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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
(2024 Scheme)

Core Values

Spiritual, Judicious, Commitment, Integrity, Trustworthy



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

SJC INSTITUTE OF TECHNOLOGY, CHIKKABALLAPURA

An Autonomous institution Under VTU from 2024 – 2025

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SCHEME OF TEACHING AND EXAMINATION – B.E. – Aerospace Engineering

(Applicable for students admitted from the Academic Year 2024-25 and onwards)

4th Semester

Aerospace Engineering

Sl. No.	Course Code	Course Title	Course Type	TD/ PSB	Teaching Hours / Week			Examination				
					L	T	P	SEE Duration (Hrs)	CIE Marks	SEE Marks	Total Marks	Credits
1	BAS401	Aerodynamics	PCC	AS	3	0	0	**3**	**50**	**50**	**100**	**3**
2	BAS402	Aircraft Propulsion	IPCC	AS	3	0	2	**3**	**50**	**50**	**100**	**4**
3	BAS403	Mechanics of Materials	IPCC	AS	3	0	2	**3**	**50**	**50**	**100**	**4**
4	BBI404	Biology for Engineers	BSC	CHE	2	0	0	**3**	**50**	**50**	**100**	**2**
5	BASL405	Aerodynamics Lab	PCCL	AS	0	0	2	**3**	**50**	**50**	**100**	**1**
6	BAS406x	ESC/ETC/PLC	ESC	AS	If the course is a Theory: 3	0	0	**3**	**50**	**50**	**100**	**3**
					If the course is a Laboratory: 2	0	2					
7	BUH407	Universal Human Values	UHV	ANY DEPT	1	0	0	**1**	**50**	**50**	**100**	**1**
8	BCS408x	Ability Enhancement Course/Skill Enhancement Course – IV	AEC/ SEC	AS	If the course is a Theory: 1	0	0	**1**	**50**	**50**	**100**	**1**
					If the course is a Laboratory: 0	0	2	**2**				
9	BMP409	Metaphysical Science	HSSMC	ANY DEPT	1	0	0	**1**	**50**	**50**	**100**	**1**
10	BNS410	National Service Scheme (NSS)		NSS	0	0	2	-	**100**	-	**100**	**0**

			NCMC	Coordinator								
	BPE410	Physical Education (PE) (Sports and Athletics)		Physical Education Director								
	BYO410	Yoga		Yoga Teacher								
	BMU410	Music		Music Teacher								
11	BCE411	Competency Enhancement Course-2	NCMC	CDCAC		2		-	**100**	-	**100**	**0**
									650	**450**	**1100**	**20**

ASC: Applied Science Course, PCC: Professional Core Course, IPCC: Integrated Professional Core Course, PCCL: Professional Core Course laboratory, UHV: Universal Human Value Course, NCMC: Non Credit Mandatory Course, AEC: Ability Enhancement Course, SEC: Skill Enhancement Course, ESC: Engineering Science Course, ETC: Emerging Technology Course, PLC: Programming Language Course, L: Lecture, T: Tutorial, P: Practical, CIE: Continuous Internal Evaluation, SEE: Semester End Evaluation.

Engineering Science Course (ESC/ETC/PLC) (Note- Student should opt for the course which should not be similar to the course opted in 1st Year)

Course Code	Course Name	Course Code	Course Name
BAS406A	Aerospace Systems and Instrumentation	BAS406C	Introduction to Space Technology
BAS406B	Aviation Management	BAS406D	Orbital Mechanics

Ability Enhancement Course/Skill Enhancement Course – IV

Course Code	Course Name	Course Code	Course Name
BAS408A	Drone Pilot Training	BAS408C	Matlab & Simulink
BAS408B	Aircraft Safety Rules & Regulations.	BAS408D	Aircrafts Maintenance and Overhaul.

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practicals of the same course. Credit for IPCC can be 04 and its Teaching– Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering (B.E.) 2024-25 may please be referred.

National Service Scheme /Physical Education/Yoga/Music: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), Yoga and Music with the concerned coordinator / teacher of the course during the first week of 3rd semester. Activities shall be carried out between 3rd semester to the 6th semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, Yoga and Music activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.

Semester: IV					
Aerodynamics					
Course Code	:	BAS401	**Credits**	:	3
Hours/Week(L:T:P)	:	3:0:0	**CIE**	:	50 Marks
Total Hours	:	40	**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	Interpret the basics of fluid mechanics for prerequisite to Aerodynamics
CLO2	Acquire knowledge on typical airfoil characteristics and two-dimensional flows over airfoil and study the incompressible over finite wings
CLO3	Apply the conservation laws to compressible flows
CLO4	Learn the characteristics of normal waves.
CL04	Describe the characteristics of oblique shock waves

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 **Text Book 1**: **Ch-2**: **2.3-2.10**	
Module – 2	**08 Hrs**
Two Dimensional Flows & Incompressible Flow Over Airfoil: 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, D-Alembert's paradox, Numerical. **Incompressible Flow Over Airfoils**: Kelvin's circulation theorem and the starting vortex, vortex sheet, Kutta condition, Classical thin airfoil theory for symmetric and cambered airfoils. Numerical. **Text Book 1: Ch-3: 3.9-3.16, Ch-4: 4.5-4.8**	
Module – 3	**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 a complete airplane. **Applications of Finite Wing Theory & High Lift Systems:** Simplified horse-shoe vortex model, formation flight, influence of downwash on tail plane, ground effects. Swept wings: Introduction to sweep effects, swept wings. Introduction to high-lift systems, flaps, leading-edge slats, Critical Mach numbers, Transonic area rule. **Text Book 1**: **Ch-5: 5.1-5.8**	
Module – 4	**08 Hrs**

Normal Shock Waves: Equation of motion for normal shock waves. Normal shock wave relation for perfect gas, Total pressure across the shock. Rankine - Hugonoit equation. Propagation of shock waves (mass-motion velocity), weak shock, reflected shock wave, centered expansion wave, shock tube. Numericals. **Text Book 3: Ch-5: 5.1-5.9**
Module – 5 **08 Hrs**
Oblique Shocks Waves: Oblique shocks and corresponding relations, relationship between β *and* θ. Shock polar & Hodograph plane. Supersonic flow over a wedge, Weak oblique shocks, Prandtl Meyer expansion, Prandtl Meyer function, Supersonic compression and supersonic expansion. Reflection and intersection of shocks and expansion waves. Detached shocks. **Text Book 3: Ch-6: 6.1-6.13**

Course Outcomes: After completing the course, the students will be able to	
CO1	Interpret the governing laws of fluid flow in various flow analyses.
CO2	Compute and analyze the incompressible flow over finite wings
CO3	Apply finite wing theory to design high lift systems from the aerodynamics viewpoint
CO4	Analyze flow properties across the shock wave by Using normal shock relations
CO5	Analyze oblique and expansion waves

Text Books	
1	Fundamental of Aerodynamics, Anderson J.D, 5th edition, 2019 McGraw-Il International Edition, I- ISBN: 13: 978-0073398105
2	Aerodynamics for Engineering Students, E.L. Houghton, P.W. Carpenter, 5th edition, 2010, Elsevier, ISBN-13:978-0080966328
3	Gas Dynamics, Radhakrishnan, E. 7th edition, 2020, Prentice Hall of India. ISBN-978-8896329085

Reference Books	
1	Aerodynamics, Lancy L. J, 5th edition, 2023, Sterling book house, ISBN-13:9780582988804
2	Theoretical Aerodynamics, Thomson, Imported Edition, 2011 Dover Publications, ISBN- 9780486619804.

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

CO-PO-Mapping:

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

Semester: IV					
Aircraft Propulsion					
Course Code	:	BAS402	**Credits**	:	4
Hours/Week(L:T:P)	:	3:0:2	**CIE**	:	50 Marks
Total Hours	:	40 + 10 Hrs	**SEE**	:	50 Marks
Course Type	:	IPCC	**SEE Duration**	:	3 Hours

Prerequisites:	
Courses	Thermodynamics, Fluid Mechanics, Aerodynamics and Mechanics of Machines
Knowledge on Fundamental Concepts	Thermodynamic Cycles, Gas Dynamics, Turbo machinery Basics, Combustion Principles, Thrust Generation
Knowledge on Connected Tools (If any)	

Course Learning Objectives: This course will enable the students to	
CLO 1	Apply principles of gas turbine and ramjet propulsion, incorporating inlet, combustion chamber, and nozzle design.
CLO 2	Investigate compressor and turbine operation within gas turbine propulsion systems.
CLO 3	Implement concepts of rocket propulsion, focusing on compressor and combustion chamber roles.
CLO 4	Interpret velocity triangles and diagrams for compressors, evaluating the influence of operating variables on performance.
CLO 5	Evaluate environmental and societal effects of aircraft propulsion technologies, recommending strategies to reduce negative impacts.

