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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
Aeronautical Engineering
(2024 Scheme)

Core Values

Spiritual, Judicious, Commitment, Integrity, Trustworthy



NATIONAL INSTITUTIONAL RANKING FRAMEWORK 151-300

A+ NAAC

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.–Aeronautical Engineering

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

4th Semester

Aeronautical 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	BAE401	Aerodynamics	PCC	AE	3	0	0	**3**	**50**	**50**	**100**	**3**
2	BAE402	Mechanics of Materials	IPCC	AE	3	0	2	**3**	**50**	**50**	**100**	**4**
3	BAE403	Aircraft Propulsion	IPCC	AE	3	0	2	**3**	**50**	**50**	**100**	**4**
4	BBI404	Biology for Engineers	BSC	CHE	2	0	0	**3**	**50**	**50**	**100**	**2**
5	BAEL405	Aerodynamics Lab	PCCL	AE	0	0	2	**3**	**50**	**50**	**100**	**1**
6	BAE406x	ESC/ETC/PLC	ESC	AE	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	BAE408x	Ability Enhancement Course/Skill Enhancement Course – IV	AEC/ SEC	AE	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	Meta physical Science	HSSMC	ANY DEPT	1	0	0	**1**	**50**	**50**	**100**	**1**

10	BNS410	National Service Scheme(NSS)	NCMC	NSS Coordinator	0	0	2	-	**100**	-	**100**	**0**
	BPE410	Physical Education (PE) (Sports and Athletics)		Physical Education Director								
	BYO410	Yoga		Yoga Teacher								
	BMU410	Music		Music Teacher								
11	BCE411	CompetencyEnhancementCourse-2	NCMC	CDCAC	2	0	0	-	**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
BAE406A	Introduction to Combustion	BAE406C	Introduction to Drone Technology
BAE406B	Additive Manufacturing	BAE406D	Machine Learning Applications in Aerospace

Ability Enhancement Course/Skill Enhancement Course–IV

Course Code	Course Name	Course Code	Course Name
BAE408A	Statistical Quality Control & Reliability	BAE408D	Bio-Inspired Computation
BAE408B	Concept of Augmented Reality	BAE408E	Aviation Safety Rules and Regulations
BAE408C	Fundamentals on Spreadsheet		

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 bee valuated 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.) 2024-25may please be referred.

National Service Scheme / Physical Education/Yoga/Music: All students have to register for anyone 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 d uring the first week of 3rdsemester. Activities shall be carried out between 3rdsemester 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 hall 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	**:**	BAE401	**Credits**	**:**	3
Hours/Week (L:T:P)	**:**	3:0:0	**CIE**	**:**	50 Marks
Total Hours	**:**	50L	**SEE**	**:**	50 Marks
Course Type	**:**	PCC	**SEE Duration**	**:**	3 Hours
Prerequisites:					
Courses	• Fluid Mechanics				
Knowledge on Fundamental Concepts	Basic principles of fluids, Types of flows, Energy and flow equations				
Knowledge on Connected Tools (If any)	--				

Course Learning Objectives: This course will enable the students

CLO1	Understand airfoil nomenclature and characteristics in incompressible and compressible flow conditions.
CLO2	Acquire knowledge of two- and three-dimensional flows using vortex lattice and lifting line theories.
CLO3	Study finite wings and high-lift devices like flaps and slats for performance enhancement.
CLO4	Learn compressible flow principles, including area variation and Mach number effects on flow.
CLO5	Understand shock wave and expansion wave theories to solve supersonic aerodynamic problems.

Module-1	**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, Substantial Derivative and its fundamental equation, Numericals.

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. Numericals.

Text Book: 1, Ch2 :2-2.9, 3.9 - 3.16, 3.20 & 4.4 - 4.8

Module-2	**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's lifting line theory. Extended lifting line theory lifting surface theory, vortex lattice method for wings. Lift, drag and moment characteristics of complete airplane.

Text Book: 1 Ch5: 5 5.1 - 5.5

Module-3	**08 Hrs**
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, pressure coefficient, typical aerodynamic characteristics, Subsonic and Supersonic leading edges. Introduction to high-lift systems, flaps, leading-edge slats and typical high – lift characteristics. Critical Mach numbers, Lift and drag divergence, shock induced separation, Effects of thickness, camber and aspect ratio of wings, Transonic area rule, Tip effects. Introduction to Source panel & vortex lattice method. **Text Book: 1 Ch3: 3 3.17, 4.13, 4.17, 5.3, 5.5, 7.22, 12.3** **Text Book: 3 Ch5:5 5.9, 5.10, 5.16 & 5.17**	
Module-4	**08 Hrs**
Basics of Compressible Flow Basics of thermodynamics-definition and basic relation, Energy Equation- For flow and non-flow process, adiabatic energy equation, stagnation pressure, temperature, density, reference velocities, Bernoulli's equation, Effect of Mach number on Compressibility, **Isentropic flow with variable area**-Area ratio as a function of Mach number, Impulse function, Mass flow rate, Flow through nozzles and diffusers, numericals. **Text Book: 2 Ch2:2 2.1 - 2.6, 2.9 - 2.11 & 4.4 - 4.8**	
Module-5	**08 Hrs**
Normal Shock Waves: Development of the shock waves, Rarefaction wave, Governing equations, Prandtl-Meyer Relation, Mach Number Downstream of the Normal Shock, Property Ratios across the shock, Strength of the shock waves, Numericals. **Oblique Shock Wave**: Nature of Flow through oblique Shock waves, Fundamental relations, Prandtl's Equation, Rankine-Hugoniot equation, variation of flow parameters, Mach Waves, Numericals. **Text Book: 2 Ch6: 6 6.1 - 6.6, 6.12, 7.1 - 7.5, 7.7**	

Course Outcome : At the end of the course, the student will be able to

CO1	Explain airfoil nomenclature, aerodynamic characteristics, and thin airfoil theory for basic flow understanding.
CO2	Apply lifting line theory and vortex lattice methods to analyze finite wings and 3D flows.
CO3	Evaluate aerodynamic performance of high-lift devices like flaps, slats, and analyze ground effects.
CO4	Analyze isentropic compressible flows through area variation, stagnation conditions, and Mach number effects.
CO5	Solve problems involving shock waves, Prandtl-Meyer expansions, and shock-expansion theory in supersonics.

Text Books

1 Fundamental of Aerodynamics, Anderson J.D, 5th edition, McGraw-Hill International Edition, New York 2011, ISBN-13: 978-0073398105.
2 Fundamentals of Compressible flow, Yahya, S.M, Wiley Eastern, 2003.
3 Introduction to Flight, John D. Anderson, Copyright © 2010, 2007, 2004, 1999, 1996 by The McGraw Hill Companies, Inc. ISBN (13): 978-0-07-070011-6

Reference Books

1 Aerodynamics, Clancy L. J. Sterling book house, New Delhi. (2006), ISBN 13: 9780582988804

2 Theoretical Aerodynamics, Louis M. Milne-Thomson, Imported Edition, Dover Publications, USA (2011), ISBN 9780486619804.

3 Gas Dynamics, Radhakrishnan, E, Prentice Hall of India.1995 edition.

4 Aerodynamics for Engineering Students, E. L. Houghton, P.W. Carpenter, 5th edition, Elsevier, New York. (2010), ISBN-13: 978-0080966328

Web links and Video Lectures (e-Resources)

1 https://archive.nptel.ac.in/courses/101/105/101105059/

2 https://archive.nptel.ac.in/courses/101/105/101105088/

CO -PO MAPPING

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

Semester: IV					
Mechanics of Materials					
Course Code	:	BAE402	**Credits**	:	4
Hours/Week (L:T:P)	:	3:0:2	**CIE**	:	50 Marks
Total Hours	:	40L+12P	**SEE**	:	50 Marks
Course Type	:	IPCC	**SEE Duration**	:	3 Hours
Prerequisites:					
Courses	• Introduction to civil engineering				
Knowledge on Fundamental Concepts	Concept of Stress , stain ,Elongation, Beams deflection, torsion ,fatigue, creep				
Knowledge on Connected Tools (If any)	--				

Course Learning Objectives: This course will enable the students

CLO1	Comprehend the basic concepts of strength of materials.
CLO2	Acquire the knowledge of stress, strain under different loading
CLO3	Understand the different properties of materials.

Module-1	**08 Hrs**

Simple Stress and strain : Introduction to Stress, Types of stress, Strain, Types of Strain, Modulus of Elasticity, True Stress, True Strain, Simple problems, Stress Strain Diagram of Ductile, Brittle, Visco- Elastic, Linear & Non-linear Elastic material Bars with varying sections, Bars of composite sections, Thermal stresses, Simple problems, **Elastic constants** and its relation, volumetric stains, Numerical problems.

Text Book:1 Ch 2:2.1-2.10

Text Book:2 Ch 1:1.1-1.8

Module-2	**08 Hrs**

Compound Stresses: Introduction to Plane stress, stresses on inclined sections, principal stresses & strains,

Mohr's Circle: Analytical & graphical method (Mohr's Circle) to find principal stresses& strains, Numerical problems

Text Book:1 Ch 7:7.1-7.8

Text Book:2 Ch 10:10.1-10.8

Module-3	**08 Hrs**

Bending Moment & Stresses in beams: Introduction, Types of beams, loads and reactions, shear forces and bending moments, rate of loading, sign conventions, relationship between shear force and bending moments. Shear force and bending moment diagrams for different beams subjected to Concentrated loads, uniformly distributed load, (UDL) uniformly varying load (UVL) and couple for different types of beams.

