AUTONOMOUS

SYLLABUS

III & IV Semesters

B.E in Aeronautical Engineering

2023

MITE

Invent Solutions

MANGALORE INSTITUTE OF TECHNOLOGY & ENGINEERING

MANGALORE INSTITUTE OF TECHNOLOGY & ENGINEERING

(A Unit of Rajalaxmi Education Trust®, Mangalore)
Autonomous Institute affiliated to VTU, Belagavi, Approved by AICTE, New Delhi
Accredited by NAAC with A+ Grade & ISO 9001:2015 Certified Institution

Institute Vision

*"To attain perfection in providing **Globally Competitive Quality Education** to all our Students and also benefit the global community by using our strength in **Research and Development**"*

Institute Mission

*"To establish world class educational institutions in their respective domains, which shall be C**enters of Excellence** in their stated and implied sense. To achieve this objective we dedicate ourselves to meet the challenges of becoming **Visionary and Realistic**, **Sensitive and Demanding**, **Innovative and Practical,** Theoretical **and Pragmatic;** ALL at the same time"*

Department Vision

To be recognized as an innovative leader in Aeronautical engineering through excellence in education by imparting the values of research and developments in the upcoming fields of Aeronautics.

Department Mission

- *The Department imparts the technical knowledge, practical skills, entrepreneurial skill to students and the channelized guiding in the varied activities with the aim of transforming the graduates into able engineers of tomorrow.*
- *Aeronautical laboratories are specifically designed and laid up in order to develop adaptable students with a strong foundation in skills that are relevant to the challenging world.*
- *To provide students with strong concepts of their core subjects and an application-oriented overview in their stipulated courses.*

Program Educational Objectives (PEOs)

After successful completion of the program,

- *Graduates will have the scientific and technical knowledge to have successful career in Aeronautical industry.*
- *Graduates will have competency to analyze challenges and advancements in the focus areas of Propulsion, Structures, Aerodynamics, Flight Mechanics and Avionics.*
- *Graduates will be motivated and confident to pursue advanced education, research and development and other creative efforts in aeronautical engineering and allied areas.*
- *Graduates will have higher order thinking and leadership skills to become technology leaders of tomorrow.*

Program Specific Outcomes (PSOs)

At the end of the program,

- *Graduates will excel in their professional career in Aeronautical industry and research with highest professional and ethical standards to their activities by acquiring knowledge in basic engineering, mathematics, science and Aeronautical engineering.*
- *Graduates will exhibit professionalism, teamwork in their chosen profession and adapt to current trends, technologies and industrial scenarios by pursuing lifelong learning.*

MANGALORE INSTITUTE OF TECHNOLOGY & ENGINEERING

(A Unit of Rajalaxmi Education Trust®, Mangalore)
Autonomous Institute affiliated to VTU, Belagavi, Approved by AICTE, New Delhi
Accredited by NAAC with A+ Grade & ISO 9001:2015 Certified Institution

LIST OF COURSES

III / IV Semester Courses			
Sl. No.	**Course Code**	**Course Title**	**Sem**
BASIC SCIENCE COURSES			
1	23BSAE201	Engineering Mathematics-III	III
2	23BSCC202	Engineering Mathematics-IV	IV
PROFESSIONAL COURSES			
3	23AEPC203	Introduction to Aircraft Structural Mechanics	III
4	23AEPC204	Aircraft Materials and Processes	III
5	23AEPC205	Fundamentals of Aeronautics	III
6	23AEPC206	Fluid Mechanics	III
7	23AEPC207	Computer Aided Aircraft Drawing	III
8	23AEPC208	Aerodynamics	IV
9	23AEPC209	Aircraft Systems & Instrumentation	IV
10	23AEPC210	Aerothermodynamics	IV
11	23AEPC211	Mechanisms and Machine Theory	IV
12	23AEPC212	Digital Measurement Systems	IV
HUMANITIES & SOCIAL SCIENCE COURSES			
13	23HMCC215	Universal Human Values	III
14	23HMCC216	Research Methodology & Intellectual Property Rights	IV
SKILL ENHANCEMENT COURSES			
15	23AESE251	Object Oriented Programming using C++	III
16	23AESE252	Hands on approach to IOT	III
17	23AESE253	Computational Tools for Aircraft Performance Analysis	III
18	23AESE254	Aircraft Assembly drawing using CATIA and GD &T	IV
19	23AESE255	Digitalization In Aeronautics	IV
20	23AESE256	Drone Pilot Training	IV
AUDIT COURSES			
21	23NMCC221	Yoga-I	III
22	23NMCC222	Physical Education-I	III
23	23NMCC223	NSS-I	III
24	23NMCC224	Arts-I	III
25	23NMCC225	Yoga-II	IV
26	23NMCC226	Physical Education-II	IV
27	23NMCC227	NSS-II	IV
28	23NMCC228	Arts-II	IV
29	23NMCC229	Environmental Studies & Sustainability	IV

MANGALORE INSTITUTE OF TECHNOLOGY & ENGINEERING

(A Unit of Rajalaxmi Education Trust®, Mangalore)
Autonomous Institute affiliated to VTU, Belagavi, Approved by AICTE, New Delhi
Accredited by NAAC with A+ Grade & ISO 9001:2015 Certified Institution

III Semester (2023 Scheme): Aeronautical Engineering

Sl. No.	Course Code	Course Title	Category	Teaching Dept.	Teaching Hrs /Week			Exam Marks			Duration of Exam (SEE) in Hrs	Credits
					L	T	P	CIE	SEE	Total		
1	23BSAE201	Engineering Mathematics-III	Basic Science Course	Mathematics	3	0	0	50	50	100	3	3
2	23AEPC203	Introduction to Aircraft Structural Mechanics	Professional Core Course	AE	3	0	2	50	50	100	3	4
3	23AEPC204	Aircraft Materials and Processes	Professional Core Course	AE	3	0	0	50	50	100	3	3
4	23AEPC205	Fundamentals of Aeronautics	Professional Core Course	AE	3	0	0	50	50	100	3	3
5	23AEPC206	Fluid Mechanics	Professional Core Course	AE	3	0	2	50	50	100	3	4
6	23AEPC207	Computer Aided Aircraft Drawing	Professional Core Course - Laboratory	AE	1	0	2	50	50	100	2.5	2
7	23HMCC215	Universal Human Values	Humanities & Social Sciences	Any Dept.	2	0	0	50	50	100	2.5	2
8	23AESE25X	Skill Enhancement Course*	SE Course	AE/Any dept	1	0	2	50	50	100	2.5	2
9	23NMCC22X	Yoga/Physical Education/NSS/Arts**	Audit Course	Yoga Teacher/ PED/NSS Coordinator/ Cultural Coordinator	0	0	1	100	-	100	-	-
											Total	**23**

***Skill Enhancement Course(s):**

Sl. No.	Course Code	Course Title	Certification Platform
1	23AESE251	Object Oriented Programming using C++	MOOC's/Industry
2	23AESE252	Hands on approach to IOT	MOOC's/Industry
3	23AESE253	Computational Tools for Aircraft Performance Analysis	MOOC's/Industry

****Yoga/Physical Education/NSS/Arts:**

Sl. No.	Course Code	Course Title
1	23NMCC221	Yoga-1
2	23NMCC222	Physical Education-I
3	23NMCC223	NSS-I
4	23NMCC224	Arts-I

Note: ** To be offered from 3rd to 6th Semester.

MANGALORE INSTITUTE OF TECHNOLOGY & ENGINEERING

(A Unit of Rajalaxmi Education Trust®, Mangalore)
Autonomous Institute affiliated to VTU, Belagavi, Approved by AICTE, New Delhi
Accredited by NAAC with A+ Grade & ISO 9001:2015 Certified Institution

IV Semester (2023 Scheme): Aeronautical Engineering

Sl. No.	Course Code	Course Title	Category	Teaching Dept.	Teaching Hrs /Week			Exam Marks			Duration of Exam (SEE) in Hrs	Credits
					L	T	P	CIE	SEE	Total		
1	23BSCC202	Engineering Mathematics-IV	Basic Science Course	Mathematics	3	0	0	50	50	100	3	3
2	23AEPC208	Aerodynamics	Professional Core Course	AE	3	0	2	50	50	100	3	4
3	23AEPC209	Aircraft Systems & Instrumentation	Professional Core Course	AE	3	0	0	50	50	100	3	3
4	23AEPC210	Aerothermodynamics	Professional Core Course	AE	2	0	2	50	50	100	3	3
5	23AEPC211	Mechanisms and Machine Theory	Professional Core Course	AE	3	0	0	50	50	100	3	3
6	23AEPC212	Digital Measurement Systems	Professional Core Course	AE	3	0	0	50	50	100	3	3
7	23HMCC216	Research Methodology & Intellectual Property Rights	Humanities & Social Sciences	AE	2	0	0	50	50	100	2.5	2
8	23AESE25X	Skill Enhancement Course*	SE Course	AE/ Any Dept.	1	0	2	50	50	100	2.5	2
9	23NMCC229	Environmental Studies & Sustainability	Audit Course	Civil Engg.	1	0	0	100	-	100	-	-
10	23NMCC22X	Yoga/ Physical Education /NSS/Arts**	Audit Course	Yoga Teacher/ PED/NSS Coordinator/ Cultural Coordinator	0	0	1	100	-	100	-	-
											Total	**23**

***Skill Enhancement Course(s):**

Sl. No.	Course Code	Course Title	Certification Platform
1	23AESE254	Aircraft Assembly drawing using CATIA and GD&T	MOOC's/Industry
2	23AESE255	Digitalization in Aeronautics	MOOC's/Industry
3	23AESE256	Drone Pilot Training	MOOC's/Industry

****Yoga/Physical Education/NSS/Arts:**

Sl. No.	Course Code	Course Title
1	23NMCC225	Yoga-II
2	23NMCC226	Physical Education-II
3	23NMCC227	NSS-II
4	23NMCC228	Arts-II

MANGALORE INSTITUTE OF TECHNOLOGY & ENGINEERING

(A Unit of Rajalaxmi Education Trust®, Mangalore)
Autonomous Institute affiliated to VTU, Belagavi, Approved by AICTE, New Delhi
Accredited by NAAC with A+ Grade & ISO 9001:2015 Certified Institution

INDEX

III Semester

IV Semester

Engineering Mathematics - III			
Semester	**III**	CIE Marks	**50**
Course Code	**23BSAE201**	SEE Marks	**50**
Teaching Hrs/Week (L: T:P)	**3:0:0**	Exam Hrs	**03**
Total Hrs	**42**	Credits	**03**

Course Learning Objectives: This course is designed to

1. Develop systematic understanding of Laplace transform and their applications in solving engineering and scientific problems
2. Impart the knowledge of Fourier series and its applications in solving engineering problems
3. Build a strong foundation in Fourier Transforms essential to solve real-world problems
4. Provide a comprehensive understanding of Numerical Methods for solving problems arising in science and engineering

Module 1: Laplace Transforms	**No. of Hrs: 09**

Laplace Transforms: Definition and Laplace Transform of elementary functions. Properties of Laplace Transform–Linearity, Shifting, Multiplication by t^n, Division by t, Unit-Step function, Dirac Delta function

Inverse Laplace Transforms: Definition, Inverse Laplace Transform, Convolution theorem to find the inverse Laplace Transforms, Solution of differential equations using Laplace Transforms

Module 2: Fourier Series	**No. of Hrs: 08**

Introduction to Infinite series, Convergence and Divergence, Periodic functions, Dirichlet's condition, Fourier series of periodic functions with arbitrary period, Half range Fourier series, Practical Harmonic Analysis

Module 3: Fourier Transforms and Numerical solution of ODE	**No. of Hrs: 09**

Fourier Transforms: Definition, Fourier Sine and Cosine transforms, Inverse Fourier Transforms, Inverse Fourier Cosine and Sine transforms

Solution of first and second order ordinary differential equations using Taylor series method

Module 4: Numerical methods -I	**No. of Hrs: 08**

Finite Differences, Newton's Forward & Backward Difference, Newton's Divided Difference, Lagrange's and Inverse Lagrange's Interpolation methods.

Module 5: Numerical methods -II	**No. of Hrs: 08**

Solution of Polynomial and Transcendental Equations: Regula-Falsi and Newton-Raphson methods

Numerical Differentiation: Forward and Backward difference methods

Numerical integration: Simpson's $(1/3)^{rd}$ rule, $(3/8)^{th}$ rule and Romberg's method

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

1. Illustrate the fundamental concepts of Laplace Transform, Fourier series, Fourier Transform, and Numerical Methods
2. Apply suitable techniques to solve engineering and scientific problems related to Laplace Transform, and Fourier Series
3. Make use of appropriate Numerical Methods to solve engineering and scientific problems
4. Solve real-life problems related to Laplace Transform, Fourier series, Fourier Transform, and Numerical Methods
5. Employ software tool to efficiently solve engineering and scientific problems allied with Laplace transform, Fourier series, Fourier Transform, and Numerical Methods

Text Books:

1. Dennis G Zill, "Advanced Engineering Mathematics", 7th Edition, Jones-Bartlett, 2022
2. E. Kreyszig, "Advanced Engineering Mathematics", 10th Edition, John Wiley & Sons, 2018

Reference Books:

1. N.P Bali and Manish Goyal, "A Textbook of Engineering Mathematics", 10th Edition, Laxmi Publications, 2022
2. S. R. K. Iyengar & R. K. Jain, "Numerical Methods", 1st Edition, New Age International (P) limited Publishers, 2020

Web links:

1. Laplace Transforms: https://ocw.mit.edu/courses/18-03-differential-equations-spring-2010/resources/lecture-19-introduction-to-the-laplace-transform/
2. Fourier Series: https://www.youtube.com/watch?v=nXEqrOt-nB8
3. Fourier Transforms: https://www.youtube.com/watch?v=1JnayXHhjlg
4. Taylor series: https://www.youtube.com/watch?v=vSKra51VJC0
5. Numerical Methods : https://archive.nptel.ac.in/courses/127/106/127106019/

Introduction to Aircraft Structural Mechanics			
Semester	**III**	CIE Marks	**50**
Course Code	**23AEPC203**	SEE Marks	**50**
Teaching Hrs/Week (L:T: P)	**3:0:2**	Exam Hrs	**03**
Total Hrs	**64**	Credits	**04**

Course Learning Objectives: This course is designed to

1. Familiarize stress classification, elastic properties, stress/strain analysis in members subjects to axial load, temperature stresses, and material/mechanical deformation through experiments
2. Establish a foundation to construct shear force and bending moment diagrams for beams under lateral loads
3. Develop proficiency in Analyzing Bending Stresses in Symmetric Section Beams, Shearing Stresses in Beams, and Stress Distribution in Thin and Thick Cylinders
4. Impart knowledge on beam deflection and slope and Design of Circular shafts subjected to torsion
5. Make an understanding of Mohr's Circle and analytical methods to determine principal stress, and realize material failure mechanisms by fracture, creep and fatigue

Module 1: Stress Strain and Axially loaded Members — **No. of Hrs: 8+6**

Stresses and Strains: Introduction to Stress and strain, Types of stress and Strain, Stress Strain Diagram of Ductile, Brittle, Visco-Elastic, Linear & Non-linear Elastic materials Properties of materials and Factor of Safety. Bars with varying sections, Bars of composite sections, Simple problems. Thermal stresses, Elastic constants and its relation, volumetric stains. Loads on Aircraft. Overview of Aircraft Structure Desirable properties of Aircraft materials for structural applications

Laboratory Components:

1. Tensile and compression test of metallic specimens using Universal Testing Machine
2. Impact Strength of metallic Specimens using Charpy and Izod Impact Testing Machines
3. Hardness tests using Rockwell, Vickers, and Brinell Hardness Testing Machines.

