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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

V Semester

Scheme & Syllabus of B.E. Programme

Aerospace Engineering

(2024 Scheme)

Core Values

Spiritual, **J**udicious, **C**ommitment, **I**ntegrity, **T**rustworthy

AICTE | nirf NATIONAL INSTITUTIONAL RANKING FRAMEWORK 151-300 | NBA ACCREDITED | NAAC A+ ACCREDITED WITH GRADE | QS I-GAUGE INDIAN UNIVERSITY RATING 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

AICTE Approved, Accredited by NBA(CSE, ISE, ECE, ME, CV, AE) and NAAC with 'A+' grade, QS – I Gauge Gold Rated

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

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

5th Semester

Aerospace Engineering

Sl. No.	Course Code	Course Title	Course Type	TD/ PSB	Teaching Hours/ Week			Examination				
					L	T	P	SEE Duration (Hrs)	CIE Marks	SEE Marks	Total Marks	Credits
1	BAS501	Aerospace Structural Mechanics	PCC	AS	3	0	0	**3**	**50**	**50**	**100**	**3**
2	BAS502	Finite Element Method	IPCC	AS	3	0	2	**3**	**50**	**50**	**100**	**4**
3	BAS503	Rocket Propulsion	PCC	AS	3	2	0	**3**	**50**	**50**	**100**	**4**
4	BASL504	Aircraft Structures Laboratory	PCCL	AS	0	0	2	**3**	**50**	**50**	**100**	**1**
5	BAS525x	Professional Elective Course – I	PEC	AS	3	0	0	**3**	**50**	**50**	**100**	**3**
6	BAS536	Mini Project	PROJ	AS	0	0	2	**3**	**50**	**50**	**100**	**2**
7	BRM507	Research Methodology and IPR	AEC	AS	2	2	0	**3**	**50**	**50**	**100**	**3**
8	BCE508	Competency Enhancement Course-3	NCMC	CDCAC	0	2	0	-	**100**	-	**100**	**0**
9	BNS509	National Service Scheme (NSS)	NCMC	NSS Coordinator	0	0	2	-	**100**	-	**100**	**0**
	BPE509	Physical Education (PE) (Sports and Athletics)		Physical Education Director								
	BYO509	Yoga		Yoga Teacher								
	BMU509	Music		Music Teacher								
									600	**400**	**1000**	**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.

Professional Elective Course – I

Course Code	Course Name	Course Code	Course Name
BAS525A	Mechanisms and Machine Theory	BAS525C	Experimental Aerodynamics
BAS525B	Aircraft Performance	BAS525D	Satellite Communication

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

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

Semester: V						
Aerospace Structural Mechanics						
Course Code	:	**BAS501**		**Credits**	:	3
Hours/Week(L:T:P)	:	3:0:0		**CIE**	:	50 Marks
Total Hours	:	40		**SEE**	:	50 Marks
Course Type	:	PCC		**SEE Duration**	:	3 Hours

Prerequisites:	
Courses	Engineering Mechanics**,** Elements of Aeronautical Engineering.
Knowledge on Fundamental Concepts	Physics, Mathematics
Knowledge on Connected Tools (If any)	**-**

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the theory of bending, stress distribution, and semi-monocoque structural concepts used in aerospace structures.
CLO2	Analyze shear flow behavior, shear center, and stress distribution in open and closed thin-walled beam sections.
CLO3	Apply torsion and shear flow theories to evaluate stresses and twist in single-cell and multi-cell aerospace structures.
CLO4	Evaluate the stability and failure characteristics of thin-walled structural elements subjected to compression, shear, bending, and combined loading.
CLO5	Examine the structural design principles, safety, life assessment, and airworthiness requirements of aircraft structures.

Module–1	**08Hrs**
Introduction: Elementary theory of bending – Introduction to semi-Monocoque structures - Stresses in beams of symmetrical and unsymmetrical sections -Box beams – General formula for bending stresses- principal axes method – Neutral axis method. **Text Book 01: 16**	
Module–2	**08Hrs**
Shear Flow in Open Section Beams: Shear stresses in beams – Shear flow in stiffened panels - Shear flow in thin walled open tubes – Shear centre – Shear flow in open sections with stiffeners. **Text Book 01: 17**	
Module–3	**08Hrs**
Shear Flow in Closed Section Beams : Shear flow in closed sections with stiffeners– Angle of twist - Shear flow in two flange and three flange box beams – Shear centre - Shear flow in thin walled closed tubes - Bredt-Batho theory - Torsional shear flow in multi cell tubes - Flexural shear flow in multi cell stiffened structures. **Text Book 01: 18, 19**	

Module–4	08Hrs
Failure concepts: Stability problems of thin walled structures– Buckling of sheets under compression, shear, bending and combined loads - Crippling stresses by Needham's and Gerard's methods–Sheet stiffener panels, Effective width, Inter rivet and sheet wrinkling failures-Tension field web beams(Wagner's). **Text Book 02: 11**	
Module–5	**08Hrs**
DESIGN OF AIRCRAFT STRUCTURE: Design criteria – Safety Factor – Design life criteria – Analysis method – Life Assessment procedures – Design Principle – Future Airworthiness Requirements – Two bay crack criteria – Widespread Fatigue damage **Text Book 03: 19**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Explain the bending behavior, stress distribution, and neutral axis concepts in symmetrical and unsymmetrical thin-walled beam sections.
CO2	Analyse shear stresses, shear flow, and shear center in open-section beams with and without stiffeners.
CO3	Apply Bredt–Batho theory and torsional analysis to determine shear flow and angle of twist in closed and multi-cell thin-walled structures.
CO4	Evaluate buckling, crippling, effective width, and other failure modes of thin-walled aerospace structural components under different loading conditions.
CO5	Assess the structural behaviour, design criteria, safety factors, fatigue life, airworthiness requirements.

Text Books:	
1	Aircraft Structures for Engineering Students by Megson, T.M.G , ELSEVIER 5th edition,2013
2	Aircraft Structures Peery, D.J. and Azar, J.J McGraw-Hill,New York 2nd Edition,1993
3	Fundamentals of Flight – Volume 2: Aircraft Structures, Lalit Gupta and Dr. O. P. Sharma, Himalayan Books, New Delhi, India, 2011.

Reference Books	
1	Analysis and Design of Flight Vehicle Structures E.F. Bruhn Tristate Offset Co 1980
2	Spacecraft Structures by Jacob Job Wijker, Springer , 2008, ISBN 978-3-540-75552-4

Web links and Video Lectures (e – Resources)	
1	https://onlinecourses.nptel.ac.in/noc20_ae08
2	https://www.aircraftsystemstech.com/humix/video/playlist/NU8GhQJzk7p?utm_sour

CO – PO MAPPING:

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

Semester: V						
Finite Element Method						
Course Code	:	**BAS502**		**Credits**	:	4
Hours/Week(L:T:P)	:	3:0:2		**CIE**	:	50 Marks
Total Hours	:	40T + 12P		**SEE**	:	50 Marks
Course Type	:	IPCC		**SEE Duration**	:	3 Hours

Prerequisites:	
Courses	Mathematics, Strength of Materials
Knowledge on Fundamental Concepts	Calculus, differential equations, and linear algebra, Numerical methods
Knowledge on Connected Tools (If any)	-