Shear Force &shear stress in Beams: Bending stress equation, Moment carrying capacity of a section. Shearing stresses in beams, shear stress across rectangular, circular, symmetrical I and T sections (Only Numerical)

Text Book:1.Ch3: 3.1-3.7,4.1-4.6

Text Book:2.Ch4: 4.1-4.6,5.1-5.8

Module-4	**08 Hrs**
Deflection of Beams and Torsion of Circular Shafts: 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**.** **Introduction to torsion of shaft**. Pure torsion, assumptions, derivation of torsional equations, polar modulus, torsional rigidity / stiffness of shafts. Power transmitted by solid and hollow circular shafts, Numerical problems. **Text Book:1 Ch 5:5.1-5.7,6.1-6.9** **Text Book:2.Ch7:7.1-7.5,9.1-9.7**	
Module-5	**08 Hrs**
Column, struts and Mechanical properties of materials: Introduction to columns and struts, Failure of a column, Expression of crippling load when (a) both ends are hinged (b) One end of the column is fixed and the other end is free (c) both ends are fixed (d) One end is fixed and the other end is hinged. Simple problems to be solved used Euler's formula and Rankine formula. **Mechanical properties of materials** Fracture: Type I, Type II and Type III. Creep: Description of the phenomenon with examples. Three stages of creep, creep properties, stress relaxation. Fatigue: Types of fatigue loading with examples, Mechanism of fatigue, fatigue properties, fatigue testing and S-N diagram. **Text Book:1.Ch 9:9.1-9.7** **Text Book: 2.Ch 14:14.1-14.7**	

Practical Component of IPCC

Sl.No.	**Experiments**
1	Rockwell hardness test on various specimens.
2	Brinell hardness test on various specimens.
3	Vicker's hardness test on various specimens
4	Izod test on various specimens using impact-testing machines.
5	Charpy test on various specimens using impact-testing machines
6	Tensile test of metallic and non-metallic specimen using Universal Testing
7	Compression test of metallic and non-metallic specimen using Universal Testing Machine.
8	Shear and Bending tests of metallic and non-metallic specimen using Universal Testing Machine.
9	Torsion test on metallic specimen using torsion testing machine
10	To study the wear characteristics of metals and non-metal materials under different parameters.
11	Preparation and study of the Microstructure of pure metals Mild Steel, LowCarbon steel and High Carbon Steel.
12	To study the defects of cast and welded components using non-destructive tests: a. Magnetic crack detection. b. Dye penetration testing.
13	Fatigue Test (demonstration only).

Course Outcomes : At the end of the course, the student will be able to	
CO1	Understand the mechanical behavior and elastic constants of materials, and stress-strain relationships.
CO2	Evaluate the shear force, bending moment, deflection and torsion for various beams under different types of loads.
CO3	Determine the torque for a circular shaft and calculate stability of columns for different end condition.
CO4	Apply the load on beam and load acting on the column.
CO5	Classifying the Mechanical properties of materials such as fatigue, fracture and creep.

Text Books

1. Strength of Materials, S.S.Bhavaikatii, Vikas Publications House, New Delhi, 2012, ISBN-13: 978- 8125927914
2. Strength of Materials, Ramamritham, R Narayanan, DhanapathRai Publishing Company, New Delhi

Reference Books

1. Introduction to Aircraft Structural for Engineering students T.H.G Megson, Butterworth-Heinemann Publications, 2017,ISBN 13: 978-93-82291-05-3
2. Mechanics of Materials, Beer .F.P. and Johnston .R, McGraw Hill Publishers, 2006, ISBN-13:978-0073380285.
3. Elements of Strength of Materials, Timoshenko and Young , East-West Press, 1976, ISBN 10:8176710199.
4. Structural Analysis, O.A. Bauchau and J.I. Craig,Springer Dordrecht Heidelberg London New York,ISBN978-90-481-2515-9, e-ISBN 978-90-481-2516-6

Web links and Video Lectures (e-Resources)

1. https://nptel.ac.in/courses/105106172

CO -PO MAPPING

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

Semester: IV					
AIRCRAFT PROPULSION					
Course Code	:	BAE403	**Credits**	:	4
Hours/Week (L:T:P)	:	3:0:2	**CIE**	:	50 Marks
Total Hours	:	40L+12P	**SEE**	:	50 Marks
Course Type	:	IPCC	**SEE Duration**	:	3Hours
Prerequisites:					
Courses	• Thermodynamics • Fluid Mechanics • Fundamentals of Aircrafts				
Knowledge on Fundamental Concepts	Units and dimensions (SI units especially) Review of thermodynamic principles,				
Knowledge on Connected Tools (If any)	--				

Course Learning Objectives: This course will enable the students

CLO1	Identify the basic principle and theory of aircraft propulsion
CLO2	Understand the purpose of centrifugal, axial compressors, axial and radial turbines.
CLO3	Acquire knowledge of importance of nozzles & inlets and combustion chamber.

Module-1	**08 Hrs**

Introduction: Principles of aircraft propulsion, Types of power plants, Working principles of internal combustion engine, Two – stroke and four – stroke piston engines, **Air breathing engines:** Turbojet-thrust equation, turboprop, turbofan & turbo shaft engines construction & working principle, Factors affecting thrust, Performance comparison of each with P-V,T-S Diagram, Numerical Calculations on Thrust and SFC, Methods of thrust augmentation

Text Book 1: Ch4: 4.1-4.6,7.1-7.11.

Module-2	**08 Hrs**

Propeller Theories: Types of propeller, Propeller thrust: momentum theory, Blade element theories, propeller blade design, and propeller selection.

Inlets, Nozzles for Jet Engine: Internal flow and Stall in subsonic inlets , relation between minimum area ratio and external deceleration ratio , diffuser performance, supersonic inlets, starting problem on supersonic inlets, shock swallowing by area variation, Real flow in nozzles and nozzle efficiency, losses in nozzles, Nozzle efficiency, Losses in nozzles. Over-expanded and under-expanded nozzles, Ejector and variable area nozzles, Thrust reversal

Text Book 1: Ch13: 13.1-13.5,

Module-3	**08 Hrs**

Compressors: Centrifugal Compressor: Principle and working, Work done and pressure rise, Blade Shapes & Velocity Triangles, Diffuser, Volute Casing, Effect of Losses, Compressor Characteristics, Surging and Choking

Axial flow compressor: Geometry and working, Elementary theory of axial flow compressor, Velocity triangles, Compressor Stage Efficiency, Effect of Losses, Pressure rise calculations, Centrifugal and Axial compressor, Performance characteristics.

Text Book 1: Ch8: 8.1-8.11, 9.1-7.14.

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

Advanced Combustion Chamber for Aircraft engines: Lean Premixed Prevaporized (LPP) Combustion, Rich-Burn, Quick-Quench, Lean-Burn (RQL) Combustors, Annular and Twin-Annular Pre-Swirl (TAPS) Combustors, Supersonic Combustion, Alternative Fuels and Their Impact on Combustor Design, Cooling Technologies for Combustor Liners.

Text Book 1: Ch10: 10.1-10.10, 9.1-7.14.

Module-5	**08 Hrs**

Axial Flow Turbines: Introduction, Turbine stage, Multi-staging of turbine, Exit flow conditions, Turbine cooling, Heat transfer in turbine cooling.

Radial turbine: Introduction, Thermodynamics of radial turbines, Losses and efficiency.

Fundamentals of Rocket Propulsion: Introduction, Classification of chemical rockets ,Thrust equation and specific impulse, vehicle acceleration, drag, gravity losses, multi-staging of rockets., performance of solid and liquid propellant rockets.

Text Book 1: Ch17: 17.1-17.7,

Practical Component of IPCC

Sl.No.	**Experiments**
1	Study of an aircraft piston engine. (Includes study of assembly of sub systems, various components, their functions and operating principles)
2	Study of an aircraft jet engine (Includes study of assembly of sub systems, various components, their functions and operating principles)
3	Measurement of nozzle flow.
4	Study of free and wall jet.
5	Study of performance of a propeller.
6	Study of free convective heat transfer over a aerofoil plate.
7	Study of forced convective heat transfer over a flat plate.
8	Determination of heat of combustion of aviation fuel.
9	Cascade testing of a model of axial compressor blade row.
10	Cascade testing of a model of turbine blade row.
11	Measurement of burning velocity of a premixed flame
12	Study of the flame lift up and fall back phenomenon for varied Air/Fuel ratio.

Course Outcomes : At the end of the course, the student will be able to	
CO1	Identify the principles and types of power-plants
CO2	Summarize the principles of propeller and jet propulsion principles
CO3	Illustrate the flow through inlets and nozzles at different flow regimes
CO4	Examine the operating principles of centrifugal and axial flow compressors
CO5	Analyze different types of combustors and turbines with their performance characteristics

Text Books

1. Gas Turbines, V. Ganesan, Tata McGraw-Hill, 2010, New Delhi, India, ISBN: 0070681929.
2. Aircraft propulsion, Bhaskar Roy, Elsevier, 2011, ISBN-13: 9788131214213.