Module – 1	**08 Hrs**
Introduction: Review of thermodynamic principles, Principles of aircraft propulsion, Types of power plants. **Fundamentals of Gas Turbine Engines:** Illustration of working of gas turbine engine, The thrust equation – Factors affecting thrust, Effect of pressure, velocity and temperature changes of air entering compressor – Methods of thrust augmentation – Characteristics of turboprop, turbofan and turbojet – Performance characteristics **Textbook 1: Ch 1-1.1, 1.2, Ch 2- 2.1-2.10**	
Module – 2	**08 Hrs**
Subsonic and Supersonic Inlets for Jet Engines: Internal flow and Stall in subsonic inlets – Boundary layer separation – Major features of external flow near a subsonic inlet – Relation between minimum area ratio and eternal deceleration ratio – Diffuser performance – Supersonic inlets – Starting problem on supersonic inlets – Shock swallowing by area variation – External declaration – Models of inlet operation. **Textbook 1: Ch 13- 13.1 -13.3**	
Module – 3	**08 Hrs**
Compressors: Principle of operation of centrifugal compressor – Work done and pressure rise – Velocity diagrams – Diffuser vane design considerations – Concept of prewire – Rotation stall – Elementary theory of axial flow compressor – Velocity triangles – degree of reaction -Centrifugal and Axial compressor performance characteristics. **Introduction to Turbines**: Types of turbines – Design considerations – Performance parameters - Basics of blade design principles. **Textbook 2: Ch 7- 7.1- 7.10, Ch 9- 9.1- 9.6 and Ch 8- 8.1 -8.8**	
Module – 4	**08 Hrs**
Combustion Chambers: Classification of combustion chambers –Important factors affecting combustion chamber design – Combustion process – Combustion chamber performance –	

Effect of operating variables on performance – Flame tube cooling – Flame stabilization – Use of flame holders – Numerical problems. **Nozzles:** Theory of flow in isentropic nozzles – Convergent / Convergent – divergent nozzles; Nozzle throat conditions – Nozzle efficiency – Losses in nozzles – Over expanded and under – expanded nozzles - Thrust reversal. **Textbook 2: Ch 10-10.1-10.10 and Ch 11- 11.1-11.8**

Module – 5	**08 Hrs**
Ramjet Propulsion: Operating principle – Sub critical, critical and supercritical operation – Combustion in ramjet engine – Ramjet performance – Introduction to scramjet – Preliminary concepts in supersonic combustion. **Textbook 1: Ch 14- 14.1- 14.6**	

Practical Component of IPCC	
Sl. No.	**Experiments**
1	Study of forced convective heat transfer over a flat plate.
2	Determination of heat of combustion of aviation fuel.
3	Measurement of burning velocity of a premixed flame.
4	Combustion performance studies in a jet engine combustion chamber.
5	Study of Free Jet
6	Study of Wall jet
7	Preparation of Propellant
8	Computation of burning rate of the propellant.
9	Estimate the Calorific value of propellant
10	Measurement of Ignition delay of a single propellant with different shapes.
11	Establishing flame stability of pre-mixed flame through flame stability setup.
12	Performance study of Hybrid Motor using a thrust stand and Analysis of grain stress and strain of a solid propellant.

Course Outcomes: After completing the course, the students will be able to	
CO1	Analyze the engineering concepts of air breathing propulsion systems.
CO2	Distinguish the different types of compressors
CO3	Select appropriate propellants for specific aerospace applications
CO4	Describe the velocity triangles and diagrams of compressors and effect of operating variables on performance
CO5	Understand the working principles of gas turbine and ramjet propulsion systems, the design principles of inlets, combustion chambers, nozzles.

Text Books	
1	Gas Turbine, V. Ganesan, 3rd edition, Tata McGraw Hill Pub. Co. Ltd., 2010, ISBN-10: 0070681929, ISBN-13: 978-007-0681927
2	Mechanics and Thermodynamics of Propulsion, 2nd edition, Hill, P.G. & Peterson, C.R. Addison – Wesley Longman INC, 1991, ISBN-10: 0201146592, ISBN-13: 978-0201146592.

Reference Books	
1	Gas Turbine Theory, H. Cohen, G.F.C. Rogers, H.I.H. Saravanamuttoo, updated by Paul Straznicky & Andrew Nix, 7th edition, Pearson Education Limited, ISBN-13: 978-1292093093, ISBN-10: 1292093093
2	Aero thermodynamics of Aircraft Engine Components, Gordon C. Oates, 1st Edition, American Institute of Aeronautics and Astronautics (AIAA) – AIAA Education Series,

	ISBN-13: 978-0915928972, ISBN-10: 0915928973.

Web links and Video Lectures (e – Resources)	
1	https://onlinecourses.nptel.ac.in/noc23_ae08/preview
2	https://nptel.ac.in/courses/101101001

CO-PO-Mapping:

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

Semester: IV					
Mechanics of Materials					
Course Code	:	BAS403	**Credits**	:	4
Hours/Week(L:T:P)	:	3:0:2	**CIE**	:	50 Marks
Total Hours	:	40T + 10P Hrs	**SEE**	:	50 Marks
Course Type	:	IPCC	**SEE Duration**	:	3 Hours

Prerequisites:	
Courses	Engineering Mechanics and Mathematics
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	Basic concepts of strength of materials and determining 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 find deflection of beams and find circumferential and hoop stresses in cylinders.
CLO4	Analyze the concepts of torsion of circular shafts and Columns subjected to forces.
CLO5	Apply Failure theories for different materials and interpret different fatigue, fracture and creep loads.

Module – 1	**08 Hrs**
Basics of linear elasticity: The concept of stress and strain, state of stress and Strain at a point, 3-D Equilibrium equations, The state of plane stress and plane strain. Stress-strain curves for brittle and ductile materials, Allowable stress, and Material selection for structural performance. **Simple and Compound Stresses:** Extension or Shortening of a bar, bars with cross sections varying in steps, bars with continuously varying cross sections. Elongation due to self-weight. Volumetric strain, expression for volumetric strain, elastic constants, simple shear stress, shear strain, temperature stresses, Introduction to Plane stress, stresses on inclined sections, principal stresses and strains, Analytical & graphical method (Mohr's Circle) to find principal stresses and strains. **Textbook 1: Ch 1**	
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 or 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. **Textbook 2: Ch 3**	
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. **Textbook 2: Ch 6**
Module – 4 **08Hrs**
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. **Textbook 2: Ch 7**
Module – 5 **08Hrs**
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) **Fracture:** Type-I, II, III **Creep:** Stages, properties stress relaxation **Fatigue:** types, S-N diagram, mechanism, properties, testing **Textbook 1: Ch 10**

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

Text Books	
1	Mechanics of Materials, Ferdinand Beer & Russell Johnston, 7th Ed,2014, TATA McGraw Hill,ISBN: 978-0073398235
2	Mechanics of Materials, K. V. Rao, G. C. Raju, 1st Edition-2012, Subhash Stores, ISBN: 978-9383214174

Reference Books	
1	Strength of Materials, S. S. Bhavikatti, 4th Ed. 2013, Vikas Publishing House-Pvt. Ltd., ISBN: 978-9325971578
2	A Text book of Strength of Materials, R. K. Bansal,6th edition,2018 Laxmi Publications. ISBN: 978-8131808146.

Web links and Video Lectures (e – Resources)	
1	https://onlinecourses.nptel.ac.in/noc23_me140/preview
2	https://www.youtube.com/watch?v=uA_HqCGo8Pg

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

CO-PO Mapping:

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

Semester: IV						
Biology for Engineers **Stream: CSE/ECE/ME/CV**						
Course Code	:	BBI404		**Credits**	:	2
Hours/Week(L:T:P)	:	3:0:0		**CIE**	:	50 Marks
Total Hours	:	30		**SEE**	:	50 Marks
Course Type	:	BSC		**SEE Duration**	:	3 Hrs

Prerequisites:	
Courses	Biology, Chemistry
Knowledge on Fundamental Concepts	-
Knowledge on Connected Tools	NA

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the fundamental biological structures and biomolecules
CLO2	Analyze the practical applications of biomolecules in biotechnology and daily life.
CLO3	Relate human organ systems to engineered designs and solutions
CLO4	Appreciate bioinspired materials and mechanisms derived from nature
CLO5	Explore emerging trends in bioengineering and biotechnology

Module – 1	**6 Hrs**
Introduction to Biology The cell: the basic unit of life, Structure and functions of a cell. The Plant Cell and animal cell, Prokaryotic and Eukaryotic cell, Stem cells and their application. Biomolecules: Properties and functions of Carbohydrates, Nucleic acids, proteins, lipids. Importance of special biomolecules; Enzymes (Classification (with one example each),Properties and functions), vitamins and hormones. **Textbook 1. Ch.1, Textbook 2, Textbook 3.**	
Module – 2	**6 Hrs**
Biomolecules and Their Applications (Qualitative) Carbohydrates (cellulose-based water filters, PHA and PLA as bioplastics), Nucleic acids (DNA Vaccine for Rabies and RNA vaccines for Covid19, Forensics – DNA fingerprinting), Protein (Proteins as food – whey protein and meat analogs, Plant based proteins), lipids (biodiesel, cleaning agents/detergents), Enzymes (glucose-oxidase in biosensors, lignolytic enzyme in bio-bleaching). **Textbook 1. Ch.5, Textbook 2. Textbook 3. Ch. 5,**	
Module-3	**6 Hrs**
Human Organ Systems and Bio Designs (Qualitative) Brain as a CPU system (architecture, CNS and Peripheral Nervous System, signal transmission, EEG, Robotic arms for prosthetics. Engineering solutions for Parkinson's disease).Eye as a Camera system (architecture of rod and cone cells, optical corrections, cataract, lens materials, bionic eye). Heart as a pump system (architecture, electrical signalling - ECG monitoring and heart related issues, reasons for blockages of blood vessels, design of stents, pace makers, defibrillators). Lungs as purification system (architecture, gas exchang mechanisms, spirometry, abnormal lung physiology - COPD, Ventilators, Heart-lung machine). Kidney as a filtration system (architecture, mechanism of filtration, CKD, dialysis systems). **Textbook 3. Ch.6, Textbook 4.**	
Module-4	**6 Hrs**

Nature-Bioinspired Materials and Mechanisms (Qualitative)

Echolocation (ultrasonography, sonars), Photosynthesis (photovoltaic cells, bionic leaf). Bird flying (GPS and aircrafts), Lotus leaf effect (Super hydrophobic and self-cleaning surfaces), Plant burrs (Velcro), Shark skin (Friction reducing swim suits), Kingfisher beak (Bullet train). Human Blood substitutes - hemoglobin-based oxygen carriers (HBOCs) and per flouro carbon (PFCs).

Textbook 3. Ch. 7, Textbook 4.

Module-5	**6 Hrs**

Trends in Bioengineering (Qualitative)

Muscular and Skeletal Systems as scaffolds (architecture, mechanisms, bioengineering solutions for muscular dystrophy and osteoporosis), scaffolds and tissue engineering, Bioprinting techniques and materials, 3D printing of ear, bone and skin. 3D printed foods. Electrical tongue and electrical nose in food science, DNA origami and Biocomputing, Bioimaging and Artificial Intelligence for disease diagnosis. Selfhealing Bioconcrete (based on bacillus spores, calcium lactate nutrients and biomineralization processes) and Bioremediatio and Biomining via microbial surface adsorption (removal of heavy metals like Lead, Cadmium, Mercury, Arsenic).

Textbook 3. Ch. 8, Textbook 4.

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the structure and function of cells and major biomolecules essential for life processes.
CO2	Describe the applications of biomolecules in healthcare, environment, and biotechnology.
CO3	Elucidate the human organ systems using engineering analogies and identify associated bioengineering interventions.
CO4	Illustrate nature-inspired biological mechanisms and their technological applications i engineering and material science.
CO5	Discuss emerging trends and tools in bioengineering for diagnostics, therapeutics and environmental sustainability.