Course Learning Objectives: This course will enable the students to	
CLO1	Learn basic principles of finite element analysis procedure.
CLO2	Learn theory and Characteristics of finite elements that represents Engineering structures.
CLO3	Understand Engineer Solutions for complex problems involving 1-D bars and trusses utilizing FEM principles
CLO4	Understand Engineer Solutions for complex problems involving, beams, and steady state heat transfer utilizing FEM principles
CLO5	Apply finite element solutions to structural, thermal, dynamic problem

Module – 1	**08Hrs**
Introduction to FEM –Basics equation of elasticity, Force distribution, Derivation of equation of Equilibrium, stress –strain relations, plain stress and plain strain, basics steps in Fem, Discretization process, Types of elements, phases of FEA **Variation approach-** Principle of virtual work, Total potential energy, Rayleigh Ritz Method, Stiffness matrix of bar element, Direct method, using principle of minimum potential energy. **Text Book 1: Ch 1 & 2** **Text Book 2: Ch 1**	
Module – 2	**08Hrs**
Interpolation models- Types of interpolation model, polynomial form of interpolation model, simplex, complex and multiplex elements. Convergence requirement, coordinate system, Relationship between Cartesian and natural coordinate system. **Shape functions**- finite element formulation of 1-D bar element-, derivation of Stiffness Matrix, shape function in Cartesian, local and natural coordinates system. Finite element formulation of 2-D constant strain triangular element (CST element) and Rectangular element - derivation of shape function in Cartesian, local and natural coordinates system.	

Text Book 1: Ch 3 & 5	
Module – 3	**08Hrs**
Higher order element: Iso parametric, sub parametric and super parametric elements, characteristics of Iso parametric quadrilateral elements, Lagrange interpolation function for linear element, shape function for two node, three node, four node bar element. Shape function for eight and nine node rectangular element. **I-D bar element:** Method of handling boundary conditions, elimination method, penalty approach method, problems. **Text Book 1: Ch 4 & 6**	
Module – 4	**08Hrs**
Trusses: Element of stiffness matrix, Finite element equation for truss element Problems. **Beams:** Derivation of Hermite shape function for beam element, elemental stiffness matrix, problems. **Text Book 1: Ch 7**	
Module – 5	**08Hrs**
Heat Transfer: Energy balance equation, rate equation. Finite element formulation of 1-D heat conduction, derivation of shape function, conductivity matrix, 1-D heat conduction with free end convection and internal heat generation. Problems **Axi symmetric Elements**: Axi symmetric formulation --finite element modeling of triangular and quadrilateral element. Dynamic consideration- Formulation Hamilton principle, Element mass matrices **Text Book 1: Ch 5 & 8** **Text Book 2: Ch 9**	

PRACTICAL COMPONENT OF IPCC

Sl. No	Experiments
	Part A
1	Bars of constant cross section area, tapered cross section area and stepped bars
2	Modeling and stress analysis of Trusses
3	Beams: Cantilever, Simply supported, overhanging beams with self-weight, Concentrated loads, UDL, Direct moment and UVL with different support conditions.
	Part B
1	Stress analysis of rectangular plate with circular hole
2	Dynamic Analysis: Modal analysis of Bars and Beams
3	Dynamic Analysis: Harmonic analysis of Bar subjected to forcing function and Fixed-Fixed beam subjected to forcing function

Part C	
1	Thermal Analysis – 1D problems with conduction and convection boundary conditions
2	Thermal Analysis – 2D problems with conduction and convection boundary conditions
3	Fluid flow Analysis – Potential distribution in 2-D bodies

Course Outcomes: After completing the course, the students will be able to	
CO1	Apply equilibrium equations and stress-strain relations to solve plane stress and strain problems using FEM techniques.
CO2	Develop interpolation polynomials and calculate shape functions for CST triangular and rectangular elements.
CO3	Analyze 1-D bar and stepped bar problems using penalty and elimination methods, constructing stiffness matrices for truss elements
CO4	Compute nodal load vectors and stiffness matrices for beam and heat transfer elements
CO5	Apply suitable boundary condition to solve dynamic problems

Text Books	
1	Hallesh , "Finite Element Methods" Publisher Sapna book House 2010
2	Chandrupatla T R and Belegundu A.D, "Introduction to Finite elements in Engineering", Printice Hall, Newyork, 2002

Reference Books	
1	Finite Element analysis - Theory and Programming, C. S. Krishnamurthy -, Tata McGraw Hill Co. Ltd, New Delhi.

Web links and Video Lectures (e – Resources)	
1	https://archive.nptel.ac.in/content/syllabus_pdf/105105041.pdf
2	https://archive.nptel.ac.in/courses/112/104/112104193/

CO – PO MAPPING

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

Semester: V						
Rocket Propulsion						
Course Code	**:**	**BAS503**		**Credits**	**:**	4
Hours/Week(L:T:P)	**:**	3:2:0		**CIE**	**:**	50 Marks
Total Hours	**:**	40		**SEE**	**:**	50 Marks
Course Type	**:**	PCC		**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Thermodynamics, Fluid Mechanics, Aerodynamics, Aircraft Propulsion
Knowledge on Fundamental Concepts	Physics, Chemistry
Knowledge on Connected Tools (If any)	-

Course Learning Objectives: This course will enable the students to	
CLO1	Explain the fundamentals of rocket propulsion and identify performance parameters.
CLO2	Distinguish between solid and liquid propulsion systems and explain their working principles
CLO3	Describe the working principles of electric propulsion systems and thrust vector control techniques.
CLO4	Analyze the different components, materials, and designs used in rocket engines.
CLO5	Outline rocket testing procedures and evaluate launch readiness based on ground and flight tests.

Module – 1	**08Hrs**
Introduction and Fundamentals: Classification, Duct Jet Propulsion, Rocket Propulsion, Applications of Rocket Propulsion, Definitions and Fundamentals, Definition, Thrust Exhaust Velocity, Energy and Efficiencies, Typical Performance Values, Problems. Introduction to Sounding rocket. **Text Book1: Ch 1 & 2**	
Module – 2	**08Hrs**
Solid Propellant Rocket Motor Systems: Solid Propellant rocket motors, principal features, applications. Solid propellants, types, composition, properties, performance. Propellant grain, desirable properties, grain configuration, preparation, loading, structural design of grain. Liners, insulators and inhibitors, function, requirements, materials. Rocket motor casing – materials. Nozzles, types, design, construction, thermal protection. Igniters, types, construction **Text Book1: Ch 11,12 & 14**	
Module – 3	**08Hrs**
Liquid Propellant Rocket Motor Systems: Liquid propellants, types, composition, properties, performance. Propellant tanks, feed systems, pressurization, turbo-	

pumps, valves and feed lines, injectors, starting and ignition. Engine cooling, support structure. Control of engine starting and thrust build up, system calibration, integration and optimisation – safety and environmental concerns. Description of the space shuttle main engine. Propellant slosh, propellant hammer, geysering effect in cryogenic rocket engines.

Text Book1: Ch 6, 7 & 8

Module – 4	**08Hrs**

Electric Propulsion: Ideal Flight Performance, Electrothermal Thrusts, Non-Thermal Electric Thrusters, Optimum Flight Performance, Mission Applications, Electric Space-Power Supplies and Power-Conditioning Systems.

Thrust Vector Control: TVC Mechanisms with a Single Nozzle, TVC with Multiple Thrust Chambers or Nozzles, Testing, Integration with Vehicle.

Text Book1: Ch 16 & 19

Module – 5	**08Hrs**

Rocket Testing: Ground Testing and Flight Testing, Types of Tests facilities and safeguards, monitoring and control of toxic materials, instrumentation and data management. Ground Testing, Flight Testing, Trajectory monitoring, post -accident procedures. Description of a typical space launch vehicle launching procedure.