Reference Books

1. Mechanics & Thermodynamics of Propulsion, Hill, P.G. & Peterson, C.R, Addison – Wesley Longman INC,1999, ISBN-13: 978-0201146592.
2. Gas Turbine Theory, Cohen, H. Rogers, G.F.C. and Saravanamuttoo, H.I.H**,** Longman, 1989, ISBN 13:9780582236325.
3. Gas Turbine Engine Technology, Irwin E. Treager, GLENCOE Aviation Technology Series, 7th Edition, Tata 09082023 04.08.23 49 McGraw Hill Publishing Co. Ltd. Print 2003, ISBN-13: 978-0028018287.

Web links and Video Lectures (e-Resources)

1. http://nptel.ac.in/courses/101106033/
2. http://nptel.ac.in/courses/101101001/
3. http://nptel.ac.in/courses/101101002/
4. http://nptel.ac.in/courses/101104019/
5. https://ocw.mit.edu/courses/aeronautics-and-astronautics/16-01-unified-engineering-i-ii-iii-iv-fall-2005-spring-2006/propulsion/
6. https://www.coursera.org/learn/aerospace-engineering

CO -PO MAPPING

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

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 (If any)	--				

Course Learning Objectives: This course will enable the students

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	**08 Hrs**

Introduction to Biology

The cell: the basic unit of life, Structure and functions of a cell. The Plant Cell and animal cell, Prokaryoticand 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. Ch1: Ch 2: Ch3: Ch4:
Textbook 2. Ch 3: Ch4:
Textbook 3. Ch 1: Ch. 2: Ch 3:
Textbook 4. Ch2: Ch 3: Ch 4:

Module-2	**08 Hrs**

Bio molecules 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), Proteins (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. Ch5:& Ch6:
Textbook 2. Ch 4:& Ch 20:
Textbook 3. Ch 5:
Textbook 4. Ch7:& Ch8:

Module-3	**08 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 exchange mechanisms, spirometry, abnormal lung physiology - COPD, Ventilators, Heart-lung machine). Kidney as a filtration system (architecture, mechanism of filtration, CKD, dialysis systems). **Textbook 1. Ch7: Ch11:** **Textbook 2. Ch 7: 10, 13, 16 & 17** **Textbook 3. Ch 6:** **Textbook 4. Ch 9: & 10.**	
Module-4	**08 Hrs**
Nature-Bio inspired 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 carbons (PFCs). **Textbook 1. Ch 12: &13,** **Textbook 2. Ch 2: &3** **Textbook 3. Ch 7:** **Textbook 4. Ch12: & 14.**	
Module-5	**08 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 Bioremediation and Biomining via microbial surface adsorption (removal of heavy metals like Lead, Cadmium, Mercury, Arsenic). **Textbook 1. Ch14: &15,** **Textbook 2. Ch 20:** **Textbook 3. Ch 8:** **Textbook 4. Ch 15:**	
Course Outcome : At the end of the course, the student 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 in 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, Arthur T. Johnson, CRC Press, Taylor and Francis, 2011
4. 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.

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
   https://www.futurelearn.com/courses/biology-basic-concepts

CO - PO MAPPING

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

Semester: IV					
Aerodynamics Lab					
Course Code	:	BAEL405	**Credits**	:	1
Hours/Week (L:T:P)	:	(0:0:2)	**CIE**	:	50 Marks
Total Hours	:	15P	**SEE**	:	50 Marks
Course Type	:	PCCL	**SEE Duration**	:	3 Hours

Course Learning Objectives: This course will enable the students	
CLO1	Be acquainted with basic principles of aerodynamics using wind tunnels.
CLO2	Acquire the knowledge on flow visualization techniques.
CLO3	Understand the procedures used for calculating the lift and drag.
Sl. No.	**Experiments**
1	Calibration of a subsonic wind tunnel: test section static pressure and total head distributions.
2	Smoke flow visualization studies on a two-dimensional circular cylinder at low speeds.
3	Smoke flow visualization studies on a two dimensional airfoil at different angles of incidence at low speeds
4	Smoke flow visualization studies on a two dimensional multi element airfoil with flaps and slats at different angles of incidence at low speeds
5	Tuft flow visualization on a wing model at different angles of incidence at low speeds: identify zones of attached and separated flows.
6	Surface pressure distributions on a two-dimensional symmetric airfoil at different angles of incidence at low speeds.
7	Surface pressure distribution 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.
11	Calculation of aerodynamic coefficients and forces acting on a model aircraft at various Angle of Attack and speeds using wind tunnel balance (With and Without Yaw).
12	Pressure measurements on aerofoil for a case of reverse flow.
13	Surface pressure distributions on a two-dimensional smooth circular cylinder at low speeds and calculation of pressure drag.
Course Outcomes : At the end of the course, the student will be able to	
CO1	Calibrate the wind tunnel for various motor speeds
CO2	Analyze the results of smoke and tuft flow visualization techniques
CO3	Calculate and Plot the pressure distribution around different airfoils and circular cylinders using pitot-static probes
CO4	Estimate the drag co-efficient for 2-D and 3-D models using pitot-static wake survey method
CO5	Predict the boundary layer velocity profile on wind tunnel wall and on the

	airfoil using pitot-static wake survey method

CO -PO MAPPING

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

Semester: IV					
Introduction to Combustion					
Course Code	**:**	BAE406A	**Credits**	**:**	3
Hours/Week (L:T:P)	**:**	3:0:0	**CIE**	**:**	50 Marks
Total Hours	**:**	40L	**SEE**	**:**	50 Marks
Course Type	**:**	ESC	**SEE Duration**	**:**	3 Hours
Prerequisites:					
Courses	• Engineering Chemistry, • Engineering Physics • Aero Thermodynamics				
Knowledge on Fundamental Concepts	Basic chemical Thermodynamics, Process of formation of flames, Law of conservation of energy.				
Knowledge on Connected Tools (If any)	--				

Course Learning Objectives: This course will enable the students

CLO1	Understand the burning of any substances in air.
CLO2	Know about the essentials or requirements to produce fire.
CLO3	Learn understand different types of combustion.
CLO4	Observe the materials forming flames or not

Module-1	**08 Hrs**
Review of Basic Concepts: Laws of thermodynamics, simple thermo chemical equations, and heat of combustion, properties of real gases. **Chemical Equilibrium And Kinetics:** Concept of chemical equilibrium, Elements of adiabatic flame temperature calculation, Chemical kinetics – rates and order of reactions, Reaction mechanism and chain reactions. **Text book 1 – Ch2: 2 – 2.1, 2.2, 2.3, 2.4 ,2.5**	
Module-2	**08 Hrs**
Combustion thermodynamics: Theoretical (Stoichiometric) air and excess air for combustion of fuels. Mass balance, actual combustion. Exhaust gas analysis. A/F ratio, Energy balance for a chemical reaction, enthalpy of formation, enthalpy and internal energy of combustion, Combustion efficiency, adiabatic flow temperature. **Text book 2 – Ch2: 3 – 3.1, 3.2, 3.3, 3.4, 3.5, 3.6.**	
Module-3	**08 Hrs**
Premixed Flames: Mechanistic description of premixed flames, Burning velocity and parametric dependences, Experimental methods of measuring burning velocity, Flames: Introduction, Flame Temperature and burning velocity, Laminar Flame theory – steady, one-dimensional Flow, Steady Non planer and Super adiabatic Flames, Flames properties and structure, flames instabilities, Decomposition and unusual flames, ionization in flames, Spray Droplet and Dust Flames, problems. **Textbook 2 – Ch8: 8.1, 8.2, 8.3, 8.4, 8.5, 8.6, 8.7, 8.8, 8.9**	

Module-4	**08 Hrs**
Combustion in Piston Engines: Review of operation of reciprocating engines, Description of the combustion process in piston engines, Combustion efficiency and factors affecting it, detonation in reciprocating engines and preventive methods. Combustion in Gas-Turbine Engines: Description of different types of combustion chambers in gas-turbine engines, primary requirements of the combustor, Flow structure, recirculation and flame stabilization in main combustion chamber, afterburners. **Textbook 3– Ch6: 6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7.**	
Module-5	**08 Hrs**
Combustion in Rocket Engines: Combustion of carbon particle, boundary layer combustion, basic principles of combustion solid propellants, extension of droplet combustion to liquid propellant rockets. Emissions: Flame radiation, pollutants – un burnt hydrocarbons, oxides of nitrogen and carbon monoxide, methods of reducing pollutants, Principle of exhaust gas analysis. **Textbook 2 – Ch16: 16.1, 16.2, 16.3, 16.4, 16.5.**	

Course Outcomes : At the end of the course, the student will be able to

CO1	Evaluate Explain basic combustion principles and chemical thermodynamics.
CO2	Analyze combustion reactions using kinetic theory and flame propagation models.
CO3	Describe the combustion techniques & flames
CO4	Evaluate pollutant formation and emission control techniques.
CO5	Understand combustion applications in various aerospace propulsion systems.