Text Books	
1	**Biology for Engineers,** Rajendra Singh C and Rathnakar Rao N, Rajendra Singh C and Rathnakar Rao, N Publishing, Bengaluru, 2023.
2	**Human Physiology,** Stuart Fox, Krista Rompolski, McGraw-Hill eBook. 16th Edition, 2022
3	**Biology for Engineers,** Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi S., and Jaganthan M.K., Tata McGraw-Hill, New Delhi, 2012.
4	**Biology for Engineers,** Arthur T. Johnson, CRC Press, Taylor and Francis, 2011

Reference Books	
1	**Biomedical Instrumentation**, Leslie Cromwell, Prentice Hall 2011.
2	**Biology for Engineers,** Sohini Singh and Tanu Allen, Vayu Education of India, New Delhi, 2014.
3	**Biomimetics: Nature-Based Innovation**, Yoseph Bar-Cohen, 1st edition, 2012, CRC Press.

Web links and Video Lectures (e – Resources)	
1	https://nptel.ac.in/courses/121106008
2	https://freevideolectures.com/course/4877/nptel-biology-engineers-other-non-biologists

3	https://ocw.mit.edu/courses/20-020-introduction-to-biological-engineering-design-spring-2009
4	https://ocw.mit.edu/courses/20-010j-introduction-to-bioengineering-be-010j-spring-2006
5	https://www.coursera.org/courses?query=biology
6	https://onlinecourses.nptel.ac.in/noc19_ge31/preview
7	https://www.classcentral.com/subject/biology
8	https://www.futurelearn.com/courses/biology-basic-concepts

CO – PO MAPPING

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

Semester: IV					
Aerodynamics Lab					
Course Code	:	BASL405	**Credits**	:	1
Hours/Week(L:T:P)	:	0:0:2	**CIE**	:	50 Marks
Total Hours	:	15 Hrs	**SEE**	:	50 Marks
Course Type	:	PCCL	**SEE Duration**	:	3 Hours

Prerequisites:	
Courses	Aerodynamics
Knowledge on Fundamental Concepts	Manometers
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.

Sl. No	**Experiment**
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	Tuft flow visualization on a wing model at different angles of incidence at low speeds: identify zones of attached and separated flows.
5	Surface pressure distributions on a two-dimensional circular cylinder at low speeds and calculation of pressure drag.
6	Surface pressure distributions on a two-dimensional symmetric airfoil at zero incidences at low speeds.
7	Surface pressure distributions on a two-dimensional cambered airfoil at different angles of incidence and calculation of lift and pressure drag
8	Calculation of total drag of a two-dimensional circular cylinder at low speeds using pitot-static probe wake survey.
9	Calculation of total drag of a two-dimensional cambered airfoil at low speeds at incidence using pitot-static probe wake survey.
10	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

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**
CO1	3	2	2	2	1						1
CO2	3	2	2	2	2				1		1
CO3	3	2	3	3	1						2
CO4	3	2	3	3	2						2
CO5	3	2	2	3	2						2

Semester: IV					
Aircraft Systems and Instrumentation					
Course Code	:	BAS406A	**Credits**	:	3
Hours/Week(L:T:P)	:	3:0:0	**CIE**	:	50 Marks
Total Hours	:	40 Hrs	**SEE**	:	50 Marks
Course Type	:	ESC	**SEE Duration**	:	3 Hours

Prerequisites:	
Courses	Fluid Mechanics, Thermodynamics
Knowledge on Fundamental Concepts	Flight control systems, Electrical & Electronics Fundamentals
Knowledge on Connected Tools (If any)	-

Course Learning Objectives: This course will enable the students to	
CLO1	Describe the functions and components of various aircraft systems.
CLO2	Understand the working principle of aircraft control systems.
CLO3	Acquire the knowledge of aircraft instruments.
CLO4	Evaluate the performance and effectiveness of various aircraft communication systems.
CLO5	Apply a basic layout of an integrated navigation system using multiple navigational aids to support precise aircraft navigation and landing.

Module – 1	**08 Hrs**
Aircraft Systems Power-plant, undercarriage, hydraulic system, fuel system, environment systems, pressurization system, air-conditioning system, Oxygen system, Fire protection system, Ice protection system, Rain-removal system, Auxiliary power unit. **Test Book 1**: **Ch. 1.1,1.2,1.3,1.4,1.5,1.6 and 1.7**	
Module – 2	**08 Hrs**
Flight Control Systems Mechanical and hydraulic flight control systems. Fly by wire system, Flight control system of Helicopter. Automatic flight control system: Longitudinal, Lateral and Direction Autopilot, Flight Computers. **Test Book 2**: **Ch 2.1,2.2,2.3 and 2.4**	
Module – 3	**08 Hrs**
Display Systems Comparison of earlier flight deck (Electromechanical type instruments) to modern flight deck (glass fight deck), Cathode Ray Tube (CRT), Active-Matrix Liquid Crystal Display (AMLCD), Head Down Display (HDD), Head Up Display (HUD), Helmet Mounted Display (HMD), Integrated Standby Instrument System (ISIS). **Test Book 1**: **Ch 3.1,3.2 and 3.3**	
Module – 4	**08 Hrs**
Communication systems HF, U/VHF, Satellite Communication, Air Traffic Control (ATC) Transponder, Traffic Collision & Avoidance System (TCAS), Identification of Friend & Foe (IFF). **Test Book 2**: **Ch 4.1,4.2**	
Module – 5	**08 Hrs**
Navigation Systems Automatic Direction Finding, Very High Frequency Omni-Range (VOR), Distance Measuring Equipment (DME), Tactical Air Navigation (TACAN), VORTAC (VOR+TACAN), Satellite Navigation System-Global Positioning System (GPS), Differential GPS, Instrument Landing System (ILS), Transponder Landing System (TLS), Microwave Landing System (MLS), Astronavigation. **Test Book 1**: **Ch 5.1,5.2,5.3,5.4**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Remember the functions of various aircraft systems.
CO2	Understand the working principle of aircraft control systems.
CO3	Analyze different types of aircraft instruments.
CO4	Evaluate different precision landing systems.
CO5	Interpret the use of satellite and non-satellite-based navigation systems in modern avionics and air traffic management.

Text Books:	
1	Aircraft Instrumentation and Systems, S. Nagabhushana, L. K. Sudha, 1st edition IK Books. 2010 ISBN-13: 978-9380578354.
2	Introduction to Avionics Systems, R. P. G. Collison.,3rd edition Springer Netherlands. 2013, ISBN13: 978-9400707078.

Reference Books	
1	Aircraft Electricity and Electronics, Thomas K. Eismin, VIIth edition McGraw Hill. 2019, ISBN-13: 978-1260108217
2	Aircraft Instruments and Integrated Systems" E.H.J. Pallett, Dorling Kindersley India Pvt. Ltd. in 2011, with ISBN 978-81-317-3443-8

Web links and Video Lectures (e – Resources)	
1	https://youtu.be/-A6f9n3NV_w?si=i9x9ptqkHD4qmVD6

CO-PO-Mapping:

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

Semester: IV					
Aviation Management					
Course Code	:	BAS406B	**Credits**	:	3
Hours/Week(L:T:P)	:	3:0:0	**CIE**	:	50 Marks
Total Hours	:	40 Hrs	**SEE**	:	50 Marks
Course Type	:	ESC	**SEE Duration**	:	3 Hours

Prerequisites:	
Courses	Engineering Management / Industrial Engineering
Knowledge on Fundamental Concepts	Basic understanding of the aviation ecosystem
Knowledge on Connected Tools (If any)	-

Course Learning Objectives: This course will enable the students to	
CLO1	Introduce the principles of leadership, Total Quality Management (TQM), and the role of ethics and communication in aviation organizations.
CLO2	Explain the structure of the global airline industry, its evolution, trends, regulatory bodies, and associated challenges
CLO3	Analyse airline and airport operational strategies including scheduling, fleet planning, marketing, terminal management, and finances.
CLO4	Familiarize with aviation policies, regulatory frameworks, and safety/security protocols applicable to air transportation in India and globally.
CLO5	Apply interdisciplinary management knowledge in aviation using case studies in software, law, international business, entrepreneurship, and aviation systems

Module – 1	**08 Hrs**
Leadership: Definition, characteristics of quality leaders, leadership concept, characteristics of effective people, ethics, the Deming philosophy, role of TQM leaders, implementation, core values, concepts and framework, strategic planning communication, decision making. **Customer Satisfaction and Employee Involvement:** Customer Satisfaction: customer and customer perception of quality, feedback, using customer complaints, service quality, translating needs into requirements, customer retention, Case studies. Employee Involvement, Motivation, employee surveys, empowerment, teams, suggestion system, recognition and reward, gain sharing, performance appraisal, unions and employee involvement, case studies. **Test Book 1**: **Ch:1,2 and 3**	
Module – 2	**08 Hrs**
The Airline Industry: Trends, Challenges and Strategies Introduction, Stages of Development Impacting the Airline Industry, Past, Present and Future Trends, Regional Analysis, and The Industry: Challenges and Strategies, The New Breed of Airlines, Failing and Achieving Success. **Air Transportation:** Regulators and Associations, Introduction, Department of Transportation, The Federal Aviation Administration, The Transportation Security Administration, air transportation The National Transportation Safety Board, Major Aviation Associations **Test Book 2**: **Ch: 1,3 and 4**	
Module – 3	**08 Hrs**
Airline Operations and Management Airline structure and business models (Full service, LCC, Regional, Cargo),Fleet planning and route selection, Flight scheduling, crew management, Revenue and yield management, Airline marketing and strategic alliances. **Airport Planning and Management**:	

Airport types and ownership models, Terminal design and airport layout, Passenger, baggage, and cargo handling, Airport finances: Aeronautical vs non-aeronautical revenue, Ground handling and apron management. **Test Book 2**: **Ch:8**
Module – 4 **08 Hrs**
Aviation Policy and Regulatory Framework: DGCA Civil Aviation Requirements (CARs), ICAO SARPs and Annexes, Airworthiness and flight operations regulation, Airport Economic Regulatory Authority (AERA), National Civil Aviation Policy, UDAN, bilateral air agreements **Aviation Safety, Security and Risk Management:** Safety Management System (SMS), Human factors in aviation, Emergency and crisis management, Security protocols at airports and in-flight, Case studies: Accidents and safety responses. **Test Book 3**: **Ch: 11 and 13**
Module – 5 **08 Hrs**
Business Application Software, Communication Skills and Business Correspondence, Research Methods in Business, International Business Management, Aviation Systems: Management of the Integrated Aviation Value Chain **Aviation Law**, Aviation Safety Management and Accident Investigations, Emerging Trends in Management - Case Study Analysis, Entrepreneurship Development, Airline Advertising and Sales Promotion **Test Book 3: Ch:14**

Course Outcomes: After completing the course, the students will be able to	
CO1	Explain the fundamentals of leadership, quality management, employee involvement, and ethical aviation practices.
CO2	Describe the evolution, trends, and challenges in the airline industry and the role of global regulators.
CO3	Apply management strategies in airline and airport operations including planning, finance, and marketing.
CO4	Analyze policies, CARs, ICAO SARPs, SMS, and aviation security and risk frameworks.
CO5	Evaluate and integrate modern aviation management tools and practices for industry-readiness.