Text Book1: Ch 20

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the fundamentals of rocket propulsion including thrust, Isp, efficiency.
CO2	Explain and compare solid and liquid propellant rocket engines, propellants, and subsystem
CO3	Illustrate electric propulsion systems and thrust vector control mechanisms with applications.
CO4	Analyse the materials, structural components, and grain configuration of rocket motors.
CO5	Evaluate rocket testing procedures, instrumentation, and safety protocols.

Text Books	
1	Rocket Propulsion Elements, Sutton, G.P., Biblarz, O., 7thEd. John Wiley & Sons, Inc., New York, 2012.

Reference Books	
1	Marcel Barrère , “Rocket Propulsion” , Revised Edition, Elsevier Publishing Company, 1960
2	Martin, J.W. “Elements of Spacecraft Propulsion” , Springer-Verlag Berlin and Heidelberg GmbH & Co. K; 3rd ed. 2009 edition (19 September 2008)
3	H. S. Mukunda, Understanding Aerospace Chemical Propulsion, Interline

	Publishing, India, 2004

Web links and Video Lectures (e – Resources)	
1	https://youtu.be/vQiIt-jX0BM?si=KqMmZrPzfsp40tzb

CO – PO MAPPING

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

Semester: V						
Aircraft Structures Laboratory						
Course Code	**:**	**BASL504**		**Credits**	**:**	1
Hours/Week(L:T:P)	**:**	0:0:2		**CIE**	**:**	50 Marks
Total Hours	**:**	15		**SEE**	**:**	50 Marks
Course Type	**:**	PCCL		**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Mechanics of Materials, Aircraft Structures
Knowledge on Fundamental Concepts	Engineering Mechanics
Knowledge on Connected Tools (If any)	Strain gauge, Calipers etc..

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the behavior of structural members under axial, shear, and bending loads.
CLO2	Experimentally determine elastic properties such as Young's modulus and Poisson's ratio.
CLO3	Analyze failure patterns in aircraft structural joints.
CLO4	Study the buckling and stability behavior of slender columns.
CLO5	Verify the theoretical concepts such as superposition and shear center using experimental methods.

Experiments	**15 Hrs**

1. Deflection of a Simply Supported Beam.
2. Verification of Maxwell's Reciprocal Theorem.
3. Determination of Young's Modulus using strain gages.
4. Poisson Ratio Determination.
5. Buckling Load of Slender Eccentric Columns and Construction of Southwell Plot
6. Shear failure of Bolted and Riveted Joints.
7. Bending Modulus of a Sandwich Beam
8. Verification of the Superposition Theorem.
9. Determination of Shear center for beams of symmetrical and arbitrary cross sections
10. Determination of Shear center for beams of open and closed sections

Course Outcomes: After completing the course, the students will be able to	
CO1	Demonstrate deflection of beams and validate theoretically.
CO2	Determine material properties using strain gauges.

CO3	Analyze buckling behavior and joint failures in structural elements.
CO4	Experimentally verify the shear center location in various cross-sections.
CO5	Validate Maxwell's Reciprocal theorem and Principle of superposition

Text Books	
1	Timoshenko, S. & Gere, J.M. "Mechanics of Materials" – McGraw-Hill Education

Reference Books	
1	Megson, T.H.G. "Aircraft Structures for Engineering Students" – Elsevier

Web links and Video Lectures (e – Resources)	
1	https://youtu.be/oYbl5xCADCM?si=vdka0uKKb5TZbp1m
2	https://youtu.be/ih9bDBDIbFs?si=TZaIi6sd2myF1Xyj

CO – PO MAPPING

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

Semester: V						
Mechanisms and Machine theory						
Course Code	:	**BAS525A**		**Credits**	:	3
Hours/Week(L:T:P)	:	3:0:0		**CIE**	:	50 Marks
Total Hours	:	40		**SEE**	:	50 Marks
Course Type	:	PEC		**SEE Duration**	:	3 Hours

Prerequisites:	
Courses	Engineering mechanics,
Knowledge on Fundamental Concepts	Physics, especially in classical mechanics.
Knowledge on Connected Tools (If any)	--

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the theory of mechanisms including velocity, acceleration and static force analysis.
CLO2	Acquire knowledge of spur gears, gear train, balancing of rotating and reciprocating masses.
CLO3	Understand the concept of governors and gyroscope.
CL04	Analyze complex mechanisms and machine systems to evaluate motion characteristics, force distribution, balancing of rotating/reciprocating masses, and performance of governors and flywheels.
CLO5	Evaluate and compare different mechanisms and power transmission systems based on efficiency, suitability, motion characteristics, and engineering constraints for specific industrial applications.

Module – 1	**08Hrs**
Introduction to Mechanisms: Types of constrained motion, Link and its types, joints and its types, kinematic pair and its types, degrees of freedom, Grubler's criterion, Types of kinematic chains and inversions: Inversions of Four bar chain: Beam engine, coupling rod of a locomotive, Watt's indicator mechanism. Inversions of Single Slider Crank Chain: Pendulum pump or Bull engine, Oscillating cylinder engine, Rotary internal combustion engine, Crank and slotted lever quick return motion mechanism, Whitworth quick return motion mechanism. **Inversions of Double Slider Crank Chain:** Elliptical trammels, Scotch yoke mechanism, Oldham's coupling. **Straight line motion mechanisms:** Peaucellier's mechanism and Robert's mechanism. **Intermittent Motion mechanisms:** Geneva wheel mechanism and Ratchet and Pawl mechanism, Ackerman steering gear mechanism.	

Text Book 1: Ch 1

Module – 2	08Hrs

Velocity, Acceleration and static force analysis of Mechanisms (Graphical Methods): Velocity and acceleration analysis of Four Bar mechanism, slider crank mechanism and Simple Mechanisms by vector polygons.

Static force analysis: Introduction, Static equilibrium, Equilibrium of two and three force members. Members with two forces and torque. Free body diagrams, principle of virtual work. Static force analysis of four bar mechanism and slider-crank mechanism with and without friction.

Text Book 1: Ch 2 & 12

Module – 3	08Hrs

Spur Gears: Gear terminology, law of gearing, Path of contact, Arc of contact, contact ratio of spur gear, Interference in involute gears, Methods of avoiding interference.

Gear Trains: Simple gear trains, Compound gear trains, Reverted gear trains, Epicyclic gear trains, Analysis of epicyclic gear train (Algebraic and tabular methods), torques in epicyclic trains.

Text Book 1: Ch 10 & 11

Module – 4	08Hrs

Balancing of Rotating and Reciprocating Masses

Balancing of Rotating Masses: Balancing of Several Masses Rotating in the Same Plane, Balancing of Several Masses Rotating in Different Planes (only Graphical Methods).

Balancing of Reciprocating Masses: Primary and Secondary Unbalanced Forces of Reciprocating Masses, Partial Balancing of Unbalanced Primary Force in a Reciprocating Engine, Balancing of Primary and secondary Forces of Multi-cylinder In-line Engines, Balancing of Radial Engines (only Graphical Methods)

Text Book 2: Ch 21 & 22

Module – 5	08Hrs

Governors and Gyroscope Governors: Types of governors; force analysis of Porter and Hartnell governors, Controlling force, stability, sensitiveness, isochronism, effort and power of Porter and Hartnell governors.