Module 2: Shear Force Bending and Moments in Beams — **No. of Hrs: 8+6**

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

Laboratory Components:

1. Shear test of metallic specimens using Universal Testing Machine
2. SFD/BMD problem solving using ANSYS

Module 3: Stresses in Beams and Cylinder — **No. of Hrs: 8+4**

Stress in Beams: Simple theory of bending, Derivation of relationship between bending stress &radius of curvature. Transverse shear stress and its distribution. Bending and shear stress distribution in rectangular & circular sections. Numerical on Circular, I and T section beams

Thick and Thin cylinders: Stresses in a thin cylinder subjected to internal pressure, Expression of circumferential stress and hoop stress, Simple problems Thick Cylinder: Lame's theorem, Stresses in a thick cylinder, Simple problems

Laboratory Components:

1. Bending Test of metallic specimens
2. Measurement of stresses in thin-walled vessel

Module 4: Deflection of Beams and Torsion of Shafts	**No. of Hrs: 8+4**

Deflection of Beams: Introduction to Deflection and slope, Relation between slope, Deflection and radius of curvature. Finding Deflection and slope of a beam (Simply Supported and Cantilever) subjected to various loads, Simple problems using Double integration and Macaulay's method

Torsion of Shafts: Introduction to torsion, Derivation of shear stress produced in a circular shaft subjected to Torsion, Expression of Torque in terms of polar moment of Inertia, Power transmitted by shaft, simple problem

Laboratory Components:

1. Deflection of simply supported and cantilever beam with point load
2. Torsion test of metallic specimen

Module 5: Compound Stresses and Failure by Fracture, Creep and Fatigue	**No. of Hrs: 8+4**

Compound Stresses: Introduction to three-dimensional stress system, Stresses on inclined planes: Uni & Bi axial direct stresses and General two dimensional stress systems. Calculation of Stresses, Principal stresses and Shearing stresses - Analytical and (Graphical Mohr's circle) method.

Fracture: Type I, Type II and Type III

Creep: Description of the phenomenon with examples. Three stages of creep, creep properties, stress relaxation

Fatigue: Types of fatigue loading with examples, fatigue properties, fatigue testing (RR Moore Method) and S-N diagram

Laboratory Components:

1. Solve compound stress problems using MATLAB
2. Virtual Lab experiment to determine the endurance limit of the given specimen under fatigue loading

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

1. Apply the stress and strain fundamentals, comprehend aircraft structural requirements, and integrate material properties and mechanical deformation principles for material selection and performance
2. Apply shear force and bending moment analysis techniques to Construct SFD and BMD for beams with varied end and loading conditions
3. Analyse the Bending Stresses and shear stresses in Beams & Determine stress distribution in thin and thick cylinders
4. Apply Double integration and Macaulay's method to determine deflection of beams and Design of Circular shafts subjected to torsion
5. Apply Mohr's Circle and analytical methods to determine principal stresses and understand material failure by fracture, creep and fatigue

Textbooks:

1. S.S. Bhavikatii, "Strength of Materials", 5th Edition, Vikas Publications House New Delhi, 2021
2. S S Rattan., "Strength of Materials", 3rd Edition, Tata McGraw Hill, 2017

Reference Books:

1. Timoshenko and Young "Elemenis of Strength of Materials", 5thEdition, East-West Press, 1976
2. Bcer.F.P. and Johnston.R, "Mechanics of Maierials", 7th Edition, McGraw-Hill Education, 2014
3. S.Ramamrutham, R Narayanan, "Strength of Materials", 20th Edition, Dhanapath Rai Publishing Company NewDelhi, 2020
4. T.H.G Megson, "Aircraft Structures for Engineering Students", 7th Edition, Butterworth-Heinemann Inc, 2021
5. O. A. Bauchau and J.I. Craig, "Structural Analyiswith Applications to Aerospace Structures", 1st Edition, Springer Dordrecht Heidelberg London New York, 2009

Web links:

1. Introduction to Mechanics of Material: https://youtu.be/N68fNrRa8-M
2. Aerospace Mechanics of Material Stress Strain and Hooke's Law: https://ocw.tudelft.nl/courses/aerospace-mechanics-of-materials/?view=lectures&subject=17224
3. Overview of Stress strain Relationship: https://www.youtube.com/watch?v=dFOoU2psFFg&list=PLx3rV8SZWEyij0jjlEVp9YuJnvSv6MV3z
4. Virtual Lab Strength of Materials Lab: https://sm-nitk.vlabs.ac.in/List%20of%20experiments.html
5. Fatigue Testing: https://eerc01-iiith.vlabs.ac.in/exp/fatigue-test-experiment/

Aircraft Materials & Processes			
Semester	**III**	CIE Marks	**50**
Course Code	**23AEPC204**	SEE Marks	**50**
Teaching Hrs/Week (L:T: P)	**3:0:0**	Exam Hrs	**03**
Total Hrs	**42**	Credits	**03**

Course Learning Objectives: This course is designed to

1. Impart knowledge of aircraft materials properties and selection criteria
2. Discuss the characteristics, heat treatment procedures and aerospace applications of high-performance Aluminium, Magnesium and Titanium Alloys
3. Describe the characteristics, manufacturing processes and aerospace applications of Steels, Superalloys, Ceramics and Composites
4. Familiarize with various corrosion prevention and non-destructive testing methods for aircraft materials

Module 1: Mechanical Behavior of Aircraft Materials	**No. of Hrs: 8**

Introduction to Aircraft materials and their classification, Mechanical and Thermal properties, Stress vs. Strain Curves-Yielding and Strain hardening, Toughness, Modulusofresilience and Bauchinger'seffect. Requirements of materials for Aircraft applications,Knowledgeofvarious Aircraft materialtesting, Case study on the fatigue failure analysis in Aircraft components

Module 2: Non-ferrous Materials In Aircraft Construction	**No. of Hrs: 8**

Aluminiumanditsalloys:Types,Designation system, Properties, Casting, Extrusion, Types ofHeat treatments and Surface treatments, Importance of Al-Cu (2xxx) and Al-Zn (7xxx) Alloys in Aircraft

Magnesiumanditsalloys: CastandWroughtalloys, Properties, Applications andSpecial treatment.

Titaniumanditsalloys: Properties, Applications, Machining, Forming, Weldingand Heat treatment.

Numerical examples on finding suitable material for Aircraft components

Module 3: Steels, Superalloys and Shape Memory Alloys in Aircraft Construction	**No. of Hrs: 10**

Steels: Plain and low carbon steels, SAE steel numbering system, Aircraft steels properties, Corrosion and heat resistant steels, Structural applications, Heat treatment and Surface hardening.

MaragingSteels: Properties and Applications

Superalloys: Properties, Microstructural Constituents and Applications of Nickel based superalloys, Cobalt based superalloys, and Iron based superalloys. Manufacturing Processes-Casting, Powder Metallurgy, Welding, Additive manufacturing and Heat treatment, Case study on Superalloys in Jet Engine Turbines

Shape memory alloys: Phase transformation, Functional properties, Applications and Limitations

Module 4: Ceramics and Composites	**No. of Hrs: 8**

Modern ceramic materials, Cermets, and Glass ceramic. Advanced ceramic manufacturing process. Properties, Aerospace applications and Limitations of Carbon/Carbon composites,Metal matrix composites (MMC), Polymer matrix composites (PMC) and Fiber metal laminates

Fabrication Methods: Carbon/Carbon composites (Chemical Vapor Deposition/Infiltration), PMC (Hand layup, Spray layup, Pultrusion and Resin transfer molding), MMC (Powder metallurgy, Diffusion bonding, Stir Casting and Squeeze Casting)

Module 5: Corrosion Prevention and Non-destructive Testing	**No. of Hrs: 8**

Corrosion: Types, Prevention techniques, Protective treatments and Numerical methods for corrosion rate estimation with examples
Non-destructivetestingtechniques: Crackdetection,Inspectionofpartsby Dye-penetrate, Fluorescent and Magneticparticles,X-ray,Ultrasonic,Eddycurrent and Acousticemission methods

Course Outcomes: At the end of the course, the student will be able to
1. Apply knowledge of mechanical properties to select appropriate materials for aircraft parts
2. Explain the properties, heat-treatment methods and applications of Aluminium Alloys, Magnesium Alloys, Titanium Alloys
3. Elucidate the properties and importance of Steels, Superalloys and Shape memory alloys for aerospace applications
4. Describe the properties, aerospace applications and manufacturing processes of Ceramics and Composites
5. Apply the principles of corrosion prevention and non-destructive techniques for aircraft materials

Textbooks:

1. George F. Titterton, "Aircraft materials and processes", 5th Edition, Himalayan Books, New Delhi. Indian Reprint, 2019
2. Adrian P. Mouritz, "Introduction to aerospace materials", 1stEdition, Woodhead Publishing Limited, United Kingdom, 2012
3. Campbell F. C, "Manufacturing technology for aerospace structural materials", 1st Edition, Elsevier Ltd, 2006

Reference Books:

1. Sam Zhang and Dongliang Zhao. (Eds.), "Aerospace materials handbook", 1st Edition, CRC Press Taylor & Francis Group, 2012
2. Alan A. Baker and Murray L. Scott (Eds.), "Composite materials for aircraft structures", 3rd Edition, The American Institute of Aeronautics and Astronautics (AIAA), 2023
3. Prasad J. and Krishnadas Nair C. G, "Non-destructive test and evaluation of materials", 2nd Edition, McGraw Hill, 2011

Web links:

1. Composite Materials and Structures (Lecture No. 1-8, 35-39): https://nptel.ac.in/courses/101104010
2. Aerospace Materials: https://youtu.be/aOapSoL9f8k

Fundamentals of Aeronautics			
Semester	**III**	CIE Marks	**50**
Course Code	**23AEPC205**	SEE Marks	**50**
Teaching Hrs/Week (L:T:P)	**3:0:0**	Exam Hrs	**03**
Total Hrs	**42**	Credits	**03**

Course Learning Objectives: This course is designed to

1. Introduce the history of aviation and basics components of Aircrafts
2. Appreciate and apply the basic principle of aviation
3. Impart the fundamentals of flight, aircraft structures & materials
4. Interpret aircraft propulsion system and its types based on thrust generation
5. Develop an understanding the dynamics of an aircraft along with its different systems

Module 1: Introduction to Aircrafts & its materials	**No. of Hrs: 8**

Introduction to Aircrafts: History of aviation; Atmosphere and its properties; Classification of aircrafts; Basic components of an aircraft; aircraft axis system; aircraft motions; control surfaces and high lift devices; conventional design configurations; principle of operation of each major part; Helicopters, their parts and functions

Aircraft Structures and Materials: Introduction; structural members; general types of construction; monocoque, semi-monocoque and geodesic structures; typical wing and fuselage structure; metallic and non-metallic materials for aircraft application

Module 2: Basic principles of Flight	**No. of Hrs: 10**

Basic principles of flight –significance of speed of sound; airspeed and groundspeed; standard atmosphere; Bernoulli's theorem and its application for generation of lift and measurement of airspeed; forces over wing section, airfoil nomenclature, pressure distribution over a wing section. Lift and drag components – generation of lift and drag; lift curve, drag curve, types of drag, factors affecting lift and drag; mass, center of gravity, center of pressure and its significance; aerodynamic center, aspect ratio, Mach number and supersonic flight effects; simple problems on lift and drag

Module 3: Aircraft Propulsion	**No. of Hrs: 8**

Aircraft Propulsion: Aircraft power plants, classification based on power plant and location and principle of operation. Turboprop, turbojet and turbofan engines; ramjets and scramjets; performance characteristics. Aircraft power plants – basic principles of piston, turboprop and jet engines; Brayton cycle and its application to gas turbine engines; use of propellers and jets for production of thrust; comparative merits and limitations of different types of propulsion engines; principle of thrust augmentation

Module 4: Aircraft Stability	**No. of Hrs: 8**

Aircraft Stability: Forces on an aircraft in flight; static and dynamic stability; longitudinal, lateral and roll stability; necessary conditions for longitudinal stability; basics of aircraft control systems. Effect of flaps and slats on lift, control tabs, stalling, gliding, landing, turning, aircraft maneuvers; stalling, gliding, turning. Simple problems on these. Performance of aircraft – power curves, maximum and minimum speeds for horizontal flight at a given altitude; effect of changes in engine power and altitude on performance; correct and incorrect angles of bank; aerobatics, inverted maneuvers, maneuverability. Simple problems

Module 5: Introduction to Aircraft Mechanical & Electrical Systems	No. of Hrs: 8

Introduction to Aircraft Systems:

Aircraft Mechanical systems – hydraulic and pneumatic systems and their applications; environment control system; fuel system, oxygen system

