B.Tech. Aviation Engineering Curriculum

Gati Shakti Vishwavidyalaya



Industry Partners

AIRBUS

SAFRAN
AEROSPACE · DEFENCE · SECURITY

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Amendments and Revisions

Amendments and revisions in academic curricula ensure that education remains relevant, effective, and aligned with the evolving needs of industry, technology, and learners.

The Aviation Engineering curriculum represents a paradigm shift driven by the rapid growth of India's aviation industry, which has a strong demand for skilled human resources across multiple domains, including pilots, aircraft maintenance engineers, ground staff, and airport management professionals.

This paradigm shift necessitates a flexible approach to curriculum development. Therefore, for the benefit of students, the industry, and other stakeholders, GSV reserves the right to modify, change, or alter the course delivery or the course itself as deemed necessary. This process will be regarded as a learning experience, and all such instances will be reviewed by the Board of Studies (BoS) for potential improvements at the subsequent BoS meeting.

References for the Curriculum Enrichment

1. Vision and mission statements of the Gati Shakti Vishwavidyalaya. (https://gsv.ac.in/vision-and-mission/)

2. SAFRAN customised courses on LEAP 1A/1B Engines.

3. DGCA CAR Part 66 (2025 Issue) and CAR Part 147 (2017 Issue).

4. EASA Part 66 and Part 147 (2023 issue).

5. B. Tech Aviation Engineering Curriculum Initial issue 2024.

B. Tech Aviation Engineering Program Objectives

Reference: https://gsv.ac.in/course/b-tech-aviation-engineering/

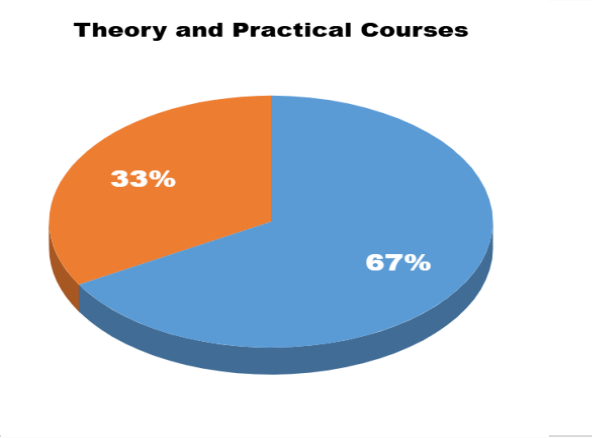
The B.Tech in Aviation Engineering program at GSV emphasizes key areas of the aviation industry. Its enriched curriculum aligns with industry standards to ensure a seamless transition into professional roles in niche areas of the aviation industry, such as SAFRAN Engine MRO, Aircraft Engineering Services, Aircraft MROs, and the UAS industry, while also providing the opportunity to explore conventional aeronautical subjects. *In addition to the objectives of the program mentioned in the initial issue, the enriched curriculum aimed to achieve the following objectives:*

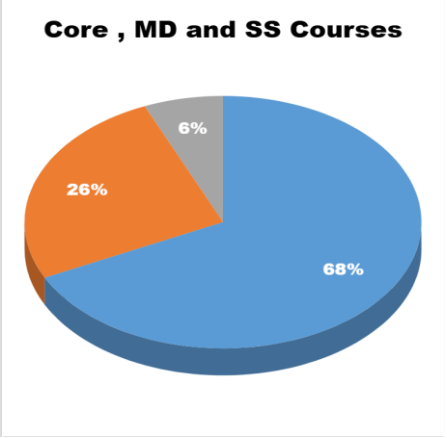
1. To holistically develop aviation engineers equipped with moral values and ethics, capable of applying learned knowledge and skills for a safer and more sustainable aviation ecosystem.
2. To inculcate a safety consciousness by applying safety protocols, human factors principles, and Safety Management principles in the aviation industry, fostering a culture of responsibility, integrity, and ethical practices.
3. To facilitate the acquisition of knowledge and understanding of the design, standards, and their certification requirements for aircraft systems, including airframe, powerplant (Aero Engines), avionics, and Unmanned Aerial Systems (UAS).
4. To develop the proficiency required for maintaining the aircraft within the intended design function and Life cycle management of the aircraft.
5. To equip the candidates with the necessary knowledge of aviation legislation, its application, and compliance throughout the operations of Aircraft by quality control and quality assurance.
6. To develop the core competencies across any specialization and practical skills required to complete the comprehensive maintenance task on time, quality, and cost control with the correct use of tools, equipment, etc.

Pedagogical Approach and Learning Hours Summary

1. The program delivery relies on the following Pedagogical and Presentation tools:
   (a) Classroom lectures.
   (b) Presentation and discussions.
   (c) Airbus Competency Trainer (Simulations) (with Industry partners).
   (d) Aircraft System Trainers for various systems (with Industry partners).
   (e) NDT and Aircraft System Repair workshops (with Industry partners).
   (f) Aircraft (A320/B737/or similar class of aircraft) (with Industry partners).
   (g) Video, Smart Board, Handouts, and PowerPoints.
2. A Summary of the distribution of credits towards theory courses, practical courses, and core, multidisciplinary (MD) and soft skill (SS) courses is represented below:

	Theory Credits	Practical Credit	Core Credits	MD Credits	SS Credits
Semester 1	17	4	3	16	2
Semester 2	15	5	8	11	1
Semester 3	19	3	17	4	1
Semester 4	19	2	17	0	4
Semester 5	14	7	14	5	2
Semester 6	20	3	19	4	0
Semester 7	18	4	18	4	0
Semester 8	2	16	12	4	2
Total	**124**	**44**	**108**	**48**	**12**
Internship/OJT 1	0	4	4	0	0
Internship/OJT 2	0	6	6	0	0
Internship/OJT 3	0	8	8	0	0
Total	**0**	**18**	**18**	**0**	**0**
Grand Total	**124**	**62**	**126**	**48**	**12**





Credit Framework & Assessment Criteria

1. As per OO no. GSV/DR/ACAD/PHD/OO/2025-26/009 dated 05 Dec 2025.

2. As per Academic Regulations (Undergraduate & Post Graduate Programs-Regular & Working Professionals)

Knowledge Level Indicators

(Specific to Standard Regulatory Aviation Courses)

The knowledge level indicators are to be applied to achieve the objectives in accordance with the regulatory requirements.

1. **LEVEL 1**
   Familiarization with the principal elements of the subject, with the objectives:
   (a) The students should be familiar with the basic elements of the subject.

   (b) The students should be able to give a simple description of the whole subject, using common words and examples.

   (c) The students should be able to use typical terms.
2. **LEVEL 2**
   A general knowledge of the theoretical and practical aspects of the subject and an ability to apply that knowledge, with the objectives:
   (a) The students should be able to understand the theoretical fundamentals of the subject.

   (b) The students should be able to give a general description of the subject using, as appropriate, typical examples.

   (c) The students should be able to use mathematical formulae in conjunction with physical laws describing the subject.

   (d) The students should be able to read and understand sketches, drawings, and schematics describing the subject.

   (e) The students should be able to apply their knowledge in a practical manner using detailed procedures.
3. **LEVEL 3**
   A detailed knowledge of the theoretical and practical aspects of the subject and a capacity to combine and apply the separate elements of knowledge logically and comprehensively, with the objectives:
   (a) The students should know the theory of the subject and its interrelationship with other subjects.

   (b) The students should be able to give a detailed description of the subject using theoretical fundamentals and specific examples.

   (c) The students should understand and be able to use mathematical formulae related to the subject.

   (d) The students should be able to read, understand, and prepare sketches, simple drawings, and schematics describing the subject.

   (e) The students should be able to apply their knowledge in a practical manner using the manufacturer's instructions.

   (f) The students should be able to interpret results from various sources and measurements and apply corrective action where appropriate.

Curriculum

Aviation Engineering

L-T-P (Lecture-Tutorial-Practice)
Lecture (L):1 Credit=15 Hrs
Tutorial (T): 1 Credit=15 Hrs
Practice (P): (Practical/Project work/On the Job Training/Internship):1 Credit=30 Hrs

Semester 1

SL. No.	COURSE CODE	COURSE TITLE	Learning Hours per week				Hours
			L	T	P	C	
1		Induction Program					
2	MAL101	Engineering Mathematics -I	4	0	0	4	60
3	PHL101	Engineering Physics	3	0	0	3	45
4	PHL102	Engineering Physics Lab	0	0	2	1	30
5	IDL104	Design Thinking	2	0	0	2	30
6	IDL101	Introduction to Mechanical and Civil Engineering	3	0	0	3	45
7	**AET201**	**Introductory Course on Aviation Industry and Aeromodelling #**	**2**	**0**	**2**	**3**	**60**
8	IDP102	Engineering Graphics and Workshop Practices	1	0	2	2	45
9	IDP103	Computer Programming - I (C Language)	2	0	2	3	60
TOTAL			**17**	**0**	**8**	**21**	**375**

Semester 2

SL. No.	COURSE CODE	COURSE TITLE	Learning Hours per week				Hours
			L	T	P	C	
1	MAL102	Engineering Mathematics -II	4	0	0	4	60
2	TLL101	Introduction to Multimodal Transportation Ecosystem	1	0	0	1	15
3	IDL105	Engineering Mechanics	2	1	0	3	45
4	IDP106	Engineering Mechanics Lab	0	0	2	1	30
5	**IDL107**	**Electrical & Electronics Fundamentals #**	**3**	**0**	**0**	**3**	**45**
6	**IDL108**	**Electrical & Electronics Fundamentals Lab***	**0**	**0**	**2**	**1**	**30**
7	HSP101	Health, Wellness, and Yoga	0	0	2	1	30
8		**Aircraft Structures and Systems (General) #**	**3**	**0**	**0**	**3**	**45**
9		**Aircraft Structures and Systems (General) Lab***	**0**	**0**	**2**	**1**	**30**
10	IDP109	Computer Programming - II (Python)	1	0	2	2	45
TOTAL			**14**	**1**	**10**	**20**	**375**
11	CSI101	Semester-end internship/On-the-Job Training/ Practical (4 weeks @30 hours/week) *** For practical and assessment**	0	0	30	4	120

 # Only for Aviation Engineering Students

L-T-P (Lecture-Tutorial-Practice)
Lecture (L):1 Credit=15 Hrs
Tutorial (T): 1 Credit=15 Hrs
Practice (P): (Practical/Project work/On the Job Training/Internship):1 Credit=30 Hrs

Semester 3

SL. No.	COURSE CODE	COURSE TITLE	Learning Hours per week				Hours
			L	T	P	C	
1	AET205	Fluid Mechanics and Hydraulics	3	0	0	3	45
2.	AEP210	Fluid Mechanics and Hydraulics Lab	0	0	2	1	30
3	AET203	Engineering Thermodynamics	3	0	0	3	45
4	AEP209	Engineering Thermodynamics Lab	0	0	2	1	30
5		Aircraft Materials and Hardware (Basic)	3	0	0	3	45
6		Aircraft Materials and Hardware (Basic) Lab*	0	0	2	1	30
7	AET216	Environmental Sciences and Sustainability	1	0	0	1	15
8	AET206	Applied Control Systems	3	0	0	3	45
9		Aerodynamics Fundamentals	2	1	0	3	45
10		Digital Techniques for Instrumentation Engineering (Basic)	3	0	0	3	45
TOTAL			**18**	**1**	**6**	**22**	**375**

Semester 4

SL. No.	COURSE CODE	COURSE TITLE	Learning Hours per week				Hours
			L	T	P	C	
1		Human Factors in Aviation	3	0	0	3	45
2	AET436	Aviation Regulations	2	1	0	3	45
3		Aircraft Maintenance Practices (General)	2	1	0	3	45
4		Aircraft Maintenance Practices (General) Lab*	0	0	2	1	30
5	AET438	Human Values and Ethics	2	0	0	2	30
6		Artificial Intelligence in Action	2	1	0	3	45
7		Gas Turbine Engines (General)	2	1	0	3	45
8		Gas Turbine Engines (General) Lab*	0	0	2	1	30
9	NPTEL(S2)	Developing Soft Skills and Personality	2	0	0	2	30
TOTAL			**15**	**4**	**4**	**21**	**345**
10	AEI201	Semester-end internship/On-the-Job Training/ Practical (6 weeks @30 hours/week) *** For practical and assessment**	0	0	30	6	**180**

L-T-P (Lecture-Tutorial-Practice)
Lecture (L):1 Credit=15 Hrs
Tutorial (T): 1 Credit=15 Hrs
Practice (P): (Practical/Project work/On the Job Training/Internship):1 Credit=30 Hrs

Semester 5

SL. No.	COURSE CODE	COURSE TITLE	Learning Hours per week				Hours
			L	T	P	C	
1	AET437	Introduction and Design of UAS	3	0	0	3	45
2	AET211	Computer-Aided Design and AM	3	0	0	3	45
3	AET211P	Additive Manufacturing of UAS Parts Lab	0	0	4	2	60
4	AET328	Computational Fluid Dynamics	3	0	0	3	45
5	AET335	Computational Fluid Dynamics Lab	0	0	4	2	60
6	AET332	Aircraft Communication System	3	0	0	3	45
7	AEP440	UAS Training	0	0	6	3	90
8	NPTEL(S4)	Mental Health and Wellbeing	2	0	0	2	30
TOTAL			**14**	**0**	**14**	**21**	**420**

Semester 6

SL. No.	COURSE CODE	COURSE TITLE	Learning Hours per week*				Hours
			L	T	P	C	
1		Propeller Mechanics and Performance	3	0	0	3	45
2		Elective I (Either from Vertical 1 or Vertical 2)	3	0	2	4	75
3		Elective II (Either from Vertical 1 or Vertical 2)	3	0	0	3	45
4	NPTEL(S5)	Operations & Supply Chain Management	2	0	0	2	30
5		Elective III (Either from Vertical 1 or Vertical 2)	3	0	2	4	75
6		Elective IV (Either from Vertical 1 or Vertical 2)	2	0	0	2	30
7		Elective V (Either from Vertical 1 or Vertical 2)	2	0	2	3	90
8	NPTEL(S6)	Quality Management	2	0	0	2	30
TOTAL			**20**	**0**	**6**	**23**	**420**
9	AEI301	Semester-end internship/On-the-Job Training/ Practical (8 weeks @30 hours/week) only for Elective A	0	0	30	8	240

**From semester 6 onwards L-T-P for Electives are indicative and primarily meant for vertical 2 only. For Vertical 1, L-T-P distribution will be worked out based on the recommendations of the industry partners and the regulatory framework.*

L-T-P (Lecture-Tutorial-Practice)
Lecture (L):1 Credit=15 Hrs
Tutorial (T): 1 Credit=15 Hrs
Practice (P): (Practical/Project work/On the Job Training/Internship):1 Credit=30 Hrs

Semester 7

SL. No.	COURSE CODE	COURSE TITLE	Learning Hours per week				Hours
			L	T	P	C	
1		Elective VI (Either from Vertical 1 or Vertical 2)	3	0	0	3	45
2		Elective VII (Either from Vertical 1 or Vertical 2)	3	0	0	3	45
3		Elective VIII (Either from Vertical 1 or Vertical 2)	2	0	2	3	90
4		Airport Management	2	0	0	2	30
5	NPTEL(S7)	Organization of Engineering System and Human Resources Management	2	0	0	2	30
6	AED441	Project Work Phase 1	1	0	6	4	195
7		Elective IX (Either from Vertical 1 or Vertical 2)	3	0	0	3	45
8		Elective X from Vertical 1	2	0	0	2	30
TOTAL			**18**	**0**	**8**	**22**	**510**

Semester 8

SL. No.	COURSE CODE	COURSE TITLE	Learning Hours per week				Hours
			L	T	P	C	
1	AED 442	Project Work Phase 2	1	0	16	9	255
2		On-the-Job Training/ Practical Experience	1	0	16	9	255
TOTAL			**2**	**0**	**32**	**18**	**510**

Elective Courses

Vertical 1: Aircraft and Aero Engine MRO					
Code	**Elective Course Name**	**L**	**T**	**P**	**C**
	Electrical & Electronics (Applied)	3	1	2	3
	Digital Techniques for Instrumentation Engineering (Applied)	3	1	2	3
	Aircraft Materials and Hardware (Advanced)	3	1	2	3
	Aircraft Maintenance Practices (Systems)	3	1	4	4
	Aircraft Maintenance Practices (Structures)OR /SAFRAN Customized Course on LEAP Engine	3	1	4	4
	Aircraft Structure (Advance)/ SAFRAN Customized Course on LEAP Engine	3	1	2	3
	Aircraft Systems I (Advance)/ SAFRAN Customized Course on LEAP Engine	3	1	2	3
	Aircraft Systems II (Advance)/ SAFRAN Customized Course on LEAP Engine	3	1	2	3
	Gas Turbine Engines (Construction)/ SAFRAN Customized Course on LEAP Engine	3	1	4	4
	Gas Turbine Engines (Systems)/ SAFRAN Customized Course on LEAP Engine	3	1	4	4

Vertical 2: General Aeronautical					
Code	**Elective Course Name**	**L**	**T**	**P**	**C**
AET204	Strength of materials	3	0	3	3
AET212	Theory of Machines	3	1	0	2
AET213	Aerodynamics I	3	0	1	2
AET215	Air Breathing Propulsion	3	1	2	3
AET321	Aerodynamics II	3	0	1	2
AET320	Flight Mechanics	3	1	0	2
AET322	Aircraft Structures-I	3	0	1	2
AET331	Aircraft Structures-II	3	1	0	2
AET449	Turbo Machines	3	1	0	2

Vertical I: Aircraft and Engine MRO

These are standard regulatory-approved aviation industry-centric courses. The syllabus of these courses is dynamic; therefore, the latest version, as amended, will be followed. Additionally, based on student preferences, the courses for Modules 13 and 14 may also be added.

Course Name	Standard Regulatory Aviation Courses References
Electrical & Electronics Fundamentals	Modules 3 and 4
Electrical & Electronics (Applied)	Modules 3 and 4
Digital Techniques for Instrumentation Engineering (Basic)	Module 5
Digital Techniques for Instrumentation Engineering (Applied)	Module 5
Aircraft Materials and Hardware (Basic)	Module 6
Aircraft Materials and Hardware (Advanced)	Module 6
Aircraft Maintenance Practices (General)	Module 7
Aircraft Maintenance Practices (Systems)	Module 7
Aircraft Maintenance Practices (Structures)	Module 7
Aerodynamics fundamentals	Module 8
Aircraft Structures & Systems (General)	Module 11
Aircraft Structure (Advanced)	Module 11
Aircraft Systems I (Advanced)	Module 11
Aircraft Systems II (Advanced)	Module 11
Gas Turbine Engines (General)	Module 15
Gas Turbine Engines (Construction)	Module 15
Gas Turbine Engines (Systems)	Module 15
Propeller Mechanics and Performance	Module 17

Syllabus

INDUCTION PROGRAM

1. Transition from school to college life is one of the most challenging events in a student's life. When students enter an institution, they come with diverse thoughts, backgrounds, and preparations. They enter a new, unfamiliar environment, and many of them have limited knowledge of the institution. The Student Induction program is designed to welcome new students to Higher Education and prepare them for their new role. This is a mandatory **3-day programme** to be conducted as soon as the students enter the institution. Normal classes start only after the induction program is over. The induction program has the following objectives:

(a) Familiarize the new student with the various courses offered at GSV, methods of study, various facilities, and the academic and administrative setup in the Institute.

(b) To develop a sense of aesthetics and enhance creativity among students.

(c) To generate favorable attitudes towards peers, senior students, teaching, and nonteaching staff in the Institution.

(d) To inculcate value systems, ethics, and leadership qualities among students.

(e) To promote entrepreneurial thinking among students.

(f) To inculcate effective communication skills, teamwork skills, multi-disciplinary approach and develop a desire to apply knowledge of engineering in real-life problems.

(g) To sensitize students towards environmental issues and to develop an attitude to protect and conserve the environment among students.

(h) Inculcate in them the ethos and culture of the GSV.

2. The following Extracurricular activities (ECAs), the student would be fully engaged throughout the day for the entire duration of the program.

   (a) **Physical Activity:** This would involve a daily routine of physical activity with games and sports, yoga, gardening, etc.

   (b) **Creative Arts:** Every student would choose one skill related to the arts, whether visual arts or performing arts. Examples include painting, sculpture, pottery, music, and dance. The student would pursue it every day for the duration of the program. These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity, which would, hopefully, grow into engineering design later.

(c) **Universal Human Values:** This is the anchoring activity of the Induction Programme. It encourages students to explore themselves and experience the joy of learning, stand up to peer pressure, make decisions with courage, be aware of relationships with colleagues, and support staying in the hostel and department. It also fosters sensitivity to others. A module in Universal Human Values provides the base. The methodology of teaching this content is extremely important. It must not be through do's and don'ts, but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real-life activities rather than lecturing. Discussions would be conducted in small groups of approximately 20 students, each with a faculty member as a mentor. It would be effective if the faculty mentor assigned is also the student's faculty advisor for the entire duration of the undergraduate programme.

(d) **Literary Activity:** Literary activity would encompass reading, writing, and possibly debating, enacting a play, etc.

(e) **Proficiency Modules:** This would address some lacunas that students might have, for example, English, computer familiarity, etc.

(f) **Lectures by Eminent People:** Motivational lectures by eminent people from all walks of life should be arranged to give the students exposure to people who are socially active or in public life.

(g) **Visits to Local Area:** A couple of visits to the landmarks of the city, a hospital, or an orphanage could be organized. This would familiarize them with the area and expose them to the underprivileged.

ENGINEERING MATHEMATICS - I

COURSE OBJECTIVES:

- To recall and remember the basics of matrices, complex numbers, and differential calculus.
- To develop a basic understanding of matrices, complex numbers, and differential calculus in various streams of engineering.
- To apply methods to solve engineering problems.

UNIT I. DIFFERENTIAL CALCULUS

Limits, Continuity and Derivative of functions, Total Derivative, Partial Derivatives, Jacobian, Chain rule, Partial Derivatives using Jacobian, Errors and Approximations, Maxima and Minima of functions of two variables, Lagrange's method of undetermined multipliers. Taylor's and Maclaurin's series for one and two variables.

UNIT II. MULTIPLE INTEGRALS

Double and Triple Integrals, Change of Order of Integration, Change of Variables. Applications of integration to areas and volumes. Beta and Gamma functions and their properties, evaluation of integrals using gamma and beta functions

UNIT III. VECTOR CALCULUS

Scalar and Vector fields, Vector differentiation, Directional derivatives, Gradient, Divergence, and curl, and their physical significance. Evaluation of Line, surface, and volume integrals, Statements and problems based on Green's theorem in the plane, Stokes' theorem, and Gauss's Divergence theorem (without proofs).

UNIT IV. MATRICES & ITS APPLICATIONS

Review of basic concepts, Elementary transformations, Rank of matrix, Inverse of matrix, Consistency of linear simultaneous equations. Application of matrix: Eigenvalues and their properties, Eigen vectors. Statement and problems based on Cayley-Hamilton theorem, Diagonalization of a matrix, and Linear Transformations.