Gyroscopes: Vectorial representation of angular motion, gyroscopic couple, effect of gyroscopic couple on plane disc and aeroplane

Text Book 1: Ch 16 & 17

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the concepts of motion, DOF and inversions of four bar mechanism and slider crank mechanism
CO2	Investigate geometrical motion, velocity and acceleration of Slider crank mechanism and Four bar mechanism by graphical methods and static force analysis in different mechanisms
CO3	Estimate the interference existing in the Spur gears and arrangement of gears to get desired velocity ratio and torque.
CO4	Interpret the magnitude and angular position of balancing of rotating and reciprocating masses.
CO5	Analyze the forces in different types of governors and gyroscopic effects on disks, aero planes

Text Books	
1	Rattan S.S, "Theory of Machines", Tata McGraw-Hill Publishing Company Ltd., New Delhi, and 3rd edition -2009, ISBN: 007014477X, 9780070144774.
2	R. S. Khurmi, J.K. Gupta, "Theory of Machines", Eurasia Publishing House, 2008, ISBN 13: 9788121925242.

Reference Books	
1	J.J. Uicker, G.R. Pennock, J.E. Shigley."Theory of Machines & Mechanisms", OXFORD 3rd Ed. 2009, ISBN 13: 978-0195371239
2	Robert L Norton,"Design of Machinery" by McGraw Hill, 2001, ISBN-13: 978-0077421717
3	Ambekar, "Mechanism and Machine theory", PHI Learning Pvt. Ltd., 2007, ISBN 13: 9788120331341

Web links and Video Lectures (e – Resources)	
1	https://nptel.ac.in/courses/112105268

CO – PO MAPPING

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

Semester: V						
Aircraft Performance						
Course Code	**:**	**BAS525B**		**Credits**	**:**	3
Hours/Week(L:T:P)	**:**	3:0:0		**CIE**	**:**	50 Marks
Total Hours	**:**	40		**SEE**	**:**	50 Marks
Course Type	**:**	PEC		**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Aerodynamics, Propulsion
Knowledge on Fundamental Concepts	Mathematics
Knowledge on Connected Tools (If any)	--

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the forces acting on an aircraft during steady, unaccelerated flight
CLO2	Analyze aircraft performance during steady level flight, climbs, and glides using equations of motion
CLO3	Interpret key performance parameters like thrust-to-weight ratio, lift-to-drag ratio, and range/endurance
CLO4	Evaluate aircraft performance during take-off, landing, and accelerated climbs
CLO5	Analyze aircraft maneuverability including turning performance and load factor constraints.

Module – 1	**08Hrs**
The Equations of Motion: Steady Unaccelerated Flight Introduction, four forces of flight, General equation of motion, Power available and power required curves. Thrust available and thrust required curves. Conditions for minimum power and thrust required. Thrust available and maximum velocity, Power available and maximum velocity, Altitude effects on power available and power required; thrust available and thrust required. **Text Book 1: Ch 3,4 & 5**	
Module – 2	**08Hrs**
Steady Performance – Level Flight, Climb & Glide Performance: Equation of motion for Rate of climb- graphical and analytical approach -Absolute ceiling, Service ceiling, Time to climb – graphical and analytical approach, climb performance graph (hodograph diagram); maximum climb angle and rate of climb Gliding flight, Range during glide, minimum rate of sink and shallowest angle of glide. **Text Book 1: Ch 6 & 7**	
Module – 3	**08Hrs**
Fundamental Airplane Performance Parameters: The Fundamental Parameters: Thrust – to – weight ratio, Wing loading, drag polar, and lift-to – drag ratio. Minimum velocity. Aerodynamic relations associated with lift-to-drag ratio. **Range and Endurance:** Propeller driven Airplane: Physical consideration, Quantitative formulation, Breguet equation for Range and Endurance, Conditions for maximum range and endurance. Jet Airplane: Physical consideration, Quantitative formulation, Equation for	

Range and Endurance, Conditions for maximum range and endurance, Effect of head wind tail wind.

Text Book 1: Ch 5 & 8

Module – 4	**08Hrs**

Aircraft Performance in Accelerated Flight Take-off Performance: Calculation of Ground roll, Calculation of distance while airborne to clear obstacle, Balanced field length, Landing **Performance and Accelerated Climb:** Calculation of approach distance, Calculation of flare distance, Calculation of ground roll, ground effects. Acceleration in climb.

Text Book 1: Ch 9 & 10

Module – 5	**08Hrs**

Maneuver Performance

Turning performance: Level turn, load factor, Constraints on load factor, Minimum turn radius, Maximum turn rate.

Pull-up and Pull-down maneuvers: (Turning rate, turn radius). Limiting case for large load factor. The V-n diagram (Flight Envelope). Limitations of pull up and push over.

Text Book 1: Ch 11 & 12

Course Outcomes: After completing the course, the students will be able to	
CO1	Explain and derive the equations of motion for steady, unaccelerated flight and analyze power and thrust curves.
CO2	Calculate performance parameters for level flight, climb, and glide, including rate of climb, service ceiling, and glide range
CO3	Evaluate fundamental performance metrics like thrust-to-weight ratio, drag polar, and lift-to-drag ratio, and apply Breguet's equations for range and endurance.
CO4	Assess take-off and landing performance, including runway length, ground roll, flare distance, and effect of obstacles.
CO5	Analyze maneuver performance using turn rate, turn radius, and V-n diagram for load factor constraints

Text Books	
1	John D. Anderson, Jr. "Aircraft Performance and Design", McGraw-Hill International Editions, Aerospace Science/ Technology Editions, 1999.
2	John D. Anderson, Jr., "Introduction to flight" McGraw-Hill International Editions, Aerospace Science/ Technology Editions, 2000.

Reference Books	
1	Perkins, C.D., and Hage, R.E., "Airplane Performance stability and Control", John Wiley Son Inc, New York, 1988.
2	Barnes W. McCormick, ` Aerodynamics, Aeronautics, and Flight Mechanics`, John Wiley& Sons, Inc. 1995.

Web links and Video Lectures (e – Resources)	
1	https://youtu.be/tEWuP1NVdgE?si=LEaj4gGARhIk8z-j

CO – PO MAPPING

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

Semester: V						
Experimental Aerodynamics						
Course Code	**:**	**BAS525C**		**Credits**	**:**	3
Hours/Week(L:T:P)	**:**	3:0:0		**CIE**	**:**	50 Marks
Total Hours	**:**	40		**SEE**	**:**	50 Marks
Course Type	**:**	PEC		**SEE Duration**	**:**	3 Hours

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

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the Necessity and Design of Wind Tunnels
CLO2	Explore Flow Visualization Techniques
CLO3	Learn Pressure, Velocity, Force, and Moment Measurement Techniques
CLO4	Study Unsteady and Turbulent Measurements
CLO5	Understand Data Acquisition Systems and Signal Processing