Aircraft Electrical systems – flight control system, cockpit instrumentation and displays; communication systems; navigation systems; power generation systems – engine driven alternators, auxiliary power Module, ram air turbine; power conversion, distribution and management

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

1. Demonstrate how the History of aviation evolved and basics of aircraft structures
2. Apply and Explain the concepts of fundaments of flight, basic principle of aviation
3. Explain the aircraft propulsion systems & distinguish the types of Engines and explain the principles of Rocket
4. Apply the static and dynamic conditions of the aircraft for different flying conditions.
5. Illustrate the aircraft mechanical & electrical systems depending on the requirement

Textbooks:

1. John D. Anderson, "Introduction to Flight", McGraw-Hill Education, 8th edition, 2015
2. Lalit Gupta and O P Sharma "Fundamentals of Flight", Vol-I to Vol-IV, Himalayan Books,2006

Reference Books:

1. A.C. Kermode, "Flight without formulae", Pearson Education India, 1989
2. Nelson R.C., "Flight stability and automatic control", McGraw-Hill International Editions, 1998
3. Ian Moir, Allan Seabridge, , "Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration", John Wiley & Sons, 2011

Web links:

1. https://www.youtube.com/watch?v=amvrL0FU1ng
2. https://www.youtube.com/watch?v=B_p3_9si5D4
3. https://www.youtube.com/watch?v=5uKmqP3kQ2A
4. https://www.youtube.com/watch?v=xpOa3B03gYg
5. https://www.digimat.in/nptel/courses/video/101104061/L01.html

Fluid Mechanics			
Semester	**III**	CIE Marks	**50**
Course Code	**23AEPC206**	SEE Marks	**50**
Teaching Hrs/Week (L:T: P)	**3:0:2**	Exam Hrs	**03**
Total Hrs	**64**	Credits	**04**

Course Learning Objectives: This course is designed to

1. Summarize the fluid properties commonly used in the analysis of fluid flow
2. Impart knowledge in forces applied by fluids at rest or in rigid-body motion
3. Explain & determine the fundamental principles of dimensional analysis
4. Determine the coefficient of discharge for internal flows
5. Derive the Compressible flow equations in fluid

Module 1: Fluid Statics — **No. of Hrs: 8+4**

Basic Considerations: Introduction, Dimensions- Modules and physical quantities, Continuum view of gases and liquids, Physical properties of fluids

Fluid Statics: Pressure distribution in a static fluid, Pressure and its measurement, hydrostatic forces on plane, Buoyancy, illustration by examples

Laboratory Component:

Determination of Viscosity of a Fluid

Module 2: Fluid Kinematics — **No. of Hrs: 8+4**

Lagrangian and Eulerian Description of fluid flow, Continuity, Momentum, Bernoulli, Energy Equation and Momentum equation, problems solving using any programming language

Laboratory Components:

1. Verification of Bernoulli's equation

Module 3: Dimensional Analysis and Similarity — **No. of Hrs: 8+4**

Dimensional Homogeneity – Method of repeating variables- Buckingham Pi Theorem- types of similarity and similitude. Dimensionless numbers. Model laws

Laboratory Components:

1. Calibration of contracted Rectangular Notch

Module 4: Flow in Pipes — **No. of Hrs: 8+6**

Overview of fluid flow in pipes and channels, Entrance Region-Laminar and Turbulent flow in pipes-Minor Losses – Pipes in parallel and in series–and Orifice and Venturimeter

Laboratory Components:

1. Determination of Coefficient of loss of head, friction factor in a sudden contraction and expansion
2. Determination of Coefficient of loss of head, friction factor in a smooth bend and sharp bend
3. Determination of the coefficient of discharge for given orifice and venturimeters

Module 5: Compressible Flow — **No. of Hrs: 8+6**

Steady, one-dimensional gas dynamics, Propagation of pressure waves in a compressible medium, velocity of sound, Mach number, Mach cone, Stagnation properties, and normal shock waves. Solving Problems using any Programming language

Laboratory Components:

1. 2-D Flow analysis of supersonic regimes using ANSYS software
2. Experimental investigation of Supersonic flow using High speed jet

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

1.Compare the fluid properties used in the analysis of fluid flow
2. Apply conservation principles to formulate governing equations for fluid flows.
3.Apply the Bernoulli equation to solve fluid flow problems
4. Estimate the major and minor losses associated with pipe flows
5. Apply the basics of compressible flows

Textbooks:

1. Bansal, R.K, "Fluid Mechanics and Hydraulics Machines", 10th edition, Laxmi publications (P) Ltd., New Delhi, 2019.
2. Radhakrishnan. E, "Fluid Mechanics - An Introduction", 4th Edition, Prentice-Hall of India Pvt. Ltd., 2022.

Reference Books:

1. Yunus A. Cengel& John M Cimbala, "Fluid Mechanics and Applications", 4th edition, Tata McGraw Hill Education, 2019.
2. Frank M White, "Fluid Mechanics", 9th Edition, Tata McGraw Hill, 2022.
3. Bruce R. Munson, Alric P. Rothmayer, Theodore H. Okiish, "Fundamentals of Fluid Mechanics", 9th Edition, Wiley, 2017.

Web links:

1. https://nptel.ac.in/courses/112104118
2. https://nptel.ac.in/courses/105101082
3. https://nptel.ac.in/courses/105103192
4. https://fmc-nitk.vlabs.ac.in/

Computer Aided Aircraft Drawing			
Semester	**III**	CIE Marks	**50**
Course Code	**23AEPC207**	SEE Marks	**50**
Teaching Hrs/Week (L:T: P)	**1:0:2**	Exam Hrs	**2.5**
Total Hrs	**37**	Credits	**02**

Course Learning Objectives: This course is designed to
1. Interpret drawings of machine and aircraft components
2. Explain assembly drawings either manually or by using standard CAD packages
3. Familiarize with standard components and their assembly of an aircraft

Module 1: Sections of Solids and Orthographic Views	**No. of Hrs: 5**

Sections of Pyramids, Prisms, Cubes, Tetrahedrons, Cones and Cylinders resting only on their bases (No problems on axis inclinations, spheres and hollow solids). True shape of sections. Conversion of pictorial views into orthographic projections of simple machine parts with or without section. Bureau of Indian Standards conventions are to be followed for the drawings

Module 2: Thread Forms and Fasteners	**No. of Hrs: 6**

Thread terminology, sectional views of threads. ISO Metric (Internal & External) BSW (Internal & External) square and Acme. Sellers thread, American Standard thread. Hexagonal headed bolt and nut with washer, square headed bolt and nut with washer, stud bolts with nut and lock nut, Flanged nut, slotted nut, taper and split pin for locking, counter sunk head screw, grub screw, Allen screw

Module 3: Keys and Joints	**No. of Hrs: 6**

Keys: Parallel key, Taper key, Feather key, Gibhead key and Woodruff key, Riveted Joints: Single and double riveted lap joints, butt joints with single/double cover straps (Chain and Zigzag, using snap head rivets). Cotter joint (socket and spigot), knuckle joint (pin joint) for two rods

Module 4: Couplings	**No. of Hrs: 5**

Split Muff coupling, protected type flanged coupling, pin (bush) type flexible coupling, Oldham's coupling and universal coupling (Hooks' Joint)

Module 5: Assembly	**No. of Hrs: 15**

Design of propeller and hub assembly, Design of wing, Design of fuselage, Design of Landing Gear Assembly, Fundamentals of Model Based design

Course Outcomes: At the end of the course, the student will be able to
1. Understand general projection theory, with an emphasis on the use of orthographic projection.
2. Explain fundamental knowledge to draw the applications of different mechanical joints, riveted joints and coupling.
3. Interpret the visualization skills and to design and assemble aircraft parts using part drawings

Textbooks:
1. K R Gopala Krishna, “Machine Drawing”, Sudha Publications, 2016
2. N D Bhatt, V M Panchal, “Machine Drawing”, 42nd Edition, Charotar Publications, 2011

Reference Books:
1. S.Trymbakaa Murthy, “A Textbook of Computer Aided Machine Drawing”, CBS Publishers, 2007
2. N Sidheswar, P Kannaiah, V V S Sastry, “Machine Drawing” McGraw Hill Education Private Limited Publications, 1980

Web links:

1. https://nptel.ac.in/courses/112103019
2. https://iitg.ac.in/mech/academics/undergraduate/latest/sem-3/machine-drawing/

Universal Human Values			
Semester	**III**	CIE Marks	**50**
Course Code	**23HMCC215**	SEE Marks	**50**
Teaching Hrs/Week (L:T: P)	**2:0:0**	Exam Hrs	**2.5**
Total Hours	**26**	Credits	**02**

Course Learning Objectives: This course is designed to
1.Impart the concepts of value education, life skills and personality
2.Create awareness about human relationship with family and society
3.Impart the knowledge on different orders in nature
4.Deliver the concept of professional ethics and value-based profession

Module 1: Introduction to Value Education	**No. of Hrs: 06**

Definition & meaning of Values, Types of values
Life skills-Overview, scope, Types, Importance of life skills, SWOT Analysis
Happiness and prosperity– Basic needs of human aspirations, Current scenario, Methods to fulfill the basic human aspirations

Module 2: Harmony in Self & Body	**No. of Hrs: 05**

Human being as co-existence of the Self and the Body, Needs, Harmony, Body as an Instrument of the Self, Strategies to enhance self-regulation and health
Empathy-Definition, Essential characteristics of empathy, Benefits of empathy, Sympathy Vs empathy

Module 3: Harmony in the Family and Society	**No. of Hrs: 05**

Family, Types of family, Family dynamics, Family life education
Harmony in the family – Basic unit of human interaction, 'Trust' – the foundational value in relationship, 'Respect' – as the right evaluation, Justice in human-to human relationship, Harmony in the society, Vision for the universal human order

Module 4: Harmony in Nature	**No. of Hrs: 05**

Introduction, Interconnectedness, Self-regulation and mutual fulfillment among the fourorders of nature, Realizing existence as co-existence at all levels, Relationship of mutual fulfillment, Holistic perception of harmony in existence

Module 5: Implications of the Holistic understanding – A look at professional ethics	**No. of Hrs: 05**

Engineering ethics-Overview, Scope and Approach.
Natural acceptance of human values, Definitiveness of ethical human conduct, Basis for humanistic education, Competence in professional ethics holistic technologies, Management models-case studies, Strategies for transition towards value-based life and profession

Course Outcomes: At the end of the course, the student will be able to
1.Understand the personality development through life skills & exhibiting the same
2.Realise the need of harmony in individual, family and society
3.Explain the need of harmony in nature towards co-existence
4.Understand the importance of ethics in professional life towards holistic approach

Textbooks:

1. R.R. Gaur, R. Asthana, G.P. Bagaria, "A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019.

2. R.S. Naagarazan, "A Textbook on Professional Ethics and Human Values", 1st Edition, New Age International Publishers, 2006.

Reference Books:

1. A. Nagaraj, "Jeevan Vidya: EK Parichaya", 1st Edition, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. A.N. Tripathi, "Human Values", 1st Edition, New Age International Publishers, New Delhi, 2004.

Web links:

Module 1: https://www.youtube.com/watch?v=2ve49BWAJRE
Module 2: https://youtu.be/0ERSMkRPQBM
Module 3: https://youtu.be/3RAU4hreptI
Module 4: https://youtu.be/LwpU7N6A8fg
Module 5:https://youtu.be/EVWcuFXeSgk

Object Oriented Programming using C++			
Semester	**III**	CIE Marks	**50**
Course Code	**23AESE251**	SEE Marks	**50**
Teaching Hrs/Week (L: T: P)	**1:0:2**	Exam Hrs	**2.5**
Total Hrs	**37**	Credits	**02**

Course Learning Objectives: This course is designed to

1. Impart knowledge of fundamental principles of object-oriented programming.
2. Familiarize the capability of a class to rely upon another class and functions.
3. Familiarize the data in files using file I/O functions.
4. Familiarize the generic programming features of C++.

Module 1: Introduction to the fundamentals of Object-Oriented Programming (OOP) and C++	**No. of Hrs: 03 + 04**

Principles of OOP: Encapsulation, Inheritance, Polymorphism, Basic syntax and structure of C++, Data types, operators, and control structures, Functions and arrays

Laboratory Components: -

1. Write a program to demonstrate the use of functions and arrays
2. Write a program to calculate the factorial of a number using both iterative and recursive methods
3. Write a program to find the largest and smallest elements in an array
4. Write a program to demonstrate the use of switch-case statements to create a basic calculator

Module 2: Classes and Objects	**No. of Hrs: 02 + 05**

Definition and declaration of classes and objects, Access specifiers: public, private, protected, Constructors and destructors, Static members

Laboratory Components:

1. Write a program to define a class with constructors and destructors to manage resources
2. Write a program to design a `Book` class with attributes for title, author, and price. Create methods to display book details and set the price
3. Write a program to use a `Student` class to manage student details, including methods for input and display of student data
4. Write a program to develop a `Bank Account` class that includes member functions for deposit, withdrawal, and displaying the account balance

Module 3: Inheritance and Polymorphism	**No. of Hrs: 03 + 06**

Types of inheritance: single, multiple, multilevel, hierarchical, hybrid; Function overloading and overriding, Virtual functions and abstract classes

Laboratory Components:

1. Write a program to Implement a C++ program using inheritance and polymorphism to model a simple class hierarchy
2. Write a program to implement a `Shape` base class with derived classes `Circle` and `Rectangle`. Use polymorphism to calculate the area of different shapes
3. Write a program to create a `Vehicle` base class and derive `Car` and `Bike` classes. Implement virtual functions to demonstrate polymorphism
4. Write a program to develop a program that uses multiple inheritance with a `Person` classinherited by both `Employee` and `Student` classes

Module 4: Advanced OOP Concepts	**No. of Hrs: 02 + 05**

Operator overloading, Friend functions and classes, Templates: function and class templates, Exception handling

Laboratory Components:

1. Write a program to demonstrate operator overloading and templates
2. Write a program to overload the `+` operator to add two complex numbers using a `Complex` class
3. Write a program to implement a template class for a stack data structure and demonstrate its usage with different data types
4. Write a program to use exception handling to manage errors in an arithmetic calculator

Module 5: Standard Template Library (STL) and File Handling	**No. of Hrs: 03 + 04**

Introduction to STL: vectors, lists, stacks, queues, and maps, Iterators and algorithms, File I/O: reading from and writing to files

Laboratory Components:

1. Write a program using STL and file handling to read data from a file, process it, and write the output to another file
2. Write a program to use the STL vector container to store integers and perform operations like sorting and searching.
3. Write a program to read data from a file, process it to count word frequencies, and write the results to another file
4. Write a program to use STL maps to manage a simple phonebook application

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

1. Develop the ability to write structured and efficient C++ programs
2. Apply OOP principles to solve real-world problems using C++
3. Solve programs with advanced features like operator overloading and templates

Textbooks:

1. Balagurusamy E, “Object Oriented Programming with C++”,Fourth Edition, Tata McGraw Hill Education Pvt.Ltd , 2008
2. Bhushan Trivedi, “Programming with ANSI C++”, Second Edition, Oxford Press, 2012

Reference Books:

1. Robert Lafore, “Object-Oriented Programming in C++”, Waite Group Publishers, 1992
2. Stanley B. Lippman, Josee Lajoie and Barbara E. Moo, C++ Primer, 5th Edition, Addison-Wesley Publishers, 2012

Online Web links:

1. Basics of C++ - https://www.youtube.com/watch?v=BClS40yzssA
2. Functions of C++ - https://www.youtube.com/watch?v=p8ehAjZWjPw

Hands on approach to IOT			
Semester	**III**	CIE Marks	**50**
Course Code	**23AESE252**	SEE Marks	**50**
Teaching Hrs/Week (L: T: P)	**1:0:2**	Exam Hrs	**2.5**
Total Hrs	**37**	Credits	**02**

Course Learning Objectives: This course is designed to

1. Impart knowledge of the fundamental concepts and architecture of IoT.
2. Familiarize the interface hardware components with IoT platforms.
3. Familiarize the implementation of IoT communication protocols.
4. Familiarize the data management and analytics for IoT applications.

