NEHRU INSTITUTE OF TECHNOLOGY

AN AUTONOMOUS INSTITUTION

COIMBATORE I TAMILNADU

B.E AERONAUTICAL ENGINEERING

CURRICULUM AND SYLLABI R2023

FOR THE STUDENTS ADMITTED IN 2023

NEHRU INSTITUTE OF TECHNOLOGY

Vision

- To be leading Institution in Academic excellence, Multidisciplinary Research, Innovation, Entrepreneurship and Industry relation in order to mould true citizens of the country

Mission

- To create innovative and vibrant young leaders in Engineering and Technology field for building India as a knowledge power by improving the teaching-learning process
- To enhance employability, entrepreneurship and to improve the research competence to address Societal needs.
- To generate engineering graduates who use knowledge as a powerful tool to drive societal transformation and inculcate in them ethical and moral values.

DEPARTMENT OF AERONAUTICAL ENGINEERING

Vision

- To mould the aeronautical students to achieve the excellence in the field of technical education, research, innovation, entrepreneurship and industry related development to meet the challenges in society.

Mission

- To impart high quality technical education and unique interdisciplinary experiences.
- To promote research, innovation and entrepreneurship culture among students for the benefits of society.
- To collaborate with industry and institute for technology up-gradation.

Program Educational Objectives (PEOs)

The Aeronautical Engineering graduate can

PEO 1: Apply knowledge in emerging and varied areas of Aerospace Engineering for higher studies, research, employment and product development.

PEO 2: Communicate their skills and have a sense of responsibility to protect the environment and have ethical conduct towards their profession and commitment to serve the society.

PEO 3: Exhibit managerial skills and leadership qualities while understanding the need for lifelong learning to be competent professionals

Program Outcomes

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

PO2 : Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 : Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 : Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 :Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6 : The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7 : Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8 : Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9 : Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 : Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11 : Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one‘s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

Programme Specific Outcomes (PSOs)

PSO 1: To gather data using modern tools and apply design techniques to develop solutions for challenges in the domain of Aerodynamics, Propulsion, Aircraft Structures and Aircraft Maintenance with professional ethics.

PSO 2: To function as engineering solution providers or entrepreneurs, who are able to manage, innovate, communicate, train and lead a team for continuous improvement.

PSO 3. Graduate will be able to work as a team member which will be a main requirement in industry or research organisation or in any business enterprise. This will pave the way for successful career for the graduate and also plays a role for the success of the organization in which the graduate is employed.

SEMESTER-I								
S.No.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PERIODS PER WEEK**			**TOTAL CONTACT PERIODS**	**CREDITS**
				L	**T**	**P**		
	U23IP101	Induction Program	MC	-	-	-	-	0
THEORY								
1	U23EN101	English for Engineers	HSMC	3	0	0	3	3
2	U23MA101	Calculus And Differential Equations	BSC	3	1	0	4	4
3	U23PH101	Engineering Physics	BSC	3	0	0	3	3
4	U23CY101	Engineering Chemistry	BSC	3	0	0	3	3
5	U23GE101	Engineering Graphics	ESC	2	0	3	5	4
6	U23HS101	Heritage of Tamil	HSMC	1	0	0	1	1
PRACTICAL								
7	U23BS111	Basic Science Laboratory	BSC	0	0	4	4	2
8	U23EN111	Communicative English Laboratory	HSMC	0	0	2	2	1
9	U23GE111	Engineering Practices Laboratory	ESC	0	0	4	4	2
10	U23VECx1	Vocational Enhancement Training-I *	VEC	0	0	2	2	1*
11	U23EE101	Career Enhancement Training – I	EEC	0	0	2	2	1
Total				**15**	**1**	**17**	**33**	**24**

SEMESTER-II								
S.No.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PERIODS PER WEEK**			**TOTAL CONTACT PERIODS**	**CREDITS**
				L	**T**	**P**		
THEORY								
1	U23MA203	Design of Experiments and Numerical Methods	BSC	3	1	0	4	4
2	U23PH202	Applied Physics	BSC	3	0	0	3	3
3	U23CE201	Engineering Mechanics	ESC	3	0	0	3	3
4	U23HS202	Tamils & Technology	HSMC	1	0	0	1	1
5	U23AE201	Fundamentals of Aeronautical Engineering	PCC	3	0	0	3	3
THEORY WITH LAB COMPONENT								
6	U23EN202	Proficiency in English	HSMC	2	0	2	4	3
7	U23GE201	Problem Solving and Python Programming	ESC	3	0	2	5	4
PRACTICAL								
8	U23EE202	Career Enhancement Training -II	EEC	0	0	2	2	1
9	U23VECx2	Vocational Enhancement Training -II*	VEC	0	0	2	2	1*
Total				**18**	**1**	**8**	**27**	**22**

SEMESTER-III								
S.No.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PERIODS PER WEEK**			**TOTAL CONTACT PERIODS**	**CREDITS**
				L	**T**	**P**		
THEORY								
1	U23MA304	Fourier Analysis and Partial Differential Equations	BSC	3	1	0	4	4
2	U23AE301	Aircraft Systems and Instruments	PCC	3	0	0	3	3
3	U23AE302	Aircraft Production Technology	PCC	3	0	0	3	3
4	U23AE303	Strength of materials	ESC	3	0	0	3	3
5	U23AE304	Fluid Mechanics and Machinery	ESC	3	0	0	3	3
THEORY WITH LAB COMPONENT								
6	U23AE305	Aero Engineering Thermodynamics	PCC	3	0	2	5	4
PRACTICAL								
7	U23AE311	Strength of materials Laboratory	ESC	0	0	2	2	1
8	U23AE312	Fluid Mechanics and Machinery Laboratory	ESC	0	0	2	2	1
9	U23EE313	Aptitude and communication for Engineers -I	EEC	0	0	2	2	1
10	U23VECx3	Vocational Enhancement Training-III	VEC	0	0	2	2	1*
MANDATORY COURSE								
11	U23MC302	Universal Human Values	MC	1	0	0	1	0
Total				**18**	**1**	**10**	**29**	**23**

SEMESTER-IV								
S.No.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PERIODS PER WEEK**			**TOTAL CONTACT PERIODS**	**CREDITS**
				L	**T**	**P**		
THEORY								
1	U23MA407	Complex Functions and Boundary Value Problems	BSC	3	1	0	4	4
2	U23AE401	Fundamentals of Aircraft Structural Analysis	PCC	2	1	0	3	3
3	U23AE402	Air Breathing Propulsion	PCC	3	0	0	3	3
4	U23AE403	Mechanics of Machines	PCC	3	0	0	3	3
THEORY WITH LAB COMPONENT								
5	U23AE404	Low-Speed Aerodynamics	PCC	3	0	2	5	4
PRACTICAL								
6	U23AE411	Aircraft Structures Laboratory	PCC	0	0	2	2	1
7	U23AE412	Propulsion Laboratory	PCC	0	0	2	2	1
8	U23AE413	Computer-Aided Design Laboratory	PCC	0	0	2	2	1
9	U23VECx4	Vocational Enhancement Training-IV	VEC	0	0	2	2	1*
10		Aptitude and communication for Engineers -II	EEC	0	0	2	2	1
MANDATORY COURSE								
11	U23CY402	Environmental Ecosystem and Sustainability	MC	2	0	0	2	0
Total				**15**	**2**	**12**	**30**	**21**

SEMESTER-V								
S.No.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PERIODS PER WEEK**			**TOTAL CONTACT PERIODS**	**CREDITS**
				L	**T**	**P**		
THEORY								
1	U23AE501	High-Speed Aerodynamics	PCC	3	0	0	3	3
2	U23AE502	Aircraft Performance	PCC	3	0	0	3	3
3		Professional Elective - I	PEC	3	0	0	3	3
4		Professional Elective - II	PEC	3	0	0	3	3
5		Professional Elective - III	PEC	3	0	0	3	3
THEORY WITH LAB COMPONENT								
6	U23AE503	Advanced Aircraft Structural Analysis	PCC	3	0	2	5	4
PRACTICAL								
7	U23AE511	Aero Engine and Airframe Laboratory	PCC	0	0	2	2	1
8		Soft skills- Reasoning	EEC	0	0	2	2	1
9	U23VECx5	Vocational Enhancement Training-V	VEC	0	0	2	2	1*
MANDATORY COURSE								
10	U23MC501	Entrepreneurship and Innovation	MC	1	0	0	1	0
Total				**19**	**-**	**8**	**29**	**21**

SEMESTER-VI								
S.No.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PERIODS PER WEEK**			**TOTAL CONTACT PERIODS**	**CREDITS**
				L	**T**	**P**		
THEORY								
1	U23AE601	Aircraft Stability and Control	PCC	3	0	0	3	3
2		Professional Elective - IV	PEC	3	0	0	3	3
3		Professional Elective - V	PEC	3	0	0	3	3
4		Professional Elective - VI	PEC	3	0	0	3	3
5		Open Elective - I	OEC	3	0	0	3	3
THEORY WITH LAB COMPONENT								
6	U23AE602	Aircraft Design Approach	PCC	3	0	2	5	4
PRACTICAL								
7	U23AE611	Flight Simulation Laboratory / Aeromodeling Laboratory	PCC	0	0	2	2	1
8		Soft skills –Verbal / Non-Verbal	EEC	0	0	2	2	1
9	U23VECx6	Vocational Enhancement Training-VI	VEC	0	0	2	2	1*
MANDATORY COURSE								
10		Intellectual Property Rights	MC	1	0	0	1	0
Total				**19**	**0**	**8**	**28**	**21**

SEMESTER-VII								
S.No.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PERIODS PER WEEK**			**TOTAL CONTACT PERIODS**	**CREDITS**
				L	**T**	**P**		
THEORY								
1	U23AE701	Product Life Cycle Management	PCC	3	0	0	3	3
2	U23AE702	Vibrations and Aeroelasticity	PCC	4	0	0	4	4
3	U23GE701	Total Quality Management	HSMC	3	0	0	3	3
4		Open Elective - II	OEC	3	0	0	3	3
5		Open Elective - III	OEC	3	0	0	3	3
6		Open Elective - IV	OEC	3	0	0	3	3
PRACTICAL								
7	U23AE711	Computer-Aided Simulation Laboratory	PCC	0	0	2	2	1
8	U23AE712	Project Phase-I	EEC	0	0	4	4	2
9	U23AE713	Internship	EEC	0	0	0	0	1
Total				**19**	**0**	**6**	**25**	**22**

SEMESTER-VIII								
S.No.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PERIODS PER WEEK**			**TOTAL CONTACT PERIODS**	**CREDITS**
				L	**T**	**P**		
PRACTICAL								
1	U23AE801	Project Phase-II / Internship / Startup	EEC	0	0	20	20	10
Total				**0**	**0**	**20**	**20**	**10**

*Students shall also undertake a start-up activity for the development of products as part of project work. If the outcome of a start-up is a fully developed product and whose concept is tested and validated, then it shall be considered in lieu of the project work. Such students shall submit a start-up report, which includes the concepts and process flow of the developed product, publications and patents, if any.

*Indicated courses have not been included for Total credits and CGPA calculation of individual semesters, it can be provided additionally as special credits.

Scheme of Credit Distribution- Summary

S. No.	Category	Semester								Total Credits	
		I	II	III	IV	V	VI	VII	VIII	NIT	ANNA UNIVERSITY
1.	Humanities and Management Courses (HSMC)	5	4					3		**12**	**12**
2.	Basic Science Course (BSC)	12	7	4	4					**27**	**29**
3.	Engineering Science Course (ESC)	6	7	8						**21**	**24**
4.	Professional Core Course (PCC)		3	10	16	11	8	8		**55**	**57**
5.	Professional Elective Course (PEC)					9	9			**18**	**18**
6.	Open Elective Course (OEC)						3	9		**12**	**12**
7.	Employability Enhancement Skills	1	1	1	1	1	1	3	10	**19**	**14**
8.	Mandatory Course (MC)	--	--	✓	✓	✓	✓	--	--	--	--
Total		**24**	**22**	**23**	**21**	**21**	**21**	**23**	**10**	**165**	**166**

PROFESSIONAL ELECTIVE COURSES: VERTICALS

AERODYNAMICS	MATERIALS AND STRUCTURES	PROPULSION AND HEAT TRANSFER	COMPUTATIONAL ENGINEERING	AVIONICS AND CONTROL SYSTEMS	AIRCRAFT MAINTENANCE
Hypersonic Aerodynamics	Composite Materials and Structures	Heat Transfer	Numerical Methods in Fluid Dynamics	Air Traffic Control	Airframe Maintenance and Repair
Industrial Aerodynamics	Additive Manufacturing	Rocket Propulsion	Computational Fluid Dynamics	Navigation and Communications Systems	Aircraft General Engineering and Maintenance Practices
Boundary Layer Theory	Experimental Stress Analysis	Advanced Propulsion Systems	Computer-Aided Design and Analysis	Control Engineering	Aircraft Engine Maintenance and Repair
Experimental Aerodynamics	Fatigue and Fracture Mechanics	Design of Gas Turbine Engine Components	Finite Element Methods	Avionics	Civil Aviation Regulations
Helicopter Aerodynamics	Aerospace Materials	Cryogenic Engineering	Computational Heat Transfer	Design of UAV Systems	Non-Destructive Testing and Evaluation
Wind Tunnel Testing	Smart Materials in Aerospace	Rockets & Missiles	Turbulence Modeling	Flight Control Systems	Air Transport Engineering and Maintenance Technologies

VERTICAL 1: AERODYNAMICS

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	U23AEP11	Hypersonic Aerodynamics	PEC	3	0	0	3	3
2.	U23AEP12	Industrial Aerodynamics	PEC	3	0	0	3	3
3.	U23AEP13	Boundary Layer Theory	PEC	3	0	0	3	3
4.	U23AEP14	Experimental Aerodynamics	PEC	3	0	0	3	3
5.	U23AEP15	Helicopter Aerodynamics	PEC	3	0	0	3	3
6.	U23AEP16	Wind Tunnel Testing	PEC	3	0	0	3	3

VERTICAL 2: MATERIALS AND STRUCTURES

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	U23AEP21	Composite Materials and Structures	PEC	3	0	0	3	3
2.	U23AEP22	Additive Manufacturing in Aviation	PEC	3	0	0	3	3
3.	U23AEP23	Experimental Stress Analysis	PEC	3	0	0	3	3
4.	U23AEP24	Fatigue and Fracture Mechanics	PEC	3	0	0	3	3
5.	U23AEP25	Aerospace Materials	PEC	3	0	0	3	3
6.	U23AEP26	Smart Materials in Aerospace	PEC	3	0	0	3	3

VERTICAL 3: PROPULSION AND HEAT TRANSFER

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	U23AEP31	Heat Transfer	PEC	3	0	0	3	3
2.	U23AEP32	Rocket Propulsion	PEC	3	0	0	3	3
3.	U23AEP33	Advanced Propulsion Systems	PEC	3	0	0	3	3
4.	U23AEP34	Design of Gas Turbine Engine Components	PEC	3	0	0	3	3
5.	U23AEP35	Cryogenic Engineering	PEC	3	0	0	3	3
6.	U23AEP36	Rockets and Missiles	PEC	3	0	0	3	3

VERTICAL 4: COMPUTATIONAL ENGINEERING

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	U23AEP41	Numerical Methods in Fluid Dynamics	PEC	3	0	0	3	3
2.	U23AEP42	Computational Fluid Dynamics	PEC	3	0	0	3	3
3.	U23AEP43	Computer-Aided Design and Analysis	PEC	3	0	0	3	3
4.	U23AEP44	Finite Element Methods	PEC	3	0	0	3	3
5.	U23AEP45	Computational Heat Transfer	PEC	3	0	0	3	3
6.	U23AEP46	Turbulence Modeling	PEC	3	0	0	3	3

VERTICAL 5: AVIONICS AND CONTROL SYSTEMS

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	U23AEP51	Air Traffic Control	PEC	3	0	0	3	3
2.	U23AEP52	Navigation and Communications	PEC	3	0	0	3	3
3.	U23AEP53	Control Engineering	PEC	3	0	0	3	3
4.	U23AEP54	Avionics	PEC	3	0	0	3	3
5.	U23AEP55	Design of UAV Systems	PEC	3	0	0	3	3
6.	U23AEP56	Flight Control Systems	PEC	3	0	0	3	3

VERTICAL 6: AIRCRAFT MAINTENANCE

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	U23AEP61	Airframe Maintenance and Repair	PEC	3	0	0	3	3
2.	U23AEP62	Aircraft General Engineering and Maintenance Practices	PEC	3	0	0	3	3
3.	U23AEP63	Aircraft Engine Maintenance and Repair	PEC	3	0	0	3	3
4.	U23AEP64	Civil Aviation Regulations	PEC	3	0	0	3	3
5.	U23AEP65	Non-Destructive Testing and Evaluation	PEC	3	0	0	3	3
6.	U23AEP66	Air Transport Engineering and Maintenance Technologies	PEC	3	0	0	3	3

OPEN ELECTIVE COURSES 1 & 2

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.		Fundamentals of MLand AI	OEC	3	0	0	3	3
2.		Fundamentals of Data Science	OEC	3	0	0	3	3
3.		IoT Concepts and its Applications in Aeronautics	OEC	3	0	0	3	3
4.		Augmented Reality and Virtual Reality	OEC	3	0	0	3	3
5.		English for Competitive Examinations	OEC	3	0	0	3	3
6.		NGOs and Sustainable Development	OEC	3	0	0	3	3
7.		Renewable Energy Technologies	OEC	3	0	0	3	3
8.		Urban Agriculture	OEC	3	0	0	3	3
9.		Drinking Water Supply and Treatment	OEC	3	0	0	3	3
10.		Nano Technology	OEC	3	0	0	3	3
11.		Functional Materials	OEC	3	0	0	3	3
12.		Traditional Indian Foods	OEC	3	0	0	3	3
13.		Introduction to Food Processing	OEC	3	0	0	3	3
14.		Team Building and Leadership Management for	OEC	3	0	0	3	3
15.		MOOC -Swayam/Coursera	OEC	3	0	0	3	3

OPEN ELECTIVE COURSES 3 & 4

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.		Project Report Writing	OEC	3	0	0	3	3
2.		Production and Operations Management for Entrepreneurs	OEC	3	0	0	3	3
3.		Basics of Integrated Water Resources Management	OEC	3	0	0	3	3
4.		New Product Development	OEC	3	0	0	3	3
5.		Industrial Design & Rapid Prototyping Techniques	OEC	3	0	0	3	3
6.		Fundamentals of Food Engineering	OEC	3	0	0	3	3
7.		Food Safety and Quality Regulations	OEC	3	0	0	3	3
8.		Energy Technology	OEC	3	0	0	3	3
9.		Surface Science	OEC	3	0	0	3	3
10.		Applied Design Thinking	OEC	3	0	0	3	3
11.		Reverse Engineering	OEC	3	0	0	3	3
12.		Principles of Marketing Management for Business	OEC	3	0	0	3	3
13.		Human Resource Management for	OEC	3	0	0	3	3
14.		Financing New Business Ventures	OEC	3	0	0	3	3
15.		MOOC -Swayam/Coursera	OEC	3	0	0	3	3

OPEN ELECTIVES PROVIDED TO OTHER DEPARTMENTS

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	U23AEO11	Introduction to Industrial Engineering	OEC	3	0	0	3	3
2.	U23AEO12	Fundamentals of Aeronautical Engineering	OEC	3	0	0	3	3
3.	U23AEO13	Drone Technologies	OEC	3	0	0	3	3
4.	U23AEO14	Industrial Aerodynamics	OEC	3	0	0	3	3
5.	U23AEO15	Space Vehicles	OEC	3	0	0	3	3
6.	U23AEO16	Space Engineering	OEC	3	0	0	3	3
7.	U23AEO17	Renewable Energy Technologies	OEC	3	0	0	3	3

VEC PROVIDED AND PLANNED

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	U23VECx3	Quadcopter Building Techniques	VEC	0	0	2	2	1*
2.	U23VECx4	Rapid Prototyping	VEC	0	0	2	2	1*
3.	U23VECx5	Aircraft Frame and Engine Maintenance	VEC	0	0	2	2	1*
4.	U23VECx6	Aircraft Electrical and Electronics Maintenance	VEC	0	0	2	2	1*

SEMESTER I

		Category: HSMC			
U23EN101	**ENGLISH FOR ENGINEERS**	**L**	**T**	**P**	**C**
SDG: 4	**(Common to all Branches)**	**3**	**0**	**0**	**3**

COURSE OBJECTIVE:

1. To enable learners of engineering and technology to develop their basic communication skills in English.
2. To acquire, command in both the respective skills (listening and reading) and the productive skills (writing and speaking) of the English language.
3. To understand the key concepts of values, life skills and business communication and motivate students to look within and create a better version of themselves.
4. To focus on the development of basic fluency in English, usage of vocabulary in the technical field, and strengthening reading and official written communication skills.
5. To use language efficiently in expressing their opinions via various media.

UNIT 1 **INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION** **9**

Listening– listening to Audio/video(formal & informal);Telephonic conversation (Activity) Speaking-Self Introduction; Introducing a friend (Activity);Conversation-politeness strategies; Reading - Reading brochures (technical context), telephone messages / social media messages relevant to technical contexts-Writing-Writing on self, Writing Definition; Jumbled sentence Grammar – Simple present tense, Present continuous, Present perfect, Present perfect continuous; Question types: Wh/ Yes or No/ and Tags; Word formation, One-word substitution.

UNIT 2 **NARRATION AND SUMMATION** **9**

Listening- Listening to the podcast, anecdotes/stories/event narration; documentaries and interviews with celebrities (Activity). Speaking-Narrating personal experiences/events; interviewing a celebrity (Activity). Reading- Reading biographies, travelogues, newspaper reports, Writing- Guided Writing-Paragraph writing, Short Report on an event (field trip etc.) - Grammar– Simple past tense, Past continuous, Past perfect, Past perfect continuous; Subject-Verb Agreement; Prepositions, Word forms (prefixes & suffixes); Error Correction.

UNIT 3 **DESCRIPTION OF PROCESS/PRODUCT** **9**

Listening – Listening to specific audio tracks (Activity) Speaking – Picture description; giving instruction to use the product; presenting a product; Role play (Activity) -Reading – Reading advertisements, gadget reviews; finding key information from a given text- Writing - Instructions; Process description; Grammar - Simple future tense, Future continuous, Future perfect, Future perfect continuous; Imperatives; Adjectives; Degrees of comparison; Compound Words.

UNIT 4 CLASSIFICATION AND RECOMMENDATIONS 9

Listening – watching videos/ documentaries and responding to the questions based on them, Scientific lectures; and educational videos. Speaking – Small Talk; Mini presentations (Activity) -Reading – Journal reports, predicting content of reading habits, Reading articles (Activity)- Writing –Memos to colleagues or friends; Opinion Blogs; Grammar – Articles; Pronouns - Possessive & Relative pronouns, Cause and Effect.

UNIT 5 EXPRESSION 9

Listening – Listening to different accent, Listening to speeches or presentation- Speaking – Debates and Expressing opinions through Simulations, exchanging personal information - (Activity)- Reading – Reading editorials; Poster making (Activity)- Writing – Creative Writing, Checklist- Grammar –Punctuation; Compound Nouns, Homonyms; and Homophones, Simple, Compound & Complex Sentences.

COURSE OUTCOMES:

At the end of the course, students would

CO1: Listen and comprehend complex academic texts.

CO2: Understand the denotative and connotative meanings of technical texts.

CO3: Identify definitions, descriptions, narrations and essays on various topics.

CO4: Apply different methods of integration in solving practical problems.

CO5: Express their opinions effectively in both oral and written medium of communication.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. English for Engineers & Technologists Orient Blackswan Private Ltd. Department of English, Anna University (2020 edition).

2. English for Science & Technology Cambridge University Press, 2021. Authored by Dr.VeenaSelvam, Dr.Sujatha Priyadarshini, Dr.Deepa Mary Francis, Dr.KN.Shoba and Dr.Lourdes Joevani, Department of English, Anna University.

REFERENCES:

1. Technical Communication – Principles and Practices By Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2016, New Delhi.

2. A Course Book on Technical English by Lakshmi Narayanan, Scitech Publications (India) Pvt.Ltd.

3.English for Technical Communication (with CD) by Aysha Viswamohan, Mc-graw Hill Education, ISBN:0070264244

4. Effective Communication Skill, KulbhusanKumar, RS Salaria, Khanna Publishing House.

5. Learning to Communicate–Dr.V.Chellammal, Allied Publishing House, NewDelhi, 2003.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	1	1	-	3	1	-	2	-	-	-
CO2	-	-	-	-	-	1	1	-	3	-	-	2	-	-	-
CO3	-	-	-	-	-	1	1	-	3	2	-	3	-	-	-
CO4	-	-	-	-	-	1	2	-	3	1	-	2	-	-	-
CO5	-	-	-	-	-	1	2	-	3	2	-	3	-	-	-

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

COURSE DESIGNED BY	APPROVED BY
Dr.T.Saranaya- AP/ English & Prof. J.Brindha Devi- AP/ English	Dr.M.Kumaresan – Professor & Head/ S&H
Name and Department	**Name and Department of BoS Chairman**

U23MA101 CALCULUS AND DIFFERENTIAL EQUATIONS **Category: BSC**

SDG: 4 **(Common to all Branches)**

L	T	P	C
3	1	0	4

COURSE OBJECTIVE:

1. To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
2. To familiarize the students with differential calculus.
3. To enlighten the students with functions of several variables. This is needed in many branches of engineering.
4. To make the students acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems.
5. To acquaint the students with mathematical tools needed in evaluating multiple integrals and their applications.

UNIT 1 MATRICES 9+3

Characteristic equation – Eigen values and Eigen vectors of a real matrix – Properties of Eigen values and Eigen vectors (without proof) – Cayley – Hamilton theorem (Statement and applications only) - Orthogonal matrices – Orthogonal transformation of a symmetric matrix to diagonal form – Quadratic form – Nature of Quadratic forms - Reduction of quadratic form to canonical form by orthogonal transformation.