Text Books	
1	Total Quality Management, Dale H. Bester field, Pearson Education India, Edition 03.
2	Air Transportation: A Management Perspective Wensveen, John G. McGraw Hill, 4th edition,2012.
3	Aviation Management: Global and National Perspectives Hardcover, 1 January 2008 by Ratandeep Singh

Reference Materials	
1	Compact Civil Aviation Requirements, Section -Ii(Airworthiness), 1 January 2005, by D.G.C.A. (Author). ISBN-13 : 978-8175980495

Web links and Video Lectures (e – Resources)	
1	www.dgca.gov.in
2	www.civilaviation.gov.in

CO – PO MAPPING

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

Semester: IV					
Introduction to Space Technology					
Course Code	:	BAS406C	**Credits**	:	3
Hours/Week(L:T:P)	:	3:0:0	**CIE**	:	50 Marks
Total Hours	:	40 Hrs	**SEE**	:	50 Marks
Course Type	:	ESC	**SEE Duration**	:	3 Hours

Prerequisites:	
Courses	Physics, Thermodynamics and Fluid Mechanics
Knowledge on Fundamental Concepts	Differential Calculus, Vectors algebra, Cartesian and Polar coordinates, Trigonometry
Knowledge on Connected Tools (If any)	-

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the fundamentals of aerospace propulsion.
CLO2	Understand the orbit mechanics and orbit maneuvers.
CLO3	Acquire the knowledge of satellite attitude dynamics and space mission operations.
CLO4	Explain the Yo-Yo design mechanism and its role in stabilizing spinning satellites.
CLO5	Describe ground segment architecture, including tracking stations and mission control centers.

Module – 1	**08 Hrs**
Introduction: Fundamentals of Aerospace Propulsion, Space Environment, fundamentals of solid propellant rockets, Fundamentals of liquid propellant rockets, Rocket equation, Tsiolkovsky rocket equation, Concepts of Specific Impulse. **Text Book 1: Ch:1,2 and 3**	
Module – 2	**08 Hrs**
Atmospheric Re-entry: Introduction-Steep Ballistic Re-entry, Ballistic Orbital Re-entry, Skip Re-entry, "Double-Dip" Re-entry, Skip reentry, glide reentry. **Text Book 1: Ch: 10**	
Module – 3	**08 Hrs**
Fundamentals of Orbit Mechanics, Orbit Manoeuvre: Two-body motion, Basic Orbital Elements, Hohmann Transfer, Bielliptical Transfer. **Text Book 2: Ch: 3,4 and 7**	
Module – 4	**08 Hrs**
Satellite Attitude Dynamics: Attitude Control for Spinning Spacecraft, Attitude Control for Non-spinning Spacecraft, The Yo-Yo Mechanism, Gravity – Gradient Satellite. **Text Book 2: Ch: 6**	
Module – 5	**08 Hrs**
Space Mission Operations: Supporting Ground Systems Architecture and Team interfaces, Mission phases and Core operations, Command, Planning, Tracking, Telemetry. **Reference Book 1: Ch: 8**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Interpret and apply the Tsiolkovsky rocket equation and evaluate propulsion system performance
CO2	Analyze different atmospheric re-entry trajectories and their thermal and dynamic challenges.
CO3	Compute orbital parameters and design orbital maneuvers using two-body mechanics.
CO4	Compare attitude control techniques for spinning and non-spinning spacecraft
CO5	Describe space mission operations, including ground system architecture, mission phases, and core functions

Text Books	
1	Rocket Propulsion and Space Dynamics, J.W. Cornelisse, J.W. Freeman and Co., Ltd, London, 1982
2	Spaceflight Dynamics, W.E. Wiesel, McGraw Hill,2nd edition,2014, ISBN-13: 978-9332901650

Reference Books	
1	Fundamentals of Space Systems, Vincet L. Pisacane, Oxford University Press, 2005
2	Understanding Space: An Introduction to Astronautics, J. Sellers, McGraw Hill, 2nd edition,2000, ISBN13: 978-0072424683
3	Introduction to Space Flight, Francis J Hale, Pearson, 1993, ISBN-13: 978-0134819129

Web links and Video Lectures (e – Resources)	
1	https://youtu.be/bLXDyNbkp08?si=CHwsYKew2eCDzVvL

CO – PO MAPPING

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

Semester: IV					
Orbital Mechanics					
Course Code	:	BAS406D	**Credits**	:	3
Hours/Week(L:T:P)	:	3:0:0	**CIE**	:	50 Marks
Total Hours	:	40 Hrs	**SEE**	:	50 Marks
Course Type	:	ESC	**SEE Duration**	:	3 Hours

Prerequisites:	
Courses	Physics, Mathematics
Knowledge on Fundamental Concepts	Trigonometry, Newtonian Mechanics, Vector Algebra.
Knowledge on Connected Tools (If any)	-

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the fundamental principles of point mass dynamics
CLO2	Analyse the two-body problem by deriving equations of motion, energy laws, and orbital mechanics for different conic sections
CLO3	Compute orbital position as a function of time using universal variables for different orbit types.
CLO4	Examine orbits in three dimensions by transforming between coordinate systems
CLO5	Apply preliminary orbit determination techniques to estimate orbital parameters

Module – 1	**08 Hrs**
Dynamics of point masses: Introduction, Kinematics, Mass, force and Newton's law of gravitation, Newton's law of motion, Time derivatives of moving vectors, Relative motion, Problems **Text Book 1: Ch 1 and Ch 2**	
Module – 2	**08 Hrs**
The two-body problem: Introduction, Equations of motion in an inertial frame, Equations of relative motion, Angular momentum and the orbit formulas, The energy law, Circular orbits, Elliptical Orbits, Parabolic trajectories, Hyperbolic trajectories, Perifocal frame, The Lagrange coefficients, Restricted three-body problem, Lagrange points, Jacobi constant, Problems. **Text Book 1: Ch: 3**	
Module – 3	**08 Hrs**
Orbital position as a function of time: Introduction, Time since periapsis, Circular orbits, Elliptical orbits, Parabolic trajectories, Hyperbolic trajectories, Universal variables, Problems **Text Book 1: Ch 4**	
Module – 4	**08 Hrs**
Orbits in three dimensions: Introduction, Geocentric right ascension–declination frame, State vector and the geocentric equatorial frame, Orbital elements and the state vector, Coordinate transformation, Transformation between geocentric equatorial and perifocal frames, Effects of the earth's oblateness, Problems **Text Book 1: Ch 5**	
Module – 5	**08 Hrs**
Preliminary orbit determination: Introduction, Gibbs' method of orbit determination from three position vectors, Lambert's problem, Sidereal time, Topocentric coordinate system, Topocentric equatorial coordinate system, Topocentric horizon coordinate system, Orbit determination from angle and range measurements, Angles-only preliminary orbit determination, Gauss's method of preliminary orbit determination, Problems. **Text Book 1: Ch 6 and 7**	
Course Outcomes: After completing the course, the students will be able to	

CO1	Formulate and solve problems related to point mass dynamics
CO2	Derive and interpret orbital mechanics equations for two-body systems,
CO3	Calculate the position of an orbiting body at any given time using Kepler's equations and universal variables.
CO4	Transform state vectors between different 3D coordinate frames and analyse perturbations due to Earth's oblateness.
CO5	Determine preliminary orbits from observational data using classical methods

Text Books	
1	Orbital Mechanics for Engineering Students, Howard D. Curtis, Butterworth-Heinemann Publisher, 4th edition, May 2019, ISBN-13 : 978-0081021330

Reference Books	
1	Elements of Astro mechanics, VandeKamP P, Pitman,1979.
2	Space Flight Dynamics, Willian E. Wiesel, Create Space Independent Publishing Platform, 3rd Edition ,2010, ISBN-13: 978-1452879598

Web links and Video Lectures (e – Resources)	
1	https://youtu.be/bLXDyNbkp08?si=p3F29jP98ZMxrnM7

CO – PO MAPPING

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

Semester: IV					
Universal Human Values (UHV) **Stream: CSE/ECE/CV/ME**					
Course Code	**:**	BUH407	**Credits**	**:**	01
Hours/Week(L:T:P)	**:**	1:0:0	**CIE**	**:**	50 Marks
Total Hours	**:**	15	**SEE**	**:**	50 Marks
Course Type	**:**	**UHV**	**SEE Duration**	**:**	1 Hr.

Course Objectives: This course will enable the students to	
1	Understand the need, purpose, and content of value-based education.
2	Facilitate self-exploration as a process to understand human aspirations and their fulfillment.
3	Understand harmony at various levels – individual, family, society, nature, and existence.
4	Promote ethical competence and awareness of professional ethics.
5	Encourage the adoption of a holistic and humanistic approach in personal and professional life.

