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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

VI Semester
Scheme & Syllabus of B.E. Programme
Aerospace Engineering
(2024 Scheme)

Core Values

Spiritual, Judicious, Commitment, Integrity, Trustworthy



NATIONAL INSTITUTIONAL RANKING FRAMEWORK 151-300

NAAC A+

QS I-GAUGE GOLD

INSTITUTION'S INNOVATION COUNCIL (Ministry of HRD Initiative) 4-Star Rating

SJC INSTITUTE OF TECHNOLOGY, CHIKKABALLAPURA

An Autonomous institution Under VTU from 2024 – 2025

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

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

6th 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	BAS601	Flight Mechanics	PCC	AS	3	2	0	3	50	50	100	4
2	BAS602	Avionics	IPCC	AS	3	0	2	3	50	50	100	4
3	BAS623x	Professional Elective Course – II	PEC	AS	3	0	0	3	50	50	100	3
4	BAS624x	Professional Elective Course – III	PEC	AS	3	0	0	3	50	50	100	3
5	BAS645x	Open Elective Course – I	OEC	AS	3	0	0	3	50	50	100	3
6	BAS636	Major Project Phase – I	PROJ	AS	0	0	4	-	100	-	100	2
7	BASL607	Flight Mechanics Lab	PCCL	AS	0	0	2	3	50	50	100	1
8	BCE608	Competency Enhancement Course-4	NCMC	CDCAC	0	2	0	-	100	-	100	0
9	BIK609	Indian Knowledge Systems	NCMC	Any Dept.	1	0	0	-	100	-	100	0
10	BNS610	National Service Scheme (NSS)	NCMC	NSS Coordinator	0	0	2	-	100	-	100	0
	BPE610	Physical Education (PE) (Sports and Athletics)		Physical Education Director								
	BYO610	Yoga		Yoga Teacher								
	BMU610	Music		Music Teacher								
									700	300	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 – II

Course Code	Course Name	Course Code	Course Name
BAS623A	Composite Materials Technology	BAS623C	Gas Dynamics
BAS623B	Theory of Aero Elasticity	BAS623D	Aviation Fuels and Combustion

Professional Elective Course – III

Course Code	Course Name	Course Code	Course Name
BAS624A	Launch Vehicle Design and Dynamics	BAS624C	Heat Transfer
BAS624B	Air and Missile defense system	BAS624D	Hypersonics

Open Elective Course – I

Course Code	Course Name	Course Code	Course Name
BAS645A	Drone Technology: Principle, Practice and Applications.	BAS645C	Aircraft Materials
BAS645B	Airport planning and Management	BAS645D	Fundamentals of Avionics

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.

Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course. The minimum number of students' strengths for offering professional electives is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.

Open Elective Courses: Students belonging to a particular stream of Engineering and Technology are not entitled to the open electives offered by their parent Department. However, they can opt for an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor. The minimum numbers of students' strength for offering Open Elective Course is 10. However, this condition shall not be applicable to class where the admission to the program is less than 10.

Project Phase-I: Students have to discuss with the mentor /guide and with their help he/she has to complete the literature survey and prepare the report and finally define the problem statement for the project work

Semester: VI						
Flight Mechanics						
Course Code	:	**BAS601**		**Credits**	:	4
Hours/Week(L:T:P)	:	3:2:0		**CIE**	:	50 Marks
Total Hours	:	50		**SEE**	:	50 Marks
Course Type	:	PCC		**SEE Duration**	:	3 Hours

Prerequisites:	
Courses	Aerodynamics, Aircraft Performance
Knowledge on Fundamental Concepts	Forces and Moments, Differential calculus
Knowledge on Connected Tools (If any)	----------

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the basics of aircraft stability and control
CLO2	Understand the static longitudinal stability
CLO3	Analyse static Lateral and directional Stability and Aerodynamic coupling
CLO4	Understand and Analyse the Dynamic longitudinal stability
CLO5	Understand and Analyze the Dynamic Lateral and directional stability

Module 01	**10 Hrs**
Flight Forces and Steady Flight Performance: The Force and Moment Systems of an Aircraft. Steady state performance. (Basic Revision of Performance of aircraft) **Static Longitudinal Stability and Control (Stick Fixed):** Degree of freedom of rigid bodies in space. Static Longitudinal stability - Stick fixed. Effects of wing, Tail, fuselage and nacelle - Influence of CG location - Power effects - Stick fixed neutral point. **Text Book 1: Ch 2 & 3** **Reference Book 2: Ch 4 & 6**	
Module 02	**10 Hrs**
Static Longitudinal Stability and Control-Stick free: Introduction, Hinge moment parameters, Control surface floating characteristics and aerodynamic balance, Estimation of hinge moment parameters, The trim tabs, Stick-free Neutral point, Stick force gradient in unaccelerated flight, Restriction on aft C.G. **Text Book 1: Ch 4 & 5**	
Module 03	**10 Hrs**
Static Directional and Lateral Stability and Control Static directional stability rudder fixed, Contribution of airframe components, Directional control. Rudder power, Stick-free directional stability, Requirements for directional control, Rudder lock, Dorsal fin. One engine inoperative condition. Weather cocking effect. Static lateral stability. Estimation of dihedral effect. Effect of wing sweep, flaps, and power. Lateral control, Estimation of lateral control power, Aileron control forces, Balancing the aileron. Coupling between rolling and yawing moments. Adverse yaw effects. Aileron reversal	

Text Book 1: Ch 6, 7 & 8	
Module 04	**10 Hrs**
Airplane 6DOF Equations of Motions (EOMs): Derivation of rigid body equations of motion, Orientation and position of the airplane, gravitational and thrust forces, Small disturbance theory. Aerodynamic force and moment representation, Derivatives due to change in forward speed, Derivatives due to the pitching velocity, Derivatives due to the time rate of change of angle of attack, Derivatives due to rolling rate, Derivatives due to yawing rate. **Text Book 2: Ch 2 & 3** **Text Book 1: Ch 9**	
Module 05	**10 Hrs**
Dynamic Stability Dynamic longitudinal stability. Types of modes of motion: phugoid motion, short period motion. Routh's stability criteria. Factors affecting period and damping of oscillations. **Dynamic lateral and directional stability**. Response to aileron step-function, side-slip excursion. Dutch roll and Spiral instability. Auto- rotation and spin. Stability derivatives for lateral and directional dynamics. **Text Book 2: Ch 6, 7 & 8** **Text Book 1: Ch 10 & 11**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Recall and explain static stability in longitudinal, lateral, and directional modes.
CO2	Identify and analyze aircraft components' contributions to stability.
CO3	Interpret and demonstrate coupling effects between lateral and directional stability.
CO4	Construct and formulate mathematical models for stability analysis.
CO5	Classify and evaluate different stability modes of an Aircraft

Text Books	
1	Perkins, C.D., and Hage, R.E., "Airplane Performance stability and Control", John Wiley Son Inc, New York, 1988
2	Nelson, R.C. "Flight Stability and Automatic Control", McGraw-Hill Book Co., 2007

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

Web links and Video Lectures (e – Resources)	
1	https://youtu.be/6ZOvc4U-v0o?si=KPxl5ZU0fgINOplF

CO – PO MAPPING

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

Semester: VI						
Avionics						
Course Code	**:**	**BAS602**		**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	Aircraft Electrical systems, Basic Instrumentation
Knowledge on Fundamental Concepts	Basic Electronics & Circuits
Knowledge on Connected Tools (If any)	

Course Learning Objectives: This course will enable the students to	
CLO1	Recall the fundamental concepts of aircraft electrical systems and avionics subsystems used in modern aircraft.
CLO2	Explain the principles of inertial navigation, flight instruments and display systems in avionics applications.
CLO3	Describe the operation and characteristics of electronic flight control and fly-by-wire systems.
CLO4	Apply digital system concepts and avionics subsystem knowledge to aircraft communication and control systems.
CLO5	Analyze integrated avionics architectures and data bus systems employed in civil and military aircraft.

Module – 1	**08Hrs**
Power Distribution System: Power distribution system in aircraft including bus bars, split bus bar systems and special purpose cables, electrical diagrams and identification schemes, circuit controlling and protection devices, power utilization in avionics systems, and the need for avionics in civil and military aircraft. **Text Book 1: Ch 1 & 2**	
Module – 2	**08Hrs**
Inertial Navigation and Flight Instrument Systems: Gyroscopic and inertial platforms, structure of stable platforms, inertial navigation units, inertial alignment procedures, inertial interface systems, importance of compass swing, and electronic flight instrument systems including displays, presentation methods, failures and annunciation of air data. **Text Book 1: Ch 5 & 6**	
Module – 3	**08Hrs**
Electronic Flight Control System: Fly-by-wire system including its basic concepts and features, pitch and roll rate command and response characteristics, control laws, frequency response of typical FBW actuators, Cooper Harper scale, redundancy and failure survival techniques, and common modes of failures and effects analysis. **Text Book 1: Ch 8 & 9**	
Module – 4	**08Hrs**

Avionics Subsystems and Digital Systems: Introduction to typical avionics subsystems and electronic circuits including amplifiers, oscillators, aircraft communication systems, transmitters, receivers and antennas, along with principles of digital systems covering digital computers, microprocessors and memory systems.

Text Book 1: Ch 3 & 4

Module – 5	**08Hrs**

Flight Deck, Cockpit Technologies and Avionics Integration: Flight deck and cockpit technologies including CRT, LED, LCD, EL and plasma panel displays, touch screen and direct voice input systems, civil and military cockpit concepts such as MFDs, HUD, MFK and HOTAS, avionics equipment fit, electrical data bus systems, communication, navigation, flight control, radar, electronic warfare and fire control systems, and avionics system architecture with MIL-STD-1553B data buses.