UNIT 2 DIFFERENTIAL CALCULUS 9 + 3

Representation of functions - Limit of a function - Continuity - Derivatives -Differentiation rules (sum, product, quotient, chain rules) - Implicit differentiation - Logarithmic differentiation - Applications: Maxima and Minima of functions of one variable.

UNIT 3 MULTIVARIABLE CALCULUS 9 + 3

Functions of two variables – Partial derivatives – Total differential – Taylor's series for functions of two variables – Jacobian’s – Constrained maxima and minima – Lagrange's multiplier and its applications

UNIT 4 **ORDINARY DIFFERENTIAL EQUATIONS OF SECOND ORDER** **9 + 3**

Linear differential equations of second order with constant coefficients. Linear differential Equations of second order with variable coefficients: Cauchy's linear differential equation - Method of variation of parameters for second order differential equations

UNIT 5 **MULTIPLE INTEGRALS** **9 + 3**

Double integration with constant and variable limits - Region of integration - Area as double integral in Cartesian coordinates. Triple integral in Cartesian coordinates. Application of integration – Volume of Solids

COURSE OUTCOMES:

At the end of the course, students will be able to:

CO1: Comprehend the concepts of Eigen values, Eigen vectors, limits, continuity, functions of several variables, double integration and region of integration for solving complex problems.

CO2: Use rules of differentiation to solve maxima and minima problems.

CO3: Apply various techniques in solving ordinary and partial differential equations for practical applications.

CO4: Apply differential and integral calculus tools in modeling problems.

CO5: Evaluate integrals to compute area, volume and other practical problems.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Grewal.B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition 2018.

2. James Stewart, "Calculus : Early Transcendentals", Cengage Learning, 8th Edition, New Delhi,2015.

3. Kreyszig.E, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New delhi,2016.

REFERENCES:

1. Bali. N., Goyal. M. and Watkins. C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009

2. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New delhi,2016

3. Anton. H, Bivens. I and Davis. S, " Calculus ", Wiley, 10th Edition, 2016

4. Narayanan. S. and Manicavachagom Pillai. T. K., “Calculus" Volume I and II, S.Viswanathan Publishers Pvt. Ltd., Chennai, 2009.

5. Jain. R.K. and Iyengar. S.R.K., “Advanced Engineering Mathematics”, Narosa Publications, New Delhi, 5th Edition, 2016.

6. Srimantha Pal and Bhunia. S.C, " Engineering Mathematics " Oxford University Press, 2015

CO’s-PO’s & PSO’s MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO 1	3	3	3	1	1	3	-	-	-	-	-	-	-	-	-
CO 2	3	3	1	-	-	3	-	-	-	-	-	-	-	-	-
CO 3	3	3	2	-	1	3	-	-	-	-	-	-	-	-	-
CO 4	3	3	3	-	-	3	-	-	-	-	-	-	-	-	-
CO 5	3	3	2	1	-	3	-	-	-	-	-	-	-	-	-

Correlation levels: 1 – low 2 – medium 3 – high “-“- no correlation

COURSE DESIGNED BY	APPROVED BY
Dr. N. Vithya- ASP/ Mathematics	Dr.M.Kumaresan – Professor & Head/ S&H
Name and Department	**Name and Department of BoS Chairman**

U23PH101	**ENGINEERING PHYSICS**	**Category : BSC**
SDG: 4	**(Common to CSE & IT)**	**L T P C**
		3 0 0 3

COURSE OBJECTIVE:

1. Understand the basics of Properties of Matter and apply them to Engineering.
2. Explore the applications of Lasers and Fiber optics in engineering contexts.
3. Apply principles of Ultrasonics and Thermal Physics to Engineering challenges.
4. Grasp foundational Quantum Physics concepts and their modern applications.
5. Analyze Crystal systems and their structures in Engineering and Technology.

UNIT 1 PROPERTIES OF MATTER 9

Elasticity – Stress-strain diagram and its uses - Factors affecting elastic modulus – Torsional stress and deformations –Torsion pendulum: theory and experiment - Bending of beams - Bending moment – Cantilever: theory and experiment – Uniform and non-uniform bending: theory and experiment - I-shaped girders - Applications. – Basic Solved Problems.

UNIT 2 LASER AND FIBER OPTICS 9

Introduction – Principle of Spontaneous emission and stimulated emission. Population inversion, pumping- Einstein's A and B coefficients: derivation. Types of lasers – Nd-YAG, CO_2- Industrial Applications of Lasers –Fiber Optics: Principle and propagation of light – Numerical aperture and Acceptance angle - Types of optical fibres (material, refractive index, mode) – Temperature and displacement sensors.

UNIT 3 ULTRASONICS AND THERMAL PHYSICS 9

Introduction – Piezoelectric effect - piezoelectric generator - Velocity measurement – Acoustic grating – Ultrasonic Medical applications - Introduction to heat - Transfer of heat energy: Thermal conduction, convection and radiation –Thermal conductivity - Forbe's and Lee's disc method: theory and experiment – Applications: heat exchangers, refrigerators, ovens and solar water heaters.

UNIT 4 QUANTUM PHYSICS 9

Black body radiation – Planck's theory (derivation) – Deduction of Wien's displacement law and Rayleigh-Jeans' Law from Planck's theory – Compton effect: Theory and experimental

verification – Matter waves – Schrödinger's wave equation: Time independent and time dependent equations – Physical significance of wave function – Particle in a one-dimensional box - Microscope: Scanning Tunnelling microscope.

UNIT 5 CRYSTAL PHYSICS 9

Lattice – Unit cell – Bravais lattice – Lattice planes – Miller indices – 'd' spacing in cubic lattice – Calculation of number of atoms per unit cell – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC and HCP structures – Diamond and graphite structures – Polymorphism and allotropy - Crystal defects – Point, line and surface defects- Burger vector.

COURSE OUTCOMES:

At the end of the course, students would

CO1: Realize the fundamental engineering ideas of matter, optics, heat, sound, and quantum theory.

CO2: Demonstrate a solid understanding of fundamental matter properties, Laser and Fiber optics classification, Quantum concepts and apply them successfully to solve practical engineering problems.

CO3: Apply the elastic modulus theory, Fiber Optic Sensors, Ultrasonics and thermal applications to integrate knowledge and problem solve at an advanced level.

CO4: Categorize the Elastic moduli concepts, Fiber optic lasers and Crystal structures to implement in Engineer problems in Material Science and electronics.

CO5: Analyze the foundational Quantum and Crystal Physics concepts to implement solutions for modern engineering problems.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Bhattacharya, D.K. & Poonam, T. "Engineering Physics". Oxford University Press, 2015.
2. Gaur, R.K. & Gupta, S.L. "Engineering Physics". Dhanpat Rai Publishers, 2012.
3. Pandey, B.K. &Chaturvedi, S. "Engineering Physics". Cengage Learning India, 2012

REFERENCES:

1. Halliday, D., Resnick, R. & Walker, J. "Principles of Physics". Wiley, 2015.

2. Serway, R.A. & Jewett, J.W. “Physics for Scientists and Engineers”. Cengage Learning, 2010.
3. Palanisamy P.K. Engineering Physics. SCITECH Publications, 2011.
4. Kittle,C,: Introduction to solid state Physics:, Wiley, 2005.
5. Mani P. Engineering Physics I. Dhanam Publications, 2011.
6. Senthilkumar G. Engineering Physics I. VRB Publishers, 2011.

CO’s-PO’s & PSO’s MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PSO 3
CO1	3	3	1	-	1	-	1	-	-	1	-	1	-	-	-
CO2	3	3	1	-	1	-	1	-	1	-	-	1	-	-	-
CO3	3	3	1	-	1	-	1	-	1	-	-	1	-	-	-
CO4	3	2	1	-	1	-	-	-	-	1	-	1	-	-	-
CO5	3	3	1	-	-	-	1	-	1	-	-	1	-	-	-

Correlation levels: 1 – low 2 – medium 3 – high “-“- no correlation

COURSE DESIGNED BY	APPROVED BY
Dr. T.Jayaprakash- Professor / Physics	Dr.M.Kumaresan – Professor & Head/ S&H
Name and Department	**Name and Department of BoS Chairman**

U23CY101	**ENGINEERING CHEMISTRY**	**Category : BSC**
SDG: 9	**(Common to all Branches)**	**L T P C**
		3 0 0 3

COURSE OBJECTIVE:

1. Learn boiler feed water requirements, and water treatment techniques.
2. To acquire knowledge about the preparation, properties and applications of polymers.
3. Understand the basic concepts of electrochemistry and its applications.
4. Learn corrosion control and protective techniques.
5. Acquire the knowledge about the fuels and properties of energy storage devices.

UNIT 1 WATER TECHNOLOGY 9

Introduction - Sources of water - Impurities in water - Types of water –Hardness of water - Expression of hardness - Units of hardness - Estimation of hardness of water by EDTA method - Disadvantages of using hard water - Boiler troubles - Scale and sludge - Softening of water - External treatment method - Demineralization process - Internal treatment process – Carbonate, Phosphate and Calgon conditioning - Desalination by reverse osmosis method.

UNIT 2 POLYMERS 9

Introduction: Classification of polymers – Natural and synthetic; Thermoplastic and Thermosetting. Functionality – Degree of polymerization. Types: Addition, condensation and copolymerization and mechanism of Addition polymerization (Free Radical); Techniques of polymerization: Bulk, emulsion, solution and suspension. Preparation, properties and uses of Nylon (6,6 and 11) and Epoxy resin. Engineering application of plastics- PVC, PTFE and Bakelite. Types of compounding of plastics- Moulding, injection moulding.

UNIT 3 ELECTRO CHEMISTRY 9

Electrochemistry**:** Introduction - Cells - Representation of a galvanic cell - Reversible and irreversible cells - Electrode potential - Nernst equation - Reference electrode (Calomel electrode) - Standard hydrogen electrode - Glass electrode - Electrochemical series and its applications – Battery: Introduction, Types of batteries- alkaline battery- lead storage battery - H_2 -O_2 fuel cell- applications. Construction of solar cells and E-Vehicle.

UNIT 4 CORROSION AND ITS CONTROL 9

Introduction - Chemical corrosion and Wet corrosion - Galvanic and differential aeration (Pitting, Crevice and Pipeline) - Factors influencing rate of corrosion - Corrosion- causes- factors- corrosion

control - material selection and design aspects - electrochemical protection – sacrificial anode method and impressed current cathodic method- Cathodic protection method.

UNIT 5 FUELS AND COMBUSTION 9

Introduction - Classification of fuels - Requirements of a good fuel – Combustion: Principle of combustion - Calorific value - Gross and net calorific values - Explosive range - Spontaneous ignition temperature. Fuels: Solid fuels - Coal and its varieties - Proximate analysis - Significance - Metallurgical coke - Otto-Hoffman byproduct method - Liquid fuel: Manufacture of synthetic petrol - Bergius method - Knocking - Octane number - Cetane number - Gaseous fuel: Liquefied petroleum gas (LPG), Compressed natural gas (CNG).

COURSE OUTCOMES:

At the end of the course, students would

CO1: Recall the concept about water technology, engineering polymers, electrodes, corrosion and combustion of fuels.

CO2: Understand the boiler problems and categorize the polymers.

CO3: Classify plastics, batteries, corrosion, and the calorific value of fuels.

CO4: Apply enough knowledge of contemporary water softening, polymerization, fuel cell, electrochemical protection, and fuel manufacturing procedures.

CO5: Analyze the hardness of water using the EDTA technique and characterization of coal.

TOTAL: 45

PERIODS

TEXT BOOKS:

1. Jain P C and Monica Jain, “Engineering Chemistry”, 17th Edition, Dhanpat Rai Publishing Co., 2018.

2. Sivasankar B., “Engineering Chemistry”, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2017.

REFERENCES:

1. B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, “Textbook of nanoscience and nanotechnology”, Universities Press-IIM Series in Metallurgy and Materials Science, 2018.

2. O.G. Palanna, “Engineering Chemistry” McGraw Hill Education (India) Private Limited, 2nd Edition, 2017.

3. Friedrich Emich, “Engineering Chemistry”, Scientific International Pvt, Ltd, New Delhi, 2017.

4. Shikha Agarwal, “Engineering Chemistry-Fundamentals and Applications”, Cambridge University Press, Delhi, Second Edition, 2019.

5. R.D. Madan, “Modern Inorganic Chemistry”, S. Chand, New Delhi, 2012

6. S.S. Dara, “A Textbook of Engineering Chemistry”, S. Chand Publishing, 12th Edition, 2018.

CO’s-PO’s & PSO’s MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	-	-	2	-	-	2	-	-	-	-	1	-	-	-
CO2	3	-	-	2	2	-	2	-	-	-	-	2	-	-	-
CO3	3	-	-	2	2	-	2	-	-	-	-	2	-	-	-
CO4	3	-	-	2	3	-	2	-	-	-	-	3	-	-	-
CO5	3	-	-	2	3	-	2	-	-	-	-	3	-	-	-
CO6	3	-	-	2	2	-	2	-	-	-	-	2.2	-	-	-

Correlation levels: 1 – low 2 – medium 3 – high “-“- no correlation

COURSE DESIGNED BY	APPROVED BY
Dr.M.Kumaresan – Professor & Head/ S&H	Dr.M.Kumaresan – Professor & Head/ S&H
Name and Department	**Name and Department of BoS Chairman**

	ENGINEERING GRAPHICS	**Category : ESC**
U23GE101S	**(Common for Aeronautical Engineering, Civil**	**L T P C**
DG:4	**Engineering, Agricultural Engineering and Food Technology)**	**3 0 2 4**

COURSE OBJECTIVE:

1. To draw engineering curves of simple objects.
2. To draw the orthographic views.
3. To draw the orthographic projection of solids and section of solids.
4. To draw the development of surfaces.
5. To draw the isometric projections of simple solids.

CONCEPTS AND CONVENTIONS (Not for Examination) **2**

Importance of graphics in engineering applications - Use of drafting instruments - BIS conventions and specifications — Size, layout and folding of drawing sheets - Lettering and dimensioning.

UNIT 1 **PLANE CURVES** **10**

Basic Geometrical constructions, Curves used in engineering practices: Conics -Construction of ellipse, parabola and hyperbola by eccentricity method - Construction of cycloid - Construction of involutes of circle - Drawing of tangents and normal to the above curves.

UNIT 2 **PROJECTION OF POINTS, LINES AND PLANES** **10**

Orthographic projection - principles - Principal planes - First angle projection -projection of points. Projection of straight lines - Determination of true lengths and true inclinations by rotating line method and traces. Projection of planes (polygonal and circular surfaces).

UNIT 3 **PROJECTION OF SOLIDS** **10**

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids by rotating object method.

UNIT 4 **PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES** **10**

Sectioning of solids in simple vertical position - obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids - Prisms, pyramids cylinders and cones.

UNIT 5 ISOMETRIC PROJECTIONS 10

Principles of isometric projection - isometric scale - lsometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders and cones.

MODELING OF SIMPLE OBJECTS (Not for Examination) 8

Practicing three-dimensional modeling of simple objects by CAD Software

COURSE OUTCOMES:

At the end of the course, students would

CO1: Understand the engineering curves of simple objects.

CO2: Construct the drawings on orthographic views.

CO3: Construct orthographic Projections of simple solids.

CO4: Develop the lateral surface of simple Solids.

CO5: Construct the isometric projection of simple plans and solids

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Venugopal K. and Prabhu Raja V., “Engineering Graphics", New Age International (P) Limited, 2008.
2. Natrajan K.V., “A Text Book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2018.
3. Dr. V. Ramesh Babu,” Engineering Graphics”, VRB Publishers Pvt. Ltd., 2023.
4. Jeyapoovan T., “Engineering Graphics", Newdelhi Vikas Publishing House, 2007.

REFERENCES:

1. Parthasarathy N. S. and Vela Murali, “Engineering Graphics”, Oxford University, Press, New Delhi, 2015.
2. Kulkarni D; Rastogi; Sarkar, “Engineering Graphics with AUTOCAD”, Newdelhi Prentice Hall of India, 2009.

CO’s-PO’s & PSO’s MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PSO3
CO1	2	1	2	1	1	0	0	0	0	2	0	0	0	1	0

CO2	2	1	2	1	1	0	0	0	0	2	0	0	0	1	0
CO3	2	1	2	1	1	0	0	0	0	2	0	0	0	1	0
CO4	2	1	2	1	1	0	0	0	0	2	0	0	0	1	0
CO5	2	1	2	1	1	0	0	0	0	2	0	0	0	1	0
Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation															

COURSE DESIGNED BY	**APPROVED BY**
Prof. S. Satheesh Kumar – Assistant Professor / Aeronautical Engineering	Dr. P. Vijayakumar – Professor & Head/ Aeronautical Engineering
Name and Department	**Name and Department of BoS Chairman**

U23HS101 **HERITAGE OF TAMIL (Common to all Branches)** **Category : HSMC**

L	**T**	**P**	**C**
1	**0**	**0**	**1**

COURSE OBJECTIVE:

1.To learn the extensive literature of classical tamil

2.To review the fine arts heritage of tamil culture

3.To realize the contribution in Indian freedom struggle

UNIT 1 LANGUAGE AND LITERATURE 3

Language Families in India - Dravidian Languages – Tamil as a Classical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

UNIT 2 HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE **3**

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

UNIT 3 FOLK AND MARTIAL ARTS 3

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

UNIT 4 THINAI CONCEPT OF TAMILS 3

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

UNIT 5 CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE 3

Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

COURSE OUTCOMES:

At the end of the course, students would

CO1: Remember the extensive literature of tamil and its classical nature, musical instruments, Folk, thinai concept, Indian Freedom Struggle& Aham, Puram and Aram Concept.

CO2: Remember the principles in Thirukural, Bakthi Literature Azhwars and Nayanmars , heritage of sculpture, painting and musical instruments of ancient people, victory of chozha dynasty.

CO3: Understand on folk and martial arts of tamil people, Justice in Sangam Literature, Development of Modern literature in Tamil, Making of musical instruments.

CO4: Understand the role of Temples in Social and Economic Life of Tamils, Ancient Cities and Ports of Sangam Age, Conquest of Cholas.

CO5: Understand the Cultural Influence of Tamils over the other parts of India, contribution of tamils self-esteem movement and siddha medicine, Print History of Tamil Books.

TOTAL: 15 PERIODS

TEXT BOOKS:

1.தமிழக வரலாறு – மக்களும் பண்பாடும் – .கே. கே பிள்ளை (வெளியீடு): தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள்கழகம்

2.கணினித்தமிழ் – முனைவர் இல. சுந்தரம் . (விகடன் பிரசுரம்).

3.கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை (வெளியீடு)

REFERENCES:

1.Social Life of Tamils (Dr. K. K. Pillay) A joint publication of TNTB & ESC and RMRL – (in print)

2.Historical Heritage of the Tamils (Dr .S. V. Subaramanian, Dr .K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).

3.The Contributions of the Tamils to Indian Culture (Dr. M. Valarmathi) (Published by: International Institute of Tamil Studies)

4. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

5.Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
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CO2	-	-	-	-	-	-	3	3	-	2	-	3	-	-	-
CO3	-	-	-	-	-	-	3	3	-	2	-	3	-	-	-
CO4	-	-	-	-	-	-	3	3	-	2	-	3	-	-	-

CO5	-	-	-	-	-	-	3	3	-	2	-	3	-	-	-

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

COURSE DESIGNED BY	APPROVED BY
Prof. Prabhakaran – AP/ Tamil	Dr.M.Kumaresan - Professor & Head / S&H
Name and Department	**Name and Department of BoS Chairman**

Category: EEC

U23EE101 CAREER ENHANCEMENT TRAINING I

SDG: 17 (Common to all Branches)

L	**T**	**P**	**C**
3	**0**	**0**	**1**

COURSE OBJECTIVE:

1. To improve mathematical and analytical abilities of students, particularly in the context of comprehending engineering concepts and making data-driven decision.
2. To develop critical thinking skills including problem solving, logic, patterns, and reasoning.
3. To Comprehend and appreciate mathematical terminologies and concepts in order to understand, interpret, and represent science and technology.

UNIT 1 FUNDAMENTALS 6

Divisibility Test - Square root and Cube roots – HCF & LCM - problems on Numbers

UNIT 2 ALGEBRA 5

Simplification – Surds & Indices – Linear & Quadratic Equations

UNIT 3 BANKING ESSENTIALS 8

Average – Percentage – Profit & Loss – Simple Interest – Compound Interest

UNIT 4 TIME AND EFFICIENCY 8

Time Speed Distance – Problems on Trains – Boats & Streams – Time & Work – Pipes & Cisterns

UNIT 5 LOGICAL REASONING 3

Number & letter series – Analogy– Pattern classification – Coding & Decoding

COURSE OUTCOMES:

At the end of the course, students would

CO1: Exhibit a clear understanding of fundamental concepts of aptitude for engineering.

CO2: Demonstrate problem-solving skills and critical thinking abilities in the context of recruitment aptitude tests.

CO3: To use appropriate strategies and shortcuts to improve speed and accuracy in solving aptitude problems during recruitment processes.

CO4: Evaluate and interpret aptitude test results to identify areas of improvement and develop a personalized study plan for further enhancement.

TOTAL: 30 PERIODS

TEXT BOOKS:

1. The Pearson Guide to Quantitative Aptitude For Competitive Examinations, Dinesh Khattar. Pearson

2. Quantitative Aptitude Dr. R.S. Aggarwal S. Chand Publication.

3. A modern Approach to Verbal and Non-Verbal Reasoning R.s. Aggarwal.

REFERENCES:

1. Quantitative Aptitude for CAT, Arun Sharma.

2. Fast Track Objective Arithmetic, Rajesh Verma, Arihant Publication.

3. Quantitative Aptitude Quantum CAT Common Admission Tests for Admission into IIMs, Sarvesh K. Verma.

4. Effective Communication Skill,Kulbhusan Kumar,R S Salaria,Khanna Publishing House.

5.Wiley's Exam Expert Quantitative Ability for CAT, 2ed, Ashu Jain.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PSO 3

CO1	3	3	3	3	-	-	-	-	-	-	-	-			
CO2	3	2	1	3	-	-	-	-	-	-	-	-			
CO3	3	1	1	2	-	-	-	-	-	-	-	-			
CO4	1	1	1	1	-	-	-	-	-	-	-	-			
CO5	-	-	-	-	-	-	-	-	-	-	-	-			
Correlation levels:			**1 – low**			**2 – medium**			**3 – high**			**"-"- no correlation**			

COURSE DESIGNED BY	**APPROVED BY**
Prof. Ramesh Raja – Head/ NCPIR	Dr.M.Kumaresan – Professor & Head/ S&H
Name and Department	**Name and Department of BoS Chairman**

Category: BSC

U23BS111 BASIC SCIENCE LABORATORY

L	**T**	**P**	**C**
0	**0**	**2**	**2**

COURSE OBJECTIVE:

1. Realize the fundamental engineering ideas of matter, optics, heat, sound, and quantum theory.
2. Demonstrate a solid understanding of fundamental matter properties, Laser and Fiber optics classification, Quantum concepts and apply them successfully to solve practical engineering problems.
3. Apply the elastic modulus theory, Fiber Optic Sensors, Ultrasonics and thermal applications to integrate knowledge and problem solve at an advanced level.
4. Categorize the Elastic moduli concepts, Fiber optic lasers and Crystal structures to implement in Engineer problems in Material Science and electronics.
5. Analyse the foundational Quantum and Crystal Physics concepts to implement solutions for modern engineering problems.

PHYSICS - LIST OF EXPERIMENTS (Any 5 Experiments)

1. Determination of rigidity modulus – Torsion pendulum
2. Determination of Young's modulus - Non uniform bending method.
3. Determination of Young's modulus - Uniform bending method.
4. Determination of thickness of a thin wire – Air wedge method.
5. Determination of the wavelength of the laser using grating.
6. Determination of Numerical Aperture and acceptance angle using Optical fibre.
7. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer.
8. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
9. Melde's string experiment.
10. Determination of Band gap of a semiconductor.

CHEMISTRY- LIST OF EXPERIMENTS (Any 5 Experiments)

1. Estimation of total, temporary and permanent hardness of water by EDTA method.
2. Estimation of alkalinity of the given water sample.
3. Determination of chloride content of water sample by Argentometric method.
4. Determination of strength of given hydrochloride acid using pH meter
5. Determination of DO content of water sample by Winkler's method.
6. Conduct metric titration strong acid Vs Strong Base.
7. Estimation of BOD of the given water sample.
8. Estimation of iron content of the given solution using potentiometer.
9. Estimation of Iron content by spectrophotometer.
10. Estimation of sodium present in water using flame photometer.

COURSE OUTCOMES:

At the end of the course, students would

CO1: Apply Physics principles of elasticity to evaluate engineering properties of materials.

CO2: Analyze the physical principle involved in various instruments in acoustics, optics and thermal physics.

CO3: Characterize the quality of water samples with respect to their acidity, alkalinity and hardness.

CO4: Apply chemistry principles to evaluate DO, BOD, Iron content of the given samples.

CO5: Analyze the strength and amount of acids using pH, potentiometer, conductivity meter and the

TOTAL: 60 PERIODS

CO's-PO's & PSO's MAPPING															
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	3	2	1	1	-	-	1	-	1	-	-	-			
CO2	3	2	1	1	-	-	1	-	1	-	-	1			
CO3	3	2	1	1	-	-	1	-	1	-	-	-			
CO4	3	2	1	1	-	-	1	-	1	-	-	1			
CO5	3	2	-	1	-	-	1	-	1	-	-	1			
Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation															

COURSE DESIGNED BY	**APPROVED BY**
Dr.M.Kumaresan – Professor & Head/ S&H & Dr.T.Jayaprakash - Professor / Physics	Dr.M.Kumaresan – Professor & Head / S&H
Name and Department	**Name and Department of BoS Chairman**

U23EN111 **COMMUNICATIVE ENGLISH LABORATORY** **Category : HSMC**

SDG : 4 **(Common to all Branches)**

L	**T**	**P**	**C**
0	**0**	**2**	**1**

COURSE OBJECTIVE:

1. To enable learners of engineering and technology to develop their basic communication skills in English.
2. To acquire, command in both the respective skills (listening and reading) and the productive skills (writing and speaking) of the English language.
3. To understand the key concepts of values, life skills and business communication and motivate students to look within and create a better version of themselves.
4. To focus on the development of basic fluency in English, usage of vocabulary in the technical field, and strengthening reading and official written communication skills.

