity– 1	**10 Hrs**
Environmental Sustainability: Plantation and adoption of plants (Know Your Plants), water conservation techniques, role of stakeholders, and implementation of sustainable environmental practices.	
Activity – 2	**09 Hrs**
Community Development and Rural Entrepreneurship: Organize National Integration and Social Harmony programs (minimum two), prepare actionable business proposals to enhance village income, and support community-based development initiatives.	
Activity – 3	**09 Hrs**
Educational and Social Welfare Initiatives: Government school rejuvenation, improving infrastructure, enhancing student academic performance and enrolment in higher/technical/vocational education through awareness and mentoring activities.	

Topics for Self learning	
Activity – 1	Plantation, biodiversity conservation, and sustainable water management practices.
	Climate change, environmental protection, and the role of citizens in

	conservation.
Activity– 2	National integration, social harmony, and community leadership.
	Rural entrepreneurship, village development, and government support schemes.
Activity – 3	School development, educational awareness, and mentoring for higher education.
	Social responsibility, volunteerism, and community engagement for sustainable development.

Pedagogy – Guidelines, it may differ depending on local resources available for the study as well as environment and climatic differences, location and time of execution

Sl. No.	Topic	Group Size	Location	Activity Execution	Reporting	Evaluation of the Topic
1.	Water conservation techniques – Role of different stakeholders– Implementation.	May be individual al or team	Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus etc.....	Site selection /proper consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by NSS officer
2.	Preparing an actionable business proposal for enhancing the village income and approach for implementation.	May be individual al or team	Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus etc.....	Group selection /proper consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by NSS officer
3.	Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education.	May be individual or team	Local government / private/ aided schools/Government Schemes officers/ etc.....	School selection/proper consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by NSS officer

Plan of Action (Execution of Activities for 4th Semester)

Sl. No.	Practice Session Description
1.	Lecture session by NSS Officer
2.	Selection of topic, Commencement of activity and its progress
3.	Execution of Activity
4.	Case study based Assessment, Individual performance
5.	Sector wise study and its consolidation
6.	Video based seminar for 10 minutes by each student At the end of semester with Report.

- In the 4th semester, each student should do activities according to the scheme and syllabus.
- At the end of the semester student performance has to be evaluated by the NSS Officer for the assigned activity progress and its completion.
- At the end of the 4th semester, consolidated report of all activities compiled report should be submitted as per the instructions.

Course Outcomes: After completing the course, the students will be able to	
CO1	Analyze environmental and societal issues and propose practical, sustainable solutions by demonstrating social responsibility and civic awareness.
CO2	Evaluate and implement government and community-driven initiatives to address societal challenges and promote community development and welfare.
CO3	Demonstrate ethical values, teamwork, leadership, effective communication, and civic responsibility while participating in social service and community engagement activities.

Assessment Details for CIE (100 Marks)

Weightage	**CIE- 100 Marks**
Selection of Topic, Commencement of activity and its progress	**40 Marks**
Case study based Assessment	**20 Marks**
Sector wise study and its consolidation	**20 Marks**
Video based seminar for 10 minutes by each student at the end of semester with Report	**20 Marks**
Total Marks for the course in each semester	**100 Marks**

Suggested Learning Resources: **Books:**	
1	NSS Course Manual, Published by NSS Cell, VTU Belagavi.
2	Government of Karnataka, NSS cell, activities reports and its manual.
3	Government of India, NSS cell, Activities reports and its manual.

CO – PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1						3	2	2	1		3
CO2						3	3	2	1		3
CO3						3	3	3	1	3	3

Semester: IV						
Physical Education						
Stream: CSE/ECE/ME/CV						
Course Code	:	**BPE410**		**Credits**	:	0
Hours/Week(L:T:P:SL)	:	0:0:0:28		**CIE**	:	**100 Marks**
Total Hours	:	28		**SEE**	:	-
Course Type	:	NCMC		**SEE Duration**	:	-

Course Learning Objectives: This course will enable the students to	
CLO1	Develop an understanding of ethical principles and moral values and their importance in sportsmanship, fair play, and personal conduct in games and athletic activities.
CLO2	Acquire practical skills and demonstrate technical proficiency in selected sports or athletic events through structured physical training and performance.
CLO3	Understand the role of effective organization, administration, and management in the successful conduct of sports events and athletic programs.