Text Book 2: Ch 10, 11 & 12

IPCC: Lab Component

Exp. No.	**Title of the Experiment**
1	Study of avionics architecture in modern aircraft (ARINC protocols, data buses)
2	Simulation of aircraft cockpit display systems (PFD, MFD, EFIS)
3	Testing and analysis of aircraft pitot-static system (altimeter, airspeed, VSI)
4	Demonstration of Attitude and Heading Reference System
5	GPS signal acquisition and waypoint navigation
6	Study and interface of Inertial Navigation System (INS)
7	Communication systems: VHF/UHF radio and antenna setup
8	Radar and transponder (Mode A/C/S, ADS-B) operation and decoding
9	Sensor interfacing with microcontroller for avionics input (temperature, pressure)
10	Digital flight data recorder (black box) structure and data retrieval simulation

Course Outcomes: After completing the course, the students will be able to	
CO1	Identify aircraft electrical power distribution components and their applications in avionics systems.
CO2	Explain the working principles of inertial navigation systems and electronic flight instruments.
CO3	Apply fly-by-wire concepts and control laws to interpret aircraft flight control responses.
CO4	Demonstrate understanding of avionics subsystems, communication circuits and digital systems used in aircraft.
CO5	Analyze avionics system integration and MIL-STD-1553B data bus architecture for aircraft applications.

Text Books	
1	R P G Collinson “Introduction to Avionics Systems”, Kulwar Academic Publishers, 2003
2	E H J Pallett “Aircraft Electrical System”, Pitman Publishers, 1976.

Reference Books	
1	Middleton, D.H., Ed., `Avionics Systems`, Longman Scientific and Technical Longman Group UK Ltd., England, 1989.
2	Spitzer, C.R., `Digital Avionic Systems`, Prentice Hall, Englewood Cliffs, N.J., USA, 1987.
3	R.B. Underdown & Tony Palmer, `Navigation~, Black Well Publishing 2001.

CO – PO MAPPING

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

Semester: VI						
Composite Materials Technology						
Course Code	**:**	**BAS623A**		**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	Material Science
Knowledge on Fundamental Concepts	Mechanics of Materials
Knowledge on Connected Tools (If any)	-

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the advantages of composite materials compared to conventional materials
CLO2	Understand the processing of MMC and PMC
CLO3	Evaluate the properties of composites
CLO4	Understand the failure theories
CLO5	Explain the inspection, quality control and applications of composites

Module – 1	**08Hrs**
Introduction to Composite Materials: Definition, classification of composite materials, classification of reinforcement - particulate, short fiber, whiskers, long fibers composites. matrix materials – metals, ceramics, polymers (including thermoplastics and thermosets), **Carbon-Carbon Composites Metal Matrix Composites:** MMC with particulate and short fiber reinforcement, liquid and solid-state processing of MMC – stir casting, squeeze casting. Properties of MMCs, Applications of Al, Mg, Ti based MMC **Test Book 1**: **Ch 2 & 3**	
Module – 2	**08Hrs**
Processing of Polymer Matrix Composites: Thermoset Polymers, Hand layup Process, Vacuum Bagging Process, Post Curing Process, Filament winding, Pultrusion, Pulforming, Autoclave Process. **Processing of Polymer Matrix Composites:** Thermoplastic Polymers, Extrusion process, Injection Molding Process, Thermo-forming process. Post Processing of Composites – Adhesive bonding, drilling, cutting processes **Test Book 1: Ch 5** **Test Book 2: Ch 4**	
Module – 3	**08Hrs**
Micro-Mechanical Behavior of a Lamina: Determination of elastic constants-Rule of mixtures, transformation of coordinates, micro-mechanics-based analysis and experimental determination of material constants. **Macro-Mechanical Behavior of a Lamina:** Global and local axis for angle lamina, determination of global and local stresses and moduli, for 2D-UD lamina with different fiber orientation and different fiber materials glass, carbon and aramid fiber reinforcement.	

Test Book 1: **Ch 11** **Test Book 2**: **Ch 5**	
Module – 4	**08Hrs**
Failure Analysis: Failure Theory – Tsai-Hill, Tsai-Wu, Max Stress and Max Strain theory, Stress and strain variation in a laminate- Resultant forces and moments- A B & D matrices- Strength analysis of a laminate. **Test Book 1: Ch 24** **Test Book 2**: **Ch 8**	
Module – 5	**08Hrs**
Inspection & Quality Control: Destructive & Non-Destructive Testing, Tensile, Compression, Flexural, Shear, Hardness; ultrasonic testing – A-B-C scan Applications of Composites Materials: Automobile, Aircrafts, missiles, Space hardware, Electrical and electronics, marine, recreational and Sports equipment, future potential of composites **Test Book 1**: **Ch 26 & 28**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the classification and application of composite materials
CO2	Illustrate the various fabrication methods for PMC and MMC
CO3	Describe the micro and macro-mechanical behavior of laminates
CO4	Evaluate the failure of composite laminates using various theories
CO5	Explain the various DT and NDT methods of laminates

Text Books	
1	K.K Chawla, Composite Materials- Science and Engineering, Springer Verlag,2nd edition,1998, ISBN: 0-387-98409-7
2	Autar Kaw, Mechanics of Composites, CRC Press,2nd edition, 2006, ISBN:978-0-8493-1343-1

Reference Books	
1	Ajay Kapadia, Non-Destructive Testing of Composite Materials, National Composites Network, Best Practices Guide, TWI Publications, 2006
2	R M Jones, "Mechanics of Composite Materials", 2nd Edn, Taylor & Francis, 2015; ISBN:978-1560327127

Web links and Video Lectures (e – Resources)	
1	https://nptel.ac.in/courses/112104121
2	https://nptel.ac.in/courses/112105236

CO – PO MAPPING:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	0	0	1	1	2	0	0	1	2
CO2	2	2	2	0	2	1	1	0	1	1	2
CO3	3	2	1	2	2	0	1	0	0	1	2
CO4	3	3	2	3	2	0	1	0	0	1	2
CO5	2	2	2	3	3	1	1	0	1	2	2

Semester: VI						
Theory of Aero Elasticity						
Course Code	**:**	**BAS623B**		**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	Aircraft Structures, Aerodynamics, Engineering Mathematics
Knowledge on Fundamental Concepts	Basics of Structural Mechanics, Natural Frequencies and Mode Shapes.
Knowledge on Connected Tools (If any)	

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the fundamental concepts of aeroelasticity and interaction between aerodynamics and structural dynamics.
CLO2	Analyze static aeroelastic phenomena such as divergence, control effectiveness, and control reversal using analytical and numerical methods.
CLO3	Examine unsteady aerodynamics and its role in aeroelasticity, including oscillatory aerodynamic derivatives, damping, and stiffness.
CLO4	Investigate dynamic aeroelastic instabilities, particularly flutter, by studying binary aeroelastic models and eigenvalue solutions
CLO5	Evaluate gust and turbulence effects on aircraft response, including time-domain analysis and frequency response functions

Module 01	**08 Hrs**
Introduction to Aeroelasticity: Vibration and its forces, Flexibility effect on aerodynamics, structure and aerodynamic interaction, Aeroelasticity, Classification of Aeroelasticity, Collar's triangle, Simple definition on Static Aeroelasticity: Divergence, load distribution, control effectiveness, control system reversal, Simple definition on Dynamic Aeroelasticity: Flutter, buffeting, dynamic response. **Text Book 1: Ch1** **Text Book 2: Ch 1**	
Module 02	**08 Hrs**
Static Aeroelasticity: Divergence: Torsional Wing Box, Divergence of A Two Dimensional Rigid Aerofoil With Spring Attachment, Static Aeroelastic Behaviour Of Fixed Root Flexible Wing, Divergence Prediction Using Dynamic Method, Numericals On Divergence. Control effectiveness and Reversal: Effect of wing Flexibility on Control Effectiveness, Rolling Effectiveness of a Flexible Wing- Steady Roll Case, and Determination of Reversal Speed for Steady Roll Case, Problems On Control Reversal **Text Book 2: Ch3 & 5**	
Module 03	**08 Hrs**
Unsteady Aerodynamics: Quasi Steady Aerodynamics, Unsteady Aerodynamics, Aerodynamic lift and moment for a harmonically oscillating Aerofoil, Oscillatory aerodynamic derivatives, Aerodynamic damping and stiffness, Unsteady Aerodynamics Related to Gusts. **Text Book 1: Ch 3** **Text Book 2: Ch 6**	
Module 04	**08 Hrs**

Dynamic Aeroelasticity: Flutter: Simplified Unsteady Aerodynamic Model, Binary Aeroelastic Model, General Form of the aeroelastic Equations, Eigenvalue Solution of Flutter Equations, Aeroelastic behaviour of the Binary Model, Aeroelastic behaviour of a Flexible Wing, Flutter speed prediction for binary systems

Text Book 1: Ch 4
Text Book 2: Ch 7

Module 05	**08 Hrs**

Dynamic Aero elasticity: Gusts and Turbulence: Types of Gust, Assumption in modeling Gust, Gust response in time domain – Flexible Aircraft, equations of motions, Definition of Continuous turbulence and harmonic gust velocity component, FRF for flexible aircraft response in Heave/Pitch per Harmonic gust velocity.