5. To use language efficiently in expressing their opinions via various media.

LIST OF EXPERIMENTS

1. Conversation: Introduction to Classmates-Audio/Video (formal & informal)
2. Self-Introduction
3. Telephone Conversation
4. Listening to voicemail & messages
5. Listening and filling a form
6. Debate
7. Group Discussion
8. Exchanging personal Information
9. Introducing a friend politeness strategy
10. Essay Writing

COURSE OUTCOMES:

At the end of the course, students would

CO1: Listen and comprehend complex academic texts.

CO2: Understand the denotative and connotative meanings of technical texts.

CO3: Identify definitions, descriptions, narrations and essays on various topics.

CO4: Apply different methods of integration in solving practical problems.

CO5: Express their opinions effectively in both oral and written medium of communication.

TOTAL: 30 PERIODS

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	2	3	1	1	1	-	-	2	-	2	2	2	2	-
CO2	3	2	2	2	1	1	-	-	2	-	2	2	3	3	-
CO3	3	2	3	2	1	2	-	-	2	-	2	2	2	2	-
CO4	3	2	2	2	1	2	-	-	3	-	2	3	3	3	-

CO5	3	2	3	1	1	2	-	-	3	-	2	3	2	3	-
Correlation levels:			**1 – low**			**2 – medium**			**3 – high**			**"-"- no correlation**			

COURSE DESIGNED BY	**APPROVED BY**
Dr.T.Saranaya- AP/ English & Prof. J.Brindha Devi- AP/ English	Dr.M.Kumaresan – Professor & Head/ S&H
Name and Department	**Name and Department of BoS Chairman**

U23GE111 **ENGINEERING PRACTICES LABORATORY** **Category : ESC**

SDG:4 & 8 **(Common for Aero, Civil, Agri and Food Tech)**

L	**T**	**P**	**C**
0	**0**	**4**	**2**

COURSE OBJECTIVE:

1. Draw pipe line plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planing; making joints in wood materials used in common household wood work.
2. Weld various joints in steel plates using arc welding work; Machining various simple processes like turning, drilling, tapping in parts.
3. Assemble simple mechanical assembly of common household equipments; Making a tray out of metal sheet using sheet metal work.
4. Wiring various basic electrical joints in common household electrical wire work.
5. Soldering and testing simple electronic circuits; Assembling and testing simple electronic components.

LIST OF EXPERIMENTS

S.NO **GROUP A (CIVIL & MECHANICAL)**

PART I CIVIL ENGINEERING PRACTICES

PLUMBING WORK:

1 Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household.

2 Preparing plumbing line sketches.

3 Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.

WOOD WORK:

4 Sawing,

5 Planing and

6 Making joints like T-Joint, Mortise joint and Tenon joint and Dovetail joint.

PART II MECHANICAL ENGINEERING PRACTICES

WELDING WORK:

7 Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.

8 Practicing gas welding.

BASIC MACHINING WORK:

9 (simple)Turning

10 (simple)Drilling.

11 (simple)Tapping.

MACHINE ASSEMBLY PRACTICE:

12 Study of centrifugal pump

13 Study of air conditioner

SHEET METAL WORK:

14 Making of a square tray

GROUP B (ELECTRICAL & ELECTRONICS)

PART I ELECTRICAL ENGINEERING PRACTICES

1 Introduction to switches, fuses, indicators and lamps - Basic switch board wiring with lamp, fan and three pin sockets.

2 Staircase wiring.

3 Fluorescent Lamp wiring with introduction LED types.

4 Energy meter wiring and related calculations/ calibration

5 Study of Iron Box wiring and assembly

PART II ELECTRONIC ENGINEERING PRACTICES

6 Study of Electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CR.

7 Study of logic gates AND, OR, EX-OR and NOT.

8 Generation of Clock Signal.

9 Soldering simple electronic circuits and checking continuity.

10 Assembly and dismantle of LED TV.

COURSE OUTCOMES:

At the end of the course, students would

CO1: Fabricate carpentry components and pipe connections including plumbing works.

CO2: Make use of welding equipments to join the structures.

CO3: Perform the basic assembling and machining operations; Make the models using sheet metal works.

CO4: Experiment with the basic electrical works and to measure the electrical quantities.

CO5: Solder the simple electronic circuits; Assemble the simple electronic devices.

TOTAL: 60 PERIODS

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO 1	2	2	2	2	0	0	0	0	0	0	1	0	0	0	1
CO 2	2	2	2	2	0	0	0	0	0	0	1	0	0	0	1
CO 3	2	2	2	2	0	0	0	0	0	0	1	0	0	0	1
CO 4	2	2	2	2	0	0	0	0	0	0	1	0	0	0	1
CO 5	2	2	2	2	0	0	0	0	0	0	1	0	0	0	1

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

COURSE DESIGNED BY	APPROVED BY
Prof. S. Satheesh Kumar – Assistant Professor / Aeronautical Engineering	Dr. P. Vijayakumar – Professor & Head/ Aeronautical Engineering
Name and Department	**Name and Department of BoS Chairman**

SEMESTER II

U23MA203	**DESIGN OF EXPERIMENT AND**	**Category: BSC**
SDG 4	**NUMERICAL METHODS**	**L T P C**
		3 1 0 4

COURSE OBJECTIVE:

1. Learn basic concepts of statistical and numerical methods as well as numerical problem-solving procedure for planning marketing strategies
2. Gain the knowledge of testing of hypothesis for samples and design of experiments
3. Understand the basic concepts in solving algebraic and transcendental equations
4. Adopt the numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines
5. Develop the various techniques and methods of solving ordinary differential equations

UNIT 1 TESTING OF HYPOTHESIS 9+3

Large Sample Test: Single Mean and Difference of two Means. Small Sample Test - Student's t Test - Single Mean-Difference of Two Means-F Test- Chi Square Test-Goodness of Fit - Test of Independence Attributes – Application- Comparative Analysis - Quality Testing.

UNIT 2 DESIGN OF EXPERIMENTS 9+3

Analysis of Variance: One way and two-way classifications - Completely randomized design – Randomized block design – Latin square design. Application: Response Surface Methodology.

UNIT 3 ALGEBRAIC AND TRANSCENDENTAL EQUATIONS 9+3

Solution of algebraic and transcendental equations–Newton Raphson method - Gauss elimination method – Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel Method. Application: System of Communications.

UNIT 4 NUMERICAL DIFFERENTIATION AND INTEGRATION 9+3

Interpolation Using Newton's Forward and Backward Difference Formulae – Numerical Integration (Single): Trapezoidal Rule and Simpson's 1/3rd and 3/8 Rules. Application: The determination of discontinuous points in Image processing.

UNIT 5 SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 9+3

Taylor's series method - Euler's method - Modified Euler's method – Fourth orders Runge-Kutta method for solving first order differential equations. Application: Electrical circuits, Chemical reactions and Mechanical system.

COURSE OUTCOMES:

At the end of the course, students would

CO1: Comprehend the concepts of Independence of attributes, one way and two-way classifications, Solution of algebraic and transcendental equations for solving complex problems.

CO2: Tests for single mean, Equality of variance, Chi square test for goodness of fit and Solution of linear equations

CO3: Apply the numerical techniques of differentiation and integration for engineering problems and solving Ordinary Differential Equations.

CO4: Analyze the concepts of classifications of design of experiments and linear equations in the field of Engineering and Technology.

CO5: Solve the ordinary differential equations using certain techniques with engineering applications.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics forEngineers", Pearson Education, Asia, 8th Edition, 2015.

2. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015

REFERENCES:

1. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016

2. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014

3. Gupta S.C. and Kapoor V. K., "Fundamentals of Mathematical Statistics", Sultan Chand &Sons, New Delhi, 12th Edition, 2020

4. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014

CO's-PO's & PSO's MAPPING															
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	3	3	2	2	-	-	-	-	-	-	-	-	2.5	-	-
CO2	3	3	3	3	-	-	-	-	-	-	-	-	3	-	-
CO3	3	3	3	2	-	-	-	-	-	-	-	-	2.75	-	-
CO4	3	3	3	3	-	-	-	-	-	-	-	-	3	-	-
CO5	3	3	3	2	-	-	-	-	-	-	-	-	2.75	-	-
Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation															

COURSE DESIGNED BY	**APPROVED BY**
Mrs Amali Theresa ASP/S&H	Dr.M.Kumaresan – Professor & Head/ S&H
Name and Department	**Name and Department of BoS Chairman**

U23PH202 **APPLIED PHYSICS** **Category: BSC**

SDG 4

L	**T**	**P**	**C**
3	**0**	**0**	**3**

COURSE OBJECTIVE:

1. Make the students to have a knowledge on the basis of conducting materials, quantum mechanics and about energy bands
2. Introduce the physics of semiconducting materials and applications of semiconductors in device fabrication
3. Make the students to learn the origin of magnetism in magnetic materials and their classifications

4. Equip the students to learn the mechanisms of polarization in dielectric materials, and about classification and properties of dielectric materials; to learn the physics of superconductivity and various properties exhibited by superconductors.
5. Make the students familiarize in the advanced engineering materials.

UNIT 1 CONDUCTING MATERIALS 9

Conducting materials: Introduction - Classical free electron theory – Electrical and thermal conductivities –Wiedemann- Franz law –Lorentz number –Merits and demerits of classical free electron theory – Quantum free electron theory-Fermi distribution function – Effect of temperature on fermi function-Density of energy states – Carrier concentration in metals - Electron effective mass- Concept of hole.

UNIT 2 SEMICONDUCTING MATERIALS 9

Elemental and Compound semiconductors - Intrinsic semiconductor – Carrier concentration derivation – Fermi level – Variation of Fermi level with temperature – Electrical conductivity – Band gap determination – Derivation of carrier concentration in n-type and p-type semiconductor – Variation of Fermi level with temperature and impurity concentration — Hall effect –Determination of Hall coefficient – Applications

UNIT 3 MAGNETIC MATERIALS 9

Origin of magnetic moment – Bohr magneton – Comparison of Dia, Para and Ferro magnetism - Ferromagnetism: Saturation magnetization and Curie temperature – Exchange interaction - Domain theory – Hysteresis – Soft and hard magnetic materials – Antiferromagnetic materials – Ferrites and its applications – Applications of Magnetic materials - Giant Magneto Resistance (GMR).

UNIT 4 DIELECTRIC AND SUPERCONDUCTING MATERIALS 9

Electrical susceptibility –Dielectric constant – Electronic, ionic, orientational and space charge polarization – Frequency and temperature dependence of polarisation – Internal field – Claussius – Mosotti relation (derivation) – Dielectric loss – Dielectric breakdown - Superconductivity: properties – Type I and Type II superconductors – High Tc superconductors – Applications of superconductors – SQUID, cryotron, magnetic levitation.

UNIT 5 ADVANCED ENGINEERING MATERIALS 9

Metallic glasses - Shape memory alloys: Ni-Ti alloy, applications – Ceramics - Composites: classification-role of matrix and reinforcement, processing of fiber reinforced plastics– Nanomaterials: preparation methods - synthesis: Pulse Laser Deposition (PLD), Ball Milling, chemical vapour deposition - Properties and applications.

COURSE OUTCOMES:

At the end of the course, students would

CO1: Understand the fundamental principles of classical and quantum mechanics, semiconductor physics, including energy band structures, magnetic properties of materials, dielectric materials, superconducting materials, and gain insights into the basics of emerging engineering materials.

CO2: Exhibit a comprehensive comprehension of classical and quantum mechanics, semiconductor physics, magnetic properties of materials, dielectric materials, and superconducting materials, enabling the effective resolution of practical engineering challenges.

CO3: Apply the fundamental theories of classical and quantum mechanics, semiconductor physics, and the properties of magnetic, dielectric, and superconducting materials to integrate knowledge into various engineering applications.

CO4: Classify the semiconductor, magnetic, dielectric, and superconducting properties of materials, utilizing this categorization to address engineering problems in Material Science effectively.

CO5: Analyze the foundational knowledge of conductors, semiconductors, magnetic, dielectric, and superconducting materials to devise and implement solutions for contemporary engineering issues.

TOTAL: 45

TEXT BOOKS:

1. Arumugam M., Materials Science. Anuradha publishers, 2010

2. Pillai S.O., Solid State Physics. New Age International(P) Ltd., publishers, 2009

3. The Physics and Chemistry of NanoSolids by Frank J. Owens and Charles P. Poole Jr, Wiley-Inter science, 2008

REFERENCES:

1. Palanisamy P.K. Materials Science. SCITECH Publishers, 2011

2. Senthilkumar G. Engineering Physics II. VRB Publishers, 2011

3. Handbook of nanoscience, Eng. & Technology by W. Gaddand, D. Bernner, S.L. Solnki & G.J. Infrate (Eds) , CRC press 2002

4. Nanostructure and Nanomaterials: Synthesis, Properties and Application by G. Cao, Imperial College Press, 2004

5. Yaser Dahman, Nanotechnology and Functional Materials for Engineers, Elsevier, 2017.

6. J.F.Shackelford. Introduction to Materials Science for Engineers. Pearson, 2015

CO's-PO's & PSO's MAPPING															
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	2	-	-	-	-	1	-	-	-	-	1	-	-	-
CO2	3	2	1	-	1	-	1	-	-	-	-	-	-	-	-
CO3	3	2	1	-	1	-	1	-	-	-	-	1	-	-	-
CO4	3	2	1	-	1	-	1	-	-	1	-	1	-	-	-
CO5	3	2	1	-	1	-	1	-	-	1	-	1	-	-	-
Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation															

COURSE DESIGNED BY	**APPROVED BY**
Dr T Jayaprakash – Professor / Physics	Dr.M.Kumaresan – Professor & Head/ S&H
Name and Department	**Name and Department of BoS Chairman**

U23CE201 **ENGINEERING MECHANICS** **Category : ESC**

SDG 4,7,9

L	**T**	**P**	**C**
3	**2**	**0**	**3**

COURSE OBJECTIVE:

1. To Learn the use scalar and vector analytical techniques for analyzing forces in Statically determinate structures.
2. To introduce the equilibrium of rigid bodies.
3. To study and understand the distributed forces, surface, loading on beam and intensity.
4. To learn the principles of friction, forces and to determine the apply the concepts of frictional forces at the contact surfaces of various engineering systems.

5. To develop basic dynamics concepts – force, momentum, work and energy.

UNIT 1 STATICS OF PARTICLES 9

Introduction – Units and Dimensions – Laws of Mechanics – Lami's theorem, Parallelogram and triangular Law of forces (Statement Only) – Vectorial representation of forces – Vector operations of forces - additions, subtraction, dot product, cross product – Coplanar Forces – rectangular components – Equilibrium of a particle – Equivalent systems of forces – Principle of transmissibility.

UNIT 2 EQUILIBRIUM OF RIGID BODIES 9

Free body diagram – Types of supports –Action and reaction forces (Beam only) – stable equilibrium – Conditions of equilibrium - Moments and Couples – Moment of a force about a point and about an axis.

UNIT 3 PROPERTIES OF SURFACES AND SOLIDS 9

Centroids and centre of mass – Centroids sections - Rectangle, Circle, Triangle – T section, I section, - Angle section, Hollow section by using standard formula –Theorems of Pappus (Statement Only) - Area moments of inertia of plane areas – Rectangle, Circle, Triangle, T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem (Statement Only) – Polar Moment of Inertia – Radius of Gyration.

UNIT 4 DYNAMICS OF PARTICLES 9

Introduction – Dynamics - Kinematics & Kinetics – Characteristics of Kinematics - Displacements, Velocity and acceleration, their relationship - Newton's laws of motion – Work Energy Equation– Impulse and Momentum.

UNIT 5 FRICTION 9

Friction – Types of friction – Limiting friction – Coulomb's law of dry friction – Impending Motion – Angle of Repose – Body on a Rough inclined plane – Simple Contact Friction – Ladder Friction – Screw Friction – Belt Friction.

COURSE OUTCOMES:

At the end of the course, students would

CO1: Illustrate the vectorial and scalar representation of forces and moments

CO2: Analyse the rigid body in equilibrium

CO3: Evaluate the centre of Gravity and Moment of Inertia of an object.

CO4: Calculate dynamic forces exerted in rigid body

CO5: Determine the friction and the effects by the laws of friction

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Bhavikatti, S.S and Rajashekarappa, K.G., "Engineering Mechanics", New Age International (P) Limited Publishers, 1998

2. Rajasekaran S and Sankarasubramanian G., "Engineering Mechanics Statics and Dynamics", 3rd Edition, Vikas Publishing House Pvt. Ltd., 2005.

REFERENCES:

1. R.S.Khurmi. "A Text Book of Engineering Mechanics, S Chand Publishing, 2019.

2. Vela Murali, "Engineering Mechanics-Statics and Dynamics", Oxford University Press, 2018.

3. P. JagetBabu, "Engineering Mechanics", Pearson Education, India Ltd, 2016

4. N.Kottiswaran, "Engineering Mechanics", Sri Balaji Publications, 2013.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	3	3	2	1	-	-	-	-	-	-	2	3	3	2
CO2	3	3	3	2	2	-	-	-	-	-	-	2	3	3	2
CO3	3	3	2	1	1	-	-	-	-	-	-	1	3	3	2
CO4	3	3	2	2	2	-	-	-	-	-	-	1	3	3	2
CO5	3	3	3	2	2	-	-	-	-	-	-	2	3	3	2

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

COURSE DESIGNED BY	APPROVED BY
Dr R Bharathi Kanna – AP (SG) / Agri	Dr M Vadivel – HoD / Civil
Name and Department	**Name and Department of BoS Chairman**

U23HS202 **TAMIL AND TECHNOLOGY** **Category: HSMC**

SDG 4

L	T	P	C
1	0	0	1

COURSE OBJECTIVE:

1. To learn the extensive literature of classical Tamil.
2. To review the fine arts heritage of Tamil culture.
3. To realize the contribution in Indian freedom struggle.

UNIT 1 TAMIL AND TECHNOLOGY 3

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

UNIT 2 DESIGN AND CONSTRUCTION TECHNOLOGY 3

Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.

UNIT 3 MANUFACTURING TECHNOLOGY 3

Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and gold- Coins as source of history - Minting of Coins – Beads making-industries Stone beads -Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.

UNIT 4 AGRICULTURE AND IRRIGATION TECHNOLOGY 3

Dam, Tank, ponds, Sluice, Significance of KumizhiThoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

UNIT 5 SCIENTIFIC TAMIL & TAMIL COMPUTING 3

Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.

COURSE OUTCOMES:

At the end of the course, students would

CO1: Understand the extensive literature of Tamil and its classical nature (understand).

CO2: Understand the heritage of sculpture, painting and musical instruments of ancient people (understand).

CO3: Review on folk and martial arts of Tamil people (understand).

CO4: Realization of thinai concepts, trade and victory of chozha dynasty (understand).

CO5: Understand the contribution of Tamils in Indian freedom struggle, self-esteem movement and siddha medicine (understand).

TOTAL: 15 PERIODS

TEXT BOOKS:

1.தமிழக வரலாறு – மக்களும் பண்பாடும்– .கே.கே பிள்ளை (வெளியீடு): தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்.

2.கணினித்தமிழ் – முனைவர்இல. சுந்தரம் . (விகடன் பிரசுரம்).

3.கீழடி – வைகைநதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல்துறை (வெளியீடு).

REFERENCES:

1.Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)

2.Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).

3.National The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: Interl Institute of Tamil Studies).

4.Keeladi - ‘Sangam City Civilization on the banks of river Vaigai’ (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu.

5.Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu).

6.Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

CO's-PO's & PSO's MAPPING															
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	-	-	-	-	-	-	3	3	-	2	-	3	-	-	-
CO2	-	-	-	-	-	-	3	3	-	2	-	3	-	-	-
CO3	-	-	-	-	-	-	3	3	-	2	-	3	-	-	-
CO4	-	-	-	-	-	-	3	3	-	2	-	3	-	-	-
CO5	-	-	-	-	-	-	3	3	-	2	-	3	-	-	-
CO6	-	-	-	-	-	-	3	3	-	2	-	3	-	-	-
Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation															

COURSE DESIGNED BY	**APPROVED BY**
Prof. A.Prabhakaran – AP/ Tamil	Dr.M.Kumaresan – Professor & Head/ S&H
Name and Department	**Name and Department of BoS Chairman**

U23AE201 **Category: PCC**

SDG 4,7,9,11 **FUNDAMENTALS OF AERONAUTICAL ENGINEERING**

L	**T**	**P**	**C**
3	**2**	**0**	**3**

COURSE OBJECTIVE:

1. To acquire the knowledge on the Historical evaluation of Airplanes
2. To learn the different component systems and functions
3. To know the concepts of basic properties and principles behind the flight
4. To learn the basics of different structures & construction
5. To learn the various types of power plants used in aircrafts

UNIT 1 **HISTORICAL EVOLUTION** **9**

Hot Air Baloons – Ornithopters - Early Airplanes - Wright Brothers Era-Biplanes and monoplanes, Developments in aerodynamics, materials, structures and propulsion over the years, Components of an Airplane and their functions - Introduction to Rotorcraft - UAV and MAVs. History of Indian Aviation, Different sectors behind the aviation, Government and Private Industries and organizations in the Aviation Stream

UNIT 2 AIRCRAFT CONFIGURATIONS 9

Classification of Aircrafts – Aerostats & Aerodynes, Classification of Aeroplane (Based on purpose & Mach) - Axis System - Primary & Secondary Control Surfaces, Introduction to Unconventional Configurations. Conventional control, Powered control, Basic instruments for flying, Typical systems for control Actuation

UNIT 3 PRINCIPLES OF FLIGHT 9

Physical properties and structure of the atmosphere- Temperature, pressure and altitude relationships- Newton's law of motions applied to aeronautics, Evolution of Lift, Drag and Moment- Airfoil's characteristics and nomenclature-Mach Number, Maneuvers.

UNIT 4 INTRODUCTION TO AIRPLANE CONSTRUCTION 9

General types of Construction- Geodesic, Monocoque, Semi monocoque, Structure of Wing, Fuselage & Landing Gear, Materials used in aircraft Construction, Introduction to Additive Manufacturing, stresses and strains-Hooke's law- stress-strain diagrams-elastic constants - Factor of Safety

UNIT 5 POWER PLANTS AND AVIATION INDUSTRIES 9

Basic ideas about piston and turbo engines, use of propeller and jets for Thrust Production. Comparative merits, Principles of operation of rocket, Types of rocket engines and typical applications, Emerging Techniques in Propulsion

COURSE OUTCOMES:

At the end of the course, students would

CO1: Illustrate the history of aircraft & developments over the years

CO2: Ability to identify the types & classifications of components and control systems

CO3: Explain the basic concepts of flight & Physical properties of Atmosphere

CO4: Identify the types of fuselage and constructions

CO5: Distinguish the types of Engines and explain the principles of Rocket

CO6: Get the knowledge on aviation industries

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Anderson, J.D., "Introduction to Flight", McGraw-Hill, 1995.

2. Richard S. Shevell, "Fundamentals of Flight", Pearson Education,2nd Edition – 2004

3. Pallet, E.H.J., "Aircraft Instruments & Principles", Pitman & Co 1933

REFERENCES:

1. Kermode, A.C., "Flight without Formulae", McGraw-Hill, 1997.

2. Lalit Gupta and O P Sharma, "Fundamentals of Flight Vol-I to Vol-IV", Himalayan Books, 2006

3. Ian Moir, Allan Seabridge, "Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration", John Wiley & Sons, 2011

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	1											2	2	1	
CO2	1	2	2	2							1	2	2	1	
CO3	1	2	2	2							1	2	2	1	
CO4	1	2	2	2							1	2	2	1	
CO5	1	2	2	2							1	2	2	1	

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

COURSE DESIGNED BY	APPROVED BY
Prof R Allocious Britto Rajkumar – AP(SG) / Aero	Dr T Manikandan – HoD / Aero
Name and Department	**Name and Department of BoS Chairman**

U23EN202

SDG: 4

PROFICIENCY IN ENGLISH

Category: HSMC

L	T	P	C
2	0	2	3

COURSE OBJECTIVE:

1. To improve the communicative competence of learners.
2. To help learners use language effectively in academic /work contexts.
3. To develop various listening strategies to comprehend various types of audio materials like lectures, discussions, videos, etc.
4. To build on students' English language skills by engaging them in listening, speaking, and grammar learning activities that are relevant to authentic contexts.
5. To use language efficiently in expressing their opinions via various media.

UNIT 1 INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION 6

Listening -conversation: Introduction to classmates - Audio / video (formal & informal), Speaking - making telephone calls-Self Introduction; Introducing a friend; - politeness strategies.

UNIT 2 NARRATION AND SUMMATION 6

Listening - Listening to podcasts, anecdotes / stories / event narration; documentaries and interviews with celebrities. Speaking - Narrating personal experiences describing experiences and feelings- engaging in small talk- describing requirements and abilities.

UNIT 3 DESCRIPTION OF A PROCESS / PRODUCT 6

Listening - Listen to product and process descriptions; a classroom lecture; and advertisements about products. Speaking – Picture description- describing locations in workplaces- Giving instruction to use the product- explaining uses and purposes- Presenting a product.

UNIT 4 CLASSIFICATION AND RECOMMENDATIONS 6

Listening –Listening to lectures - and educational videos. Speaking – Small Talk; discussing and making plans-talking about tasks-talking about progress talking about travel preparations.

UNIT 5 EXPRESSION 6

Listening – Listening to debates/ discussions; panel discussions. Speaking –making predictions- talking about a given topic-giving opinions.

LIST OF EXPERIMENTS

1.Conversation: Introduction to Classmates-Audio/video (formal & informal).

