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||Jai Sri Gurudev||

Sri Adichunchanagiri Shikshana Trust (R.)

# SJC INSTITUTE OF TECHNOLOGY

**An Autonomous Institution under VTU from 2024-25**

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

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

Estd : 1986

# V Semester

## Scheme & Syllabus of B.E. Programme

## Aerospace Engineering

## (2024 Scheme)

## Core Values

**Spiritual, Judicious, Commitment, Integrity, Trustworthy**



NATIONAL INSTITUTIONAL RANKING FRAMEWORK 151-300

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

# SJC INSTITUTE OF TECHNOLOGY, CHIKKABALLAPURA

*An Autonomous institution Under VTU from 2024 – 2025*

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

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

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

**5th Semester**

### Aerospace Engineering

| Sl. No. | Course Code | Course Title | Course Type | TD/ PSB | Teaching Hours/ Week | | | Examination | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | L | T | P | SEE Duration (Hrs) | CIE Marks | SEE Marks | Total Marks | Credits |
| 1 | BAS501 | Aerospace Structural Mechanics | PCC | AS | 3 | 0 | 0 | **3** | **50** | **50** | **100** | **3** |
| 2 | BAS502 | Finite Element Method | IPCC | AS | 3 | 0 | 2 | **3** | **50** | **50** | **100** | **4** |
| 3 | BAS503 | Rocket Propulsion | PCC | AS | 3 | 2 | 0 | **3** | **50** | **50** | **100** | **4** |
| 4 | BASL504 | Aircraft Structures Laboratory | PCCL | AS | 0 | 0 | 2 | **3** | **50** | **50** | **100** | **1** |
| 5 | BAS525x | Professional Elective Course – I | PEC | AS | 3 | 0 | 0 | **3** | **50** | **50** | **100** | **3** |
| 6 | BAS536 | Mini Project | PROJ | AS | 0 | 0 | 2 | **3** | **50** | **50** | **100** | **2** |
| 7 | BRM507 | Research Methodology and IPR | AEC | AS | 2 | 2 | 0 | **3** | **50** | **50** | **100** | **3** |
| 8 | BCE508 | Competency Enhancement Course-3 | NCMC | CDCAC | 0 | 2 | 0 | - | **100** | - | **100** | **0** |
| 9 | BNS509 | National Service Scheme (NSS) | NCMC | NSS Coordinator | 0 | 0 | 2 | - | **100** | - | **100** | **0** |
| | BPE509 | Physical Education (PE) (Sports and Athletics) | | Physical Education Director | | | | | | | | |
| | BYO509 | Yoga | | Yoga Teacher | | | | | | | | |
| | BMU509 | Music | | Music Teacher | | | | | | | | |
| | | | | | | | | | **600** | **400** | **1000** | **20** |

ASC: Applied Science Course, PCC: Professional Core Course, IPCC: Integrated Professional Core Course, PCCL: Professional Core Course laboratory, UHV: Universal Human Value Course, NCMC: Non Credit Mandatory Course, AEC: Ability Enhancement Course, SEC: Skill

Enhancement Course, ESC: Engineering Science Course, ETC: Emerging Technology Course, PLC: Programming Language Course, L: Lecture, T: Tutorial, P: Practical, CIE: Continuous Internal Evaluation, SEE: Semester End Evaluation.

**Professional Elective Course – I**

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

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

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

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

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

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

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

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

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

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

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

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

**CO – PO MAPPING:**

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

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

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

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

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

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

**PRACTICAL COMPONENT OF IPCC**

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

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

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

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

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

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

**CO – PO MAPPING**

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

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

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

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

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

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

**Text Book1: Ch 6, 7 & 8**

| **Module – 4** | **08Hrs** |
|---|---|

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

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

**Text Book1: Ch 16 & 19**

| **Module – 5** | **08Hrs** |
|---|---|

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

**Text Book1: Ch 20**

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

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

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

| | |
|---|---|
| | Publishing, India, 2004 |

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

**CO – PO MAPPING**

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

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

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

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

| **Experiments** | **15 Hrs** |
|---|---|

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

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

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

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

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

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

**CO – PO MAPPING**

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

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

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

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

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

**Text Book 1: Ch 1**

| Module – 2 | 08Hrs |
|---|---|

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

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

**Text Book 1: Ch 2 & 12**

| Module – 3 | 08Hrs |
|---|---|

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

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

**Text Book 1: Ch 10 & 11**

| Module – 4 | 08Hrs |
|---|---|

**Balancing of Rotating and Reciprocating Masses**

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

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

**Text Book 2: Ch 21 & 22**

| Module – 5 | 08Hrs |
|---|---|

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

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

**Text Book 1: Ch 16 & 17**

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

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

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

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

**CO – PO MAPPING**

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

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

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

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

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

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

**Text Book 1: Ch 5 & 8**

| **Module – 4** | **08Hrs** |
|---|---|

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

**Text Book 1: Ch 9 & 10**

| **Module – 5** | **08Hrs** |
|---|---|

**Maneuver Performance**

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

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

**Text Book 1: Ch 11 & 12**

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

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

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

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

**CO – PO MAPPING**

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

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

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

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

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

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

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

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

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

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

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

**CO PO PSO Mapping:**

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

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

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

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

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

| |
|---|
| telemetry in spacecraft systems, Base Band Telemetry system, Computer command & Data handling, Satellite command system, Issues.<br>**Textbook 1: Ch 8**<br>**Textbook 2: Ch 10** |

| **Module – 5** | **08Hrs** |
|---|---|
| **Applications**: VSAT-VSAT Technologies, Networks MSS-AMSS, MMSS.<br>**Textbook 1: Ch 9**<br>**Textbook 2: Ch 8** | |