Text Books

1. An Introduction to Combustion, Stephen R. Turns**,** McGraw Hill
2. Combustion fundamentals**,** Roger Strehlow
3. Combustion, R. Yetter, & N. Glumac, I. Glassman,– Academic Press

Reference Books

1. Fuels and Combustion Sharma, S.P and Chandra Mohan, Tata Mc.Graw Hill Publishing Co.Ltd., New Delhi, 1987.
2. Gas Turbine, Jet and Rocket Propulsion, Mathur.M.L , and Sharma,R.P, Standard Publishers and Distributors, Delhi, 1988
3. Combustion, Fossil Power Systems, G. Singer, 4th Ed. 1966 Ed Pub.

Web links and Video Lectures (e-Resources)

1. https://nptel.ac.in/courses/101104014/
2. https://nptel.ac.in/courses/101106037/2

CO -PO MAPPING

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

Semester: IV					
Additive Manufacturing					
Course Code	:	BAE406B	**Credits**	:	3
Hours/Week (L:T:P)	:	3:0:0	**CIE**	:	50 Marks
Total Hours	:	40L	**SEE**	:	50 Marks
Course Type	:	ESC	**SEE Duration**	:	3 Hours

Prerequisites:	
Courses	• Computer Aided Aircraft Drawing
Knowledge on Fundamental Concepts	Components of aircraft
Knowledge on Connected Tools (If any)	--

Course Learning Objectives: This course will enable the students

CLO1	Know the principle methods, areas of usage, possibilities and limitations of the Additive Manufacturing
CLO2	Learn the characteristics of the different materials those are used in Additive Manufacturing
CLO3	Understand the principles of polymerization and powder metallurgy process, extrusion-based system printing
CLO4	Acquire the knowledge of application of additive manufacturing in Aeronautical and Aerospace field

Module-1	**08 Hrs**

Introduction and basic principles: Need for Additive Manufacturing, Generic AM process, stereo lithography or3dprinting, rapid proto typing, the benefits of AM, distinction between AM and CNC machining, other related technologies- reverse engineering technology.

Development of Additive Manufacturing Technology: Introduction, computers, computer-aided design technology, other associated technologies, the use of layers, metals systems, hybrid systems, variations from one AM machine to another ,metal systems,

TextBook:1Ch1:1to 3

Module-2	**08 Hrs**

3D Printing Materials: Various forms of 3D printing raw material- Liquid, Solid, Wire, 3D printing materials-Polymers, Metals, Non- Metals, Ceramics-Polymers and their properties-Powder Preparation and their desired properties.

Solid based 3DPrinting Processes

Basic principle of Solid based 3D printing processes; Constructional details, Basic Principle and working of fused deposition modeling (FDM) process; Post Processing of FDM and other Solid based 3D Printed components. Troubleshooting Common Issues, Applications of FDM, DED and SL; Advanced Concepts and Future Trends.

TextBook:1Ch2:2

Module-3	**08 Hrs**

Liquid based 3D Printing Processes: Basic principle of Liquid based 3D printing processes; Photo Polymerization-Principle and working of stereo lithography apparatus SLA based 3D printing processes-Curing processes; Applications; Post Processing;

Advanced Concepts and Future Trends.

Powder based 3D Printing Processes: Powder fusion mechanism-Principle and working of Selective Laser Sintering (SLS) process-SLS based 3D printers-Laser Engineering, Net Shaping process-Electron Beam Melting Binder Jet 3D Printing; Applications; Post Processing; Advanced Concepts and Future Trends.

TextBook: 1Ch4:4 & 5

Module-4	**08 Hrs**

Guidelines for Process Selection: Introduction, selection methods for apart, challenges of selection, example system for preliminary selection, production planning and control.

Software issues for Additive Manufacturing: Introduction, preparation of cad models – the STL file, problems with STL files, STL file manipulation.

Post- Processing: Support material removal, surface texture improvements, preparation for use as a pattern, property enhancements using non-thermal techniques and thermal techniques.

TextBook:Ch12:12

Module-5	**08 Hrs**

Direct digital manufacturing: Align Technology, Siemens and Phonak, DDM drivers, manufacturing vs. prototyping, life- cycle costing, and future of direct digital manufacturing.

Recent 3D Printing Application trends, Tooling, Aerospace, Oil & Gas, Automotive Industries, Medical & Healthcare, Consumer Goods, Construction, Education & Research, Oil and Gas

Text Book: Ch:14

Course Outcomes : At the end of the course, the student will be able to

CO1	Understand the fundamentals of need for computers and its related technologies for Additive manufacturing.
CO2	Analyze the benefits, drawbacks and applications of various Photo polymerization processes in 3D printing
CO3	Demonstrate various Additive manufacturing software tools, its issues & also Post processing techniques
CO4	Identify the challenges involved in Production Planning, Software issues and Post processing techniques
CO5	Elaborate the use of multiple materials in additive manufacturing & its applications in various domains

Text Books

1 Additive Manufacturing Technologies Rapid Prototyping to Direct Digital Manufacturing, Gibson D. W. Rosen, B.Stucker, Springer New York Heidelberg Dordrecht, London, ISBN: 978-1- 4419-1119-3 e-ISBN: 978- 1-4419- 1120-9 DOI10.1007/978 -1-4419- 1120-9

2 Understanding additive manufacturing: rapid prototyping, rapid tooling, Andreas Gebhardt Hanser, Rapid manufacturing Publishers 2011 Edition.

Reference Books

1 Getting Started with 3D Printing: A Hands-on Guide to the Hardware, Software, and Services, Liza Wallach Kloski, Nick Kloski, Behind the New Manufacturing Revolution. Make Community, LLC; 2nd edition, 2021ISBN: 9781680450200

2 3D Printing and Design, Sabrie Soloman, Khanna Publishing House, Delhi ISBN: 9789386173768

3 Rapid Prototyping: Principles & Applications, Chua Chee Kai, Leong Kah Fai World Scientific 2003 Edition.

4 Additive Manufacturing Technology, Hari Prasad, A.V.Suresh, Cengage 2019 Edition

Web links and Video Lectures (e-Resources)

1 https://nptel.ac.in/courses/108108115

2 https://onlinecourses.swayam2.ac.in/ntr24_ed17/preview

3 https://online.umich.edu/courses/introduction-to-3d-printing-with-metals/

CO -PO MAPPING

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

Semester: IV					
Introduction to Drone Technology					
Course Code	**:**	BAE406C	**Credits**	**:**	3
Hours/Week (L:T:P)	**:**	3:0:0	**CIE**	**:**	50 Marks
Total Hours	**:**	40L	**SEE**	**:**	50 Marks
Course Type	**:**	ESC	**SEE Duration**	**:**	3 Hours
Prerequisites:					
Courses	• Fundamentals of Aircrafts • Aerodynamics				
Knowledge on Fundamental Concepts	Flight principles Components Control mechanisms				
Knowledge on Connected Tools (If any)	--				

Course Learning Objectives: This course will enable the students

CLO1	Provide foundational knowledge of UAV systems and their classifications.
CLO2	Understand drone aerodynamics, propulsion, and control mechanisms.
CLO3	Introduce the components and design aspects of drones.
CLO4	Explore drone navigation, communication, and autonomy.
CLO5	Familiarize students with applications, regulations, and ethical aspects.

Module-1	**08 Hrs**
Introduction to Drones and UAV Systems: Definition and classification of drones (Micro, Mini, Tactical, MALE, HALE, etc.) History and evolution of drone technology, Civil vs. military applications, Fixed-wing and rotary-wing drones, Introduction to drone architecture: airframe, sensors, propulsion, payload, communication **Text book 1 – Ch2: 2 – 2.1, 2.2, 2.3, 2.4 ,2.5**	
Module-2	**08 Hrs**
Drone Aerodynamics and Flight Mechanics: Basic principles of flight, Lift, drag, thrust, and weight considerations, Aerodynamic differences between fixed-wing and multirotor drones, Stability and control, Flight envelopes and performance metrics. **Text book 2 – Ch3: 3 – 3.1,3.9**	
Module-3	**08 Hrs**
Propulsion Systems and Drone Components: Types of propulsion: Electric motors, internal combustion engines, ESCs (Electronic Speed Controllers), batteries, and power systems, Propeller design and thrust calculation, Frames and materials, Assembly of drone components. **Textbook 2 – Ch8:8 – 8.1, 8.2, 8.3, 8.4, 8.5, 8.6, 8.7, 8.8, 8.9**	
Module-4	**08 Hrs**
Control, Navigation and Communication Systems: Basics of drone control: manual vs. autonomous. Flight controllers (e.g., Pixhawk, KK2, APM) Sensors: IMU, GPS, magnetometer, barometer, Communication protocols: RC, telemetry, Wi-Fi, and LoRa, Basics of waypoint navigation and path planning. **Textbook 2– Ch6: 6 – 6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7.**	
Module-5	**08 Hrs**

Applications, Regulations and Future Trends: Commercial, industrial, and scientific applications: agriculture, surveillance, delivery, mapping, Overview of DGCA Rules and regulations and UAV policy in India, Ethical and legal issues, Drone safety and fail-safes, Future of drone technology: swarm drones, AI, BVLOS operations

Textbook 2 – Ch16: 16 – 16.1, 16.2, 16.3, 16.4, 16.5.

Course Outcome : At the end of the course, the student will be able to

CO1	Understand the types, classifications, and historical evolution of drones.
CO2	Analyze drone aerodynamics and performance characteristics.
CO3	Explain propulsion systems and components used in UAVs.
CO4	Understand control mechanisms, communication, and navigation systems.
CO5	Explore current applications and future trends in drone technology.