2. Self-Introduction.

3. Telephone Conversation.

4. Listening to voicemail & messages.

5. Listening and filling a form.

6. Debate.

7. Group Discussion.

8. Exchanging personal Information.

9. Introducing a friend politeness strategy.

10. Essay Writing.

COURSE OUTCOMES:

At the end of the course, students would

CO1: To listen and comprehend general as well as complex academic information

CO2: To listen to and understand different points of view in a discussion.

CO3: To speak fluently and accurately in formal and informal communicative contexts.

CO4: To describe products and processes and explain their uses and purposes clearly and accurately.

CO5: To express their opinions effectively in both formal and informal discussions.

CO6: To learn at their own pace and can repeat exercises to improve their skills.

TOTAL: 60 PERIODS

TEXT BOOKS:

1.English for Engineers & Technologists, Orient Blackswan Private Ltd. Department of English, Anna University, 2020

2. English for Science & Technology Cambridge University Press, 2021. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.

3. A Handbook for English Language Laboratories, E. Suresh Kumar, Department of English, College of Engineering, Osmania University, P. Sreehari, Department of English, College of Engineering, Osmania University. 2011.

REFERENCES:

1. Technical Communication – Principles And Practices By Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2016, New Delhi.

2. A Course Book on Technical English By Lakshmi Narayanan, Scitech Publications (India) Pvt. Ltd.

3. English For Technical Communication (With CD) By Aysha Viswamohan Mcgraw Hill Education, ISBN : 0070264244.

4. Effective Communication Skill, Kulbhusan Kumar, R S Salaria, Khanna Publishing House.

5. Learning to Communicate – Dr. V. Chellammal, Allied Publishing House, New Delhi, 2003.

6. A Manual For English Language Laboratory, D. Sudha Rani, Pearson Education India, 2009.

CO's-PO's & PSO's MAPPING

CO	PO1	PO 2	PO 3	PO 4	PO 5	PO6	PO7	PO 8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	-	-	-	-	-	-	1	2	2	2	-	3	-	-	-
CO2	-	-	-	-	-	-	-	3	3	1	-	2	-	-	-
CO3	-	-	-	-	-	-	-	2	-	2	-	3	-	-	-
CO4	-	-	-	-	-	-	2	3	3	1	-	3	-	-	-
CO5	-	-	-	-	-	-	1	3	2	1	-	3	-	-	-

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

COURSE DESIGNED BY	APPROVED BY
Dr. Alice Evangalin Jebaselvi - Professor / English	Dr.M.Kumaresan – Professor & Head/ S&H
Name and Department	**Name and Department of BoS Chairman**

U23GE201

SDG: 4,8,9

PROBLEM SOLVING AND PYTHON PROGRAMMING

Category: ESC

L	T	P	C
3	0	2	4

COURSE OBJECTIVE:

1. To understand the basics of algorithmic problem solving.
2. To learn to solve problems using Python conditionals and loops.
3. To define Python functions and use function calls to solve problems.
4. To use Python data structures - lists, tuples, dictionaries to represent complex data.
5. To do input/output with files in Python.

UNIT 1 COMPUTATIONAL THINKING AND PROBLEM SOLVING 9

Introduction-Python Interpreter-Interactive and script mode -Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), Simple strategies for developing algorithms (iteration, recursion)

UNIT 2 DATA TYPES, EXPRESSIONS, STATEMENTS 9

Python interpreter and interactive mode, debugging; values and types: int, float, Boolean, string, and list; variables, expressions, statements, tuple assignment.

UNIT 3 CONTROL FLOW, FUNCTIONS, STRINGS 9

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-else if-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods.

UNIT 4 LISTS, TUPLES, DICTIONARIES 9

Lists: list operations, list slices, list methods, list loop, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension

UNIT 5 FILES, MODULES, PACKAGES 9

Files and exceptions: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages

LIST OF EXPERIMENTS

1. Find minimum in a list
2. Insert a card in a list of sorted cards
3. Guess an integer number in a range.
4. Towers of hanoi. Illustrative programs.
5. Exchange the values of two variables.
6. Circulate the values of n variables.
7. Distance between two points. Illustrative programs.
8. Square root, Exponentiation.
9. Sum an array of numbers.
10. Linear search, binary search.
11. Simple sorting, histogram.
12. Students marks statement.
13. Word count, copy file, voter's age validation, marks range validation (0-100)

COURSE OUTCOMES:

At the end of the course, students would

CO1: Develop algorithmic solutions to simple computational problems.

CO2: Develop and execute simple Python programs.

CO3: Write simple Python programs using conditionals and loops for solving problems.

CO4: Decompose a Python program into functions.

CO5: Represent compound data using Python lists, tuples, dictionaries etc.

CO6: Read and write data from/to files in Python programs.

TOTAL: 75 PERIODS

TEXT BOOKS:

1. Allen B. Downey, "Think Python: How to Think like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016.

2. Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and Programming", 1st Edition, BCS Learning & Development Limited, 2017.

REFERENCES:

1. Paul Deitel and Harvey Deitel, “Python for Programmers”, Pearson Education, 1st Edition, 2021.

2. G Venkatesh and Madhavan Mukund, “Computational Thinking: A Primer for Programmers and Data Scientists”, 1st Edition, Notion Press, 2021.

3. John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data”, Third Edition, MIT Press, 2021

4. Eric Matthes, “Python Crash Course, A Hands - on Project Based Introduction to Programming”, 2nd Edition, No Starch Press, 2019.

CO’s-PO’s & PSO’s MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	3	3	3	2	-	-	-	-	-	2	2	3	3	-
CO2	3	3	3	3	2	-	-	-	-	-	2	2	3	-	-
CO3	3	3	3	3	2	-	-	-	-	-	2	-	3	-	-
CO4	2	2	-	2	2	-	-	-	-	-	1	-	3	-	-
CO5	1	2	-	-	1	-	-	-	-	-	1	-	2	-	-

Correlation levels: 1 – low 2 – medium 3 – high “-“- no correlation

COURSE DESIGNED BY	APPROVED BY
Dr.S.Pathur Nisha – Professor & Head/ CSE & Prof. Evance Leethail – AP/CSE	Dr.S.Pathur Nisha – Professor & Head/ CSE
Name and Department	**Name and Department of BoS Chairman**

U23EE202

SDG:17

CAREER ENHANCEMENT TRAINING II

Category: EEC

L	T	P	C
3	0	0	1

COURSE OBJECTIVE:

1. To help students demonstrate various principles involved in solving mathematical problems and thereby reducing the time taken for performing job functions.
2. To enable students critically evaluate various real-life situations by resorting to an analysis of key issues and factors.
3. To help them improve their communicative English for Interview and corporate readiness.

UNIT 1 NUMERICAL REASONING 6

Problems on Ages – Arithmetic Reasoning - Ratio & Proportion – Alligation & Mixtures

UNIT 2 GEOMETRY & SHAPES 6

Mensuration 2D –Mensuration 3D – Height – Distance - Perimeter – Area – Volume

UNIT 3 COMBINATIONS & CALENDARS 6

Permutation and Combination – Probability-Circular Permutation - Clocks and Calendars

UNIT 4 CLASSIC REASONING 6

Blood Relation – Direction Sense – Seating Arrangement – Syllogism – Statement & Conclusion

UNIT 5 VERBAL APTITUDE 6

Synonyms Antonyms – Spotting Error – Sentence Correction – Change of Voice – Change of Speech – Spelling – Reading Comprehension – Select Words – Closet Test.

COURSE OUTCOMES:

At the end of the course, students would

CO1: Demonstrate problem-solving skills and critical thinking abilities in the context of Engineering Aptitude.

CO2: To use appropriate strategies and shortcuts to improve speed and accuracy in solving aptitude problems during recruitment processes.

CO3: Evaluate and interpret aptitude test results to identify areas of improvement and develop a personalized study plan for further enhancement.

CO4: Use the correct Grammar, Vocabulary, Spelling and Comprehension ensuring the enhancement their language skills and the ability to use the skills for effective Communication

TOTAL: 30 PERIODS

TEXT BOOKS:

1. The Pearson Guide to Quantitative Aptitude For Competitive Examinations, Dinesh Khattar. Pearson
2. Quantitative Aptitude Dr. R.S. Aggarwal S. Chand Publication
3. A modern Approach to Verbal and Non-Verbal Reasoning R.s. Aggarwal

REFERENCES:

1. Quantitative Aptitude for CAT, Arun Sharma.
2. Fast Track Objective Arithmetic, Rajesh Verma, Arihant Publication.
3. Quantitative Aptitude Quantum CAT Common Admission Tests for Admission into IIMs, Sarvesh K. Verma.
4.Wiley's Exam Expert Quantitative Ability for CAT, 2ed, Ashu Jain.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	3	3	3	-	-	-	-	-	1	-	-			
CO2	3	2	1	3	-	-	-	-	-	1	-	-			
CO3	3	1	1	2	-	-	-	-	-	1	-	-			
CO4	1	1	1	1	-	-	-	-	-	3	-	-			
CO5	-	-	-	-	-	-	-	-	-	-	-	-			

Correlation level: 1 – low 2 – medium 3 – high "-"- no correlation

COURSE DESIGNED BY	APPROVED BY
Prof. Ramesh Raja – Head/ NCPIR	Dr T Manikandan – HoD / Aero
Name and Department	**Name and Department of BoS Chairman**

SEMESTER III

		Category: BSC			
U23MA304	**FOURIER ANALYSIS AND PARTIAL**	**L**	**T**	**P**	**C**
SDG:4	**DIFFERENTIAL EQUATIONS**	**3**	**1**	**0**	**4**

COURSE OBJECTIVE:

1. To impart knowledge on partial differential equations.
2. To construct Fourier series for different periodic functions and to evaluate infinite series.
3. To classify different types of PDE and solve boundary value problems.
4. To acquaint the student with different transform techniques used in wide variety of situations.
5. To solve difference equations using Z – transforms that arise in discrete time systems.

UNIT 1 PARTIAL DIFFERENTIAL EQUATIONS 9+3

Formation of partial differential equations — Singular integrals — Solutions of standard types of first order partial differential equations — Lagrange's linear equation - Linear partial differential equations of second order with constant coefficients of homogeneous types. Application: Modeling one dimensional dynamic problems

UNIT 2 FOURIER SERIES 9+3

Dirichlet's conditions — General Fourier series — Odd and even functions — Half range sine series — Half range cosine series — Parseval's Identity - Harmonic analysis. Application: Modeling of vibrating membrane using Fourier series

UNIT 3 BOUNDARY VALUE PROBLEMS 9+3

Classification of PDE –Fourier series solutions of one-dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two- dimensional equation of heat conduction. Application: wave propagation in cylinders

UNIT 4 FOURIER TRANSFORMS 9+3

Fourier Transform, Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity. Application: Medical Imaging

UNIT 5 Z TRANSFORMS AND DIFFERENCE EQUATIONS 9+3

Z-transforms — Elementary properties — Inverse Z-transform (using partial fraction and residues) — Initial and final value theorems — Convolution theorem — Formation of difference equations — Solution of difference equations using Z — transform. Application: Image analysis

COURSE OUTCOMES:

At the end of the course, students would

CO1: Solve the PDE using various techniques

CO2: Apply differentiation techniques to find extreme values of functions using Fourier series analysis

CO3: Design the Fourier series techniques in solving one and two -dimensional heat flow problems and one-dimensional wave equations.

CO4: Analyze the system using Fourier transforms

CO5: Understand the knowledge of Z transform techniques for solving partial differential equations

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Grewal B.S., “Higher Engineering Mathematics", 44thEdition, Khanna Publishers, New Delhi, 2018.
2. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2018.
3. Kreyszig E, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, New Delhi, India, 2018.

REFERENCES:

1. Andrews. L.C and Shivamoggi. B, "Integral Transforms for Engineers" SPIE Press, 1999.
2. James. G., "Advanced Modern Engineering Mathematics", 4thEdition, Pearson Education, New Delhi, 2016.
3. Wylie. R.C. and Barrett. L.C., “Advanced Engineering Mathematics “Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012
4. Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 10th Edition, Laxmi

Publications Pvt. Ltd, 2021.

5. Narayanan. S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CO 1	3	2	1						1			1	-	-	-
CO 2	3	2	1						1			1	-	-	-
CO 3	3	3	2						1			1	-	-	-
CO 4	3	2	3						1			1	-	-	-
CO 5	3	3	1						1			1	-	-	-

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

COURSE DESIGNED BY	APPROVED BY
Dr. N. Vithya- ASP/ Mathematics	Dr. K.Parimala Gandhi – Professor & Head/ S&H
Name and Department	**Name and Department of BoS Chairman**

U23AE301 **Category : PCC**

SDG:4,7.9, 11,12,13	**AIRCRAFT SYSTEMS AND INSTRUMENTS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVE:

1. To impart knowledge of the hydraulic and pneumatic systems components
2. To study the various control systems in aircraft
3. To learn the various engine systems in aircraft

4. To acquire the knowledge of essential systems of safe aircraft operation
5. To study the types of instruments and their operation including navigational instruments

UNIT 1 AIRCRAFT SYSTEMS 9

Hydraulic systems – components, Pneumatic systems – Working principles – Typical Pneumatic Power system, Brake system – Components, Landing Gear Systems – Classification, Shock absorbers, Retractive mechanism.

UNIT 2 AIRPLANE CONTROL SYSTEMS 9

Types of control surfaces – components, Conventional Systems – operating principles, Fly by wire systems, Digital fly by wire systems, Autopilot, AI-enabled autopilot, Active control Technology, Automatic Dependent Surveillance-Broadcast (ADS-B)

UNIT 3 ENGINE SYSTEMS 9

Piston and Jet Engines, Fuel systems – Components, Multi-engine fuel systems, lubricating systems, Starting and Ignition systems, Engine control systems

UNIT 4 AIRCONDITIONING AND ENVIRONMENTAL SYSTEMS 9

Basic Air Cycle systems, Boot-strap air cycle systems, Vapour Cycle Systems, Oxygen systems – Fire extinguishing system and smoke detection system, Deicing and Anti-Icing systems – Water and Waste Removal Systems

UNIT 5 AIRCRAFT INSTRUMENTS 9

Flight Instruments and Navigation Instruments –Gyroscopic Instruments – Principles and operation – Study of various types of engine instruments – Tachometers – Temperature Gauges- Thermo couples and Pressure gauges – Barometers – Manometers – Pitot - static tube – operating principles - Fully digital glass cockpit – HMD & HUD - ALICIA

COURSE OUTCOMES:

At the end of the course, students would

CO1: Demonstrate the ability to design a various system using pneumatic and hydraulic components.

CO2: Keep up-to-date knowledge of various flight control systems and their recent advancements.

CO3: Demonstrate a fundamental understanding of the operation of engine auxiliary systems.

CO4: Understand the various cabin comfort and environmental systems used in aircraft.

CO5: Describe the principle behind the operation of various vital parameter displays

CO6: Know about the emerging technologies in the aviation field

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Aviation Maintenance Technician Hand Book - General, US dept. of Transportation, Federal Aviation Administration, the English Book Store, New Delhi, 2023.
2. Aviation Maintenance Technician Hand Book - Airframe, US dept. of Transportation, Federal Aviation Administration, the English Book Store, New Delhi, 2023.
3. Aviation Maintenance Technician Hand Book - Powerplant, US dept. of Transportation, Federal Aviation Administration, the English Book Store, New Delhi, 2023.

REFERENCES:

1. McKinley, J.L. and R.D. Bent, Aircraft Power Plants, McGraw Hill, 2020.
2. Dr. Ronald Sterkenburg, Aircraft Maintenance & Repair, McGraw Hill, 2019.
3. Teager, S, "Aircraft Gas Turbine technology, McGraw Hill 2013.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CO 1	3	2	3	1	2	1	1	1	2	2	1	2	2	-	-
CO 2	3	2	2	2	3	2	1	1	1	2	1	3	2	-	-
CO 3	3	2	2	2	2	2	1	1	1	2	1	2	2	-	-
CO 4	3	2	2	1	2	3	3	1	1	2	1	2	2	-	-
CO 5	3	2	2	2	2	2	1	1	1	2	1	2	2	-	-
CO 6	3	2	2	2	3	2	2	1	1	2	1	3	2	-	-

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

COURSE DESIGNED BY	APPROVED BY
Prof R Allocious Britto Rajkumar – AP(SG) / Aero	Dr.P.Vijayakumar, Assistant Professor (SG) & HoD / Aero

Name and Department	Name and Department of BoS Chairman

U23AE302 **Category: PCC**

SDG:4 **AIRCRAFT PRODUCTION TECHNOLOGY**

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:

1. To familiarize students with the classifications and properties of materials used in aircraft construction.
2. To provide students with an in-depth understanding of the properties, applications, and manufacturing processes associated with various aerospace materials and gain the knowledge in geometric dimensioning and tolerance.
3. To learn about specific properties of super alloys, composite materials, and their applications in aircraft construction.
4. To gain proficiency in the machining, forming, welding, and heat treatment processes associated with these materials.
5. To familiarize students with diverse manufacturing methods essential in aircraft engineering, encompassing a wide range of techniques and applications.

UNIT 1 INTRODUCTION 9

Introduction to aircraft materials and its classifications, properties of flight vehicle materials and their significant factors affecting the selection of material for different parts of airplanes, introduction to powder metallurgy, stages of powder metallurgy process, emerging trends in aerospace materials.

UNIT 2 METALS AND ALLOYS 9

Aluminum and its alloys, high strength and high corrosion alloys. Titanium and its alloys: applications, machining, forming, welding and heat treatment; Classification of steels alloys, effect of alloying elements, magnesium alloys and their properties, heat treatment processes, maraging steels: properties and applications.

UNIT 3 SUPER ALLOYS AND COMPOSITE MATERIALS 9

Classification of Super Alloys: iron, nickel and cobalt based alloys, refractory materials, ceramics, properties and applications of super alloys in aircrafts. Heat treatment of super alloys: Case hardening, initial stresses and stress alleviation procedures, corrosion and erosion prevention and protective

treatments. Heat treatment of non-ferrous metals. Classification, characteristics of composite materials, Application of Composite materials.

UNIT 4 GEOMETRIC DIMENSIONING AND TOLERANCING 9

Types of GD&T, Datum, Machine tool tests to check for Straightness, Flatness, Parallelism, Squareness, Roundness, Cylindricity, Runout Coordinate Measuring Machines: Structure, Probes, Operation, Applications of Coordinate Measuring Machines.

UNIT 5 AIRCRAFT MANUFACTURING PROCESSES 9

Profiling, hydro forming, spar Milling, spark erosion and powered metal parts, integral machining, lathe operations, shaping, grinding and drilling processes, various casting processes, shell molding types, various welding processes, soldering and brazing techniques, sheet metal operations, riveting, types and techniques, contour etching, additive manufacturing processes, basics of jigs and fixtures, high energy rate forming and manufacturing of honeycomb structures and general methods of construction of aircraft engine parts.

COURSE OUTCOMES:

At the end of the course, students would

CO1: Categorize aircraft materials based on their composition and properties, enabling them to make informed decisions regarding material selection for different components of aircraft.

CO2: Analyze the properties and applications of metals and non-metals used in aerospace engineering.

CO3: Have the knowledge and skills to identify and classify various heat-resistant materials used in aerospace engineering.

CO4: Possess the skills and knowledge necessary to perform machining, forming, welding, and heat treatment processes on a variety of aerospace materials.

CO5: Apply manufacturing techniques effectively across different contexts and applications within the aerospace industry.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. G. F. Titterton, Aircraft Materials and Processes, 5th edition, Sterling Book House,1998.
2. F. C. Campbell, Manufacturing Technology for Aerospace Structural Materials,1st edition, Elsevier Publications, 2006.

3. Agarwal, B.D., and Broutman, L.J., "Analysis and Performance of Fibre Composites," 3rd edition, John Wiley and sons. Inc., New York, 2006.
4. L. Gupta, Advanced Composite Materials, 2nd edition, Himalayan Books, 2006.
5. S. C. Keshu, K. K Ganapathy, “Aircraft production technology and management”, Interline Publishing House, Bangalore, 3rd edition, 1993.
6. Douglas F. Horne, “Aircraft production technology”, Cambridge University Press, 1st Edition, 1986.

REFERENCES:

1. R. H. Avner, Introduction to Physical Metallurgy, 3rd edition, Tata McGraw Hill, 2007.
2. W. D. Callister, D. G. Rethwisch, An Introduction on Material Science and Engineering, 9th edition, John Wiley, 2013.
3. Autar K Kaw, ‘Mechanics of Composite Materials’, 2nd edition, CRC Press, 2006.
4. Lubin, G., "Handbook on Advanced Plastics and Fibre Glass", Von Nostrand Reinhold Co., New York, 1989.
5. Allen Baker, "Composite Materials for Aircraft Structures", AIAA Series, 3rd edition, 2004.
6. N.V. Raghavendra and L.Krishnamurthy, Engineering Metrology and Measurements, 1st edition, Oxford University Press,2013.

CO’s-PO’s & PSO’s MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	3	3	2	-	-	-	-	-	2	3	-	-	-
CO 2	3	2	2	3	2	-	-	-	-	-	3	3	-	-	-
CO 3	2	2	3	2	3	-	-	-	-	-	-	3	-	-	-
CO 4	3	3	3	2	2	-	-	-	-	-	3	3	-	-	-
CO 5	3	3	3	3	3	-	-	-	-	-	2	3	-	-	-

Correlation levels: 1 – low 2 – medium 3 – high “- “- no correlation

COURSE DESIGNED BY	APPROVED BY
Dr.P.Vijayakumar, Assistant Professor (SG) & HoD / Aero	Dr.P.Vijayakumar, Assistant Professor (SG) & HoD / Aero
Name and Department	**Name and Department of BoS Chairman**

U23AE303 **STRENGTH OF MATERIALS** **Category: PCC**

SDG: 4

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:

1. To understand the basic concepts of the stresses and strains for different materials and the strength of structural elements.

2. To know the development of internal forces and resistance mechanisms for one- dimensional and two-dimensional structural elements

3. To analyse and understand different internal forces and resistance mechanisms for one- dimensional and two-dimensional structural elements.

4. To analyse and understand the torsion of solid & hollow circular shafts and helical springs.

5. To evaluate the behaviour of torsional members, columns and struts.

UNIT 1 BASICS OF MATERIAL TESTING 8

Stress, Strain, Poisson’s ratio, Hooke’s law (1D,2D,3D),Mechanical properties of materials -Tension, Flexure, Impact, Hardness, Fatigue, Creep, FOS, Elastic constants – their relations.

UNIT 2 STRESSES IN AXIAL BAR 9

Axial loading, statically indeterminate structures, Principle of superposition, stresses in composite bars, thermal stresses & strains, Thermal stresses in composite bar.

UNIT 3 STRESSES IN BEAM 9

Shear force, Bending moment of statically determinate structures, Shear force bending moment diagrams-cantilever SSB, Overhanging, Constant strength beam, Bending stress, Pure bending, Bending & stresses in rectangular (I,T-section)

UNIT 4 TORSION & SPRINGS 9

Torsion of solid & hollow circular shaft, Thin shells-Spherical & cylindrical pressure vessels, Open & closed coiled helical springs – Stress in helical spring (Combined loading)

UNIT 5 PLANE STRESSES, STRAINS & COLUMNS 10

Plane stress, Principal stresses, Mohr's circle and its construction Classification of columns, Euler buckling, Different end conditions, Rankine's formula, Eccentric loading, Beam column.

COURSE OUTCOMES:

At the end of the course, students would

At the end of the course, students would

CO1: To understand the basic concepts of the stresses and strains for different materials and the strength of structural elements.

CO2: To know the development of internal forces and resistance mechanisms for one-dimensional and two-dimensional structural elements.

CO3: To analyse and understand different internal forces and resistance mechanisms for one-dimensional and two-dimensional structural elements.

CO4: To analyse and understand the torsion of solid & hollow circular shafts and helical springs.

CO5: To evaluate the behaviour of torsional members, columns and struts.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Mechanics of Materials, James M. Gere, Cengage Learning (Brooks\Cole).
2. An Introduction to the Mechanics of Solids, Crandall, Dahl and Lardner, Tata McGraw Hill.
3. Strength of Materials, Sadhu Singh, Khanna Publishers.
4. Mechanics of Materials, Beer, Johnston, Dewolf and Mazurek, Tata McGraw Hill.

REFERENCES:

1. Strength of Materials, R.K. Bansal, R., K. Rajput.
2. William F. Riley, Leroy D. Sturges, Don H. Morris, Mechanics of Materials, John Wiley & Sons, 1998.
3. Advanced Mechanics of Materials, 6th Edition, authored by Arthur P. Boresi, Richard J. Schmidt, Wiley India Pvt. Limited.
4. Mechanics of Materials, 5th Edition, Timothy A. Philpot, Jeffery S. Thomas, Wiley India Pvt. Limited.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
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CO 2	3	2.5	2	2.5	-	-	-	-	-	-	1	3	3	2	1
CO 3	3	2.5	2	2.5	-	-	-	-	-	-	1	3	3	2	1
CO 4	3	2.5	2	3	-	-	-	-	-	-	1	3	3	2	1
CO 5	3	3	2.5	3	-	-	-	-	-	-	1	3	3	2	1
CO 6	3	2.5	2.5	2.5	-	-	-	-	-	-	1	3	3	2	1

Correlation levels: 1 – low 2 – medium 3 – high "- "- no correlation

COURSE DESIGNED BY	APPROVED BY
Mrs.T.Banu AP SG/AERO	Dr.P.Vijayakumar, Assistant Professor (SG) & HoD / Aero
Name and Department	**Name and Department of BoS Chairman**

U23AE305	**Fluid Mechanics and Machinery**	**Category: ESC**			
SDG: 4		**L**	**T**	**P**	**C**
		3	**0**	**3**	**3**

COURSE OBJECTIVE:

1. To learn the properties of fluids and the concept of control volume.
2. To illustrate applications of the conservation laws to flow through pipes.
3. To build the importance of dimensional analysis.
4. To analyze the importance of various types of flow in pumps.
5. To examine the importance of various types of flow in turbines.