UNIT V. COMPLEX ANALYSIS:

Representation of complex numbers, modulus and argument of complex numbers, De-Moivre's theorem and Euler's formula, Functions of a Complex Variable, Limits, Continuity and Derivatives, Analytic Function, Cauchy-Riemann Equations (without proof). Cauchy Integral Formula, Taylor and Laurent Series theorem (without proof), and examples based on all theorems.

COURSE OUTCOMES:

CO1: Apply differentiation and integration to solve applied problems in engineering and find the maxima and minima of functions

CO2: Describe all of the concepts of integrals: Double and Triple integrals, and evaluate the area and volume by using multiple integrals. Beta and Gamma functions to evaluate various types of integrals.

CO3: Understand the abstract concepts of matrices, systems of linear equations, and their solutions. Also, finding the eigenvalues and powers of matrices

CO4: Understand the abstract concepts of complex analysis and solve engineering problems

CO5: Apply divergence and curl to solve problems involving line, surface, and Volume integrals and their applications (Green, Stokes, and Gauss Divergence theorems)

CO6: Applications: Differential calculus, integral calculus, and matrices are useful in many branches of mathematics, including engineering fields such as nuclear, aerospace, mechanical, and electrical engineering, applied mathematics, and physics.

TEXT BOOKS:

1. B.S. Grewal, 'Higher engineering Mathematics', Khanna publishers, Delhi (43th edition), (2012).
2. B. V. Ramana, ‘Higher Engineering Mathematics’, Tata McGraw Hill Publications (2007)

REFERENCE BOOKS:

1. C.R.Wylie, L.C. Barrette, ‘Advanced Engineering Mathematics’, McGraw Hill Publications, New Delhi.(6th edition)(2003).
2. Erwin Kreyszig, 'Advanced Engineering Mathematics' Wiley Eastern Ltd. (8th Student Edition) (2004).
3. Michael D. Greenberg, Advanced Engineering Mathematics, 2006, 2nd Edition, Pearson Education, Indian edition.
4. A First Course in Differential Equations with Modelling Applications, Dennis Zill, 2018, 11th Edition, Cengage Publishers.

ENGINEERING PHYSICS

COURSE OBJECTIVES:

- To enable the students to gain knowledge of electromagnetic waves and its applications.
- To introduce the basics of oscillations, optics, and lasers.
- Equipping the students to successfully understand the importance of quantum physics.
- To motivate the students towards the applications of quantum mechanics.

UNIT I. OSCILLATIONS AND WAVES

Oscillatory motion, Energy of oscillation, coupled oscillator, Damped Harmonic motion, Forced Harmonic oscillator, Applications-Electromagnetic damping, Wave motion, Transverse wave motion: velocity and wave equation, Longitudinal wave motion: velocity and wave equation, impedance of a string.

UNIT II. ELECTROMAGNETIC WAVES

Scalar and vector fields, Gradient, divergence, and curl, stokes' and Green's theorems, continuity equation for current density, Concept of Displacement current, Maxwell's equations: differential and integral forms, Electromagnetic wave equations in free space and in conducting media, Application - skin depth, Poynting Vector, and Poynting theorem.

UNIT III. OPTICS

Interference: Coherent sources, Interference in Parallel and wedge-shaped thin films, Newton rings, Applications as Non-reflecting coatings, Measurement of wavelength and refractive index. Diffraction: Single slit diffraction and Diffraction grating, Applications - Dispersive and Resolving Powers. Rayleigh's criterion of resolution. Lasers: Basic concepts, Absorption of radiation, Spontaneous and stimulated emission of radiation, Einstein's coefficients, Population inversion, Laser properties and applications, Ruby, He Ne, and Semiconductor lasers, Applications – Optical communication.

UNIT IV. QUANTUM MECHANICS

Wave function, Steady State time-dependent and time-independent Schrodinger wave equation, Expectation value, Normalization of a wave function, operators. Infinite potential well and its Energy. Tunneling effect (Qualitative idea).

COURSE OUTCOMES:

CO1: Demonstrate a detailed knowledge of oscillations, electromagnetic waves, wave optics, lasers, and quantum mechanics;

CO2: Discuss how the laws of physics have been exploited and applied in the development and design of simple engineering systems.

CO3: Collate, analyze, and formulate an experimental report with error analysis and conclusions

TEXT BOOKS:

1. Jenkins, F.A. and White, H.E., Fundamentals of Optics, McGraw Hill (2001).
2. Beiser, A., Concept of Modern Physics, Tata McGraw Hill (2007)
3. Griffiths, D.J., Introduction to Electrodynamics, Prentice Hall of India (1999).
4. Matthew N. O. Sadiku, Elements of Electromagnetics

REFERENCE BOOKS:

1. Pedrotti, Frank L., Pedrotti, Leno S., and Pedrotti, Leno M., Introduction to Optics, Pearson Prentice HallTM (2008).
2. Verma, N.K., Physics for Engineers, Prentice Hall of India (2014)

DESIGN THINKING

COURSE OBJECTIVES:

- To introduce students to the fundamentals of design thinking and its applications in various engineering disciplines.
- To develop students' creative thinking, empathy, and problem-solving skills.
- To apply design thinking methods for identifying user needs and defining design challenges.
- To teach students to ideate, prototype, and iterate on solutions through a human-centered design approach.
- To encourage interdisciplinary collaboration and teamwork in the design process.

UNIT I.

Review of design and design process

What is Design, Key Characteristics of Design, Design Process, Design Vs Design Thinking, Innovative Solutions, Innovation Vs Invention, Human-Centred Design (HCD) process.

Design thinking introduction

Definition and Objective of Design Thinking, Divergence and Convergence in Design Thinking, Key Principles of Design Thinking, Design Thinking Skills.

Design thinking frameworks

Framework or Structure of DT Process, IDEO's Human-Centered Design Framework, Double Diamond Model, IBM Design Thinking, Google Ventures (GV) Design Sprint, Stanford d.school Design, Thinking Process.

UNIT II.

DESIGN THINKING(DT) PROCESS AND IMPLEMENTATION

Overview of the five-stage process: empathize, define, ideate, prototype, test.

DT team and team formation

Design Thinking Team, Quality and characteristics for team, building, Challenges in team building, A case Study on Team Building.

Visualization techniques and diagrams in DT

Empathy Map, User Journey Map, Mind Mapping, Persona Profile, Storyboarding, Prototyping, Wireframes, Flowcharts, Concept Maps, 3D Models and Mockups, Value Proposition Canvas, Business Model Canvas, SWOT Analysis, Mood Boards, Roadmaps.

UNIT III.

Storytelling techniques in DT

Storytelling, including its stages, enhances the ability to convey design concepts and ideas through effective storytelling.

IT and changing trends in DT

Information Technology (IT) in DT, Leveraging IT for Empathy and Research, Ideation and Collaboration with IT, Testing and Feedback Utilizing IT, and Transforming Design Thinking with IT.

Role of design thinking in engineering & business development

Design Thinking in Business- Product Innovation, Service, Design, Innovating Business Models, Agility and Adaptation, Design Thinking in Engineering- Product Design and Development, Process Optimization, Interdisciplinary Collaboration

UNIT IV.

Implementation challenges of DT

Lack of Buy-In and Understanding- Challenge, Fear of Failure- Challenge, Resource Constraints – Challenge.

Cultural and organizational challenges

Resistance to Change- Challenge, Silos and Collaboration Barriers- Challenge, Scaling Design Thinking – Challenge.

Cautions and pitfalls

Superficial Understanding, Overemphasis on Empathy, Groupthink, Confirmation Bias, Solution Bias, Ignoring Constraints, Lack of Implementation Planning, Over-Reliance on Workshops, Failure to Iterate, Misunderstanding of Users, Chasing Trends, Inadequate Testing, Lack of Commitment, Oversimplification, Disregarding Emotional Aspects.

UNIT IV.

Applications of DT

Healthcare, Automotive, Education, Transportation, Agriculture

Case studies

Design Thinking Approach to Develop Split AC in Place of Window AC, Design Thinking Approach to Reducing Traffic Waiting Time at Railway Crossings, Design Thinking Approach to Reduce the Chances of Confusion in Push-Pull Doors.

COURSE OUTCOMES:

CO1: Demonstrate the critical theories of design, systems thinking, and design methodologies.

CO2: Produce great designs, be a more effective engineer, and communicate with high emotional and intellectual impact.

CO3: Understand the diverse methods employed in design thinking and establish a workable design thinking framework to use in their practices.

CO4: Conceive, organize, lead, and implement projects in an interdisciplinary domain and address social concerns with innovative approaches.

TEXT BOOKS:

1. Tim Brown, Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation, HarperCollins Publishers Ltd.
2. IdrisMootee, Design Thinking for Strategic Innovation,2013, John Wiley & Sons Inc
3. Gavin Ambrose, Paul Harris, “Basics Design - 8: Design Thinking”, illustrated, reprint, AVA Publishing, 2010.

INTRODUCTION TO MECHANICAL AND CIVIL ENGINEERING

COURSE OBJECTIVES:

- To provide the students with an illustration of the significance of the Civil and Mechanical Engineering Profession in satisfying the societal needs.
- To help students acquire knowledge in the basics of surveying and the materials used for construction.
- To provide an insight into the essentials of components of a building and the infrastructure facilities.
- To explain the components of power plant units and provide a detailed explanation of the working principles of IC engines.
- To explain the Refrigeration & Air-conditioning system

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UNIT I. OVERVIEW OF MECHANICAL ENGINEERING – THERMAL ENGINEERING

Overview of Mechanical Engineering - Mechanical Engineering Contributions to the welfare of Society –Specialized sub-disciplines in Mechanical Engineering – Manufacturing, Automation, Automobile, and Energy Engineering - Interdisciplinary concepts in Mechanical Engineering.

Thermal Engineering: Classification of Power Plants- Working principle of steam, Gas, Diesel, hydroelectric, and Nuclear Power plants.

Internal Combustion Engines: Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Hybrid Engine – Electric Vehicle.

Terminology of Refrigeration and Air Conditioning: Principle of vapour compression and absorption system–Layout of a typical domestic refrigerator.

Properties of Air: Water mixture, concepts of psychometric and its process - Definitions of dry, wet & dew point temperatures, specific humidity and relative humidity, Cooling and dehumidification - Layout of unit and central air conditioners - Window and Split type room Air conditioners.

UNIT II. MANUFACTURING ENGINEERING

Manufacturing Process: Basic description of the manufacturing processes – Sand Casting, Forging, Rolling, Extrusion, and their applications.

Metal Joining Processes: List types of welding, description with sketches of Arc Welding, Soldering, and Brazing, and their applications.

Basic Machining operations: Turning, Drilling, Milling, and Grinding. Description about working with block diagrams of: Lathe machine, Drilling Machine, Milling machine, CNC Machine, and Tool failure.

Rapid Prototyping and Additive Manufacturing.

Materials for Manufacturing: Metals and non-metals, solidification, lightweight form-filled structures, applications in engineering products, friction, wear and lubrication.

Unconventional machining process and micro-fabrication techniques

UNIT III. INTRODUCTION TO CIVIL ENGINEERING

Brief introduction to major disciplines of Civil Engineering like Transportation Engineering, Structural Engineering, Geo-technical Engineering, Water Resources Engineering, and Environmental Engineering. Civil Engineering contributions to the welfare of Society - Specialized sub-disciplines in Civil Engineering – Structural, Construction, Geotechnical, Environmental, Transportation, and Water Resources Engineering.
Introduction to Surveying: Introduction, Importance of Surveying, Objectives of Surveying, Types of Surveying
Classification of Surveys, Principles of Surveying, Maps, Measurement of Distances, Measurement of Angles.
Levelling, Determination of Areas, Contouring.

UNIT IV. CIVIL ENGINEERING MATERIALS

Bricks: - Classification, properties of good bricks, and tests on bricks.
Stones: - Qualities of good stones, types of stones, and their uses.
Cement: - Good qualities of cement, types of cement, and their uses.
Sand: - Classification, qualities of good sand, and sieve analysis.
Timber: - Characteristics, properties and uses.
Cement concrete: - Constituent materials, properties, and types,
Steel: - Steel sections and steel reinforcements, types and uses.
Modern construction materials include architectural glass, ceramics, plastics, composite materials, thermal and acoustic insulating materials, decorative panels, waterproofing materials, and modern uses of gypsum, as well as pre-fabricated building components.
Building Components and Structures.
Foundations: - Bearing capacity of soil, functions of foundations, types – shallow and deep.
Superstructure: Brick masonry: - Header and stretcher bond, English bond & Flemish bond– elevation and plan.
Random rubble masonry.
Roofs: Functions, types; roofing materials
Floors: Functions, types; flooring materials
Basic infrastructure services include MEP, HVAC, Elevators, escalators, ramps, and fire safety for buildings.
National building code – terminologists: Plinth area, Carpet area, Floor area, Buildup area, Floor space index - Types of buildings: Residential buildings, Industrial buildings.

UNIT V. BUILDING COMPONENTS AND STRUCTURES

Bridges: Introduction, Components, Classification, and Culverts.
Dams: Introduction, Purpose of Dams, Components of a Reservoir, Selection of Site, Classification of Dams, Geological Effects.
Green Buildings: Materials, Energy Systems, Water Management, and Environment for Sustainable Green Buildings.

COURSE OUTCOMES:

CO1: Recall the role of a civil engineer in society and relate the various disciplines of Civil Engineering.

C02. Explain different types of buildings, building components, building materials, and building construction

CO3: Describe the importance, objectives, and principles of surveying.

CO4: Summarise the basic infrastructure services MEP, HVAC, elevators, escalators, and ramps

CO5: Discuss the Materials, energy systems, water management, and environment for green buildings.

CO6: Analyse thermodynamic cycles and calculate their efficiency.

CO7: Illustrate the working and features of IC Engines.

CO8: Explain the basic principles of Refrigeration and Air Conditioning.

CO9: Describe the working of hydraulic machines.

CO10: Explain the working of power transmission elements.

CO11: Describe the basic manufacturing, metal joining, and machining processes.

TEXT BOOKS:

1. Shanmugam G, Palanichamy M S, Basic Civil and Mechanical Engineering, McGraw Hill Education; First edition, 2018.
2. Nag P K, Basic and Applied Thermodynamics (8 th Edition)- Tata McGraw Hill India, 2006.
3. Rajput, R K, Textbook of Internal Combustion Engines (3 rd Edition)- Laxmi Publications India, 2016
4. Khurmi RS, Gupta J K, Textbook of Refrigeration and Air Conditioning, S. Chand Limited India, 2008.
5. Ghosh A. and Mallik A K, Manufacturing Science, Affiliated East-West Press.
6. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)- Pearson India, 2014.
7. B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, Surveying Vol. I, Laxmi Publications, 17th Edition, 2016.
8. Michael Bauer , Peter Mösle, Michael Schwarz, Green Building Guidebook for Sustainable Architecture, Springer publications.

INTRODUCTORY COURSE ON AVIATION INDUSTRY AND AEROMODELLING

Course Objectives:

- To familiarize with the aviation engineering course conducted at the GSV
- To introduce the concept of "Safety", "Safety Management", and the regulatory framework applied to the aviation industry.
- To introduce the fundamentals of aerodynamics.
- To introduce the fundamentals of aircraft structure, various systems, and propulsion.
- To introduce the aeromodelling activities.
- To create passion for the Aviation Industry.

UNIT I.

Introduction and overview of the Aviation Engineering Curriculum.

Concept of Safety in Aviation, Terms and Terminology, Evolution of Safety, Various Safety Models Used in the Aviation Industry, and Safety Management System (SMS) Familiarization.

Role and responsibility of ICAO and State regulators. Familiarization with various annexes of ICAO. Familiarization with various stakeholders of the aviation industry.

ICAO and DGCA Safety reports and other reports on various aspects of the global and domestic aviation industry.

UNIT II.

ICAO standard atmospheric conditions.

Fundamentals of aerodynamics; Airflow theory and various parts of airfoil, mean aerodynamic chord, aspect ratio, fineness ratio, boundary layer laminar and transition, and turbulent flow over an aerofoil, aerofoil contamination, familiarization with the terms lift, drag, thrust, primary and secondary control surfaces.

Airplane Stability and Control: Airplane axis system, forces and moments about longitudinal, lateral, and vertical axes, equilibrium of forces developed on wing and horizontal tail, centre of gravity, centre of pressure, angle of attack, angle of incidence, aircraft stall condition, aircraft stall relation with angle of attack, its importance in stability and control. Control surfaces include elevators, ailerons, and the rudder.

UNIT III.

Airplane Structure: various types, including monocoque and semi-monocoque, ATA chapter specifications, and a brief introduction to key aircraft systems, such as Hydraulic and pneumatic systems, pressurization, temperature control, and the oxygen system. System

Integration, accessories. Aircraft Electrical System: Generation and distribution of Electricity on board the airplane. Flight Control System temperature / Environment, Aircraft Fuel System, Fire Protection, Ice and Rain Protection System, Airplane Propulsion: various types of jet turbine engines, their performance. Functioning of the Jet engine, turbo-prop, turbo-fan, turbo-shaft, various sections, and accessories.

UNIT IV.

Aeromodelling

Familiarization with various types of aircraft models and the materials they are made of. Familiarization with various types of power plants and fuels used for aircraft models. Various types of tools are used for assembling aircraft models. Finishing the model airfoil surfaces, final assembly, and flight testing.

Course Outcomes

- To describe the concept of "Safety", "Safety Management", and the regulatory framework applied to the aviation industry.
- To describe the fundamentals of aerodynamics.
- To describe the fundamentals of aircraft structure, various systems, and propulsion.
- To demonstrate the passion for the Aviation Industry.

REFERENCES:

https://nptel.ac.in/courses/101101079
https://nptel.ac.in/courses/101104071

ICAO and DGCA reports.
1. E H J Pallet, Aircraft Electrical Systems, Himalayan Books
2. E W Somerset Maugham, Jet Engine Manual, BIP Publications

ENGINEERING GRAPHICS AND WORKSHOP PRACTICES

COURSE OBJECTIVES:

- Ability to make basic engineering drawings using both geometric instruments and graphics software with equal ease.
- Ability to read engineering drawings
- Workshop practices involve hands-on training and practical experience in using tools, machines, and equipment commonly found in workshops and manufacturing environments.
- Learn how to handle and use a variety of hand tools (e.g., wrenches, screwdrivers, pliers) and power tools (e.g., drills, saws, grinders) for tasks such as cutting, shaping, fastening, and assembling materials.

Theory: https://archive.nptel.ac.in/content/syllabus_pdf/105104148.pdf

UNIT 1.

Introduction to sketching, Principal views, principles of dimensioning, missing lines and missing views, sectional view, assembly drawings, overview of pictorial representation, isometric drawing in detail, and perspective drawing.

UNIT 2.

lines, planes, auxiliary view, intersection of lines and planes, intersections of solids and Development of lateral surfaces.

LIST OF EXPERIMENTS:

1. Machining: Prepare a workpiece of given dimensions using turning, drilling, and facing operations.
2. Fitting: Make a simple open and sliding fitting (T-Fitting) as per drawing.
3. Carpentry: Prepare a Tee (halved) joint using a wood piece for the given dimensions.
4. Sheet Metal: Make a Square Tray from G.I. Sheet as per Drawing.
5. Welding: Make a T' Fillet joint in flat position by Arc Welding.

COURSE OUTCOMES:

- Demonstrate ability to make basic engineering drawings using both geometric instruments as well as graphics software with equal ease.
- Demonstrate ability to read engineering drawings
- Demonstrate workshop skills such as cutting, bending, shaping, and welding metals.
- Demonstrate accurate measurements and work with precision, as engineering often requires precise measurements and tolerances.

REFERENCE BOOKS:

1. Elements of Mechanical Engineering - Hajra Choudhury & others, Media Promoters 2010.
2. The Elements of Workshop Technology - Vol I & II, S.K. Hajra Choudhury, A.K. Hajra Choudhury, Nirjhar Roy, 11th edition 2001 others, Media Promoters and Publishers, Mumbai.

TECHNICAL ENGLISH COURSE

COURSE OBJECTIVES:

- To enable the students to use active and passive vocabulary in different academic and professional contexts
- To enable the students to develop their LSRW skills (listening, speaking, reading, and writing skills)
- To enable students to improve their proficiency in oral and written communication in technical English

UNIT 1.

- Technical vocabulary, using words in context- Use of suffixes to form nouns from verbs and Adjectives-Articles- Conjunctions and prepositions.
- Tenses-Active and Passive voices, Degrees of comparison.
- Reading text: Skimming for general information, note-making, listening, and transferring of information from text to graphic forms-bar charts, flow Charts-Paragraph writing.
- Role play - Conversational Techniques, Discussions-Oral reporting.

UNIT 2.

- Vocabulary items: Words with prefixes ("Multi" - "Under"), asking and answering questions, spelling, and punctuation.
- Reading comprehension- Scanning for information.
- Listening and guided note-taking, paragraph writing, using notes, giving suitable headings, and sub-headings for paragraphs.
- Comparing and contrasting using expressions of comparisons- Discussing creative ideas.

UNIT 3.

- Compound nouns - negative prefixes - Antonyms - Use of modal verbs.
- Making sentences using phrases.
- Tenses: Simple past and present perfect, Reported Speech.
- Reading and guessing meanings in context, listening, and Note-taking.

UNIT 4.

- Channel conversation from text to chart, making recommendations.
- Discussion- Role play, explaining, and convincing.
- Expanding nominal compounds-words with multiple meanings –moderate verbs, error correction, compound adjectives.
- Simple past and present perfect tense.

UNIT 5.

- Reading – Prediction of Content-Understanding advertisements.

- Scanning the text and comprehension check.
- Listening for Details-Listening comprehension.
- Writing Definitions - Expression of views and purpose- Role Play-Discussion-Speculating about the future.

UNIT 6.

- Formation of nouns, verbs, and adjectives from root words.
- Useful phrases and expressions.
- 'If' conditional clauses-gerunds.
- Reading for comprehension- Intensive reading.

UNIT 7.

- Accuracy in listening- listening to the discussion on specific issues.
- Group Discussion.
- Role play - (Stating, discussing problems, and proposing solutions).
- Planning a tour- writing an itinerary, writing formal letters to the editor.

COURSE OUTCOMES:

- To demonstrate the use of active and passive vocabulary in different academic and professional contexts
- To demonstrate the LSRW skills (listening, speaking, reading, and writing skills)
- To demonstrate the improved proficiency in oral and written communication in technical English.

REFERENCES:

https://archive.nptel.ac.in/content/syllabus_pdf/109106066.pdf

COMPUTER PROGRAMMING-I (C Language)

COURSE OBJECTIVES:

- To introduce students to the fundamental concepts of computer programming.
- To teach students the basics of algorithm development and problem-solving techniques.
- To familiarize students with a high-level programming language for practical implementation.
- To enable students to write, debug, and execute simple programs independently.
- To prepare students for more advanced programming courses in their respective engineering disciplines.

UNIT I. C LANGUAGE FUNDAMENTALS:

Character set, Identifiers, keyword, data types, Constants and variables, statements, expression, operators, precedence of operators, Input-output, Assignments, control structures, decision making, and branching.

UNIT II. ARRAYS, FUNCTIONS, AND STRINGS:

Declaration, manipulation, and string–handling functions, monolithic vs. Modular programs, user-defined vs. standard functions, formal vs. actual arguments, function category, function prototypes, parameter passing, recursion, and storage classes: auto, extern, global, static.