Text Books

1 Unmanned Aircraft Systems, Austin.R, UAVS Design, Development and Deployment, Wiley

2 Introduction to UAV Systems, Paul G. Fahlstrom and Thomas J. Gleason, Wiley

Reference Books

1 UAV Fundamentals – MIT Open Course Ware, Supplementary.

2 ARDUINO and Drone Programming with Python/ROS – Various Authors

Web links and Video Lectures (e-Resources)

1 https://onlinecourses.nptel.ac.in/noc22_ae15/preview

2 https://onlinecourses.nptel.ac.in/noc22_ae16/preview

CO - PO MAPPING

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

Semester: IV					
Machine Learning Applications in Aerospace					
Course Code	**:**	BAE406D	**Credits**	**:**	3
Hours/Week (L:T:P)	**:**	3:0:0	**CIE**	**:**	50 Marks
Total Hours	**:**	50L	**SEE**	**:**	50 Marks
Course Type	**:**	ESC	**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	• Introduction to C- program • Python, IOT
Knowledge on Fundamental Concepts	IoT, Python
Knowledge on Connected Tools (If any)	C- program, Python

Course Learning Objectives: This course will enable the students

CLO1	Introduce students to machine learning techniques applied to health monitoring of satellites and aerospace systems.
CLO2	Develop an understanding of tensor-based anomaly detection and fuzzy logic for satellite telemetry data analysis.
CLO3	Familiarize students with the challenges in satellite monitoring, including risk and space environment factors.
CLO4	Enable students to design intelligent health monitoring systems using data mining and predictive models.
CLO5	Provide practical exposure to satellite simulator design, telemetry packet analysis, and validation techniques.

Module-1	**08 Hrs**
Health Monitoring of Artificial Satellites, Tensor-Based Anomaly Detection for Satellite Telemetry Data: Introduction, Satellite Telemetry Data Anomalies Detection, Tensor-Based Anomaly Detection (TAD), Supervised Models, Tensor Decomposition for Dimensionality Reduction, Tensor Classifier, Tensor Decomposition, Pervious Anomaly Detection Techniques for Satellite Telemetry Data, Tensor-Based Anomaly Detection Technique for Satellite Telemetry Data **Text Book: 1 Ch1: 1.1 - 1.6**	

Module-2	**08 Hrs**
Machine Learning in Satellites Monitoring and Risk Challenges: Satellite Orbit, Different Orbits of Satellites, Different Uses of Satellites, Satellites Monitoring, Satellite Remote Sensing, Data Characteristics, Risk Challenges, Space Weather Impacts, Radio Systems, Satellite Drag, Debris, Importance of Machine Learning and Applications **Text Book: 1 Ch2: 2.1 - 2.5**	

Module-3	**08 Hrs**
Formalization, Prediction and Recognition of Expert Evaluations of Telemetric Data of Artificial Satellites: Introduction, Creation of Expert Evaluation Models Based on Type-I Fuzzy Sets, Creation of Generalized Expert Evaluation Models Based on Interval Type-II Fuzzy Sets, Weighted Intervals for Interval Type-2 Fuzzy Sets, Prediction of Expert Evaluations Based on Linear Regression with Initial Interval Type-II Data, Prediction of Expert Evaluations Based on Linear Regression with Initial Special Case of Interval Type-2 Fuzzy Sets, Prediction of Expert Evaluations Based on Nonlinear Regression with Initial Interval Type-II Data, Prediction of Quantitative Parameters Values Based on Linear Regression with Interval Type-II Coefficients **Text Book: 1 Ch3: 3.1 - 3.8**	
Module-4	**08 Hrs**
Intelligent Health Monitoring Systems for Space Missions Based on Data Mining Techniques: Introduction, Satellite Telemetry Data, Characteristics of Satellite Telemetry Data, Health Monitoring System, Health Monitoring Based on Conventional Techniques, Limit Checking, Expert Systems, , Model-Based Diagnosis, Intelligent Health Monitoring Based on Data Mining Techniques, Intelligent Health Monitoring Applications, **Text Book: 1 Ch4: 4.1 - 4.3**	
Module-5	**08 Hrs**
Design, Implementation, and Validation of Satellite Simulator and Data Packets Analysis: Introduction and Basics, Satellite Simulator Design Phase, Parameters of Simulator Inputs, Communication Subsystem Simulator GUI, Data Packets, Satellite Communications System Segments, Satellite Applications, Satellite Functions, Satellite Orbits and Pointing Angles, Satellite Links, Satellite Communication Advantages, **Text Book: 1 Ch5: 5.1 - 5.8**	

Course Outcomes : At the end of the course, the student will be able to

CO1	Explain machine learning-based health monitoring techniques for artificial satellites
CO2	Apply tensor-based anomaly detection and fuzzy models to satellite telemetry data
CO3	Analyze the risks and challenges in satellite operations using ML-based prediction models
CO4	Develop intelligent health monitoring systems for space missions using data mining techniques
CO5	Design, implement, and validate satellite simulators and analyze telemetry data packets for performance monitoring

Text Books

1 Machine Learning and Data Mining in Aerospace Technology Aboul Ella Hassanien Ashraf Darwish Hesham El-Askary, ISBN 978-3-030-20211-8 ISBN 978-3-030-20212-5 (eBook),

2 Kamesh Subbarao, Machine Learning and Deep Learning for Astronautics, Publisher: Cambridge University Press 2023

Reference Books

1 Innovative Machine Learning Applications in the Aerospace Industry Venkata Tulasiramu Ponnada, DOI: 10.4018/979-8-3693-7525-9

2	Aerospace Data Analytics and Machine Learning, Sulaiman Khan, Mukul Shirvaikar "" Publisher: Springer,2021

Web links and Video Lectures (e-Resources)

1	https://nptel.ac.in/courses/106106224
2	https://nptel.ac.in/courses/106106228
3	https://nptel.ac.in/courses/106106202
4	https://doi.org/10.1007/978-3-030-20212-5

CO -PO MAPPING

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

Semester: IV					
Universal Human Values (UHV) **Stream: CSE/ECE/CV/ME**					
Course Code	:	BUH408	**Credits**	:	01
Hours/Week(L:T:P)	:	1:0:0	**CIE**	:	50Marks
Total Hours	:	15	**SEE**	:	50Marks
Course Type	:	UHV	**SEE Duration**	:	1 Hr

Course Learning Objectives : This course will enable the students to

CLO1	Understand the need, purpose, and content of value-based education.
CLO2	Facilitate self-exploration as a process to understand human aspirations and their fulfillment.
CLO3	Understand harmony at various levels – individual, family, society, nature, and existence.
CLO4	Promote ethical competence and awareness of professional ethics.
CLO5	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.

Textbook 1- Ch1: & Ch2:

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.

Textbook 1- 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.

Textbook 1- Ch 4: &Ch 5:

Module-4	**03 Hrs**

Harmony in the Nature/Existence

Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Ful filment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels and The Holistic Perception of Harmony in Existence.

Textbook 1 Ch 6: & Ch 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

Textbook 1- Ch 8: & Ch 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: EkParichaya, 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 – PanditSunderlal
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 VidyaEkParichay, 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)

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

CO – PO MAPPING

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

Semester: IV					
Statistical Quality Control & Reliability					
Course Code	**:**	BAE408A	**Credits**	**:**	1
Hours/Week (L:T:P)	**:**	1:0:0	**CIE**	**:**	50 Marks
Total Hours	**:**	15L	**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

CLO1	Comprehend the basic concepts of Quality control
CLO2	Acquire the knowledge of SQC Tools, causes of variations, Sampling
CLO3	Understand the different Redundant Systems.

Module-1	**03 Hrs**
Definitions of the term quality, Introduction to Total Quality Control, Organization for quality, General quality control engineering fundamentals: Measures of central tendency and dispersion like Average, Standard deviation, Median, Mode, Range. **Text Book:1 Ch 2: 2.1-2.8**	
Module-2	**03 Hrs**
7QC, Variance, Concept of variation, Causes of Variation, Patterns of variation, Frequency distribution, and The Normal distribution curve. **Text Book:1 Ch 3:3.1-3.7**	
Module-3	**03 Hrs**
Acceptance sampling: Acceptance sampling by attributes – Single, Double and Multiple sampling plans, Operating characteristic curve, **Text Book:1.Ch 9:9.1-9.9**	
Module-4	**03 Hrs**
Reliability Engineering: Concepts of reliability, Statistical Models of reliability, Reliability of hazard functions, AOQ curve, AOQL, Producer's and Consumer's risks. **Text Book:1.Ch10:10.1-10.6**	
Module-5	**03 Hrs**
System reliability, Redundancy techniques in system design. Failure modes, effects & criticality analysis. **Text Book:1.Ch14:14.1-14.8**	

Course Outcomes : At the end of the course, the student will be able to

CO1	How mean median and modes, helps in monitoring manufacturing processes.
CO2	Apply normal distribution curve process capability and variability using statistical techniques.
CO3	Evaluate sampling processes used for manufacturing processes
CO4	Assess and model system reliability, failure rates, and life data distributions

CO5	Design quality and reliability improvement strategies for aeronautical systems

Text Books

1. Statistical Quality Control, R.C .Gupta, Khanna publisher 8th edition Delhi,2008
2. Statistical Quality Control, Grant E.L.,6thEdition, McGraw Hill Publications, New York, 1988
3. Quality Planning and Analysis, Juran J.M, 2ndEdition McGraw Hill Publications, Delhi, 1984
4. Reliability Engineering, Rao S S, Pearson Education, 2014

Reference Books

1. Introduction to Statistical Quality Control, Montgomery D. C. 2ndEdition, John Wiley & Sons, New York 2005
2. Fundamentals of quality control and improvement, Amitav Mitra, 3rd Edition, Wiley, 2008.