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

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

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

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

**CO PO PSO Mapping:**

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

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

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

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

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

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

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

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

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

| **Module – 4** | **08Hrs** |
|---|---|

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

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

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

| **Module – 5** | **08Hrs** |
|---|---|

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

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

Classes of GI. Non-Registerable GI. Protection of GI. Collective or Certification Marks. Enforcement of GI Rights. Procedure for GI Registration Documents Required for GI Registration. GI Ecosystem in India.

**Case Studies on Patents**. Case study of Curcuma (Turmeric) Patent, Case study of Neem Patent, Case study of Basmati patent. IP Organizations In India. Schemes and Programmes

**Test Book 1**: **Ch. 9**: 9.1-9.17, **Ch. 10**: 10.1-10.13, **Ch. 11**: 11.1-11.3

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

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

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

**CO – PO MAPPING**

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

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

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

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

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

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

**File Management in C**

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

**Textbook 1- Ch2-16**

| **Module-3** | **8 Hrs** |
|---|---|

**C++**

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

**Textbook 2 –Ch1-6**

| **Module-4** | **8 Hrs** |
|---|---|

**C++**

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

**Textbook 2- Ch7-11**

| **Module-5** | **8 Hrs** |
|---|---|

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

**Textbook 3 – Ch1-8**

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

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

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

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

**CO – PO MAPPING**

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

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

| **Course Learning Objectives: This course will enable the students to** | |
|---|---|
| **CLO1** | Understand the community in general in which they work |
| **CLO2** | Identify the needs and problems of the community and involve them in problem – solving |
| **CLO3** | Develop among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions t |
| **CLO4** | Develop competence required for group-living and sharing of responsibilities & gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes. |
| **CLO5** | Appraise the importance of ethical issues and team working abilities pertaining to the social services. |

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

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

| **Sl.** | **Topic** | **Group Size** | **Location** | **Activity Execution** | **Reporting** | **Evaluation of the Topic** |
|---|---|---|---|---|---|---|
| **1.** | Developing Sustainable Water management system for rural areas | May be individual or team | Villages/ City Areas / Grama panchayat/ public associations/Government | Site selection /proper consultation/ Continuous monitoring/ Information | Report should be submitted by individual to the | Evaluation as per the rubrics Of scheme and |

| | | | | | | |
|---|---|---|---|---|---|---|
| | and implementation approaches. | | Schemes officers/ campus etc. | board | concerned evaluation authority | syllabus by NSS officer |
| **2.** | Contribution to any national level initiative of Government of India. For eg. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill development programs etc. | May be individual or team | Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus etc. | Group selection /proper consultation/ Continuous monitoring/ Information board | Report should be submitted by individual to the concerned evaluation authority | Evaluation as per the rubrics Of scheme and syllabus by NSS officer |
| **3.** | Spreading public awareness under rural outreach programs. (minimum5 programs). | May be individual or team | Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus etc. | Group selection/proper consultation/ Continuous monitoring / Information board | Report should be submitted by individual to the concerned evaluation authority | Evaluation as per the rubrics Of scheme and syllabus by NSS officer |
| **4.** | Social connect and responsibilities. | May be individual or team | Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus etc. | Group selection/proper consultation/ Continuous monitoring / Information board | Report should be submitted by individual to the concerned evaluation authority | Evaluation as per the rubrics Of scheme and syllabus by NSS officer |

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

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

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

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

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

**Assessment Details for CIE (100 Marks)**

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

**Suggested Learning Resources:**

**Books:**

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

**CO-PO Matrix**

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

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

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

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

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

**Scheme and Assessment for auditing the course and Grades:**

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

**CO – PO MAPPING**

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

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

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

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

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

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

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

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

**CO – PO MAPPING**

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

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

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

| **Module -I** | **03 Hrs** |
|---|---|
| **Preamble**<br>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.<br>Origin of the Indian Music: Evolution of the Indian music system, understanding of Shruthi, Nada, Swara, Laya, Raga, Tala, Mela<br>**Textbook1, V-1 Ch. 1-4** | |
| **Module – II** | **03 Hrs** |
| **Compositions**<br>Introduction to the types of composition in Carnatic Music – Geethe, Jathi, Swara, Swarajathi, Varna, Krithi and Thillana, Notation System.<br>**Textbook2 – Ch. 4-7** | |
| **Module –III** | **03 Hrs** |
| **Composers**<br>Biography and contributions of Purandaradasa, Thyagaraja, Mysoro asudevacharya, Kanakadasa<br>**Textbook3 – Ch. 2-5** | |
| **Module –IV** | **03 Hrs** |
| **Music Instruments**<br>Classification and construction of string instruments, wind instruments, percussion Instruments, Idiophones (Ghana Vaadya), Examples of each class of instruments.<br>**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<br>**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**

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

**Chikkaballapur - 562 101, Karnataka**