Module-1	**03 Hrs**
Introduction to Value Education Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education) Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to Fulfil the Basic Human Aspirations. **Textbook1- Ch.1&2**	
Module-2	**03 Hrs**
Harmony in the Human Being Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health. **Textbook1- Ch.3**	
Module-3	**03 Hrs**
Harmony in the Family and Society Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order. **Textbook1- Ch.4&5**	
Module-4	**03 Hrs**
Harmony in the Nature/Existence Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels and The Holistic Perception of Harmony in Existence. **Textbook1- Ch.6&7**	
Module-5	**03 Hrs**

Implications of the Holistic Understanding – a Look at Professional Ethics
Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession
Textbook1- Ch.8&9

Course Outcomes: After completing the course, the students will be able to	
CO1	Describe the need and importance of value education and the process of self-exploration.
CO2	Explain the concept of harmony in the human being, differentiating the needs of the self and the body.
CO3	Apply the principles of trust, respect, and justice to improve relationships within the family and society.
CO4	Analyze and appreciate the interconnectedness and mutual fulfillment among the four orders of nature.
CO5	Demonstrate ethical behavior and decision-making in professional and personal contexts by integrating human values.

Text Books	
1	The Textbook A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034- 47-1
2	The Teacher‟s Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G

Reference Books

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amar kantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews.
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj – Pandit Sunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)
14. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
15. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books.
16. A Nagraj, 1998, Jeevan Vidya Ek Parichay, Divya Path Sansthan, Amarkantak.
17. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
18. A N Tripathy, 2003, Human Values, New Age International Publishers.
19. SubhasPalekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) KrishiTantraShodh, Amravati.
20. E G Seebauer & Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers , Oxford University Press
21. M Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.

22. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
23. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.

Web links and Video Lectures (e – Resources)

- Value Education websites,
- https://www.uhv.org.in/uhv-ii,
- http://uhv.ac.in,
- http://www.uptu.ac.in
- Story of Stuff,
- http://www.storyofstuff.com
- Al Gore, An Inconvenient Truth, Paramount Classics, USA
- Charlie Chaplin, Modern Times, United Artists, USA
- IIT Delhi, Modern Technology – the Untold Story
- Gandhi A., Right Here Right Now, Cyclewala Productions
- https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw
- https://fdp-si.aicte-india.org/8dayUHV_download.php
- https://www.youtube.com/watch?v=8ovkLRYXIjE
- https://www.youtube.com/watch?v=OgdNx0X923I
- https://www.youtube.com/watch?v=nGRcbRpvGoU
- https://www.youtube.com/watch?v=sDxGXOgYEKM

CO – PO MAPPING

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

Semester: IV					
Drone Pilot Training					
Course Code	:	BAS408A	**Credits**	:	1
Hours/Week(L:T:P)	:	1:0:0	**CIE**	:	50 Marks
Total Hours	:	15 Hrs	**SEE**	:	50 Marks
Course Type	:	AEC	**SEE Duration**	:	2 Hours

Prerequisites:	
Courses	Fundamentals of Electronics and Communication, Engineering Physics and Mathematics
Knowledge on Fundamental Concepts	Basic understanding of flight principles (lift, drag, thrust)
Knowledge on Connected Tools (If any)	-

Course Learning Objectives: This course will enable the students to	
CLO1	Train participants in drone operations, airspace knowledge, and safety protocols.
CLO2	Ensure compliance with DGCA policies under the Digital Sky platform.
CLO3	Equip participants with hands-on flying skills, simulator training, and field operations.
CLO4	Prepare candidates for careers in drone-based industries (surveying, agriculture, delivery, inspection, defense, etc.).
CLO5	Operate and handle drones proficiently through simulator and practical training, including assembly, calibration, flight maneuvers, emergency handling, and payload operations

Module – 1	**03 Hrs**
Regulations of DGCA, Basic Principles of Flight, ATC Procedures and Radio Telephony Overview of DGCA and its role in civil aviation, UAS Rules, 2021 – Classification of drones (Nano, Micro, Small, etc.), Requirements for drone pilot licensing and RPTOs, Permissions via Digital Sky Platform, No Drone Zones, NPNT compliance, geo-fencing, General Do's and Don'ts for safe drone operations. **Text Book 2: Ch: 5**	
Module – 2	**03 Hrs**
Fixed wing Operations/Aerodynamics, Multi rotor Operations/Aerodynamics: Types of fixed-wing UAVs and components, Flight dynamics and control surfaces (ailerons, rudder, elevators), Take-off and landing techniques, Turning, banking, and gliding principles, Use in long-range surveillance, mapping, Types of multi-rotor drones (quad copter, hex copter, octo copter), Working of rotors and ESCs, Hovering, take-off, landing, yaw, pitch, roll, GPS and manual mode operation, Use in short-range missions, inspection, delivery, agriculture. **Text Book 1: Part 2**	
Module – 3	**03 Hrs**
Weather and Meteorology, Drone equipment and maintenance, Emergency Identification and handling: Importance of weather in drone flight, Wind patterns, humidity, temperature, barometric pressure, Weather apps and interpreting aviation weather forecasts, Visibility and cloud base considerations, Frame types, motors, ESCs, propellers, batteries, flight controllers. Telemetry and ground control stations, Pre-flight and post-flight maintenance checks, Battery safety and management, Routine calibration and firmware upgrades, GPS loss or signal interference, Motor failure, low battery, flyaway situations, Emergency landing techniques and incident reporting. **Text Book 1: Part 3**	

Module – 4	03 Hrs
Payload installation and utilization, Image/video interpretation, Final Test Theory: Types of payloads: Cameras (RGB, thermal), LiDAR, spraying nozzles, Gimbal integration and stabilization, Balancing the drone after payload installation, Payload limitations and DGCA guidelines, Live streaming and telemetry sync, Aerial imagery basics: resolution, angle, lighting, Common applications: agriculture, surveillance, inspection, Objective MCQ-style exam covering all modules, Based on DGCA syllabus for Remote Pilot Certificate. **Text Book 1: Part 4**	
Module – 5	**03 Hrs**
Flight Simulator training, Practical lessons in Lab, Practical flying lessons Orientation and basic maneuvers using simulator software, Manual vs GPS-based flying practice, Emergency simulation: GPS failure, low battery, crash landing Hardware familiarization: Assembling drones, sensor integration, Calibration: IMU, compass, GPS, Controller settings, flight modes (Loiter, RTL, Stabilize, etc.) Hands-on flying with training drones (DJI, Pixhawk-based, etc.), Take-off, landing, hovering, figure-eight, and manual control, Pre-flight inspection checklist, Mid-air controls and payload testing. **Text Book 2: Part 6**	

Course Outcomes: After completing the course, the students will be able to	
CO 1	Understand DGCA regulations, airspace classifications, and drone operation safety protocols.
CO 2	Demonstrate knowledge of basic flight principles, aerodynamics, and ATC communication procedures.
CO 3	Apply practical skills in handling both fixed-wing and multirotor drones, including flight planning and execution.
CO 4	Analyze weather conditions, perform drone maintenance, and implement emergency protocols.
CO 5	Demonstrate simulator and hands-on flying skills through field tests and assessments.

Text Books	
1	Introduction to UAV Systems Paul Gerin, Fahlstrom, Thomas James, Wiley Publication 4th edition, 2012, ISBN-13: 978-1118396803
2	Introduction to Unmanned Aircraft Systems, R. Austin, CRC Press, 2021, ISBN: 978-0367366599, eBook ISBN: 978-0429347498

Reference Books	
1	Practical Guide to Drone Regulations in India, Team at India Drone Rules. 3rd Edition, 2016, ISBN-13: 978-145287959
2	Handbook of Unmanned Aerial Vehicles Valavanis, K., Vachtsevano S, George J Springer

Web links and Video Lectures (e – Resources)	
1	https://www.youtube.com/watch?v=1gI87ga_rz0

CO – PO MAPPING

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

Semester: IV					
Aircraft Safety Rules and Regulations					
Course Code	:	BAS408B	**Credits**	:	1
Hours/Week(L:T:P)	:	1:0:0	**CIE**	:	50 Marks
Total Hours	:	15 Hrs	**SEE**	:	50 Marks
Course Type	:	AEC	**SEE Duration**	:	2 Hours

Prerequisites:	
Courses	-
Knowledge on Fundamental Concepts	-
Knowledge on Connected Tools (If any)	-

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the structure, purpose, and regulatory framework of Civil Aviation Requirements (CAR) issued by DGCA.
CLO2	Learn the responsibilities of operators and owners in maintaining airworthiness and complying with CAR procedures.
CLO3	Develop the ability to interpret defect reporting, maintenance programs, and reliability-based maintenance methods.
CLO4	Gain knowledge of the approval process for maintenance organizations, AME licensing, and continued airworthiness procedures.
CLO5	Familiarize with aircraft documentation, flight testing, registration, weight and balance, and mandatory onboard records.

Module – 1	**03 Hrs**
C.A.R. Series 'A' – Procedure for Civil Air Worthiness Requirements And Responsibility Operators Vis-A-Visa Air Worthiness Directorate**,** Responsibilities of operators / owners- Procedure of CAR issue, amendments etc., Objectives and targets of airworthiness directorate; Airworthiness regulations and safety oversight of engineering activities of operators. **C.A.R. Series 'B'** – Issue Approval of Cockpit Check List, MEL, CDL**:** Deficiency list (MEL and CDL); Preparation and use of cockpit checklist and emergency list. **Textbook 1: Series A and B**	
Module – 2	**03 Hrs**
C.A.R. Series 'C' – Defect Recording, Monitoring, Investigation and Reporting: Defect recording, reporting, investigation, rectification and analysis; Flight report; Reporting and rectification of defects observed on aircraft; Analytical study of in-flight readings and recordings; Maintenance control by reliability Method. **C.A.R. SERIES 'D' –** And Aircraft Maintenance Programmes**:** Reliability Programmes (Engines); Aircraft maintenance programme and their approval; On condition maintenance of reciprocating engines; TBO –Revision programme; Maintenance of fuel and oil uplift and consumption records – Light aircraft engines; Fixing routine maintenance periods and component TBOs – Initial and revisions. **Textbook 1: Series C and D**	
Module – 3	**03 Hrs**
C.A.R. Series 'E' – Approval Of Organizations**:** Approval of organizations in categories A, B, C, D, E, F, and G – Requirements of infrastructure at stations other than parent base. **C.A.R. Series 'F' –** Air Worthiness and Continued Airworthiness**:** Procedure relating to registration of aircraft; Procedure for issue / revalidation of Type Certificate of aircraft and its engines / propeller; Issue / revalidation of Certificate of Airworthiness; Requirements for renewal of Certificate of Airworthiness. **Textbook 1: Series E and F**	

Module – 4	**03 Hrs**
C.A.R. Series 'L'and'M': Issue of AME License, its classification and experience requirements, Mandatory Modifications / Inspections **C.A.R. Series 'T'and'X':** Flight testing of (Series) aircraft for issue of C of A; Flight testing of aircraft for which C of A had been previously issued. **Textbook 1: Series L and M, Series T and X**	
Module – 5	**03 Hrs**
Registration Markings of aircraft; Weight and balance control of an aircraft; Provision of first aid kits and Physician's kit in an aircraft; Use furnishing materials in an aircraft; Concessions; **Aircraft log books;** Document to be carried on board on Indian registered aircraft; Procedure for issue of tax permit; Procedure for issue of type approval of aircraft components and equipment including instruments**.** **Textbook 1: Series X (Part II & VII)**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Explain the objectives, procedures, and safety oversight functions of CAR Series A and B related to airworthiness and cockpit documentation.
CO2	Analyze defect reporting, rectification processes, and maintenance reliability programs as per CAR Series C and D.
CO3	Demonstrate understanding of the approval procedures for maintenance organizations and airworthiness certificates under CAR Series E and F.
CO4	Describe AME licensing requirements, mandatory inspections, and aircraft flight testing procedures under CAR Series L, M, T, and X.
CO5	Apply knowledge of aircraft registration, weight and balance, mandatory documents, and type approval procedures for aircraft components.