Module – 1	**4 Hrs**
Ethics and Moral Values A. Ethics in Sports B. Moral Values in Sports and Games	
Module – 2	**16 Hrs**
Specific Games (Any one to be selected by the student) A. Volleyball – Attack, Block, Service, Upper Hand Pass and Lower hand Pass. B. Athletics (Track Events) – Any event as per availability of Ground	
Module-3	**4 Hrs**
Role of Organization and administration	

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the principles of ethics and moral values and their application in sports and games.
CO2	Demonstrate fundamental skills, techniques and rules of the selected game or athletic event.
CO3	Apply sportsmanship, fairness and respect for rules during practice and competition
CO4	Analyze the role of organization and administration in conducting sports events effectively
CO5	Develop teamwork, leadership and decision-making skills through participation in sports activities

Scheme and Assessment for auditing the course and Grades:

Sl. No.	Activity	Marks
1.	Participation of student in all the modules	20
2.	Quizzes – 2, each of 15 marks	30
3.	Final presentation / exhibition / Participation in competitions/ practical on specific tasks assigned to the students	50
	Total	**100**

CO – PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2						3	3			
CO2	3		2		2		1	2	3		
CO3	2		1				3	3	2		
CO4	2	2				2		2	3		2
CO5	1	2							3		2

Semester: IV					
Yoga **Streams: CSE/ECE/CV/ME**					
Course Code	**:**	1BYO410	**Credit**	**:**	0
Hours/Semester (L:T:P:SL)	**:**	14:0:0:16	**CIE**	**:**	100 Marks
Total Hours	**:**	30	**SEE**	**:**	---
Course Type	**:**	NCMC	**SEE Duration**	**:**	---

Prerequisites:	
Courses	**--**
Knowledge on Fundamental Concepts	• Basic understanding of physical fitness, health and personal hygiene. • Awareness of body posture, breathing, and general wellness practices.
Knowledge on Connected Tools (If any)	**--**

Course Learning Objectives: This course will enable the students to	
CLO1	Explain the philosophy and principles of Patanjali's Ashtanga Yoga for holistic well-being.
CLO2	Demonstrate the correct techniques of Surya Namaskar, Yogasanas, Kriyas, and Pranayama with appropriate safety measures.
CLO3	Practice Yogic techniques to enhance physical fitness, mental wellness, and healthy lifestyle habits.

Module - 1	**04 Hrs**
Foundations of Ashtanga Yoga: Patanjali's Ashtanga Yoga: Introduction, need and importance, Eight Limbs of Yoga – Overview, Yama: Ahimsa, Satya, Asteya, Brahmacharya, Aparigraha, Niyama: Shoucha, Santosha, Tapa, Svaadhyaya, Eshvarapranidhana. **T-1: Ch. 4**	
Module - 2	**05 Hrs**
Surya Namaskar and Yogasanas: Surya Namaskar: Concept, significance, 12-step sequence, breathing coordination, posture alignment, and practice of four rounds, Asanas: Meaning, need, importance, classification, Practice of Sitting, Standing, Prone, and Supine Asanas (Sukhasana, Paschimottanasana, Ardhakati Chakrasana, Parshva Chakrasana, Dhanurasana, Halasana, Karna Peedasana) with techniques, precautions and benefits. **T-1: Ch. 3, 4**	
Module - 3	**05 Hrs**
Kriyas and Pranayama: Kriyas: Introduction to Shatkarmas, Kapalabhati – meaning, importance, technique, precautions, and benefits, Pranayama: Meaning, need, importance, techniques, precautions, and benefits, Types of Pranayama: Suryanuloma–Viloma, Chandranuloma–Viloma, Suryabhedana, Chandrabhedana, Nadishodhana. **T-1: Ch. 5, T-2: Ch. 2**	