Module 1: Introduction to IoT — **No. of Hrs: 03 + 04**

Overview of IoT concepts and architecture, IoT communication models and protocols, IoT enabling technologies

Laboratory Components:

1. Write a program to setup and configure an IoT development environment
2. Write a program to create a simple IoT application and read data from a sensor
3. Write a program to send data to a cloud platform
4. Write a program to implement a basic IoT device control system

Module 2: IoT Hardware and Software — **No. of Hrs: 02 + 05**

Introduction to IoT hardware platforms (Arduino, Raspberry Pi, etc.), IoT software platforms and frameworks, Interfacing sensors and actuators with microcontrollers

Laboratory Components:

1. Write a program to interface a temperature sensor with Arduino and display data
2. Write a program to connect and control an LED using Raspberry Pi
3. Write a program to develop a program to read data from multiple sensors
4. Write a program to implement an actuator control system using a microcontroller

Module 3: IoT Communication Protocols — **No. of Hrs: 03 + 06**

Overview of IoT communication protocols (HTTP, Message Queuing Telemetry Transport (MQTT), Constrained Application Protocol (CoAP), etc.), Implementing communication between IoT devices, Security protocols for IoT communication

Laboratory Components:

1. Write a program to implement MQTT protocol to send data between two IoT devices
2. Write a program to secure IoT communication using HTTPS
3. Write a program to develop a CoAP client-server application
4. Write a program to implement data encryption for IoT communication

Module 4: IoT Data Management and Analytics — **No. of Hrs: 02 + 05**

Data collection and storage in IoT, Data processing and analytics techniques, Introduction to cloud platforms for IoT (AWS, Azure, etc.)

Laboratory Components:

1. Write a program to store IoT data in a local database
2. Write a program to analyze sensor data using basic statistical methods
3. Write a program to develop a real-time data visualization dashboard

4. Program to integrate an IoT application with a cloud service for data analytics.	
Module 5: IoT Applications and Case Studies	**No. of Hrs: 03 + 04**
Overview of various IoT applications (smart home, healthcare, industrial IoT, etc.), Case studies of successful IoT implementations, Future trends and challenges in IoT **Laboratory Components:** 1. Write a program to develop a smart home application to control lights and temperature 2. Write a program to implement a health monitoring system using IoT devices 3. Write a program to create an IoT-based predictive maintenance system for industrial equipment 4. Write a program to develop a prototype for a smart city application (e.g., smart parking)	
Course Outcomes: At the end of the course, the student will be able to: 1. Develop the IoT applications using various hardware and software platforms 2. Apply IoT technologies to solve real-world problems in various domains 3. Solve and visualize IoT data for meaningful insights	
Textbooks: 1. Arshdeep Bahga and Vijay Madisetti,"Internet of Things: A Hands-On Approach", Orient Blackswan Private Limited - New Delhi, 2015. 2. Maciej Kranz, "Building the Internet of Things: Implement New Business Models", Disrupt Competitors, Transform Your Industry, Wiley Publishers, 2016	
Reference Books: 1. Rajkumar Buyya and Amir Vahid Dastjerdi, "Internet of Things: Principles and Paradigms", Morgan Kaufmann Publishers In, 2016. 2. Peter Waher, "Mastering Internet of Things: Design and create your own IoT applications using Raspberry Pi 3",Packt Publishing, 2018.	
Web links: 1. Internet of Things | Physical Design of IOT – https://youtu.be/JeZeGJ-MfxA?si=m5W253wRYG3Uprus 2. IoT Tutorial For Beginners - https://youtu.be/b7GC4Zr74M0?si=uzMHc-CXRW5wisk 3. IoT Full Course - https://youtu.be/h0gWfVCSGQQ?si=zjNAgxktQmIEpahS	

Computational Tools for Aircraft Performance Analysis			
Semester	**III**	CIE Marks	**50**
Course Code	**23AESE253**	SEE Marks	**50**
Teaching Hrs/Week (L:T: P)	**1:0:2**	Exam Hrs	**2.5**
Total Hrs	**37**	Credits	**02**

Course Learning Objectives: This course is designed to
1. Discuss the fundamental principles of computational tools.
2. Demonstrate the applications of computational tools for data analysis and visualization of aeronautical data.

Module 1: Introduction to Operations in Computational Tools	**No. of Hrs: 02 + 04**
Mathematical operations such as addition, subtraction, multiplication, division, scalar multiplication on matrices using computational tools	
Module 2: Loops in Programming	**No. of Hrs: 03 + 06**
Use of For and While loops to perform calculations such as area under the curve, loop control statements and nested loops and plotting of loop output	
Module 3: Aircraft Performance Determination	**No. of Hrs: 03 + 06**
Determination of aerodynamic parameters such as ISA density, lift force, climb rate, take off and landing distance using computational tools	
Module 4: Aerodynamic Parameter Analysis	**No. of Hrs: 02 + 04**
Analysis of text files to determine aerodynamic results such as distance calculation from IMU data, aircraft performance analysis, pitch and roll rates and GPS latitude and longitude	
Module 5: PID system Design	**No. of Hrs: 03 + 04**
Design of basic PID controller and plotting of step response of the closed-loop system to visualize its performance	

Course Outcomes: At the end of the course, the student will be able to
1. Develop skills to implement loops, branching, control instruction and functions in computational tools.
2. Illustrate programming of curve fitting, numerical differentiation and integration, solution of linear equations.
3. Identify errors in computational tools and apply debugging techniques

Textbooks:
1. Holly Moore, "MATLAB for Engineers, 6th edition", Pearson Publications, 2023
2. Dr. Shailendra Jain, "Modelling & Simulation using MATLAB – Simulink", Wiley – India, 2021

Reference Books:
1. Won Y. Tang, Wemun Cao, Tae-Sang Ching and John Morris, "Applied Numerical Methods Using MATLAB", A John Wiley & Sons, 2021
2. Amos Gilat, "MATLAB : An Introduction With Applications", John Wiley & Sons Publications, 2017

Web link:
MathWorks Course:
https://www.youtube.com/watch?v=OHxR8iMHDWw&list=PL7CAABC40B2825C8B&ab_channel=MATLAB

Yoga-I			
Semester	**III**	CIE Marks	**100**
Course Code	**23NMCC221**	SEE Marks	**-**
Teaching Hrs/Week (L:T: P)	**0:0:1**	Exam Hrs	**-**
Total Hrs	**13**	Credits	**-**

Course Learning Objectives: This course is designed to

1. Empower students to achieve and maintain good health
2. Promote the practice of mental hygiene
3. Facilitate students in attaining emotional stability
4. Impart moral values and higher level of consciousness

Contents	**No. of Hrs: 13**

- Yoga, its origin, history and development, Yoga, its meaning, definitions
- Different schools of yoga, Aim and Objectives of yoga, importance of prayer
- Yogic practices for common man to promote positive health
- Rules to be followed during yogic practices by practitioner
- Difference between yogic and non yogic practices
- Suryanamaskar prayer and its meaning, Need, importance and benefits of Suryanamaskar13 count, 1rounds
- Asana, Need, importance of Asana, Different types of asana, Asana its meaning by name, technique, precautionary measures and benefits of each asana
- Different types of Asanas
  a) Sitting
    1. Padmasana
    2. Vajrasana
  b) Standing
    1. Vrikshana
    2. Trikonasana
  c) Prone line
    1. Bhujangasana
    2. Shalabhasana
  d) Supine line
    1. Utthitadvipadasana
    2. Ardhahalasana
- Meaning, importance and benefits of Kapalabhati, 10 strokes/min 3 rounds
- Meaning by name, technique, precautionary measures and benefits of Pranayama AnulomaViloma

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

1. Describe the meaning, aim and objectives of Yoga
2. Perform Suryanamaskar and able to analyze its benefits
3. Exhibit the different Asanas by name, its importance, methods and benefits
4. Perform Kapalabhati
5. Perform the different types of Pranayama by its name, precautions, procedure and uses

Textbooks:

1. Ajitkumar ,"YogaPravesha in Kannada" 1st Edition, Raashtroththaana Saahithya, 2017,ISBN-13: 978-8175310124
2. BKS Iyengar, "Light on Yoga", 1st Edition, Thorsons, 2017, ISBN-13: 978-0008267919
3. Dr. M L Gharote& Dr. S K Ganguly,"Teaching Methods for Yogic practices", 1st Edition, Kaivalyadhama, 2001, ISBN-13 : 978-8189485252

Reference Book:

YaminiMuthanna, "Yoga for Children step by step", 1st Edition, Om Books International, 2022, ISBN-13: 978-9394547018

Web links:

1. My Life My Yoga: https://youtu.be/KB-TYlgd1wE
2. Adiyoga: https://youtu.be/aa-TG0Wg1Ls

Physical Education-I			
Semester	**III**	CIE Marks	**100**
Course Code	**23NMCC222**	SEE Marks	**-**
Teaching Hrs/Week (L: T: P)	**0:0:1**	Exam Hrs	**-**
Total Hrs	**13**	Credits	**-**

Course Learning Objectives: This course is designed to

1. Impart the fundamental concepts and skills of Physical Education, Health, Nutrition and Fitness
2. Familiarization of health-related Exercises, Sports for overall growth and development
3. Build a strong foundation for the professionals in Physical Education and Sports

Contents	**No. of Hrs: 13**

- Definitions & components of Physical Fitness and Life Style
- Meaning and Definitions of Physical Fitness and Life Style
- Physical activity for engineers: stress management & injury prevention
- Components of fitness: cardiovascular endurance, muscular strength & endurance, flexibility, body composition (Lectures & Assessments)
- FITT principle (Frequency, Intensity, Time, Type) of exercise planning (Lectures)
- Fitness assessments: BMI, flexibility tests (Practical Sessions)
- Warm-up and cool-down techniques to prevent injuries (Practical Sessions)

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

1. Explain the benefits of physical activity for academic performance, stress management, and injury prevention in engineers
2. Design a personalized fitness program utilizing the FITT principle for targeted improvement
3. Demonstrate proper warm-up and cool-down techniques to enhance performance and prevent injuries

Textbooks:

1. Muller, J. P., "Health, Exercise and Fitness", 1st Edition, Sports Publication, 2018
2. Uppal, A.K., "Physical Fitness", Friends Publication New Delhi, 1992
3. Russell R.P., "Health & Fitness through Physical Education: Human Kinematics", Human Kinetics Publishers, 1994

Reference Books:

1. Anaika , "Play Field Manual", Friends Publication New Delhi, 2005
2. Pinto John & Roshan Kumar Shetty, "Introduction to Physical Education"

Web links:

1. How to exercise with a fitness plan: https://www.youtube.com/watch?v=08ryXxjaF1o
2. Health Related Physical Fitness: https://www.youtube.com/watch?v=rc3ZDoheMQs

National Service Scheme -I			
Semester	**III**	CIE Marks	**100**
Course Code	**23NMCC223**	SEE Marks	**-**
Teaching Hrs/Week (L:T: P)	**0:0:1**	Exam Hrs	**-**
Total Hrs	**13**	Credits	**-**

Course Learning Objectives: This course is designed to

1. Develop discipline, character, brotherhood, the spirit of adventure and ideals of selfless service amongst young citizens
2. Develop youth leadership in the students
3. Induce social consciousness among students through various societal activities
4. Impart knowledge in finding practical solutions to individual and community problems

NSS -Contents	**No. of Hrs: 13**

Introduction:

- Importance and role of youth leadership, Life competencies
- Skill development and empowerment
- Innovation and personal growth

Activities:

- Organic farming
- Waste management

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

1. Understand the importance of nation building and individual contribution to the betterment of the society
2. Discover grassroots challenges of community and solve them by technological intervention
3. Create societal impact by upholding the value of one for all and all for one
4. Maintain discipline and team spirit

Textbooks:

1. Ministry of Youth Affairs & Sports, Government of India, "National Service Scheme Manual", 2022
2. Rajiv Gandhi National Institute of Youth Development, Ministry of Youth Affairs & Sports, Government of India, "Introduction Training Module for National Service Scheme Program officers", 2017
3. Gurmeet Hans, "Case material as Training Aid for field workers", TISS, 1996

Reference Books:

1. Dr. G R Bannerjee, "Social service opportunities in Hospitals", TISS, 2012
2. Ram Ahuja, "Social Problems in India", Rawat publications, 3rd Edition, 2014