Web links and Video Lectures (e-Resources)

1. https://asq.org/quality-resources
2. https://www.nasa.gov/offices/oce/llis/lessons/rl
3. https://nptel.ac.in/courses/112105185
4. https://www.coursera.org/learn/six-sigma-improve

CO -PO MAPPING

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

Semester: IV					
Concept of Augmented Reality					
Course Code	**:**	BAE408B	**Credits**	**:**	1
Hours/Week (L:T:P)	**:**	1:0:0	**CIE**	**:**	50 Marks
Total Hours	**:**	15L	**SEE**	**:**	50 Marks
Course Type	**:**	AEC	**SEE Duration**	**:**	1 Hours
Prerequisites:					
Courses	• Fundamentals of C- Programming				
Knowledge on Fundamental Concepts	Basic of C- programming				
Knowledge on Connected Tools (If any)	Basic Computer Knowledge				

Course Learning Objectives: This course will enable the students

CLO1	Describe how AR systems work and list the applications of AR.
CLO2	Understand the hardware requirement of AR.
CLO3	Use computer vision concepts for AR and describe AR techniques
CLO4	Acquire knowledge of mixed reality

Module-1	**03 Hrs**

Introduction to Augmented Reality (A.R): Defining augmented reality, history of augmented reality, The Relationship between Augmented Reality and Other Technologies-Media, Technologies, Other Ideas Related to the Spectrum between Real and Virtual Worlds, applications of augmented reality

Augmented Reality Concepts- Concepts Related to Augmented Reality, Ingredients of an Augmented Reality Experience.

Text Book 1: Ch1: 1.1-1.8.

Module-2	**03 Hrs**

Augmented Reality Hardware: Augmented Reality Hardware – Displays – Audio Displays, Haptic Displays, Visual Displays, Other sensory displays, Visual Perception, Requirements and Characteristics, Spatial Display Model.

Processors – Role of Processors, Processor System Architecture, Processor Specifications.

Tracking & Sensors - Tracking, Calibration, and Registration, Characteristics of Tracking Technology, Stationary Tracking Systems, Mobile Sensors, Optical Tracking, Sensor Fusion.

Text Book 1: Ch2: 2.1-2.10, 12.1-12.9.

Module-3	**03 Hrs**

Computer Vision for Augmented Reality & A.R. Software:

Computer Vision for Augmented Reality - Marker Tracking, Multiple-Camera Infrared Tracking, Natural Feature Tracking by Detection, Simultaneous Localization and Mapping, Outdoor Tracking

Augmented Reality Software - Introduction, Major Software Components for Augmented Reality Systems, Software used to Create Content for the Augmented Reality Application.

Text Book 1: Ch10: 10.1-10.14, 11.1-11.11.

Module-4	**03 Hrs**

AR Techniques- Marker based & Marker less tracking:

Marker-based approach- Introduction to marker-based tracking, types of markers, marker camera pose and identification, visual tracking, mathematical representation of matrix multiplication

Marker types- Template markers, 2D barcode markers, imperceptible markers. **Marker-less approach**- Localization based augmentation, real world examples **Tracking methods-** Visual tracking, feature based tracking, hybrid tracking, and initialization and recovery.

Text Book: 2 Ch21: 21.1-21.6,22.1-22.8.

Module-5	**03 Hrs**

IoT Applications and Case Studies:

AR Devices &Components : AR Components – Scene Generator, Tracking system, monitoring system, display, Game scene

AR Devices – Optical See- through HMD, Virtual retinal systems, Monitor bases systems, Projection displays, and Video see-through systems

Text Book: 1, Ch16: 16.1-16.16,17.1-17.8.

Course Outcomes : At the end of the course, the student will be able to

CO1	Describe how AR systems work and list the applications of AR.
CO2	Understand and analyse the hardware requirement of AR.
CO3	Use computer vision concepts for AR and describe AR techniques
CO4	Analyse and understand the working of various state of the art AR devices
CO5	Acquire knowledge of mixed reality

Text Books

1. AR Game Development, Allan Fowler, 1st Edition, A press Publications, 2018, ISBN 978-1484236178
2. Augmented Reality: Principles & Practice, Schmalstie, Hollerer, Pearson Education India; 1st Edition, 12 October 2016, ISBN-10: 9332578494

Reference Books

1. Designing for Mixed Reality, Kharis O'Connell, Published O'Reilly Media, Inc., 2016, ISBN: 9781491962381
2. Theory and applications of marker-based augmented reality, Sanni Siltanen-. Julkaisija – Utgivare Publisher. 2012.ISBN 978-951-38-7449-0

Web links and Video Lectures (e-Resources)

1. https://www.vttresearch.com/sites/default/files/pdf/science/2012/S3.pdf
2. https://docs.microsoft.com/en-us/windows/mixed-reality/
3. https://docs.microsoft.com/en-us/archive/msdn magazine/2016/november/hololensintroduction-to-the-hololens

CO -PO MAPPING

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

Semester: IV					
Fundamentals on Spreadsheet					
Course Code	:	BAE408C	**Credits**	:	1
Hours/Week (L:T:P)	:	0:0:2	**CIE**	:	50 Marks
Total Hours	:	15P	**SEE**	:	50 Marks
Course Type	:	SEC	**SEE Duration**	:	2Hours
Prerequisites:					
Courses	• Basic computer.				
Knowledge on Fundamental Concepts	Understanding of rows, columns and cells. Basic math operations (addition, subtraction, multiplication, division). Awareness of data types (numbers, text, dates). Introductory understanding of data organization (e.g., tables/lists).				
Knowledge on Connected Tools (If any)	Basic experience with local file systems for saving/opening spreadsheet files.				

Course Learning Objectives: This course will enable the students	
CLO1	Introduce spreadsheet-based engineering computations including data visualization, mathematical functions, and regression analysis.
CLO2	Enable the use of Excel for solving algebraic, statistical, and optimization problems using built-in tools and functions
CLO3	Develop automation skills using Visual Basic for Applications (VBA) for custom function creation, user-defined procedures, and aerospace-specific problem solving.

Sl. No.	**List of Experiments**
1.	**Charting:** Create an XY scatter graph, XY chart with two Y-Axes, add error bars to your plot, create a combination chart
2.	**Functions:** Computing Sum, Average, Count, Max and Min, Computing Weighted Average, Trigonometric Functions, Exponential Functions, Using The CONVERT Function to Convert Units
3.	**Conditional Functions:** Logical Expressions, Boolean Functions, IF Function, Creating a Quadratic Equation Solver, Table VLOOKUP Function, AND, OR and XOR functions.
4.	**Regression Analysis:** Trend line, Slope and Intercept, Interpolation and Forecast, The LINEST Function, Multi linear Regression, Polynomial Fit Functions, Residuals Plot, Slope and Tangent, Analysis Tool Pack.
5.	**Iterative Solutions Using Excel:** Using Goal Seek in Excel, Using The Solver To Find Roots, Finding Multiple Roots, Optimization Using The Solver, Minimization Analysis, Non Linear Regression Analysis.
6.	**Matrix Operations Using Excel:** Adding Two Matrices, Multiplying a Matrix by a Scalar, Multiplying Two Matrices, Transposing a Matrix, Inverting a Matrix and Solving System of Linear Equations.
7.	**VBA User-Defined Functions (UDF**): The Visual Basic Editor (VBE), The IF Structure, The Select Case Structure, The For Next Structure, The Do Loop Structure, Declaring Variables and Data Types, An Array Function The Excel

	Object Model, For Each Next Structure.
8.	**VBA Subroutines or Macros:** Recording a Macro, Coding a Macro Finding Roots by Bisection, Using Arrays, Adding a Control and Creating User Forms.
Demonstration Experiments (For CIE)	
9.	**Aerospace equations:** Many of the aerospace equations, such as lift and drag coefficients, can be calculated using custom formulas in Excel
10.	**Wind tunnel correction functions:** To correct wind tunnel data based on atmospheric conditions.("ISBLANK" and "IF" functions can be used)
11.	**Flight trajectory functions:** To look up flight path parameters based on any given conditions.("Vlookup" and "Match" functions can be used)
12.	**Launch vehicle functions:** To look up rocket performance parameters based on any given conditions.("INDEX" and "MATCH" functions c
Course Outcomes : At the end of the course, the student will be able to	
CO1	Create various types of charts, including XY scatter plots, dual Y-axis charts, and combination charts, and enhance them using error bars.
CO2	Conduct regression analysis, including trendlines, linear/multilinear regression, and residual plotting using Excel functions and the Analysis ToolPak.
CO3	Solve engineering problems using iterative methods such as Goal Seek and Solver for optimization, root finding, and nonlinear analysis.
CO4	Automate tasks using VBA macros and user-defined functions, and implement custom solutions for aerospace-specific problems such as lift, drag, trajectory, and performance parameters.