Topics for Self learning	
Module – 1	Role of Yama and Niyama in personal and professional ethics
Module – 2	Scientific benefits of Surya Namaskar and Yogasanas in stress management and lifestyle disorders
Module – 3	Advanced Pranayama, Meditation, and Yoga for mental health and holistic wellness

Course Outcomes: After completing the course, the students will be able to	
CO1	Summarize the philosophy, principles, and significance of Patanjali's Ashtanga Yoga and its role in healthy living.
CO2	Demonstrate Surya Namaskar, selected Yogasanas, Kapalabhati and Pranayama using proper techniques and precautions.
CO3	Practice appropriate Yogic techniques to improve physical fitness, mental concentration, emotional balance, and overall wellness.

Text Book	
1	Light on Yoga, B.K.S. Iyengar, HarperCollins Publishers India, 2006, ISBN: 978-81-7223-501-7.
2	Asana Pranayama Mudra Bandha, Swami Satyananda Saraswati, Yoga Publications Trust, Bihar School of Yoga, Munger, 2008, ISBN: 978-81-86336-14-4

Reference Books	
1	Teaching Methods for Yogic practices by Dr. M L Gharote & Dr. S K Ganguly, 4th Edition, Kaivalyadhama Publishers, ISBN-10 : 9788189485245
2	Yoga Instructor Course hand book published by SVYASA University, Bengaluru
3	Raja Yoga, Swami Vivekananda, Advaita Ashrama, Kolkata, 2018, ISBN: 978-81-7505-151-5.

Web links and Video Lectures (e – Resources)	
1	https://www.youtube.com/playlist?list=PLzF4lOyPf_Z9yQ_Gphjh1wZ5fEhMg6hmP
2	https://www.youtube.com/playlist?list=PLOzRYVm0a65cCcY4qKX5MIyJxBt7hJgQY
3	https://youtu.be/KB-TYlgd1wE
4	https://youtu.be/aa-TG0Wg1Ls

CO – PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1						2	2				2
CO2						3	2	1			2
CO3						3	2	2			2

Semester: IV					
Music **Stream: CSE/ECE/ME/CV**					
Course Code	**:**	1BMU409	**Credit**	**:**	0
Hours/Semester (L:T:P:SL)	**:**	14:0:0:16	**CIE**	**:**	100 Marks
Total Hours	**:**	30	**SEE**	**:**	-
Course Type	**:**	NCMC	**SEE Duration**	**:**	-

Prerequisites:	
Courses	Familiarity with school-level cultural or music activities is beneficial
Knowledge on Fundamental Concepts	Basic awareness of vocal music and musical instruments.
Knowledge on Connected Tools (If any)	Metronome or Tala application for rhythm practice. Audio playback device (mobile phone/laptop) for listening to compositions.

Course Learning Objectives: This course will enable the students to	
CLO1	Interpret the contributions of key composers like Purandaradasa, Thyagaraja and Mysore Vasudevacharya to Indian music and understand their musical legacy.
CLO2	Contrast the classification and basic construction of traditional Indian musical instruments, including string, wind, percussion and idiophones, with appropriate examples.
CLO3	Demonstrate basic vocal proficiency through the practice of Sarale Varase exercises, notations for Suladi Sapta Tala in Mayamalavagowla raga and performance of selected compositions such as Geethe, Jathi Swara and Krithi.