Web links:

1. History of NSS: https://thebetterindia.com/140/national-service-scheme-nss/
2. NSS – an introduction: https://www.youtube.com/@nationalserviceschemeoffic4034/videos

Arts-I			
Semester	**III**	CIE Marks	**100**
Course Code	**23NMCC224**	SEE Marks	**-**
Teaching Hrs/Week (L: T: P)	**0:0:1**	Exam Hrs.	**-**
Total Hrs	**13**	Credits	**-**

Course Learning Objectives: This course is designed to

1. To impart an understanding of the creative process from initial concept to final execution
2. Create and demonstrate proficiency in a chosen arts discipline through practical application
3. Analyze and appreciate diverse art forms and styles
4. To participate in art competitions at regional, state, national, and international levels, as well as in cultural events

Contents	**No. of Hrs: 13**

Note: Student shall select any one form of arts and continue the same till 6th semester

Performing Arts (Dance)	Welcome and Brainstorming, Introduction to Performing Arts: Dance, Folk, Cinema, Basic study of Folk Dance Forms, Exploration of Coastal Karnataka Folk Forms, Introduction to Bharatanatyam/Kathak: Theory and Practical, Introduction to Western Dance: Theory and Practical - Basics of Hip Hop, Introduction to Yakshagana: Theory and Practical, Group Presentation, Evaluation
Music	Welcome and Brainstorming, Introduction to Music and its Classifications, Voice and Pitch test, Voice Culture exercises, Exercises for Pitch, Volume, Energy, and Clarity, Basic Singing Practice with Scales, Understanding Compositions and Pitch Mapping, Practice on a Specific Song, Group Presentation, Evaluation
Arts & Crafts	Welcome and Brainstorming, Introduction to Art & Craft, Lines and Shapes, Object Drawing, Colors and Gradations, Color Fusion, Sketching Basics, Paper crafts, Group Presentation, Evaluation
Theatre	Welcome and Brainstorming, Introduction to acting and theatre, Talent Hunt, Physical and Voice Exercise, Body Language in acting, eye contact and tone, Theatre Compositions, Evaluation

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

1. Capable of creating choreography and delivering live performances for an audience
2. Employ a range of acting techniques and use them to create a performance
3. Evolve into creative, effective, independent, and reflective individuals capable of making informed decisions in both process and performance
4. Acquire knowledge and comprehension of the roles and processes used in current theatre arts practice

Textbooks:

1. Bruce Benward and Marilyn Sake, “Music in Theory and Practice”, McGraw-Hill Education, 2014
2. Otto G. Ocvirk, Robert E. Stinson, Philip R. Wigg, Robert Bone, and David L. Cayton, “Art Fundamentals: Theory and Practice”, McGraw-Hill Education, 2012
3. Anne Bogart and Tina Landau, “The Viewpoints Book: A Practical Guide to Viewpoints and Composition”, Theatre Communications Group, 2004

Reference Books:

1. Jacqueline M. Smith, "Dance Composition: A practical guide to creative success in dance making"
2. Ralph Mayer, "The Artist's handbook of method and materials"
3. Dr. Arun Bangre, "Glimpses of Indian music and dance"

Web links:

1. Audio visual catalogu: https://ccrtindia.gov.in/audio-visual-catalogue/
2. Essential Acting Lesson for Beginners: https://www.youtube.com/watch?v=GGl9Wri70aQ

Engineering Mathematics - IV			
Semester	**IV**	CIE Marks	**50**
Course Code	**23BSCC202**	SEE Marks	**50**
Teaching Hrs/Week (L: T: P)	**3:0:0**	Exam Hrs	**03**
Total Hrs	**42**	Credits	**03**

Course Learning Objectives: This course is designed to

1. Impart the basic knowledge on collection and presentation of data, measure of central tendency and dispersion, correlation, regression, and curve fitting for analyzing data.
2. Provide a comprehensive understanding of sampling distributions, estimation methods, hypothesis testing, experimental designs, and analysis of variance along with exploring their engineering applications.
3. Develop a systematic understanding of Markov chain and its application in solving Engineering and Scientific problems.
4. Build a strong foundation in multivariate analysis techniques for analyzing data.
5. Develop skills for analyzing data using R program.

Module 1: Statistics	**No. of Hrs: 08**

Statistics: Collection & Presentation of data - Graphical & Tabular representation, Measures of Central Tendency, Dispersion, Skewness and Kurtosis

Correlation & Regression-Scatter plot, Multiple & Partial Correlation and Regression Coefficients, Curve fitting – Linear & Non-Linear

Module 2: Sampling, Estimation & Inference	**No. of Hrs: 09**

Sampling, Estimation & Inference: Population and Sample, Complete Enumeration v/s Sample Surveys – Merits, Demerits, and Applications. Sampling Distributions (t, Chi-Squared & F distributions)

Estimation-Maximum likelihood, Moment Estimators, Bayes' Estimators

Hypothesis testing - t test, z-test, Chi-Squared test for independence of attributes & Goodness of fit, Non-Parametric tests. Interval estimation

Module 3: Design of Experiments and Analysis of Variance	**No. of Hrs: 08**

Design of Experiments – Principles of experimentation in design, Basic Principle of Analysis of Variance (ANOVA), One-way ANOVA, Two-way ANOVA, Types of designs - Completely Randomized Design (CRD), Randomized Block Design (RBD), Latin Square Design (LSD). Missing plot technique, and Analysis of Covariance (ANOCOVA)

Module 4: Stochastic Process	**No. of Hrs: 07**

Stochastic Process: Types, Markov Chains, Chapman–Kolmogorov equations for n-step transition probabilities, Classification of States, Limiting Probabilities

Module 5: Multivariate Analysis	**No. of Hrs: 10**
Multivariate Analysis: Multivariate normal distribution, estimation & inference on vector parameters, Multivariate linear regression, Principal Components Analysis (PCA), Factor Analysis, Discriminant Analysis, Classification & Cluster Analysis	

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

1. Apply Statistical methods to real world data to get deeper insights useful for informed decision making.
2. Estimate the parameters of a distribution and perform various tests as inferential measures.
3. Plan/Conduct/Choose experiments and analyze results by applying principles of Design of Experiments.
4. Model systems that evolve over time in a probabilistic manner.
5. Use R program for analyzing and visualizing data.

Textbooks:

1. S. C. Gupta, & V. K. Kapoor, "Fundamental of Mathematical Statistics", 12th Edition, Sultan Chand & sons, 2020
2. Ronald E. Walpole, Raymond H Myers, Sharon L Myers & Keying Ye, "Probability & Statistics for Engineers & Scientists", 9th Edition, Pearson Education, 2017
3. Richard Arnold Johnson & Dean W. Wichern, "Applied Multivariate Statistical Analysis", Pearson International, 2023

Reference Books:

1. S. C. Gupta, & V. K. Kapoor, "Fundamental of Applied Statistics", 4th Edition, Sultan Chand & sons, 2018
2. George Casella & Roger L. Berger, "Statistical Inference", 1st Edition, Cengage Learning India Pvt. Ltd., 2007
3. William J. Stewart, "Probability, Markov Chains, Queues, and Simulation", Princeton University Press, 2009
4. Sudha G. Purohit, Sharad D. Gore & Shailaja R. Deshmukh, "Statistics Using R", 2nd Edition, Narosa Publishing House, 2019
5. Shayle R. Searle & Andre I. Khuri, "Matrix Algebra: useful for Statistics", 2nd Edition, Wiley Series in Probability and Statistics, 2017

Web links:

1. Descriptive statistics, https://archive.nptel.ac.in/courses/111/104/111104120/
2. Probability and statistical inference, https://archive.nptel.ac.in/courses/111/104/111104146/
3. Sampling theory and linear regression Analysis, https://archive.nptel.ac.in/courses/111/104/111104147/
4. Stochastic process, https://archive.nptel.ac.in/courses/111/102/111102111/
5. Multivariate Analysis, https://archive.nptel.ac.in/courses/111/104/111104024/

Aerodynamics			
Semester	**IV**	CIE Marks	**50**
Course Code	**23AEPC208**	SEE Marks	**50**
Teaching Hrs/Week (L:T: P)	**3:0:2**	Exam Hrs	**03**
Total Hrs	**64**	Credits	**04**

Course Learning Objectives: This course is designed to

1. Impart the knowledge of source, sink and pressure, velocity distributions with and without circulation
2. Emphasize the concept of thin aerofoil theory and its applications
3. Provide comprehensive understanding of lifting line theory aspect ratio and taper ratio of wings
4. Disseminate the knowledge about the pattern of flows, shock and expansion waves
5. Develop the knowledge about the various types of wind tunnel and measuring methods

Module 1: Two Dimensional Flows	**No. of Hrs: 8+6**

Stream function and velocity potential functions. Uniform, Source, Sink Flows, Doublet and Vortex Flows. Pressure and Velocity distributions of Lifting and Non Lifting flow around the cylinders. Magnus effect. D-Alembert Paradox

Laboratory Components:

1. Calibration of Subsonic wind tunnel
2. Measurement of Pressure Distribution over a circular cylinder

Module 2: Airfoils	**No. of Hrs: 8+6**

Conformal Transformations. Transforming the circle to Symmetrical and Camber Airfoils. Anatomy of Airfoil and various digits of NACA Series. Thin airfoil theory and its applications

Laboratory Components:

1. Measurement of Pressure Distribution over a symmetrical airfoil with various angle's of attack
2. Measurement of Pressure Distribution over a camber airfoil with various angle's of attack

Module 3: Wing Theory	**No. of Hrs: 10+2**

Vortex line, Horse-shoe vortex, Biot-Savart law. Lifting line theory and applications to various wing sections. Effect of planform and aspect ratio of wing. Aircraft Design considerations

Laboratory Component:

Measurement of wake in circular cylinder and airfoil

Module 4: Elements of Compressible Flows	**No. of Hrs: 8+4**

Rankine Hugonoit equation, Normal Shock, Oblique Shock and Expansion waves and Numerical. Interaction of shock waves with the same family and different families. Shock Polar. Hodograph

Laboratory Components:

1. Flow Visualization on symmetrical airfoil
2. Flow Visualization on camber airfoil

Module 5: Introduction to Wind Tunnels	**No. of Hrs: 8+4**

Types of Wind Tunnels, Optical methods of Flow visualization techniques, Measurements in wind tunnels and Three component balances (Lift, Drag, Moments), Six component balances (Lift, Drag, Moments, Rolling, Pitching, Yawing

Laboratory Components:

1. Force Measurements over a symmetrical airfoil with various angle of attack
2. Force Measurements over a camber airfoil with various angle of attack
3. Flow Visualization Tuft method

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

1.Understand the source, sink, pressure, velocity distributions with and without circulation
2.Apply the fundamental knowledge of thin aerofoil theory and its applications
3. Analyze the concept of lifting line theory aspect ratio and taper ratio of wings
4. Solve the problems in the flows, shock and expansion waves in supersonic aircraft's'
5.Apply the various types of measuring methods in wind tunnels

Textbooks:

1. J.D.Anderson.. "Fundamentals of Aerodynamics"- 6th Edition. M.C.Graw Hill, Newyak, 2012
2. S.M.Yahyaa. "Fundamentals of Compressible Flow"- 2nd Edition. Stanford, 2022

Reference Books:

1. Ethirajan Radhakrishnan. "Theoretical Aerodynamics"- 4th Edition. Dover Publication, INC Newyak, 2013
2. Clancy. "Aerodynamics for Engineering Students"- 5th Edition, 1985
3. Houghton and Carpenter. "Aerodynamics for Engineering Students"- 5th Edition. Elsevier Ltd., 2012
4. Ethirajan Radhakrishnan. "Gas Dynamics"- 6th Edition. Prentice hall of India. PHI Learning Ltd., 2017
5. W.H. Rae and A.Pope. "Low Speed wind tunnel techniques"- 3rd Edition. John Wiley Publications, 1999

Web links:

1. https://ocw.mit.edu/courses/16-100-aerodynamics-fall-2005/
2. https://guides.libraries.psu.edu/c.php?g=374719&p=2537010

Aircraft Systems and Instrumentation			
Semester	**IV**	CIE Marks	**50**
Course Code	**23AEPC209**	SEE Marks	**50**
Teaching Hrs/Week (L:T:P)	**3:0:0**	Exam Hrs	**03**
Total Hrs	**42**	Credits	**03**

Course Learning Objectives: This Course is designed to
1. Impart the Knowledge of different systems used in aircraft
2.Develop the Knowledge on principle of operation of Air Data Instruments and Gyroscopic instruments used in Aircraft
3.Familiarize the appropriate sensors for relevant aircraft systems
4. Deliver thedifferent systems used in the management of aircraft data

Module 1: Introduction to Aircraft Systems	**No. of Hrs: 8**

Elementary ideas about aircraft systems: Aircraft Electrical Systems, Flight control system, Hydraulic and pneumatic systems, Fuel system, Navigation systems, Pressurization, temperature control and oxygen systems , Fire protection and De-icing system, Seat and Escape System

Module 2: Flight Instruments and Display Systems	**No. of Hrs: 8**

Air Data Instruments: Pitot static flight instruments, Airspeed, Altitude, Vertical speed indicator, Total and static air temperature, Mach meter, Angle of attack measurement and Air data computer Flight and Navigational Instruments
Display Devices: Multi-Function Display (MFD), Head Up Display (HUD)and Helmet Mounted Display (HMD)

Module 3: Gyroscopic Systems	**No. of Hrs: 8**

Gyroscope: Gyroscopic instruments in an aircraft, Fundamental properties of mechanical gyroscope, Degrees of freedom of gyroscope, Powering the gyro
Non-mechanical gyroscopes and working principles: Fiber Optic Gyro, Micro Electro Mechanical Systems (MEMS Gyro), Ring Laser Gyro

Module 4: Measurements in Aircraft and Related Sensors	**No. of Hrs: 10**

Temperature Measurement: Thermocouple. Resistant Temperature Detector (RTD), Radiation Pyrometer, Exhaust Gas Temperature (EGT), Cylinder Head Temperature (CHT), Outside Air Temperature (OAT), Oil Temp, Fuel Temp
Position Measurement: Potentiometer, Linear Variable Differential transformer (LVDT), Stick position, Control surface position
Load Measurement: Load cell, Control forces
RPM Measurement: Rotary Pulse generator and Photoelectric sensor, Low & high RPM measurement techniques
Pressure Measurement: Barometric pressure measurement, MEMS pressure sensors, air data pressure measurement
Fuel Quantity Measurement: Capacitance type fuel gauge