Web links and Video Lectures (e-Resources)

1. https://www.microsoftpressstore.com/store/microsoft-excel-2019-formulas-and-functions-9781509306190
2. https://paulmcfedries.com/books/excel-2019-formulas-and-functions/
3. https://ptgmedia.pearsoncmg.com/images/9781509306190/samplepages/9781509306190_Sample.pdf

CO - PO MAPPING

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

Semester: IV					
Bio-inspired Computation					
Course Code	**:**	BAE408D	**Credits**	**:**	1
Hours/Week (L:T:P)	**:**	1:0:0	**CIE**	**:**	50 Marks
Total Hours	**:**	15L	**SEE**	**:**	50 Marks
Course Type	**:**	AEC	**SEE Duration**	**:**	1 Hours
Prerequisites:					
Courses	• Biology for Engineers				
Knowledge on Fundamental Concepts	--				
Knowledge on Connected Tools (If any)	--				

Course Learning Objectives: This course will enable the students

CLO1	Introduce foundational concepts of bio-inspired algorithms and natural computation.
CLO2	Analyze how nature-inspired methods solve complex aerospace problems.
CLO3	Explore applications of evolutionary computation, swarm intelligence, and neural models in aircraft design, optimization, and control.
CLO4	Apply bio-inspired algorithms to problems such as flight path planning, fault diagnosis, and structural optimization.

Module-1	**03 Hrs**
Introduction to Bio-Inspired Computation: Principles of natural computation and complex adaptive systems, Biological motivation: evolution, swarm behavior, neural systems, Overview of algorithms: Genetic Algorithms (GA), Particle Swarm Optimization (PSO), Artificial Neural Networks (ANN), Applications in aerospace and aircraft systems **Practical**: Simulate simple GA and PSO in MATLAB/Python for a benchmark problem **Text Book 1: Ch1: 1.1-1.8.**	
Module-2	**03 Hrs**
Evolutionary Algorithms in Aircraft Design: Genetic Algorithms and Genetic Programming, Aircraft wing and fuselage optimization using Gas, Multi-objective evolutionary algorithms (NSGA-II), Structural design and Aerodynamic optimization **Practical**: Use GAs to optimize airfoil shape for lift-to-drag ratio **Text Book 1: Ch2: 2.1-2.10, 12.1-12.9.**	
Module-3	**03 Hrs**
Swarm Intelligence for Navigation and Control: Particle Swarm Optimization (PSO), Ant Colony Optimization (ACO), Swarm robotics principles applied to UAV formation and flocking, Path planning, route optimization, and real-time re-planning **Practical**: Implement PSO for multi-drone path planning in a constrained environment **Text Book 1: Ch10: 10.1-10.14, 11.1-11.11.**	

Module-4	**03 Hrs**
Artificial Neural Networks and Adaptive Control: Neural networks and flight control systems, Adaptive flight control using neural learning, Fault detection and failure prediction using ANN and Deep Learning, Reinforcement Learning basics and applications to autonomous flight **Practical:** Use ANN to model aircraft dynamics and simulate fault detection **Text Book: 2 Ch21: 21.1-21.6,22.1-22.8.**	
Module-5	**03 Hrs**
Advanced Applications and Case Studies: Hybrid algorithms: neuro evolution, GA-PSO hybrids, Bio-inspired sensors (e.g., bat sonar, insect vision) and bio-mimetic aircraft designs, Case studies: NASA's X-planes, Harvard Robo Bees, MIT UAV swarms, Ethical concerns and limitations of bio-inspired systems in aviation **Practical**: Final project—design a bio-inspired control/optimization model for an aircraft subsystem **Text Book: 1, Ch16: 16.1-16.16,17.1-17.8.**	

Course Outcomes : At the end of the course, the student will be able to

CO1	Understand the principles and mechanisms of various bio-inspired algorithms.
CO2	Apply evolutionary and swarm-based techniques to optimize aircraft design parameters.
CO3	Design fault-tolerant and adaptive flight control systems using neural models.
CO4	Compare performance of conventional vs bio-inspired algorithms for real-time aerospace applications.
CO5	Develop and simulate nature-inspired solutions to path planning, aerodynamic modeling, and mission planning problems.

Text Books

1. Bio-Inspired Artificial Intelligence: Theories, Methods, and Technologies Dario Floreano and Claudio Mattiussi, MIT Press.
2. Nature-Inspired Optimization Algorithms Xin-She Yang, Elsevier.
3. Introduction to Artificial Neural Systems, Jacek M. Zurada, West Publishing

Reference Books

1. Swarm Intelligence: From Natural to Artificial Systems, Eric Bonabeau, Marco Dorigo, Guy Theraulaz, Oxford University Press.
2. Computational Intelligence in Aerospace Engineering, S. K. Kuo, Springer
3. Neural Networks for Applied Sciences and Engineering: From Fundamentals to Complex Pattern Recognition, Sandhya Samara singh, Auerbach Publications.

Web links and Video Lectures (e-Resources)

1. https://www.nasa.gov/directorates/spacetech/strg/bio-inspired
2. https://gecco-2024.sigevo.org/
3. https://ocw.mit.edu/courses/6-034-artificial-intelligence-fall-2023/
4. https://nptel.ac.in/courses/106/106/106106126/

CO -PO MAPPING

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

CO4	3	3	-	-	2	-	-	2	2	2	2	2	3
CO5	3	3	-	-	2	-	-	2	2	-	-	-	2

Semester: IV					
Aviation Safety Rules and Regulations					
Course Code	**:**	BAE408E	**Credits**	**:**	1
Hours/Week (L:T:P)	**:**	1:0:0	**CIE**	**:**	50 Marks
Total Hours	**:**	15L	**SEE**	**:**	50 Marks
Course Type	**:**	AEC	**SEE Duration**	**:**	1 Hours

Prerequisites:	
Courses	• Fundamentals of Aircrafts
Knowledge on Fundamental Concepts	The Flying conditions and medium of an aircraft, pressure distribution and generation of lift.
Knowledge on Connected Tools (If any)	--

Course Learning Objectives: This course will enable the students

CLO1	Understand the national and international aviation safety frameworks.
CLO2	Examine key safety protocols and accident prevention strategies.
CLO3	Familiarize with the regulatory authorities and standards (e.g., ICAO, FAA, EASA, DGCA).

Module-1	**03 Hrs**

Introduction to Aircraft Safety: Evolution of aircraft safety, Basic aviation safety concepts, Definitions: accident, incident, hazard, risk, Safety versus security in aviation, Key safety principles and global safety trends.

Human Factors in Aviation Safety: Introduction to human factors, SHELL model, CRM (Crew Resource Management) and TEM (Threat and Error Management), Fatigue, stress, and decision-making in aviation

Text book 3 – Ch1: 1 – 1.2, 1.3, Ch 2 – 2.4
Text book 1 – Ch1: 1.1, 1.3,
Text book 2 – Ch2: 2 – 2.1

Module-2	**03 Hrs**

Augmented Reality Hardware: Augmented Reality Hardware – Displays – Audio Displays, Haptic Displays, Visual Displays, Other sensory displays, Visual Perception, Requirements and Characteristics, Spatial Display Model.

Processors – Role of Processors, Processor System Architecture, Processor Specifications.

Tracking & Sensors - Tracking, Calibration, and Registration, Characteristics of Tracking Technology, Stationary Tracking Systems, Mobile Sensors, Optical Tracking, Sensor Fusion.

Text book 2 – Ch2:2 – 2.1, 2.2, 2.3, 2.4, 2.5, 2.6.

Module-3	**03 Hrs**

Regulatory Authorities and Aviation Law:ICAO, FAA, EASA, DGCA – structure and roles, ICAO Annexes overview (especially Annex 6, 8, 13, 19), Civil Aviation Acts and Rules (India and international comparison), Legal responsibilities of stakeholders (pilots, maintenance, ATC).

Safety Management Systems (SMS): ICAO Annex 19 framework, Four pillars of SMS: Safety Policy, Risk Management, Assurance, Promotion, Hazard identification and risk assessment, Safety performance indicators and auditing

Text book 2 – Ch1 – 1.3, 1.4, 1.5, 1.6, 1.8, 1.10	
Module-4	**03 Hrs**
Accident and Incident Investigation:ICAO Annex 13 principles, Investigation process, reporting and safety recommendations, Role of investigation agencies (e.g., NTSB, AAIB),Runway Incursions: Runway Incursion Severity Categories, Reported Runway Incursions by Severity, Distribution by Aircraft Type and Combination. Case studies of major aviation accidents (American Airlines Flight 1420, TWA Flight 843, Delta Airlines Flight 106 , Air India Express 1344, Tenerife). **Textbook 1 – Ch1: 1 – 1.5.1, 1.5.2, 1.5.8, 2 – 2.1, 2.2, 2.3.**	
Module-5	**03 Hrs**
Mid-Air collision Avoidance From See-and-Avoid to Search-and–Detect. Mechanical and maintenance. Safety Audits and Quality Assurance: Internal and external safety audits, IOSA (IATA Operational Safety Audit), IS-BAO, Quality control and assurance in aviation organizations, Continuous improvement strategies in safety management. **Textbook 1 – Ch4: 4 – 4.1, 5 – 5.1.**	

Course Outcomes : At the end of the course, the student will be able to	
CO1	Understand global and local aviation safety regulations.
CO2	Analyze the framework of aviation authorities (ICAO, FAA, EASA, DGCA).
CO3	Apply safety management systems (SMS) in aviation environments.
CO4	Interpret and comply with aircraft operation and maintenance safety rules.
CO5	Evaluate case studies of aircraft incidents/accidents. And Participate in aircraft safety audits and inspections.