Module – 1	**05 Hrs**
Composers Biography and contributions of Purandaradasaru, Thyagarajaru, Mysuru vasudevacharyaru, Kanakadasaru. **T-3** Ch. 2-5	
Module – 2	**05 Hrs**
Music Instruments Classification and construction of string instruments, wind instruments, percussion Instruments, Idiophones (Ghana Vaadya), Examples of each class of instruments. **T-1**,V-4 – Ch. 2-6	
Module – 3	**04 Hrs**
Abhyasa Gana Singing the swara exercises (Sarale Varase Only), Botatio writing for sarale varase andsulafi sapta tala (Only in mayamalavagowla raga), singing 4 geethe in malahari and one jathi swara, oe krithi in a mela raga. **T-1**, V-1&2 **T-2** Ch.2-4	

Topics for Self learning	
Module – 1	Contributions of the trinity of Carnatic music (Thyagaraja, Muthuswami Dikshitar, Syama Sastri)
	Women composers and their contributions to Indian Classical Music
Module – 2	Modern electronic musical instruments used in Indian Music
	Evolution and global influence of traditional Indian musical instruments
Module – 3	Voice culture techniques and vocal health for singers
	Introduction to digital music learning tools (Shruthi Box, Tala Apps, and Online Music Platforms)

Course Outcomes: After completing the course, the students will be able to	
CO1	Comprehend the contributions of composers.
CO2	Classify Indian musical instruments and describe their construction and use.
CO3	Illustrate basic Carnatic vocal skills through selected exercises and compositions.

Text Books	
1	South Indian Music – Vol. I to VI, Prof. P. Sambamoorthy, 2019th Edition,2021. The Indian Music Publishing House, Chennai, ASIN : B093Y3TL52 Chapters:2,3,4,5,6
2	A Textbook of Carnatic Music, Dr. S. Bhagyalekshmy, 4th Edition ,2008,CBH Publications , ISBN 81 85 381 50 Chapters:2,3,4
3	Karnataka Sangeetha Charitre, Dr. V. S. Sampathkumaracharya, Kannada University, Hampi Chapters:2,3,4,5

ReferenceBooks	
1	History of South Indian (Carnatic) Music (From Vedic Times to the Present) , R Rangaramanuja ayyangar ,2019 edition ,Vipanchi charitable trust publisher ISBN: 9788187723158.
2	Music of India, B. Chaitanya Deva, 2nd edition , 1995 Munshiram Manoharlal Publishers. ISBN-10 : 8121501954
3	Essentials of Musicology in South Indian Music, Prof. S. R. Janakiraman, 2013 Edition, Asian Educational Services
Web links and Video Lectures (e – Resources)	
1	https://youtu.be/DZA_cSb0Zo8?si=55M6QAC2T8VqZN39
2	https://www.youtube.com/live/RfM4lAJQgCc?si=xfK0b6exvkBujugr
3	https://youtu.be/DZA_cSb0Zo8?si=55M6QAC2T8VqZN39

CO – PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	1				1	1	1		1		
CO2	2		2		3	1	1	1	1		1
CO3	3			1	2	1	1	1	1		1

Semester: IV					
National Cadet Corps (NCC) – II **(General Awareness – Common Subjects) (Common to all Branches)**					
Course Code	**:**	1BNC410	**Credit**	**:**	0
Hours/Semester (L:T:P:SL)	**:**	14:0:0:16	**CIE**	**:**	100 Marks
Total Hours	**:**	30	**SEE**	**:**	NA
Course Type	**:**	NCMC	**SEE Duration**	**:**	NA

Prerequisites:	
Courses	National Cadet Corps (NCC) – I (1BNC309), if NCC was the option chosen in III Semester
Knowledge on Fundamental Concepts	NCC, National Integration, Disaster Management, Social Awareness
Knowledge on Connected Tools (If any)	-

Course Learning Objectives: This course will enable the students to	
CLO1	Acquire general knowledge of health, hygiene and preventive well-being practices prescribed for NCC cadets
CLO2	Gain awareness of environmental conservation and natural-resource management as taught to NCC cadets
CLO3	Understand the elements of personality development and leadership traits expected of a responsible citizen