UNIT III. POINTERS, STRUCTURES, UNIONS, FILE HANDLING:

Pointer variable and its importance, pointer arithmetic, passing parameters, Declaration of structures, pointer to pointer, pointer to structure, pointer to function, union, dynamic memory allocation, file management.

COURSE OUTCOMES:

CO1: Develop a C program
CO2: Control the sequence of the program and give logical outputs
CO3: Implement strings in your C program
CO4: Store different data types in the same memory
CO5: Manage I/O operations in your C program
CO6: Repeat the sequence of instructions and points for a memory location
CO7: Apply code reusability with functions and pointers
CO8: Understand the basics of file handling mechanisms
CO9: Explain the uses of pre-processors and various memory models

REFERENCE BOOKS:

1. E. Balagurusamy “Programming in C”. Tata McGraw Hill
2. Programming in C, a complete introduction to the programming language, Stephan G. Kocham, third edition.
3. Ashok N. Kamthane “Programming with ANSI and TURBO C”. Pearson Education.

ENGINEERING MATHEMATICS – II

COURSE OBJECTIVES:

The objective of this course is to familiarize the graduate engineers with techniques in Differential Equations, Fourier Series, Laplace Transforms, and their applications. It aims to equip students with standard mathematical concepts and tools that can be applied to solve various engineering applications, which will be beneficial in their respective disciplines.

UNIT I. ORDINARY DIFFERENTIAL EQUATIONS:

General introduction of the ordinary differential equations and differential equations of first order and first degree, Exact differential. Linear differential equation of higher order with constant coefficients: Complementary function and particular integral for some standard functions. Method of Variation of parameters and its application for solving the Damped forced oscillations problem. Applications of differential equations: solving LCR circuit theory problems.

UNIT II. PARTIAL DIFFERENTIAL EQUATIONS:

Formation of Partial Differential Equations, Solutions of standard types of first-order partial differential equations – Lagrange's linear equation, Charpit's method for solving non-linear PDE, Method of separation of variables. Application of Partial Differential Equations: Classification of 2nd order PDE, Solution of the wave equation in one and two dimensions, Solution of the heat equation (in one dimension), and the Laplace equation using the method of separation of variables.

UNIT III. LAPLACE TRANSFORMS:

Introduction of Laplace Transform, Laplace transform of some standard functions, and their properties. Laplace transform of periodic functions, special functions, derivatives, and integrals. Evaluation of integrals using Laplace Transforms.

UNIT IV. INVERSE LAPLACE TRANSFORMS & APPLICATIONS:

Inverse Laplace Transform and its properties. Convolution Theorem. Application of Laplace Transform: To solve differential equations, Unit Step Function, Unit Impulse Function

UNIT V. FOURIER SERIES:

Introduction to Fourier Series, Euler's Formula, and Conditions of Fourier Expansion. Fourier Series of period 2π, Change of interval, Even and odd functions, Function having point of discontinuity, Half range sine and cosine series, and typical Waveforms.

UNIT VI. PROBABILITY AND STATISTICS:

Definitions of probability, sampling theorems, conditional probability; mean, median, mode, and standard deviation; random variables, binomial, Poisson, and normal distributions.

COURSE OUTCOMES:

CO1: Students will learn to solve ordinary differential equations and their application in the solution of mechanical and electrical driven problems.

CO2: Describe the method of partial differential equations and classification of PDEs. Apply the method of PDEs to solve heat, wave, and Laplace equations.

CO3: Understand basic concepts of Laplace Transforms and inverse Laplace transform, and solve engineering problems involving step functions, impulse functions, and differential equations

CO4: Describe the concepts of the Fourier series and apply the Fourier series to generate various mathematical functions, such as the half-range sine and cosine series

TEXT BOOKS:

1. Kreyszig.E, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.
2. Grewal.B.S., “Higher Engineering Mathematics”, Khanna Publishers, New Delhi, 44th Edition, 2018.

REFERENCE BOOKS:

1. Anton. H, Bivens. I and Davis. S, " Calculus ", Wiley, 10th Edition, 2016
2. Bali. N., Goyal. M. and Watkins. C., “Advanced Engineering Mathematics”, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
3. Jain. R.K. and Iyengar. S.R.K., “Advanced Engineering Mathematics”, Narosa Publications, New Delhi, 5th Edition, 2016.
4. Narayanan. S. and Manicavachagom Pillai. T. K., “Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2009.

DEVELOPING SOFT SKILLS AND PERSONALITY

COURSE OBJECTIVES:

- To impart basic awareness about the significance of soft skills in professional and inter-personal communications.
- To facilitate an all-round development of personality.
- To impart awareness of soft skills such as self-confidence, positive attitude, emotional intelligence, social grace, flexibility, friendliness, and effective communication skills.

UNIT 1.

Introduction: A New Approach to Learning, Planning and Goal-Setting, Human Perceptions: Understanding People, Types of Soft Skills: Self-Management Skills, aiming for Excellence: Developing Potential and Self-Actualisation, Need Achievement And Spiritual Intelligence, Conflict Resolution Skills: Seeking Win-Win Solution, Inter-Personal Conflicts: Two Examples, Inter-Personal Conflicts: Two Solutions, Types Of Conflicts: Becoming A Conflict Resolution Expert, Types Of Stress: Self-Awareness About Stress, Regulating Stress: Making The Best Out Of Stress

UNIT 2.

Habits: Guiding Principles, Habits: Identifying Good and Bad Habits, Habits: Habit Cycle, Breaking Bad Habits, Using The Zeigarnik Effect for Productivity and Personal Growth, Forming Habits of Success, Communication: Significance of Listening, Communication: Active Listening, Communication: Barriers to Active Listening, Telephone Communication: Basic Telephone Skills, Telephone Communication: Advanced Telephone Skills, Telephone Communication: Essential Telephone Skills

UNIT 3.

Technology And Communication: Technological Personality, Technology And Communication: Mobile Personality?, Topic: Technology And Communication: E-Mail Principles, Technology And Communication: How Not To Send E-Mails!, Technology And Communication: Netiquette, Technology And Communication: E-Mail Etiquette, Communication Skills: Effective Communication, Barriers To Communication: Arising Out Of Sender/Receiver's Personality, Barriers To Communication: Interpersonal Transactions, Barriers To Communication: Miscommunication, Non-Verbal Communication: Pre-Thinking Assessment-1, Non-Verbal Communication: Pre-Thinking Assessment-2

UNIT 4.

Nonverbal Communication: Introduction and Importance, Non-Verbal Communication: Issues and Types, Non-Verbal Communication: Basics and Universals, Non-Verbal Communication: Interpreting Non-Verbal Cues, Body Language: For Interviews, Body Language: For Group Discussions, Presentation Skills: Overcoming Fear, Presentation Skills: Becoming A

Professional, Presentation Skills: The Role of Body Language, Presentation Skills: Using Visuals, Reading Skills: Effective Reading, Human Relations: Developing Trust And Integrity

COURSE OUTCOMES:

- Describe awareness about the significance of soft skills in professional and inter-personal communications.
- Demonstrate an all-round development of personality.
- Describe awareness of soft skills such as self-confidence, positive attitude, emotional intelligence, social grace, flexibility, friendliness, and effective communication skills.

REFERENCES:

https://archive.nptel.ac.in/content/syllabus_pdf/109104107.pdf

INTRODUCTION TO MULTIMODAL TRANSPORTATION ECOSYSTEM

COURSE OBJECTIVES:

- To introduce the concept of multimodal transportation and its significance in modern logistics.
- To understand the different modes of transportation (road, rail, air, water) and their unique characteristics.
- To analyze the intermodal connectivity and the seamless flow of goods and services across transportation networks.
- To explore the role of technology and digitalization in optimizing multimodal transportation operations.
- To familiarize students with sustainable practices and environmental considerations in multimodal logistics.
- To promote critical thinking and problem-solving skills for addressing challenges in the transportation and logistics ecosystem.

UNIT I. INTRODUCTION TO MULTIMODAL TRANSPORTATION

Definition and significance of multimodal transportation.
Advantages and Challenges of Integrated Transportation Systems.

UNIT II. MODES OF TRANSPORTATION

Road Transportation: Vehicles, networks, and infrastructure.
Rail Transportation: Trains, tracks, and electrification.
Air Transportation: Aircraft, airports, and air traffic management.
Water Transportation: Ships, ports, and waterways.

UNIT III. INTERMODAL CONNECTIVITY

Containerization and standardization.
Transshipment and intermodal terminals
Last-mile connectivity and integration

UNIT IV. SUPPLY CHAIN MANAGEMENT AND LOGISTICS

Basics of supply chain management
Logistics processes and activities
Role of transportation in logistics

UNIT V. TECHNOLOGICAL ADVANCEMENTS IN MULTIMODAL TRANSPORTATION

Intelligent transportation systems (ITS)
IoT and data-driven logistics solutions
Automation and autonomous vehicles in transportation

UNIT VI. DIGITALIZATION AND DATA ANALYTICS

Big data and analytics in transportation planning
Real-time tracking and monitoring of shipments
Optimization algorithms for route planning

UNIT VII. SUSTAINABILITY AND ENVIRONMENTAL CONSIDERATIONS

Green logistics and eco-friendly transportation practices
Energy efficiency and emissions reduction
Sustainable supply chain initiatives

UNIT VIII. INTERMODAL TRANSPORTATION REGULATIONS AND POLICIES

National and international transportation regulations
Freight forwarding and customs procedures
Safety and security in multimodal logistics

COURSE OUTCOMES:

CO1: Compares the diverse aspects of transportation;
CO2: Applies analytical techniques to arrive at cost-effective remedies to Indian transportation needs;
CO3: Manages global logistics partners and service providers;
CO4: Decides optimal transportation modal benefit;
CO5: Summarizes domestic and international transportation networks;
CO6: Identifies transport problems in logistics and warehouses.

REFERENCE BOOKS:

1. Multimodel Transport System by **Slim Hammadi and Mekki Ksouri, Wiley.**
2. Multimodal Transportation Planning Curriculum for Urban Planning Programs by Kristine M. Williams, Tia Claridge, Alexandria Carroll.

ENGINEERING MECHANICS

COURSE OBJECTIVES:

- Understand the fundamental principles of statics and dynamics.
- Analyze and solve problems related to forces, moments, and equilibrium.
- Develop the ability to calculate reactions in structures and mechanical systems.
- Apply engineering mechanics principles to real-world engineering problems.
- Determine internal forces, deflections, and stability of structures under various loading conditions.

UNIT I. INTRODUCTION TO VECTORS AND TENSORS AND CO-ORDINATE SYSTEMS

Introduction to vectors and tensors and coordinate systems; Vector and tensor algebra; Indicial notation; Symmetric and anti-symmetric tensors; Eigenvalues and Principal axes.

UNIT II. THREE-DIMENSIONAL ROTATION

Three-dimensional rotation: Euler's theorem, Axis-angle formulation, and Euler angles; Coordinate transformation of vectors and tensors.

UNIT III. KINEMATICS OF A RIGID BODY

Kinematics of rigid bodies: Dentition and motion of a rigid body; Rigid bodies as coordinate systems; Angular velocity of a rigid body, and its rate of change; Distinction between two- and three-dimensional rotational motion; Integration of angular velocity to find orientation; Motion relative to a rotating rigid body: Five-term acceleration formula.

UNIT IV. KINETICS OF RIGID BODIES

Kinetics of rigid bodies: Angular momentum about a point; Inertia tensor: Determination and computation, Principal moments and axes of inertia, Parallel and perpendicular axes theorems; Mass moment of inertia of symmetrical bodies, cylinder, sphere, cone, etc., Area moment of inertia and Polar moment of inertia, Forces and moments; Newton-Euler's laws of rigid body motion.

UNIT V. FREE BODY DIAGRAM

Free body diagrams; Examples on modelling of typical supports and joints, and discussion on the Cinematic and kinetic constraints that they impose.

UNIT VI. GENERAL MOTION

Examples and problems. General planar motions. General 3-D motions. Free precession, Gyroscopes, Rolling coin.

UNIT VII. BENDING MOMENT

Transverse loading on beams, shear force and bending moment in beams, analysis of cantilevers, supported beams and overhanging beams, relationships between loading, shear force and bending moment, shear force and bending moment diagrams.

UNIT VIII. TORSIONAL MOTION

Torsion of circular shafts, derivation of the torsion equation, stress, and deformation in circular and hollow shafts.

UNIT IX. FRICTION

Concept of Friction; Laws of Coulomb friction; Angle of Repose; Coefficient of friction.

COURSE OUTCOMES:

CO1: Understand the concepts of coordinate systems.
CO2: Analyse the three-dimensional motion.
CO3: Understand the concepts of rigid bodies.
CO4: Analyse the free-body diagrams of different arrangements.
CO5: Analyse torsional motion and bending moment.

TEXT BOOKS:

1. J.L. Meriamand L.G. Kraige, "Engineering Mechanics: Dynamics",Wiley, 2011.
2. Timoshenko S, and Young D.H, 'Engineering Mechanics', Tata McGraw Hill, 2006
3. Shames I.H, and Rao G.K.M, 'Engineering Mechanics – Static and Dynamics', Pearson Education, 2009.

REFERENCE BOOKS:

1. Kumar K.L., Kumar V, 'Engineering Mechanics', Tata McGraw Hill, 2011.

ELECTRICAL & ELECTRONICS FUNDAMENTALS

COURSE OBJECTIVES:

- To introduce the 'Electrical' and 'Electronics' fundamentals, including the terminologies.
- To enable students to correctly understand the Electrical and Electronics fundamentals in the context of aircraft maintenance.
- To use mathematical formulae related to the subject.
- To apply the knowledge of semiconductors, ICs, and PCBs practically in aircraft maintenance using the manufacturer's instructions.

3.1 Electron Theory

Structure and distribution of electrical charges within: atoms, molecules, ions, compounds;
Molecular structure of conductors, semiconductors and insulators.

3.2 Static Electricity and Conduction

Static electricity and distribution of electrostatic charges; Electrostatic laws of attraction and repulsion;
Units of charge, Coulomb's Law; Conduction of electricity in solids, liquids, gases and a vacuum.

3.3 Electrical Terminology

The following terms, their units and factors affecting them: potential difference, electromotive force, voltage, current, resistance, conductance, charge, conventional current flow, electron flow.

3.4 Generation of Electricity

Production of electricity by the following methods: light, heat, friction, pressure, chemical reaction, magnetism and motion.

3.5 Sources of DC Electricity

Construction and basic chemical reaction of: primary cells, secondary cells, lead acid cells, nickel cadmium cells, lithium cells, nickel cells and other alkaline cells;
Cells connected in series and parallel; Internal resistance and its effect on a battery; Construction, materials and operation of thermocouples; Operation of photo-cells.

3.6 DC Circuits

Ohm's Law, Kirchoff's Voltage and Current Laws;
Calculations using the above laws to find resistance, voltage and current; Significance of the internal resistance of a supply.

3.7 Resistance/Resistor

(a) Resistance

Specific resistance; Calculation of total resistance using series, parallel and series parallel combinations; Operation and use of potentiometers and rheostats; Operation of Wheatstone Bridge.

(b) Resistor

Positive and negative temperature coefficient conductance; Resistor colour code, values and tolerances, preferred values, wattage ratings; Resistors in series and in parallel; Fixed resistors, stability, tolerance and limitations, methods of construction; Variable resistors, thermistors, voltage-dependent resistors; Construction of potentiometers and rheostats; Construction of Wheatstone Bridge.

3.8 Power

Power, work and energy (kinetic and potential); Dissipation of power by a resistor; Power formula; Calculations involving power, work and energy.

3.9 Capacitance/Capacitor

Operation and function of a capacitor; Factors that affect the capacitance area of plates, distance between plates, number of plates, dielectric and dielectric constant, working voltage, voltage rating; Capacitor types, construction, and function; Capacitor colour-coding; Calculations of capacitance and voltage in series and in parallel circuits; Exponential charge and discharge of a capacitor, time constants; Testing of capacitors.

3.10 Magnetism

(a) Theory of magnetism; Properties of a magnet; Action of a magnet suspended in the Earth's magnetic field; Magnetisation and demagnetisation; Magnetic shielding; Various types of magnetic material; Electromagnet construction and principles of operation; Handclasp rules to determine magnetic field around current-carrying conductor.

(b)Magnetomotive force, field strength, magnetic flux density, permeability, hysteresis loop, retentivity, coercive force reluctance, saturation point, eddy currents; Precautions for care and storage of magnets.

3.11 Inductance/Inductor

Faraday's Law;

Action of inducing a voltage in a conductor that moves in a magnetic field; Induction principles; Effects of the following on the magnitude of an induced voltage: magnetic field strength, rate of change of flux, number of conductor turns; Mutual induction; The effect that the rates of change of primary current and mutual inductance have on induced voltage;
Factors that affect mutual inductance: number of turns in the coil, physical size of the coil, permeability of the coil, position of coils with respect to each other; Lenz's law and polarity determining rules; Back EMF, self-induction; Saturation point; Principal uses of inductors.

3.12 DC Motor/Generator Theory

Basic motor and generator theory; Construction and purpose of components in a DC generator; Operation of and factors that affect the output and direction of the current in DC generators; Operation of and factors that affect the output power, torque, speed, and direction of rotation of DC motors; Series-wound, shunt-wound and compound motors; Starter generator construction.

3.13 AC Theory

Sinusoidal waveform: phase, period, frequency, cycle; Instantaneous, average, root mean square, peak, peak to peak current values and calculations of these values in relation to voltage, current and power Triangular/Square waves; Single-phase/Three-phase principles.

3.14 Resistive (R), Capacitive (C) and Inductive (L) Circuits

Phase the relationship of voltage and current in L, C and R circuits, parallel, series and series parallel; Power dissipation in L, C and R circuits; Impedance, phase angle, power factor and current calculations; True power, apparent power, and reactive power calculations.

3.15 Transformers

Transformer construction principles and operation; Transformer losses and methods for overcoming them; Transformer action under load and no-load conditions; Power transfer, efficiency, polarity markings; Line and phase voltages and currents; Power in a three-phase system; Primary and secondary current, voltage, turn ratio, power, efficiency; Auto-transformers.

3.16 Filters

Operation, application and uses of the following filters: low pass, high pass, band pass, band stop.

3.17 AC Generators

Rotation of loop in a magnetic field and waveform produced; Operation and construction of revolving armature and revolving field type AC generators; Single phase, two phase and three phase alternators; Three phase star and delta connections advantages and uses; Permanent Magnet Generators.

3.18 AC Motors

Construction, principles of operation and characteristics of: AC synchronous and induction motors both single-phase and poly-phase; Methods of speed control and direction of rotation; Methods of producing a rotating field: capacitor, shaded or split pole.

4.1 Semiconductors

4.1.1 Diodes

(a) Description and characteristics Diode symbols; Diode characteristics and properties; Diodes in series and in parallel; Materials, electron configuration, electrical properties; P and N type materials: effects of impurities on conduction, majority and minority characters; P N junction

in a semiconductor, development of a potential across a P N junction in unbiased, forward-biased and reverse-biased conditions; Diode parameters: peak inverse voltage, maximum forward current, temperature, frequency, leakage current, power dissipation; Main characteristics and use of silicon-controlled rectifiers (thyristors), light- emitting diodes (LEDs), photo-conductive diodes, rectifier diodes.

(b) Operation and function

Operation and function of diodes in the following circuits: clippers, clampers, full- and half-wave rectifiers, bridge rectifiers, voltage doublers and triplers; Detailed operation and characteristics of the following devices: silicon- controlled rectifier (thyristor), light-emitting diode (LED), Schottky diode, photo-conductive diode, varactor diode, varistor, rectifier diodes, Zener diode. Functional testing of diodes.

4.1.2 Transistors

(a) Description and characteristics Transistor symbols; Component description and orientation; Transistor characteristics and properties.

(b) Construction and operation Construction and operation of PNP and NPN transistors; Base, collector and emitter configurations; Testing of transistors; Basic appreciation of other transistor types, including types of FET and their uses; Application of transistors: amplifier classes (A, B, C); Simple circuits including bias, decoupling, feedback and stabilisation; Multistage circuit principles: cascades, push pull, oscillators, multivibrators, flip-flop circuits; Operation and amplifier stages connecting methods: resistive, capacitive, direct, inverting, non-inverting and adding

4.1.3 Integrated Circuits

(a)Description and operation of logic circuits and linear circuits/operational amplifiers.

(b) Introduction to the operation and function of an operational amplifier used as: an integrator, a differentiator, a voltage follower, a comparator; Advantages and disadvantages of positive and negative feedback.

4.2 Printed Circuit Boards

Description and use of printed circuit boards.

4.3 Servomechanisms

(a) Principles

Understanding of the following principles: open- and closed-loop systems, servomechanism, feedback, follow-up, null, overshoot, damping, deadband, hunting, proximity switches, analogue transducers, synchro systems and components, digital tachometers and encoders, inductance, and capacitance transmitters;

b) Construction operation and use of the following synchro-system components: resolvers, differential, control and torque, E and I transformers, inductance transmitters, capacitance

transmitters, synchronous transmitters; Construction, operation and use of servomechanism and PID controller; Fault- finding of servo defects, reversal of synchro leads, hunting.

COURSE OUTCOMES:

- Describe ‘Electrical’ and ‘Electronics’ fundamentals and the terminologies.
- Demonstrate the understanding of Electrical and Electronics fundamentals in the context of aircraft maintenance.
- Demonstrate application of mathematical formulae related to the Electrical fundamentals.
- Demonstrate the knowledge of semiconductors, ICs, and PCBs practically in aircraft maintenance using the manufacturer's instructions.

REFERENCES:

Bernard Grob	Basic Electronics
Albert D Helfrick	Modern Aviation Electronics
B.L.Theraja	Electrical Technology
EASA Module-03	Electrical Fundamental

Health, Wellness, and Yoga (Holistic development)

COURSE OBJECTIVES:

- The course will empower and motivate students to achieve wellness.
- It will also give them requisite skills in various Yoga techniques that can be practiced for their own benefit or shared with others.
- It will develop them all-round personality.

UNIT I. INTRODUCTION

What is Yoga? Brief history and development of Yoga, The Fundamentals of Yoga, Traditional Schools of Yoga, Yogic practices for health and wellness, General Guidelines for Yoga Practice, Food for thought, How Yoga can help?

UNIT II. PRAYER

Sadilaja /CālanaKriyās/Loosening Practices, Neck Bending, Shoulder's movement, Trunk Movement, Knee Movement

UNIT III. YOGĀSANAS

Standing Postures: Tāḍāsana, Vṛkṣāsana, Pāda-Hastāsana, ArdhaCakrāsana, Trikoṇāsana
Sitting Postures: Bhadrāsana, Vajrāsana/Vīrāsana, ArdhaUṣṭrāsana, Uṣṭrāsana, Śaśakāsana, UttānaMaṇḍūkāsana, Marīchyāsana / Vakrāsana
Prone Postures: Makarāsana, Bhujaṅgāsana, Śalabhāsana
Supine Postures: Setubandhāsana, Uttānapādāsana, Ardhahalāsana, Pavanamuktāsana, Śavāsana
Kapālabhāti, Prāṇāyāma, Naḍīśodhana / AnulomaVilomaPrāṇāyāma, ŚītalīPrāṇāyāma, BhrāmarīPrāṇāyāma, Dhyāna, Saṅkalpa, ŚāntiḥPāṭha

COURSE OUTCOMES:

CO1: Knowledge of Yogic practices
CO2: Ability to demonstrate the practices

REFERENCE BOOKS:

1. Sanjeev S. Tonni, Yoga and Wellness, Saraswati Prakashan, Gujarat, 2020.
2. Carrie Schell, Yoga Recovery: A Mind-Body-Spirit Journey to Wellness, Austin Macauley Publishers, USA, 2019.
3. Gary Kraftsow, Yoga for Wellness: Healing with the Timeless Teachings of Viniyoga, Penguin Books, UK, 1999.