Text Book 1: Ch 6 & 7
Reference Book 1: Ch 5

Course Outcomes: After completing the course, the students will be able to	
CO1	Explain the principles of aero elasticity, Collar's triangle, and classify different aero elastic phenomena
CO2	Derive and solve problems related to static aero elasticity, including wing divergence and control reversal
CO3	Apply unsteady aerodynamic theories to compute lift and moment for oscillating airfoils and gust responses
CO4	Formulate and analyze flutter dynamics using binary aero elastic models and predict flutter speeds
CO5	Model and assess aircraft response to gusts and turbulence using time-domain and frequency-domain approaches

Text Books	
1	A Modern Course in Aero elasticity, Dowell, E. H., Crawley, E. F., Curtiss Jr., H. C., Peters, D. A., Scanlan, R. H., and Sisto, F., 3rd Edition, 1995, Kluwer Academic Publishers,. (TL574.A37.M62)
2	Aero elasticity, Bisplingh off, R., Ashley, H., and Halfman, R. L., 1st Edition, 1996, Dover Publications, ISBN-13: 978-0486691893

Reference Books	
1	An Introduction to the Theory of Aero elasticity, Fung, Y. C., 1st Edition, 1955, Dover Publications, ISBN 9780486495057
2	Aircraft structures for Engineering students, Megson THG, 3rd Edition, 1999, Edward Arnold, ISBN- 13: 978-0470349373

Web links and Video Lectures (e – Resources)	
1	https://www.youtube.com/watch?v=pi5hAK0FdWA&list=PL59C0B5D9811F3609

CO – PO MAPPING

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

Semester: VI						
Gas Dynamics						
Course Code	**:**	**BAS623C**		**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	Thermodynamics and Fluid Mechanics
Knowledge on Fundamental Concepts	Mathematics & Physics
Knowledge on Connected Tools (If any)	------

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the fundamentals of one-dimensional compressible flow and analyze flow properties through ducts, shocks, and expansions
CLO2	Analyze unsteady wave propagation, shock tube phenomena, and acoustic wave behavior in compressible flows
CLO3	Apply oblique shock, expansion wave theory, and shock interactions for supersonic flow over different geometries.
CLO4	Evaluate supersonic inlet, diffuser, and duct performance considering shock patterns and flow starting problems
CLO5	Apply similarity rules and theoretical models to transonic flow problems using linearized flow theories

Module 01	**08 Hrs**
One-Dimensional Flow : 1- D Flow Equations; Quasi 1- D Flow; Area- Velocity Relation; Isentropic Flow through Variable Area Ducts; Diffusers; Speed of Sound and Mach Number; Normal Shock; Pressure, Temperature, Density and Entropy Relations across a Normal Shock; Shock Strength; Rarefaction Shock an Impossibility; Hugoniot Equation; 1- D Flow with Heat Addition; 1- D Flow with Friction; Reyleigh and Fanno Lines; **Text Book 1: Ch: 3, 4 & 5**	
Module 02	**08 Hrs**
Unsteady 1D Flow: Unsteady Wave Motion; Moving Normal Shock Wave; Reflected Shock Wave; Physical Picture of Wave Propagation; The acoustic equations; Propagation of acoustic wave, Pressure and particle velocity in a sound wave, Linearized shock tube, Propagation of finite wave; Centered expansion wave, Incident and Reflected Expansion Waves; The Shock Tube. **Text Book 1: Ch: 6** **Reference Book 2: Ch: 5**	
Module 03	**08 Hrs**
Oblique Shock and Expansion Wave : Introduction and Source of Oblique Waves; Mach Wave; Mach Cone; Oblique Shock Relations for Pressure, Temperature and Mach Number; Supersonic Flow over Wedges and Cones; Weak Oblique Shock; Shock Polar; Pressure - Deflection Diagram; Reflection of Shock from a Solid Boundary; Intersection of Shocks of Opposite and Same Family; Detached Shock Wave; Physical Aspect of Conical Flow; Taylor and Maccoll Formulation; Numerical Procedure, Prandtl- Meyer Expansion Wave; Shock Expansion Theory; Laminar and Turbulent Flow Separation Caused by the Interaction of Shock Waves with the Boundary Layer	

Text Book 1: Ch: 7 & 8

Module 04	08 Hrs

Supersonic Flow in Diffusers and Ducts : The Problem of Starting a Supersonic Flow in Diffusers; Supersonic Inlet – Internal, External and Mixed Compression, Total Pressure Recovery, Mass Flow Characteristics and Inlet Performance; Starting of Supersonic Inlets; Shock Wave Patterns in Ducts and Shock Train Behaviour.

Text Book 1: Ch: 9

Module 05	08 Hrs

Similarity rules and Transonic Flows: 2D linearized flow, Prandtl-Glauert and Gothert rules, von Karman's rule, Linearised axially symmetric and planar flow, Application; Physical and Theoretical Aspects of Transonic Flows; Definition of transonic range, Flow past wedge section, cone, smooth 2D shape, Example Solution of small Perturbation, full Velocity Potential Equations and Euler Equations.

Text Book 1: Ch: 10

Course Outcomes: After completing the course, the students will be able to	
CO1	Analyze 1D compressible flow, isentropic flow in variable area ducts, and normal shock relations.
CO2	Evaluate unsteady wave propagation, moving shock waves, and shock tube behavior
CO3	Solve supersonic flow problems using oblique shock and Prandtl-Meyer expansion wave theory
CO4	Assess the performance of supersonic inlets, diffusers, and ducts, considering shock train patterns and total pressure recovery
CO5	Apply similarity rules and transonic flow theory to analyze flow around simple aerodynamic shapes

Text Books	
1	John D. Anderson, "Modem compressible flow: with historical perspective" ,3rd Edition McGraw-Hill series in aeronautical and aerospace engineering, ISBN 0-07-l 12161-7
2	H. W. Lipmann, A. Rosko, "Elements of Gas Dynamics", Dover Publications 2002

Reference Books	
1	Ascher H. Shapiro, "The Dynamics And Thermodynamics Of Compressible Fluid flow", The Ronald Press Company, New York.
2	Rathakrishnan, E, "Gas Dynamics" ,Seventh Edition, Phi Learning Pvt. Ltd., 2020, Isbn 9389347742, 9789389347746

Web links and Video Lectures (e – Resources)	
1	https://www.youtube.com/watch?v=y81L9wBMZ3Y&list=PLgMDNELGJ1CaqPU5YQqjjIDUsCsjny6z6

CO – PO MAPPING

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

Semester: VI						
Aviation Fuels and Combustion						
Course Code	:	**BAS623D**		**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:	Fluid Mechanics, Heat transfer, basics of Aircraft propulsion
Courses	Thermodynamics
Knowledge on Fundamental Concepts	Fundamentals of Physical Chemistry
Knowledge on Connected Tools (If any)	CFD and Combustion simulation software

Course Learning Objectives: This course will enable the students to	
CLO1	Introduction to the various classification of fuel energy sources
CLO2	Identify the manufacture methods of various types of derived fuels and their applicability in the fuel industry
CLO3	Understand the concept of thermochemistry, enthalpy, adiabatic flame temperature, ignition, combustion products and their application to combustion related problems
CLO4	Apply the concept of chemical rates of reaction, collision theory and Arrhenius equation for analyzing the different types of reactions.
CLO5	Compare the properties and characteristics of different type of flames and apply the same to combustion phenomenon in rocket motors and its exhaust.

Module 01	**08 Hrs**
Fuels and their classification: Different fuel energy sources, Classification of fuels sources - Non-renewable and Renewable fuels, primary fuels and secondary fuels and solid, liquid and gaseous fuels. **Text Book 2: Ch 1** **Reference Book 1: Ch 1**	
Module 02	**08 Hrs**
Manufactured fuels and derived fuels: Manufactured liquid and gaseous fuels. Derived fuels from coal- coal gasification, liquefaction and carbonization of coal, refuse derived fuels, bio-fuels, biomass, algae, bio-diesel, alcohol fuels **Text Book 2: Ch 2 & 3** **Reference Book 1: Ch2**	
Module 03	**08 Hrs**
Thermochemistry: Stoichiometry; Absolute Enthalpy and Enthalpy of Formation, Enthalpy of Combustion, Pressure and Temperature Effect on Enthalpy of Formation, Adiabatic Flame Temperature, Chemical and Equilibrium Products of Combustion, Some Applications, Ignition-Self Ignition and Forced Ignition, Factors affecting Ignition Energy. **Text Book1: Ch 2 & 3** **Text Book 2: Ch 4**	
Module 04	**08 Hrs**

Combustion Kinetics: Rate and order of Reaction; First, Second and Third Order Reaction, Reversible Reactions, Arrhenius Equation, Molecular Kinetics: Molecularity and Order, Theories of Collision, Chain Reaction, Explosion Limits Equilibrium constants and their Relationship, Combustion Products in Equilibrium, Gibbs phase rule.

Text Book 1: Ch 4 & 5
Text Book 2: Ch 5

Module 05	**08 Hrs**

Flames and Combustion: Concept of Flame; Definition, Classification and Properties of Premixed Flames; Properties of Diffusion Flames; Measurement of Burning Velocity, Flame Stabilization; Quenching; Flame Temperature Measurement Techniques Structure of Laminar Flame, Laminar Flame Propagation in Tubes, Description of Turbulent Flames, Concept of Turbulent Flow; Turbulent Burning Velocity, Solid fuel combustion and Liquid droplet combustion.

Text Book 1: Ch 6 & 7
R2: Ch 3 & 4

Course Outcomes: After completing the course, the students will be able to	
CO1	Classification of various fuel energy sources and their ways of utilization
CO2	Analyze the various types of derived fuels with methods of manufacture and their utilization
CO3	Apply the basic concept of thermochemistry, adiabatic flame temperature and ignition to combustion related problems
CO4	Demonstrate the utilization of the concept of chemical kinetics in combustion reactions.
CO5	Distinguish between premixed, diffusion flames a laminar and turbulent flames and their use in combustion devices.

Text Books	
1	S. R. Turn, An Introduction to Combustion - Concepts and Applications, 3rd Edition, McGraw- Hill, India, 2012
2	K. K. Kuo, Principles of Combustion, John Wiley and Sons, New York, 1986.

Reference Books	
1	B. Lewis and G. von Elbe, Combustion, Flames and Explosions of Gases, 3rd Edition, Academic Press, Orlando, 1987
2	A. G. Gaydon and H. D. Wolfhard, Flames: Their Structure, Radiation and Temperature, 3rd Edition, Springer NY, USA, 1970.