Module – 1	**05 Hrs**
Health and Hygiene – General Awareness Structure and Functioning of the Human Body; Hygiene and Sanitation (Personal and Food Hygiene). Physical and Mental Health (general awareness); Infectious and Contagious Diseases and their Prevention. First Aid in Common Medical Emergencies (awareness only); Introduction to Yoga Exercises.	
Module – 2	**05 Hrs**
Environment Awareness and Conservation – General Awareness Natural Resources – Conservation and Management; Water Conservation and Rain Water Harvesting. Waste Management; Pollution Control – Water, Air, Noise and Soil. Energy Conservation; Wildlife Conservation and Projects in India.	
Module – 3	**04 Hrs**
Personality Development and Leadership – General Awareness Introduction to Personality Development; Factors Influencing Personality (Physical, Social, Psychological and Philosophical); Self-Awareness. Interpersonal Relationship and Communication Skills; Leadership Traits and Types of Leadership. Attitude – Assertiveness and Negotiation; Time Management; Stress Management Skills; Interview Skills.	

Topics for Self learning	
Module – 1	Reading on personal hygiene/sanitation practices; a short note on common infectious diseases and their prevention
Module – 2	Short report on a local water-conservation or waste-management initiative; awareness reading on a wildlife conservation project in India
Module – 3	Preparation of a short self-awareness/communication-skills reflection note; practice of a mock interview with peers

Course Outcomes: After completing the course, the students will be able to	
CO1	Explain the structure and functioning of the human body and describe common health, hygiene and preventive practices
CO2	Describe key concepts of environmental conservation, natural-resource management and pollution control
CO3	Exhibit an understanding of personality development, leadership traits, communication and stress/time-management skills

Text Books	
1	Cadet's Handbook – Common Subjects (SD/SW), Directorate General NCC, Ministry of Defence, Government of India, Edition dated 06 May 2013 (or latest edition).
2	NCC Handbook for 'A', 'B' and 'C' Certificate Examinations, Upkar Prakashan, Latest Edition.

Reference Books	
1	Personality Development and Leadership – A Cadet's Guide, published by DGNCC, Latest Edition.
2	Ministry of Environment, Forest and Climate Change – awareness publications on conservation, Latest Edition.
3	NCC Directorate/Group HQ training literature and circulars, as issued from time to time.

Web links and Video Lectures (e – Resources)	
1	Directorate General National Cadet Corps – https://www.nccindia.gov.in/
2	Ministry of Environment, Forest and Climate Change – https://moef.gov.in

CO – PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1						2		1	1		
CO2						2	3				
CO3								2	3	3	

Semester: IV						
Competency Enhancement Course-2 **Stream: CSE/ECE/ME/CV**						
Course Code	:	1BCE411		**Credits**	:	0
Hours/Week(L:T:P: SL)	:	36:0:0:24		**CIE**	:	100 Marks
Total Hours	:	50		**SEE**	:	-
Course Type	:	NCMC		**SEE Duration**	:	-

Prerequisites:	
Courses	Competency enhancement course-1
Knowledge on Fundamental Concepts	Arithmetic operations, fractions, decimals and elementary algebra. comprehension of basic English
Knowledge on Connected Tools (If any)	NA

Course Learning Objectives: This course will enable the students to	
CLO1	Enhance Quantitative Problem-Solving Skills
CLO2	Master Data Interpretation and Visual Analysis
CLO3	Strengthen Logical Reasoning and Spatial Intelligence
CLO4	Develop Advanced Verbal Aptitude and Communication Accuracy
CLO5	Sharpen Critical Thinking through Assumptions and Analytical Judgement

Module – 1	**6 Hrs**

Data Interpretation

Approach to interpretation - simple arithmetic, rules for comparing fractions, Calculating (approximation) fractions, short cut ways to find the percentages, Classification of data– Tables, Bar graph, line graph, Cumulative bar graph, Pie graph, Combination of graphs. Combination of table and graphs

T-1, C-36

Module – 2	**6 Hrs**

Pipes & Cisterns

Speed, Time, and Distance, Core concepts of speed, time, and distance with formula-based problem-solving techniques. Understanding the relationships between speed, time, and distance, and applying them to real-world scenarios.