UNIT 1 **BASIC CONCEPTS, PROPERTIES AND FLOW CHARACTERISTICS** **11**

Fluid – definition, distinction between solid and fluid - Units and dimensions Properties of fluids- mass density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapor pressure, surface tension and capillarity. Flow characteristics- concept of control volume- application of continuity equation, energy equation and momentum equation.

UNIT 2 **FLUID FLOW THROUGH CIRCULAR CONDUITS AND PIPES** **10**

Hydraulic and energy gradient- Laminar flow through circular conduits circular annuli - Fluid Flow-Boundary layer concepts- types of boundary layer thickness- Darcy Weisbach equation- friction factor- Moody diagram-minor losses- Flow through pipes in series and parallel.

UNIT 3 **DIMENSIONAL AND MODEL ANALYSIS** **8**

Dimensional analysis- Rayleigh method and Buckingham's π theorem- applications- Concept of geometric, kinematic and dynamic similarity, non-dimensional parameters and their physical significance- Model analysis.

UNIT 4 **HYDRAULIC PUMPS** **8**

Pumps: Centrifugal pump: Classifications, working principles, velocity triangles, specific speed, efficiency and performance curves. Reciprocating pump: classification, working principles, indicator diagram, performance curves - cavitation in pumps, working principles and classification of rotary pumps.

UNIT 5 HYDRAULIC TURBINES 8

Euler's equation for turbo machines - Construction of velocity vector diagrams - head and specific work - degree of reaction. Turbo machinery- Pelton wheel, Francis and Kaplan turbines - impulse and reaction principles, draft tube, performance curves for turbines- governing of turbines.

COURSE OUTCOMES:

At the end of the course, students would

CO1: Classify the different types of fluid, properties and their behaviour under various conditions.

CO2: Apply the characteristics of a fluid flow.

CO3: Analyze and estimate major and minor losses related with pipe flow in piping networks and also to understand the concepts of boundary layer and its thickness on the flat solid surface.

CO4: Apply principles of dimensional analysis to identify non dimensional parameters.

CO5: Ability to analyze the performance of pumps.

CO6: Examine the turbines performance.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Dr.P.N. Modi, S.M. Seth Hydraulics and Fluid Mechanics Including Hydraulics Machines, Rajsons Publications Pvt Ltd, Paper back 22ndEdition 2019.
2. R.K. Bansal, A Textbook of Fluid Mechanics and Hydraulic Machines, Lakshmi Publications,10thEdition2018
3. Jain A. K. Fluid Mechanics including Hydraulic Machines, Khanna Publishers, New Delhi, 2014.
4. Yunus A. Çengel, John M. Cimbala, Fluid Mechanics: Fundamentals and Applications,3rd Edition, 2019

REFERENCES:

1. Kumar K.L., "Engineering Fluid Mechanics", Eurasia Publishing House (p)Ltd., NewDelhi,2016.
2. Frank M. White, 'Fluid Mechanics', McGraw Hill Education India Private Limited, Eighth Edition, 2017.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
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CO 2	3	2.5	2	2.5	-	-	-	-	-	-	1	3	3	2	1
CO 3	3	2.5	2	2.5	-	-	-	-	-	-	1	3	3	2	1
CO 4	3	2.5	2	3	-	-	-	-	-	-	1	3	3	2	1
CO 5	3	3	2.5	3	-	-	-	-	-	-	1	3	3	2	1
CO 6	3	2.5	2.5	2.5	-	-	-	-	-	-	1	3	3	2	1

Correlation levels: 1 – low 2 – medium 3 – high "- "- no correlation

COURSE DESIGNED BY	APPROVED BY
Prof R.Anand – AP / Aero	Dr.P.Vijayakumar, Assistant Professor (SG) & HoD / Aero
Name and Department	**Name and Department of BoS Chairman**

U23AE305 **AERO ENGINEERING THERMODYNAMICS** **Category: PCC**

SDG:4

L	T	P	C
3	0	2	4

COURSE OBJECTIVE:

1. To understand the basic concepts of heat and work transfer.
2. To understand the concepts of reversible and irreversible heat engines.
3. To learn the various air standard cycles and its application in heat engines.
4. To learn the basic concepts of jet engine and to analyze its performance.
5. To learn and study the working principle of Refrigeration and air conditioning cycles.

UNIT 1 BASIC CONCEPTS AND FIRST LAW 9

Concept of continuum, macroscopic approach, and thermodynamic systems – Property, state, path and process-quasi-static process - work, Zeroth law of thermodynamics – Concept of temperature and heat, internal energy, specific heat capacities, enthalpy – Concept of ideal and real gases – First law of thermodynamics and its applications to closed and open systems.

UNIT 2 SECOND LAW AND ENTROPY 9

Second law of thermodynamics – Kelvin Planck and Clausius statements of second law – Reversibility and irreversibility – Carnot theorem – Carnot cycle, Reversed Carnot cycle, Efficiency– Thermodynamic temperature scale – Clausius inequality, concept of entropy, entropy of ideal gas - principle of increase of entropy.

UNIT 3 AIR STANDARD CYCLES 9

Otto, Diesel, Dual and Brayton cycles – P-V and T-S diagrams, description - Air standard efficiency - Mean effective pressure. Working principle: SI and CI engines – 2 stroke – 4 stroke. Standard Rankine cycle, Reheat and Regeneration cycle.

UNIT 4 BASICS OF HEAT TRANSFER 9

General Differential Equation – Cartesian coordinates - One Dimensional Steady State Heat Conduction – Heat transfer through composite walls and composite cylinders – Extended Surfaces (FINS) - Forced Convection: External Flow – Flow over Plates, Cylinders - Free Convection – Flow over Vertical Plate - Heat Exchanger Types - Radiation laws and Radiative properties – Black Body and Gray body Radiation.

UNIT 5 REFRIGERATION CYCLES 9

Introduction to Refrigeration - Unit of Refrigeration and C.O.P.– Ideal cycles- Refrigerants Desirable properties – Classification – Nomenclature. Vapour compression refrigeration system - p-h and T-s diagrams - deviations from theoretical cycle – subcooling and super heating - effects of condenser and evaporator pressure on COP. Working principles of Vapour absorption systems and adsorption cooling systems. Introduction to air conditioning system.

LIST OF EXPERIMENTS

1. Determination of flash and fire point in a given fuel.
2. Determination of viscosity of the fuel.
3. Valve timing diagram of 4 Stroke Engine.
4. Port timing diagram of 2 Storke Engine.
5. Performance Test on CI Engine.
6. COP test on a vapour compression refrigeration test rig.
7. COP test on a Airconditioning test rig.
8. Thermal conductivity measurement of pipe insulation using lagged pipe apparatus.
9. Heat transfer from pin-fin apparatus (natural and forced convection modes).
10. Determination of Emissivity of a Grey Surface.

COURSE OUTCOMES:

At the end of the course, students would

CO1: Apply the basic concepts in solving the problems in closed and open system.

CO2: Apply second law concepts in heat engines and heat pumps.

CO3: Analyze Otto, Diesel, Dual and Brayton cycle under various operating conditions.

CO4: Solve the problems in basic concepts of heat transfer.

CO5: Demonstrate the working principle of various refrigeration systems.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Nag, P. K., Engineering Thermodynamics, 5th edition. Tata McGraw-Hill (2013).
2. Rathakrishnan E., “Fundamentals of Engineering Thermodynamics”, Prentice-Hall India, 2005.

REFERENCES:

1. Cengel, Y. A. and Boles, M. A., Thermodynamics: An Engineering Approach, 8th ed., McGraw-Hill (2014).
2. Holman.J.P., "Thermodynamics", 3rd Edition, McGraw-Hill, 2007.
3. Arora C.P, "Thermodynamics", Tata McGraw-Hill, New Delhi, 2003.
4. Ramalingam K.K. "Thermodynamics", Sci-Tech Publications, 2006
5. Balmer, R. T., Modern Engineering Thermodynamics, Academic Press (2011)
6. Richard E. Sonntag, Claus Borgnakke, Gordon J. Van Wylen, Fundamentals of Thermodynamics, John Wiley & Sons, 2002.
7. K. A. Bhaskaran, A. Venkatesh, "Problems in Engineering Thermodynamics", Tata McGraw-Hill, 1978.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	1	1	-	-	-	-	-	-	-	2	2	-
CO2	3	2	2	1	1	1	-	-	-	-	-	-	3	2	-
CO3	3	2	2	1	1	1	-	-	-	-	-	-	3	2	-
CO4	3	2	3	2	1	-	-	-	-	-	-	-	3	2	-
CO5	3	2	2	1	1	1	-	-	-	-	-	-	3	2	-

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

COURSE DESIGNED BY	APPROVED BY
Prof. S. Satheesh Kumar – Assistant Professor (SG)/ Aero	Dr. P. Vijayakumar – Professor & Head/ Aero
Name and Department	**Name and Department of BoS Chairman**

U23AE306					**Category : ESC**	
SDG : 4	**STRENGTH OF MATERIALS LABORATORY**	**L**	**T**	**P**	**C**	
		0	**0**	**2**	**1**	

COURSE OBJECTIVE:

1. To study the mechanical properties of materials when subjected to different types of loading.
2. To study how to improve the material properties.
3. To understand the nature of materials under microscopic Examination

LIST OF EXPERIMENTS

1. Tension test on a mild steel rod.
2. Double shear test on Mild steel and Aluminum rods.
3. Torsion test on a mild steel rod.
4. Impact test on the metal specimen.
5. Hardness test on metals - Brinnell and Rockwell Hardness Number.
6. Buckling load estimation of slender eccentric columns
7. Compression test on helical springs.
8. Estimation of Constant strength beam
9. Effect of hardening- Improvement in hardness and impact resistance of steels.
10. Tempering- Improvement Mechanical Properties Comparison
    (i) Unhardened specimen
    (ii) Quenched Specimen and
    (iii) Quenched Specimen and tempered specimen.

COURSE OUTCOMES:

At the end of the course, students would

CO1: Analyze the Hardness and Tensile strength of the given material

CO2: Examine the deformation and torsion strength of the given material

CO3: Analyze the compression and shear strength of given materials

CO4: Determine Compressive & Flexural Strength of materials.

CO5: Determine the strain Measurement using Rosette strain gauge.

TOTAL: 30 PERIODS

CO's-PO's & PSO's MAPPING															
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	3	2	2	1	2	1	1	2	3	2	2	2	3	2	2
CO2	3	2	2	-	2	1	1	2	3	2	2	2	3	2	2
CO3	3	3	3	1	2	1	-	2	3	2	1	1	3	3	3
CO4	3	2	2	2	2	2	2	2	3	2	1	1	3	2	2
CO5	3	2	2	1	2	1	1	2	3	2	1	1	3	2	2
CO6	3	2	2	1	2	2	1	2	3	2	1	1	3	2	2
Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation															

COURSE DESIGNED BY	**APPROVED BY**
Mrs.T.Banu AP SG/AERO	Dr.P.Vijayakumar, Assistant Professor (SG) & HoD / Aero
Name and Department	**Name and Department of BoS Chairman**

U23AE307 **FLUID MECHANICS AND MACHINERY LABORATORY** **Category : ESC**

SDG : 4

L	**T**	**P**	**C**
0	**0**	**2**	**1**

COURSE OBJECTIVE:

1. Upon Completion of this subject, the students can able to have hands on experience in flow measurements using different devices.
2. Perform calculations related to losses in pipes
3. Perform characteristic study of pumps, turbines etc.,

LIST OF EXPERIMENTS

1. Determination of the Coefficient of discharge of a given Orifice meter.

2. Determination of the Coefficient of discharge of a given Venturi meter
3. Determination of friction factor for a given set of pipes.
4. Verification of Bernoulli's theorem.
5. Conducting experiments and drawing the characteristic curves of centrifugal pump.
6. Conducting experiments and drawing the characteristic curves of reciprocating pump.
7. Conducting experiments and drawing the characteristic curves of Gear pump.
8. Conducting experiments and drawing the characteristic curves of the Pelton wheel.
9. Conducting experiments and drawing the characteristics curves of Francis turbine.
10. Conducting experiments and drawing the characteristics curves of Kaplan turbine.

COURSE OUTCOMES:

At the end of the course, students would

CO1: Determine the coefficient of discharge of orifice meter and venturimeter.

CO2: Determine the friction factor of given set of pipes when there is change in pressure

CO3: Conduct experiments and draw the characteristic curves of centrifugal pump, submergible pump, reciprocating pump, Gear pump and also can find the discharge of the pump.

CO4: Conduct experiment and draw the characteristics curves of Pelton wheel.

CO5: Conduct experiments and draw the characteristics curves of Francis turbine and Kaplan

TOTAL: 30 PERIODS

CO's-PO's & PSO's MAPPING

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CO3	3	3	-	2	-	2	-	2	-	2	1	2	3	1	-
CO4	3	3	2	2	-	3	-	2	-	2	1	2	3	1	-
CO5	3	3	2	2	-	3	-	2	-	2	1	2	3	1	-

Correlation levels: 1 – low	**2 – medium**	**3 – high**	**"-"- no correlation**

COURSE DESIGNED BY	**APPROVED BY**
Prof R.Anand – AP / Aero	Dr.P.Vijayakumar, Assistant Professor (SG) & HoD / Aero
Name and Department	**Name and Department of BoS Chairman**

U23EE313 APTITUDE & COMMUNICATION FOR ENGINEERS - I **Category : EEC**

SDG:8&17

L	**T**	**P**	**C**
0	**0**	**2**	**1**

COURSE OBJECTIVE:

1. To create an awareness regarding the internal inhibitions that prevents the students from opening out in classrooms and other forums and there by overcoming the shyness to perform.
2. To make students understand the importance of English as a global language and train them for simple English communication through various speech craft activities and improve their communicative English for industry readiness.
3. To develop an awareness about making a conscious effort towards avoiding errors in daily communication.
4. To train students on clearing various placement papers with greater accuracy.

UNIT 1 INTRODUCTION 3

Introduction about the Course -Learning expectations - Communication pre-assessment

UNIT 2 SPEAKING SKILLS -NOVICE 6

Communication skills – Shy barrier - Importance of English - Challenges faced in English communication - Developing a globally comprehensible accent -Speech Craft- Public Speaking – Squabble.

UNIT 3 SPEAKING SKILLS -INTERMEDIATE 6

Speech Craft –for and against –Debate (Ship Wreck Activity)

UNIT 4 LANGUAGE GYM - I 6

Tenses for various communication scenarios – Common errors in daily communication – Thought Group reading – Passage writing.

UNIT 5 APTITUDE FOR PLACEMENTS - I 9

Placement Paper 1 – HCF & LCM, Problems on Numbers-Placement Paper 2 – Average, Simplification – Placement Paper 3-Percentage, Simple & compound Interest - Placement Paper 4 – Time & Distance – Placement Paper 5-Trains & Boats, Placement Paper 6 – Time & Work, Pipes & Cistern.

COURSE OUTCOMES:

At the end of the course, students would

CO1: Students will be able to participate in any learning activity without any reservations. They shall be ready to move beyond their comfort zone to acquire new skills throughout their life.

CO2: Students shall understand and appreciate the importance of English in the current global scenario and make efforts towards up skilling the same.

CO3: Students shall be able to present their view and standpoints in any scenarios confidently.

CO4: Use the correct Grammar and Vocabulary, ensuring the enhancement their language skills and effective communication.

CO5: To use appropriate strategies and shortcuts to improve speed and accuracy in solving aptitude problems during recruitment processes.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. The Pearson Guide to Quantitative Aptitude for Competitive Examinations, Dinesh Khattar. Pearson.
2. Quantitative Aptitude Dr. R.S. Aggarwal S. Chand Publication.
3. A Modern Approach to Verbal and Non-Verbal Reasoning R.s. Aggarwal.

REFERENCES:

1. Quantitative Aptitude for CAT, Arun Sharma.
2. Fast Track Objective Arithmetic, Rajesh Verma, Arihant Publication.
3. Quantitative Aptitude Quantum CAT Common Admission Tests for Admission into IIMs, Sarvesh K. Verma.

4. Wiley's Exam Xpert Quantitative Ability for CAT, 2ed, Ashu Jain.

CO's-PO's & PSO's MAPPING

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CO2	1	-	-	-	-	-	-	1	-	3	-	-	-	-	-
CO3	1	-	-	-	-	-	-	1	-	3	-	-	-	-	-
CO4	1	-	-	-	-	-	-	1	-	3	-	-	-	-	-
CO5	3	-	-	-	-	-	-	1	1	-	-	-	-	-	-

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

COURSE DESIGNED BY	**APPROVED BY**
Prof. Ramesh Raja – Head/NCPIR	Dr.P.Vijayakumar, Assistant Professor (SG) & HoD / Aero
Name and Department	**Name and Department of BoS Chairman**

U23MX081

SDG:3,4&8

UNIVERSAL HUMAN VALUES

Category : MC

L	**T**	**P**	**C**
1	**0**	**0**	**1**

COURSE OBJECTIVE:

1. To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.

3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.

UNIT 1 INTRODUCTION TO VALUE EDUCATION 3

Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education) Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to Fulfil the Basic Human Aspirations.

UNIT 2 HARMONY IN THE HUMAN BEING 3

Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health.

UNIT 3 HARMONY IN THE FAMILY AND SOCIETY 3

Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order.

UNIT 4 HARMONY IN THE NATURE/EXISTENCE 3

Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfillment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence.

UNIT 5 IMPLICATIONS OF THE HOLISTIC UNDERSTANDING – A LOOK AT PROFESSIONAL ETHICS 3

Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession.

COURSE OUTCOMES:

At the end of the course, students would

CO1: To become more aware of themselves, and their surroundings (family, society, nature)

CO2: To become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.

CO3: To have better critical ability.

CO4: To become sensitive to their commitment towards what they have understood (human values, human relationship and human society)

CO5: To apply what they have learnt to their own self in different day to-day settings in real life, at least a beginning would be made in this direction.

TOTAL: 15 PERIODS

TEXT BOOKS:

1. The Textbook A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1

2. The Teacher‟s Manual Teachers‟ Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G

REFERENCES:

1. JeevanVidya: EkParichaya, A Nagaraj, JeevanVidyaPrakashan, Amarkantak, 1999.

2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.

3. The Story of Stuff (Book).

4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi

5. Small is Beautiful - E. F Schumacher.

6. Slow is Beautiful - Cecile Andrews

7. Economy of Permanence - J C Kumarappa

8. Bharat Mein Angreji Raj – Pandit Sunderlal

9. Rediscovering India - by Dharampal

10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi

11. India Wins Freedom - Maulana Abdul Kalam Azad

12. Vivekananda - Romain Rolland (English)

13. Gandhi - Romain Rolland (English)

14. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991

15. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books.

16. A Nagraj, 1998, Jeevan Vidya Ek Parichay, Divya Path Sansthan, Amarkantak.

17. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.

18. A N Tripathy, 2003, Human Values, New Age International Publishers.

19. SubhasPalekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) KrishiTantraShodh, Amravati.

20. E G Seebauer & Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers , Oxford

University Press

21. M Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.

22. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.

23. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	3	3	0	0	1	1	3	2	1	1
CO2	1	1	1	1	1	2	0	2	0	1	1	3	2	1	2
CO3	1	1	1	1	1	0	2	0	0	1	1	3	2	2	1
CO4	1	1	1	1	1	3	3	3	0	1	1	3	2	3	1
CO5	1	1	1	1	1	3	3	3	0	1	1	3	2	1	2

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

COURSE DESIGNED BY	APPROVED BY
Dr.S.Pathur Nisha – Professor & Head / CSE	Dr.S.Pathur Nisha – Professor & Head / CSE
Name and Department	**Name and Department of BoS Chairman**

SUSTAINABLE DEVELOPMENT GOALS

SDG	Short Form	Full Form
1	No Poverty	End poverty in all its forms everywhere
2	Zero Hunger	End hunger, achieve food security and improved nutrition, And promote sustainable agriculture
3	Good health and well being	Ensure healthy lives and promote well-being for all at all Ages
4	Quality education	Ensure inclusive and equitable quality education and Promote lifelong learning opportunities for all
5	Gender Equality	Achieve gender equality and empower all women and girls
6	Clean water and sanitation	Ensure availability and sustainable management of water and sanitation for all
7	Affordable and clean energy	Ensure access to affordable, reliable, sustainable and modern energy for all
8	Decent work and Economic Growth	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
9	Industry, Innovation and Infrastructure	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
10	Reducing Inequality	Reduce income inequality within and among countries
11	Sustainable cities and communities	Make cities and human settlements inclusive, safe, Resilient and sustainable

12	Responsible consumption and production	Ensure sustainable consumption and production patterns
13	Climate action	Take urgent action to combat climate change and its impacts by regulating emissions and promoting developments in renewable energy
14	Life below water	Conserve and sustainably use the oceans, seas and marine Resources for sustainable development
15	Life on Land	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and Halt biodiversity loss
16	Peace, justice and string Institutions	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
17	Partnerships for the goals	Strengthen the means of implementation and revitalize the Global partnership for sustainable development

SEMESTER IV

U23MA407 SDG:9	COMPLEX FUNCTIONS AND BOUNDARY VALUE PROBLEMS	Category : BSC			
		L	T	P	C
		3	1	0	4

COURSE OBJECTIVE:

1. To acquaint the student with the concepts of vector calculus, needed for problems in all engineering disciplines
2. To comprehend the standard techniques of complex variable theory and analytic functions
3. To impart the knowledge of complex functions.
4. To provide essential concepts in Laplace transform
5. To understand the knowledge of various techniques and methods of solving various types of partial differential equations.

UNIT 1	**VECTOR CALCULUS**	**9 +3**

Gradient and directional derivative – Divergence and curl - Vector identities – Irrotational and Solenoidal vector fields – Vector Integration: Green's, Gauss divergence and Stoke's theorems. Applications: 3D modeling.

UNIT 2	**ANALYTIC FUNCTIONS**	**9 +3**

Functions of a complex variable – Analytic functions – Necessary conditions, Cauchy-Riemann equations in Cartesian coordinates and sufficient conditions (excluding proofs)– Properties of analytic function (excluding proofs) – Construction of analytic function by Milne Thomson method – Conformal mapping: w = z + c, cz, 1/ z – Bilinear Transformation. Application: Applications to Potential Flow in Two Dimensions

UNIT 3	**COMPLEX INTEGRATION**	**9 +3**

Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series– Singularities – Residues – Residue theorem. Application: Spacecraft Stability

UNIT 4	**LAPLACE TRANSFORMS**	**9 +3**

Definition - Properties: Time Derivatives, Time Integral - Initial Value Theorem - Final Value Theorem - Transform of periodic functions - Inverse transforms - Convolution theorem – Solution of linear ordinary differential equations of second order with constant coefficients. Application: Building Integrated Circuits and Chips for Computers

UNIT 5	**BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS**	**9 +3**

Finite difference techniques for the solution of two-dimensional Laplace's and Poisson's equations on rectangular domain–Application: One-dimensional heat equation using Bender Schmidt and Crank Nicholson difference schemes –Solution of one-dimensional wave equation by explicit scheme.

COURSE OUTCOMES:

At the end of the course, students would

CO1: Understand core concepts of vector calculus, analytic functions, complex integration, Laplace transforms, and differential equations in engineering contexts.

CO2: Apply Gauss's, Stokes's, and Green's theorems, conformal mappings, and Laplace transforms to simplify and model engineering problems.

CO3: Compute real and complex integrals using Cauchy's formula, residue theorem, and series expansions for engineering applications.

CO4: Analyze ordinary differential equations using inverse Laplace transforms and convolution techniques for practical systems.

CO5: Solve boundary value problems in partial and ordinary differential equations using finite difference and numerical methods for engineering scenarios.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", 44thEdition, Khanna Publishers, New Delhi, 2018.
2. T Veerarajan, Engineering Mathematics –II, Mc Graw Hill Education, 2018
3. Kreyszig E, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, New Delhi, India, 2018.

REFERENCES:

1. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., New Delhi, 11th Reprint, 2010.
2. James. G., "Advanced Modern Engineering Mathematics", 4thEdition, Pearson Education, New Delhi, 2016
3. Wylie. R.C. and Barrett. L.C., "Advanced Engineering Mathematics "Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012
4. Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 10th Edition, Laxmi Publications

Pvt. Ltd, 2021.

5. Narayanan. S., ManicavachagomPillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CO1	3	3	3	3											
CO2	3	3	3	3											
CO3	3	3	3	3											
CO4	3	3	3	3											
CO5	3	3	3	3											

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

U23AE401 SDG: 7,9,13	FUNDAMENTALS OF AIRCRAFT STRUCTURAL ANALYSIS	Category: Theory			
		L	T	P	C
		2	1	0	3

COURSE OBJECTIVE:

1 To understand the statically determinate structures in an airplane.

2 To study the statically indeterminate structures of beams loading in an airplane.

3 Apply various energy methods in aerospace applications.

4 Analysis of various rivets and welded joints in an airplane construction.

5 To Predict material failure and structural safe design from certain theories of failure.

UNIT 1	STATICALLY DETERMINATE STRUCTURES	9

Plane truss analysis – method of joints – method of sections, Maxwell's reciprocal theorem, Deflections of Beams- Double integration method, McCaulay's method, moment area method, Conjugate beam method.

UNIT 2	STATICALLY INDETERMINATE STRUCTURES	9

Fixed- Fixed Beams, Continuous Beams - Clapeyron's 3 moment equation & moment distribution method for indeterminate beams.

UNIT 3	**ENERGY METHODS**	**9**

Strain Energy in axial, bending, torsion and shear loadings. Castigliano's theorems and their applications. Energy theorems – Dummy load & Unit load methods – energy methods applied to statically determinate and indeterminate beams & trusses.

UNIT 4	**RIVETED AND WELDED JOINTS**	**9**

Riveted joints - Types of riveted joints - Failure of riveted joints, strength & efficiency of riveted joints, Design of riveted joints. Welded Joints -Types of welded joints, Analysis of welded sections.

UNIT 5	**FAILURE THEORIES**	**9**

Failure of Ductile and brittle materials – maximum principal stress theory - maximum principal strain theory - maximum shear stress theory - distortion energy theory – octahedral shear stress theory, Application to aircraft structural problems.