Module – 1	**08Hrs**
Wind Tunnel: Necessity of Wind Tunnels; Basic Principle; Types of Wind Tunnels; Components of Subsonic Tunnel, Supersonic Tunnel, Hypersonic Tunnel and Shock Tunnel; Special Purpose Wind Tunnel; Design Consideration of Subsonic Tunnel and Supersonic Tunnel; Calibration Methods of Different Wind Tunnels; **Text Book 1: Ch 1, 2 & 8**	
Module – 2	**06 Hrs**
Flow Visualisation: Different Types of Flow Visualization Techniques for Subsonic, Supersonic and Hypersonic Tunnels; Basics of Schlieren, Shadowgraph and Interferometers; Laser Based Flow Visualization Technique. **Text Book 1: Ch 3**	
Module – 3	**12 Hrs**
Pressure, Velocity, Force and Moment Measurement: Pitot Static Probe; Laser Doppler Velocimeter; Mechanical System for Pressure Measurement; Water and Mercury Manometers; Principle of Pressure Transducer; Different Types of Pressure Transducers; Mechanical Pressure Scanner, Electronic Pressure Scanner; Pressure Sensitive Paint; Calibration of Pressure Measuring Units, Definition of Forces and Moments on Aerospace Vehicles; Basic Principle of Mechanical Balance and Strain Gage Balance; Interaction between Different Components of Forces and Moments; Major Components for Force and Moment Measuring Systems. **Text Book 1: Ch 4, 5 & 6**	
Module – 4	**08Hrs**
Unsteady Measurement: Introduction to Unsteady data; Introduction to Turbulent measurements; Basic Principle of Hot Wire Anemometer; Constant Current and Constant Temperature Anemometer, Measurement of Unsteady Velocities Using Hot Wire Anemometers; Measurement of Turbulent Stresses; Single and Multiple Hot	

Wire Probes; Basic Principles of Unsteady Pressure Transducers; Calibration of Steady and Unsteady Pressure Transducers. **Text Book 2: Ch 4, 5 & 8**

Module – 5	**06 Hrs**
Data Acquisition System: Analog and Digital Signals; Mean and Fluctuating Signals; ADC Cards; Amplifiers; Signal Conditioners; P C Based Data Acquisition System, Data Acquisition Software; Error Analysis. **Text Book 2: Ch 18**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Expertise in Wind Tunnel Principles and Design
CO2	Proficiency in Flow Visualization Techniques
CO3	Competence in Aerodynamic Measurement Techniques
CO4	Mastery of Unsteady and Turbulent Flow Measurement
CO5	Proficiency in Data Acquisition and Signal Processing

Text Books	
1	High Speed Wind Tunnel Testing, Roe, W. H. and Pope, A., Wiley, 1965.
2	Goldstein, R.J., *"Fluid Mechanics Measurements"* , CRC Press

Reference Books	
1	Random Data: Analysis and Measurement Procedures, Bendat, J. S. and Piersol. A.G., Wiley, 2010.
2	Low Speed Wind Tunnel Testing, Pope, A. and Goin, L., Wiley,

Web links and Video Lectures (e – Resources)	
1	https://youtu.be/cZCSyEIgA3U?si=G04J5GFSMnwnISSp

CO PO PSO Mapping:

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

Semester: V						
Satellite Communication						
Course Code	**:**	**BAS525D**		**Credits**	**:**	3
Hours/Week(L:T:P)	**:**	3:0:0		**CIE**	**:**	50Marks
Total Hours	**:**	40		**SEE**	**:**	50Marks
Course Type	**:**	PEC		**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Basic Electronics
Knowledge on Fundamental Concepts	Physics
Knowledge on Connected Tools (If any)	

Course Learning Objectives: This course will enable the students to	
CLO1	Explain the fundamental principles of satellite systems, orbital mechanics (LEO, MEO, GSO), and bandwidth allocation.
CLO2	Analyze modulation, multiplexing, multiple access techniques (FDMA, TDMA, CDMA, DAMA), and coding schemes in satellite communication.
CLO3	Design and evaluate satellite links considering interference, rain attenuation, ionospheric effects, and frequency reuse.
CLO4	Describe satellite telemetry, tracking, and command systems, including their applications in spacecraft.
CLO5	Apply satellite communication concepts to real-world systems such as VSAT, MSS, AMSS, and MMSS.

Module – 1	**08Hrs**
Elements of Satellite Communication: Satellite Systems, Orbital description and Orbital mechanics of LEO, MEO and GSO, Placement of a Satellite in a GSO, Satellite – description of different Communication subsystems, Bandwidth allocation. **Textbook 1: Ch 1,2 & 3** **Textbook 2: Ch 2 & 3**	
Module – 2	**08Hrs**
Transmission, Multiplexing, Multiple Access and Coding: Different modulation and Multiplexing Schemes, Multiple Access Techniques FDMA, TDMA, CDMA and DAMA, Coding Schemes, Satellite Packet Communications. **Textbook 1: Ch 4 & 5** **Textbook 2: Ch 5 & 7**	
Module – 3	**08Hrs**
Satellite Link Design: Basic link analysis, Interference analysis, Rain induced attenuation and interference, Ionospheric characteristics, Link Design with and without frequency reuse. **Textbook 1: Ch 6 & 7** **Textbook 2: Ch 4 & 9**	
Module – 4	**08Hrs**
Satellite Telemetry, Tracking and Telecommand: Introduction to telemetry systems, Aerospace transducer, signal conditioning, multiplexing methods, Analog and digital telemetry, Command line and remote-control system, Application of	

telemetry in spacecraft systems, Base Band Telemetry system, Computer command & Data handling, Satellite command system, Issues. **Textbook 1: Ch 8** **Textbook 2: Ch 10**	
Module – 5	**08Hrs**
Applications: VSAT-VSAT Technologies, Networks MSS-AMSS, MMSS. **Textbook 1: Ch 9** **Textbook 2: Ch 8**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand satellite communication system architecture, orbital characteristics, geostationary satellite placement, communication subsystems, and bandwidth allocation.
CO2	Compare various transmission techniques including modulation, multiplexing, multiple access methods, coding techniques, and satellite packet communication.
CO3	Analyze satellite links considering link budget, interference, rain attenuation, ionospheric effects, and frequency reuse.
CO4	Explain the working of satellite telemetry, tracking, and telecommand systems and their components.
CO5	Describe satellite communication applications such as VSAT and mobile satellite services.

Text Books	
1	Wilbur L. Pritchard and Joseph A. Sciulli, Satellite Communication Systems Engineering, Pearson Education India,2nd edition,2003, ISBN-13: 978-8131702420.
2	Timothy Pratt and Charles W. Bostain, Satellite Communications, John Wiley andSons,2nd edition,2006, ISBN-13: 978-8126508334.

Reference Books	
1	Tri T Ha, Digital Satellite Communication, McGraw Hill Education, second edition, 2008, ISBN13: 978-0070077522.

Web links and Video Lectures (e – Resources)	
1	https://www.youtube.com/watch?v=WARM4fwsoT4&list=PLVsrfTSlZ_43SERuuAZZ-u1PBnwwn2ZfC
2	https://youtu.be/hXa3bTcIGPU?si=Qc7xHm2Zrsvyn10v

CO PO PSO Mapping:

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

Semester: V					
Research Methodology and IPR **Stream: CSE/ECE/CV/ME**					
Course Code	**:**	BRM507	**Credits**	**:**	**3**
Hours/Week(L:T:P)	**:**	2:2:0	**CIE**	**:**	50 Marks
Total Hours	**:**	40 Hrs	**SEE**	**:**	50 Marks
Course Type	**:**	AEC	**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Understanding of academic writing and analytical thinking
Knowledge on Fundamental Concepts	Fundamental knowledge of scientific principles
Knowledge on Connected Tools (If any)	Citation managers (e.g., Mendeley, Zotero) and plagiarism detection software.