Module 5: Flight Data Recording and Encoding	**No. of Hrs: 8**

Flight data recording & applications: Flight Data Recorder (FDR), Cockpit Voice Recorder (CVR), Quick Access Recorder (QAR) and Aircraft Condition Monitoring Systems (ACMS)
Encoding of aircraft data and storage: Analog to Digital conversion of signals, Resolution and quantization, Aliasing and sampling rate, Nyquist theorem for sampling, Pulse Code Modulation (PCM) encoding and PCM Data Acquisition system

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

1. Describe the major systems which are used in aircraft
2. Explain the concepts of air data systems and the instruments used to display air data
3. Elucidate the need and application of different types of gyroscopes in aircraft
4. Apply the knowledge on sensors for measuring physical parameters in aircraft
5. Explain collection, storage and applications of aircraft system data

Textbooks:

1. Ian Moir & Allan Seabridge "Aircraft Systems: Mechanical, Electrical and Avionics Subsystem Integration" 3rd edition, John Wiley & Sons Ltd, 2008
2. S. Nagabhushana, L.K. Sudha, "Aircraft Instrumentation and Systems," Published by I K International, 2010

Reference Books

1. Stinton, D, "The Anatomy of The Airplane." 2nd ed., Reston, VA: AIAA Education Series, 1998
2. Max F. Henderson, "Aircraft Instruments and Avionics for A & P Technicians," Jeppesen Sanderson, 1993
3. E. H. J. Pallett,"Aircraft Instruments: Principles and Applications," Pitman Publications, 1972

Web links:

1. https://youtu.be/Dim0fLFlFOg?si=k5nY85TJoijL7Ml8
2. https://youtu.be/ntHQgJCTsi8?si=Ci1GJHoIJFKtkCPn
3. https://youtu.be/Kjfzve6lNWI?si=Wrhp4I5bLKG8V5jh
4. https://youtu.be/nE1C4ghfvac?si=qh_D38SAWAvIWk7L
5. https://youtu.be/lPiWlBG16Wo?si=FOkNrsEN9bHmhip6

Aerothermodynamics			
Semester	**IV**	CIE Marks	**50**
Course Code	**23AEPC210**	SEE Marks	**50**
Teaching Hrs/Week (L:T: P)	**2:0:2**	Exam Hrs	**03**
Total Hrs	**50**	Credits	**03**

Course Learning Objectives: This course is designed to

1. Impartthe knowledge of thermodynamic systems and its equilibrium and zeroth law of thermodynamics
2. Establish the concepts of various forms of energy, heat & work transfer
3. Provide comprehensive understanding of the second law of thermodynamics and entropy
4. Develop the knowledge of behaviour of pure substances and its application
5. Familiarize the working of air standard cycle, gas power cycle and vapour power cycle

Module 1: Zeroth Law of Thermodynamics and Work & Heat — **No. of Hrs: 8+2**

Introduction: Thermodynamics definitions, Thermodynamics approaches, Thermodynamic Systems, Characteristics of system boundary and control surface. Thermodynamic properties, Thermodynamic process, Thermodynamic state and equilibrium

Zeroth law of thermodynamics: Temperature measurement, Applications and Numerical examples

Work and Heat: Mechanical work and Thermodynamic work, work and heat transfer of various processes through p-v diagrams. Numerical examples

Laboratory Components:

1. Determination of Flash point and Fire point of lubricating oil using Abel Pensky Apparatus
2. Determination of Flash point and Fire point of lubricating oil using Pensky Martins Apparatus

Module 2: First Law of Thermodynamics — **No. of Hrs: 6+4**

Energy, Energy transfer by heat and work, First law for process and cycle, Open and closed systems, steady flow and unsteady flow, cyclic and non - cyclic processes, Internal Energy, Steady flow energy equation (SFEE) for compressor, turbine, nozzle, diffuser, heat exchanger. Numerical examples

Laboratory Components:

1. Determination of Calorific value of gaseous fuel using Boy's Gas calorimeter
2. Determination of Calorific value of solid fuel using Bomb calorimeter

Module 3: Second Law of Thermodynamics and Entropy — **No. of Hrs: 6+4**

Second Law of Thermodynamics: Kelvin - Planck statement and Clausius statement of Second law of Thermodynamics, Equivalence of the two statements. Applications of 2nd law in Heat engine, refrigerator and heat pump. Carnot Cycle, Efficiency and COP – Carnot theorem - Absolute thermodynamic temperature scale

Entropy: Clausius inequality - change of entropy for solids, liquids and gases in different thermodynamic processes. Principle of increase of entropy, entropy as a quantitative test for irreversibility, calculation of entropy using TDS relations, Available and unavailable energy, Numerical examples

Laboratory Components:

1. Calculation of work done and heat transfer from PV and TS diagram using Planimeter
2. Heat transfer through natural convection
3. Heat transfer through forced convection

Module 4: Pure Substances & Gas Mixtures	**No. of Hrs: 10**

Pure Substances: Compressible and incompressible fluid - Sensible heat and latent heat – phase diagrams of water/steam (p-v, p-T, T-v, T-s, h-s) Tables and charts of physical properties. Numerical examples

Ideal gasses: Avogadro‟s law, Dalton‟s law of partial pressure, property equations and change of properties of gas mixture. Numerical examples

Real gasses: Introduction, Van-der Waal's Equation of state, Van-der Waal's constants in terms of critical properties, Law of corresponding states, compressibility factor; compressibility chart. Difference between Ideal and real gasses. Numerical examples

Module 5: Gas Power Cycles	**No. of Hrs: 6+4**

Air standard cycle: Efficiency of air standard cycles, Carnot, Otto, Diesel cycles, mean effective pressure, Comparison of Otto and Diesel cycles, Numerical problems

Gas power Cycles: Gas turbine (Brayton) cycle; description and analysis. Regenerative, Intercooling and reheating in gas turbine cycles

Laboratory Component:

Performance Test on Four stroke Multi Cylinder Petrol Engine and calculations of IP, BP, Thermal efficiencies, SFC, FP and to draw heat balance sheet

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

1. Understand the fundamental concepts of thermodynamics such as temperature measurement, work & heat transfer, entropy, pure substances etc
2. Apply the concepts of thermodynamic properties & laws of thermodynamics for the measurement of temperature and energy transfer
3. Interpret the behaviour of pure substances and its application in practical problems
4. Understand various thermodynamic properties using the laws of gasses
5. Analyse the performance of air standard cycles and gas power cycles

Textbooks:

1. P K Nag, “Engineering Thermodynamics”, 6th Edition, Tata McGraw Hill Publication, 2017
2. B.K Venkanna, Swati B. Wadavadagi, “Basic Thermodynamics”, 1st Edition, PHI Publication, New Delhi, 2010

Reference Books:

1. Yunus A. Cenegal and Michael A. Boles “Thermodynamics: An Engineering Approach”, 6th Edition, Tata McGraw Hill publications, 2006
2. Michael J. Moran, Howard N. Shapiro, Daisie D. Boettner, and Margaret B. Bailey "Fundamentals of Engineering Thermodynamics" 9th Edition, Wiley Eastern Publications, 2018
3. A Venkatesh “Basic Engineering Thermodynamics”, 1st Edition, Universities Press Publications, 2007

Web links:

1. https://archive.nptel.ac.in/courses/112/105/112105123/
2. https://onlinecourses.nptel.ac.in/noc23_me76/preview
3. https://home.iitk.ac.in/~gtm/thermodynamics/ui/TOC.htm

Mechanisms and Machine Theory			
Semester	**IV**	CIE Marks	**50**
Course Code	**23AEPC211**	SEE Marks	**50**
Teaching Hrs/Week (L:T: P)	**3:0:0**	Exam Hrs	**03**
Total Hrs	**42**	Credits	**03**

Course Learning Objectives: This course is designed to

1. Familiarize the operational principles of diverse mechanisms and their associated terminologies.
2. Impart Knowledge on velocity and acceleration analysis concepts to resolve problems concerning simple mechanisms through graphical methods.
3. Develop a systematic understanding of static force analysis concepts to resolve problems concerning simple mechanisms through graphical methods.
4. Provide insights of spur gears and epicyclic gear trains to ascertain required torque, gear ratio, and speed for particular applications.
5. Describe the operational principles and utilize the applications of Porter and Hartnell Governors and know the importance of the gyroscopic effect on airplanes

Module 1: Introduction to Mechanisms	**No. of Hrs: 10**

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, Watfs indicator mechanism. Inversions of Single Slider Crank Chain: Pendulum pump or Bull engine, Oscillating cylinder engine, Rotary internal combustion engine, Crank and slotted lever quick return motion mechanism, Whitworth quick return motion mechanism. Inversions of Double Slider Crank Chain: Elliptical trammels, Scotch yoke mechanism, Oldham's coupling. Straight line motion mechanisms: Peaucellier's mechanism and Robert's mechanism. Intermittent Motion mechanisms: Geneva wheel mechanism and Ratchet and Pawl mechanisms

Module 2: Velocity, Acceleration Analysis of Mechanisms	**No. of Hrs: 8**

Graphical Methods -Velocity and acceleration analysis of Four Bar mechanism, slider crank mechanism and Simple Mechanisms by vector polygons

Module 3: Static force Analysis of Mechanisms & Balancing of Rotating Masses	**No. of Hrs: 8**

Static force analysis (Graphical Methods): 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

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

Module 4: Spur Gears and Gear Trains	**No. of Hrs: 8**

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

Module 5: Governors and Gyroscopes	**No. of Hrs: 8**

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

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

1. Understand the working principles of different mechanisms and related terminologies
2. Apply the knowledge of velocity simple mechanisms by graphical method
3. Apply the knowledge of Static force analysis in simple mechanisms and solve the problems related to static and dynamic balancing of rotating masses
4. Understand Spur gear terminology, laws and analyze spur gears and epicyclic gear trains
5. Demonstrate the working principles, application of Porter and Hartnell Governors and determine the gyroscopic effect on an aero plane

Textbooks:

1. Rattan S.S, "Theory of Machines", 5th Edition, McGraw Hill Education, 2019
2. John J. Uicker, Gordon R. Pennock & Joseph E. Shigley, "Theory Of Machine and Mechanisms", 4th Edition, Oxford Higher Education/Oxford University Press, 2014

Reference Books:

1. R. S. Khurmi, J.K. Gupta, "Theory of Machines", 14th Edition, S Chand, 2020
2. Ambekar, "Mechanism and Machine theory", 1st Edition, PHI Learning Pvt. Ltd, 2007
3. Sadhu Singh, "Theory of Machines: Kinematics and Dynamics", 3rd Edition, Pearson Education India, 2011
4. Thomas Bevan, "Mechanism and Machine Theory", 3rd Edition, Pearson Education India, 2009
5. Robert L Norton, "Design of Machinery", 6th Edition, Tata McGraw Hill, 2020

Web links:

1. Introduction to Kinematics of Machines NPTEL: https://www.youtube.com/watch?v=MJeRFzs4oRU#action=share
2. Mechanisms Module-1: https://mm2-nitk.vlabs.ac.in/List%20of%20experiments.html
3. Kinematics and Dynamics of Mechanisms Laboratory: https://kdm-iitkgp.vlabs.ac.in/
4. Velocity and Acceleration Analysis: https://mm-nitk.vlabs.ac.in/Introduction.html
5. Gyroscope: https://www.youtube.com/watch?v=ty9QSiVC2g0

Digital Measurement Systems			
Semester	**IV**	CIE Marks	**50**
Course Code	**23AEPC212**	SEE Marks	**50**
Teaching Hrs/Week (L:T: P)	**3:0:0**	Exam Hrs	**03**
Total Hrs	**42**	Credits	**03**

Course Learning Objectives: This course is designed to
1. Convey the basic components of measurement systems
2. Introduce the basic principle of digital measurements
3. Demonstrate the fundamentals of analog to digital conversion systems
4. Introduce advanced trends in digital measurement systems for aviation applications

Module 1: Introduction to Digital Measurement Systems	**No. of Hrs: 8**

Basics of digital measurements, Advantages over analog measurement systems, Applications in aeronautical engineering, Considerations for digital measurement systems in aeronautical engineering, Redundancy and fault tolerance

Module 2: Sensors for Aeronautical Applications	**No. of Hrs: 8**

Applications of Pressure Sensors, Temperature Sensors, Inertial Sensors, Proximity Sensors, Load Sensors, Optical Sensors, RPM Sensors, Capacitive Sensors, Remote Sensing Systems, Impact of sensor failure on flight safety

Module 3: Signal Conditioning and Digital Signal Processing (DSP)	**No. of Hrs: 9**

Amplification and filtering techniques, Noise reduction, Error correction, Discrete-time signals and systems, Fourier analysis and frequency domain processing, Filters and spectral analysis techniques

Module 4: Data Acquisition for Aeronautical Engineering	**No. of Hrs: 9**

Introduction to data acquisition systems, Sampling techniques and considerations for aeronautical data, Analog-to-digital converters (ADCs) and digital-to-analog converters (DACs), Timing and synchronization

Module 5: Advanced Topics and Emerging Trends	**No. of Hrs: 8**

Synthetic Vision Systems (SVS), Crew Resource Management (CRM), Sensor integration and data fusion, Impact of artificial intelligence and machine learning, Digital Data link networks

Course Outcomes: At the end of the course, the student will be able to
1. Explain the need and application of digital instrumentation systems
2. Select sensors for digital instrumentation systems of aircraft
3. Explain signal filtration techniques
4. Evaluate data sampling requirements for aircraft digital instrumentation systems
5. Identify the latest trends in digital instrumentation systems used in aviation

Textbooks:

1. T. S. Rathore, “Digital Measurement Techniques”, CRC Press, 2003
2. Thomas L. Floyd (2006), "Digital Fundamentals" Pearson Education India, 2006
3. John G. Proakis and Dimitris G. Manolakis, "Digital Signal Processing: Principles, Algorithms, and Applications", Pearson Education / PHI, 2007