Relative Speed

Calculating relative speed in scenarios involving objects moving in the same or opposite directions. Application of relative speed in solving problems on overtaking, crossing, and meeting points.

Average Speed

Techniques for calculating average speed over multiple journeys or varying speeds. Application in mixed-distance and mixed-speed problems.

Problems on Trains

Solving problems involving trains, including crossing stationary and moving objects. Concepts of platform length, tunnel length, and calculating crossing times for accurate results.

Boats and Streams

Understanding upstream and downstream speeds, including the effect of current on boat movement. Solving problems based on effective speed in both still water and flowing water scenarios.

Races

Concepts of time, distance, and lead in competitive races. Analyzing head-starts, leads, and gaps between racers, and calculating who wins and by how much.

T-1, C-14-18

Module-3	**6 Hrs**

Cubes and Dice

Introduction to the properties and visualizations of cubes and dice. Understanding different orientations and views of cubes and dice, including adjacent and opposite faces. Solving problems related to numbering, coloring, and arranging cubes and dice. Techniques to quickly analyze and answer questions on folding/unfolding and rotation. Application in spatial reasoning and enhancing 3D visualization skills.

Puzzles

Developing logical thinking and problem-solving skills through a variety of puzzles. Types of puzzles, including number puzzles, pattern recognition, arrangement, and logical deduction. Strategies for approaching and solving puzzles efficiently. Practice with common puzzle formats found in competitive exams and aptitude tests. Enhancing analytical abilities, critical thinking, and creative problem-solving through diverse puzzle exercises.

Verbal Aptitude

Reading Comprehension

Introduction to Reading Skills, Emphasizing the importance of regular reading for comprehension, vocabulary, and overall verbal aptitude. Understanding how strong reading skills benefit areas beyond comprehension, like analytical thinking and verbal reasoning. Establishing a daily reading habit to improve focus and retention.

Para Jumbles

Techniques for logically ordering jumbled sentences into a coherent paragraph. Understanding linkages between sentences, transitional words, and thematic flow.

Sentence Completion

Strategies for filling in the blanks with appropriate words or phrases. Developing skills to recognize context, tone, and logical flow for accurate sentence completion.

Antonyms/Synonyms

Building a strong vocabulary by mastering antonyms and synonyms. Practice with context-based word selection to improve vocabulary and precision in language.

T-2, C6-9,13-16

Module-4	**6 Hrs**

Verbal Aptitude

Error in Sentences

Identifying common grammatical errors in sentences, including subject-verb agreement, tense consistency, and pronoun usage. Understanding sentence structure and common pitfalls in grammar for error detection.

Sentence Rearrangement

Techniques to rearrange words or phrases to form coherent and grammatically correct sentences. Focus on grammar, context, and logical structure for rearrangement accuracy.

Idioms and Phrases

Understanding and correctly using idioms and phrases in context. Building familiarity with common idioms to enhance comprehension and verbal accuracy.

Verbal Analogies

Solving analogies by identifying the relationships between words or phrases. Developing logical thinking to understand and complete analogy-based questions.

T-1, C28-29

Module-5	**6 Hrs**

Permutation and Combination

Understanding the difference between the permutation and combination, Rules of Counting-rule of addition, rule of multiplication, factorial function, Concept of step arrangement, Permutation of things when some of them are identical, Concept of 2n, Arrangement in a circle.

Probability

Single event probability, multi event probability, independent events and dependent events, mutually exclusive events, non-mutually exclusive events, combination method for finding the outcomes.

Crypt arithmetic

Basic concepts, addition, subtraction, multiplication of coded alphabets, Types of cryptarithm.