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the knowledge on basics of research and its types
CLO2	Learn the concept of Literature Review, Technical Reading, Attributions and Citations.
CLO3	Learn Ethics in Engineering Research.
CLO4	Discuss the concepts of Intellectual Property Rights in engineering

Module – 1	**08Hrs**
Introduction: Meaning of Research**,** Objectives of Engineering Research, and Motivation in Engineering Research, Types of Engineering Research, Finding and Solving a Worthwhile Problem. Ethics in Engineering Research, Ethics in Engineering Research Practice, Types of Research Misconduct, Ethical Issues Related to Authorship. **Test Book 1**: **Ch. 1**: 1.1-1.9	
Module – 2	**08Hrs**
Literature Review and Technical Reading, New and Existing Knowledge, Analysis and Synthesis of Prior Art Bibliographic Databases, Web of Science, Google and Google Scholar, Effective Search: The Way Forward Introduction to Technical Reading Conceptualizing Research, Critical and Creative Reading, Taking Notes While Reading, Reading Mathematics and Algorithms, Reading a Datasheet. **Attributions and Citations**: Giving Credit Wherever Due, Citations: Functions and Attributes, Impact of Title and Keywords on Citations, Knowledge Flow through Citation, Citing Datasets, Styles for Citations, Acknowledgments and Attributions, What Should Be Acknowledged, Acknowledgments in Books/ Dissertations, Dedication or Acknowledgments **Test Book 1**: **Ch. 2**: 2.1-2.5.5, **Ch. 3**: 3.1-3.9	
Module – 3	**08Hrs**

Introduction To Intellectual Property: Role of IP in the Economic and Cultural Development of the Society, IP Governance, IP as a Global Indicator of Innovation, Origin of IP History of IP in India. Major Amendments in IP Laws and Acts in India.

Patents: Conditions for Obtaining a Patent Protection, To Patent or Not to Patent an Invention. Rights Associated with Patents. Enforcement of Patent Rights. Inventions Eligible for Patenting. Non-Patentable Matters. Patent Infringements. Avoid Public Disclosure of an Invention before Patenting.

Process of Patenting. Prior Art Search. Choice of Application to be Filed. Patent Application Forms. Jurisdiction of Filing Patent Application. Publication. Pre-grant Opposition. Examination. Grant of a Patent. Validity of Patent Protection. Post-grant Opposition. Commercialization of a Patent. Need for a Patent Attorney/Agent. Can a Worldwide Patent be Obtained? Do I Need First to File a Patent in India? Patent Related Forms. Fee Structure. Types of Patent Applications. Commonly Used Terms in Patenting. National Bodies Dealing with Patent Affairs. Utility Models.

Test Book 1: **Ch. 4**: 4.1-4.6, **Ch. 5**: 5.1-5.8, **Ch. 6**: 6.1-6.20

Module – 4	**08Hrs**

Copyrights and Related Rights: Classes of Copyrights. Criteria for Copyright. Ownership of Copyright. Copyrights of the Author. Copyright Infringements. Copyright Infringement is a Criminal Offence. Copyright Infringement is a Cognizable Offence. Fair Use Doctrine. Copyrights and Internet. Non-Copyright Work. Copyright Registration. Judicial Powers of the Registrar of Copyrights. Fee Structure. Copyright Symbol. Validity of Copyright. Copyright Profile of India. Copyright and the word 'Publish'. Transfer of Copyrights to a Publisher. Copyrights and the Word 'Adaptation'. Copyrights and the Word 'Indian Work'. Joint Authorship. Copyright Society. Copyright Board. Copyright Enforcement Advisory Council (CEAC). International Copyright Agreements, Conventions and Treaties. Interesting Copyrights Cases.

Trademarks: Eligibility Criteria. Who Can Apply for a Trademark. Acts and Laws. Designation of Trademark Symbols. Classification of Trademarks. Registration of a Trademark is Not Compulsory. Validity of Trademark. Types of Trademark Registered in India. Trademark Registry. Process for Trademarks Registration. Prior Art Search. Famous Case Law: Coca-Cola Company vs. Bisleri International Pvt. Ltd.

Test Book 1: **Ch. 7**: 7.1-7.27, **Ch. 8**: 8.1-8.12

Module – 5	**08Hrs**

Industrial Designs: Eligibility Criteria. Acts and Laws to Govern Industrial Designs. Design Rights. Enforcement of Design Rights. Non-Protectable Industrial Designs India. Protection Term. Procedure for Registration of Industrial Designs. Prior Art Search. Application for Registration. Duration of the Registration of a Design. Importance of Design Registration. Cancellation of the Registered Design. Application Forms. Classification of Industrial Designs. Designs Registration Trend in India. International Treaties. Famous Case Law: Apple Inc. vs. Samsung Electronics Co.

Geographical Indications: Acts, Laws and Rules Pertaining to GI. Ownership of GI. Rights Granted to the Holders. Registered GI in India. Identification of Registered GI.

Classes of GI. Non-Registerable GI. Protection of GI. Collective or Certification Marks. Enforcement of GI Rights. Procedure for GI Registration Documents Required for GI Registration. GI Ecosystem in India. **Case Studies on Patents**. Case study of Curcuma (Turmeric) Patent, Case study of Neem Patent, Case study of Basmati patent. IP Organizations In India. Schemes and Programmes **Test Book 1**: **Ch. 9**: 9.1-9.17, **Ch. 10**: 10.1-10.13, **Ch. 11**: 11.1-11.3

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the fundamentals of engineering research, its types, objectives and ethical considerations in conducting research.
CO2	Conduct effective literature reviews, perform technical reading and apply appropriate citation and attribution practices
CO3	Demonstrate an understanding of intellectual property concepts, laws and processes, with a focus on patents and their commercialization.
CO4	Interpret copyright, trademark and related rights, including their legal frameworks, enforcement and case laws
CO5	Analyze industrial designs, geographical indications and selected IPR case studies and evaluate their impact on innovation and society

Text Books	
1	Dr. Santosh M Nejakar, Dr. Harish Bendigeri "Research Methodology and Intellectual Property Rights", ISBN 978-93-5987-928-4, Edition: 2023-24.

Reference Books	
1	David V. Thiel "Research Methods for Engineers" Cambridge University Press, 978-1-107-03488-4
2	Intellectual Property Rights by N.K.Acharya Asia Law House 6th Edition. ISBN: 978-93-81849-30-9

CO – PO MAPPING

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

Semester: V						
Competency Enhancement Course-3 **Stream: CSE/ECE/ME/CV**						
Course Code	**:**	**BCE508**		**Credits**	**:**	0
Hours/Week(L:T:P)	**:**	0:2:0		**CIE**	**:**	100 Marks
Total Hours	**:**	40		**SEE**	**:**	-
Course Type	**:**	NCMC		**SEE Duration**	**:**	-

Prerequisites:	
Courses	Fundamentals of C Programing
Knowledge on Fundamental Concepts	Programming fundamentals, including variables, data types, control structures (if, loops), and syntax
Knowledge on Connected Tools	NA

Course Learning Objectives: This course will enable the students to	
CLO1	Understand and apply fundamental programming concepts using C
CLO2	Develop object-oriented programs in C++
CLO3	Write and debug multi-file programs in C and C++
CLO4	Design and manage databases using SQL in Oracle and MySQL
CLO5	Compare and analyze different database models (RDBMS vs NoSQL)