Web links and Video Lectures (e – Resources)	
1	https://www.youtube.com/watch?v=wtol--hku0M
2	https://youtu.be/VnGH2EScMDE?si=vmijY1VdgKPKnzzn
3	https://youtu.be/jKPLQ8D8G7I?si=gK3I1rWDyDWARGgJ

CO – PO MAPPING

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

Semester: VI						
Launch Vehicle Design and Dynamics						
Course Code	**:**	**BAS624A**		**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	Orbital Mechanics and Rocket Propulsion
Knowledge on Fundamental Concepts	Physics and Mathematics
Knowledge on Connected Tools (If any)	----------

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the fundamental principles and subsystems of launch vehicle design.
CLO2	Apply flight dynamics principles to model and simulate the trajectory of launch vehicles.
CLO3	Analyze structural and thermal loads acting on a launch vehicle during ascent
CLO4	Evaluate the impact of propulsion systems and staging strategies on performance.
CLO5	Design a conceptual launch vehicle considering mission constraints and performance optimization.

Module – 1	**08Hrs**
Introduction to Launch Vehicles Classification: Expendable vs Reusable Launch Vehicles, Mission profile: Ascent, orbital insertion, re-entry Major subsystems: Structures, propulsion, avionics, thermal protection Launch environment and key design drivers Design process and system engineering overview **Text Book 1: Ch 1**	
Module – 2	**08Hrs**
Launch Vehicle Dynamics and Trajectory: Equations of motion in inertial and rotating reference frames, Gravitational, thrust, and aerodynamic forces, Flight path angle, angle of attack, and velocity vector , Powered and coasting flight segments, Trajectory simulation and optimization, Guidance, navigation, and control (GNC) basics **Reference Book 1: Ch 2 & 3**	
Module – 3	**08Hrs**
Propulsion Systems and Staging: Overview of liquid, solid, hybrid propulsion systems, Specific impulse, thrust-to-weight ratio, multi-stage launch vehicles: ideal vs real performance, Stage separation dynamics, Thrust vector control and its influence on dynamics, Performance trade-offs and staging optimization **Text Book 1: Ch 2, 3 & 11**	
Module – 4	**08Hrs**

Structural and Thermal Design Considerations: Load environment during launch and ascent, Structural elements: skin, frames, stringers, Material selection and structural efficiency, Vibration, acoustics, and dynamic loads, Thermal loads and insulation strategies , Structural integrity analysis **Text Book 2: Ch 1, 2 & 9** **Reference Book 2: Ch 5**

Module – 5	**08Hrs**
Design Methodology and Case Studies: Design loop: requirements, conceptual design, sizing, analysis, Payload integration and fairing design, Safety, reliability, and risk assessment, Case studies: PSLV, GSLV, Falcon 9, Ariane 5, Emerging trends: reusable launch vehicles, small satellite launchers and Team-based conceptual launch vehicle design project. **Reference Book 2: Ch 10, 11 & 13**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Define and explain major launch vehicle components, mission profiles, and design considerations
CO2	Analyze equations of motion and simulate the trajectory of a launch vehicle. Analyze
CO3	Evaluate the effect of multi-stage propulsion systems on payload delivery and mission success.
CO4	Assess structural and aerodynamic loads acting on the launch vehicle during various flight phases
CO5	Design a conceptual launch vehicle meeting specified mission and performance criteria

Text Books	
1	Burt R. Rowen, Space Vehicle Design, 1st Edition, AIAA (American Institute of Aeronautics and Astronautics), 2008, ISBN: 978-1-56347-912-6
2	Clark J. Structures for Launch Vehicles, 1st Edition, AIAA, 2012, ISBN: 978-1-60086-911-9

Reference Books	
1	Howard D. Curtis, Orbital Mechanics for Engineering Students, 4th Edition, Elsevier, 2020, ISBN: 978-0-08-102133-0
2	Wiley J. Larson, James R. Wertz, Launch Vehicle Design, Microcosm Press, 2011, ISBN: 978-1-881883-09-8
3	W. J. Larson and J. R. Wertz, Space Mission Analysis and Design, Microcosm Press

Web links and Video Lectures (e – Resources)	
1	https://www.youtube.com/watch?v=Pqi6dMrtB0E&list=PLOzRYVm0a65fA3I5-9ZgqaX9rNwGT1hfO

CO – PO MAPPING

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

Semester: VI						
Air and Missile Defense Systems						
Course Code	:	**BAS624B**		**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	Newtonian mechanics, aircraft performance
Knowledge on Connected Tools (If any)	----------

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the historical evolution, classification, and key elements of missile systems, including propulsion and guidance.
CLO2	Explain missile aerodynamics, flight phases, and control systems, and design autopilots for stability.
CLO3	Apply tactical guidance laws (PN, APN, beam riding) and compare their performance in interception scenarios.
CLO4	Analyze ballistic missile re-entry, interception challenges, and cruise missile navigation (TERCOM).
CLO5	Assess weapon delivery accuracy, flight control integration, and warhead mechanisms for different missile systems.

Module – 1	**08Hrs**
Missile Systems Introduction History of guided missile for defense applications-Classification of missiles, missile system elements, missile ground systems, Missile propulsion and missile guidance. **Textbook 1: Ch 1,2 & 3** **Textbook 2: Ch 1 & 2**	
Module – 2	**08Hrs**
Missile Airframes, Autopilots and Control Missile aerodynamics, Phases of missile flight. Missile control configurations. Missile Mathematical Model. Autopilots — Definitions, Types of Autopilots, Pitch Autopilot Design, Pitch-Yaw-Roll Autopilot Design. **Textbook 1: Ch 4, 5 & 6** **Textbook 2: Ch 5 & 6**	
Module – 3	**08Hrs**
Missile Guidance Laws Tactical Guidance Intercept Techniques, explicit, Proportional Navigation, Augmented Proportional Navigation, beam riding, bank to turn missile guidance, comparison of guidance system performance. **Text Book 1: Ch7, 8 & 9** **Text Book 2: Ch 7 & 8**	
Module – 4	**08Hrs**

Strategic Missiles
Introduction, Atmospheric Re-entry, Ballistic Missile Intercept, Threat analysis for Boost phase interception – Typical assessment errors. Introduction to Cruise Missiles, The Terrain-Contour Matching (TERCOM) Concept.

Textbook 1: Ch 10 & 11
Reference book 1: Ch 6 & 7

Module – 5	**08Hrs**

Weapon Delivery Systems
Weapon Delivery Requirements, Factors Influencing Weapon Delivery Accuracy, Unguided Weapons, The Bombing Problem, Guided Weapons, Integrated Flight Control in Weapon Delivery, Missile Launch Envelope. Warhead and fuzes.

Textbook 1: Ch 12 & 13
Textbook 2: Ch 9

Course Outcomes: After completing the course, the students will be able to	
CO1	Explain the fundamentals of missile systems, including classification, propulsion, and guidance mechanisms.
CO2	Analyze missile aerodynamics, control configurations, and autopilot design for stability and precision.
CO3	Apply different missile guidance laws and their effectiveness in tactical interception scenarios.
CO4	Understand strategic missile systems, including ballistic missile intercept techniques, re-entry dynamics, and cruise missile guidance concepts.
CO5	Assess weapon delivery systems, factors affecting accuracy, and the role of warheads and fuzes in missile effectiveness.

Text Books	
1	Siouris,G.M. "Missile Guidance and control systems", Springer, 2003.
2	Blakelock, J. H.; Automatic Control of Aircraft and Missiles, 2nd Edition, John Wiley& Sons, 1990

Reference Books	
1	Fleeman, EugeneL.; Tactical Missile Design, First Edition, AIAA Education series, 2001.
2	Garnell,P.,"GuidedWeaponControlSystems",2nd Edition,PergamonPress, 1980.
3	Joseph Ben Asher and Isaac Yaesh “Advances in Missile Guidance Theory” AIAA Education series, 1998
4	Guided missiles Popular Science & Technology (PST) series is being published by DESIDOC, Defence Scientific Information & Documentation Centre (DESIDOC) Ministry of Defence, DRDO Metcalfe House, Delhi – 110054.

Web links and Video Lectures (e – Resources)	
1	https;//youtu.be/pj8vQQyXYA8
2	https://youtu.be/CIgmwm_D61Q?si=7tyOTISxboubMrQ_

CO – PO MAPPING

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

Semester: VI					
Heat Transfer					
Course Code	**:**	**BAS624C**	**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	Thermodynamics, Fluid Mechanics.
Knowledge on Fundamental Concepts	Mathematical Proficiency, Material Science Basics
Knowledge on Connected Tools (If any)	-

Course Learning Objectives: This course will enable the students to	
CLO1	Understand heat transfer modes (conduction, convection, radiation), governing laws, and boundary conditions.
CLO2	Analyse insulation, fins, and transient conduction for aerospace thermal management.
CLO3	Evaluate forced/free convection using boundary layer theory and flow equations.
CLO4	Apply radiation principles (blackbody laws, view factors) to aerospace systems.
CLO5	Design heat exchangers using LMTD/NTU methods for optimal performance.