AIRCRAFT STRUCTURES AND SYSTEMS (GENERAL)

COURSE OBJECTIVES:

- To impart knowledge of Theory of Flight, flight controls and high speed flights.
- To impart knowledge of Airframe Structure.
- To impart knowledge of fuselage, wings, stabilizer, flight control surfaces, nacelle and pylons, air conditioning and pressurization systems of an aircraft.
- To impart knowledge of instrument system, avionics, and electrical systems of an aircraft

11.1 Theory of Flight

(a) Aeroplane Aerodynamics and Flight Controls Operation and effect of:

roll control: ailerons and spoilers; pitch control: elevators, stabilators, variable incidence stabilisers and canards; yaw control, rudder limiters; elevons, ruddervators; high-lift devices, slots, slats, flaps, flaperons; drag-inducing devices, spoilers, lift dumpers, speed brakes; trim tabs, servo tabs, control surface bias.

(b) Aeroplane: other aerodynamic devices Operation and effect of:

balance and anti-balance (leading) tabs; spring tabs, mass balance, aerodynamic balance panels; mass balance, aerodynamic balance panels; effects of wing fences, saw tooth leading edges; boundary layer control using vortex generators, stall wedges or leading-edge devices.

11.2 Airframe Structures (ATA 51)

(a) General concepts:

Zonal and station identification systems; Electrical bonding; Lightning strike protection provisions.

(b) Airworthiness requirements for structural strength:

Structural classification: primary, secondary, and tertiary; Fail-safe, safe-life, damage-tolerance concepts; Stress, strain, bending, compression, shear, torsion, tension, hoop stress, fatigue; Drains and ventilation provisions; System installation provisions.

(c) Construction methods

Stressed skin fuselage, formers, stringers, longerons, bulkheads, frames, doublers, struts, ties, beams, floor structures, reinforcement, skinning, anticorrosive protection, wing, empennage and engine attachments; Structure assembly techniques: riveting, bolting, bonding; Methods of surface protection, such as chromating, anodising, painting; Surface cleaning; Airframe symmetry: methods of alignment and symmetry checks.

11.3 Airframe Structures —Aeroplanes

11.3.1 Fuselage, doors, windows (ATA 52/53/56)

(a) Construction principles Construction and pressurisation sealing; Wing, stabiliser, pylon, and undercarriage attachments; Seat installation and cargo loading system; Doors and emergency exits: construction, mechanisms, operation and safety devices; Windows and windscreen construction and mechanisms.
(b) Airborne towing devices (glider, banner, target)
(c) Doors
Doors and emergency exits: safety devices; − Cargo loading system.

11.3.2 Wings (ATA 57)

Construction; Fuel storage; Landing gear, pylon, control surface and high lift/drag attachments.

11.3.3 Stabilisers (ATA 55)

Construction; Control surface attachment.

11.3.4 Flight Control Surfaces (ATA 55/57)

Construction and attachment; Balancing mass and aerodynamic.

11.3.5 Nacelles/Pylons (ATA 54)

Nacelles/Pylons: Construction; Firewalls; Engine mounts.

11.4 Air Conditioning and Cabin Pressurisation (ATA 21)

(a) Pressurisation
Pressurisation systems; Cabin pressure controllers, control, and safety valves; Control and indication.
(b) Air supply
Sources of air supply including engine bleed, APU and ground cart; Distribution systems.
(c) Air conditioning
Air-conditioning systems; Air cycle and vapour cycle machines; Flow, temperature and humidity control system; Control and indication control valves.
(d) Safety and warning devices Protection and warning devices.
(e) Heating and ventilation systems.

11.5 Instruments/Avionic Systems

11.5.1 Instrument Systems (ATA 31)

Pitot static: Airspeed indicators, Vertical speed indicators, Altimeters; Gyroscopic: Gyroscopic principles, Artificial horizons, Attitude directors, Direction indicators, Horizontal situation indicators (HSI), Slip indicators, Turn indicators, Turn coordinators; Compass systems: systems, direct reading, remote reading, Stall-warning systems and angle-of-attack indicating systems, Glass cockpit, Indications of other aircraft systems.

11.5.2 Avionic Systems

Fundamentals of system layouts and operation of: Autoflight (ATA 22); Communication systems (ATA 23): Very High Frequency (VHF) communications, High Frequency (HF) communications, Satellite Communications (SATCOM), Controller pilot data link communications (CPDLC), Audio systems, − Emergency Locator Transmitters (ELTs), − Cockpit Voice Recorder (CVR);

Navigation systems (ATA 34): Very high frequency omnidirectional range (VOR), Automatic direction finder (ADF), Instrument landing system (ILS), Microwave landing system (MLS), Flight director systems (FDSs), distance-measuring equipment (DME), Area navigation (RNAV) systems, Flight management systems (FMSs), Satellite navigation systems, Air traffic control transponder, secondary surveillance radar, Traffic alert and collision avoidance system (TCAS), Weather avoidance radar, Radio altimeter, Inertial navigation system (INS), ARINC (Aeronautical Radio Incorporated) communication and reporting. Types and uses of avionics general test equipment.

11.6 Electrical Power (ATA 24)

Installation and operation of batteries; DC power generation; AC power generation; Emergency power generation; Voltage regulation; Power distribution; Inverters, transformers, rectifiers; Circuit protection; External/ground power.

11.7 Equipment and Furnishings (ATA 25)

(a)Emergency equipment requirements.

(b)Cabin cargo layout:

Seats, harnesses, and belts; Cabin layout; Equipment layout; Cabin furnishing installation; Galley installation; Cargo handling and retention equipment; Airstairs.

11.8 Fire Protection (ATA 26)

(a)Fire and smoke detection system, and fire-extinguishing systems:

Fire and smoke detection and warning systems; Fire-extinguishing systems; System tests.

(b)Portable fire extinguisher

11.9 Flight Controls (ATA 27)

Primary and secondary flight controls:

Primary controls: aileron, elevator, rudder, spoiler; Trim control, trim tabs; High-lift devices; System operation: manual; Gust locks and gust lock systems; Artificial feel, yaw damper, Mach trim, rudder limiter; Stall-warning systems.

(b) Actuation and protection: Active load control; Lift dump, speed brakes; Hydraulic, pneumatic systems; Stall-protection systems.

(c) System operation: Electrical systems, fly-by-wire systems.

(d) Balancing and rigging.

11.10 Fuel Systems (ATA 28, ATA 47)

(a) Systems: System layout; Fuel tanks; Supply systems.

(b) Fuel handling: Cross-feed and transfer; Refuelling and defuelling.
(c) Indication and warnings.
(d) Special systems: Dumping, venting, and draining; Inert gas systems.
(e) Balancing: Longitudinal balance fuel systems.

11.11 Hydraulic Power (ATA 29)
(a) System description: System layout; Hydraulic fluids; Hydraulic reservoirs and accumulators; Filters; Power distribution.
(b) System operation (1): Pressure generation: electric and mechanical; Pressure control; Indication and warning systems; Servicing.
(c) System operation (2): Pressure generation: pneumatic; Emergency pressure generation; Interface with other systems.

11.12 Ice and Rain Protection (ATA 30)
(a) Principles: Ice formation, classification, and detection.
(b) De-icing: De-icing systems: electrical, hot-air, pneumatic, chemical; Probe and drain heating.
(c) Anti-icing: Anti-icing systems: electrical, hot-air, chemical.
(d) Wipers: Wiper systems.
(e) Rain-repellent systems.

11.13 Landing Gear (ATA 32)
(a) Description: Construction, shock absorbing; Tyres.
(b) Systems: Extension and retraction systems: normal and emergency; Indications and warnings; Wheels, brakes, antiskid, and autobraking; Steering.
(c) Air ground sensing.
(d) Tail protection: Skids.

11.14 Lights (ATA 33)
External: navigation, anti-collision, landing, taxiing, ice; Internal: cabin, cockpit, cargo; Emergency.

11.15 Oxygen (ATA 35)
System lay-out: cockpit, cabin; Sources, storage, charging and distribution; Supply regulation; Indications and warnings;

11.16 Pneumatic/Vacuum (ATA 36)
(a) Systems: System lay-out; Sources: engine / APU (Auxiliary Power Unit), compressors, reservoirs, ground supply; Pressure control; Distribution; Indications and warnings; Interface with other systems.
(b) Pumps: Pressure and vacuum pumps.

11.17 Water/Waste (ATA 38)
(a) Systems: Water system layout, supply, distribution, servicing and draining; Toilet system layout, flushing and servicing.

(b) Corrosion: Corrosion aspects.

11.18 On Board Maintenance Systems (ATA 45)

Central maintenance computers; Data-loading system; Electronic library system; Printing systems; Structure monitoring (damage-tolerance monitoring). Bleed management, air pressure control, air ventilation and control, avionics and cockpit ventilation control, temperature control, air traffic communication, avionics communication router, electrical load management, circuit breaker monitoring, electrical system BITE, fuel management, braking control, steering control, landing gear extension and retraction, tyre pressure indication, oleo pressure indication, brake temperature monitoring, etc.
(b) Typical system layout.

11.20 Cabin Systems (ATA44)

System architecture, operation, and control of systems for: passenger in-flight entertainment; communication within the aircraft (Cabin intercommunication data system (CIDS); communication between the aircraft cabin and ground stations; including voice, data, music, and video transmission. CIDS interface between cockpit/cabin crew and cabin systems. Data exchange between the different related line replaceable units (LRUs). Flight attendant panels (FAPs). Cabin network server (CNS) and interfaces with the following systems:

Data/radio communication; Cabin core system (CCS); In-flight entertainment system (IFES); External communication system (ECS); Cabin mass memory system (CMMS); Cabin monitoring system (CMS); Miscellaneous cabin systems (MCSs); and Other systems. Cabin network server (CNS) hosting functions: Access to predeparture/departure reports; Email/intranet/internet access; passenger database; In-flight entertainment system; External communication system; Cabin mass memory system; Cabin monitoring system; Miscellaneous Cabin System.

11.21 Information Systems (ATA46)

System architecture, operation, and control of: − Storage and electronic library; − Updating; − Retrieving of digital information; − Air traffic and information management systems (ATIMS) and network server systems; − Aircraft general information system; − Flight deck information system; − Maintenance information system; − Passenger cabin information system; − Miscellaneous information systems; − Other linked systems.

COURSE OUTCOMES:

- Describe and demonstrate knowledge of Theory of Flight, flight controls and high speed flights.
- Describe and demonstrate knowledge of Airframe Structure.
- Describe and demonstrate knowledge of fuselage, wings, stabilizer, flight control surfaces, nacelle and pylons, air conditioning and pressurization systems of an aircraft.
- Describe and demonstrate knowledge of instrument systems, avionics, and electrical systems of an aircraft.

COMPUTER PROGRAMMING – II (PYTHON)

COURSE OBJECTIVES:

- To introduce basic concepts of the Python programming language as well as common packages and libraries.
- To generate an ability to design, analyze, and perform experiments on real-life problems in mechanical engineering using Python.

UNIT I. INTRODUCTION TO PYTHON

Introduction to Python: Features of Python, History and Future of Python, Working with Python – interactive and script mode, Identifiers and Keywords, Comments, Indentation and Multi-lining, Data types – built-in data types, Operators and Expressions, Console Input/Output, Formatted printing, Built-in Functions, Library Functions.

UNIT II. DECISION CONTROL STATEMENTS

Selection/Conditional Branching Statements: if, if-else, nested if, if-elif-else statement(s), Basic Loop Structures/ Iterative Statements – while and for loop, Nested loops, break and continue statement, pass Statement, else Statement used with loops.

UNIT III. CONTAINER DATA TYPES

Lists: Accessing List elements, List operations, List methods, List comprehension; Tuples: Accessing Tuple elements, Tuple operations, Tuple methods, Tuple comprehension, Conversion of List comprehension to Tuple, Iterators and Iterables, zip function.

UNIT IV. STRINGS AND FUNCTIONS

Strings: Accessing String elements, String properties, String operations. Functions: Communicating with functions, Variable Scope and lifetime, return statement, Types of arguments, Lambda functions, and Recursive functions.

UNIT V. CLASSES AND OBJECTS

Classes and Objects – Defining Classes, Creating Objects, Data Abstraction and Hiding through Classes, Class Method and self-Argument, Class variables and Object variables, __init()__ and __del__() method, Public and private data members, Built-in Class Attributes, Garbage Collection. OOPs Features: Abstraction, Encapsulation, Inheritance, and Polymorphism.

COURSE OUTCOMES:

CO1: Demonstrate the basic concepts of Python programming with the help of data. Understand types, operators, expressions, and console input/output.

CO2: Make use of control statements for altering the sequential execution of programs. Apply to solving problems.

CO3: Demonstrate operations on built-in container data types (list, tuple, set, and dictionary) and strings.

CO4: Illustrate operations and applications on strings with the help of built-in Understand functions.

CO5: Solve the problems by using modular programming concepts through functions.

CO6: Identify object-oriented programming constructs for developing large, modular, and reusable real-time programs.

REFERENCE BOOKS:

1. Yashavant Kanetkar, Aditya Kanetkar, “Let Us Python”, BPB Publications, 2 nd Edition, 2019.
2. Martin C. Brown, “Python: The Complete Reference”, Mc. Graw Hill, Indian Edition, 2018.
3. Michael H.Goldwasser, David Letscher, “Object Oriented Programming in Python”, Prentice Hall, 1st Edition, 2007.
4. Taneja Sheetal, Kumar Naveen, “Python Programming – A Modular Approach”, Pearson, 1st Edition, 2017. R Nageswar Rao, “Core Python Programming”, Dreamtech Press, 2018.

NPTEL AND OTHER DIGITAL RESOURCES:

1. NPTEL - Programming, Data Structures and Algorithms using Python: https://nptel.ac.in/courses/106106145

FLUID MECHANICS AND HYDRAULICS

COURSE OBJECTIVES:

- Understand the basic properties of fluids (density, viscosity, compressibility, surface tension).
- Ability to evaluate pressure distribution in fluids at rest and apply hydrostatic laws to calculate forces on submerged surfaces.
- Derive and apply governing equations (continuity, momentum, energy equations).
- Understanding of Flow Measurement & Analysis
- Understanding of Hydraulic Machines and Developing problem-solving skills for real-world hydraulic systems

UNIT I.

Fluids: Definition of fluids, the science of fluid mechanics, fluid properties, capillarity, surface tension, compressibility, units, and dimensions.
Normal and Shear stresses in fluid flows, measurement of fluid velocity.
Regimes of fluid flows: Continuum and free molecular flow, inviscid and viscous flows, incompressible and compressible flows, Newtonian and Non-Newtonian flow, Aerodynamic force and moments, Dimensional analysis, Non-dimensional parameters, M, Re, Fr, etc.

UNIT II.

Fluid Statistics: Pascal's law, types of forces on a fluid system, measurement of pressure, use of manometers and gauges, numerical problems. Hydraulic devices, forces on partially and fully submerged bodies, including those on curved surfaces, numerical problems, buoyancy, stability of floating bodies, centre of gravity, and metacentric heights.
Description of Fluid Motion: Lagrangian and Eulerian methods, description of properties in a moving fluid, local and material rate of change, equation of conservation of mass for a control volume.
Streamlines, path lines, streak lines, vorticity and circulation, laws of vertex motion, translation, rotation, and rate of deformation of fluid particle.
Equations of Fluid Motion: Euler's and Navier-Stokes equations, derivation of Bernoulli's equation for inviscid and viscous flow fields, momentum equation, and angular momentum equation in Integral form.

UNIT III.

Inviscid - Incompressible Flow: Condition on velocity for incompressible flow, Laplace's equation, potential function, stream function. Basic elementary flows: uniform flows, source flows, doublet flow, and vortex flow. Superimposition of elementary flows, non-lifting and lifting flow over a circular cylinder. Pressure distribution over a circular cylinder in real flow. Kutta - Juokowaski Theorem, Generation of lift. Lift on air foils.

Introduction to Viscous Flows: Qualitative aspects of viscous flows, viscosity and thermal conductivity, phenomenon of separation, Navier-Stokes equations in vector form, viscous flow energy equation, some exact solutions of Navier-Stokes equations: Plane Poiseuille flow, Couette flow, Hagen-Poiseuille flow, Hele-Shaw flow, flow through corotating cylinders. Transition from laminar to turbulent flow. Turbulent flow in a circular pipe.

UNIT IV.

Introduction to Incompressible Boundary Layer (BL): BL Concept, BL Properties, derivation of Prandtl's BL Equation, Blasius solution, Karman's Integral equation, Turbulent BL over a flat plate, skin friction drag, BL Control.

Dimensional Analysis and Similitude: Buckingham's theorem, non-dimensional groups, Geometric, Kinematic, and Dynamic similarity, Applications.

UNIT V.

Elements of Compressible Flows: Compressible flow properties, total Enthalpy, total temperature, temperature and pressure ratio as a function of Mach number. Mass flow parameter (MFP), Isentropic area ratio A/A*, velocity - area variation, 2-D small amplitude wave propagation, Adiabatic Steady Flow Ellipse. Description of flow regimes, Introduction to Normal and Oblique shock waves, working out solutions through Gas Tables/Charts

COURSE OUTCOMES:

- Describe basic properties of fluids (density, viscosity, compressibility, surface tension).
- Demonstrate hydrostatic laws to calculate forces on submerged surfaces.
- Demonstrate application of governing equations (continuity, momentum, energy equations).
- Describe Flow Measurement & Analysis
- Describe Hydraulic Machines and demonstrate problem-solving skills for real-world hydraulic systems

TEXT BOOKS:

1. John D Anderson Jr., Fundamentals of Aerodynamics, McGraw-Hill, 2nd Ed.
2. S W Yuan, Foundations of Fluid Mechanics, Prentice Hall
3. Gupta Vijay and Gupta S K, Fluid Mechanics and its Applications, Wiley-Eastern, 1982

REFERENCE BOOKS:

1. Jack D Mattingly, Principles of Gas Turbine Propulsion, 1st Ed., McGraw-Hill, 1997
2. H. Schlichting and K. Gersten, Boundary Layer Theory, 8th Ed., McGraw-Hill, 2000
3. Frank M White, Fluid Mechanics, 2nd Ed., McGraw-Hill, 1986
4. E. Rathakrishnan, Gas Dynamics, Prentice Hall India

ENGINEERING THERMODYNAMICS

COURSE OBJECTIVES:

- Understanding of Laws of Thermodynamics and the concepts of energy transformation and the conversion of heat into work.
- Understand the behaviour of ideal and real gases and apply gas laws.
- Understanding of processes such as isothermal, adiabatic, isobaric, and isochoric transformations.
- Understanding of Thermodynamic Cycles (Carnot, Rankine, Otto, Diesel, Brayton).
- Understand the working principles of engines, turbines, compressors, and refrigeration systems.
- Apply thermodynamic analysis to real-world systems such as power plants, IC engines, and HVAC systems.

UNIT I.

Fundamental Concepts and Definitions: Scope and limitations of thermodynamics. Thermodynamic system, state, property, change of state, thermodynamic equilibrium, path process, cycle density, pressure, and their molecular interpretation - dimension and units - Zeroth law of thermodynamics and concept of temperature, temperature scales, work and heat definition and units of work and heat, work of a frictionless process, PV diagram, indicator diagram.

UNIT II.

First law of Thermodynamics: Statement of the first law. Energy. Internal energy and its microscopic interpretation, enthalpy, and applications of the first law.
Steady Flow Energy Equation (SFEE). The steady-state, steady-flow process. The Joule Thomson coefficient and the throttling process. Uniform state, Uniform flow process, SFEE, and its applications.

UNIT III.

Second Law of Thermodynamics: Limitations of the first law, heat engines, reversed heat engines and their performance, Kelvin-Planck's and Clausius statements of the second law, reversibility-reversible and irreversible processes: Carnot cycle, thermodynamic temperature scale, Clausius-Clapeyron equation.
Entropy: The property, the principle of increase of entropy, calculation of entropy changes, T-S and h-s diagrams. Microscopic interpretation of Entropy-Helmholtz (A) and Gibbs (G) functions.

UNIT IV.

Physical properties: Pure substance definition-internal energy and enthalpy of a pure substance, specific heats, equilibrium of phases, phase diagrams, phase changes, critical state, PVT surface, tabulated properties, and process calculations. Maxwell relations.

Ideal and Real Gases: Definition-internal energy and enthalpy, specific heats and their calculation from simple kinetic theory, gas tables, Van der Waals' equation of state, principle of corresponding states, compressibility factor.

UNIT V.

Vapour Power Cycles: Carnot cycle using steam, Rankine cycle, reheat cycle, binary vapour cycles. Air Standard Power Cycles: Carnot cycle, Otto cycle, Diesel cycle, dual cycle, gas turbine cycles, inter-cooling, reheating, and regeneration, gas turbine jet propulsion, deviation from ideal cycles.

COURSE OUTCOMES:

- Describe Laws of Thermodynamics and the concepts of energy transformation and the conversion of heat into work.
- Describe behaviour of ideal and real gases and apply gas laws.
- Describe isothermal, adiabatic, isobaric, and isochoric transformations.
- Describe Thermodynamic Cycles (Carnot, Rankine, Otto, Diesel, Brayton).
- Describe working principles of engines, turbines, compressors, and refrigeration systems.
- Demonstrate analysis to real-world systems such as power plants, IC engines, and HVAC systems.

TEXT BOOKS:

1. C O Van Wylen; Classical Thermodynamics Wiley 2001
2. J B Jones and C A Hawkins, Engineering Thermodynamics, John Wiley and Sons Inc., New York
3. P K Nag, Engineering Thermodynamics, Tata McGraw-Hill Book Co., 1981

REFERENCE BOOKS:

1. R A Sonntag and C O Van Wylen, Fundamentals of Thermodynamics, Wiley, New York
2. D B Spalding and E H Cole, Engineering Thermodynamics, 2nd Ed., Arnold, London 1973
3. John F Les and Francis W Sears, Thermodynamics: An Introductory Text for Engineering Students, Addison-Wesley Reading

AIR CRAFT MATERIALS AND HARDWARE (BASIC)

COURSE OBJECTIVES:

- To enable students to understand various aircraft materials (ferrous, nonferrous and composites) their properties and testing.
- To enable students to understand the concept of corrosion, its types and identification in aircraft structural parts.
- To enable students to understand various types of fasteners used in the aircraft.

6.1 Aircraft Materials — Ferrous

(a)Characteristics, properties, and identification of common alloy steels used in aircraft; Heat treatment and application of alloy steels;

(b)Testing of ferrous materials for hardness, tensile strength, fatigue strength and impact resistance.