Module – 1	**8 Hrs**
C programming (A) Data Types, Operators and Expressions Input and output Operations Control Flow – Branching, Control Flow – Looping, Statements and Blocks, If Else, Switch, Nesting of If Else, GOTO statement, The while statement, The For statement, The Do statement, Jumps in loops **C programming (B)** Arrays, Strings, One-dimensional arrays, Initialization of one-dimensional arrays, Two-dimensional Arrays, Initializing Two-dimensional arrays, Multi-dimensional arrays, Dynamic arrays, Declaring and Initializing string variables, Reading Strings from Terminal, Writing Strings to screen, String handling functions, Operations on strings **C programming (C)** User-defined Functions, Structures, Basics of Functions, Functions Returning Non-integers, External Variables, Scope Rules, Header Files, Static Variables, Register Variables, Block Structure, Initialization, Recursion, Category of functions, Functions that return multiple values, Nesting functions, Multi-file programs, Structures and Functions, Arrays of Structures, Pointers to Structures, Self-referential structures **Textbook 1, Ch1-11**	
Module – 2	**8 Hrs**
C Programming (D)	

Unions, Pointers, Difference between Structures and Unions, Accessing the address of a variable, Declaring and Initializing pointer variables, Accessing a variable through its pointers, Chain of pointers, Pointer Expressions, Pointer Increments and Scale Factors, Pointers and character strings, Array of pointers, Pointers as function arguments, Functions returning pointers, Pointers to functions, Drawback of Pointers

File Management in C

The Preprocessor, Defining and Opening a File, Closing a File, Input / Output Operations on Files, Random Access to Files, Command Line Arguments. Macro Substitution, File Inclusion, Compiler Control Directives, ANSI Additions

Textbook 1- Ch2-16

Module-3	**8 Hrs**

C++

Object oriented Programming, Class and Objects, Dynamic Memory Management POP,OOPs in C++, Console Input / Output in C++, Comment lines in C++, Importance of function prototyping in C++, Function overloading, Inline functions and default arguments

Textbook 2 –Ch1-6

Module-4	**8 Hrs**

C++

Scope Resolution Operator, Structures, Defining function outside the class , Friend functions, Friend class, Array of class objects, Passing class objects to and returning class objects from functions, Nested classes, Namespaces, Dynamic memory allocation using new and deallocation, new handler function

Textbook 2- Ch7-11

Module-5	**8 Hrs**

Database Management System : Types of DBMS – Merits and Demerits Oracle and MySQL, SDLC, Architecture (Oracle 10g) - Instance, User Accounts, Client Applications IP, Port Number, SQL Introduction Tables, DDL and DML, Pluggable Databases – Oracle 19c, Architecture Undo and Redo, Operators Constraints Sequences Triggers, Functions – Conversion, String, Math, Aggregate Clauses, Joins, Views, Synonyms, Indexes Stored Procedures, Normalization, Triggers and stored procedures, NoSQL Db, normalisation – tables

Textbook 3 – Ch1-8

Course Outcomes: After completing the course, the students will be able to	
CO1	Demonstrate basic C programming skills in data types, control flow, arrays and strings to solve problems.
CO2	Apply advanced C features like functions, structures, pointers, unions and file handling for modular coding
CO3	Apply C++ OOP concepts, including classes, function overloading, friend functions and dynamic memory management.
CO4	Design and manage databases with Oracle/MySQL, write SQL queries, normalize data and use stored procedures.
CO5	Combine C/C++ programming with database operations to build applications for data storage and retrieval.

Text Books	
1	**Let Us C** by Yashavant Kanetkar (ISBN- 978-8183331630), 15th Edition, BPB Publications- 2016
2	**Object-Oriented Programming with C++** by E. Balagurusamy (ISBN- 978-9389949186), 8th Edition, Tata McGraw-Hill - 2020
3	**Database System Concepts** by Abraham Silberschatz, Henry Korth, S. Sudarshan(ISBN- 978-9332901384),6th Edition, McGraw Hill Education- 2013

Reference Books	
1	**Programming in ANSI C,** by E. Balaguruswamy, (ISBN- 978-9339219666), 7th Edition, Tata McGraw-Hill – 2017
2	**C PROGRAMMING LANGUAGE** by Brian W. Kernighan / Dennis Ritchie(ISBN-978-9332549449), 2nd Edition, Pearson Education India - 2015

Web links and Video Lectures (e – Resources)	
1	https://www.softprayog.in/programming/c-programming-tutorial-data-types-and-expressions
2	https://www.geeksforgeeks.org/array-of-strings-in-c/
3	https://www.programiz.com/c-programming/c-structures-pointers
4	https://www.w3schools.com/cpp/cpp_oop.asp
5	https://www.geeksforgeeks.org/dbms/

CO – PO MAPPING

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

Semester: V						
NATIONAL SERVICE SCHEME Stream: CSE/ECE/ME/CV						
Course Code	**:**	**BNS509**		**Credits**	**:**	0
Hours/Week(L:T:P)	**:**	0:0:2		**CIE**	**:**	100 Marks
Total Hours	**:**	24		**SEE**	**:**	-
Course Type	**:**	NCMC		**SEE Duration**	**:**	-

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the community in general in which they work
CLO2	Identify the needs and problems of the community and involve them in problem – 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.
CLO5	Appraise the importance of ethical issues and team working abilities pertaining to the social services.

Activity– 1	**06Hrs**
Developing Sustainable Water management system for rural areas and implementation approaches.	
Activity – 2	**06 Hrs**
Contribution to any national level initiative of Government of India. Foreg. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill development programs etc.	
Activity – 3	**06 Hrs**
Spreading public awareness under rural outreach programs.(Minimum 3 programs).	
Activity – 4	**06 Hrs**
Social connect and responsibilities.	

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.	Developing Sustainable Water management system for rural areas	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/Government	Site selection /proper consultation/ Continuous monitoring/ Information	Report should be submitted by individual to the	Evaluation as per the rubrics Of scheme and

	and implementation approaches.		Schemes officers/ campus etc.	board	concerned evaluation authority	syllabus by NSS officer
2.	Contribution to any national level initiative of Government of India. For eg. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill development programs etc.	May be individual 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.	Spreading public awareness under rural outreach programs. (minimum5 programs).	May be individual 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
4.	Social connect and responsibilities.	May be individual 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

Plan of Action (Execution of Activities for 5th Semester)

Sl. No.	Practice Session Description
1.	Lecture session by NSS Officer

2.	Selection of topic, Commencement of activity and its progress
3.	Execution of Activity
4.	Case study based Assessment, Individual performance
5.	Sector wise study and its consolidation
6.	Video based seminar for 10 minutes by each student At the end of semester with Report.

- In the 5th semester, each student should do activities according to the scheme and syllabus.
- At the end of the semester student performance has to be evaluated by the NSS Officer for the assigned activity progress and its completion.
- At the end of the 5th semester, consolidated report of all activities compiled report should be submitted as per the instructions.

Course Outcomes: After completing the course, the students will be able to	
CO1	Exploit the importance of his / her responsibilities towards society.
CO2	Analyze the environmental and societal problems/issues and will be able to design solutions for the same.
CO3	Evaluate the existing system and to propose practical solutions for the same for sustainable development.
CO4	Implement government or self-driven projects effectively in the field of societal problems.
CO5	Appraise the importance of ethical issues and team working abilities pertaining to the social services.

Assessment Details for CIE (100 Marks)

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

Suggested Learning Resources:

Books:

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

CO-PO Matrix

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

Semester: V						
Physical Education (PE) (Sports & Athletics) **Stream: CSE/ECE/ME/CV**						
Course Code	**:**	**BPE509**		**Credits**	**:**	0
Hours/Week(L:T:P)	**:**	0:0:2		**CIE**	**:**	100 Marks
Total Hours	**:**	24		**SEE**	**:**	-
Course Type	**:**	NCMC		**SEE Duration**	**:**	-

Course Learning Objectives: This course will enable the students to	
CLO1	Impart foundational knowledge on the importance of physical fitness, food, and nutrition for a healthy lifestyle and personal well-being.
CLO2	Develop awareness and proficiency in general fitness components such as agility, flexibility, and cardiovascular endurance through standardized physical fitness tests.
CLO3	Enhance motor skills and techniques in a selected sport (Badminton, Basketball, or Athletics) through structured practice and application of fundamental game-specific skills.