Text Books	
1	Airworthiness: An Introduction to Aircraft Certification and Operations, Filippo De Florio, 3rd edition, Butterworth-Heinemann (Elsevier imprint), ISBN-10: 0081008880, ISBN-13: 978-0081008881

Reference Books	
1	Aircraft Manual (India) Volume" – Latest Edition, The English Book Store, 17-1, Connaught Circus, New Delhi.

Web links and Video Lectures (e – Resources)	
1	https://www.youtube.com/watch?v=mG-NZmRtIU0&list=PLpYy_l2an7Y5wod-Dy0vq-OCniPBXkMb3

CO – PO MAPPING

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

Semester: IV					
Mat Lab and Simulink					
Course Code	:	BAS408C	**Credits**	:	1
Hours/Week(L:T:P)	:	0:0:2	**CIE**	:	50 Marks
Total Hours	:	15 Hrs	**SEE**	:	50 Marks
Course Type	:	AEC	**SEE Duration**	:	3 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 the fundamentals of MATLAB, including data types, arrays, vectors, matrices, and basic mathematical operations.
CLO2	Develop the ability to create and customize 2D plots to visualize and interpret data effectively.
CLO3	Learn to design and implement MATLAB scripts and functions, including handling inputs, outputs, and errors.
CLO4	Apply control structures, loops, and file-handling techniques to solve engineering problems.
CLO5	Explore modeling and simulation using Simulink, including subsystem creation and graphical interface development

Module – 1	**03 Hrs**
Basics: Introduction, writing simple expression, Data types, MATLAB Array, creating vectors and matrices, Operators, Properties of matrix, replicating data to form a matrix	
Module – 2	**03 Hrs**
MATLAB Graphics and Plotting: 2-Dimensional Plots, Plot Aesthetics, Multiple Plots, Sub plotting.	
Module – 3	**03 Hrs**
Scripts and Functions: Making simple scripts and function Files, Input and Output Arguments, Types of functions, Global and Persistent variables, Polynomial functions, Recursive Functions Common errors in Using Functions	
Module – 4	**03 Hrs**
Control Structures loops and File Handling: Conditional statements, Loops, Nested Loops, Break and Continue, File types, Handling External Files	
Module – 5	**03 Hrs**
Modeling and Simulink: Creating a Simulink Model, dealing with the Complex System Equation, Creating Sub System, Masking Subsystem, Using the Block sets and toolbox, Development of Graphical user interface	

Course Outcomes: After completing the course, the students will be able to	
CO1	Demonstrate proficiency in MATLAB basics, including matrix operations, vector creation, and data replication.
CO2	Generate and customize 2D plots and subplots to analyze and present data graphically
CO3	Create MATLAB scripts and user-defined functions with appropriate input/output handling and identify common function-related errors.

CO4	Implement conditional statements, loops, and file-handling techniques to automate computational tasks
CO5	Develop and simulate engineering models in Simulink, including the creation of subsystems, masking, and use of blocksets/toolboxes.

Text Books	
1	Programming in MATLAB ®: A problem-solving approach, 1e Paperback by Patel /Mittal (Author)
2	MATLAB Programming for Engineers by Stephen J. Chapman
Reference Books	
1	"Simulink: Dynamic System Simulation for MATLAB", Author: Kathryn E. Logan. Publisher: Springer
2	MATLAB: A Practical Introduction to Programming and Problem Solving". Author: Stormy Attaway, Publisher: Elsevier, Edition: 5th Edition

CO – PO MAPPING

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

Semester: IV					
Aircraft Maintenance and Overhaul					
Course Code	:	BAS408D	**Credits**	:	1
Hours/Week(L:T:P)	:	1:0:0	**CIE**	:	50 Marks
Total Hours	:	15 Hrs	**SEE**	:	50 Marks
Course Type	:	AEC	**SEE Duration**	:	2 Hours

Prerequisites:	
Courses	Strength of materials, Aircraft Materials
Knowledge on Fundamental Concepts	-
Knowledge on Connected Tools (If any)	-

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the principles and regulations governing aircraft maintenance, repair and overhaul.
CLO2	Identify and explain the different types of aircraft maintenance, including routine, non-routine, and heavy maintenance.
CLO3	Describe the procedures for inspecting, troubleshooting, and repairing aircraft systems and components.
CLO4	Understand the importance of documentation, record-keeping, and compliance with regulatory requirements.
CLO5	Explain the role of quality control and assurance in aircraft MRO

Module – 1	**03 Hrs**
Welding in Aircraft Structural Components: Equipment's used in welding shop and their maintenance – Ensuring quality welds – Welding jigs and fixtures – Soldering and brazing. **Sheet Metal Repair and Maintenance**: Inspection of damage – Classification – Repair or replacement – Sheet metal inspection – N.D.T. Testing – Riveted repair design, Damage investigation –reverse technology. **Text Book 1: Ch 5, Ch 6 and Ch 15**	
Module – 2	**03 Hrs**
Plastics and Composites in Aircraft: Review of types of plastics used in airplanes – Maintenance and repair of plastic components – Repair of cracks, holes etc., various repair schemes –Scopes. **Inspection and Repair of Composite Components:** Inspection and Repair of composite components – Special precautions –Autoclaves. **Text Book 1: Ch 9**	
Module – 3	**03 Hrs**
Aircraft Jacking, Assembly and Rigging: Airplane jacking and weighing and C.G. Location. Balancing of control surfaces – Inspection maintenance. Helicopter flight controls. Tracking and balancing of main rotor. **Text Book 1: Ch 7**	
Module – 4	**03 Hrs**
Review of Hydraulic and Pneumatic System: Trouble shooting and maintenance practices – Service and inspection. Inspection and maintenance of landing gear systems. Inspection and maintenance of air-conditioning and pressurization system, water and waste system. Installation and maintenance of Instruments – handling – Testing –Inspection. **Text Book 1: Ch: 10, Ch11 and Ch 13**	
Module – 5	**03 Hrs**

Inspection and Maintenance of Auxiliary Systems: Inspection and maintenance of auxiliary systems – Fire protection systems –Ice protection system – Rain removal system – Position and warning system– Auxiliary Power Units (APUs).
Safety Practices: Hazardous materials storage and handling, Aircraft furnishing practices – Equipment's. Trouble shooting - Theory and practices.
Text Book 1: Ch 12, Ch 14 and Ch 16

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand and apply safety procedures and protocols to prevent accidents and injuries.
CO2	Identify and mitigate potential hazards in the workplace.
CO3	Use personal protective equipment (PPE) and safety gear correctly.
CO4	Follow emergency procedures in case of an incident or accident.
CO5	Promote a safety-first culture in the workplace.

Text Books	
1	KROES, WATKINS, DELP, "Aircraft Maintenance and Repair", McGraw-Hill, New York, 1992.

Reference Books	
1	LARRY REITHMEIR, "Aircraft Repair Manual", Palamar Books, Marquette, 1992
2	BRIMM D.J. BOGGES H.E., "Aircraft Maintenance", Pitman Publishing corp. New York, 1940.

CO-PO Mapping:

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

Semester: IV						
Metaphysical Science **Streams: CSE/ECE/CV/ME**						
Course Code	**:**	BMP409		**Credits**	**:**	1
Hours/Week(L:T:P)	**:**	1:0:0		**CIE**	**:**	50 Marks
Total Hours	**:**	15 Hrs		**SEE**	**:**	50 Marks
Course Type	**:**	HSSMC		**SEE Duration**	**:**	1 Hr.

Course Learning Objectives: This course will enable the students to	
CLO1	Explore the philosophical and spiritual aspects of the universe.
CLO2	Compare and contrast ontological & **Epistemology** theories
CLO3	Analyze metaphysical perspectives on time, space, and the origin of the universe.
CLO4	Inculcate the Metaphysical inquiries into the nature of mind and consciousness.
CLO5	Apply and analyze the nature of reality, existence, and universe beyond the physical sciences.

Module 1	**03 Hrs**
Introduction to Metaphysics: Definition **of Metaphysics**, scope, and historical roots (Aristotle, Plato, Kant). Distinction between metaphysics, physics and spirituality. **Branches of Metaphysics:** Ontology, cosmology, epistemology, and their interconnections. **Key Metaphysical Questions:** Why is there something rather than nothing? The nature of abstract entities (numbers, moral values). **Textbook2, Ch.1&2**	
Module 2	**03 Hrs**
Ontology & Epistemology **Ontology (Study of Being):** Materialism vs. Idealism vs. Dualism, The Problem of Universals (Realism vs. Nominalism). **Epistemology (Study of Knowledge):** Rationalism (Descartes) vs. Empiricism (Locke, Hume). Theories of truth (Correspondence, Coherence, Pragmatic). **Skepticism & Constructivism:** Can we truly know reality? (Descartes' Evil Demon, Simulation Theory). **Textbook2, Ch.3-5**	
Module 3	**03 Hrs**
Cosmology – Metaphysical Perspectives on the Universe Philosophical cosmology vs. physical cosmology, Metaphysical views on time, space, and the origin of the universe, The Anthropic Principle and Fine-Tuning debate, Creation, causality, and the infinite regress problem, Multiverse theory and its metaphysical implications, Spiritual and ancient cosmologies: Vedic, Taoist, and Indigenous models. **Textbook1, Ch.1, Textbook2, Ch.6-7**	
Module 4	**03 Hrs**
Mind and Consciousness Definition of mind and consciousness, Mind-body problem: Dualism vs. Physicalism, Theories of consciousness: Integrated Information Theory (IIT), Global Workspace, Panpsychism, Eastern and Western views of the self and mind; Artificial intelligence and machine consciousness, Role of consciousness in observation and decision-making. **Textbook1, Ch.2, Textbook2, Ch.8**	
Module 5	**03 Hrs**

Quantum Healing and Energy Medicine

Basics of quantum mechanics (superposition, entanglement, observer effect), Quantum theory and the mind: Role of consciousness in quantum collapse, Overview of Quantum Healing – Deepak Chopra's model, Energy fields: Biofield theory, chakras, subtle energy systems, Placebo effect, intention and non-local healing, Implications for engineering bio-resonant technologies.