(c) Repair and inspection procedures for ferrous materials, structures, and airframes.

6.2 Aircraft Materials — Non-Ferrous

(a)Characteristics, properties, and identification of common non-ferrous materials used in aircraft; Heat treatment and application of non-ferrous materials;

(b)Testing of non-ferrous material for hardness, tensile strength, fatigue strength and impact resistance.

(c) Repair and inspection procedures for non-ferrous materials, structures, and airframes.

6.3 Aircraft Materials - Composite and Non-Metallic

6.3.1 Composite and non-metallic other than wood and fabric

(a) Characteristics, properties, and identification of common composite and non-metallic materials, other than wood, used in aircraft; sealants and bonding agents.

(b) Detection of defects/deterioration in composite and non-metallic materials.

(c) Repair of and inspection procedures for composite and non-metallic materials, structures, and airframes.

6.3.2 Wooden structures

Construction methods of wooden airframe structures; Characteristics, properties and types of wood and glue used in aeroplanes; Preservation and maintenance of wooden structures; Types of defects in wood material and wooden structures; Detection of defects in wooden structures; Repair of wooden structures.

6.3.3 Fabric covering

Characteristics, properties, and types of fabrics used in aeroplanes; Inspection methods for fabric; Types of defects in fabrics; Repair of fabric covering.

6.4 Corrosion

(a) Chemical fundamentals; Formation by galvanic action process, microbiological contamination, and mechanical stress.

(b)Types of corrosion and their identification; Causes of corrosion; Material types, susceptibility to corrosion.

6.5 Fasteners

6.5.1 Screw threads

Screw nomenclature; Thread forms, dimensions, and tolerances for standard threads used in aircraft; Measuring screw threads;

6.5.2 Bolts, studs, and screws

Bolt types: specification, identification, and marking of aircraft bolts, international standards; Nuts: self-locking, anchor, standard types; Machine screws: aircraft specifications; Studs: types and uses, insertion, and removal; Self-tapping screws, dowels.

6.5.3 Locking devices

Tab and spring washers, locking plates, split pins, pal-nuts, wire locking, quick-release fasteners, keys, circlips, and cotter pins.

6.5.4 Aircraft rivets

Types of solid and blind rivets: specifications and identification, heat treatment.

6.6 Pipes and Unions

(a)Identification of, and types of rigid and flexible pipes and their connectors used in aircraft; (b)Standard unions for aircraft hydraulic, fuel, oil, pneumatic, and air system pipes.

6.7 Springs

Types of springs, materials, characteristics, and applications.

6.8 Bearings

Purpose of bearings, loads, material, and construction; Types of bearings and their application.

6.9 Transmissions

Gear types and their application; Gear ratios, reduction and multiplication gear systems, driven and driving gears, idler gears, mesh patterns; Belts and pulleys, chains and sprockets.

6.10 Control Cables

Types of cables: End fittings, turnbuckles, and compensation devices; Pulleys and cable system components; Bowden cables; Aircraft flexible control systems.

6.11 Electrical Cables and Connectors

Cable types, construction, and characteristics; High tension and coaxial cables; Crimping; Connector types, pins, plugs, sockets, insulators, current and voltage rating, coupling, identification codes.

COURSE OUTCOMES:

- Describe various aircraft materials (ferrous, nonferrous and composites) their properties and testing.
- Describe concept of corrosion, its types and identification in aircraft structural parts.
- Describe various types of fasteners used in the aircraft.

REFERENCES:

EASA Module-06	Aircraft Hardware and Materials
Cindy Foreman	Advanced Composites
George F. Titterton	Aircraft Materials and Processes
Joe Christy	Aircraft Construction Repair and Inspection

ENVIRONMENTAL SCIENCES AND SUSTAINABILITY

COURSE OBJECTIVES:

- To introduce the basic concepts of environment, ecosystems, and biodiversity, and emphasize the biodiversity of India and its conservation.
- To impart knowledge on the causes, effects, and control or prevention measures of environmental pollution and natural disasters.
- To facilitate the understanding of the global and Indian scenario of renewable and nonrenewable resources, causes of their degradation, and measures to preserve them.
- To familiarize the concept of sustainable development goals and appreciate the interdependence of economic and social aspects of sustainability, recognize and analyze climate changes, the concept of carbon credit, and the challenges of environmental management.
- To inculcate and embrace sustainability practices and develop a broader understanding of green materials, energy cycles, and analyze the role of sustainable urbanization.

UNIT I. ENVIRONMENT AND BIODIVERSITY

Definition, Scope, and Importance of the Environment – The Need for Public Awareness. Ecosystem and Energy Flow – Ecological Succession. Types of biodiversity: genetic, species, and ecosystem diversity– values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ.

UNIT II. ENVIRONMENTAL POLLUTION

Causes, Effects, and Preventive Measures of Water, Soil, Air, and Noise Pollutions. Solid, Hazardous, and E-Waste Management. Case studies on Occupational Health and Safety Management System (OHASMS). Environmental protection, Environmental protection acts.

UNIT III. RENEWABLE SOURCES OF ENERGY

Energy management and conservation of Energy sources, as well as the need for new sources. Different types of new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin, and power plants of geothermal energy.

UNIT IV. SUSTAINABILITY AND MANAGEMENT

Development, GDP, Sustainability - concept, needs and challenges-economic, social, and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and protocols- Sustainable Development Goals-targets, indicators, and intervention areas Climate change- Global, Regional, and local environmental issues and possible solutions-case studies. Concept of Carbon Credit, Carbon Footprint. Environmental management in industry: A case study.

UNIT V. SUSTAINABILITY PRACTICES

Zero waste and R concept, Circular Economy, ISO 14000 Series, Material Life Cycle Assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy efficiency, Sustainable transport. Sustainable energy: Non-conventional Sources, Energy Cycles- carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socio-economic and technological change.

COURSE OUTCOMES:

CO1: To recognize and understand the functions of the environment, ecosystems, and biodiversity and their conservation.
CO2: To identify the causes and effects of environmental pollution and natural disasters, and contribute to the preventive measures in society.
CO3: To identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.
CO4: To recognize the different goals of sustainable development and apply them for suitable technological advancement and societal development.
CO5: To demonstrate the knowledge of sustainability practices and identify green materials, energy cycles, and the role of sustainable urbanization.

TEXT BOOKS:

1. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers ,2018.
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016.
3. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
4. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
5. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning.
6. Environment Impact Assessment Guidelines, Notification of Government of India, 2006.
7. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998.

REFERENCES:

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38. Edition 2010.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, Third Edition, 2015.
5. Erach Bharucha "Textbook of Environmental studies or Undergraduate Courses" Orient Black swan Pvt. Ltd. 2013.

APPLIED CONTROL SYSTEMS

COURSE OBJECTIVES:

CO1 : understand the fundamental concepts and principles of control systems, including open-loop and closed-loop systems.
CO2 : describe the operation and application of DC/AC servo motors, stepper motors, and tacho generators.
CO3 : analyze the transient and steady-state responses of first and second-order systems.
CO4 : evaluate system stability using Routh's criterion, root locus, Bode, and Nyquist plots.
CO5 : Relate theoretical control system concepts to practical applications in aviation and aerospace engineering.

UNIT I.
Basic concepts of control systems, Open loop and closed loop control systems, Definition of feedback terms, symbols to represent feedback control variables, characteristics of basic feedback loop. Introduction to dynamics of stable and unstable vehicles. examples in aviation (autopilot, flight control surfaces). Definition of Aerodynamic coefficients, force and moment equations, definition of relaxed static stability, CCV concept in modern flight control system.

UNIT II.
Models of Components and Systems: Its variables and equations, modeling of passive electrical components and systems, static and dynamic variables, modeling of DC motors and servo systems, transducer, sensors and actuators, transport delay. block diagram representation - block diagram reduction - signal flow graph - Mason's gain formula – characteristic equation.

UNIT III.
Time domain analysis of control systems: Transient and steady state responses - time domain specifications - first and second order systems - step responses of first and second order systems. Error analysis - steady state error analysis - static error coefficient of type 0,1, 2 systems - Dynamic error coefficients. Concept of stability: Time response for various pole locations -stability of feedback system - Routh’s stability criterion.

UNIT IV.
Root locus - General rules for constructing Root loci – stability from root loci - effect of addition of poles and zeros. Analysis of closed loop systems: Stability and relative stability; Root-locus approach.

UNIT V.

BODE Plots: The BODE magnitude plot, Studies on BODE phase plot, stability margins on the BODE plot, Time delay effects. Nyquist diagram, Nyquist stability criterion, Stability margins, illustration of phase margin and gain margins, Control System Design: PID and Lag-Lead Controller Design.

TEXT BOOKS:

A Text Book :

T1. Katsuhiko Ogata, Modern Control Engineering, Prentice Hall of India

T2. Robert C Nelson, Flight Stability and Automatic Control, McGrawHill, New York

T3. Nise, N., (2007), Control Systems Engineering, Wiley India

T4. B Etkin, Dynamics of Aircraft, McGraw Hill, New York

REFERENCE BOOKS:

R1. Duglas B Miron, Design of Feed Back Systems, Harcourt Brace Jovanovic Publications, NY

R2. Franklin, G. F. , Powell, J. D., and Emami-Naeini, A. E.,(2002), Feedback Control of Dynamic Systems, Prentice Hall Inc.

R3. Benjamin C Kuo, Digital Control Systems

AERODYNAMICS FUNDAMENTALS

COURSE OBJECTIVES:

- Understand the International Standard Atmosphere (ISA).
- To understand airflow characteristics, aerofoil geometry, drag types, lift generation, and the impact of aerofoil contamination.
- To understand glide ratio, steady flight, performance metrics, and the flight Stability and Dynamics.

8.1 Physics of the Atmosphere

International Standard Atmosphere (ISA), application to aerodynamics.

8.2 Aerodynamics

Airflow around a body; Boundary layer, laminar and turbulent flow, free stream flow, relative airflow, upwash and downwash, vortices, stagnation; The terms: camber, chord, mean aerodynamic chord, profile (parasite) drag, induced drag, centre of pressure, angle of attack, wash-in and wash-out, fineness ratio, wing shape and aspect ratio; Thrust, weight, aerodynamic resultant; Generation of lift and drag angle of attack, lift coefficient, drag coefficient, polar curve, stall; Aerofoil contamination including ice, snow, and frost.

8.3 Theory of Flight

Relationship between lift, weight, thrust and drag; Glide ratio; Steady-state flights, performance; Theory of the turn; Influence of load factor: stall, flight envelope, and structural limitations; Lift augmentation.

8.4 High-speed airflow

Speed of sound, subsonic flight, transonic flight, supersonic flight, Mach number, critical Mach number, compressibility buffet, shock wave, aerodynamic heating, area rule; Factors that affect airflow in engine intakes of high-speed aircraft; Effects of sweepback on critical Mach number.

8.5 Flight Stability and Dynamics

Longitudinal, lateral, and directional stability (active and passive).

COURSE OUTCOMES:

- Describe the International Standard Atmosphere (ISA).
- Describe airflow characteristics, aerofoil geometry, drag types, lift generation, and the impact of aerofoil contamination.
- Describe glide ratio, steady flight, performance metrics, and the flight Stability and Dynamics.

REFERENCES:

EASA Module- 08	Basic Aerodynamics
AC Kermode	Mechanics of Flight
Clancey	Aerodynamics

AVIATION SAFETY MANAGEMENT SYSTEMS

COURSE OBJECTIVES:

- Understand Core Safety Concepts
- Ability to interpret Regulatory and Organizational Requirements
- Understanding of the Four Components of SMS
- Ability to apply Risk Management Techniques

Unit 1: Introduction to Aviation Safety
- Evolution of safety in aviation
- ICAO Annex 19 overview
- SMS vs traditional safety approaches

Unit 2: Safety Concepts and Terminology
- Definitions: hazard, risk, safety, mitigation
- Safety performance indicators (SPIs)
- Safety targets and thresholds

Unit 3: Regulatory Framework
- ICAO SARPs
- National aviation authority requirements
- SMS in airlines, airports, and ANSPs

Unit 4: SMS Components
- Safety Policy and Objectives
- Safety Risk Management
- Safety Assurance
- Safety Promotion

Unit 5: Hazard Identification and Risk Assessment
- Hazard identification techniques
- Risk analysis and matrix
- Mitigation strategies and controls

Unit 6: Human Factors and Safety Culture
- Human error models (e.g., Reason's Swiss Cheese)
- Just culture and reporting systems
- Organizational safety culture

Unit 7: Safety Assurance and Auditing
- Safety performance monitoring
- Internal audits and evaluations
- Corrective and preventive actions

Unit 8: SMS Implementation and Integration
- Phased implementation approach
- Integration with QMS and ERP systems
- Documentation and record-keeping

Unit 9: Safety Promotion and Training
- Safety communication strategies

- Training needs analysis
- Building safety awareness

Unit 10: Case Studies and Practical Applications

- Real-world SMS failures and successes
- Group exercises and simulations
- Safety reporting systems (ASRS, ECCAIRS)

Unit 11: Final Assessment and Review

- Group presentations
- Written test or project

COURSE OUTCOMES:

- Describe Core Safety Concepts
- Demonstrate Regulatory and Organizational Requirements
- Describe the Four Components of SMS
- Demonstrate application of Risk Management Techniques

REFERENCES:

- ICAO Annex 17

ICAO Doc 9859: Safety Management Manual, Fourth Edition, 2018

DIGITAL TECHNIQUES FOR INSTRUMENTATION ENGINEERING (BASIC)

COURSE OBJECTIVES:

- To introduce digital techniques and electronic instrument system fundamentals.
- To enable students to understand the concept of numbering system, data conversion, data buses, and logic circuits in the context of avionics systems.
- To enable students to understand the concept of basic computer structure, microprocessors, and integrated circuits in the context of avionics systems
- To introduce the concepts of multiplexing, fibre optics, and ESDs
- To enable students to understand the typical electronic/ digital aircraft systems

5.1 Electronic Instrument Systems

Typical arrangements of systems and cockpit layout of electronic instrument systems.

5.2 Numbering Systems

Numbering systems: binary, octal, and hexadecimal; Demonstration of conversions between the decimal and binary systems, octal and hexadecimal systems and vice versa.

5.3 Data Conversion

Analogue Data, Digital Data; Operation and application of analogue to digital, and digital to analogue converters, inputs and outputs, limitations of various types.

5.4 Data Buses

Operation of data buses in aircraft systems, including knowledge of ARINC and other specifications. Aircraft network/Ethernet.

5.5 Logic Circuits

(a)Identification of common logic gate symbols, tables and equivalent circuits; Applications used for aircraft systems, schematic diagrams.

(b)Interpretation of logic diagrams.

5.6 Basic Computer Structure

(a) Computer terminology (including bit, byte, software, hardware, CPU, IC, and various memory devices such as RAM, ROM, PROM); Computer technology (as applied in aircraft systems).

(b) Computer operation, layout, and interface of the major components in a microcomputer, including their associated bus systems; Information contained in single- and multi-address instruction words; Memory-associated terms; Operation of typical memory devices; Operation, advantages, and disadvantages of the various data storage systems.

5.7 Microprocessors
Functions performed and overall operation of a microprocessor; Basic operation of each of the following microprocessor elements: control and processing unit, clock, register, arithmetic logic unit.

5.8 Integrated Circuits
Operation and use of encoders and decoders; Function of encoder types.

5.9 Multiplexing
Operation, application and identification in logic diagrams of multiplexers and demultiplexers.

5.10 Fibre Optics
Advantages and disadvantages of fibre optic data transmission over electrical wire propagation; Fibre optic data bus; Fibre optic related terms; Terminations; Couplers, control terminals, remote terminals; Application of fibre optics in aircraft systems.

5.11 Electronic Displays
Principles of operation of common types of displays used in modern aircraft, including cathode-ray tubes (CRTs), light-emitting diodes (LEDs) and liquid crystal displays (LCDs).

5.12 Electrostatic Sensitive Devices
Special handling of components sensitive to electrostatic discharges; Awareness of risks and possible damage, component and personnel antistatic protection devices.

5.13 Software Management Control
Awareness of restrictions, airworthiness requirements and possible catastrophic effects of unapproved changes to software programmes.

5.14 Electromagnetic Environment
Influence of the following phenomena on maintenance practices for electronic system: EMC-Electromagnetic Compatibility, EMI-Electromagnetic Interference, HIRF-High Intensity Radiated Field, Lightning/lightning protection

5.15 Typical Electronic/Digital Aircraft Systems
General arrangement of typical electronic/digital aircraft systems and associated BITE (Built In Test Equipment) such as:

(a) ACARS – ARINC Communication and Addressing and Reporting System, FBW - Fly-by-Wire, FMS- flight management system, IRS - inertial reference system;

(b) ECAM - electronic centralised aircraft monitoring, EICAS - engine indication and crew alerting system, EFIS- electronic flight instrument system, GNSS- global navigation satellite system, TCAS- traffic alert collision avoidance system, Integrated Modular Avionics, Cabin Systems, Information Systems.

COURSE OUTCOMES:

- To describe Digital Techniques and electronic instrument system fundamentals.
- To describe the numbering system, data conversion, data buses, and logic circuits in the context of avionics systems.
- To describe the basic computer structure, microprocessors, and integrated circuits in the context of avionics systems.
- To describe the concepts of multiplexing, fibre optics, and ESDs
- To describe the typical electronic/ digital aircraft systems

REFERENCES:

Mike Tooley	Aircraft Digital Electronic and Computer System
B.L.Theraja	Electrical Technology
Bernard Grob	Basic Electronics
Albert D Helfrick	Modern Aviation Electronics
Edward Hughes	Electrical & Electronics Technology

HUMAN FACTORS IN AVIATION

COURSE OBJECTIVES:

- Understanding Human Performance and the impact of fatigue, stress, workload, and decision-making on performance.
- Error Management: Learn strategies to prevent, detect, and mitigate errors.
- Understanding of Safety Culture & Compliance.
- Understanding of Crew Resource Management (CRM) principles to daily operations and situational awareness & decision-making.

9.1 General
The need to take human factors into account when performing maintenance; Incidents attributable to human factors/human error; 'Murphy's' law.

9.2 Human Performance and Limitations
Vision; Hearing; Information processing; Attention and perception; Memory; Claustrophobia and physical access.

9.3 Social Psychology
Accountability and responsibility: individual and group; Motivation and demotivation; Peer pressure; Cultural issues; Teamwork; Management, supervision, and leadership.

9.4 Factors that Affect Performance
Fitness/health; Stress: domestic and work related; Time pressure and deadlines; Workload: overload, underload, and workload management; Sleep and fatigue, shift work; Alcohol, medication, drug abuse; Lack of manpower.

9.5 Physical Environment
Noise and fumes; Illumination; Climate and temperature; Motion and vibration; Working environment Situational awareness.

9.6 Tasks
Physical work; Repetitive tasks; complacency; Visual inspection; Complex systems; Critical maintenance tasks and error-capturing methods; Technical documentation: access, use, and quality.

9.7 Communication
Within and between teams; Work logging and recording; Shift handover; Keeping up to date, currency; Dissemination of information.

9.8 Human Error
Error models and theories; Types of error in maintenance tasks; Implications of errors (e.g. accidents); Organisational errors; Avoiding and managing errors.

9.9 Safety management Risk management; Occurrence reporting; Safety culture Just culture; Identifying, avoiding, and reporting hazards; Organisational human-factors programme: professionalism and integrity, error-provoking behaviour, reporting errors, disciplinary policy, error investigation, action to address problems, feedback, assertiveness; Dealing with emergencies.

9.10 The 'Dirty Dozen' and the risk-mitigation

The 'Dirty Dozen': The twelve most common human -factors errors in maintenance: Lack of communication, Lack of teamwork, Lack of assertiveness, Complacency, Fatigue, Stress, Lack of knowledge, Lack of resources, Lack of awareness, Distraction, Pressure, Norms. Risk-mitigation methods.

COURSE OUTCOMES:

- Describe Human Performance and the impact of fatigue, stress, workload, and decision-making on performance.
- Describe strategies to prevent, detect, and mitigate errors.
- Describe and demonstrate Safety Culture & Compliance.
- Describe Crew Resource Management (CRM) principles to daily operations and situational awareness & decision-making.

REFERENCES:

EASA Module 9

AVIATION REGULATIONS

COURSE OBJECTIVES:

- Understanding Air Law
- Understanding of Regulatory Frameworks & Authorities
- Understanding of Certification & Airworthiness
- Understanding of Operational & Commercial Regulations
- Understanding of Cybersecurity in aviation maintenance

10.1 Regulatory Framework

Role of:

International Civil Aviation Organization (ICAO); − Directorate General of Civil Aviation (DGCA), India; − The Aircraft Act and Rules made thereunder relating to airworthiness; − CAR-21, CAR-M, CAR-145, CAR-66, CAR 147, CAR ML, CAR- CAMO, CAR-CAO − the relationship between regulations and AMC, GM, AAC etc. − occurrence reporting according to CAR Section 2 Series C Part I, CAR M, CAR ML, CAR-145 and CAR-CAO; − Aeronautical Information Circulars (Applicable to Aircraft Maintenance and Release) − the relationship between Initial and Continuing Airworthiness (such as CAR 21, CAR M, CAR-145, CAR-66, CAR-147, CAR-ML, CAR-CAMO, and CAR-CAO) and regulations related to the Air Operations and regulation related to the Air Crew

10.2 Certifying Staff - Maintenance

General understanding of CAR-66 maintenance licences with the associated privileges and authorisations, and how to exercise them properly for the different aircraft categories.

10.3 Approved Maintenance Organisations

Detailed understanding of CAR-145 and CAR -CAO

10.4 Independent certifying staff

Privileges, responsibilities, record-keeping, limitations, and oversight according to CAR-M, CAR -66 and CAR -ML.

10.5 Aircraft Operations

General understanding of regulation relating to air operations; Differences between commercial and non-commercial air operations, and their influence on aircraft maintenance; Air Operator Certificates (AOCs)/ Air Operator Permits (AOP) Air operator responsibilities, in particular regarding continuing airworthiness and maintenance; Specialised operations / specific approvals: ETOPS, CAT I/II/III, and BRNAV. Minimum Equipment List (MEL) and Configuration Deviation List (CDL); Aircraft placarding and markings; Documents to be carried on board: Certificate of Airworthiness / Restricted Certificate of Airworthiness; Airworthiness Review Certificate; Permit to Fly; Certificate of Registration; Noise Certificate; Weight and Balance report; Radio Station Licence.

10.6 Certification of aircraft, parts, and appliances
Basic understanding of CAR 21

10.7 Continuing Airworthiness
General understanding of the CAR 21 requirements on continuing airworthiness; General understanding of CAR-M, CAR-ML and CAR-CAMO; Aircraft Maintenance Programme.
Introduction to AD/SB review methodology (Sources and Interfaces) (BoS)
Introduction to Air Accident Investigation Techniques (BoS)
Introduction to Aviation Auditing Practices (BoS)

10.8 Oversight principles in continuing airworthiness

10.9 Reserved

10.10 Cybersecurity in aviation maintenance
Regulation on the introduction of organisation requirements for the management of information security risks related to aeronautical information systems used in civil aviation.