Text Books

1. Aircraft Safety: Accident Investigations, Analyses, & Applications, Shari Stamford Krause, McGraw-Hill Education. New Delhi 2015, ISBN13: 978-8131808153.
2. Safety Management Systems in Aviation, Alan J. Stolzer, Carl D. Halford, John J. Goglia – Routledge, 2013
3. Design and Airworthiness Requirements for Service Aircraft, Ministry of Defense

Reference Books

1. Fuels and Combustion, Sharma, S.P, and Chandra Mohan, Tata Mc.Graw Hill Publishing Co, Ltd., New Delhi, 1987.
2. ICAO Annex 13 – Aircraft Accident and Incident Investigation
3. ICAO Doc 9859 – Safety Management Manual
4. FAA FAR Parts 43, 91, 121

Web links and Video Lectures (e-Resources)

1. https://www.iata.org/en/training/subject-areas/safety-courses
2. https://jaato.com/courses/36/introduction-to-aviation-regulations/
3. https://www.classcentral.com/course/canvas-network-aircraft-maintenance-repair-and-overhaul-7103

CO -PO MAPPING

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

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

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	**03Hrs**

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).
Textbook 2, 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, Textbook 2, 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.
Textbook 1, Ch.2, Textbook 2, 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.

Textbook 1, 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 andtheories of consciousness.
CO5	Differentiate the theoretical and practical intersections between quantum physics, quantum healing and meditation.

Text Books

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

Reference Books

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

Web links and Video Lectures (e-Resources)

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**	**PSO1**	**PSO2**
CO1	3	2	-	-	-	2	2	1	1	-	3	2	1
CO2	3	2	2	2	-	2	2	1	1	-	3	-	1
CO3	-	3	-	-	-	2	2	1	1	-	2	2	1
CO4	-	3	-	-	-	2	2	1	1	-	-	-	1
CO5	-	3	-	-	-	2	2	1	1	-	-	2	1

Semester: IV					
National Service Scheme **Stream: CSE/ECE/ME/CV**					
Course Code	**:**	BNS410	**Credits**	**:**	0
Hours/Week(L:T:P)	**:**	0:0:2	**CIE**	**:**	100Marks
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 – solving
CLO3	Develop among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions t
CLO4	Develop competence required for group-living and sharing of responsibilities & gain skills 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 social 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 enhancing the village income and approach for implementation.	May be individual al or team	Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus etc…..	Group selection /proper consultation /Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by NSS officer
3	Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education.	May be individual or team	Local government / private/ aided schools/Government Schemes officers/ etc…..	School selection/proper consultation /Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by NSS officer

Plan of Action (Execution of Activities for 4thSemester)

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 4thsemester, 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 4thsemester, 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 tothe 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 Mapping

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

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 or athletic events through structured physical training and performance.
CLO3	Understand the role of effective organization, administration, and management in the successful conduct of sports events and athletic programs.

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

Course Outcomes: After completing the course, the students will be able to

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

Scheme and Assessment for auditing the course and Grades:

Sl.No.	**Activity**	**Marks**
1.	Participation of student in all the modules	20
2.	Quizzes–2,eachof15marks	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**	**PSO1**	**PSO2**
CO1	2	-	-	-	-		3	3	-	-	-	2	-
CO2	3	-	2	-	2		1	2	3	-	-	-	1
CO3	2	-	1	-	-	-	3	3	2	-	-	2	-
CO4	2	2	-	-	-	2	-	2	3	-	2	-	1
CO5	1	2	-	-	-	-	-	-	3	-	2	2	

Semester: IV					
Yoga **Stream: CSE/ECE/CV/ME**					
Course Code	**:**	BYO410	**Credits**	**:**	0
Hours/Week(L:T:P)	**:**	0:0:2	**CIE**	**:**	100Marks
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 surya namaskar 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	**05 Hrs**
Patanjali'sAshtanga 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	**04 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	**05 Hrs**
Asanas: Meaning of Asana, Need and importance of practicing Asanas, Classification of Asanas, Sitting Asanas -Sukhasana, Paschimottanasana, Standing Asanas - ArdhakatiChakrasana, ParshvaChakrasana, 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	**05Hrs**
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	**05Hrs**
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'sashtanga Yoga and its significance in promoting daily well-being.
CO2	Demonstrate suryanamaskar 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.

TextBook

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

ReferenceBooks

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	PSO1	PSO2
CO1	-	-	-	-	-	2	-	-	2	-	-	2	-
CO2	-	-	-	-	-	2	2	3	2	-	2	-	1
CO3	-	-	-	-	-	2	2	3	2	-	2	2	
CO4	-	-	-	-	-	2	2	3	2	-	2	-	1
CO5	-	-	-	-	-	2	2	3	2	-	2	2	-

Semester: VI					
Music **Stream: CSE/ECE/CV/ME**					
Course Code	**:**	BMU410	**Credits**	**:**	0
Hours/Week(L:T:P)	**:**	0:0:2	**CIE**	**:**	100Marks
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 SaraleVarase exercises, notations for SuladiSapta Tala in Mayamalavagowla raga and performance of selected compositions such as Geethe, JathiSwara and Krithi.

Module-1	**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–2	**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 –3	**03 Hrs**

Composers

Biography and contributions of Purandaradasa, Thyagaraja, Mysoroasudevacharya, Kanakadasa

Textbook3 – Ch. 2-5

Module–4	**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 –5	**14 Hrs**

AbhyasaGana

Singing the swara exercises (SaraleVarase Only), Botatio writing for saralevarase and sulafisapta tala (Only in mayamalavagowla raga), singing 4 geethe in malahari and one jathiswara, oekrithi 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, MunshiramManoharlal 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**	**PSO1**	**PSO2**
CO1	3	-	1	-	1	-	1	1	1	-	1	2	1
CO2	3	-	3	1	2	1	2	1	1	-	1	2	1
CO3	1	-	-	-	1	1	1	-	1	-	-	2	1
CO4	2	-	2	-	3	1	1	1	1	-	1	2	1
CO5	3	-	-	1	2	1	1	1	1	-	1	2	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**	**:**	100Marks
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)	--

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, Complex 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, Alternate 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, Substitution Coding, Decipher Coding, Direct Coding-Decoding, Conditional Coding, Message Coding, Operations-Based Coding-Decoding, and Complex Coding-Decoding Problem

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 Direction 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 in 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 in Races, Application-Based Race Problems.

Seating Arrangement

Linear Arrangement, Circular Arrangement, Square/Rectangular Arrangement, Single-Row and Double-Row Arrangements, Facing Inside and Outside Arrangements, Arrangement Based on Directions (Left/Right/Clockwise/Counterclockwise), Seating Based on Conditions or 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 multiple 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 a circle.

Probability

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

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, Mirror 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 a Given Day, Number of Sundays/Saturdays/Specific Weekdays in a Period, Day-Difference Problems.

Textbook-1, Ch:6-9&13-16

Module-4	**8 Hrs**

Data Interpretation

Tables, Bar Graphs, Line Graphs, Pie Charts, Caselets (Paragraph-based Data Sets), Radar Charts, Mixed or Combination Graphs (Multiple Data Forms Together), Data Comparison and Analysis, Calculation-Based Data Interpretation, Ratio and Percentage Interpretation, Data 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 problems with equation formulation, and age problems involving time intervals such as years ago or 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 Data Interpretation, and Conclusions Drawing from Statements.

Textbook-1, Ch:28-29

Module-5	**8Hrs**

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, Data Sufficiency on Blood Relations, Data Sufficiency on Order and Ranking, Data Sufficiency on 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 in 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 completion and idioms.
CO4	Enhance verbal reasoning by solving analogies, rearranging sentences and identifying assumptions and conclusions.
CO5	Apply combinatorics and probability to solve permutation, combination and crypt arithmetic problems.

Text Books

1. Quantitative Aptitude for Competitive Examinations, 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 Sharma6th 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**	**PSO1**	**PSO2**
CO1	3	2	-	-	-	-	-	2	2	-	1	2	-
CO2	2	2	-	-	-	-	-	2	2	-	-	-	1
CO3	1	1	-	-	-	-	-	2	2	-	-	2	-
CO4	2	2	2	-	-	-	-	2	2	-	1	-	1
CO5	3	3	2	-	-	-	-	2	2	-	1	2	-

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

Preparing Competent Aeronautical Engineers To Serve the Society

Department Mission

- Strengthening the Fundamental concepts in Aeronautical Engineering.
- Building Analytical ability among students with innovative problem-solving techniques.
- Training students in multidisciplinary research areas in collaboration with Industries embedding the culture of continuous learning.
- Imparting skillset in line with emerging industrial needs with leadership qualities
- Making students responsible citizens to serve society with ethics and values.

SJC INSTITUTE OF TECHNOLOGY

An Autonomous Institution under VTU from 2024-25

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