Textbook1, Ch. 3-15

Course Outcomes: After completing the course, the students will be able to	
CO1	Assess the nature of reality, existence and the universe.
CO2	Evaluate the competing **ontology** and epistemological frameworks.
CO3	Interpret the various multiverse models and their philosophical significance.
CO4	**Analyze** the *mind-body problem* and theories of consciousness.
CO5	Differentiate the theoretical and practical intersections between quantum physics, quantum healing and meditation.

Text Books	
1	Quantum Metaphysics, Tarja Kallio-Tamminen, ISBN 952-10-1927-1 Otamedia, Oy 2004.
2	Metaphysics-A Very Short Introduction, Stephen Mumfor, 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				3
CO2	3	2	2	2		2	2				3
CO3		3				2	2				2
CO4		3				2	2				
CO5		3				2	2				

Semester: IV						
National Service Scheme **Stream: CSE/ECE/ME/CV**						
Course Code	**:**	BNS410		**Credits**	**:**	0
Hours/Week(L:T:P)	**:**	0:0:2		**CIE**	**:**	100 Marks
Total Hours	**:**	24		**SEE**	**:**	-
Course Type	**:**	NCMC		**SEE Duration**	**:**	-

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the community in general in which they work
CLO2	Identify the needs and problems of the community and involve them in problem olving
CLO3	Develop among themselves a sense of social & civic responsibility & utilize thei knowledge in finding practical solutions t
CLO4	Develop competence required for group-living and sharing of responsibilities & gai kills in mobilizing community participation to acquire leadership qualities and democratic attitudes.
CL05	Appraise the importance of ethical issues and team working abilities pertaining to the ocial services

Activity– 1	**08 Hrs**
Water conservation techniques – Role of different stakeholders– Implementation	
Activity – 2	**08 Hrs**
Preparing an actionable business proposal for enhancing the village income and approach for implementation.	
Activity – 3	**08 Hrs**
Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education.	

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.	**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	May be individual al or team	Villages/ City Areas / Grama panchayat/ public associations/Gover	Group selection /proper consultation/Continuous	Report should be submitted by	Evaluation as per the rubrics Of scheme

	enhancing the village income and approach for implementation.		nment Schemes officers/ campus etc…..	monitoring/ Information board	individual to the concerned evaluation authority	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/pro per 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	Exploit the importance of his / her responsibilities towards society.
CO2	Analyze the environmental and societal problems/issues and will be able to design solutions for the same.
CO3	Evaluate the existing system and to propose practical solutions for the same for sustainable development.
CO4	Implement government or self-driven projects effectively in the field of societal problems.
CO5	Appraise the importance of ethical issues and team working abilities pertaining to the social services.

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 Matrix

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

Semester: IV						
Physical Education (PE) (Sports & Athletics) **Stream: CSE/ECE/ME/CV**						
Course Code	**:**	BPE410		**Credits**	**:**	0
Hours/Week(L:T:P)	**:**	0:0:1		**CIE**	**:**	100 Marks
Total Hours	**:**	24		**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 o 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 i 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 Stream: CSE/ECE/CV/ME						
Course Code	:	BYO410		**Credits**	:	0
Hours/Week(L:T:P)	:	0:0:2		**CIE**	:	100 Marks
Total Hours	:	12 Hrs		**SEE**	:	-
Course Type	:	NCMC		**SEE Duration**	:	-

Course Learning Objectives: This course will enable the students to	
CLO1	Describe patanjali's ashtanga yoga and its role in holistic well-being.
CLO2	Perform the suryanamaskar sequence with correct breathing and posture.
CLO3	Identify different types of asanas with their techniques and benefits.
CLO4	Utilize the knowledge of kapalabhati with proper technique and safety measures.
CLO5	Apply pranayama techniques to enhance physical and mental health.

Module - 1	**02 Hrs**
Patanjali's Ashtanga Yoga: Introduction, its need and importance, Eight limbs of Yoga – overview, **Yama:** Ahimsa, Satya, Asteya, Brahmacharya, Aparigraha **Niyama:** Shoucha, Santosha, Tapa, Svaadhyaya, Eshvarapranidhana **Text Book 1: Ch. 1 (Part 1)**	
Module - 2	**02 Hrs**
Surya Namaskar: Concept and significance of Surya Namaskar, 12-step Surya Namaskar sequence, Practice - 4 rounds of Surya Namaskar, Breathing coordination and posture alignment. **Text Book 1: Ch. 2 (Part 2)**	
Module - 3	**03 Hrs**
Asanas: Meaning of Asana, Need and importance of practicing Asanas, Classification of Asanas, Sitting Asanas - Sukhasana, Paschimottanasana, Standing Asanas - Ardhakati Chakrasana, Parshva Chakrasana, Prone Line Asana - Dhanurasana, Supine Line Asanas - Halasana, Karna Peedasana, For each Asana - Meaning by name, Technique of performing, Precautionary measures, Benefits **Text Book 1: Ch. 2 (Part 2)**	
Module - 4	**02 Hrs**
Kriyas: Introduction to Shatkarmas (Cleansing practices), Meaning and importance of Kapalabhati, Technique of Kapalabhati (40 strokes/min, 3 rounds), Precautionary measures and benefits. **Text Book 1: Ch. 3 (Part 3)**	
Module - 5	**03 Hrs**
Pranayama: Meaning, need, and importance of Pranayama, Types of Pranayama and their benefits, For each type - Meaning by name, Technique, Precautionary measures, Benefits, Types included – Suryanuloma-Viloma, Chandranuloma–Viloma, Suryabhedana, Chandra Bhedana, Nadishodhana **Text Book 1: Ch. 3 (Part 3)**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Summarize patanjali's ashtanga Yoga and its significance in promoting daily well-being.

CO2	Demonstrate surya namaskar with correct sequence, breathing and posture alignment.
CO3	Classify various types of asanas with their benefits and precautions.
CO4	Utilize the knowledge to practice kapalabhati with correct technique, breathing rhythm and safety guidelines.
CO5	Apply pranayama to improve overall physical fitness and mental wellness.

Text Book	
1	"The Illustrates Light on Yoga" by BKS Iyengar, HarperCollins Publishers, ISBN-81:7223-606-9

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	Yogapravesha in Kannada by Ajitkumar
4	Yoga for Children –step by step – by Yamini Muthanna

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		
CO2						2	2	3	2		2
CO3						2	2	3	2		2
CO4						2	2	3	2		2
CO5						2	2	3	2		2

Semester: VI					
Music Stream: CSE/ECE/CV/ME					
Course Code	**:**	BMU410	**Credits**	**:**	0
Hours/Week(L:T:P)	**:**	0:0:2	**CIE**	**:**	**100 Marks**
Total Hours	**:**	26	**SEE**	**:**	-
Course Type	**:**	NCMC	**SEE Duration**	**:**	-

Course Objectives: This course will enable the students to	
1	Understand the foundational concepts of Indian classical music, including the evolution and structure of Shruthi, Nada, Swara, Laya, Raga, Tala and Mela systems.
2	Recognize and describe various types of Carnatic compositions such as Geethe, Jathi, Swara, Swarajathi, Varna, Krithi and Thillana, along with the basics of the notation system.
3	Appreciate the contributions of key composers like Purandaradasa, Thyagaraja and Mysore Vasudevacharya to Indian music and understand their musical legacy.
4	Identify and explain the classification and basic construction of traditional Indian musical instruments, including string, wind, percussion and idiophones, with appropriate examples.
5	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 -I	**03 Hrs**
Preamble Contents of the curriculum intended to promote music as language to develop an analytical, creative and intuitive understanding. For this the student must experience music through study and direct participation in improvisation and composition. Origin of the Indian Music: Evolution of the Indian music system, understanding of Shruthi, Nada, Swara, Laya, Raga, Tala, Mela **Textbook1, V-1 Ch. 1-4**	
Module – II	**03 Hrs**
Compositions Introduction to the types of composition in Carnatic Music – Geethe, Jathi, Swara, Swarajathi, Varna, Krithi and Thillana, Notation System. **Textbook2 – Ch. 4-7**	
Module –III	**03 Hrs**
Composers Biography and contributions of Purandaradasa, Thyagaraja, Mysoro asudevacharya, Kanakadasa **Textbook3 – Ch. 2-5**	
Module –IV	**03 Hrs**
Music Instruments Classification and construction of string instruments, wind instruments, percussion Instruments, Idiophones (Ghana Vaadya), Examples of each class of instruments. **Textbook1,V-4 – Ch. 2-6**	
Module –V	**14 Hrs**
Abhyasa Gana Singing the swara exercises (Sarale Varase Only), Botatio writing for sarale varase and sulafi sapta tala (Only in mayamalavagowla raga), singing 4 geethe in malahari and one jathi swara, oe krithi in a mela raga **Textbook1, V-1&2**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Outline the evolution of Indian music and key concepts like Shruthi, Swara, Raga and Tala.
CO2	Identify and interpret basic Carnatic compositions using standard notation.
CO3	Summarize the contributions of composers.
CO4	Classify Indian musical instruments and describe their construction and use.
CO5	Demonstrate basic Carnatic vocal skills through selected exercises and compositions.

Text Books	
1	South Indian Music – Vol. I to VI, Prof. P. Sambamoorthy, The Indian Music Publishing House, Chennai.
2	A Textbook of Carnatic Music, Dr. S. Bhagyalekshmy, CBH Publications
3	Karnataka Sangeetha Charitre, Dr. V. S. Sampathkumaracharya, Kannada University, Hampi.