COURSE OUTCOMES:

At the end of the course, students will be able to:

CO1: Illustrate linear analysis of determinate structures in various aircraft structural components.

CO2: Solve the reaction forces and illustrate the shear force and bending moment diagrams for indeterminate Beams.

CO3: Calculate the reactions of structures using energy methods.

CO4: Analysis the effects of riveted and welded joints in structural components.

CO5: Examine the structural failures using failure theories.

CO6: Design the structures of components and study the behaviour of materials.

L – 30 **T – 15** **P – 0** **TOTAL: 45 PERIODS**

TEXT BOOKS:

1. Howard D. Curtis, "Fundamentals of Aircraft Structural Analysis", McGraw Hill Higher Education Group, 1996.
2. Megson, T.H.G., "Aircraft Structures for Engineering Students", Fifth Edition (Rev.), Butterworth-Heinemann, 2012.

REFERENCES:

1. David J. Peery, “Aircraft Structures (Dover Books on Aeronautical Engineering)”, Dover Publications,2013.

2. Timoshenko, S., “Strength of Materials”, Vol. II, CBS Publishers, 2002.

3. S. S. Bhavikatti, “Strength of Materials”, Third Edition, Vikas Publishing House Pvt. Ltd, 2009.

4. James M. Gere and Barry J Goodno, "Mechanics of Materials", 8th Edition, Cengage Learning Custom Publication. 2012

5. John Case, and Chilver, A.H., “Strength of Materials and structures, Edward Arnold Publishers Ltd., 2016

CO’s-PO’s & PSO’s MAPPING

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CO1	3	3	2	2	2	-	-	-	-	-	2	3	2	2	-
CO2	3	3	3	3	2	-	-	-	-	-	-	3	3	2	-
CO3	3	3	3	2	2	-	-	-	-	-	2	3	2	2	2
CO4	3	3	3	3	2	-	-	-	-	-	2	3	-	-	2
CO5	3	3	3	3	2	-	-	-	-	-	2	3	-	2	2
CO6	2	2	3	3	2	2	2	2	-	-	2	3	2	-	2

Correlation levels: 1 – low 2 – medium 3 – high “-“- no correlation

U23AE402 **SDG:7,9**	**AIR BREATHING PROPULSION**	**Category :**			
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVE:

1 To understand the fundamentals of piston and gas turbine engines, including their operating principles, efficiency calculations, and thrust augmentation methods.

2 To explore the principles of inlets and nozzles in jet engines, focusing on their performance in subsonic and supersonic conditions.

3 To learn the combustion process and types of combustion chambers, including flame stabilization and cooling techniques.

4 To understand the principles of centrifugal and axial flow compressors and analyze their performance characteristics.

5 To study the operation of axial flow turbines, including turbine cooling methods and the matching of compressors and turbines for optimal engine performance.

UNIT 1	**PRINCIPLES OF AIR-BREATHING ENGINES**	**9**

Operating principles of piston engines –Classification of piston engines - Illustration of working of gas turbine engines - Thrust equation - Factors affecting thrust– Thrust augmentation- Methods of thrust augmentation – Thermal efficiency calculations – performance characteristics of turboprop, turbofan and turbojet engine.

UNIT 2	**INLETS AND NOZZLES FOR JET ENGINES**	**9**

Ram effect ,Internal flow and Stall in subsonic inlets – Relation between minimum area ratio and external deceleration ratio – Diffuser performance – Modes of operation - Supersonic inlets – Starting problem on supersonic inlets – Convergent / Convergent - divergent nozzles-Real flow through nozzles and nozzle efficiency – Losses in nozzles – Ejector and variable area nozzles - Thrust reversal.

UNIT 3	**COMBUSTION CHAMBERS FOR JET ENGINES**	**9**

Introduction to combustion Chemistry- Combustion process - Classification of Gas turbine combustion chambers - Combustion chamber performance - Flame tube cooling - Flame stabilization - Cooling process- Materials

UNIT 4	**COMPRESSORS FOR JET ENGINES**	**9**

Types of compressors-Principle of operation of centrifugal compressor - Work done and pressure rise - Velocity diagrams - Principle operation of axial flow compressor–Velocity triangles - Compressor blade design – comparison of Centrifugal and axial compressor performance characteristics –cascade testing

UNIT 5	**TURBINES FOR JET ENGINES**	**9**

Principle of operation of axial flow turbines – limitations of radial flow turbines- Work done and pressure rise – Velocity diagrams – Degree of reaction- Performance characteristics of axial flow turbine– stage efficiency calculations- Turbine blade cooling methods– Choice of blade profile, pitch and chord– matching of compressor and turbine

COURSE OUTCOMES:

At the end of the course, students would

CO1: Recall the operating principles of air-breathing engines, identify key components of jet engines, and define terms like thrust and combustion.

CO2: Explain the performance characteristics of different air-breathing engines and describe the process of combustion in gas turbine engines.

CO3: Apply thermal efficiency calculations to various engine types and use the thrust equation to determine engine performance.

CO4: Analyze the performance of inlets, nozzles, and diffusers, and analyze the functioning of centrifugal and axial flow compressors.

CO5: Utilize different thrust augmentation methods and determine the efficiency of combustion chambers.

CO6: Analyze the matching of compressors and turbines to optimize overall engine performance.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. V. Ganeshan, *Gas Turbines*, 6th ed. New York: McGraw-Hill Education, 2020.

2. H. Cohen, G.F.C. Rogers, and H.I.H. Saravanamuttoo, *Gas Turbine Theory*, 8th ed. Toronto, Canada: Pearson Education, 2020.

3. P.G. Hill and C.R. Peterson, *Mechanics & Thermodynamics of Propulsion*, 3rd ed. Upper Saddle River, NJ: Pearson Education, 2020.

4. J.D. Mattingly, *Elements of Propulsion: Gas Turbines and Rockets*, 2nd ed. Reston, VA: AIAA Education Series, 2020.

5. M.L. Mathur and R.P. Sharma, *Gas Turbine, Jet and Rocket Propulsion*, 3rd ed. New Delhi, India: Standard Publishers & Distributors, 2021.

REFERENCES:

1. G.C. Oates, *Aerothermodynamics of Aircraft Engine Components*, 2nd ed. Reston, VA: AIAA Education Series, 2021.

2. S. Farokhi, *Aircraft Propulsion*, 3rd ed. Hoboken, NJ: Wiley, 2020.

3. *Rolls-Royce Jet Engine*, 6th ed. Derby, U.K.: Rolls-Royce, 2021.

4. S. A. S. S. R. R. Rao, *Gas Turbine Engine Design and Performance*, 2nd ed. New Delhi, India: McGraw-Hill Education, 2021.

5. C. Jaganathan and S.K. Jain, *Jet Engines*, 2nd ed. New Delhi, India: Yes Dee, 2020.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CO1	3	3	3	2	2	-	-	-	-	-	2	1	2	2	2
CO2	2	3	3	3	2	-	-	-	1	-	2	1	2	2	3
CO3	2	3	3	3	3	-	-	-	1	-	2	1	3	3	3
CO4	2	2	1	3	2	-	-	-	1	-	2	1	3	3	3
CO5	2	2	3	2	2	-	-	-	1	-	2	1	2	3	3
CO6	2	2	3	2	3	-	-	-	-	-	3	3	3	3	3

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

U23AE403 **SDG: 9**	**MECHANICS OF MACHINES**	**Category :**			
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVE:

1. To introduce the basic concepts of kinematic mechanisms, including linkages, pairs, chains, and inversions.
2. To familiarize students with gear trains, their classifications, and the design principles of spur gears and epicyclic gear systems.
3. To develop an understanding of friction, its types, laws, and practical applications in machines like screws and clutches.

4. To impart knowledge of force analysis in static and dynamic conditions using free-body diagrams and D'Alembert's principle.

5. To provide insight into balancing rotating masses and understanding vibrations in mechanical systems to enhance stability and performance.

UNIT 1	**SIMPLE MECHANISMS**	**9**

Kinematic Link – Types. Kinematic Pair - Classification and types of Constrained Motions. Kinematic Chain - Types of Chains and Joints. Mechanism and Inversion of Mechanism, Degrees of Freedom - Kutzbach and Grubler's Criteria. Theoretical Concept of Velocity, Acceleration in Mechanisms - Concept and Simple Problems. Cams - Classification of Followers and Cams. Displacement, Velocity, and Acceleration Diagrams, Cam Profile Construction for Radial Cams.

UNIT 2	**GEAR TRAINS**	**9**

Types of Gear Trains: Simple Gear Train, Compound Gear Train, Design of Spur Gears, Reverted Gear Train, Epicyclic Gear Train, Velocity Ratio of Epicyclic Gear Train, Compound Epicyclic Gear Train—Sun and Planet Gear – Simple problems

UNIT 3	**FRICTION**	**9**

Types of Friction, Laws of Friction, Coefficient of Friction, Limiting Friction and Limiting Angle of Friction, Angle of Repose. Friction on Horizontal and Inclined Planes, Screw Friction with Simple Problems. Types of Clutches, Problems in Single and Multiple Clutches.

UNIT 4	**FORCE ANALYSIS**	**9**

Applied and Constrained Forces – Free body diagrams – Static equilibrium conditions. Static Force analysis – Simple problems – Theoretical concept of Dynamic Force Analysis. Inertia Forces – D'Alembert's principle - Klien's Construction – Simple problems.

UNIT 5	**BALANCING AND VIBRATION**	**9**

Balancing of Rotating Masses – Simple problems. Free vibrations – natural Frequency – Damped Vibration – critical speed of simple shaft – Forced vibration – harmonic Forcing – Vibration isolation.

COURSE OUTCOMES:

At the end of the course, students would

CO1: Explain the fundamentals of kinematic mechanisms, including links, pairs, chains, and inversions.

CO2: Analyze velocity and acceleration in mechanical systems and construct cam profiles for radial cams.

CO3: Design and calculate gear ratios for simple, compound, and epicyclic gear trains.

CO4: Solve problems involving friction, including applications in screws and clutches, and evaluate mechanical efficiency.

CO5: Perform static and dynamic force analysis using free-body diagrams and D'Alembert's principle.

CO6: Apply principles of balancing and vibration analysis to rotating machinery, ensuring operational stability and reduced vibration.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. R. S. Khurmi and J. K. Gupta, Theory of Machines, 14th ed. New Delhi, India: S. Chand & Company Ltd., 2020.

2. M. A. Mostafa, Mechanics of Machinery, 1st ed. Boca Raton, FL, USA: CRC Press, 2017.

3. S. S. Rattan, Theory of Machines, 5th ed. New Delhi, India: McGraw Hill Education, 2019.

4. T. Bevan, Theory of Machines, 3rd ed. Essex, UK: Pearson Education, 2015.

5. D. J. Inman, Engineering Vibration, 5th ed. New York, NY, USA: Pearson, 2020.

REFERENCES:

1. R. K. Bansal, A Textbook of Theory of Machines (Kinematics and Dynamics), 1st ed. New Delhi, India: Laxmi Publications, 2019.

2. N. Sadhu Singh, Theory of Machines and Mechanisms, 3rd ed. New Delhi, India: Pearson, 2021.

3. A. Ghosh and A. K. Malik, Theory of Mechanisms and Machines, 3rd ed. New Delhi, India: Affiliated East-West Press, 2022.

4. J. J. Uicker Jr., G. R. Pennock, and J. E. Shigley, Theory of Machines and Mechanisms, 6th ed. Cambridge, UK: Cambridge University Press, 2023.

5. Prof. Ashok K Mallik, Kinematics of Machines, IIT Kanpur, https://nptel.ac.in/courses/112104121

CO's-PO's & PSO's MAPPING

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

CO5	3	3	2	3	3	-	-	-	-	2	1	2	3	2	3
CO6	2	3	2	2	3	-	-	1	-	2	3	2	2	3	3
Correlation levels:	**1 – low**		**2 – medium**			**3 – high**			**"-"- no correlation**						

U23AE404 **SDG: 7,9**	**LOW SPEED AERODYNAMICS**	**Category: TCP**			
		L	**T**	**P**	**C**
		3	**0**	**2**	**4**

COURSE OBJECTIVE:

1 To understand and apply fundamental aerodynamic principles including forces, moments, drag, and flow equations.

2 To analyze and solve potential flow problems involving uniform, source, sink, doublet, and vortex flows.

3 To apply complex potential theory and conformal transformations to solve aerodynamic flow problems.

4 To understand and apply airfoil theory to predict lift, drag, and stability.

5 To understand the principles, types, and performance analysis of propellers in lift generation.

UNIT 1	**INTRODUCTION TO AERODYNAMICS**	**9**

Importance of Aerodynamics – Aerodynamic forces and moments – Pressure distribution on an airfoil – Types of drag – Flow similarity, Types of flow – Continuity, momentum and energy equations – Incompressible-inviscid flow – Irrotational flow – Circulation and Vorticity – Euler's equation – Bernoulli's Equation – Pitot tube: Measurement of airspeed. Pressure Coefficient.

UNIT 2	**TWO DIMENSIONAL POTENTIAL FLOWS**	**9**

Elementary flows – Uniform, Source, Sink, Doublet and Vortex flow, Combination of a uniform flow with a source and sink, Non lifting flow over a circular cylinder, Lifting flow over a cylinder, Kutta Joukowski theorem and Generation of lift, Flow over a flat plate, D'Alembert Paradox, Magnus effect.

UNIT 3	**CONFORMAL TRANSFORMATION**	**9**

Complex Potential-Complex potential for Elementary Flows-Cauchy-Riemann equation, Joukowski transformation- and its application to fluid flow problems, Karman-Trefftz Profiles

UNIT 4	**INCOMPRESSIBLE FLOW OVER A AIRFOILS**	**12**

Airfoil Nomenclature – Airfoil characteristics – Kutta condition – Thin airfoil theory and its applications – Aerodynamic Center – Horse shoe vortex, Biot and Savart law – Downwash and induced drag – Helmholtz theorems, Lifting line theory and its limitations-Element lifting surface theory-introduction to vortex lattice method and general 3D panel Method.

UNIT 5	**PROPELLER THEORY**	**6**

Introduction to propeller –importance of propeller in lift Generation-Types and application of Propellers-Froude momentum and Blade element theories – Propeller coefficients – Performance of fixed and variable pitch propeller.

LIST OF EXPERIMENTS

1. Calibration of a subsonic wind tunnel.
2. Determination of lift for the given airfoil section.
3. Pressure distribution over a smooth circular cylinder.
4. Pressure distribution over a symmetric airfoil.
5. Pressure distribution over a cambered airfoil.
6. Force measurement using wind tunnel balancing set up.
7. Flow over a flat plate at different angles of incidence.
8. Flow visualization studies in low speed flows over cylinder and airfoil with different angle of incidence.

COURSE OUTCOMES:

At the end of the course, students would

CO1: Analyze aerodynamic forces, moments, drag, and apply flow equations to solve practical problems.

CO2: Apply potential flow theory to solve problems involving lift generation and flow separation.

CO3: Use complex potential theory and transformations to solve aerodynamic flow problems.

CO4: Predict airfoil lift, drag, and stability using airfoil theory.

CO5: Analyze propeller theories and evaluate the performance of fixed and variable pitch propellers.

CO6: Apply the theoretical knowledge to practical engineering challenges, particularly in vehicle and aircraft Design.

L – 45 **T – 0** **P – 30** **TOTAL: 75 PERIODS**

TEXT BOOKS:

1 Anderson, J.D., ‘Fundamentals of Aerodynamics’, Sixth Edition, McGraw-Hill Education, 2016.

2 Clancy, L.J., 'Aerodynamics', Shroff, 2006

3 E. L. Houghton, P. W. Carpenter, Steven H. Collicott, and Daniel T. Valentine, 'Aerodynamics for Engineering Students', Seventh Edition, Butterworth-Heinemann, 2016.

4 Aircraft Power plants, 9th Edition, 2018 McGraw-Hill Education

REFERENCES:

1 Ethirajan Rathakrishnan , Theoretical Aerodynamics, Wiley; First Edition, 2013.

2 A.M. Kuethe and C-Y Chow, 'Foundations of Aerodynamics: Bases of Aerodynamic Design', Wiley India Pvt Ltd,

Fifth edition, 2009.

3 Theodore A. Talay, 'NASA's Flight Aerodynamics Introduction', NASA, 2013.

4 Kunal Ghosh, Low Speed Aerodynamics, PHI Learning Private Limited, 2017.

5 Charles E. Dole, and James E. Lewis, Flight Theory and Aerodynamics: A Practical Guide for Operational Safety, Wiley India Pvt Ltd, Second edition, 2009.

6 Bertin, J. J., Aerodynamics for Engineers, Pearson Education, 2002.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CO1	3	2	1	1	1	-	-	-	-	1	1	1	3	2	-
CO2	3	2	1	1	2	-	-	-	-	1	1	1	3	2	-
CO3	3	3	2	-	2	-	-	-	-	1	1	2	3	1	-
CO4	3	2	1	1	2	-	-	-	-	1	1	1	3	1	-
CO5	3	3	2	-	2	-	-	-	-	1	1	2	3	1	-
CO6	3	3	2	-	2	-	-	-	-	1	1	3	2	1	-

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

CODE: U23AE411 SDG: 4	AIRCRAFT STRUCTURES -I LABORATORY	Category : Lab			
		L	**T**	**P**	**C**
		0	**0**	**2**	**1**

COURSE OBJECTIVE:

1. To understand the behavior of aircraft structural components under different loading conditions.
2. To estimate the failure loads of various structures with different loads.
3. To study the behaviour of materials both destructive and non-destructive conditions.

LIST OF EXPERIMENTS

1. Deflections of a simply-supported beam
2. Deflections of a cantilever beam
3. Verifications of Maxwell's reciprocal theorem
4. Verification of superposition theorem
5. Combined bending and Torsion of Hollow Circular tube
6. Shear failure of bolted Joints
7. Shear failure of riveted Joints
8. Evaluation of flaw on welded metal surface by dye-penetration method (NDT)
9. Determination of young's modulus for metallic materials
10. Determination of flexural strength of metallic materials.

COURSE OUTCOMES:

At the end of the course, students would

CO1: Understand the concept of loading with various boundary conditions.

CO2: Apply the Principles of loading and verify with experiments.

CO3: Analyse the various type of structures with relevant loadings.

CO4: Evaluate the failure loads and stresses with different loads.

CO5: Apply the non-destructive testing and study about the metallic materials.

CO6: Design the components of structure and evaluate the material properties.

TOTAL: 30 PERIODS

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	2	-	2	-	-	1	3	1	1	3
CO2	3	3	2	2	2	1	-	2	2	-	-	3	1	2	2
CO3	3	3	2	2	2	1	-	2	2	-	-	3	1	2	2
CO4	3	3	2	2	2	1	-	2	2	-	-	3	2	2	2
CO5	3	3	2	2	2	1	-	2	2	-	-	3	2	3	3
CO6	3	3	3	3	2	2	2	3	2	2	2	3	2	3	3

U23AE412 **SDG : 4,9**	**Propulsion Laboratory**	**Category :**			
		L	**T**	**P**	**C**
		0	**0**	**3**	**1**

COURSE OBJECTIVE:

1. Understand and apply the dismantling and reassembly procedures for aircraft piston engines, focusing on the key components and systems.
2. Investigate and analyze the operational characteristics of aircraft jet engines, including performance evaluation and key parameters.
3. Conduct experiments to determine velocity profiles of free jets and wall jets, and understand their impact on jet propulsion systems.

LIST OF EXPERIMENTS

1. Dismantling and reassembly procedures for aircraft piston engines.
2. Study of an aircraft jet engines.
3. Determine the velocity profiles of free jets.

4. Determine Velocity profiles of wall jets.
5. Wall pressure measurements of a subsonic diffusers and ramjet ducts.
6. Flame stabilization studies using conical and hemispherical flame holders.
7. Cascade testing of compressor blades.
8. Performance test of propeller
9. Determination of heat transfer coefficient under natural convection.
10. Determination of heat transfer coefficient under forced convection.

COURSE OUTCOMES:

At the end of the course, students would

CO1: Demonstrate the ability to dismantle and reassemble aircraft piston engines safely and accurately, applying theoretical knowledge to practical tasks.

CO2: Analyze the operational parameters and performance characteristics of aircraft jet engines, interpreting experimental data to assess engine efficiency.

CO3: Apply principles of fluid dynamics to determine velocity profiles of free jets and wall jets, and interpret findings in relation to propulsion system performance.

CO4: Measure and analyze wall pressure in subsonic diffusers and ramjet ducts, and assess the impact on airflow and engine performance.

CO5: Design and conduct experiments to measure heat transfer coefficients under both natural and forced convection, and evaluate their impact on heat transfer efficiency.

CO6: Perform cascade testing on compressor blades, evaluate their aerodynamic performance, and propose modifications to enhance efficiency.

TOTAL: 30 PERIODS

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	3	3	3	3	-	-	-	-	-	2	2	3	2	2
CO2	3	3	3	3	3	-	-	-	-	-	2	2	3	2	2
CO3	3	3	3	3	3	-	-	-	-	-	2	2	3	3	3

CO4	3	3	3	3	3	-	-	-	-	-	2	2	3	3	3
CO5	3	2	2	3	3	-	-	-	-	-	2	2	3	3	3
CO6	3	3	2	3	3	-	-	-	-	-	2	2	3	3	3
Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation															

U23AE413 **SDG : 4**	**CAD LABORATORY**	**Category :**			
		L	**T**	**P**	**C**
		0	0	4	2

COURSE OBJECTIVE:

1. To make theoretical and practical knowledge necessary for utilizing computer-aided design (CAD) tools in aerospace engineering.
2. To develop skills in designing various aerospace components and systems using Solidworks software for both 2D and 3D modelling
3. To familiarize with the specific challenges and considerations involved in designing subsonic and supersonic diffusers, compressor blades, nozzles, aircraft wings, fuselage structures, landing gears, launch vehicles, re-entry vehicles, missiles, and satellites.
4. To learn CAD techniques to optimize the performance, efficiency, and safety of aerospace designs
5. To encourage collaborative problem-solving and innovation through CAD-based design projects

LIST OF EXPERIMENTS

1. Computer aided design of subsonic diffusers.
2. Computer aided design of supersonic diffusers.
3. Computer aided design of convergent nozzle.
4. Computer aided design of diverging nozzle.
5. Computer aided design of typical fuselage structure
6. Computer aided design of a landing gear
7. Computer aided design of a launch vehicle.
8. Computer aided design of re-entry vehicles.

9. Computer aided design of a Missiles.
10. Computer aided design of typical aircraft wing.

COURSE OUTCOMES:

At the end of the course, students would

CO1: Develop skills in using CAD software to design and analyze key aerospace components such as diffusers, nozzles, fuselages, and wings.

CO2: Demonstrate an understanding of the principles underlying the design of aerospace components and systems, including aerodynamics, and structural mechanics.

CO3: Apply CAD techniques to address specific challenges related to aerodynamic performance, structural integrity, weight optimization, and manufacturability in aerospace design

CO4: Adhere to industry standards, regulations, and best practices in aerospace engineering throughout the design process

CO5: Continuously update their CAD skills and knowledge to adapt to advancements in technology and industry trends in aerospace engineering

CO6: Promote collaborative learning and problem-solving by engaging in hands-on design experiments related to various aerospace systems, emphasizing teamwork in solving complex engineering problems.

TOTAL: 30 PERIODS

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CO1	2	2	2	1	-	-	-	-	-	-	-	-	2	1	1
CO2	2	2	2	-	-	-	-	-	-	-	-	-	2	1	1
CO3	2	2	2	1	-	-	-	-	-	-	-	-	2	1	1
CO4	2	2	2	-	-	-	-	-	-	-	-	-	2	1	1
CO5	2	2	2	-	-	-	-	-	-	-	-	-	2	1	1
CO6	2	2	2	1	-	-	-	-	-	-	-	-	2	1	1

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

U23CY402 SDG: 6,12,13,14,15	Environmental Ecosystem and Sustainability	Category: ESC			
		L	T	P	C
		2	0	0	0

COURSE OBJECTIVE:

1. Study the interrelationship between living organism and environment
2. Assess the environmental pollution and its impact.
3. Understand the significance of natural resources and their conservation.
4. Identify and implement scientific, economic and political solutions to environmental problems.
5. Understand the influence of human population on environmental issues and role of information technology as a tool to minimize the environmental problems.

UNIT 1	ECOSYSTEMS AND BIODIVERSITY	6

Definition, Scope and importance of environment - Concept of an ecosystem - Structure and function of an ecosystem (Grassland and River ecosystem only) - Food chains, Food webs and ecological pyramids - Introduction to biodiversity- Definition- Genetic, Species and ecosystem diversity - Value of biodiversity - Threats to biodiversity- Conservation of biodiversity. Case study of simple ecosystems -pond, river, hill slopes, etc.

UNIT 2	ENVIRONMENTAL POLLUTION	6

Definition - Causes, Effects and control measures of (a) Air pollution (b) Water pollution (c) Thermal pollution - Solid waste management: Causes, Effects and control measures of municipal solid wastes - Role of an individual in prevention of pollution - Pollution case studies -Disaster management - Floods, Earthquake, Cyclone and landslides. Case study of local polluted site - Urban / Rural / Industrial / Agricultural.

UNIT 3	NATURAL RESOURCES	6

Forest resources - Use and over-exploitation, Deforestation - Water resources - Use and over-utilization of surface and ground water, Drought, Conflicts over water, dams-Benefits and problems - Food resources- Changes caused by agriculture and overgrazing, Effects of modern agriculture, Fertilizer-pesticide problems, water logging, Salinity- Role of an individual in conservation of natural resources (National and International level).

UNIT 4	SOCIAL ISSUES AND SUSTAINABILITY MANAGEMENT	6

Unsustainable to sustainable development- millennium development goals, and protocols- Sustainable Development Goals-targets- Zero waste and R concept - ISO 14000 Series- Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials- Sustainable transports –Carbon credit, Carbon footprint, Climate change, Global warming, Acid rain, Ozone layer depletion.