Module – 1	**4 Hrs**
Orientation A. Fitness B. Food & Nutrition	
Module – 2	**4 Hrs**
General Fitness & Components of Fitness A. Agility – Shuttle Run B. Flexibility – Sit and Reach C. Cardiovascular Endurance – Harvard step Test	
Module-3	**16 Hours**
Specific games (Any one to be selected by the student) A. Badminton (Fore hand low/high service, back hand service, smash, drop) B. Basketball (Dribbling, passing, shooting etc.) C. Athletics (Field events – Throws)	

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the fundamentals of fitness, food and nutrition and their role in a healthy lifestyle.
CO2	Demonstrate understanding of general fitness components such as agility, flexibility and cardiovascular endurance through standard fitness tests
CO3	Apply basic techniques, rules and strategies in the chosen sport (Badminton, Basketball, or Athletics)
CO4	Develop sport-specific skills to enhance performance in both practice and competitive situations
CO5	Exhibit teamwork, discipline and sportsmanship during training and game play

Scheme and Assessment for auditing the course and Grades:

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

CO – PO MAPPING

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

Semester: V						
Yoga Stream: CSE/ECE/ME/CV						
Course Code	**:**	**BYO509**		**Credits**	**:**	0
Hours/Week(L:T:P:S)	**:**	0:0:2		**CIE**	**:**	100 Marks
Total Hours	**:**	15 Hrs		**SEE**	**:**	-
Course Type	**:**	NCMC		**SEE Duration**	**:**	-

Course Learning Objectives: This course will enable the students to	
CLO1	**Adopt** healthy lifestyle practices and maintain mental hygiene to promote physical and mental well-being
CLO2	**Develop** emotional intelligence and foster emotional stability through self-awareness and mindfulness practices.
CLO3	**Impart** moral values and enhance self-awareness to facilitate personal growth and attain higher levels of consciousness.

Module - 1	03 Hrs
Ashtanga Yoga Basics: Patanjali's Ashtanga Yoga – definition, need & importance, Introduction to 3 limbs: Asana, Pranayama, Pratyahara	
Module - 2	**03 Hrs**
Asana Overview: Meaning, need & benefits of Asanas, Classification: Sitting, Standing, Prone , Supine	
Module - 3	**03 Hrs**
Sitting & Standing Asanas: *Sitting Asanas*: Ardha Ushtrasana, Vakrasana, Yogamudra in Padmasana, *Standing Asanas*: Urdhva Hastothanasana, Hastapadasana, Parivritta Trikonasana Utkatasana, Technique, precautions & benefits	
Module - 4	**03 Hrs**
Prone & Supine Asanas: Prone Asanas: Padangushtha Dhanurasana, Poorna Bhujangasana / Rajakapotasana, Supine Asanas: Sarvangasana, Chakrasana, Navasana / Noukasana, Pavanamuktasana Technique, precautions & benefits	
Module - 5	**03 Hrs**
Pranayama Practice: Meaning, need & benefits of Pranayama, Breathing practice: 60 strokes/min, 3 rounds, Types of Pranayama:Ujjayi, Sheetali, Sheektari, Technique, precautions & benefits	

Course Outcomes: After completing the course, the students will be able to	
CO1	Describe the origin, history, objectives, and fundamental concepts of Yoga and its various schools.
CO2	Demonstrate Suryanamaskara and various types of Asanas with correct techniques, precautions, and benefits.
CO3	Differentiate between yogic and non-yogic practices
CO4	Apply yogic principles to promote physical and mental well-being.

Text Books
1. Light on Yoga by BKS Iyengar, Thorsons Publishers, ISBN-10 : 8172235011
2. Teaching Methods for Yogic practices by Dr. M L Gharote & Dr. S K Ganguly, 4th Edition, Kaivalyadhama Publishers, ISBN-10 : 9788189485245
3. Yoga Instructor Course hand book published by SVYASA University, Bengaluru

Reference Books	
1	Yogapravesha in Kannada by Ajitkumar
2	Yoga for Children –step by step – by Yamini Muthanna

Web links and Video Lectures (e – Resources)	
1	https://www.youtube.com/watch?v=KB-TYlgd1wE
2	https://www.youtube.com/watch?v=aa-TG0Wg1Ls

CO – PO MAPPING

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

Semester: V					
Music **Stream: CSE/ECE/CV/ME**					
Course Code	**:**	**BMU509**	**Credits**	**:**	0
Hours/Week(L:T:P)	**:**	0:0:2	**CIE**	**:**	100 Marks
Total Hours	**:**	26	**SEE**	**:**	-
Course Type	**:**	NCMC	**SEE Duration**	**:**	-

Course Objectives: This course will enable the students to	
1	Understand the foundational concepts of Indian classical music, including the evolution and structure of Shruthi, Nada, Swara, Laya, Raga, Tala and Mela systems.
2	Recognize and describe various types of Carnatic compositions such as Geethe, Jathi, Swara, Swarajathi, Varna, Krithi and Thillana, along with the basics of the notation system.
3	Appreciate the contributions of key composers like Purandaradasa, Thyagaraja and Mysore Vasudevacharya to Indian music and understand their musical legacy.
4	Identify and explain the classification and basic construction of traditional Indian musical instruments, including string, wind, percussion and idiophones, with appropriate examples.
5	Demonstrate basic vocal proficiency through the practice of Sarale Varase exercises, notations for Suladi Sapta Tala in Mayamalavagowla raga and performance of selected compositions such as Geethe, Jathi Swara and Krithi.

Module -I	**03 Hrs**
Preamble Contents of the curriculum intended to promote music as language to develop an analytical, creative and intuitive understanding. For this the student must experience music through study and direct participation in improvisation and composition. Origin of the Indian Music: Evolution of the Indian music system, understanding of Shruthi, Nada, Swara, Laya, Raga, Tala, Mela **Textbook1, V-1 Ch. 1-4**	
Module – II	**03 Hrs**
Compositions Introduction to the types of composition in Carnatic Music – Geethe, Jathi, Swara, Swarajathi, Varna, Krithi and Thillana, Notation System. **Textbook2 – Ch. 4-7**	
Module –III	**03 Hrs**
Composers Biography and contributions of Purandaradasa, Thyagaraja, Mysoro asudevacharya, Kanakadasa **Textbook3 – Ch. 2-5**	
Module –IV	**03 Hrs**
Music Instruments Classification and construction of string instruments, wind instruments, percussion Instruments, Idiophones (Ghana Vaadya), Examples of each class of instruments. **Textbook1,V-4 – Ch. 2-6**	
Module –V	**14 Hrs**

Abhyasa Gana
Singing the swara exercises (Sarale Varase Only), Botatio writing for sarale varase and sulafi sapta tala (Only in mayamalavagowla raga), singing 4 geethe in malahari and one jathi swara, oe krithi in a mela raga **Textbook1, V-1&2**

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

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

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

CO – PO MAPPING

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

Institute Vision

Preparing Competent Engineering and Management Professionals to Serve the Society

Institute Mission

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

Department Vision

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

Department Mission

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

SJC INSTITUTE OF TECHNOLOGY

An Autonomous Institution under VTU from 2024-25

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