COURSE OUTCOMES:

- Describe Air Law.
- Describe Regulatory Frameworks & Authorities.
- Describe Certification & Airworthiness.
- Describe Operational & Commercial Regulations.
- Describe Cybersecurity in aviation maintenance.

REFERENCES:

EASA Module 10

AIRCRAFT MAINTENANCE PRACTICES (GENERAL)

COURSE OBJECTIVES:

- To impart knowledge of safety precautions and aircraft workshop practices
- To enable students to have knowledge of various tools and equipment used in aircraft maintenance.
- To impart knowledge of engineering drawing, and EWIS
- To impart knowledge about the transmission systems and control cables used in the aircraft systems.
- To impart knowledge about the material handling (metallic, nonmetallic and composites) processes used in the aircraft maintenance.

7.1 Safety Precautions Aircraft and Workshop

Aspects of safe working practices including precautions to be taken when working with electricity, gases (especially oxygen), oils, and chemicals. Fuel tank safety and fuel tank entry procedures and precautions. Awareness and precautions regarding aircraft equipped with ballistic recovery systems. Also, instructions for the remedial action to be taken in the event of a fire or another accident with one or more of these hazards, including information on fire-extinguishing agents.

7.2 Workshop Practices

Care of tools, control of tools, use of workshop materials; Dimensions, allowances and tolerances, workmanship standards; Calibration of tools and equipment, calibration standards.

7.3 Tools

Common hand tool types; Common power tool types; Operation and use of precision measuring tools; Lubrication equipment and methods. Operation, function and use of electrical general test equipment;

7.4 (Reserved)

7.5 Engineering Drawings, Diagrams and Standards

Drawing types and diagrams, their symbols, dimensions, tolerances and projections; Identification of title block information; Microfilm, microfiche, and computerised presentations; Specification 100 of the Air Transport Association (ATA) of America; Aeronautical and other applicable standards including ISO, AN, MS, NAS and MIL; Wiring diagrams and schematic diagrams.

7.6 Fits and Clearances

Drill sizes for bolt holes, classes of fits; Common system for fits and clearances; Schedule of fits and clearances for aircraft and engines; Limits for bow, twist and wear; Standard methods for checking shafts, bearings, and other parts.

7.7 Electrical Wiring Interconnection System (EWIS)

Continuity, insulation and bonding techniques and testing; Use of crimp tools: hand and hydraulic operated; Testing of crimp joints; Connector pin removal and insertion; Coaxial cables: testing and installation precautions; Identification of wire types, their inspection criteria and damage tolerance; Wiring protection techniques: cable looming and loom support, cable clamps, protective sleeving techniques including heat shrink wrapping, shielding; High-Intensity Radiated Fields (HIRF) and protection principles; Soldering of electrical wires, EWIS installations, inspection, repair, maintenance, and cleanliness standards.

7.8 Riveting

Riveted joints, rivet spacing and pitch; Tools used for riveting and dimpling; Inspection of riveted joints.

7.9 Pipes and Hoses

Bending and belling/flaring aircraft pipes; Inspection and testing of aircraft pipes and hoses;

Installation and clamping of pipes.

7.10 Springs

Inspection and testing of springs.

7.11 Bearings

Testing, cleaning and inspection of bearings; Lubrication requirements for bearings; Defects in bearings and their causes.

7.12 Transmissions

Inspection of gears, backlash; Inspection of belts and pulleys, chains and sprockets; Inspection of screw jacks, lever devices, push-pull rod systems.

7.13 Control Cables

Swaging of end fittings; Inspection and testing of control cables; Bowden cables; aircraft flexible control systems.

7.14 Material handling

7.14.1 Sheet Metal

Marking out and calculation of bend allowance; Sheet metal working, including bending and forming; Inspection of sheet metal work.

7.14.2 Composite and non-metallic

Bonding practices; Environmental conditions Inspection methods

7.14.3 Additive manufacturing

Common additive manufacturing techniques and their influence on the mechanical properties of the finished part; Inspection of additive manufactured parts and common production failures

7.15 (Reserved)

7.16 Aircraft Weight and Balance

(a) Calculation of centre-of-gravity / balance limits: use of relevant documents.

(b)Preparation of aircraft for weighing; Aircraft weighing;

7.17 Aircraft Handling and Storage

Aircraft taxiing/towing and associated safety precautions; Aircraft jacking, chocking, securing and associated safety precautions; Aircraft storage methods;

7.18 Disassembly, Inspection, Repair and Assembly Techniques

(a) Types of defects and visual inspection techniques; Corrosion removal, assessment and reprotection;
(b)General repair methods, Structural Repair Manual; Ageing, fatigue and corrosion control programmes;
(c) Non-destructive inspection techniques including penetrant, radiographic, eddy current, magnetic particle, ultrasonic and borescope inspections; including practical training in colour contrast penetrant inspection;
(d) Disassembly and reassembly techniques;
(e) Troubleshooting techniques.

7.19 Abnormal Events

(a)Inspections following lightning strikes and HIRF penetration.
(b)Inspections following abnormal events such as heavy landings and flight through turbulence.

7.20 Maintenance Procedures

Maintenance planning; Modification procedures; Stores procedures; Certification/release procedures; Interface with aircraft operation; Maintenance Inspection / Quality Control / Quality Assurance; Additional maintenance procedures; Control of life-limited components.

7.21 Documentation and communication

Documentation: elements and criteria for writing work reports, troubleshooting reports, and shift handover instructions. Communication: clear, comprehensive, and concise.

COURSE OUTCOMES:

- To describe and demonstrate knowledge of safety precautions and aircraft workshop practices
- To describe and demonstrate knowledge of various tools and equipment used in aircraft maintenance.

- To describe and demonstrate knowledge of engineering drawing, and EWIS.
- Describe and demonstrate knowledge about the riveting process, pipes and hoses, springs, bearings, transmission systems used on the aircraft structures.
- Describe and demonstrate knowledge about the transmission systems and control cables used in the aircraft systems.
- Describe and demonstrate knowledge about the material handling (metallic, nonmetallic and composites) processes used in the aircraft maintenance.

REFERENCES:

EASA Module 7

HUMAN VALUES AND ETHICS

COURSE OBJECTIVES:

- To create awareness about values and ethics enshrined in the Constitution of India
- To sensitize students about the democratic values to be upheld in the modern society.
- To inculcate respect for all people irrespective of their religion or other affiliations.
- To instill the scientific temper in the students' minds and develop their critical thinking.
- To promote sense of responsibility and understanding of the duties of citizen.

UNIT I. DEMOCRATIC VALUES

Understanding Democratic values: Equality, Liberty, Fraternity, Freedom, Justice, Pluralism, Tolerance, Respect for All, Freedom of Expression, Citizen Participation in Governance – World Democracies: French Revolution, American Independence, Indian Freedom Movement.
Reading Text: Excerpts from John Stuart Mills' On Liberty

UNIT II. SECULAR VALUES

Understanding Secular values – Interpretation of secularism in Indian context - Disassociation of state from religion – Acceptance of all faiths – Encouraging non-discriminatory practices.
Reading Text: Excerpt from Secularism in India: Concept and Practice by Ram Puniyani

UNIT III. SCIENTIFIC VALUES

Scientific thinking and method: Inductive and Deductive thinking, Proposing and testing Hypothesis, Validating facts using evidence based approach – Skepticism and Empiricism – Rationalism and Scientific Temper.
Reading Text: Excerpt from The Scientific Temper by Antony Michaelis R

UNIT IV. SOCIAL ETHICS

Application of ethical reasoning to social problems – Gender bias and issues – Gender violence – Social discrimination – Constitutional protection and policies – Inclusive practices.
Reading Text: Excerpt from 21 Lessons for the 21st Century by Yuval Noah Harari

UNIT V. SCIENTIFIC ETHICS

Transparency and Fairness in scientific pursuits – Scientific inventions for the betterment of society - Unfair application of scientific inventions – Role and Responsibility of Scientist in the modern society.
Reading Text: Excerpt from American Prometheus: The Triumph and Tragedy of J.Robert Oppenheimer by Kai Bird and Martin J. Sherwin.

COURSE OUTCOMES

CO1: Identify the importance of democratic, secular and scientific values in harmonious functioning of social life
CO2: Practice democratic and scientific values in both their personal and professional life.
CO3: Find rational solutions to social problems.

CO4: Behave in an ethical manner in society
CO5: Practice critical thinking and the pursuit of truth.

REFERENCES:

1. The Nonreligious: Understanding Secular People and Societies, Luke W. Galen Oxford University Press, 2016.
2. Secularism: A Dictionary of Atheism, Bullivant, Stephen; Lee, Lois, Oxford University Press, 2016.
3. The Oxford Handbook of Secularism, John R. Shook, Oxford University Press, 2017.
4. The Civic Culture: Political Attitudes and Democracy in Five Nations by Gabriel A. Almond and Sidney Verba, Princeton University Press,
5. Research Methodology for Natural Sciences by Soumitro Banerjee, IISc Press, January 2022

ARTIFICIAL INTELLIGENCE IN ACTION

COURSE OBJECTIVES:
Upon successful completion of this course, students will be able to:

- Identify and articulate the value proposition for AI solutions to complex problems in aviation operations, maintenance, and design.
- Select and apply appropriate machine learning algorithms (e.g., regression, classification, clustering) to analyze aviation-related datasets.
- Implement and train basic deep learning models, including neural networks for time-series data and convolutional neural networks (CNNs) for visual inspection tasks.
- Critically evaluate an aviation workflow (e.g., maintenance, operations, or design) and propose a suitable AI/ML solution, justifying the model choice.

UNIT 1: Foundations of AI

What is AI? Symbolic AI vs. Machine Learning. Agents and environments. State-space search. Heuristics. DFS, BFS, Best First Search, A* search algorithm etc.

UNIT 2: Machine Learning: Supervised Algorithm

Supervised learning. Linear and polynomial regression. Model evaluation metrics (MAE, RMSE). Feature engineering and selection, : Classification tasks. Logistic regression. Support Vector Machines (SVM). Decision trees and Random Forests. Confusion matrix, precision, recall, F1-score. Unsupervised learning. K-Means clustering. Hierarchical clustering. Dimensionality reduction with PCA (Principal Component Analysis).

Unsupervised learning. K-Means clustering. Hierarchical clustering. Dimensionality reduction with PCA (Principal Component Analysis).

UNIT 3: Deep Learning: Vision

Limitations of traditional ML. The perceptron. Multilayer Perceptron (MLPs). Backpropagation. Activation functions. Overfitting and regularization. Convolutional layers. Pooling layers. Building a Convolutional Neural Network (CNN). Image classification., Object Detection, Segmentation

UNIT 4: Deep Learning: NLP

Handling text data. Tokenization. Embeddings (Word2Vec, Bag-of-Words). Recurrent Neural Networks (RNNs) - basic concepts. Sentiment analysis

UNIT 5: Generative AI

What is GenAI? Generative Adversarial Networks (GANs). Large Language Models (LLMs), Stable Diffusion, Prompt engineering**.**

RECOMMENDED READINGS:

TEXT BOOKS:

1. Artificial Intelligence: A Modern Approach, Stuart J. Russell and Peter Norvig
2. T. M. MITCHELL (2017), Machine Learning, McGraw Hill Education, 1st Edition.
3. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, “Deep Learning,” First Edition, MIT Press
4. "Generative Deep Learning" by David Foster

REFERENCE BOOKS:

"Artificial Intelligence: A Guide to Intelligent Systems" by Michael Negnevitsk

GAS TURBINE ENGINES (GENERAL)

COURSE OBJECTIVES:

- To introduce fundamentals, types and performance parameters of a gas turbine engines.
- To impart knowledge about various sections of a gas turbine engine.
- To impart knowledge about gas turbine oil, lubricating and fuel (including FADEC) systems.
- To impart knowledge of Air systems and ignition systems of a gas turbine engines.
- To impart knowledge of engine indication and, power augmentation systems of a gas turbine engine.
- To impart knowledge about turbo-prop, turbo-shaft and Auxiliary Power Units.
- To impart knowledge about engine installation, fire protection systems, engine run-up, its storage and preservation.

15.1 Fundamentals

Potential energy, kinetic energy, Newton's laws of motion, Brayton cycle; The relationship between force, work, power, energy, velocity, acceleration; Constructional arrangement and operation of turbojet, turbofan, turbo shaft, turboprop and geared turbofan engines.

15.2 Engine Performance

Gross thrust, net thrust, choked nozzle thrust, thrust distribution, resultant thrust, thrust horsepower, equivalent shaft horsepower, specific fuel consumption; Engine efficiencies; By-pass ratio and engine pressure ratio; Pressure, temperature, and velocity of the gas flow; Engine ratings, static thrust, influence of speed, altitude and hot climate, flat rating, limitations.

15.3 Inlet

Compressor inlet ducts; Effects of various inlet configurations; Ice protection.

15.4 Compressors

Axial and centrifugal types; Constructional features and operating principles and applications; Fan balancing; Operation: Causes and effects of compressor stall and surge; Methods of air flow control: bleed valves, variable inlet guide vanes, variable stator vanes, rotating stator blades; Compressor ratio.

15.5 Combustion Section

Constructional features and principles of operation.

15.6 Turbine Section

Operation and characteristics of different turbine blade types; Blade to disk attachment; Nozzle guide vanes; Causes and effects of turbine blade stress and creep.

15.7 Exhaust

Constructional features and principles of operation; Convergent, divergent and variable area nozzles; Engine noise reduction; Thrust reversers.

15.8 Bearings and Seals
Constructional features and principles of operation.

15.9 Lubricants and Fuels
Properties and specifications of standard, alternate, and drop-in fuel; Properties and specifications of lubricants; Fuel additives; Safety precautions.

15.10 Lubrication Systems
System operation/lay-out and components.

15.11 Fuel Systems
Operation of engine control and fuel-metering systems, including electronic engine control (full authority digital engine control (FADEC)) and electronic power augmentation; System layout and components.

15.12 Air Systems
Operation of engine air distribution and anti-ice control systems, including internal cooling, sealing and external air services.

15.13 Starting and Ignition Systems
Operation of engine start systems and components; Ignition systems and components; Maintenance safety requirements.

15.14 Engine Indication Systems
Exhaust gas temperature / interstage turbine temperature; Engine thrust indication: engine pressure ratio, engine turbine discharge pressure or jet pipe pressure systems; Oil pressure and temperature; Fuel pressure and flow; Engine speed; Vibration measurement and indication; Torque; Power.

15.15 Alternate turbine constructions
Geared turbofan (GTF); Variable fan blades; Open rotor/propfan; Hybrid turbine-electric concepts and electric power augmentation; Future trends and developments.

15.16 Turboprop Engines
Gas coupled/free turbine and gear coupled turbines; Reduction gears; Integrated engine and propeller controls; Overspeed safety devices.

15.17 Turboshaft engines
Arrangements, drive systems, reduction gearing, couplings, control systems.

15.18 Auxiliary Power Units (APUs)
Purpose, operation, protective systems.

15.19 Power plant Installation

Configuration of firewalls, cowlings, acoustic panels, engine mounts, antivibration mounts, hoses, pipes, feeders, connectors, wiring looms, control cables and rods, lifting points and drains.

15.20 Fire Protection Systems

Operation of fire-detection and fire-extinguishing systems.

15.21 Engine Monitoring and Ground Operation

Procedures for starting and ground run-up; Interpretation of engine power output and parameters; Trend (including oil analysis, vibration and borescope) monitoring; Inspection of engine and components to criteria, tolerances and data specified by the engine manufacturer; Compressor washing/cleaning; Foreign object damage (FOD).

15.22 Engine Storage and Preservation

Preservation and depreservation for the engine and its accessories/systems.

COURSE OUTCOMES:

- Describe fundamentals, types and performance parameters of a gas turbine engines.
- Describe various sections of a gas turbine engine.
- Describe gas turbine oil, lubricating and fuel (including FADEC) systems.
- Describe Air systems and ignition systems of a gas turbine engines.
- Describe engine indication and, power augmentation systems of a gas turbine engine.
- Describe turbo-prop, turbo-shaft and Auxiliary Power Units.
- Describe and demonstrate engine installation, fire protection systems, engine run-up, its storage and preservation.

REFERENCES:

EASA Module 15

ENHANCING SOFT SKILLS AND PERSONALITY

COURSE OBJECTIVES:

- To impart enhanced awareness about the significance of soft skills in professional and inter-personal communications.
- To impart awareness of soft skills such as self-confidence, positive attitude, emotional intelligence, social grace, flexibility, friendliness and effective communication skills.
- To impart knowledge of interpersonal and management skills.

UNIT 1.

Highlights of Developing Soft Skills and Personality Course-1-24, Highlights of Developing Soft Skills and Personality Course-25-48, Definitions and Types of Mindset, Learning Mindsets, Secrets of Developing Growth Mindsets, Importance of Time and Understanding Perceptions of Time, Using Time Efficiently

Understanding Procrastination, Overcoming Procrastination, Don't Say "Yes" to Make Others Happy!

UNIT 2.

Types of People, How to Say "No", Controlling Anger, Gaining Power from Positive Thinking-1, Gaining Power from Positive Thinking-2, What Makes Others Dislike You?, What Makes Others Like You?-1, What Makes Others Like You?-2, Being Attractive-1, Being Attractive-2

UNIT 3.

Common Errors-1, Common Errors-2, Common Errors-3, Common Errors-4, Common Errors-5, Humour in Communication, Humour in the Workplace, Function of Humour in the Workplace, Money and Personality, Managing Money

UNIT 4.

Health and Personality, Managing Health-1: Importance of Exercise, Managing Health-2: Diet and Sleep, Love and Personality, Managing Love, Ethics and Etiquette, Business Etiquette, Managing Mind and Memory, Improving Memory, Care for Environment, Highlights of the Course

COURSE OUTCOMES:

- Demonstrate enhanced awareness about the significance of soft skills in professional and inter-personal communications.
- Demonstrate soft skills such as self-confidence, positive attitude, emotional intelligence, social grace, flexibility, friendliness and effective communication skills.
- Demonstrate knowledge of interpersonal and management skills.

REFERENCES:

https://archive.nptel.ac.in/content/syllabus_pdf/109104115.pdf

INTRODUCTION AND DESIGN OF UAS

UNIT 1. Introduction to Unmanned Aerial Systems

Fundamental concept of UASs, History and overview of UASs, Classes: ground (wheeled and legged), aerial (fixed, flapping, and rotary wings), underwater vehicles) and Missions of UASs, Applications, Design Process and Design goals. [Textbook: Paul G Fahlstrom, Thomas J Gleason, "Introduction to UAS Systems", UAS

UNIT 2. Modelling and Design

Rigid body dynamics, Equation of motion, Rigid body transformation/rotation, Kinematics and Dynamics of fixed wing, Rotary wing, Flapping wing UASs, UAS Design Principles, Small UAS Design Development and Sizing, Systematic Design Methodology and Construction of Aerial Quadrotor Vehicles, Payload Design of Small UASs.

UNIT 3. AERODYNAMICS AND PERFORMANCE OF FIXED WING SYSTEMS

Introduction to fixed wing aerodynamic performance – lift, drag, L/D, effect of pitching moment, wing loading, load factor, range, endurance, rate of climb etc. - Low Reynolds number aerodynamics. [Textbook: Paul G Fahlstrom, Thomas J Gleason, "Introduction to UAS Systems", UAV Systems,
Inc, 1998] [Hours: 6]

UNIT 4. AERODYNAMICS AND PERFORMANCE OF ROTARY and FLAPPING WING SYSTEMS

Introduction to rotary wing aerodynamics – momentum theory, blade element theory, blade element momentum theory, rotors in axial and edgewise flight - performance of rotary wing systems, range, endurance, rate of climb, maximum speed, Introduction to flapping wing aerodynamics and unsteady aerodynamics. [Textbook: Paul G Fahlstrom, Thomas J Gleason, "Introduction to UAS Systems",

UNIT 5. UAS Propulsion and Sensing Strategies

UAS Propulsion schemes, Propulsion System Powered by Solar Cells, Fuel Cells, and Batteries for UAVs, Sensing Strategies, Types of sensor:(proximity, IMU, magnetometers, thermal imaging, vision, LiDAR, GPS, RTK, etc.) and their characteristics, Sensor data aggregation, processing, and sensor fusion, Introduction to popular computing platforms for data processing, Different types of actuators: motors, servos, harmonic drive, linear actuators [Textbook: Textbook: Paul G Fahlstrom, Thomas J Gleason, "Introduction to UAS",

UNIT 6. Data Acquisition and communication

Data acquisition systems and schemes, communication protocols and attributes [4]

Design of UAV Systems Laboratory (Lab - 1)
MATLAB (UAV Toolbox)
ROS and Gazebo Introduction
Flight Controller (Pixhawk, Orangecube, Darkmatter) + Autopilot (Ardupilot, PX4)
Transmitter+Receiver
Motor Driver and Controller (ESC)

UAS Technology and Applications

UNIT 1. Basics of UAS
Introduction, History of UAS, Rigid body transformation/rotation, Dynamic model of multi-rotor Quad copters -Basic Components and Categories – Principles of Flight - Flight Maneuvers – Airframes - Creating a Frame: Materials, Different Frame Shapes – Building Airframes - Flight dynamics - Applications - Future potential - Comparison with other aerial vehicles.

UNIT 2. Basics of Navigation and Control
Introduction to Mission Planning, Instrument Flying & Navigation,Aircraft Navigation; Kinds of navigation - Position Fixing and Dead-reckoning systems, GPS based navigation; Inertial Navigation Systems. Integrated navigation systems.

UNIT 3: Design of controllers for UAS
Feedback control design, Linear Flight Control Techniques, Nonlinear Flight Control Techniques, Robust and Adaptive Control Methods for Aerial Vehicles

UNIT 4. Path Planning and Obstacle Avoidance
Global path planning: basic algorithms, RRT algorithm, A* algorithm, Obstacle avoidance, Artificial potential field, Collision cone-based approaches, Control barrier function.

UNIT 5. Real World Applications and Case Studies

Beneficial Drones, Aerial Photography, Mapping and Surveying, Precision Agriculture, Search and Rescue, Infrastructure Inspection, and Conservation. Case Studies: Agriculture Weed Classification, Microdrone surveillances.

COMPUTER AIDED DESIGN AND ADDITIVE MANUFACTURING OF UAS PARTS

COURSE OBJECTIVE: Upon successful completion of the course, students will be able to:

- Utilize industry-standard CAD software to create and modify 3D models.
- Apply design thinking and "Design for Additive Manufacturing" (DfAM) principles to create lightweight, strong parts.
- Understand basic aerodynamic and structural considerations for UAS design.
- Operate and maintain Fused Deposition Modeling (FDM) 3D printers.
- Prepare models for printing using slicing software and operate FDM 3D printers.
- Design, print, and assemble a functional drone frame.

UNIT 1.

Introduction to CAD, AM & UAS Overview

History and evaluation of 3D Printing (Additive Manufacturing (AM)).

Overview of the AM process: from CAD to finished part

Comparison with subtractive (CNC) and formative (Injection Molding) manufacturing.

Industrial application (aerospace, medical, automotive, consumer)

Introduction to UAS: Multi-rotor vs. fixed-wing, key components (frame, motors, ESC, FC, battery, propellers).

UNIT 2.