UNIT 5	**HUMAN POPULATION AND THE ENVIRONMENT**	**6**

Population growth, Variation among nations -Population explosion - Family welfare programme - Environment and human health -Value education - Pandemic issues and management-Women and child welfare - Role of information technology in environment and human health - Case studies

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: The students will able to understand the basis of ecological principles and environmental regulations which in turn helps in sustainable development and human population and environment. Use and over exploitation of forest and water and food resources.

CO2: The students will able to understand various schemes for the protection of species, role of an individual in prevention of pollution and conservation of natural resources

CO3: The students will able to understand design of pollution control structures, resettlement and rehabilitation of people, welfare about the women and child.

CO4: The students will able to apply enough knowledge of implement various Environmental ethics, regulations and schemes, Pandemic issues and management, dams-benefits and problems, conservation of biodiversity.

CO5: The students will able to analyze the disaster management – floods, earthquake, cyclone and landslides. Water logging, salinity, climate change, global warming, acid rain and ozone layer depletion.

TOTAL: 30 PERIODS

TEXT BOOKS:

1. Benny Joseph, “Environmental Science and Engineering”, Tata McGrawHill, New Delhi, 2017.

2. Gilbert M.Masters, “Introduction to Environmental Engineering and Science”, 2nd Edition, Pearson Education, 2016.

3.George Tchobanoglous, Frank Kreith, “Handbook of Solid Waste Management” (McGrawHill Handbooks), McGraw-Hill Education, 2ndEdition July 2017.

REFERENCES:

1. R.K. Trivedi, "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards", Vol. I and II, Enviro Media. 2015.

2. ErachBharucha, "Textbook of Environmental Studies", Universities Press (I) Private Limited, Hydrabad, 2015.

3. Rajagopalan R, "Environmental Studies-From Crisis to Cure", Oxford University Press, 2005.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	1	1	1	-	-	1	-	1	1	-	1	-	-	-
CO2	3	1	1	1	-	-	1	-	1	1	-	1	-	-	-
CO3	3	1	1	1	-	-	1	-	1	1	-	1	-	-	-
CO4	3	1	1	1	-	-	1	-	1	1	-	1	-	-	-
CO5	3	1	1	1	-	-	1	-	1	1	-	1	-	-	-

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

SEMESTER V

U23AE501 SDG:4,9	HIGH SPEED AERODYNAMICS	Category: PCC			
		L	T	P	C
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

1. Understand basic principles and equations of compressible flow.
2. Analyze one-dimensional flows including nozzles and diffusers.
3. Study shock waves and their applications.
4. Apply methods for solving supersonic and expansion flows.
5. Examine aerodynamic effects in transonic flows.

UNIT 1	**FUNDAMENTALS OF COMPRESSIBLE FLOW**	**9**

Basic governing equations: Continuity, Momentum, Energy, and Equation of State, Speed of sound, Mach number, Adiabatic steady-state flow equations, Rayleigh and Fanno flows

UNIT 2	**ONE-DIMENSIONAL AND QUASI-ONE-DIMENSIONAL FLOWS**	**9**

Isentropic flow through nozzles: Flow in convergent and convergent-divergent passages, Choking and effects of back pressure, Performance analysis under various conditions, Small perturbation theory: Linearized flow for subsonic and supersonic speeds, Mach waves, Mach angles, and affine transformation for subsonic flow

UNIT 3	**SHOCK WAVES**	**9**

Normal shocks: Prandtl and Rankine–Hugoniot relations, Pitot-static tube corrections for subsonic/supersonic flows, Oblique shocks: Shock polar, pressure turning angle, Flow past wedges and corners: Weak, strong, and detached shocks, Reflection and interaction of shocks

UNIT 4	**EXPANSION WAVES AND 2D SUPERSONIC FLOWS**	**9**

Flow past convex corners, expansion hodograph, Prandtl-Meyer expansion and Mach lines, Method of Characteristics for supersonic flow, Design of 2D supersonic nozzle contours

UNIT 5	**TRANSONIC AERODYNAMICS**	**9**

Critical Mach numbers: Lower and upper, Transonic effects: Shock-induced separation, drag divergence, Wing characteristics in transonic regime: Thickness, camber, aspect ratio, swept wings and Transonic Area Rule, Lift, drag, pitching moment, and center of pressure in compressible flows
45 HOURS

COURSE OUTCOMES:

At the end of the course, students will be able to

CO1: Apply fundamental equations to analyze 1D compressible flows.

CO2: Calculate properties across normal and oblique shocks.

CO3: Use expansion wave theory and characteristics in supersonic flows.

CO4: Analyze aerodynamic forces using linearized flow theory.

CO5: Evaluate transonic effects on airfoils and wing design.

TEXTBOOKS:

1. Modern Compressible Flow: With Historical Perspective – John D. Anderson, 4th Edition, McGraw-Hill Education, 2023.
2. Gas Dynamics – Ethirajan Rathakrishnan, 5th Edition, Prentice Hall India, 2022.
3. Fundamentals of Gas Dynamics – V. Ganesan, 3rd Edition, McGraw Hill Education, 2021.

REFERENCES:

1. Elements of Gas Dynamics – Liepmann and Roshko, Dover Publications, Reprint 2020.
2. Introduction to Fluid Mechanics and Compressible Flow – A. W. Pattison, CRC Press, 2021.
3. Compressible Fluid Dynamics – M.D. Salas, Cambridge University Press, 2022.

ONLINE COURSES:

1. https://ocw.mit.edu/
2. https://nptel.ac.in/courses/112/104/112104118
3. https://nptel.ac.in/courses/101/101/101101002

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	-	2	-	-	-	-	-	-	-	2	3	-	-

CO2	3	3	-	3	2	-	-	-	-	-	-	2	3	2	1
CO3	3	3	2	3	3	-	-	-	-	-	-		3	2	2
CO4	3	3	3	3	3	-	-	-	-	-	-	2	3	3	2
CO5	3	3	3	3	3	-	-	-	-	-	-	3	3	3	3

U23AE502 **SDG:4,9**	**AIRCRAFT PERFORMANCE**	**Category: PCC**			
		L	**T**	**P**	**C**
		3	0	0	3

COURSE OBJECTIVE:

- To understand the key aerodynamic and propulsion parameters affecting aircraft performance.
- To analyse aircraft behaviour under various flight conditions including take-off, cruise, landing, climb, glide, and turns.
- To develop analytical skills for performance prediction in different phases of flight using mathematical models and practical examples.

UNIT 1	**LIFT AND DRAG ON FLIGHT PERFORMANCE:**	**9**

Aerofoil characteristics, drag reduction methods, effect of planform and twist, stall control devices, airplane drag polar, airplane drag contributions.

UNIT 2	**SPECIAL PERFORMANCE**	**9**

Range and endurance of jet and propeller type of airplanes, Effect of high lift devices on airfoil maximum lift coefficient, estimation of take-off and landing distance.

UNIT 3	**TURNING PERFORMANCE**	**9**

Bank angle and load factor, Steady, level and coordinated turns, symmetrical pull up - Instantaneous and sustained pull up, the v-n diagram.

UNIT 4	**STEADY FLIGHT AND GLIDING PERFORMANCE**	**9**

Steady level flight, Thrust/power, available and required and SFC with altitude and speed, Estimation of maximum level flight speed, conditions for minimum drag and minimum power required. Steady unpowered flight, Glide angle, rate of descent and speed, hodograph, unpowered glide at high speed.

UNIT 5	CLIMBING AND DRIFT DOWN PERFORMANCE	9
Climbing performance for propeller and jet powered airplane, climbing performance at steep angles, drift down performance for propeller and jet powered airplane, Methods for predicting time to climb, time to drift down, Absolute ceiling and service ceiling.		
	TOTAL HOURS	**45**

TEXT BOOKS:

1. John D. Anderson Jr. – Aircraft Performance and Design, 1st Ed., McGraw-Hill Education, Reprint 2023.
2. Antonio Filippone – Advanced Aircraft Flight Performance, 2nd Ed., Cambridge University Press, 2021.
3. W. Austyn Mair & D. L. Birdsall – Aircraft Performance, Latest Reprint 2020, Cambridge University Press.

REFERENCES:

1. James F. Marchman III – Aerodynamics and Aircraft Performance, 3rd Ed., Virginia Tech, 2020.
2. Jan Roskam & Chuan-Tau Edward Lan – Airplane Aerodynamics and Performance, Roskam Aviation and Engineering, 2007.
3. Brian L. Stevens & Frank L. Lewis – Aircraft Control and Simulation, 3rd Ed., Wiley, 2016.
4. Aerodynamics and Aircraft Performance - 3rd edition, James F. Marchman III, Virginia Tech, Copyright Year: 2004, ISBN 13: 9781949373639, Publisher: Virginia Tech Libraries.
5. Airplane Aerodynamics and Performance, By Jan Roskam, Chuan-Tau Edward Lan · 1997, Roskam Aviation and Engineering.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	–	–	–	3	2	1	3	3	–	–	–	3	2
CO2	3	3	2	2	–	3	2	1	3	3	2	2	–	3	2
CO3	3	3	2	2	–	3	2	1	3	3	2	2	–	3	2
CO4	3	3	2	2	–	3	2	1	3	3	2	2	–	3	2

CO5	3	3	2	2	–	3	2	1	3	3	2	2	–	3	2

U23AE503 **SDG: 7,9,13**	**ADVANCED AIRCRAFT STRUCTURAL ANALYSIS**	**Category: PCC**			
		L	**T**	**P**	**C**
		2	**1**	**2**	**4**

COURSE OBJECTIVE:

1. To familiarise the student, the generalized theory of pure bending and work out problems in the calculation of bending stress involving different methods.
2. To gain knowledge in the concept of shear flow in thin-walled sections.
3. To carry out shear flow analysis involving different types of sections.
4. To Impart theoretical knowledge on the behaviour of thin plates and thin-walled columns.
5. To carry out basic stress analysis procedures involving aircraft structural components.

UNIT 1	**UNSYMMETRICAL BENDING OF BEAMS**	**9**

Unsymmetrical bending of beams – different methods of analysis ('K' method, Neutral axis method, and Principal axis method), stresses and deflections in beams under unsymmetrical bending.

UNIT 2	**SHEAR FLOW IN OPEN SECTIONS**	**9**

Definition of shear flow- expression for shear flow due to bending, shear flow in thin-walled Open sections. torsion of thin-walled Open sections, the shear center of symmetric and unsymmetrical open sections, structural idealization.

UNIT 3	**SHEAR FLOW IN CLOSED SECTIONS**	**9**

Shear flow in Closed sections- due to bending and torsion in single-cell and multi-cell structures, the shear center of symmetric and unsymmetrical closed sections, effect of structural idealization, shear flow in a tapered Beam.

UNIT 4	**BUCKLING OF PLATES**	**9**

Behaviour of a rectangular plate under compression, governing equation for plate buckling, buckling analysis of sheets and stiffened panel under compression, concept of the effective sheet width, buckling due to shear and combined loading, Crippling Stresses -Needham and Gerard method.

UNIT 5	**AIRCRAFT STRESS ANALYSIS**	**9**

Loading and analysis of aircraft wing, fuselage, and tail unit. Use of V-n diagram for sizing the aircraft wing, fuselage, and tail unit, Stress analysis of thin-webbed beams using Wagner's theory.

S.NO	LIST OF EXPERIMENTS
1.	Unsymmetrical Bending (Z-Section) of a Cantilever Beam
2.	Shear Centre of a Channel Section
3.	Shear Centre of an Angle Section
4.	Shear Centre of a closed ("D") Section
5.	Free Vibration of a Cantilever Beam
6.	Forced Vibration of a cantilever Beam
7.	Material Fringe Constant of a Photo elastic Models
8.	Fabrication of a Composite Laminate.
9.	Tension field beam
10.	Determination of Elastic constants for a Composite Tensile Specimen.
11.	Determination of Elastic constants for a Composite Flexural Specimen.

L – 30 **T – 15** **P – 30** **TOTAL: 75 PERIODS**

COURSE OUTCOMES:

At the end of the course, students will be able to:

CO1: Analyse and investigate the normal stress variation on unsymmetrical sections, subjected to bending moments.

CO2: Determine the shear flow variation in thin-walled open sections with skin effective and in-effective in bending. Also, to find out the shear centre of sections.

CO3: Calculate the shear flow variation in single cell and multicell tubes subjected to shear and torque loads.

CO4: Investigate the behaviour of buckling of simply supported plates and also to know the effective width of sheet stringers combination.

CO5: Analyse the shear and bending moment variation of aircraft wing and fuselage and also to know the characteristics of thin webbed beams.

TEXT BOOKS:

1. Bruhn. E.H., 'Analysis and Design of Flight Vehicles Structures', Tri-state off-set company, USA, 1985.

2. Howard D Curtis, 'Fundamentals of Aircraft Structural Analysis', WCB-McGraw Hill,1997.

3. Megson T M G, 'Aircraft Structures for Engineering Students', Butterworth-Heinemann;5th edition, 2012.

REFERENCES:

1. David J. Peery, "Aircraft Structures (Dover Books on Aeronautical Engineering)", Dover Publications,2013.

2. Peery, D.J., and Azar, J.J., Aircraft Structures, 2nd edition, McGraw – Hill, N.Y., 1999.

3. Rivello, R.M., Theory and Analysis of Flight Structures, McGraw Hill, 1993

4. James M. Gere and Barry J Goodno, "Mechanics of Materials", 8th Edition, Cengage Learning Custom Publication. 2012.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CO1	3	3	2	2	2	-	-	-	-	-	2	3	2	2	-
CO2	3	3	3	3	2	-	-	-	-	-	-	3	3	2	-
CO3	3	3	3	2	2	-	-	-	-	-	2	3	2	2	2
CO4	3	3	3	3	2	-	-	-	-	-	2	3	-	-	2
CO5	3	3	3	3	2	-	-	-	-	-	2	3	-	2	2

U23AE511 **SDG : 4,9**	**AERO ENGINE AND AIRFRAME LABORATORY**	**Category : PCC**			
		L	**T**	**P**	**C**
		0	**0**	**2**	**1**

COURSE OBJECTIVE:

1. To introduce the knowledge of the maintenance and repair procedures followed for overhaul of aero engines.
2. To acquire knowledge in preparation of glass epoxy of composite laminates and its

specimens

3. To learn about Welding and sheet metal repair.

LIST OF EXPERIMENTS

1. Dismantling of an aircraft piston engine.
2. Assembling of an aircraft piston engine.
3. Study of Camshaft operation, firing order and magneto, valve timing
4. Study of lubrication and cooling system
5. Study of auxiliary systems, pumps and carburetor
6. Aircraft wood gluing-single & double scarf joints
7. Preparation of Single/Double Riveted Lap joint
8. Preparation of Single/Double Riveted butt joint
9. Sheet metal forming
10. Sheet metal - Riveted Patch Repair.
11. Dye penetrant test - NDT

COURSE OUTCOMES:

At the end of the course, students would

CO1: Take part in Dismantling and reassembling of an aircraft piston engine

CO2: Inspect the Welding repair in various components of aircraft frames

CO3: Take part in preparation of glass epoxy of composite laminates and its specimens

TOTAL: 30 PERIODS

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	3	2	1	2	1	2	2	3	3	2	2	2	1	2
CO2	2	3	1	1	1	1	2	2	2	2	1	1	3	2	3
CO3	2	3	1	1	1	1	2	2	2	2	1	2	2	1	2

U23MC501 SDG:4,9	ENTREPRENEURSHIP DEVELOPMENT	Category: MC			
		L	T	P	C
		2	**0**	**2**	**0**

COURSE OBJECTIVES:

1. Learn basic concepts in entrepreneurship, develop mind-set and skills necessary to explore entrepreneurship
2. Apply process of problem - opportunity identification and validation through human centred approach to design thinking in building solutions as part of engineering projects
3. Analyse market types, conduct market estimation, identify customers, create customer persona, develop the skills to create a compelling value proposition and build a Minimum Viable Product
4. Explore business models, create business plan, conduct financial analysis and feasibility analysis to assess the financial viability of a venture ideas & solutions built with domain expertise
5. Prepare and present an investible pitch deck of their practice venture to attract stakeholders

UNIT 1	**ENTREPRENEURIAL MINDSET**	**4+8**

Introduction to Entrepreneurship: Definition – Types of Entrepreneurs – Emerging Economics – Developing and Understanding an Entrepreneurial Mindset – Importance of Technology Entrepreneurship – Benefits to the Society.

Case Analysis: Study cases of successful & failed engineering entrepreneurs - Foster Creative Thinking: Engage in a series of Problem-Identification and Problem-Solving tasks

UNIT 2	**OPPORTUNITIES**	**4+8**

Problems and Opportunities – Ideas and Opportunities – Identifying problems in society – Creation of opportunities – Exploring Market Types – Estimating the Market Size, - Knowing the Customer and Consumer - Customer Segmentation - Identifying niche markets – Customer discovery and validation; Market research techniques, tools for validation of ideas and opportunities

Activity Session: Identify emerging sectors / potential opportunities in existing markets - Customer Interviews: Conduct preliminary interviews with potential customers for Opportunity Validation - Analyse feedback to refine the opportunity.

UNIT 3	**PROTOTYPING & ITERATION**	**4+8**
Prototyping – Importance in entrepreneurial process – Types of Prototypes - Different methods – Tools & Techniques. Hands-on sessions on prototyping tools (3D printing, electronics, software), Develop a prototype based on identified opportunities; Receive feedback and iterate on the prototypes.		
UNIT 4	**BUSINESS MODELS & PITCHING**	**4+8**
Business Model and Types - Lean Approach - 9 block Lean Canvas Model – Riskiest assumptions to Business Models – Using Business Model Canvas as a Tool – Pitching Techniques: Importance of pitching - Types of pitches - crafting a compelling pitch – pitch presentation skills - using storytelling to gain investor/customer attention. Activity Session: Develop a business model canvas for the prototype; present and receive feedback from peers and mentors - Prepare and practice pitching the business ideas- Participate in a Pitching Competition and present to a panel of judges - receive & reflect feedback		
UNIT 5	**ENTREPRENEURIAL ECOSYSTEM**	**4+8**
Understanding the Entrepreneurial Ecosystem – Components: Angels, Venture Capitalists, Maker Spaces, Incubators, Accelerators, Investors. Financing models – equity, debt, crowdfunding, etc, Support from the government and corporates. Navigating Ecosystem Support: Searching & Identifying the Right Ecosystem Partner – Leveraging the Ecosystem - Building the right stakeholder network Activity Session: Arrangement of Guest Speaker Sessions by successful entrepreneurs and entrepreneurial ecosystem leaders (incubation managers; angels; etc), Visit one or two entrepreneurial ecosystem players (Travel and visit a research park or incubator or makerspace or interact with startup founders).		
		60 HOURS
COURSE OUTCOMES: At the end of the course, students will be able to **CO1:** Develop an Entrepreneurial Mind-set and Understand the Entrepreneurial Ecosystem Components and Funding types **CO2:** Comprehend the process of opportunity identification through design thinking, identify market potential and customers		

CO3: Generate and develop creative ideas through ideation techniques

CO4: Create prototypes to materialize design concepts and conduct testing to gather feedback and refine prototypes to build a validated MVP

CO5: Analyse and refine business models to ensure sustainability and profitability Prepare and deliver an investible pitch deck of their practice venture to attract stakeholders

TEXTBOOKS:

1. Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, Sabyasachi Sinha (2020). Entrepreneurship, McGrawHill, 11th Edition
2. Ries, E. (2011). The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses. Crown Business
3. Blank, S. G., & Dorf, B. (2012). The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company. K&S Ranch

REFERENCES:

1. Roy, R. (2017). Indian Entrepreneurship: Theory and Practice. New Delhi: Oxford University Press
2. Osterwalder, A., & Pigneur, Y. (2010). Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers. John Wiley & Sons

VERTICAL 1: AERODYNAMICS

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	U23AEP11	Hypersonic Aerodynamics	PEC	3	0	0	3	3
2.	U23AEP12	Industrial Aerodynamics	PEC	3	0	0	3	3
3.	U23AEP13	Boundary Layer Theory	PEC	3	0	0	3	3
4.	U23AEP14	Experimental Aerodynamics	PEC	3	0	0	3	3
5.	U23AEP15	Helicopter Dynamics	PEC	3	0	0	3	3
6.	U23AEP16	Wind Tunnel Testing	PEC	3	0	0	3	3

U23AEP11 SDG:9	HYPERSONIC AERODYNAMICS	Category: PEC			
		L	T	P	C
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

1. To learn basics of hypersonic flow, shock wave, boundary layer interaction and aerodynamic heating.
2. To extend the surface inclination methods for hypersonic inviscid flows.
3. To explain the approximate methods for inviscid hypersonic flows.
4. To familiarize them with the aerodynamical aspects of hypersonic vehicles and the general hypersonic flow theory
5. To understand the viscous interactions in hypersonic viscous flow.

UNIT 1	**BASICS OF HYPERSONIC AERODYNAMICS**	**9**

Thin shock layers – entropy layers – low density and high-density flows – hypersonic flight paths – hypersonic flight similarity parameters – shock wave and expansion wave relations of inviscid hypersonic flows.

UNIT 2	**SURFACE INCLINATION METHODS FOR HYPERSONIC INVISCID FLOWS**	**9**

Local surface inclination methods – modified Newtonian Law – Newtonian theory – tangent wedge or tangent cone and shock expansion methods – Calculation of surface flow properties.

UNIT 3	**APPROXIMATE METHODS FOR INVISCID HYPERSONIC FLOWS**	**9**

Approximate methods – hypersonic small disturbance equation and theory – thin shock layer theory – blast wave theory – entropy effects – rotational method of characteristics – hypersonic shock wave, shapes and correlations.

UNIT 4	**VISCOUS HYPERSONIC FLOW THEORY**	**9**

Navier-Stokes equations – boundary layer equations for hypersonic flow – hypersonic boundary layer – hypersonic boundary layer theory and non-similar hypersonic boundary layers – hypersonic aerodynamic heating and entropy layers effects on aerodynamic heating – heat flux estimation.

UNIT 5	**VISCOUS INTERACTIONS IN HYPERSONIC FLOWS**	**9**

Strong and weak viscous interactions – hypersonic shockwaves and boundary layer interactions –

Estimation of hypersonic boundary layer transition – Role of similarity parameter for laminar viscous interactions in hypersonic viscous flow

45 HOURS

COURSE OUTCOMES:

At the end of the course, students will be able to

CO1: Explain shock wave and expansion wave relations of inviscid hypersonic flows

CO2: Explain the solution methods for hypersonic inviscid flows

CO3: Analyze the hypersonic boundary layers

CO4: Explain the viscous interaction in hypersonic flows

CO5: Analyze chemical and temperature effects in hypersonic flow

TEXTBOOKS:

1. Anderson J. D., "Hypersonic and High Temperature Gas Dynamics", AIAA Education Series, 3rd Ed., 2019.
2. Anderson J. D., "Modern Compressible Flow with Historical Perspective", TMH, 4th Ed., 2020.

REFERENCES:

1. Heiser, W. H. and Pratt, D. T., "Hypersonic Air Breathing Propulsion", AIAA, 1994.
2. John T. Bertin, "Hypersonic Aerothermodynamics", AIAA Inc., Washington DC, 1994

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	1	1	1	-	-	-	-	1	1	1	3	2	-
CO2	3	2	1	1	2	-	-	-	-	1	1	1	3	2	-
CO3	3	3	2	-	2	-	-	-	-	1	1	2	3	1	-
CO4	3	2	1	1	2	-	-	-	-	1	1	1	3	1	-
CO5	3	2	1	1	2	-	-	-	-	1	1	1	3	2	-

U23AEP12 SDG:7,9,11,13	INDUSTRIAL AERODYNAMICS	Category: PEC			
		L	T	P	C
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

1. Understand how wind behaves in the atmosphere and near the ground.
2. Learn how wind energy is captured using different types of turbines.
3. Study how wind affects the shape and performance of vehicles.
4. Explore how buildings are affected by wind and how to design for comfort and safety.
5. Learn about wind-induced vibrations in structures and how to control them.

UNIT 1	**ATMOSPHERE**	**9**

Types of winds, causes of variation of winds, Atmospheric boundary layer, Effect of terrain on gradient height, Structure of turbulent flows, Use of remote sensing (e.g., LiDAR) in atmospheric wind profiling

UNIT 2	**WIND ENERGY COLLECTORS**	**9**

Horizontal axis and vertical axis machines, Power coefficient, Betz coefficient by momentum theory, Smart blade technology and real-time performance monitoring

UNIT 3	**VEHICLE AERODYNAMICS**	**9**

Power requirements and drag coefficients of automobiles, Effects of cut back angle, Aerodynamics of trains and Hovercraft, CFD tools and AI optimization in vehicle aerodynamics

UNIT 4	**BUILDING AERODYNAMICS**	**9**

Pressure distribution on low rise buildings, wind forces on buildings. Environmental winds in city blocks, Special problems of tall buildings, building codes, Building ventilation and architectural aerodynamics, Urban microclimate modeling and green building aerodynamics

UNIT 5	**FLOW INDUCED VIBRATIONS**	**9**

Effects of Reynolds number on wake formation of bluff shapes, Vortex induced vibrations, Galloping and stall flutter, Real-time vibration monitoring using IoT sensors

	45 HOURS

COURSE OUTCOMES:

At the end of the course, students will be able to

CO1 Describe how wind flows near the Earth's surface and how terrain affects it.

CO2	Explain how wind turbines work and analyze their energy output.
CO3	Evaluate how wind affects vehicles and suggest ways to reduce drag.
CO4	Analyze wind effects on buildings and propose ways to improve ventilation and safety.
CO5	Identify types of wind-induced vibrations and suggest control methods for structures.

TEXT BOOKS:

1. Simiu, E., & Scanlan, R. H. (2019). Wind Effects on Structures: Fundamentals and Applications to Design (4th ed.). Wiley.
2. Murakami, S. (2020). Introduction to Wind Engineering. Springer.
3. Obidi, T. Y. (2015). Vehicle Aerodynamics: Fluid Mechanics, Analysis, and Design. SAE International.