Reference Books:

1. Robert H. Bishop, "Introduction to Data Acquisition with LabVIEW", National Instruments, 2010
2. R. K. Rajput, Electrical & Electronic Measurement and Instrumentation, S. Chand Publication, 2003

Web link:

Module 1: https://archive.nptel.ac.in/courses/108/105/108105153/

Research Methodology & Intellectual Property Rights			
Semester	**IV**	CIE Marks	**50**
Course Code	**23HMCC216**	SEE Marks	**50**
Teaching Hrs/Week (L:T: P)	**2:0:0**	Exam Hrs.	**2.5**
Total Hrs	**26**	Credits	**02**

Course Learning Objectives: This course is designed to
1.Impart knowledge on basics of research
2.Discuss the concepts of Intellectual Property Rights

Module 1: Introduction, Literature Review and Technical Reading	**No. of Hrs: 7**

Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research

New and Existing Knowledge, Analysis and Synthesis of Prior Art, Bibliographic Databases, 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

Module 2: Research Design	**No. of Hrs: 5**

What is a Research Problem? Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, Meaning of Research Design, Need for Research Design, features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs

Module 3: Ethics in Engineering Research & Technical Writing	**No. of Hrs: 5**

Ethics in Engineering Research Practice, Types of Research Misconduct, Ethical Issues Related to Authorship, Free Writing and Mining for Ideas, Attributes and Reasons of Technical Writing, Writing Strategies, Journal Paper: Structure and Approach, Language Skills, Writing Style, and Editing, Rules of Mathematical Writing, Publish Articles to Get Cited, or Perish, IMRaD Guidelines, COPE Guidelines

Module 4: Introduction to Intellectual Property	**No. of Hrs: 4**

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- Copyrights, Patents, Trademarks, Geographical Indications, Trade secrets, Semiconductor Integrated circuits and layout designs, Plant varieties, Industrial Design

Module 5: Process of Patenting	**No. of Hrs: 5**

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

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

1. Apply the basic research principles and methodologies
2. Review the Literature, Technical Reading, Attributions and Citations
3. Understand Various Intellectual Property Rights
4. Draft patent application

Textbooks:

1. C.R Kothari "Research MethodologyMethods and Techniques" 2nd Edition, Newage international, 2009
2. Dipankar Deb, Rajeeb Dey, Valentina E. Balas,"Engineering Research Methodology A Practical Insight for Researchers",1st Edition, Springer Nature, 2019
3. Prof. Rupinder Tewari Ms. MamtaBhardwa, "Intellectual Property A Primer for Academia", Publication Bureau Panjab University Chandigarh, 2021

Reference Books:

1. David V. Thiel,"Research Methods for Engineers", 1st Edition, Cambridge University Press, 2014
2. William G. Zikmund, Barry J. Babin, Jon C Carr, Mitch Griffin, "Business Research Methods", 9th Edition, Cengage India Private Limited, 2013
3. "WIPO Intellectual Property Handbook", WIPO Publication

Web links:

1. Research Methodology Course: https://onlinecourses.nptel.ac.in/noc24_ge41/preview
2. Module 4,5: https://www.ipindia.gov.in/
3. Module 4,5: https://www.wipo.int/
4. Refence Management tool: https://desktop-download.mendeley.com/download/Getting_Started_Guide.pdf
5. IMRad Guidelines: https://writingcenter.gmu.edu/writing-resources/imrad/writing-an-imrad-report
6. COPE Guidelines: https://publicationethics.org/files/u7141/1999pdf13.pdf

Aircraft Assembly Drawing and GD&T			
Semester	**IV**	CIE Marks	**50**
Course Code	**23AESE254**	SEE Marks	**50**
Teaching Hrs/Week (L: T: P)	**1:0:2**	Exam Hrs	**2.5**
Total Hrs	**37**	Credits	**02**

Course Learning Objectives: This course is designed to

1. Impart the knowledge of aircraft component drawings, assembly layouts and standard drafting practices used in the aero Industry.
2. Familiarize students with computer-aided modeling and the preparation of production drawings of aircraft structural parts and assemblies.
3. Enhance understanding and enable application of Geometric Dimensioning & Tolerancing (GD&T), limits, fits, and tolerances for functional and manufacturing requirements of aircraft components.

Module 1: Basics of Sketches module	**No. of Hrs: 02 + 04**

GUI & Shortcuts, Sketcher workbench, Sketch based features Dress-up features, Part workbench

Laboratory Components:

1.Generation of basic sketches with geometric constraints (lines, arcs, dimensions)

Module 2: Assembly Drawing & Wireframe modeling	**No. of Hrs: 03 + 06**

Assembly constraints &Drawing, Wire frame & Surface modeling

Laboratory Components:

1. Creation of 3D Part using Pad, Pocket, Rib & Shaft features
2. Development of basic wireframe and surface models

Module 3: Sheet Metal Modelling & Drafting	**No. of Hrs: 03 + 06**

Sheet metal design, Standard Drafting

Laboratory Components:

1. Modeling of sheet metal aircraft components (rib / L-bracket)
2. Fuselage Construction by the method of sheet metal.

Module 4: Fundamentals of Geometric Dimensioning & Tolerancing	**No. of Hrs: 02 + 04**

GD & T Rules, Introduction, Basic tolerances, Deviations, Methods of placing limit dimensions, machining symbols, ASME Y14.5M-1994, Size Tolerance, Form Tolerance.

Laboratory Components:

1. Creation of datum features and application of geometric dimensioning & tolerancing (GD&T)

Module 5: Limits, Fits and Geometric Tolerancing Standards	**No. of Hrs: 03 + 04**

Types of fits with symbols and applications, geometrical tolerances on drawings. Standards followed in the industry. Orientation Tolerance, Profile Tolerance, Location Tolerance, Run out & Datum

Laboratory Components:

1. Generation of manufacturing annotations using Functional Tolerancing & Annotation (FTA)

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

1. Analyze parametric sketches and modeling features to construct accurate 3D component geometry.
2. Develop assemblies and wireframe/surface models using appropriate constraint relationships.
3. Design sheet-metal models and engineering drawings of aircraft structural components for

manufacturability and standard compliance.
4. Apply size, form tolerances, and datum systems according to GD&T rules and standards.
5. Analyze manufacturing drawings incorporating fits and geometric tolerances as per industrial standards.

Textbooks:

1. N. D. Bhatt, V M Panchal, "Machine Drawing", 42nd Edition, Charotar Publications, 2011
2. Alex Krulikowski, "Fundamentals of Geometric Dimensioning and Tolerancing", 3rd Edition, Based on ASME Y14.5-2009.

Reference Books:

1. N Sidheswar, P Kannaiah, V V S Sastry, "Machine Drawing" McGraw Hill Education Private Limited Publications, 1980.
2. Alex Krulikowski "Fundamentals of Geometric Dimensioning and Tolerancing: Based on Asmey 14.5", Delmar Cengage Learning Publishers, 2012.

Web Links:

1. Sketcher Design https://youtu.be/ie8FRUs2dp8?si=wNLQ8Pp0kEON5sYK
2. Sheet Metal https://youtube.com/shorts/6jzVDP9L2SY?si=M_lu9IDtSL3aUPVQ
3. Datums & Datum Reference Frame https://youtu.be/MxvJ9aWbiY8?si=jD_DbocPLig79TH6
4. 3D Functional Tolerancing https://youtu.be/HFCbiVGe4kw?si=3xMg4_UJLrZzTKPs

Digitalization in Aeronautics			
Semester	**IV**	CIE Marks	**50**
Course Code	**23AESE255**	SEE Marks	**50**
Teaching Hrs/Week (L:T: P)	**1:0:2**	Exam Hrs	**2.5**
Total Hrs	**37**	Credits	**02**

Course Learning Objectives: This course is designed to
1. Illustrate the role of digitalization in modern aeronautical engineering.
2. Impart skills in data analysis and visualization to effectively interpret engineering data.
3. Design 3D models of aircraft wings and apply finite element techniques to evaluate structural integrity.
4. Deliver the concept of digital manufacturing technologies relevant to aerospace applications.

Module 1: Introduction to Digitalization, Wing Design & Analysis	**No. of Hrs: 03 + 06**

Overview of digital transformation in aerospace, Key technologies driving digitalization, Impact of digital technologies on design, manufacturing, and operations.
Aircraft Wing Design and Analysis: Wing parameter definition, Airfoil selection, 3D modeling of airfoil, Incorporating wing features, Model refinement, Finite element analysis integration, Discretization, Applying boundary conditions, Solver settings and analysis types, Post-Processing.

Module 2: 3D Printing Fundamentals & Fabrication	**No. of Hrs: 03 + 04**

Principles of 3D printing technology, Components and functions of 3D Printer, Model conversion to toolpaths, Optimization of process parameters (layer thickness, infill density, and printing orientation), Additive manufacturing fabrication: Wing, Fuselage, and Tail Section

Module 3: Integrating RFID & Sensors for Monitoring Prototype	**No. of Hrs: 03 + 04**

Concept of radio frequency identification (RFID), Sensor selection and placement, Sensor interfacing with microcontroller board, Programming microcontroller, Tracking and monitoring of prototype components, Database for deviation recording, Case studies on data-driven decision making

Module 4: Project Planning & Scheduling of Aircraft Structures	**No. of Hrs: 02 + 05**

Project Task Breakdown: Design review and optimization, Material selection and acquisition, Pre-printing preparations (machine calibration, slicing), 3D printing process, Post-processing and quality control, Project Scheduling using software tools

Module 5: Aerospace Transformation: IIoT, Digital Twin, Predictive Maintenance	**No. of Hrs: 02 + 05**

Industrial Internet of Things (IIoT), Concept and applications of digital twins, Creating digital twins for aircraft systems, Predictive maintenance and optimization, Collaborative aircraft design, Aircraft flight data analysis and Digital mock-up

Course Outcomes: At the end of the course, the student will be able to
1. Implement digitalization methodologies in design, manufacturing and operational phases.
2. Demonstrate process optimization techniques used in digitalization.
3. Apply RFID techniques and sensors to track and monitor prototype components.

Textbooks:

1. Diego Carou,"Aerospace and digitalization: A transformation through key industry 4.0 technologies", 1st Edition, Springer, Cham, 2021
2. Peter Cope, "Mastering the digital world: A guide to understanding, using and exploiting digital media", 1st Edition, Carlton Books Ltd, London, 2005

Reference Book:

Alasdair Gilchrist, "Industry 4.0: The industrial internet of things", 1st Edition, Apress Berkeley, CA, ISBN: 978-1-4842-2047-4, 2016

Web links:

1. Model-Based Systems Engineering https://www.youtube.com/watch?v=qsHGnl_7EeY&list=PLBLcQ9faF_0T7KzGEZnreJCFJb1rIMzkP
2. Industry 4.0 Examples https://www.youtube.com/watch?v=K_gTcaoVjxs
3. Digitalization in Aeronauticshttps://www.coursera.org/learn/aeronauticsW

Drone Pilot Training			
Semester	**IV**	CIE Marks	**50**
Course Code	**23AESE256**	SEE Marks	**50**
Teaching Hours/Week (L:T: P)	**1:0:2**	Exam Hrs	**2.5**
Total Hrs	**37**	Credits	**02**

Course Objectives: This course is designed to

1. Familiarize drone assembly, DGCA drone regulations, pre-flight inspection and environmental assessment.
2. Provide practical experience to estimate centre of gravity (CG) and Gross Take Off Weight (GTOW) and propeller performance testing.
3. Develop skills in basic, circuit flight maneuvers and mission planning using simulators and mission planner.

Module 1: Drone Rules and Components	**No. of Hrs: 03+04**

Summary of Air Law/ The Drone Rules as per DGCA, CG of a drone using its components

Laboratory Components

1.Identification of Drone Components and integration

2.Determination of Centre of Gravity (CG) of Quadcopter & Fixed Wing UAV

Module 2: Drone Performance	**No. of Hrs: 03+06**

Performance of a drone motor-propeller system, GTOW of a drone in current atmospheric conditions considering meteorological measurements.

Laboratory Components

1. Motor–Propeller Performance Testing (Thrust Estimation).
2. Estimation of GTOW under Current Atmospheric Conditions
3. Meteorological Measurement for UAV Operations

Module 3: Drone Maneuvers	**No. of Hrs: 03+06**

Basic take-off, hover, cruise, loiter and landing operations, Circuit Flying maneuvers such as Rectangle, Square, Circle, Orbit and Figure of 8, Fault-analysis exercise to determine drone faults.

Laboratory Components

1. RC Transmitter Calibration and Pre-Flight Inspection Procedure
2. Basic Flight Operations (Take-off, Hover, Cruise, Landing)
3. Circuit Flying Maneuvers in Simulator (Rectangle, Square, Circle and Figure-8

Module4: Drone Missions	**No. of Hrs: 02+04**

Surveillance mission using a drone simulator by following way-points, focusing the sensor using pan and tilt operations of the gimbal, Abnormal/ Emergency procedures.

Laboratory Components

1. Planning mission using Waypoint & Events in mission planner.

Module 5: Mission Planning	**No. of Hrs: 03+04**

Ardupilot/ Q-ground control for a surveillance mission

Laboratory Components

Experiment-1: Mission Planning using ArduPilot Control/Mission Planner

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

1. Determine CG and GTOW of quadcopter and Fixed wing UAV.
2. Evaluate motor–propeller performance characteristics.
3. Demonstrate pre-flight procedures based on meteorological measurements.
4. Demonstrate basic and circuit flight maneuvers.
5. Demonstrate planning a mission using waypoints and events in mission planner.