CAD Fundamentals and Sketching

Introduction to CAD software, User Interface (UI), Workspace, toolbars, navigation. Concept of parametric modelling. Sketching: Creating 2D profiles (lines, rectangles, circles, arcs). Applying constraints (geometric and dimensional) to define sketches.

UNIT 3.

Creating 3D Geometry

Extrude (add, remove, to object). Revolve (shafts, symmetrical parts). Sweep (pipes, wires, complex paths). Loft (organic shapes, transitions). Reference geometry: Planes, axes, points. Applying materials and visual properties.

Modifying and Assembly Geometry

Modification Tools: Fillets and Chamfers (for strength and safety). Shell (creating hollow parts). Pattern (linear and circular). Draft (for moldability). Introduction to Assemblies: Creating multi-part assemblies. Applying joints and constraints (mate, flush, rotate). Checking for interference.

UAS Aerodynamics and Structural Basics

Basic Aerodynamics: Thrust, lift, drag, weight. How propellers generate thrust. Structural Considerations: Vibration damping,

stiffness to prevent oscillation (jello effect in camera mounts), impact resistance. Center of Gravity (CG): criticality and design.

UNIT 4.

Design for Additive Manufacturing (DfAM)

The core philosophy of DfAM. Geometric Freedom: Designing complex geometries only possible with AM. Part Consolidation: Combining multiple parts into one. Topology Optimization: Software-driven lightweighting. Lattice Structures: For weight reduction and custom properties.

UNIT 5.

Fused Deposition Modeling (FDM)

Detailed mechanics, components, and materials for UAS.

Stereolithography (SLA): Principles of photopolymer resin printing. Materials, post-processing, pros/cons. Selective Laser Sintering (SLS): Principles of powder bed fusion. Advantages for functional, complex parts. Brief overview of Metal 3D Printing.

UNIT 6.

Slicing, Post Processing, and Finishing

The role of the Slicer and file type (Ultimaker Cura/STL). Critical Slicing Parameters. Importing and orienting models (considering overhangs, strength). Critical Slicing Parameters Demystified: Layer Height, Line Width. Infill (density, patterns). Shells (perimeters, top/bottom layers). Speeds and temperatures. Generating and interpreting G-code.

Post Processing and Finishing

Support removal, sanding, priming, and gap filling. Acetone vapor smoothing. Techniques for SLA: Washing and curing. Polishing/painting and finishing.

STUDY MATERIAL/REFERENCE BOOKS/REFERENCE PAPERS:

1. Mark E. Coticchia, George W. Crawford, and Edward J. Preston, CAD/CAM/CAE systems: justification, implementation and productivity measurement, 2nd edition, New York, Marcel Dekker, 1993.
2. Chris Macmahon and Jimmie Browne CADCAM: principles, practice and manufacturing management, 2nd edition, Addison Wesley, 1998.
3. Mikell P. Groover and Emory W. Zimmers ,CAD/CAM: Computer aided design manufacturing, Prentice Hall, 1996.
4. P. Radhakrishnan, S. Subramanyan, and V. Raju, CAD/CAM/CIM , 2nd edition, New Age, 2000.

COMPUTER AIDED DESIGN AND ADDITIVE MANUFACTURING OF UAS PARTS PRATICAL

COURSE OBJECTIVE: Upon successful completion of the course, students will be able to:

- Understand the CAD-to-Print Workflow
- Utilize CAD Software
- Apply Design Principles
- Develop a Physical Object
- Operate a 3D Printer

Lab 1:
Basic Sketching
Sketch the top plate of a drone frame based on a given motor-to-motor diagonal measurement.

Lab 2.
From 2D to 3D and Advanced Features & Parts
Extrude the top plate and create a simple standoff. Revolve a simple dome.
Use Loft to create a streamlined drone arm that connects the motor to the body. Model a custom propeller guard using Sweep.

Lab 3.
Drone Assembly
Create a new assembly file. Import the top plate, 4 arms, and 4 motors. Use joints to connect them all and ensure proper alignment.

Lab 4.
Printer Operation and Calibration
Filament loading and bed levelling.
Understand temperature settings for different materials.
Identify UAS part issues with materials: Warping (causes misalignment), layer separation (causes weakness).

Lab 5.
Slicing and Printing - 1
Export and slice a calibration cube. Print it to verify printer accuracy, which is critical for parts fitting together.

Lab 6.
Slicing and Printing - 2
Slice a sample drone arm. Compare two versions: one with 10% infill and one with 40% infill. Discuss the weight vs. strength trade-off.

Lab 7.
Slicing and Printing - 3

Designing and printing other parts (hood, prop, nut, screw, antenna mount, etc.)

Lab 8-10.
Final design and assembly, post-processing of parts, and report writing

STUDY MATERIAL/REFERENCE BOOKS/REFERENCE PAPERS:

1. Mark E. Coticchia, George W. Crawford, and Edward J. Preston, CAD/CAM/CAE systems: justification, implementation and productivity measurement, 2nd edition, New York, Marcel Dekker, 1993.
2. Chris Macmahon and Jimmie Browne CADCAM: principles, practice and manufacturing management, 2nd edition, Addison Wesley, 1998.
3. Mikell P. Groover and Emory W. Zimmers, CAD/CAM: Computer aided design manufacturing, Prentice Hall, 1996.
4. P. Radhakrishnan, S. Subramanyan, and V. Raju, CAD/CAM/CIM, 2nd edition, New Age, 2000.

COMPUTATIONAL FLUID DYNAMICS

COURSE OBJECTIVES:

- Understand the basic flow equations, characteristics of mathematical models for a given flow.
- Know the importance and significance of panel methods
- Familiarize with Finite Volume techniques in Computational fluid analysis.
- To learn the concepts of time dependent methods
- To acquire the knowledge in both structures and unstructured grid generation.

UNIT I. FUNDAMENTAL CONCEPTS

Introduction – Basic Equations of Fluid Dynamics – Mathematical properties of Fluid Dynamics Equations – Elliptic, Parabolic and Hyperbolic equations – Well posed problems – discretization of partial Differential Equations – Transformations and grids – Explicit finite difference methods of subsonic, supersonic and viscous flows.

UNIT II. GRID GENERATION

Need for grid generation – Various grid generation techniques – Algebraic, conformal and numerical grid generation – importance of grid control functions – boundary point control – orthogonality of grid lines at boundaries – Elliptic grid generation using Laplace's equations for geometries like aerofoil and CD nozzle.

UNIT III. PANEL METHODS

Elements of two and three-dimensional panels, panel singularities – Application of panel methods to incompressible, compressible, subsonic and supersonic flows – Numerical solution of flow over a cylinder using 2D panel methods using both vertex and source panel methods for lifting and non- lifting cases respectively.

UNIT IV. TIME DEPENDENT METHODS

Stability of solution – Explicit methods – Time split methods – Approximate factorization scheme – Unsteady transonic flow around aerofoils - time dependent solutions of gas dynamic problems– Numerical solution of unsteady 2D heat conduction problems using SLOR methods.

UNIT V. FINITE VOLUME TECHNIQUES

Finite Volume Techniques – Cell Centred Formulation – Lax-Vendoroff Time Stepping – Runge- Kutta Time Stepping – Multi-stage Time Stepping – Accuracy – Cell Vertex Formulation – Multistage Time Stepping – FDM-like Finite Volume Techniques – Central and Up-wind Type Discretization – Treatment of Derivatives.

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Explain and calculate the governing equations for fluid flow.

CO2: Explain how grids are generated and conduct a grid-convergence assessment.
CO3: Describe the issues about two-phase flow modelling.
CO4: Apply the concept of discretization, upwind differencing and implicit, explicit solutions.
CO5: Apply finite difference and finite volume methods to fluid flow problems.

TEXT BOOKS:

1. Blazek, J., “Computational Fluid Dynamics: Principles and Applications”, 2nd Ed., Elsevier, 2006.
2. Fletcher, C.A.J., "Computational Techniques for Fluid Dynamics", Vols. I and II, Springer - Verlag, Berlin, 1998.

REFERENCE BOOKS:

1. Anderson J. D., “Fundamentals of Aerodynamics”, 5th Ed., McGraw-Hill, 2010.
2. Charles Hirsch, “Numerical Computation of Internal and External Flows”, Vols. I and II. Butterworth-Heinemann, 2nd Ed., 2007.
3. John F. Wendt (Editor), "Computational Fluid Dynamics - An Introduction", Springer - Verlag, Berlin, 2009.

AIRCRAFT COMMUNICATION SYSTEM

COURSE OBJECTIVES:

- Understanding the advanced concepts of Aircraft Navigation.
- To impart mathematical knowledge for modeling the navigation processes.
- Understanding of various Navigation systems such as Inertial Measurement systems, Radio Navigation Systems, Satellite Navigation – GPS.
- Learn and apply the principles of Radar and its related components.

UNIT I. Introduction to Digital Communications

Introduction, Channel capacity, Communication Network basics Fourier – Series, Fourier Transform – Signal energy and autocorrelation, bandwidth, LTI systems –Bandpass and passband, Hilbert transform – Complex baseband, Radar – AM modulation & demodulation, angle modulations – Noise, stationary random processes – Digital Communications, A/D conversion

UNIT II. Wireless Communications

Wireless impairments, Fading, Shadowing, Doppler – Diversity, BER Performance –CDMA, Walsh codes, PN sequences, Multipath, Synchronization – MIMO, capacity, Spatial multiplexing OFDM, multicarrier modulation

UNIT II. Radar

Introduction – Radar Equation – Propagation Effects – Target Cross Section – Detection, Noise, Pulse Compression – Radar Antennas – Clutter – Signal Processing – Tracking and Parameter Estimation – Transmission and Reception

UNIT IV. AIRCRAFT COMMUNICATION SYSTEMS

Basics of aircraft communication system, types Very High Frequency Communication system, Description, Principle, Operation of VHF Communication system and its layout on aircraft, High Frequency communication system, Description, Principle and operation of High Frequency communication system and its layout on aircraft. Satellite communication system, Description, Operation and its layout on aircraft.

UNIT V. GPS

Receiver Overview – Error Sources, Measurements, Ambiguity – Kalman Filtering, Position Estimation

COURSE OUTCOMES:

- Describe advanced concepts of Aircraft Navigation.
- Demonstrate modeling the navigation processes.
- Describe Inertial Measurement systems, Radio Navigation Systems, Satellite Navigation – GPS.
- Describe principles of Radar and its related components.

REFERENCE:

1. Aircraft Electricity and electronics by Thomas K Eismin (Fifth edition-1994, McGraw-Hill Book Co)
2. Aircraft Radio system by James Powell, Sterling book house, Mumbai, Indian edition - 2006.
3. Aircraft Communications and Navigation systems – Mike Tooley and David Wyatt, Reed Elsevier, India, Noida, Edition – 2007)

PROPELLER MECHANICS AND PERFORMANCE

COURSE OBJECTIVES:

- To introduce fundamentals of propellers.
- To impart knowledge of Propeller construction, Pitch control and Synchronizing.
- To impart knowledge of Propeller ice protection, maintenance including storage and preservation.

17.1 Fundamentals

Blade element theory; High/low blade angle, reverse angle, angle of attack, rotational speed; Propeller slip; Aerodynamic, centrifugal, and thrust forces; Torque; Relative airflow on blade angle of attack; Vibration and resonance.

17.2 Propeller Construction

Construction methods and materials used in wooden, composite and metal propellers; Blade station, blade face, blade shank, blade back / thrust face and hub assembly; Fixed pitch, controllable pitch, constant speeding propeller; Propeller/spinner installation.

17.3 Propeller Pitch Control

Speed control and pitch change methods, mechanical and electrical/electronic; Feathering and reverse pitch; Overspeed protection.

17.4 Propeller Synchronising

Synchronising and synchrophasing equipment.

17.5 Propeller Ice Protection

Fluid and electrical de-icing equipment.

17.6 Propeller Maintenance

Static and dynamic balancing; lade tracking; Assessment of blade damage, erosion, corrosion, impact damage, delamination; Propeller treatment/repair schemes; Propeller engine running.

17.7 Propeller Storage and Preservation

Propeller preservation and depreservation.

COURSE OUTCOMES:

- Describe fundamentals of propellers.
- Describe Propeller construction, Pitch control and Synchronizing.
- Describe Propeller ice protection, maintenance including storage and preservation.

REFERENCES:

EASA Module 17

UAS TRAINING

1. Familiarization with UAS Parts
2. Assembling UAS
3. Preparation for UAS for Flight, making flight plan and basic flight training
4. Debugging and repairing of the UAS
5. Operation of UAS for different Applications using MATLAB, ROS-GAZEBO

UAS Pilot Training (Lab - 1)

MENTAL HEALTH AND WELLBEING

COURSE OBJECTIVES:

- To enable students to in skill-building for conflict resolution, time management, and goal setting,
- To enable students to understand various tools to manage stress, anxiety, and personal growth.
- To enable students to understand various Life Skills for Transition and Resilience

UNIT 1.

1.1. Foundations of Mental Health and Emotional Well-being

- Importance of Mental and Emotional Health during Adolescence
- The Role of Social Support and Relationships in Promoting Well-being
- Strategies for Managing Stress and Anxiety
- The Impact of Technology and Social Media on Adolescent Well-being
- The Importance of Self-care and Self-compassion

1.2. Building Healthy Coping Mechanisms

- Healthy Coping Mechanisms
- Navigating Peer Pressure and Relationships
- Addressing Issues Related to Body Image and Self-esteem
- Mindfulness for Mental Well-being
- Communication Skills for Mental Well-being

UNIT 2.

2.1. Life Skills for Transition and Resilience

- Conflict Resolution Skills
- Building Resilience During the Transition from High School to College
- Time Management and Goal Setting
- Emotional Regulation and Understanding Emotions
- The Role of Sleep, Nutrition, and Physical Activity in Mental Well-being

2.2. Advanced Skills for Mental Health

- Dealing with Academic Pressure
- Navigating Career Anxiety
- Introduction to Therapy and Counseling
- Emotional Intelligence and Leadership
- Social Responsibility and Mental Well-being

UNIT 3.

3.1. Advanced Emotional Skills and Boundaries

- Emotional Validation and Ventilation
- Setting Boundaries in Relationships
- Managing Emotional Overwhelm and Stress
- Navigating Conflict with Emotional Intelligence
- Fostering Emotional Resilience

3.2. Creative Expression for Mental Well-being

- The Role of Creative Arts (Painting and Music) in Mental Health
- Managing Exam Anxiety
- Writing as a Tool for Emotional Clarity
- Movement-Based Therapies for Mental Health
- Storytelling and Role-Playing for Personal Growth

UNIT 4.

4.1. Understanding Relationships and Attachment

- Attachment Styles and Love in Relationships
- Balancing Personal Life and Professional Life
- Building Healthy Friendships
- Healing from Relationship Trauma
- The Interplay Between Attachment and Parenting

4.2. Motivation, Crisis, and First Aid for Mental Health

- Motivational Enhancement Training
- Psychological First Aid
- Suicide Prevention and Intervention in Higher Education
- Resilience Building in Times of Crisis
- Addressing Burnout in Academic and Professional Settings
- Crisis Management Skills for Mental Health Professionals

UNIT 5.

5.1. Fostering Academic Relationships

- Supervisor-Student Relationships
- Peer Collaboration and Teamwork in Academia
- Interdisciplinary Networking and Academic Growth
- Cultural Sensitivity in Academic Relationship
- Building Relationships with Administrative and Support Staff

5.2. Reflection on Mental Health and Emotional Well-being

- Understanding Mental Health in Adolescence and Early Adulthood
- Impact of Academic Pressures on Emotional Well-being
- Navigating Social Relationships and Emotional Intelligence
- Personal Experiences and Emotional Growth
- Promoting Self-Care and Emotional Resilience

UNIT 6

6.1. Stress Management Strategy

- Understanding Stress and Its Impact on Mental Health
- Mindfulness as a Stress Management Technique
- Physical Exercise for Stress Relief
- Relaxation Techniques for Managing Stress
- Building a Personalized Stress Management Routine

6.2. Social Media and Its Impact on Mental Health

- The Role of Social Media in Modern Life
- Social Media and Self-Esteem
- Body Image and Social Media
- Mental Health Risks of Social Media Use
- Building Healthy Digital Habits for Well-being

COURSE OUTCOMES:

- Describe techniques to conflict resolution, time management, and goal setting,
- Describe various tools to manage stress, anxiety, and personal growth.
- Describe various Life Skills for Transition and Resilience

REFERENCES:

https://nptel.ac.in/courses/109104666

OPERATIONS AND SUPPLY CHAIN MANAGEMENT

UNIT 1.

Introduction to Logistics: Design and Management, Logistics Stakeholders and Modern Logistics Concepts,

Manufacturing Logistics: National and International Scenario, Storage and Warehousing, Logistics Services Providers, Outsourcing logistics, Case studies.

Industry Scenario: E-commerce Industry; International Logistics; International Market Penetration Strategies; Logistics Key Performance Area (KPIs): Transportation, Supply, Distribution, Warehousing and Order management; Tools for Improving Logistics Efficiency; Case studies.

UNIT 2.

Reverse Logistics; Performance measures in reverse logistics; Green Supply Chain Management (GSCM); Key Technologies in Green Logistics for Minimizing Carbon Emissions; Implementing green logistics; Lean Logistics; Principles of lean logistics; Case studies.

Trends in Logistics: Technological Advancements; Categories of Modern Logistics; Performance measures for modern logistics; Logistics versus SCM; Logistical Components of the Supply Chain; Case studies.

UNIT 3.

Fundamentals of Supply Chain Management (SCM); Supply Chain Decisions; Types of Supply Chain Models; Supply Chain (SC) Operations: Manufacturing versus Service SC; Examples of Manufacturing and Service Sector; Principle Streams of Supply Chain: 1st stream, 2nd stream, and 3rd stream, 25: Objectives of Supply Chain Networks; Factors influencing Supply Chain Network Decisions; Framework of Network Design Decision; Case studies.

Supply Chain Uncertainty and Processes; How to mitigate Supply Chain Uncertainty?; Supply Chain Operational Views: SCOR Model; Cyclic View and Push/Pull View of Supply Chain; Supply Chain Model and Modelling Systems; Supply Chain Control Towers (Future of SC Modelling); Supply Chain Drivers; Case studies.

UNIT 4.

SC performance and Strategy: Impellers of Supply Chain and Value Chain, Supply Chain Strategy:

Introduction; Achieving Strategic Fit in the Supply Chain, Models for developing Supply Chain Strategy; Make-or-Buy Decisions; Case studies.

Strategic sourcing; Supplier selection and management; Vendor selection and rating; Global sourcing; Coordination in Supply Chain; SC Performance Measurement; Case study.

UNIT 5.

Importance of distribution in SC; Decision-making in distribution networks design; Designing distribution networks and Distribution Management; Facility Location Decisions, Case Studies.

Forecasting Demand; Facility Capacity Planning: Sequencing and scheduling; Transportation decisions; Assignment of markets to factories through assignment problem-solving algorithm, Case Studies.

UNIT 6.

Inventory management; Designing Smart, Resilient and Sustainable Supply Chains; Smart practices in SCM: 21st Century Supply Chains; Supply chain 4.0 and its benefits; Financing Global Supply Chain; Supply Chain Finance, Case Studies.

Sustainable SCs; Designing emergency supply chains; Assets Management in the Supply Chains; Future perspectives of SCM; Case Studies.

REFERENCES:

https://nptel.ac.in/courses/109105494

QUALITY MANAGEMENT

COURSE OBJECTIVES:

- To impart basic understanding of quality issues in the context of organizations.
- To impart knowledge of Quality management perspective, and its importance.
- To impart knowledge of different methodologies, tools and techniques meant for product and process improvement.

UNIT I. Introduction to Quality Management

Evolution of Quality Management, Concepts of Product and Service Quality, Dimensions of Quality, Deming's, Juran's, Crosby's Quality, Philosophy, Quality Cost

UNIT II. Process Quality Improvement

Introduction to Process Quality, Graphical and statistical techniques for, Process Quality Improvement, Graphical tools for data representation, 7 QC tools, Sampling, sampling distribution, and, hypothesis Testing, Regression, Control charts, Process capability analysis, Measurement system analysis, Analysis of Variance (ANOVA), Design and Analysis of Experiment (DOE), Acceptance sampling plan, TQM, Leadership, Lean and JIT Quality Philosophy, Benchmarking, Process failure mode and effect analysis(PFMEA), Service Quality, Six sigma for Process Improvement, ISO 9001 and QS 9000, Quality Audit,Quality Circles

UNIT III. Product Quality Improvement

Quality Function Deployment, Robust Design and Taguchi Method, Design Failure Mode & Effect Analysis, Product Reliability Analysis, Six Sigma in Product Development

COURSE OUTCOMES:

- Describe basic understanding of quality issues in the context of organizations.
- Describe Quality management perspective, and its importance.
- Describe different methodologies, tools and techniques meant for product and process improvement.

REFERENCES:

https://archive.nptel.ac.in/content/syllabus_pdf/110101010.pdf

AIRPORT MANAGEMENT

COURSE OBJECTIVES:

- To acquire solid background of managerial skills in airport management
- To develop personality to face business difficulties.
- To control multicultural conditions.
- To identify the relevant analytical and logical skills to deal with problems in the airline industry.
- To learn the concepts of performing well in teams, professionalism, and the knowledge acquired in the field of airport planning, airport security, passengers forecasting, etc.

UNIT I. INTRODUCTION

History of aviation - organization, global, social & ethical environment - history of aviation in India -major players in the airline industry - swot analysis of the different airline companies in India - market potential of airline industry in India - new airport development plans - current challenges in the airline industry - competition in the airline industry - domestic and international from an Indian perspective

UNIT II. AIRPORT INFRASTRUCTURE AND MANAGEMENT

Airport planning - terminal planning design and operation - airport operations - airport functions -organization structure in an airline - airport authority of India - comparison of global and Indian airport management - role of AAI -airline privatization-full privatization-gradual privatization - partial privatization.

UNIT III. AIR TRANSPORT SERVICES

Various airport services - international air transport services - Indian scenario - an overview of airports in Delhi, Mumbai, Hyderabad and Bangalore -the role of private operators - airport development fees, rates, tariffs.

UNIT IV. INSTITUTIONAL FRAMEWORK

Role of DGCA - slot allocation - methodology followed by ATC and DGCA -management of bilaterals -economic regulations

UNIT V. CONTROLLING

Role of air traffic control - airspace and navigational ads - control process - case studies in airline industry - Mumbai Delhi airport privatization - Navi Mumbai airport tendering process - 6 cases in the airline industry

TEXT BOOKS:

1. Graham. A. Managing airports: an international perspective-Butterworth - Heinemann, oxford 2001.
2. Wells. A. Airport planning and management, 4th edition Mcgraw- Hill, London 2000.

REFERENCES:

1. Doganis. R. The airport business Routledge, London 1992
2. Alexender T. Wells, Seth Young, Principles of airport management, McGraw Hill 2003
3. P.S. Senguttavan Fundamentals of air transport management, excel books 2007
4. Richard de Neufille, Airport systems: planning, design and management, McGraw-Hill London 2007.
5. Manual of aerodrome licensing of AAI airports-AAI website-freely downloadable - issue may 2010.