Module – 1	**08Hrs**
Introductory concepts and definitions: Modes of heat transfer: Basic laws governing conduction, convection, and radiation heat transfer; Thermal conductivity; convective heat transfer coefficient; radiation heat transfer combined heat transfer mechanism, Types of boundary conditions. General Heat Conduction Equation: Derivation of the equation in (i) Cartesian, (ii) Polar and (iii) Spherical Co-ordinate Systems. Steady-state one-dimensional heat conduction problems in Cartesian System: Steady-state one-dimensional heat conduction problems without heat generation and varying thermal conductivity - in Cartesian system with various possible boundary conditions. **Textbook 1: Ch: 1 and 2** **Textbook 2: Ch: 1,2 and 3**	
Module – 2	**08Hrs**
Critical Thickness of Insulation: Concept, Derivation, Extended Surfaces or Fins: Classification, Straight Rectangular and Circular Fins, Temperature Distribution and Heat Transfer Calculations, Fin Efficiency and Effectiveness, Applications **Transient [Unsteady-state] heat conduction:** Definition, Different cases - Negligible internal thermal resistance, negligible surface resistance, comparable internal thermal and surface resistance, Lumped body, Numerical Problems **Textbook 1: Ch: 2** **Textbook 2: Ch: 3**	
Module – 3	**08Hrs**
Forced Convection: Boundary Layer Theory, Velocity and Thermal Boundary Layers, Prandtl number, Governing Equations – Continuity, Navier Stokes and Energy equations, forced convection flow, Internal flows –laminar and turbulent flow solutions, **Free convection:** Laminar and Turbulent flows, Vertical Plates, Vertical Tubes and Horizontal Tubes.	

Textbook 1: Ch: 3
Textbook 2: Ch: 4 and 6

Module – 4	**08Hrs**

Thermal Radiation: Fundamental principles - Gray, White, Opaque, Transparent and Black bodies, Spectral emissive power, Wien's, Rayleigh-Jeans' and Planck's laws, Hemispherical Emissive Power, Stefan-Boltzmann law for the total emissive power of a black body, Emissivity and Kirchhoff's Laws, View factor, Net radiation exchange in a two-body enclosure, examples for these enclosures, Radiation Shield.

Textbook 1: Ch: 5, 7 and 8
Textbook 2: Ch: 12 and 13

Module – 5	**08Hrs**

Heat Exchangers: Definition, Classification, applications, LMTD method, Effectiveness - NTU method, Analytical Methods, Fouling Factors, Chart Solution Procedures for solving Heat Exchanger problems: Correction Factor Charts and Effectiveness-NTU Charts, compact heat exchangers.

Textbook 1: Ch: 10
Textbook 2: Ch: 11

Course Outcomes: After completing the course, the students will be able to	
CO1	Apply fundamental heat transfer principles to solve conduction, convection, and radiation problems in aerospace systems.
CO2	Design and optimize thermal insulation, extended surfaces (fins), and transient heat transfer solutions for aircraft and spacecraft.
CO3	Analyse forced and free convection phenomena using boundary layer theory and empirical correlations for aerospace applications.
CO4	Evaluate radiative heat exchange using blackbody laws, view factors, and shielding techniques in high-temperature aerospace environments.
CO5	Select and size heat exchangers using LMTD and NTU methods for efficient thermal management in propulsion and avionics.

Text Books	
1	Principles of heat transfer, Frank Reith, Raj M. Manglik, Mark S. Bohn, Seventh Edition, Cengage learning, 2011.
2	Yunus A. Cengel - Heat transfer, a practical approach, Fifth edition, Tata Mc Graw Hill.
3	Heat Transfer, Holman, J. P., 9th Edition, Tata McGraw Hill, New York, 2008.

Reference Books	
1	Heat and mass transfer, Kurt C, Rolle, second edition, Cengage learning.
2	Heat Transfer, M. Necati Ozisik, A Basic Approach, McGraw Hill, New York, 2005.
3	Fundamentals of Heat and Mass Transfer, Incropera, F. P. and De Witt, D. P., 5th Edition, John Wiley and Sons, New York, 2006.
4	A Text book of Heat Transfer, John H Lienhard, 4th Edition,
5	Heat Transfer, Chris Long & Naser Sayma, Bookboon.com

Web links and Video Lectures (e – Resources)	
1	https://nptel.ac.in/courses/112103297/
2	http://nptel.ac.in/courses/112101097/

CO-PO Mapping:

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

Semester: VI						
Hypersonics						
Course Code	**:**	**BAS624D**		**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 and Gas Dynamics
Knowledge on Fundamental Concepts	Fluid Mechanics
Knowledge on Connected Tools (If any)	----------

Course Learning Objectives: This course will enable the students to	
CLO1	Know fundamental of hypersonic flow and its importance.
CLO2	Learn hypersonic shock, expansion-wave relations
CLO3	Analyze the hypersonic inviscid flow fields using approximate and exact methods
CLO4	Comprehend basic aspects boundary layer and aerodynamic heating in viscous hypersonic flow
CLO5	Apply computational fluid dynamics in hypersonic viscous flow

Module 01	**08 Hrs**
Introduction: Hypersonic Flow and Its Importance; Shock Layer; Entropy Layer; Viscous Interaction; High Temperature Flows; Low Density Flows; Hypersonic Flight Paths: Velocity-Altitude Map. **Text Book 1: Ch 1 & 2**	
Module 02	**08 Hrs**
Hypersonic Shock- Expansion Theory: Shock Relation; Hypersonic Shock Relations in Terms of the Hypersonic Similarity Parameter; Expansion-Wave Relation; Newtonian Flow; Modified Newtonian Law; Centrifugal Force Corrections to Newtonian Theory; Tangent-Wedge/ Tangent- Cone Methods; Shock- Expansion Method. **Text Book 1: Ch 3 & 4**	
Module 03	**08 Hrs**
Hypersonic Inviscid Flow fields (Approximate and Exact Methods): Introduction; The Governing Equations; Mach Number Independence; The Hypersonic Small- Disturbance Equations; Hypersonic Similarity; Hypersonic Small- Disturbance Theory; The Hypersonic Equivalence Principle and Blast Wave Theory; Thin Shock- Layer Theory; Method of Characteristics; The Hypersonic Blunt- Body Problem; Correlations for Hypersonic Shock Wave Shapes; Modern Computational Hypersonics. **Text Book 1: Ch 5,6 & 7**	
Module 04	**08 Hrs**
Viscous Hypersonic Flow: Governing Equations for Viscous Flow; The Navier- Stokes Equations; Similarity Parameters and Boundary Conditions; The Boundary Layer Equations for Hypersonic Flow; Hypersonic Boundary Layer Theory: Self- Similar Solutions, Flat Plate Case, Stagnation Point Case; Hypersonic Transition; Hypersonic Turbulent Boundary Layer; Hypersonic Aerodynamic Heating; Entropy Layer Effects on Aerodynamic Heating.	

Text Book 1: Ch 8 & 9

Module 05	08 Hrs

Computational Fluid Dynamic Solutions of Hypersonic Viscous Flows: Introduction; Viscous Shock- Layer Technique; Parabolized Navier- Stokes Solutions; Full Navier- Stokes Solutions.

Text Book 1: Ch 10

Course Outcomes: After completing the course, the students will be able to	
CO1	Learn the basics of hypersonic flow, high temperature and low density flows.
CO2	Understand the hypersonic shock and expansion-wave theory, Newtonian and modified Newtonian laws
CO3	Analyze the in-viscid flow fields in hypersonic flow using approximate and exact methods.
CO4	Learn the hypersonic boundary layer theory and hypersonic aerodynamic heating.
CO5	Apply the computational fluid dynamics for Navier- Stokes solutions in hypersonic flows.

Text Books	
1	Hypersonic and High Temperature Gas Dynamics – Anderson, John D., McGraw Hill, 1989.

Reference Books	
1	Aerothermodynamics Design Problems of Hypersonic Flight Vehicles, E. Hirschel, C. Weiland, Springer-Verlag Berlin and AIAA, 2009

Web links and Video Lectures (e – Resources)	
1	https://www.youtube.com/watch?v=hVeP_62SaCA&list=PLndEULTswG5aTuZ4gGTCZ-PWx3JUCFjyk&index=2

CO – PO MAPPING

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

Semester: VI						
Drone Technology: Principle, Practices and Applications						
Course Code	**:**	**BAS645A**		**Credits**	**:**	3
Hours/Week(L:T:P)	**:**	3:0:0		**CIE**	**:**	50 Marks
Total Hours	**:**	40		**SEE**	**:**	50 Marks
Course Type	**:**	OEC		**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Aerodynamics, Propulsion, Fluid Mechanics
Knowledge on Fundamental Concepts	Basics of electronics
Knowledge on Connected Tools (If any)	

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the Fundamentals of Drone Technology.
CLO2	Analyse Drone Components and Systems.
CLO3	Apply Practical Skills in Drone Construction & Testing.
CLO4	Design and Select Drone Structures & Propulsion Systems.
CLO5	Comply with Airworthiness and Regulations.

Module 01	**08 Hrs**
Basics: Introduction, History, UV types: UGV, UAV, USV, UUWV, Drones in India, Future scope. Introduction to Nano drones and Swarm Drones. Principles, Newton's Laws, Degrees of Freedom, Stick Movements, Flight Modes, Basic Maneuvers, Take-off, Pitch, Roll, Yaw, Landing. **Test Book 1: Ch 1,2,3 & 5** **Reference Book 1: Ch 1,2 & 4**	
Module 02	**08 Hrs**
Components and Systems: Basic components, Micro controllers, microprocessors, Sensors, Pre-Flight Checks, Flight Planning, Transmitter, Receiver. Introduction to Arduino Sensors, Program Structures, Flight Controllers, Telemetry, Mission Planning, Camera, Binding, etc. **Test Book 1: Ch 5,6,7,8 & 9** **Reference Book 2: Ch 3**	
Module 03	**08 Hrs**
Air Worthiness: DGCA Rules and Regulations, Pilot Licensing requirements, NPNT Compliance. Certifications. **Test Book 1: Ch 1 & 2** **Reference Book 2: Ch 1**	
Module 04	**08 Hrs**
Basics of Structures: Configurations, Payload Configurations, Design Considerations. **Basics of Propulsion:** Batteries, Hybrid Propulsions, IC Engines, Mini Turbines, Solar. **Test Book 1: Ch 6 & 7** **Reference Book 2: Ch 3**	
Module 05	**08 Hrs**

Flight Testing: Tuning, Testing, Manufacturing Constraints, Simulator Training, Applications

CASE Studies: Construction and testing of a basic drone.