Textbooks: 1. Randal W. Beard and Timothy W. McLain, "Small Unmanned Aircraft: Theory and Practice", Princeton University Press; 2012 2. Federal Aviation Administration, "Remote Pilot – Small Unmanned Aircraft Systems Study Guide", Flight Standards Service Washington, DC 20591, 2016 3. DGCA, “Drone Training Circular 02 of 2022”, Office Of The Director General Of Civil Aviation, 2022
Reference Book: E. H. J. Pallett, “Aircraft Instruments: Principles and Applications”, Pitman Publications 1972
Web link: Module 1: https://www.youtube.com/watch?v=jnyQJVzRiyg&list=PL_Fsqn9m2GhU3ep- PzQ4jg8aa-oxFP8W6&ab_channel=TheDroneExpert

Environmental Studies & Sustainability			
Semester	**IV**	CIE Marks	**100**
Course Code	**23NMCC229**	SEE Marks	**-**
Teaching Hrs/Week (L:T: P)	**1:0:0**	Exam Hrs	**-**
Total Hrs	**13**	Credits	**-**

Course Learning Objectives: This course is designed to

1. Create environmental awareness among the students
2. Provide knowledge on different types of pollution and their impacts in the environment
3. Enable the learners to understand the environmental management plan and socio-economic skills for sustainable development
4. Know about the major challenges in Environmental Issues and Evaluate possible solutions

Module 1: Ecosystems and Biodiversity	**No. of Hrs: 02**

Ecosystems: Value of Forest, Desert, Wetlands, River, Oceanic and Lake
Biodiversity: Types, Value, Hot-spots, Threats and Conservation of biodiversity, Forest Wealth and Deforestation

Module 2: Sustainable Energy Resources	**No. of Hrs: 02**

Energy Resources: Types of Energy, Conventional Sources and Non-Conventional Sources, Renewable Energy Sources: Hydrogen, Solar, OTEC, Tidal, Wind, Geothermal, Biomass and Bio Fuels

Module 3: Environmental Pollution and Sustainable Waste Management	**No. of Hrs: 03**

Environmental Pollution: Surface and Ground Water Pollution, Noise pollution, Air Pollution and Carbon Trading
Sustainable Waste Management & Public Health Aspects: Bio-medical Waste, Solid Waste, Hazardous Waste, E-waste, Industrial and Municipal Sludge

Module 4: Global Environmental Concerns	**No. of Hrs: 03**

Population Growth, Climate Change, Ground Water Depletion/Recharging, Ozone Depletion, Radon and Fluoride problem in drinking water, Disaster Management, Resettlement and Rehabilitation of People

Module 5: Environmental Pollution Mitigation Tools	**No. of Hrs: 03**

Remote Sensing& G.I.S., Environment Impact Assessment, Environmental Management Systems, ISO14001, Green Credit Program, Waste Audits, Environmental Stewardship - NGOs

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

1. Describe the principles of ecology and conservation of biodiversity importance on a global scale
2. Observe the energy related issues in the specified surrounding area and draw their inferences regarding suitable sustainable energy resources
3. Describe the Global environmental concerns and the individual responsibility to protect environment for sustainable environment
4. Describe the strategies for mitigation of Environmental issues and remediation/restoration of degraded environment

Textbooks:

1. Benny Joseph, "Environmental Studies", 2nd Edition, Tata Mcgraw-Hill, 2012
2. Erach Bharucha, "Environmental Studies",1st Edition, University Grant Commission and Bharati Vidyapeeth Institute of Environmental Education and Research, Pune, 2004

Reference Books:

1. B. S Chauhan, "Environmental Studies", 1st Edition, Laxmi Publications Pvt. Ltd.,2019
2. S M Prakash, "Environmental Studies", 3rd Edition, Pristine Publishing House, Mangalore, 2018
3. Aloka Debi,"Environmental Science and Engineering", 2nd Edition, Universities Press (India) Pvt. Ltd, 2012
4. R. J. Ranjit Daniels and Jagadish Krishnaswamy, "Environmental Studies", 1st Edition, Wiley India Private Ltd., New Delhi, 2009
5. M.Ayi Reddy, "Environmental Science and Technology", 1st Edition, BS Publications, 2007

Web links:

1. Environmental Studies Module 1: https://www.youtube.com/watch?v=siGaqKXCmg8
2. Question Bank| Environmental Studies: https://www.youtube.com/watch?v=F9uwkhoT3MQ
3. Environmental Science and Engineering Module 1-5: https://www.youtube.com/watch?v=Y5B1nWYle40

Yoga-II			
Semester	**IV**	CIE Marks	**100**
Course Code	**23NMCC225**	SEE Marks	**-**
Teaching Hrs/Week (L:T: P)	**0:0:1**	Exam Hrs	**-**
Total Hrs	**13**	Credits	**-**

Course Learning Objectives: This course is designed to

1. Empower students to achieve and maintain good health
2. Promote the practice of mental hygiene
3. Facilitate students in attaining emotional stability
4. Impart moral values and higher level of consciousness

Contents	**No. of Hrs: 13**

- Ashtanga Yoga, its need and importance
- Yama : Ahimsa, satya, asteya, brahmacarya, aparigrahaNiyama :shoucha, santosh, tapa, svaadhyaya, Eshvarapranidhan etc.,.
- Suryanamaskar13 count- 2 rounds of practice
- Asana, Need, importance of Asana, Different types of asana, Asana its meaning by name, technique, precautionary measures and benefits of each asana
- Different types of Asanas
  a) Sitting
    1. Sukhasana
    2. Paschimottanasana
  b) Standing
    1. ArdhakatiChakrasana
    2. ParshvaChakrasana
  c) Prone line
    1. Dhanurasana
    2. Sarpasana
  d) Supine line
    1. Halasana
    2. KarnaPeedasana
- Meaning, importance and benefits of Kapalabhati. 20 strokes/min 3 rounds
- Meaning, Need, importance of Pranayama, Different types, Meaning by name, technique, precautionary measures and benefits of each Pranayama
  1. Suryanuloma –Viloma
  2. Chandranuloma-Viloma
  3. Suryabhedana
  4. Chandra Bhedana
  5. Nadishodhana

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

1. Describe the meaning, aim and objectives of Yoga
2. Perform Suryanamaskar and able to analyze its benefits
3. Exhibit the different Asanas by name, its importance, methods and benefits
4. Perform Kapalabhati
5. Perform the different types of Pranayama by its name, precautions, procedure and uses

Textbooks:

1. Ajitkumar ,"YogaPravesha in Kannada" 1st Edition, Raashtroththaana Saahithya, 2017,ISBN-13: 978-8175310124
2. BKS Iyengar, "Light on Yoga", 1st Edition, Thorsons, 2017, ISBN-13: 978-0008267919
3. Dr. M L Gharote& Dr. S K Ganguly,"Teaching Methods for Yogic practices", 1st Edition, Kaivalyadhama, 2001, ISBN-13 : 978-8189485252

Reference Book:

YaminiMuthanna, "Yoga for Children step by step", 1st Edition, Om Books International, 2022, ISBN-13: 978-9394547018

Web links:

1. My Life My Yoga: https://youtu.be/KB-TYlgd1wE
2. Adiyoga: https://youtu.be/aa-TG0Wg1Ls

Physical Education-II			
Semester	**IV**	CIE Marks	**100**
Course Code	**23NMCC226**	SEE Marks	**-**
Teaching Hrs/Week (L: T: P)	**0:0:1**	Exam Hrs	**-**
Total Hrs	**13**	Credits	**-**

Course Learning Objectives: This course is designed to

1. Impart the fundamental concepts and skills of Physical Education, Health, Nutrition and Fitness
2. Familiarization of health-related Exercises, Sports for overall growth and development
3. Build a strong foundation for the professionals in Physical Education and Sports

Contents	**No. of Hrs: 13**

- Training Components: Strength, Speed, Endurance, Flexibility, Agility & Coordinative abilities
- Basic rules and strategies of chosen team sports. (Practical Sessions)
- Causes & Prevention of Sports Injuries: Sprain, Strain, Cramps, Fractures and Dislocation
- Specific Games (Any one to be selected by the student)

Basic Training

Basket ball Dribbling with both hands - Layup shot - Chest pass - Proper footwork and body positioning - Basic jump shot technique

Cricket Holding the bat grip - Stance and footwork - Basic batting shots (defense & hitting) - Bowling grip and action - Fielding techniques (catching & throwing)

Football Dribbling with both feet - Passing with accuracy (short and long) - Controlling the ball (laces, inside of foot) - Shooting technique - Stopping the ball - Basic heading technique

Hockey Dribbling the ball with a stick - Stopping the ball with the stick - Basic passing techniques (forehand, backhand) - Shooting technique (push shot, flick shot) - Body positioning and balance

Table Tennis Holding the paddle grip - Forehand and backhand grip changes - Basic strokes (forehand drive, backhand push) - Footwork and positioning - Serving technique (underhand serve)

Throwball One-handed chest pass - Two-handed overhead pass - Pivoting with the ball Footwork and movement - Shooting technique (one-handed and two-handed throws) - Catching the ball safely

Volleyball Overhand serve - Proper hand setting technique (bump pass) - Forearm pass

Badminton Holding the racquet grip : Forehand , backhand, universal and panhandle grip changes ,Basic serves (high serve, low serve), Stance and Strokes

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

1. Design a basic training program incorporating various training components to improve specific physical fitness aspects
2. Identify common sports injuries, explain their causes, and implement preventative measures
3. Perform in the selected sports or athletic events

Textbooks:

1. Muller J. P., "Health, Exercise and Fitness", 1st Edition, Sports Publication, 2018
2. Uppal A.K., "Physical Fitness", Friends Publication New Delhi, 1992
3. Russell R.P., "Health & Fitness through Physical Education: Human Kinematics", Human Kinetics Publishers, 1994

Reference Books:

1. Anaika, "Play Field Manual", Friends Publication New Delhi, 2005
2. IAAF Manual
3. Pinto John & Roshan Kumar Shetty, "Introduction to Physical Education"

Web links:

1. Football: https://www.youtube.com/watch?v=wvlztaJYKYI
2. Basketball Basics: https://www.youtube.com/watch?v=d0z7QqblJaM
3. Cricket with the correct grip: https://www.youtube.com/watch?v=UxX4IQL03UU
4. Basics of Dribbling: https://www.youtube.com/watch?v=naEccnjzLxM
5. Karate Training: https://www.youtube.com/watch?v=br89-xhWezs

National Service Scheme-II			
Semester	**IV**	CIE Marks	**100**
Course Code	**23NMCC227**	SEE Marks	**-**
Teaching Hrs/Week (L:T: P)	**0:0:1**	Exam Hrs	**-**
Total Hrs	**13**	Credits	**-**

Course Learning Objectives: This course is designed to

1. Develop discipline, character, brotherhood, the spirit of adventure and ideals of selfless service amongst young citizens
2. Develop youth leadership in the students
3. Induce social consciousness among students through various societal activities
4. Impart knowledge in finding practical solutions to individual and community problems

NSS -Contents	**No. of Hrs: 13**

Introduction:

- Youth development programmes
- Health, hygiene and sanitation awareness programs
- Peer leadership training

Activities:

- Social and economic activities to support the society
- Water conservation – awareness sessions on water conservation, rain water harvesting, maintaining the surroundings, safeguarding water sources, etc.

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

1. Understand the importance of nation building and individual contribution to the betterment of the society
2. Discover grassroots challenges of community and solve them by technological intervention
3. Create societal impact by upholding the value of one for all and all for one
4. Maintain discipline and team spirit

Textbooks:

1. Ministry of Youth Affairs & Sports, Government of India, "National Service Scheme Manual", 2022
2. Rajiv Gandhi National Institute of Youth Development, Ministry of Youth Affairs & Sports, Government of India, "Introduction Training Module for National Service Scheme (NSS) Program officers", 2017
3. Gurmeet Hans, "Case material as Training Aid for field workers" TISS, 1996

Reference Books:

1. Dr. G R Bannerjee, Social service opportunities in Hospitals, TISS, 2012
2. Ram Ahuja, Social Problems in India, Rawat publications, 3rd Edition2014

Web links:

1. History of NSS : https://thebetterindia.com/140/national-service-scheme-nss/
2. NSS – an introduction: https://www.youtube.com/@nationalserviceschemeoffic4034/videos

Arts-II			
Semester	**IV**	CIE Marks	**100**
Course Code	**23NMCC228**	SEE Marks	**-**
Teaching Hrs/Week (L: T: P)	**0:0:1**	Exam Hrs	**-**
Total Hrs	**13**	Credits	**-**

Course Learning Objectives: This course is designed to

1. To impart an understanding of the creative process from initial concept to final execution
2. Create and demonstrate proficiency in a chosen arts discipline through practical application
3. Analyze and appreciate diverse art forms and styles
4. To participate in art competitions at regional, state, national, and international levels, as well as in cultural events

Contents	**No. of Hrs: 13**

Note: Student shall continue the arts form selected in previous semester

Performing Arts (Dance)	Orientation, Head to Toe Exercise, Contemporary /filmy dance, Basic expression and choreography, Zumba and aerobics, Dance practice and Group Performance, Evaluation
Music	Orientation, Introduction to Musical Instruments, Basic Instrumental Practice, Singing Genres Demo, Niche Mapping, Folk Singing with instrument, Group Song Practice, Group Presentation, Evaluation
Arts & Crafts	Orientation, Sketching lifestyle and modelling, Pencil Shading-practical, Brush/Crayon Techniques, Charcoal Drawing, water color practical, collage, Group Presentation, Evaluation
Theatre	Orientation, Realistic Acting: input and output applications, Stylized Acting, Absurd acting, Group Rehearsal, Basics of Costume Design, Prop Usage, Group Presentation, Evaluation

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

1. To be capable of creating choreography and delivering live performances for an audience
2. Employ a range of acting techniques and use them to create a performance
3. Evolve into creative, effective, independent, and reflective individuals capable of making informed decisions in both process and performance
4. Acquire knowledge and comprehension of the roles and processes used in current theatre arts practice

Textbooks:

1. Bruce Benward and Marilyn Sake, “Music in Theory and Practice”, McGraw-Hill Education, 2014
2. Otto G. Ocvirk, Robert E. Stinson, Philip R. Wigg, Robert Bone, and David L. Cayton, “Art Fundamentals: Theory and Practice”, McGraw-Hill Education, 2012
3. Anne Bogart and Tina Landau, “The Viewpoints Book: A Practical Guide to Viewpoints and Composition”, Theatre Communications Group, 2004

Reference Books:

1. Jacqueline M. Smith, "Dance Composition: A practical guide to creative success in dance making"
2. Ralph Mayer, "The Artist's handbook of method and materials"
3. Dr. Arun Bangre, "Glimpses of Indian music and dance"

Web link:

Audio visual catalogue: https://ccrtindia.gov.in/audio-visual-catalogue/