ORGANISATION OF ENGINEERING SYSTEMS AND HUMAN RESOURCES MANAGEMENT

COURSE OBJECTIVES:

- To develop an understanding of the theory and principles of Organisation of engineering systems & Human Resources Management.
- To develop the ability to perceive issues from an overall management perspective.
- To develop the ability to effectively understand organizational functioning and its human elements.

UNIT 1. Basics of organisations and human resources management

- Introduction to the subject and the course
- Understanding organisations
- Concerns of organising engineering business and systems
- Structure and process issues in running organisations
- Design issues in running organisations
- Operating organisations

UNIT 2. Effectiveness and performance

- Cybernetics and systems framework
- Socio-technical systems
- Dealing with efficiency and excellence
- Man-machine relationship
- Longitudinal Thinking

UNIT 3. Human elements of functioning organisations

- Concerns of recruitment, selection, skill formation and redeployment
- Developing teams and leadership
- Understanding motivation
- Elements of human resources planning
- Indian Industrial Law and managing industrial relations

COURSE OUTCOMES:

- To describe theory and principles of Organisation of engineering systems & Human Resources Management.
- To demonstrate the ability to perceive issues from an overall management perspective.
- To describe understanding of organizational functioning and its human elements.

REFERENCES:

https://nptel.ac.in/courses/110102058

VERTICAL II

STRENGTH OF MATERIALS

UNIT I.
Introduction: Concept of Stress, axial loading normal stress, shearing stress, bearing stress, stress on an oblique plane under axial loading.

UNIT II.
Deformation: Concept of strain, normal strain under axial loading, stress-strain diagrams, Hooke's law, modules of elasticity, Poisson's ratio, thermal stresses, bulk modulus, modulus of rigidity, shearing strain, stress-strain relationship.
Transformation of Stress and Strain: Principal stresses, maximum shearing stress, Mohr's circle for plane stresses. Stresses in thin-walled pressure vessels, measurement of strain Rosette.

UNIT III.
Pure Bending: Deformation in a transverse cross-section, derivation of formula for bending stresses. Bending stresses in composite sections.
Shearing Force and Bending Moment: Diagram for simply supported Beam, Cantilevers, with concentrated, uniformly distributed and variable loads. Castigliano's theorems, unit load method.
Deflection of Beams: Deflection in simply supported beams and cantilevers with concentrated loads, uniformly distributed loads and combination of these. Macaulay's method, moment area method.

UNIT IV.
Springs: Design of Helical (closed coiled) springs and leaf springs.
Columns: Euler formula for pin-ended columns and its extension to columns with other end conditions. Rankine Gordon formula.
Torsion: Deformation in a circular shaft, angle of twist, stresses due to torsion, derivation of torsion formula, torsion in composite shafts.

UNIT V.
Loads on Airplane Components: Steady and unsteady load.

TEXT BOOKS:
1. S Ramamrutham, Strength of Materials, Dhanpat Rai Publishing Co.
2. E P Papov, Mechanics of Materials, Prentice Hall Inc.
3. U C Jindal, Strength of Materials, Umesh Publications

REFERENCE BOOKS:

1. S Timoshenko, Strength of Materials, D Van Standard Co. Inc.
2. G H Ryder, Strength of Materials, B I Publications, Mumbai

THEORY OF MACHINES

COURSE OBJECTIVES:

- To understand the principles in the formation of mechanisms and their kinematics.
- To learn the basic concepts of toothed gearing and kinematics of gear trains.
- To study the effect of friction in different machine elements.
- To analyse the forces and torque acting on simple mechanical systems
- To understand the importance of balancing and vibration

UNIT I. KINEMATIC ANALYSIS IN SIMPLE MECHANISMS AND CAMS

Mechanisms – Terminology and definitions – kinematics inversions and analysis of 4 bar and slide crank chain – velocity and acceleration polygons – cams – classifications – displacement diagrams - layout of plate cam profiles.

UNIT II. TOOTHED GEARING AND GEAR TRAINS

Gear terminology – law of toothed gearing – involute gearing – Gear tooth action - Interference and undercutting – gear trains – parallel axis gear trains – epicyclic gear trains.

UNIT III. FRICTION ASPECTS IN MACHINE COMPONENTS

Surface contacts – Sliding and Rolling friction – Friction drives – Friction in screw threads – Friction clutches – Belt drives – Friction aspects in brakes.

UNIT IV. STATIC AND DYNAMIC FORCE ANALYSIS

Applied and Constrained Forces – Free body diagrams – Static equilibrium conditions – Static Force analysis in simple mechanisms – Dynamic Force Analysis in simple machine members – Inertia Forces and Inertia Torque – D'Alembert's principle.

UNIT V. BALANCING OF ROTATING MASSES AND VIBRATION

Static and Dynamic balancing – Balancing o revolving masses – Balancing machines – Free vibrations – natural Frequency – Damped Vibration – bending critical speed of simple shaft – Forced vibration – harmonic Forcing – Vibration isolation.

COURSE OUTCOMES:

CO1: Design the linkages and the cam mechanisms for specified output motions.
CO2: Determine the gear parameters of toothed gearing and speeds of gear trains in various applications.
CO3: Evaluate the frictional torque in screw threads, clutches, brakes and belt drives.
CO4: Determine the forces on members of mechanisms during static and dynamic equilibrium conditions.
CO5: Determine the balancing masses on rotating machineries and the natural frequencies of free and forced vibratory systems

TEXT BOOK:

1. Uicker, J.J., Pennock G.R and Shigley, J.E., “Theory of Machines and Mechanisms”, Oxford University Press, 2017.

REFERENCES:

1. Cleghorn. W. L., Nikolai Dechev, “Mechanisms of Machines”, Oxford University Press, 2015.
2. Rao.J.S. and Dukkipati.R.V. “Mechanism and Machine Theory”, New Age International Pvt.Ltd., 2006.
3. Rattan, S.S, “Theory of Machines”, McGraw-Hill Education Pvt. Ltd., 2014.
4. Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGraw-Hill, 2009.
5. Thomas Bevan, “The Theory of Machines”, Pearson Education Ltd., 2010

AERODYNAMICS I

COURSE OBJECTIVES:

- To introduce the concepts of mass, momentum and energy conservation relating to aerodynamics.
- To introduce the Navier Stroke equations and its application
- To make the student understand the concept of vorticity, irrotationality, theory of airfoil and wing sections.
- To introduce the basics of viscous flow.
- To make the student to understand the different boundary layers and Blasius Solution
- To introduce the basics of turbulence flow

UNIT I. INTRODUCTION TO LOW-SPEED FLOW

Euler equation, incompressible Bernoulli's equation. circulation and vorticity, green's lemma and Stoke's theorem, barotropic flow, kelvin's theorem, streamline, stream function, irrotational flow, potential function, Equipotential lines, elementary flows and their combinations.

UNIT II. TWO-DIMENSIONAL INVISCID INCOMPRESSIBLE FLOW

Ideal Flow over a circular cylinder, D'Alembert's paradox, magnus effect, Kutta Joukowski's theorem, starting vortex, Kutta condition, real flow over smooth and rough cylinder.

UNIT III. AIRFOIL THEORY

Cauchy-Riemann relations, complex potential, methodology of conformal transformation, Kutta- Joukowski transformation and its applications, thin airfoil theory and its applications.

UNIT IV. SUBSONIC WING THEORY

Vortex filament, Biot and Savart law, bound vortex and trailing vortex, horse shoe vortex, lifting line theory and its limitations.

UNIT V. INTRODUCTION TO BOUNDARY LAYER THEORY

Boundary layer and boundary layer thickness, displacement thickness, momentum thickness, energy thickness, shape parameter, boundary layer equations for a steady, two-dimensional incompressible flow, boundary layer growth over a flat plate, critical Reynolds number, Blasius solution, basics of turbulent flow.

COURSE OUTCOMES:

CO1. Apply the basics physics for low-speed flows.
CO2. Apply the concept of 2D, inviscid incompressible flows in low-speed aerodynamics.
CO3. Solve lift generation problems using aerofoil theories.
CO4. Make use of lifting line theory for solving flow properties.
CO5. Solve the boundary layer equations for a steady, two-dimensional incompressible flow
CO6. Solve the properties of turbulent flow.

TEXT BOOKS:

1. Anderson, J.D., "Fundamentals of Aerodynamics", McGraw Hill Book Co., 2010
2. Houghton, E.L., and Caruthers, N.B., "Aerodynamics for Engineering students", Edward Arnold Publishers Ltd., London, 1989.
3. E Rathakrishnan, “Theoretical Aerodynamics”, John Wiley, NJ, 2013

REFERENCES:

1. Clancey, L J.," Aerodynamics", Pitman, 1986
2. John J Bertin., "Aerodynamics for Engineers", Pearson Education Inc, 2002
3. Kuethe, A.M and Chow, C.Y, “Foundations of Aerodynamics”, Fifth Edition, John Wiley & Sons, 2000.
4. Milne Thomson, L.H., "Theoretical Aerodynamics", Macmillan, 1985.

AIR BREATHING PROPULSION

OBJECTIVES:

- To establish fundamental approach and application of jet engine components.
- To learn about the analysis of flow phenomenon and estimation of thrust developed by jet engine.
- To introduce about the application of various equations in Gas Turbine Engines.
- To learn the concepts of jet engine combustion chambers
- To acquire knowledge on compressors and turbines

UNIT I. PRINCIPLES OF AIR BREATHING ENGINES

Operating principles of piston engines – thermal efficiency calculations – classification of piston engines - illustration of working of gas turbine engines – factors affecting thrust – methods of thrust augmentation – performance parameters of jet engines.

UNIT II. JET ENGINE INTAKES AND EXHAUST NOZZLES

Ram effect, Internal flow and Stall in subsonic inlets – relation between minimum area ratio and eternal deceleration ratio – diffuser performance – modes of operation - supersonic inlets – starting problem on supersonic inlets – shock swallowing by area variation – real flow through nozzles and nozzle efficiency – losses in nozzles – ejector and variable area nozzles - interaction of nozzle flow with adjacent surfaces – thrust reversal.

UNIT III. JET ENGINE COMBUSTION CHAMBERS

Chemistry of combustion, Combustion equations, Combustion process, classification of combustion chambers – combustion chamber performance – effect of operating variables on performance – flame stabilization, Cooling process, Materials, Aircraft fuels, HHV, LHV, Orsat apparatus

UNIT IV. JET ENGINE COMPRESSORS

Euler's turbo machinery equation, Principle operation of centrifugal compressor, Principle operation of axial flow compressor– Work done and pressure rise – velocity diagrams – degree of reaction – free vortex and constant reaction designs of axial flow compressor – performance parameters axial flow compressors– stage efficiency.

UNIT V. JET ENGINE TURBINES

Principle of operation of axial flow turbines– limitations of radial flow turbines- Work done and pressure rise – Velocity diagrams – degree of reaction – constant nozzle angle designs – performance parameters of axial flow turbine– turbine blade cooling methods – stage efficiency calculations – basic blade profile design considerations – matching of compressor and turbine

COURSE OUTCOMES:

CO1: To be able to apply control volume and momentum equation to estimate the forces produced by aircraft propulsion systems

CO2: To be able to describe the principal figures of merit for aircraft engine
CO3: To be able to describe the principal design parameters and constraints that set the performance of gas turbine engines.
CO4: To apply ideal and actual cycle analysis to a gas turbine engine to relate thrust and fuel burn to component performance parameters.
CO5: Understanding the workings of multistage compressor or turbine, and to be able to use velocity triangles and the Euler Turbine Equation to estimate the performance of a compressor or turbine stage.

TEXT BOOK:

1. Hill, P.G. & Peterson, C.R. "Mechanics & Thermodynamics of Propulsion" Pearson education (2009)

REFERENCES:

1. Cohen, H. Rogers, G.F.C. and Saravanamuttoo, H.I.H. "Gas Turbine Theory", Pearson Education Canada; 6th edition, 2008.
2. Mathur, M.L. and Sharma, R.P., "Gas Turbine, Jet and Rocket Propulsion", Standard Publishers & Distributors, Delhi, 2nd edition 2014.
3. Oates, G.C., "Aero thermodynamics of Aircraft Engine Components", AIAA Education Series, New York, 1985.
4. "Rolls Royce Jet Engine", Rolls Royce; 4th revised edition, 1986

AERODYNAMICS – II

COURSE OBJECTIVES:

- To introduce the concepts of compressibility,
- To learn the theory behind the formation of shocks and expansion fans in Supersonic flows.
- To introduce the methodology of measurements in Supersonic flows.
- To get knowledge on high-speed flow over air foils, wings and airplane configuration.
- To learn the concepts of Transonic flow

UNIT I. ONE DIMENSIONAL COMPRESSIBLE FLOW

Energy, Momentum, continuity and state equations, velocity of sound, adiabatic steady state flow equations, Flow through convergent- divergent passage, Performance under various back pressures.

UNIT II. NORMAL AND OBLIQUE SHOCKS

Prandtl equation and Rankine – Hugonoit relation, Normal shock equations, Pitot static tube, corrections for subsonic and supersonic flows, Oblique shocks and corresponding equations, Hodograph and pressure turning angle, shock polar, flow past wedges and concave corners, strong, weak and detached shocks.

UNIT III. EXPANSION WAVES AND METHOD OF HARACTERISTICS

Flow past convex corners, Expansion hodograph, Reflection and interaction of shocks and expansion, waves. Method of Characteristics Two-dimensional supersonic nozzle contours. Rayleigh and Fanno Flows.

UNIT IV. DIFFERENTIAL EQUATIONS OF MOTION FOR STEADY COMPRESSIBLE FLOWS

Small perturbation potential theory, solutions for supersonic flows, Mach waves and Mach angles, Prandtl-Glauert rule - affine transformation relations for subsonic flows, linearized two-dimensional supersonic flow theory - Lift, drag, pitching moment and center of pressure of supersonic profiles.

UNIT V. TRANSONIC FLOW OVER WING

Lower and upper critical Mach numbers, Lift and drag, divergence, shock induced separation, Characteristics of swept wings, Effects of thickness, camber and aspect ratio of wings, Transonic area rule.

COURSE OUTCOMES:

CO1: Calculate the compressible flow through a duct of varying cross section.
CO2: Use quasi one-dimensional theory to analyse compressible flow problems.
CO3: Estimate fluid properties in Rayleigh and Fanno type flows.
CO4: Estimate the properties across normal and oblique shock waves.

CO5: Understand the knowledge of various techniques and methods for solving differential equations of motion for steady compressible flows.
CO6: Predict the properties of transonic flows.

TEXT BOOKS:

1. Anderson Jr., D., – "Modern compressible flows", McGraw-Hill Book Co., New York, 1999.
2. L.J. Clancy, "Aerodynamics" Sterling Book House, 2006

REFERENCES:

1. Rathakrishnan, E., "Gas Dynamics", 6th Edition, Prentice Hall of India, 2017.
2. Shapiro, A.H., "Dynamics and Thermodynamics of Compressible Fluid Flow", Ronald Press, 1982.

FLIGHT MECHANICS

UNIT I.

Atmosphere: ISA, Geopotential and Geometric altitude, Troposphere and Stratosphere, stability of atmosphere.

Aerodynamic characteristics: Drag Aerodynamics, Drag polar, estimation of drag. Forces and moments from dimensional analysis, pressure distribution over airfoils, variation with angle of attack, aerodynamic centre, centre of pressure - related problems.

Estimation of CL, CD and CM from pressure distribution, variation of aerodynamic coefficients with Reynolds number and Mach number. Effect of span, aspect ratio, planform, sweep, taper and twist on aerodynamic characteristics. High lift devices. V/STOL configurations.

UNIT II.

Airplane Performance in Steady and Level Flight: Equations of motion of aircraft, variation of drag with flight, power required and power available, minimum drag and minimum power conditions, climbing and gliding performance.

Airplane Performance in Accelerated Flight: Take-off and landing distances, Jet Assisted Take off, Range and Endurance. Turning flight performance.

UNIT III.

Static longitudinal stability: Stick fixed static longitudinal stability, neutral point, power effects, stick free static longitudinal stability. Hinge moments, Aerodynamic Balancing, Static Margin. In flight measurement of stick fixed and stick free neutral points.

Maneuvering flight: Elevator angle per g and stick force per g maneuver margin. Lateral and Directional Stability and Control: Assymmetric flight, weather cock stability, Rudder fixed and Rudder free static directional stability - Rudder lock, dihedral effect. Control in Roll, Aileron control power. Cross coupling of lateral and directional effects. Numerical problems.

UNIT IV.

Dynamic Stability: Equations of motion of airplane, stability derivatives, split-up of equations in symmetrical and non-symmetric groups of motion. Analysis of short period and phugoid mode. Analysis of roll and spiral modes, Dutch Roll.

TEXT BOOKS:

1. John D Anderson Jr., Introduction to Flight, McGraw Hill
2. R C Nelson, Flight Stability & Automation Control, McGraw Hill

REFERENCE BOOKS:

1. B Etkins, Dynamics of Flight, John Wiley
2. E L Houghton and N B Caruthers, Aerodynamics for Engineers, Edward Arnold, UK

AIRCRAFT STRUCTURES – I

UNIT I.

V-n diagram for the loads acting on the aircraft, salient features of the V-n diagram. Flight envelope for different flying conditions.

Analysis of statically indeterminate structures: planar and space trusses; Deflection of Beams; Area moment Method, slope-deflection method, moment distribution method, Basic elasticity, stresses and strains, equations of equilibrium, plane stress and plane strain problems, compatibility equations, stress - strain relations.

UNIT II.

Strain energy and complementary energy, total potential energy; principle of virtual work; principle of the stationary value of the total potential energy and total complementary energy. Application to deflection problems, application to statically indeterminate problems, Rayleigh Ritz and Galerkin techniques.

UNIT III.

Bending of open and closed section thin walled beams, shear of open section and closed section beams, shear centre and centre of twist, Torsion of closed and open section beams, membrane analogy. Deflection of open and close section beams.

UNIT IV.

Aircraft materials-properties of flight vehicle materials importance of strength to weight ratio, temperature variations, factors affecting choice of materials for different part of airplane. Light metal alloys: heat treatment, high temperature and corrosion resistant alloys, Aircraft steels, effect of alloying elements, heat treatment, selection of steel for aircraft application composite materials: classification and characteristics of composite materials, strength to weight comparison with metals, fiber reinforced and particulate composites.

TEXT BOOKS:

1. T H G Megson, Aircraft Structures for Engineering Students, Edward Arnold, U.K.
2. R M Rivello, Theory and Analysis of Flight Structures, McGrawHill Book Co.
3. E F Bruhn, Analysis and Design of Flight Vehicle Structures, Tri State offset Co. USA

REFERENCE BOOKS:

1. G F Titterton, Aircraft Materials and Processes, Himalayan Books, New Delhi
2. E T Hill, The Materials for Aircraft Construction, Pitman, London

AIRCRAFT STRUCTURES – II

UNIT I.
Bending of thin plates; pure bending, plate subjected to bending and twisting, plates subjected to distributed load, combined bending and in-plane loading of a thin rectangular plate, energy method for bending of thin plates.

UNIT II.
STRUCTURAL STABILITY: Euler buckling of columns: inelastic stability of columns, effect of initial imperfections, energy method for the calculation of buckling loads in columns, flexural and torsional buckling of the thin walled columns, buckling of stiffenced plates, local instability.

UNIT III.
Stress analysis of aircraft components: tapered beams, fuselages, wings, fuselage frames, wing ribs, shear lag.
Matrix methods of structural analysis: stiffness matrix for an elastic spring, pinjointed frame work, application to statically indeterminate frame works, matrix analysis of space frames, stiffness matrix for a beam. Concept and introduction to finite element methods.

UNIT IV.
Introduction to vibration: Free and forced vibration of single, two and multiple degrees of freedom systems, Principal modes, normal modes, static coupling and dynamic coupling.

TEXT BOOKS:
1. T H G Megson, Aircraft Structures for Engineering Students, Edward Arnold, U.K.
2. R M Rivello, Theory and Analysis of Flight Structure, McGrawHill Book Co.
3. N G R Iyengar, Structural Stability of Columns and Plates, Affiliated East West Press(P) Ltd, New Delhi.

REFERENCE BOOKS:
1. W T Thomson, Vibration Theory and Application
2. Perry, D.E Azar, Aircraft Structures, McGraw Hill
3. Bruhn, Fundamentals of Aircraft Structures, McGraw Hill

TURBO MACHINES

COURSE OBJECTIVES:

To study the energy transfer in rotor and stator parts of the turbo machines.

- To study the function of various elements of centrifugal fans and blowers.
- To evaluating the working and performance of centrifugal compressor
- To analyzing flow behavior and flow losses in axial flow compressor.
- To study the types and working of axial and radial flow turbines.

UNIT – I. WORKING PRINCIPLES

Classification of Turbomachines. Energy transfer between fluid and rotor - Euler equation and its interpretation. Velocity triangles. Efficiencies in Compressor and Turbine stages. Degree of reaction. Dimensionless parameters for Turbomachines.

UNIT – II. CENTRIFUGAL FANS AND BLOWERS

Types – components – working. Flow analysis in impeller blades-volute and diffusers. Velocity triangles- h-s diagram. Stage parameters in fans and blowers. Performance characteristic curves – various losses. Fan – bearings, drives and noise.

UNIT – III. CENTRIFUGAL COMPRESSOR

Components - blade types. Velocity triangles - h-s diagram, stage work. Slip factor and Degree of Reaction. Performance characteristics and various losses. Geometry and performance calculation.

UNIT – IV. AXIAL FLOW COMPRESSOR

Construction details. Work done factor. Velocity triangles - h-s diagram, stage work. Work done factor. Performance characteristics, efficiency and stage losses – Stalling and Surging. Free and Forced vortex flow.

UNIT – V. AXIAL AND RADIAL FLOW TURBINES

Axial flow turbines - Types – Elements - Stage velocity diagrams - h-s diagram, stage work - impulse and reaction stages. Compounding of turbines. Performance coefficients and losses. Radial flow turbines: Types – Elements - Stage velocity diagrams - h-s diagram, stage work Performance coefficients and losses.

COURSE OUTCOMES:

CO: Explain the energy transfer in rotor and stator parts of the turbo machines.
CO2: Explain the function of various elements of centrifugal fans and blowers
CO3: Evaluate the working and performance of centrifugal compressor.
C04: Analyze flow behavior and flow losses in axial flow compressor.
CO5: Explain the types and working of axial and radial flow turbines

TEXT BOOKS:

1. Ganesan, V., “Gas Turbines”, 3rd Edition, Tata McGraw Hill, 2011.
2. Yahya, S.M., “Turbines, Compressor and Fans”, 4th Edition, Tata McGraw Hill, 2011.

REFERENCES:

1. Dixon, S.L., “Fluid Mechanics and Thermodynamics of Turbomachinery”, 7th Edition, Butterworth- Heinemann, 2014.
2. Gopalakrishnan. G and Prithvi Raj. D,” A Treatise on Turbomachines”, Scitech Publications (India) Pvt. Ltd., 2nd Edition, 2008.
3. Lewis, R.I., “Turbomachinery Performance Analysis” 1st Edition, Arnold Publisher, 1996.
4. Saravanamutto, Rogers, Cohen, Straznicky., “Gas Turbine Theory” 6th Edition, Pearson Education Ltd, 2009.
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