Statements and Assumptions

Identifying implicit assumptions within a statement. Developing the ability to read between the lines and recognize underlying premises.

Statements and Conclusions

Analyzing a given statement to derive logical conclusions. Differentiating between valid and invalid inferences based on the provided information.

Cause and Effect

Understanding cause-effect relationships and identifying causation or correlation between events. Analyzing statements to determine whether one event directly influences another.

R-1, C1-6

Topics for Self learning	
Module – 1	Data sufficiency, caselet DI and interpretation of radar/scatter graphs.
Module – 2	Circular track problems, unit conversions and applications in transportation and logistics.
Module – 3	Mirror images, paper folding, advanced puzzles and vocabulary building through reading.
Module – 4	Cloze tests, critical reasoning, workplace vocabulary and commonly confused words.
Module – 5	Set theory, Venn diagrams, conditional probability and decision-making case studies.

Course Outcomes: After completing the course, the students will be able to	
CO1	Apply arithmetic and logical reasoning to solve problems.
CO2	Develop spatial and logical skills to solve cube, dice, puzzle and seating arrangement questions.
CO3	Improve reading, vocabulary, and grammar through para jumbles, sentence completion and idioms.
CO4	Enhance verbal reasoning by solving analogies, rearranging sentences and identifying assumptions and conclusions.
CO5	Apply combinatorics and probability to solve permutation, combination and

	crypt arithmetic problems.

Text Books	
1	**Quantitative Aptitude for Competitive Examinations** by R.S. Aggarwal Chand Publishing. – 2023.
2	**Word Power Made Easy** by Norman Lewis (ISBN- 978-0143424680), , Published by PENGUIN INDIA - 2015
3	**How to Prepare for Quantitative Aptitude for the CAT** by Arun Sharma (ISBN- 978-9339205126), 6th Edition, McGraw-Hill Education - 2014

Reference Books	
1	**Puzzle Test & Seating Arrangements** by K. Kundan (ISBN: 9789394666023),1st Edition, BSC Publishing Company Pvt Ltd. - 2023
2	**A Modern Approach to Verbal & Non-Verbal Reasoning** by R.S. Aggarwal, 2025-26 Edition, S. Chand Publishing -2024

Web links and Video Lectures (e – Resources)	
1	https://youtu.be/KWZ0lR8cCwc
2	https://youtu.be/mBtBD1N7ywQ
3	https://youtu.be/B9MhxmcwnpQ
4	https://youtu.be/VaEbefWFIlc
5	https://youtu.be/3AL_6EQmnkY

CO – PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**2**										**1**
CO2	**2**	**2**										
CO3	**1**	**1**								**3**		
CO4	**2**	**2**								**2**		**1**
CO5	**3**	**3**										**1**

Institute Vision

Preparing Competent Engineering and Management Professionals to Serve the Society

Institute Mission

- Providing Students with a Sound Knowledge in Fundamentals of their branch of Study.
- Promoting Excellence in Teaching, Training, Research and Consultancy.
- Exposing Students to Emerging Frontiers in various domains enabling Continuous Learning.
- Developing Entrepreneurial acumen to venture into Innovative areas.
- Imparting Value based Professional Education with a sense of Social Responsibility.

Department Vision

Building Competent Aerospace Engineers with a blend of Research, Innovation and Entrepreneurship Centre for the Real world

Department Mission

- Imparting knowledge in basic and applied areas of Aerospace Engineering.
- Providing hands on training on state-of-the-art technologies related to Aerospace Engineering.
- Creating a learning atmosphere for higher studies and research blossom both amongst the students and the faculty.
- Developing teamwork, interdisciplinary research, internship and entrepreneur skills through industry-institute interface.
- Inculcating Technical, leadership skills and life-long learning embedded with ethical values and social relevance.

SJC INSTITUTE OF TECHNOLOGY

An Autonomous Institution under VTU from 2024-25

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