Test Book 1: Ch 7 & 8
Reference Book 2: Ch 4

Course Outcomes: After completing the course, the students will be able to	
CO1	Apply the basic concepts of UAV systems.
CO2	Explain the basic aerodynamics, performance, stability and control required for UAV
CO3	Select the propulsion system and materials for structures
CO4	Understand Regulatory and Certification aspects.
CO5	Understand basic flight with experimentation

Text Books	
1	Introduction to UAV Systems - Paul Gerin, Fahlstrom, Thomas James Wiley Publication 4th Edition,2012
2	Unmanned Aerial Vehicles: DOD's Acquisition Efforts Alpha Editions.

Reference Books	
1	Handbook of Unmanned Aerial Vehicles Valavanis, K., Vachtsevano S, George J Springer.

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

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

Semester: VI						
Airport Planning and Management						
Course Code	**:**	**BAS645B**		**Credits**	**:**	3
Hours/Week(L:T:P)	**:**	3:0:0		**CIE**	**:**	50 Marks
Total Hours	**:**	40		**SEE**	**:**	50 Marks
Course Type	**:**	OEC		**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Introduction to Aviation Management
Knowledge on Fundamental Concepts	Transportation Economics, Environmental Science Fundamentals
Knowledge on Connected Tools (If any)	-

Course Learning Objectives: This course will enable the students to	
CLO1	Comprehend the regulatory, economic, and operational frameworks governing airports.
CLO2	Analyse airfield infrastructure, terminal design, and security systems.
CLO3	Evaluate financial strategies and funding mechanisms for airport sustainability.
CLO4	Apply planning tools to optimize capacity and reduce delays.
CLO5	Predict future trends in airport technology and management.

Module 01	**08 Hrs**
Introduction to Airport Systems: Categorization of airports (commercial, GA, military),International vs. domestic airport operations, Regulatory Framework Role of ICAO, FAA, EASA, and DGCA, National Plan of Integrated Airport Systems (NPIAS), FAR Part 139 and airport certification requirements. Organizational Public vs. private airport ownership models, Airport organizational charts and management roles, Career paths in airport management **Case Study:** Comparison of Hartsfield-Jackson Atlanta (public) vs. London Heathrow (private) **Text Book 1: Ch 1, 2 & 3** **ICAO Annex 14: Vol 1 - Ch 1**	
Module 02	**08 Hrs**
Airfield Operations and Infrastructure: Airfield Components, Runway configurations (parallel, intersecting, open-V), Taxiway design standards (FAA AC 150/5300-13), Apron management and gate allocation. Navigational Aids and Lighting , Visual aids (PAPI, REIL, ALS), Electronic NAVAIDS (ILS, VOR, DME), Airfield lighting circuits (runway edge, centreline), ATC and Weather Systems Tower, TRACON, and ARTCC roles, Automated Weather Observing Systems (AWOS), Impact of weather on airfield capacity **Practical Exercise:** Design a runway lighting plan for a CAT II/III airport **Text Book 1: Chr 6 & 8** **FAA AC 150/5300-13B**	
Module 03	**08 Hrs**
Terminal Design Evolution: Linear, pier, satellite, and midfield terminal concepts, Passenger flow modeling (IATA Level of Service standards), Security Systems, TSA regulatory	

framework (49 CFR Part 1542), Screening technologies (CT scanners, millimeter wave), Access control systems (biometrics, SIDA badges), Ground Access Planning, Multimodal integration (APMs, intermodal hubs), Curbside management and way finding systems, Parking demand forecasting models

Simulation: Optimize baggage handling for a peak-hour international terminal

Text Book 1: Ch 5 & 10
CFR Part 1542

Module 04	**08 Hrs**

Financial and Environmental Management: Revenue Strategies, Aeronautical vs. non aeronautical revenue streams, Passenger Facility Charges (PFCs) and AIP grants, Concessionaire management models, Capital Planning Master planning process (ADP, ALP updates), Benefit-Cost Analysis for infrastructure projects, Sustainability ACAF carbon accreditation levels, Noise abatement procedures (RNAV, PBN), Electrification of GSE and renewable energy adoption.

Workshop: Develop a 5-year sustainability plan for a regional airport

Text Book 1: Ch7 & 12
ICAO Annex 14 - Vol 1 Ch 2 & 5

Module 05	**08 Hrs**

Strategic Planning and Future Trends: Capacity-Delay Analysis, FAA AC 150/5060-5 capacity estimation methods, Queuing theory applications (M/M/1 models), Demand management strategies (slot controls), Emerging Technologies, Smart airport concepts (IoT, digital twins), Urban Air Mobility (UAM) vertiport integration, AI in predictive maintenance and pax flow, Risk Management, SMS implementation (ICAO Doc 9859), Business continuity planning for disruptions

Text Book 1: Ch 13 & 15
ICAO Doc 9859

Course Outcomes: After completing the course, the students will be able to	
CO1	Explain the roles of ICAO, FAA, and TSA in airport governance.
CO2	Design compliant airfield layouts adhering to FAR Part 139.
CO3	Assess terminal efficiency and security protocols.
CO4	Formulate financial plans using AIP grants and PFCs.
CO5	Propose solutions for capacity expansion and environmental sustainability.

Text Books	
1	Airport Systems: Planning, Design and Management (Richard de Neufville)
2	FAA AC 150/5300-13B, ICAO Annex 14

Reference Books
FAA AC 150/5300-13B, ICAO Annex 14

Web links and Video Lectures (e – Resources)	
1	https://www.youtube.com/watch?v=UNRVaMykHPc&list=PLRo6dG4oqePfxRj7cUGdroz7Ly5lrC-dt

CO – PO MAPPING

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

Semester: VI						
Aircraft Materials						
Course Code	:	**BAS645C**		**Credits**	:	3
Hours/Week(L:T:P)	:	3:0:0		**CIE**	:	50Marks
Total Hours	:	40		**SEE**	:	50Marks
Course Type	:	OEC		**SEE Duration**	:	3 Hours

Prerequisites:	
Courses	Elements of Mechanical Engineering
Knowledge on Fundamental Concepts	Engineering Materials, Physics
Knowledge on Connected Tools (If any)	-

Course Learning Objectives: This course will enable the students to	
CLO1	Classify aircraft materials (metals, composites, ceramics) and select them based on properties, corrosion resistance, and applications
CLO2	Evaluate non-ferrous alloys (Al, Mg, Ti) and their treatments (heat treatment, welding) for aircraft construction.
CLO3	Analyze ferrous materials (steels, super alloys) for structural aerospace applications, including heat treatment and welding.
CLO4	Design with advanced materials (ceramics, composites) and explain their fabrication processes for aircraft.
CLO5	Understand the different types of high temperature materials

Module–1	**08Hrs**
Mechanical Behavior of Engineering Materials: Introduction to aerospace materials and their classification, Linear and non-linear elastic properties - Stress and Strain Curves - Yielding and strain Hardening, Toughness - Modules of resilience -- Bauchinger's effect - Effect of notches - Testing and flaw detection of materials and components, knowledge of various material testing machines **Text Book 1: Ch 1 & 2** **Text Book 2: Ch 3**	
Module–2	**08Hrs**
Non-ferrous Materials in aircraft construction: **Aluminum and its alloys:** Types and identification. Properties-Castings–Heat treatment processes- Surface treatments. **Magnesium and its alloys**: Cast and Wrought alloys-Aircraft application, features specification, fabrication problems, Special treatments. **Titanium and its alloys**: Applications, machining, forming, welding and heat treatment, Copper Alloys. Wood and fabric in aircraft construction: Glues, Use of glass, plastics & rubber in aircraft. **Text Book 1: Ch 4, 5 & 6** **Text Book 2: Ch 4**	
Module–3	**08Hrs**

Ferrous Materials in aircraft construction:

Steels: Plain and low carbon steels, various low alloy steels, aircraft steel specifications, corrosion and heat resistant steels, structural applications.

Maraging Steels: Properties and applications;

Super Alloys: Use-Nickel base-Cobalt base-Iron base-forging and casting of super alloys-welding, Heat treatment.

Text Book 1: Ch 7, 8 & 9

Text Book 2: Ch5

Module–4	**08Hrs**

Ceramics and Composites::

Introduction, modern ceramic materials, cermet's, glass ceramic, production of semi-fabricated forms, Carbon/Carbon composites, Fabrication processes involved in metal matrix composites, polymer composites and applications.

Text Book 1: Ch6 & 7

Text Book 2: Ch 10

Module–5	**08Hrs**

High Temperature Materials:

Materials for space environment: Radiation shielding materials, Atomic oxygen resistant materials, Space suit materials and materials for life support systems. Smart systems for space applications: Elastic memory composites, Smart corrosion protection coatings, Self-healing materials.

Text Book 2: Ch 8 & 9

Course Outcomes: After completing the course, the students will be able to	
CO1	Apply the knowledge about the mechanical behavior of different aircraft & aerospace Materials.
CO2	Illustrate the use of ferrous and non-ferrous materials in aircraft construction.
CO3	Summarize the applications of ferrous and non-ferrous materials, Ceramics and Composites Materials in aircrafts.
CO4	Analyze the importance of testing and processing of aerospace materials.(L4)
CO5	Elucidate the importance of high temperature materials and their application.

Text Books	
1	Titter ton G F, Aircraft material and processes, 5th edition, new Delhi, 1998, ISBN-13:978- 8175980136
2	H. Buhl, advanced aerospace materials, springer, berlin 1992, ISBN-13:978-3540558880

Reference Books	
1	Balram Gupta, "Aerospace material" , volume 4, S Chand & co, 2009, ISBN 13: 978-812192205
2	Hilln E T, "The materials of aircraft construction", Pitman London.