Reference Books	
1	Music of India, B. Chaitanya Deva, Munshiram Manoharlal Publishers
2	Essentials of Musicology in South Indian Music, Prof. S. R. Janakiraman, Asian Educational Services

CO – PO MAPPING

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

Semester: IV						
Competency Enhancement Course-2 **Stream: CSE/ECE/ME/CV**						
Course Code	:	BCE411		**Credits**	:	0
Hours/Week(L:T:P)	:	2:0:0		**CIE**	:	100 Marks
Total Hours	:	40		**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	**8 Hrs**

Partnership

Definition of Partnership, Types of Partnerships (Simple and Compound), Calculation of Profit Sharing Ratio, Capital and Time of Investment, Working and Sleeping Partners, Admission and Retirement of Partners, Distribution of Profits and Losses, Partnership Formulas, Comple Partnership Problems.

Time and Work

Definition and Concept of Time and Work, Relation between Work, Time, and Efficiency, Calculation of Individual and Combined Work, Work Rate and Work Done in a Given Time, Efficiency Comparison of Different Workers, Time Taken by Individuals or Groups, Alternat Work and Negative Work (Destructive Work), M:W:D Rule (Men:Work:Days Problems), Work Equivalence Formula, Problems Involving Wages Based on Work, Pipes and Cisterns (Work with Inlets and Outlets), Successive Work Distribution, Complex Time and Work Questions

Coding and Decoding

Letter Coding, Number Coding, Symbol Coding, Mixed Letter-Number Coding, Substitutio Coding, Decipher Coding, Direct Coding-Decoding, Conditional Coding, Message Coding, Operations-Based Coding-Decoding, and Complex Coding-Decoding Proble

Analogy

Number Analogy, Alphabet Analogy (using letter sequences or codes), Symbol Analogy, Figure/Pattern Analogy, Geometrical Shapes Analogy, Matrix-Based Analogy, Series-Based Numeric Analogy, Mirror and Water Image Analogy, Classification-Based Figure Analogy, Embedded Figure Analogy, Complex Numerical and Visual Analogy Problems.

Textbook-1, Ch-36

Module – 2	**8 Hrs**

Time, Speed and Distance

Definition and Relationship of Time, Speed, and Distance, Units and Conversion of Speed and Distance, Average Speed, Relative Speed, Problems on Trains, Problems on Boats and Streams,

Upstream and Downstream Concepts, Races and Games, Time to Meet/Opposite Directio Problems, Circular Tracks, Shortcut Tricks and Application-Based Problems.

Trains, Boats and Streams, Races

Trains: Problems on Trains, Time Taken to Cross a Stationary Object, Time Taken to Cross Another Moving Train, Relative Speed in Same and Opposite Direction, Length of Train and Platform Calculations, Speed and Time Conversions, Overtaking and Passing Scenarios, Shortcut Tricks for Train Problems.

Boats and Streams: Upstream and Downstream Concepts, Speed of Boat in Still Water, Speed of Stream, Calculation of Effective Speed (Upstream and Downstream), Time and Distance i Streams, Problems on Boats Overtaking/Meeting, Relative Speed in Water, Application-Based Boat and Stream Questions.

Races: Types of Races (Straight, Circular, Relay), Start Types (Head Start, Dead Heat), Calculating Winner and Margin, Calculation of Lead or Lag, Relative Speed in Races, Time Calculations to Meet or Overtake, Race Completion Time, Use of Ratio and Proportion i Races, Application-Based Race Problems.

Seating Arrangement

Linear Arrangement, Circular Arrangement, Square/Rectangular Arrangement, Single-Ro and Double-Row Arrangements, Facing Inside and Outside Arrangements, Arrangement Based on Directions (Left/Right/Clockwise/Counterclockwise), Seating Based on Conditions o Constraints, Position and Order Determination, Seating with Blood Relations or Attributes, Arrangement with Vacant Seats.

Data Arrangement

Linear Data Arrangement, Circular Data Arrangement, Matrix/Table-Based Data Arrangement, Parallel/Double Row Arrangement, Attributes/Property-Based Arrangement (with multipl characteristics), Sequencing and Ranking Arrangement, Floor/Building Arrangement, Conditional Arrangement (with Direct and Indirect Clues), Application of Consolidated Table and Matrix Methods.

Textbook -1, Ch-14-18

Module-3	**8 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 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.

Clocks and Calendars

Clocks: Calculation of Angle Between Hands (Hour, Minute, Second), Time Gains and Losses by Clocks, Number of Times Hands Coincide or Oppose, Incorrect/Slow/Fast Clocks, Mirro and Water Image Questions on Clocks, Alarm and Time Calculation Problems, Calculation of Overlapping/Adjacent Hands, Problems on Clock Striking.

Calendars: Odd Days Concept, Leap Year and Ordinary Year Calculation, Counting Odd Days in Multiple Years, Day of the Week Calculation for a Given Date, Calendar Repetition, Month and Year Code Methods, Finding Dates with Same Day, Calculation of Future/Past Day from Given Day, Number of Sundays/Saturdays/Specific Weekdays in a Period, Day-Differenc Problems.

Textbook -1, Ch6-9 & 13-16

Module-4	**8 Hrs**

Data Interpretation

Tables, Bar Graphs, Line Graphs, Pie Charts, Caselets (Paragraph-based Data Sets), Rada Charts, Mixed or Combination Graphs (Multiple Data Forms Together), Data Comparison and Analysis, Calculation-Based Data Interpretation, Ratio and Percentage Interpretation, Dat Sufficiency in Data Interpretation.

Ages

Present age and future age calculations, past age calculations, age problems in ratios, age difference problems, multiple or submultiple age relations, product of ages problems, age problems involving sum of ages, age relationships in family contexts, age-based word problem with equation formulation, and age problems involving time intervals such as years ago o years hence.

Crypt arithmetic

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

Syllogisms

Basic Concepts of Syllogism, Types of Statements (A, E, I, O), Venn Diagram Representation, Rules of Syllogism, Direct and Indirect Syllogism Questions, Condition-based Syllogism, Coded Syllogism, Double/Triple Syllogism Problems, Syllogism with Quantifiers, Syllogism in Dat Interpretation, and Conclusions Drawing from Statements.

Textbook -1, Ch28-29

Module-5	**8 Hrs**

Mensuration

Basic Geometrical Figures, Perimeter and Area of Plane Figures (Square, Rectangle, Triangle, Parallelogram, Rhombus, Trapezium), Area and Circumference of Circle, Area of Sector and Segment of a Circle, Surface Area and Volume of Cuboid, Surface Area and Volume of Cube, Surface Area and Volume of Cylinder, Surface Area and Volume of Cone, Surface Area and Volume of Sphere and Hemisphere, Frustum of a Cone, Conversion between Units of Measurement, Application-Based Problems on Mensuration.

Data sufficiency

Statement Evaluation, Identifying Sufficient and Insufficient Statements, Dealing with Irrelevant Information, Definite vs. Indefinite Information, Elimination Method, Dat Sufficiency on Blood Relations, Data Sufficiency on Order and Ranking, Data Sufficiency o Direction and Distance, Data Sufficiency on Coding-Decoding, Data Sufficiency on Seating Arrangement, Data Sufficiency on Puzzles, Data Sufficiency on Syllogism, Data Sufficiency on Alphanumeric Series.

Visual Reasoning and Cubes

Visual Reasoning: Figure/Image Series Completion, Odd-One-Out (Visual Discrimination), Mirror Images, Water Images, Embedded Figures, Paper Folding and Cutting, Analytical Puzzles with Patterns, Figure Counting, Pattern Completion, Analogy in Figures, Classification of Visual Data, Venn Diagrams, Direction and Distance with Visuals.

Cubes: Basic Properties of Cubes (Faces, Vertices, Edges), Cube and Dice Basics, Counting of Smaller Cubes, Painted Cube Problems (Counting Cubes with 0/1/2/3 Painted Faces), Cube Cutting and Partitioning, Dice (Number/Colour/Letter Arrangements), Unfolded (Net) Cube to Folded Cube Problems, Opposite and Adjacent Faces of Dice, Identification of Hidden Surfaces, Face Rotation and Positioning, Shortcuts and Tricks for Cubes and Dice Problems

Para Jumbles and Cloze Test

Sentence Jumble/Ordering, Identification of Opening/Closing Sentences, Logical Sequencing and Linking, Transitional Words and Connectors, Theme Identification in Jumbled Passages, Cloze Test with Contextual Blanks, Vocabulary and Grammar-based Blanks, Contextual Inference for Blank Filling, Error Detection in Cloze Test.

Reading Comprehension

Main Idea Identification, Factual/Inference-based Questions, Tone and Attitude Analysis, Vocabulary in Context, Passage Summarization, Structure and Organization of Passage, Logical Completion of Paragraphs, Supporting/Contradicting Evidence, Eliminating Irrelevant Information, Comparative Comprehension Passages.

Critical Reasoning
Assumption-Based Questions, Strengthen/Weaken the Argument, Inference Drawing, Conclusion Identification, Evaluating Arguments and Evidence, Identifying Flaws i Reasoning, Paradox/Discrepancy Resolution, Cause-and-Effect Reasoning, Analogy and Parallel Reasoning, Application of Logical Principles. **Textbook 1,Ch22-25, Textbook 2 & 3**

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	Develop reading, vocabulary and grammar through para jumbles, sentence completio 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,** R.S. Aggarwal Chand Publishing. – 2023.
2	**Word Power Made Easy,** Norman Lewis, Published by PENGUIN INDIA – 2015, (ISBN- 978-0143424680)
3	**How to Prepare for Quantitative Aptitude for the CAT,** Arun Sharma 6th Edition, McGraw-Hill Education – 2014, (ISBN- 978-9339205126)

Reference Books	
1	**Puzzle Test & Seating Arrangements,** K. Kundan,1st Edition, BSC Publishing Company Pvt Ltd. – 2023, (ISBN: 9789394666023)
2	**A Modern Approach to Verbal & Non-Verbal Reasoning,** 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**
CO1	3	2									1
CO2	2	2									
CO3	1	1							3		
CO4	2	2	2						2		1
CO5	3	3	2								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

P.B. No.20, B.B Road,

Chikkaballapur - 562 101, Karnataka