Web links and Video Lectures (e–Resources)	
1	https://nptel.ac.in/courses/112107086.

CO – PO MAPPING

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

Semester: VI						
Fundamentals of Avionics						
Course Code	**:**	**BAS645D**		**Credits**	**:**	3
Hours/Week(L:T:P)	**:**	3:0:0		**CIE**	**:**	50 Marks
Total Hours	**:**	40		**SEE**	**:**	50 Marks
Course Type	**:**	OEC		**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Aircraft Systems , Basics Electronics,
Knowledge on Fundamental Concepts	Digital electronics and basic of aircraft systems. Basic Electronics & Circuits
Knowledge on Connected Tools (If any)	Simulation, testing and understanding aircraft systems.

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the working principles and qualitative behavior of electronic amplifiers,
CLO2	Analyze the characteristics and behavior of transmission lines and waveguides
CLO3	Apply the theory of electromagnetic wave propagation through various media
CLO4	Evaluate the performance and parameters of various antennas
CLO5	Demonstrate knowledge of analog and digital communication techniques

Module – 1	**08Hrs**
Electronic Circuits: Qualitative Analysis of Amplifiers and Feedback Amplifiers, Oscillators, Wave shaping circuits; A/D - D/A converters; Single/multi-stage Mixer and Modulators / Demodulators **Text Book 1: Ch 8, 9 & 11** **Text Book 2: Ch10 & 11**	
Module – 2	**08Hrs**
Transmission Lines: Introduction, transmission lines equations and significance, termination of line by infinite line, by characteristic impedance, short circuit line, and open circuit line, VSWR, problems Microstrip lines. Qualitative Analysis of Waveguides: Rectangular and circular type, TE and TM waves in wave guides, their transmission properties and attenuation., E-plane & H Plane Waveguides, Magic Tee, Circulator, Duplexer and their S matrices, Wave guide resonator, loaded and unloaded **Reference Book 1: Ch 5 & 7**	
Module – 3	**08Hrs**
Propagation of EM Waves: Electromagnetic Spectrum; Basics of E M Wave, Polarization, Types of Polarization, Modes of Radio wave Propagation, Surface wave, Troposphere duct Propagation, Tropo-scatter Propagation, Ionosphere Propagation, Magneto-ionic theory, Secant law, MUF, Critical frequency, Skip distance. Fading & Remedial measures. **Antenna Basics & Microwave Antenna:** Oscillating dipole: Electromagnetic radiation, retarding potential, Antenna parameters: directivity, beam width, gain, radiation, effective	

aperture, Friss transmission formula Antenna array: Horn, Parabolic Reflector and its feed, Cass grain antenna, Slot array, lens antenna. Beam Forming, Phased Arrays

Reference Book1: Ch 9 & 10
Text Book 1: Ch 12

Module – 4	**08Hrs**

Elements of Communication Systems: Definition of Signal & System, Types of Signals, Classification of Signals, Classification of Systems; Signals Gain, Attenuation & Decibels; Filters & their classification,; Noise & SNR comparison;, Frequency Synthesizer, Phase lock loop, Modulator / Demodulator, Block Diagrams of Microwave Transmitter / Receiver

Text Book 2: Ch 6 & 8

Reference Book 1: Ch 12

Module – 5	**08Hrs**

Basics of Digital Communication: Pulse Modulation, Sampling, quantizing, coding, PCM, DPCM, multiplexing-audio/video; Digital modulation: ASK, FSK, PSK; Multiple access: TDMA, FDMA, CDMA.

Reference Book 2: Ch 3, 5, 7 & 9

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the need, evolution, and architecture of avionics systems.
CO2	Explain cockpit layouts, display systems, and data transfer techniques in avionics.
CO3	Describe the operation of airborne and ground-based radio and satellite navigation
CO4	Demonstrate understanding of navigation and control principles
CO5	Apply avionics concepts to integrate navigation, communication, and control systems

Text Books	
1	Electronic Devices & Circuit Theory : Robert L Boylestad & Louis Nashelsky, 11th Edition, 1 July 2017, Pearson, ISBN: 978-0-13-262226-4
2	Principles of Electronics : A P Malvino & David J Bates, ISBN: 978-0-07-063424-4 Tata McGraw - Hill, New Delhi

Reference Books	
1	Electronic Communication Systems: George Kenndy & Bernard Davis, Tata McGraw Hill, 37th reprint 2009, ISBN-13: 978-0-07-463682-4, .ISBN-10: 0-07-463682-0 .
2	Principle of Digital Communication System: Robert G Gallager, 2008 Edition, Cambridge University

CO – PO MAPPING

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

Semester: VI						
Flight Mechanics Lab						
Course Code	:	**BASL607**		**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	Aircraft Performance, Stability and Control
Knowledge on Fundamental Concepts	Mathematics
Knowledge on Connected Tools (If any)	MAT Lab

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the principles of aircraft performance and stability using MATLAB simulations.
CLO2	Develop the ability to simulate steady and dynamic flight conditions including climb, descent, and turns.
CLO3	Analyze and estimate aircraft takeoff, landing, and mission performance parameters.
CLO4	Perform flight maneuvers and disturbed-to-trim recovery using MATLAB.
CLO5	Evaluate lateral, directional, and spin recovery modes to understand stability characteristics.

Experiments	**15 Hrs**
1. Simulation of Steady Level Flight Conditions Using MATLAB and Simulink	
2. Modeling and Simulation of Steady Climb Performance of an Aircraft	
3. Modeling and Simulation of Steady Descent Flight Trajectory	
4. Estimation of Aircraft Takeoff Velocity Using Performance Equations	
5. Simulation of Ground Roll Distance and Takeoff Trajectory Analysis	
6. Simulation of Landing Approach, Flare, and Total Landing Distance Estimation	
7. Simulation and Analysis of Typical Aircraft Mission Profiles	
8. Simulation of Aircraft Trim Recovery from Disturbed Flight Conditions	
9. Modeling and Analysis of Lateral-Directional Dynamic Modes of an Aircraft	
10. Simulation of Aircraft Spin Dynamics and Spin Recovery Maneuvers	
11. Simulation of Coordinated Level Turn for a Specified Turn Rate	
12. Simulation of Coordinated Level Turn for a Specified Turn Radius	

Course Outcomes: After completing the course, the students will be able to	
CO1	Simulate steady, climb, and descent flight conditions using MATLAB.
CO2	Estimate takeoff velocity, ground roll, and landing distance for given aircraft parameters

CO3	Perform and analyze mission profiles and maneuver simulations including level turns and barrel rolls
CO4	Demonstrate the recovery of aircraft from disturbed flight to trimmed flight and analyze stability modes
CO5	Apply MATLAB simulations to evaluate spin recovery and lateral-directional stability of aircraft.

Text Books	
1	Peter John Davison. "A summary of studies conducted on the effect of motion in flight simulator pilot training".

Reference Books	
1	Beard, Steven; et al. "Space Shuttle Landing and Rollout Training at the Vertical Motion Simulator" (PDF). AIAA. Retrieved 5 February 2014.

Web links and Video Lectures (e – Resources)	
1	https://ch.mathworks.com/help/aeroblks/flight-simulator-interfaces.html

CO – PO MAPPING

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

Semester: VI						
Competency Enhancement Course-4 **Stream: ME**						
Course Code	:	**BCE608**		**Credits**	:	0
Hours/Week(L:T:P)	:	2:0:0		**CIE**	:	**100 Marks**
Total Hours	:	40		**SEE**	:	-
Course Type	:	NCMC		**SEE Duration**	:	-

Prerequisites:	
Courses	FEM, Solid Edge, Auto cad
Knowledge on Fundamental Concepts	
Knowledge on Connected Tools	NA

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the fundamentals of Finite Element Analysis (FEA)
CLO2	Familiarize with ANSYS software environment
CLO3	Apply the general FEA analysis procedure in ANSYS
CLO4	Perform different types of engineering analyses in ANSYS
CLO5	Develop simulation-based solutions through projects and case studies

Module – 1	**3 Hrs**
Fundamentals of Finite Element Analysis (FEA) **Introduction to FEA:** Concept, applications and limitations, Historical development and role of FEA in engineering. **Mathematical foundation:** governing equations, boundary conditions and discretization, Types of problems solved by FEA (structural, thermal, fluid, coupled field) **Steps in FEA:** Pre-processing, solution, post-processing, Common terminology in FEA (nodes, elements, DOFs, meshing, shape functions) **Textbook1 - Ch.1&2, Textbook2 - Ch.1&2**	
Module – 2	**3 Hrs**
Introduction to ANSYS Environment Overview of ANSYS software and its capabilities, ANSYS workbench vs. classical interface, ANSYS GUI and menus: Project schematic, toolbox, engineering data, geometry, mesh, solution, results, File management and units system in ANSYS, Understanding ANSYS element library, Importing and creating geometry (Design Modeler/Space Claim basics) **Textbook1 - Ch.3, Textbook3 – Ch.1,2&3, Textbook 4**	
Module-3	**6 Hrs**
General FEA Analysis Procedure in ANSYS **Pre-processing in ANSYS:** geometry creation, material properties, meshing, Types of meshing and mesh quality parameters, Defining loads, boundary conditions and constraints, Solver settings and run procedure. **Post-processing:** interpreting results (stress, strain, deformation, temperature) Error checking, convergence studies and result verification.	

Textbook1 - Ch.4,5&6, Textbook 4	
Module-4	**8 Hrs**
Analysis Types in ANSYS **Structural Analysis:** Linear static analysis of beams, trusses and frames, Contact analysis and nonlinear material behavior, Buckling analysis. **Thermal Analysis:** Steady-state and transient heat transfer problems, Conduction, convection and radiation in ANSYS **Modal Analysis:** Natural frequencies and mode shapes, Harmonic and transient vibration analysis, Damping effects and interpretation of modal results. **Textbook1 - Ch.7,8&9, Textbook 3, Ch.6,7&8**	
Module-5	**20 Hrs**
Case Studies & Project Work Hands-on tutorials for each analysis type (structural, thermal, modal), Real-world problem simulation (e.g., mechanical component under load, heat dissipation in electronics), Optimization studies and parametric analysis, Documentation and report preparation for FEA projects **Mini-projects:** Problem definition, modeling, simulation, validation and presentation **Textbook3 - Ch.9&10, Textbook 4**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Describe the fundamental concepts, mathematical foundations and applications of Finite Element Analysis (FEA) in engineering
CO2	Demonstrate proficiency in navigating and utilizing the ANSYS Workbench environment for different engineering simulations
CO3	Apply the general FEA procedure (pre-processing, solution and post-processing) to model, analyze and interpret engineering problems
CO4	Perform structural, thermal and modal analyses in ANSYS, including interpretation of results for decision-making
CO5	Design and execute simulation-based projects, perform optimization studies, validate results and prepare professional technical reports

Text Books	
1	Finite Element Analysis: Theory and Application with ANSYS, Saeed Moaveni, 4th Edition, Pearson Education, 2014. ISBN: 978-0133840803
2	Fundamentals of Finite Element Analysis, David Hutton, McGraw Hill Education, 2017. ISBN: 978-0072922363
3	Practical Finite Element Analysis for Mechanical Engineers with ANSYS Applications. Kishore Kumar G., Venkatesh K, I.K. International Publishing House, 2021. ISBN: 978-9386768830
4	ANSYS, Inc. – ANSYS Workbench User's Guide (Latest Release Documentation, available via ANSYS Help)

Web links and Video Lectures (e – Resources)	
1	https://www.ansys.com/learning
2	https://forum.ansys.com/
3	https://ocw.mit.edu/courses/mechanical-engineering/2-092-finite-element-procedures-for-solids-and-structures-spring-2004/
4	https://www.engineeringtoolbox.com/

5	https://confluence.cornell.edu/display/SIMULATION/ANSYS+Tutorials
6	https://caeai.com/resources

CO – PO MAPPING

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

Semester: VI						
Indian Knowledge Systems **Stream: CSE/ECE/ME/CV**						
Course Code	**:**	**BIK609**		**Credits**	**:**	0
Hours/Week(L:T:P)	**:**	1:0:0		**CIE**	**:**	**100 Marks**
Total Hours	**:**	15		**SEE**	**:**	-
Course Type	**:**	NCMC		**SEE Duration**	**:**	-

Prerequisites:	
Courses	Environmental Studies, Indian Philosophy or Ethics
Knowledge on Fundamental Concepts	Basic understanding of ancient Indian civilization, literature
Knowledge on Connected Tools (If any)	NA

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the foundational concepts of Indian Knowledge Systems (IKS)
CLO2	Explore the contributions of traditional Indian knowledge to various fields in the humanities and sciences
CLO3	Recognize the relevance and applications of traditional knowledge in professional domains
CLO4	Develop an appreciation for the interdisciplinary nature of IKS
CLO5	Analyze the integration of IKS with contemporary academic and professional practices

Module – 1	**5 Hrs**
Introduction to Indian Knowledge Systems (IKS) Overview, Vedic Corpus, Philosophy, Character scope and importance, traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge vs. western knowledge. **Textbook-1, Ch.1,2&3, Textbook-2: Ch. 2&3**	
Module – 2	**5 Hrs**
Traditional Knowledge in Humanities and Sciences Linguistics, Number and measurements- Mathematics, Chemistry, Physics, Art, Astronomy, Astrology, Crafts and Trade in India and Engineering and Technology. **Textbook-1, Ch.4,5,6&7, Textbook-2: Ch. 3&4**	
Module-3	**5 Hrs**
Traditional Knowledge in Professional domain Town planning and architecture Construction, Health, wellness and Psychology-Medicine, Agriculture, Governance and public administration, United Nations Sustainable development goals. **Textbook-1, Ch.8,9,10,11&12, Textbook-2: Ch. 5,6&7**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Elucidate the scope, significance and philosophical foundations of Indian

	Knowledge Systems (IKS).
CO2	Compare traditional knowledge systems with indigenous and western knowledge frameworks.
CO3	Identify the applications of traditional Indian knowledge in humanities and scientific domains.
CO4	Demonstrate an understanding of traditional Indian contributions to professional domains.
CO5	Relate traditional knowledge systems to contemporary global frameworks such as Sustainable Development Goals (SDGs).

Text Books	
1	Introduction to Indian Knowledge System- concepts and applications, B Mahadevan, Vinayak Rajat Bhat, Nagendra Pavana R N, 2022, PHI Learning Private Ltd, ISBN-978-93-91818-21-0
2	Traditional Knowledge System in India, Amit Jha, 2009, Atlantic Publishers and Distributors (P) Ltd., ISBN-13: 978-8126912230

Reference Book	
1	Knowledge Traditions and Practices of India, Kapil Kapoor, Avadesh Kumar Singh, Vol. 1, 2005, DK Print World (P) Ltd., ISBN 81-246-0334

Web links and Video Lectures (e – Resources)	
1	https://www.youtube.com/watch?v=LZP1StpYEPM
2	http://nptel.ac.in/courses/121106003/
3	http://www.iitkgp.ac.in/department/KS;jsessionid=C5042785F727F6EB46CBF432D7683B63 (Centre of Excellence for Indian Knowledge System, IIT Kharagpur)
4	https://www.wipo.int/pressroom/en/briefs/tk_ip.html
5	https://unctad.org/system/files/official-document/ditcted10_en.pdf
6	http://nbaindia.org/uploaded/docs/traditionalknowledge_190707.pdf
7	https://unfoundation.org/whatwedo/issues/sustainabledevelopmentgoals/?gclid=EAIaIQobChMInpJtb_p8gIVTeN3Ch27LAmPEAAYASAAEgIm1vD_BwE

CO – PO MAPPING

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

Semester: VI						
National Service Scheme Stream: CSE/ECE/ME/CV						
Course Code	**:**	**BNS610**		**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	**08Hrs**
Plantation and adoption of plants. Know your plants.	
Activity – 2	**08 Hrs**
Organize National integration and social harmony events /workshops /seminars. (Minimum 02 programs).	
Activity – 3	**08 Hrs**
Govt. school Rejuvenation and helping them to achieve good infrastructure.	

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	Plantation and adoption of plants. Know your plants.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus etc.	Place 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	Organize National integration and social harmony events	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus	Place selection /proper consultation/ Continuous monitoring/ Information	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by

	/workshops /seminars. (Minimum 02 programs).		etc.	board		NSS officer
3	Govt. school Rejuvenation and helping them to achieve good infrastructure.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus etc.	Place 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 6th 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 6th 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 6th 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: VI						
Physical Education (PE) (Sports and Athletics) **Stream: CSE/ECE/ME/CV**						
Course Code	**:**	BPE610		**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 awareness about common postural deformities and equip students with techniques for stress management to enhance physical and mental well-being.
CLO2	Enable students to acquire the basic rules, techniques, and motor skills of selected games such as Throw Ball, Table Tennis, or Athletics, and to encourage regular participation in physical activities.
CLO3	Improve cardiovascular fitness, flexibility, and coordination through structured aerobic exercises.

Module – 1	**4 Hrs**
Orientation A. Postural deformities. B. Stress management	
Module – 2	**16 Hrs**
Specific games (Any one to be selected by the student) A. Throw ball B. Table Tennis C. Athletics (Field Events- Jumps) – Any event as per availability of Ground.	
Module-3	**4 Hours**
Aerobics	

Course Outcomes: After completing the course, the students will be able to	
CO1	Identify common postural deformities and suggest corrective measures
CO2	Apply basic stress management techniques to enhance physical and mental well-being
CO3	Demonstrate fundamental skills, rules and techniques of a selected game (Throw Ball / Table Tennis / Athletics – Field Events)
CO4	Exhibit improved coordination, flexibility, endurance and cardiovascular fitness through aerobic exercises
CO5	Integrate principles of physical fitness, posture correction and stress management into daily routines for holistic health

Scheme and Assessment for auditing the course and Grades:

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

CO – PO MAPPING

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

Semester: VI						
Yoga Stream: CSE/ECE/ME/CV						
Course Code	**:**	BYO610		**Credits**	**:**	00
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**
Higher Ashtanga Yoga: Ashtanga Yoga – last three limbs: Dharana (Concentration), Dhyana (Meditation), Samadhi (Absorption), Importance in spiritual and mental well-being	
Module - 2	**03 Hrs**
Sitting & Standing Asanas: Sitting Asanas: Bakasana, Hanumanasana, Ekapada Rajakapotasana, Yogamudra in Vajrasana, Standing Asanas: Vatayanasana, Garudasana, Technique, precautions & benefits	
Module - 3	**03 Hrs**
Balancing & Supine Asanas: Balancing Asanas: Veerabhadrasana, Sheershasana, Supine Asanas: Sarvangasana, Setubandha Sarvangasana, Shavasana (Relaxation), Asana meaning, method, safety tips & benefits	
Module - 4	**03 Hrs**
Pranayama & Kapalabhati: Pranayama: Bhastrika, Bhramari, Kapalabhati revision – 80 strokes/min, 3 rounds, Technique, precautions & benefits	
Module - 5	**03 Hrs**
Shatkriyas: Meaning, need & types of Shatkriyas, Techniques, safety & benefits of: Jalaneti & Sutraneti, Nouli (only for men), Sheetkarma Kapalabhati	

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		3					3			1
CO3	2	3						2			1
CO4	2	2						3			1

Semester: VI					
Music Stream: CSE/ECE/CV/ME					
Course Code	**:**	**BMU610**	**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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