REFERENCES:

1. Oke, T. R. (2002). Boundary Layer Climates (2nd ed.). Routledge.
2. Blevins, R. D. (2001). Flow-Induced Vibrations. Van Nostrand Reinhold.

ONLINE COURSES:

1. https://nptel.ac.in/courses/107106080
2. https://nptel.ac.in/courses/101104546

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	2	-	1	2	-	1	-	-	1	3	2	1
CO2	3	3	3	2	2	-	2	-	2	1	-	1	3	3	2
CO3	3	3	3	3	2	-	2	-	3	2	1	2	3	3	3
CO4	2	2	2	2	1	2	3	1	2	2	1	2	3	3	3
CO5	3	2	3	3	1	1	2	-	2	1	2	2	3	2	3

U23AEP13 SDG:4,9	BOUNDARY LAYER THEORY	Category : PEC			
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

1. To introduce the fundamental concepts of boundary layers and their formation.
2. To develop an understanding of laminar and turbulent boundary layer flows over flat and curved surfaces.
3. To derive and solve boundary layer equations using analytical and approximate methods.
4. To study the influence of pressure gradients, separation, and transition phenomena.
5. To apply boundary layer theory to real-world fluid flow problems in engineering.

UNIT 1	INTRODUCTION TO BOUNDARY LAYERS	9

Development of boundary layer concept – Concept of thin shear layer – Comparison of viscous and inviscid flow – Prandtl's boundary layer theory – Boundary layer thickness definitions: displacement thickness, momentum thickness, energy thickness – Reynolds number and flow regimes.

UNIT 2	LAMINAR BOUNDARY LAYER FLOW	9

Boundary layer equations for 2D steady incompressible flow – Blasius solution for flat plate – Similarity solutions – Falkner–Skan equation – Effects of pressure gradient – Integral momentum equation – Thwaites' method – Von Karman momentum integral method.

UNIT 3	TURBULENT BOUNDARY LAYER FLOW	9

Transition from laminar to turbulent flow – Characteristics of turbulent boundary layer – Empirical velocity profiles (1/7th power law, logarithmic law) – Boundary layer equations for turbulent flow – Wall shear stress and skin friction coefficient – Turbulent boundary layer on flat plates and curved surfaces.

UNIT 4	BOUNDARY LAYER WITH PRESSURE GRADIENT AND SEPARATION	9

Effect of favorable and adverse pressure gradients – Separation of boundary layers – Criteria for separation – Methods for controlling separation – Flow past bluff and streamlined bodies – Boundary layer control techniques.

UNIT 5	APPLICATIONS AND ADVANCED TOPICS	9

Boundary layer effects in airfoils and turbomachinery – Heat and mass transfer in boundary layers – Compressible boundary layers (overview) – Numerical solutions of boundary layer equations – Introduction to CFD tools for boundary layer simulation.

COURSE OUTCOMES:

At the end of the course, students would

CO1: Understand the formation and characteristics of boundary layers in fluid flows.

CO2: Solve laminar boundary layer equations analytically and approximately.

CO3: Analyze turbulent boundary layer flow and evaluate skin friction and velocity profiles.

CO4: Assess the impact of pressure gradients and predict boundary layer separation.

CO5: Apply boundary layer theory to engineering systems and simulate basic boundary flows.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Schlichting, H. and Gersten, K., Boundary Layer Theory, Springer, 8th Edition, 2017.

2. White, F.M., Viscous Fluid Flow, McGraw-Hill Education, 3rd Edition, 2006.

3. Kundu, P.K., Cohen, I.M., and Dowling, D.R., Fluid Mechanics, Academic Press, 6th Edition, 2015.

4. Narasimha, R., Aspects of Boundary Layer Flow, Hindustan Book Agency, 2007.

REFERENCES:

1. Fox, R.W., McDonald, A.T., and Pritchard, P.J., Introduction to Fluid Mechanics, Wiley, 8th Edition, 2011.

2. Batchelor, G.K., An Introduction to Fluid Dynamics, Cambridge University Press, 2000.

3. Cebeci, T. and Bradshaw, P., Momentum Transfer in Boundary Layers, Hemisphere Publishing, 1980.

4. Panton, R.L., Incompressible Flow, Wiley, 4th Edition, 2013.

5. NPTEL course: Introduction to Boundary Layers https://archive.nptel.ac.in/courses/112/106/112106190/

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2	PSO 3
CO1	3	2	-	-	1	-	-	-	-	-	-	-	3	-	-
CO2	3	3	-	2	2	-	-	-	-	-	-	-	3	-	-
CO3	3	3	2	2	3	-	-	-	-	-	-	-	3	-	-
CO4	3	3	-	2	2	-	-	-	-	-	-	-	3	-	-
CO5	3	3	3	2	3	-	-	-	-	-	-	-	3	-	-

U23AEP14 SDG-9	EXPERIMENTAL AERODYNAMICS	Category : PEC			
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

To provide details, operating principles and limitations of forces, pressure, velocity and temperature measurements. To describe flow visualization techniques and to highlight in depth discussion of Analog methods.

UNIT 1	**BASIC MEASUREMENTS IN FLUID MECHANICS**	**9**

Objective of experimental studies – Fluid mechanics measurements – Properties of fluids – Measuring instruments – Performance terms associated with measurement systems – Direct measurements – Analogue methods – Flow visualization –Components of measuring systems – Importance of model studies

UNIT 2	**CHARACTERISTICS OF MEASUREMENTS**	**9**

Characteristic features, operation and performance of low speed, transonic, supersonic and special tunnels – Power losses in a wind tunnel – Instrumentation of wind tunnels – Turbulence, Wind tunnel balance –principles, types and classifications -Balance calibration.

UNIT 3	**FLOW VISUALIZATION AND ANALOGUE METHODS**	**9**

Principles of Flow Visualization – Hele-Shaw apparatus – Interferometer – FringeDisplacement method – Schlieren system – Shadowgraph – Hydraulic analogy – Hydraulic jumps – Electrolytic tank.

UNIT 4	**PRESSURE, VELOCITY AND TEMPERATURE**	**9**

Measurement of static and total pressures in low and high speed flows- Pitot Static tube characteristics – Pressure transducers – principle and operation – Velocity measurements – Hot-wire anemometry – LDV – PIV: Temperature measurements.

UNIT 5	**SPECIAL FLOWS AND UNCERTAINTY ANALYSIS**	**9**

Experiments on Taylor-Proudman theorem and Ekman layer – Measurements in boundary layers – Data acquisition and processing – Signal conditioning – Uncertainty analysis – Estimation of measurement errors – External estimate of the error – Internal estimate of the error – Uncertainty calculation – Uses of uncertainty analysis.

COURSE OUTCOMES:

At the end of the course, students would

CO1: Explain the measurement systems in fluids

CO2: Utilize wind tunnel balance for aerodynamic measurements.

CO3: Demonstrate flow visualization techniques

CO4: Measure pressure, velocity and temperature of fluid flows.

CO5: Analyze the data using data acquisition system

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Rathakrishnan, E., "Instrumentation, Measurements, and Experiments in Fluids," CRC Press –Taylor & Francis, 2007.
2. Robert B Northrop, "Introduction to Instrumentation and Measurements", Second Edition, CRC Press, Taylor & Francis, 2006.

REFERENCES:

1. Pope, A., and Goin, L., "High Speed Wind Tunnel Testing", John Wiley, 1985.Bradsaw Experimental Fluid Mechanics.

2. NAL-UNI Lecture Series 12: Experimental Aerodynamics, NAL SP 98 01 April 1998

3. Lecture course on "Advanced Flow diagnostic techniques" 17-19 September 2008 NAL, Bangalore

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CO1	-	-	-	-	3	2	-	-	-	-	-	-	-	-	-
CO2	2	-	-	-	-	-	-	-	-	-	-	-	-	2	-
CO3	-	-	3	3	-	-	-	-	-	-	-	-	2	-	-
CO4	-	-	3	3	-	-	-	-	-	-	-	-	2	-	-
CO5	-	-	-	3	3	-	-	-	-	-	-	-	-	2	-

U23AEP15 SDG-9	HELICOPTER AERODYNAMICS	Category : PEC			
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

Understand the elements of helicopter aerodynamics and ground effect machines, their components and methods of control.

- Formulate the mathematical model using simple blade element theory, analyze its figure of merit and evaluate power estimations.
- Evaluate performance and its effect on altitude and understand the preliminary stability aspects of helicopters.
- Apply the aerodynamics, propulsion and control concepts for various VTOL and STOL aircraft and ground effect machines.

UNIT 1	ELEMENTS OF HELICOPTER AERODYNAMICS	9

Configurations based on torque reaction, jet rotors and compound helicopters, methods of control, collective and cyclic pitch changes, lead and lag, flapping hinges.

UNIT 2	IDEAL ROTOR THEORY	9

Hovering performance, momentum and simple blade element theories, figure of merit, profile and induced power estimation, constant chord and ideal twist rotors

UNIT 3	POWER ESTIMATES	9

Induced, profile and parasite power requirements in forward flight. Performance curves with effects of altitude, preliminary ideas on helicopter stability.

UNIT 4	LIFT, PROPULSION AND CONTROL OF VSTOL AIRCRAFT	9

Various configurations: propeller, rotor, ducted fan and jet lift, tilt wing and vectored thrust, performance of VTOL and STOL aircraft in hover, transition and forward motion.

UNIT 5	GROUND EFFECT MACHINES	9

Hover height, lift augmentation and power calculations for plenum chamber and peripheral jet machine, drag of hovercraft on land and water, applications of hovercraft.

COURSE OUTCOMES:

At the end of the course, students would

CO1: Understand the fundamental principles and configurations of helicopters and their control methods.

CO2: Apply ideal rotor theory to analyze hovering performance using blade element and momentum theories.

CO3: Estimate various power requirements (induced, profile, parasite) and assess helicopter performance at different altitudes.

CO4: Analyze the lift, propulsion, and control mechanisms of VTOL and STOL aircraft.

CO5: Evaluate performance and aerodynamic characteristics of ground effect machines such as hovercraft.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Gessow A, and Myers G C, ―Aerodynamics of Helicopter, Macmillan &Co., 1st Edition 1987.

2. McCormick B W, ―Aerodynamics of V/STOL Flight, Academic Press, 1st Edition, 1987.

REFERENCES:

1. Johnson W, ―Helicopter Theory, Princeton University Press, 1st Edition, 1980.

2. McCormick BW, ―Aerodynamics, Aeronautics and Flight Mechanics, John Wiley, 1st Edition, 1995.

3. Gupta L, ―Helicopter Engineering, Himalayan Books, 1st Edition, 1996.

CO's-PO's & PSO's MAPPING

CO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CO1	3	3	2	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	3	3	2	2	-	-	-	-	-	-	-	3	-	-
CO3	3	3	3	2	2	2	-	-	-	-	-	-	3	-	-
CO4	3	2	3	2	2	-	-	-	-	-	-	-	3	-	-
CO5	3	3	3	3	3	3	-	-	-	-	-	-	3	1	-

VERTICAL 2: MATERIALS AND STRUCTURES

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	U23AEP21	Composite Materials and Structures	PEC	3	0	0	3	3
2.	U23AEP22	Additive Manufacturing	PEC	3	0	0	3	3
3.	U23AEP23	Experimental Stress Analysis	PEC	3	0	0	3	3
4.	U23AEP24	Fatigue and Fracture Mechanics	PEC	3	0	0	3	3
5.	U23AEP25	Aerospace Materials	PEC	3	0	0	3	3
6.	U23AEP26	Smart Materials in Aerospace	PEC	3	0	0	3	3

U23AEP21 SDG: 7,9,13	COMPOSITE MATERIALS AND STRUCTURES	Category: PEC			
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

1. To provide the students an understanding on classification and applications of composite materials and its micromechanical study.
2. To provide the students an understanding on Macromechanics and engineering constants required to relate stress and strain.
3. To make the students to learn about laminate coding and its governing equations.
4. To make the students to familiar with various methods of composite fabrication

UNIT 1	MICROMECHANICS	10

Introduction - advantages and application of composite materials – types of reinforcements and matrices - micro mechanics – mechanics of materials approach, fiber volume ratio – mass fraction – density of composites. effect of voids in composites.

UNIT 2	MACROMECHANICS	10

Generalized Hooke's Law - elastic constants for anisotropic, orthotropic and isotropic materials - macro mechanics – stress-strain relations with respect to natural axis, arbitrary axis. failure theories of a lamina. hygrothermal effects on lamina.

UNIT 3	LAMINATED PLATE THEORY	10

Governing differential equation for a laminate. stress – strain relations for a laminate. different types of laminates and laminate codes. Analysis of a laminate- Impact resistance and interlaminar stresses. Netting analysis.

UNIT 4	FABRICATION PROCESS AND REPAIR METHODS	8

Various open mould and closed mould processes, Manufacture of fibers, importance of composites repair and different types of repair techniques in composites.

UNIT 5	SANDWICH CONSTRUCTIONS	7

Basic design concepts of sandwich construction - materials used for sandwich construction - failure modes of sandwich panels.

COURSE OUTCOMES:

At the end of the course, students will be able to:

CO1: Apply the micromechanics for the analysis of composite materials

CO2: Apply the macromechanics for the analysis of composite materials

CO3: Experiment with the laminated composites for various loading cases

CO4: Demonstrate the manufacturing of composites

CO5: Explain the applications and uses of composites in various fields

L – 45 **T – 0** **P – 0** **TOTAL: 45 PERIODS**

TEXT BOOKS:

1. Howard D. Curtis, "Fundamentals of Aircraft Structural Analysis", McGraw Hill Higher Education Group, 1996.

2. Megson, T.H.G., "Aircraft Structures for Engineering Students", Fifth Edition (Rev.), Butterworth-Heinemann, 2012.

TEXT BOOKS:

1. Autar K Kaw, 'Mechanics of Composite Materials', CRC Press, 2nd edition, 2005.

2. Isaac M. Daniel & Ori Ishai , "Mechanics of Composite Materials," OUP USA publishers, 2nd edition, 2005.

3. Madhujit Mukhopadhyay, Mechanics of Composite Materials and Structures, University Press, 2004

REFERENCES:

1. Agarwal, B.D., and Broutman, L.J., "Analysis and Performance of Fibre Composites," John Wiley & Sons, 3rd edition, July 2006.

2. Allen Baker, Composite Materials for Aircraft Structures, AIAA Series, 2ndEdition, 2004.

3. Calcote, L R. "The Analysis of laminated Composite Structures", Von – Nostrand Reinhold Company, New York 1998.

4. Lubing, Handbook on Advanced Plastics and Fibre Glass, Von Nostran Reinhold Co., New York, 1989.

5. Michael F. Ashley, "Material Selection in Mechanical Design", 5th edition, Butterworth-Heiner, 2016.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CO1	3	3	2	2	2	-	-	-	-	-	2	3	2	2	-
CO2	3	3	3	3	2	-	-	-	-	-	-	3	3	2	-
CO3	3	3	3	2	2	-	-	-	-	-	2	3	2	2	2

CO4	3	3	3	3	2	-	-	-	-	-	2	3	-	-	2
CO5	3	3	3	3	2	-	-	-	-	-	2	3	-	2	2
Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation															

U23AEP22 SDG:4,9	**ADDITIVE MANUFACTURING**	**Category: PEC**			
		L	T	P	C
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

1. Understand the principles and classifications of additive manufacturing (AM) processes.
2. Explore the role of AM in the aerospace and aviation industry.
3. Analyze material selection and design considerations specific to aviation components.
4. Evaluate the integration of AM into the aviation supply chain, including quality assurance and certification standards.
5. Investigate emerging trends, case studies, and future applications of AM in aviation.

UNIT 1	**INTRODUCTION**	**9**

History and evolution of AM, Overview of AM processes (FDM, SLS, SLA, DMLS, EBM, etc.), Comparison with traditional manufacturing, Process chain in AM, Benefits and limitations of AM

UNIT 2	**MATERIALS FOR ADDITIVE MANUFACTURING IN AVIATION**	**9**

Overview of materials used in AM: polymers, metals, and composites, Material properties critical for aerospace applications, Process-material compatibility, Advances in AM powders and feedstock, Material characterization techniques

UNIT 3	**DESIGN FOR ADDITIVE MANUFACTURING**	**9**

DfAM principles and strategies, Topology optimization and generative design, Lightweight structures and lattice designs, CAD tools for AM, Case studies on aviation components

UNIT 4	**AM APPLICATIONS IN AVIATION INDUSTRY**	**9**

Applications of AM in commercial and military aviation, Components: brackets, ducts, engine parts, tooling, Repair and maintenance through AM, Case studies: GE, Boeing, Airbus, NASA, Economic and environmental impact		
UNIT 5	**QUALITY, STANDARDS, AND FUTURE TRENDS**	**9**
Process monitoring and control, Inspection methods: CT scanning, NDT, in-situ monitoring, Certification and regulatory aspects (FAA, EASA), Challenges in AM adoption, Future outlook and research directions		
		45 HOURS

COURSE OUTCOMES:

At the end of the course, students will be able to

CO1: Explain the fundamentals and various types of additive manufacturing technologies.

CO2: Select and justify suitable materials for additive manufacturing of aviation components.

CO3: Apply DfAM concepts to optimize designs for additive manufacturing in aviation.

CO4: Evaluate the real-world applications and benefits of additive manufacturing in the aviation sector.

CO5: Understand and assess the quality control and regulatory requirements for AM components in aviation.

TEXTBOOKS:

1. Additive Manufacturing for the Aerospace Industry, Francis H. Froes, Rodney Boyer, Elsevier, Amsterdam, 2019.
2. Additive Manufacturing in Aerospace: A Game Changer, Parag Kamal, White Falcon Publishing, India, 2023.
3. Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, Ian Gibson, David Rosen, Brent Stucker, Springer, New York, 2021 (Updated Edition).

REFERENCES:

1. Metal Additive Manufacturing for Propulsion Applications, American Institute of Aeronautics and Astronautics (AIAA), Virginia, 2023.
2. Recent Advances in Additive Manufacturing, Volume 1, Ajay Vikram Singh et al., Springer, Singapore, 2024.

3. Handbook of Aerospace Additive Manufacturing, Amit Bandyopadhyay, Susmita Bose, Elsevier, Amsterdam, 2021.

ONLINE COURSES:

1. https://onlinecourses.nptel.ac.in/noc21_me115/preview
2. https://onlinecourses.nptel.ac.in/noc24_me130/preview
3. https://onlinecourses.nptel.ac.in/noc25_mm02/preview

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	1		2	-	-	-	-	1	-	2	3	2	1
CO2	3	3	2	2	2	-	-	-	-	1	-	2	3	2	1
CO3	3	2	3	2	3	-	-	-	-	-	-	2	3	3	2
CO4	3	3	2	3	3	2	2	-	1	1	1	3	3	3	3
CO5	2	2	2	2	2	2	3	2	-	-	1	3	3	2	2

U23AEP23 **SDG: 7,9,13**	**EXPERIMENTAL STRESS ANALYSIS**	**Category: PEC**			
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVE:

1. Be able to understand the various experimental techniques involved for measuring displacements, stresses, strains in structural components.
2. To familiarize with the different types of strain gages used.
3. To familiarize with the instrumentation system used for strain gauges.
4. Be able to use photo elasticity techniques and methods for stress analysis.
5. Be able to familiarize with the different NDT techniques.

UNIT 1	**BASICS OF MECHANICAL MEASUREMENTS**	**9**

Basic Characteristics and Requirements of a Measuring System – Principles of Measurements – Precision, Accuracy, Sensitivity and Range of Measurements – Sources of Error – Statistical Analysis of Experimental Data – Contact Type Mechanical Extensometers – Advantages and disadvantages – Examples of Non -Contact Measurement Techniques.		
UNIT 2	**ELECTRICAL-RESISTANCE STRAIN GAUGES**	**9**
Strain Sensitivity in Metallic Alloys – Gage Construction – Gage Sensitivities and Gage Factor – Corrections for Transverse Strain Effects – Performance Characteristics of Foil Strain Gages – Materials Used for Strain Gauges – Environmental Effects – The Three-Element Rectangular Rosette for Strain Measurement – Other Types of Strain Gages –Brittle Coating Methods of Strain Analysis.		
UNIT 3	**STRAIN-GAUGE CIRCUITS & INSTRUMENTATION**	**9**
The Potentiometer Circuit and Its Application to Strain Measurement – The Wheatstone Bridge Circuit – Current and Constant Voltage Circuits – Analog to Digital Conversion – Calibrating Strain-Gage Circuits– Strain Measurement in Bars, Beams and Shafts – Circuit Sensitivity & Circuit Efficiency.		
UNIT 4	**PHOTOELASTIC METHODS OF STRESS ANALYSIS**	**9**
Introduction to Photo elastic Methods – Stress-Optic Law – Effects of a Stressed Model in a Plane Polariscope – Effects of a Stressed Model in a Circular Polariscope - Tardy Compensation - Two-Dimensional Photo elastic Stress Analysis – Fringe Multiplication and Fringe Sharpening - Materials for Two-Dimensional Photo elasticity – Introduction to Three-Dimensional Photo elasticity.		
UNIT 5	**NON-DESTRUCTIVE TESTING**	**9**
Different types of NDT Techniques - Acoustic Emission Technique – Ultrasonic scanning A,B,C methods – Pulse-Echo – Through Transmission – Eddy Current Testing – Magnetic Particle Inspection – X-Ray Radiography – Challenges in Non-Destructive Evaluation – Non-Destructive Evaluation in Composites.		
COURSE OUTCOMES:		
At the end of the course, students will be able to:		
CO1: Analyse the performance of measuring instrumentation.		
CO2: Impart knowledge on different methods of strain measurement.		
CO3: Design different strain gauge circuits.		
CO4: Use photo elasticity for stress analysis.		
CO5: Exposure the different types of non-destructive testing methods.		

L – 45	**T – 0**	**P – 0**	**TOTAL: 45 PERIODS**

TEXT BOOKS:

1. Dally, J.W., and Riley, W.F., "Experimental Stress Analysis", McGraw Hill Inc., New York 1998.
2. Srinath, L.S., Raghava, M.R., Lingaiah, K., Garagesha, G., Pant B., and Ramachandra, K., "Experimental Stress Analysis", Tata McGraw Hill, New Delhi, 1984.
3. Sadhu Singh, "Experimental Stress Analysis", Khanna Publishers, New Delhi, 1996.

REFERENCES:

1. Albert S. Kobayashi,' Handbook on Experimental Mechanics, Prentice HallPublishers,2008.
2. Durelli, A.J.Applied Stress Analysis, Prentice Hall of India Pvt Ltd., New Delhi, 1970.
3. Hetenyi, M., Hand book of Experimental Stress Analysis, John Wiley and Sons Inc.,New York, 1972.
4. James F. Doyle and James W. Phillips, 'Manual on Experimental Stress Analysis',5thEdition, 1989.
5. Ramesh, K., Digital Photoelasticity, Springer, New York, 2000.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CO1	3	3	2	2	2	-	-	-	-	-	2	3	2	2	-
CO2	3	3	3	3	2	-	-	-	-	-	-	3	3	2	-
CO3	3	3	3	2	2	-	-	-	-	-	2	3	2	2	2
CO4	3	3	3	3	2	-	-	-	-	-	2	3	-	-	2
CO5	3	3	3	3	2	-	-	-	-	-	2	3	-	2	2

U23AE24 **SDG: 7,9,13**	**FATIGUE AND FRACTURE MECHANICS**	**Category: PEC**			
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

1. To learn about mathematical and principles of facture mechanics.
2. To impart the knowledge about the fundamental source of failure of mechanical components.
3. To make students understand the fatigue design curve approaches and limitations.

4. To make the students learn the characterization of variables in cyclic loads.
5. To expand student's knowledge on testing of the material for the fatigue failure

UNIT 1	**FATIGUE OF STRUCTURES**	**9**

S.N. curves - Endurance limits - Effect of mean stress, Goodman, Gerber and Soderberg relations and diagrams - Notches and stress concentrations - Neuber's stress concentration factors - Plastic stress concentration factors - Notched S.N. curves – Fatigue of composite materials.

UNIT 2	**STATISTICAL ASPECTS OF FATIGUE BEHAVIOUR**	**9**

Low cycle and high cycle fatigue - Coffin - Manson's relation - Transition life - cyclic strain hardening and softening - Analysis of load histories - Cycle counting techniques -Cumulative damage - Miner's theory - Other theories.

UNIT 3	**PHYSICAL ASPECTS OF FATIGUE**	**9**

Phase in fatigue life - Crack initiation - Crack growth - Final Fracture - Dislocations - fatigue fracture Surfaces.

UNIT 4	**FRACTURE MECHANICS**	**9**

Potential energy and surface energy - Griffith's theory - Irwin - Orwin extension of Griffith's theory to ductile materials - stress analysis of "cracked bodies - Effect of thickness on fracture toughness" - stress intensity factors for typical 'geometries.

UNIT 5	**FATIGUE DESIGN AND TESTING**	**9**

Safe life and Fail-safe design philosophies - Importance of Fracture Mechanics in aerospace structures - Application to composite materials and structures.

COURSE OUTCOMES:

At the end of the course, students will be able to:

CO1: Apply the mathematical knowledge to define fatigue behaviours of the materials

CO2: Identify the causes for the fatigue failure of the materials.

CO3: Ability to analyse the fracture due to fatigue

CO4: Select the testing method for the fatigue failure prediction of the materials.

CO5: Solve the causes of the crack initiation & its growth.

L – 45 **T – 0** **P – 0** **TOTAL: 45 PERIODS**

TEXT BOOKS:

1. Barrois W, Ripely, E.L., “Fatigue of aircraft structure," Pergamon press. Oxford, 1983.
2. Prasanth Kumar, "Elements of fracture mechanics", Wheeter publication, 1999.

REFERENCES:

1. Kare Hellan ,’Introduction to Fracture Mechanics’, McGraw Hill, Singapore,1985
2. Knott, J.F., “Fundamentals of Fracture Mechanics,” - Buterworth & Co., Ltd., London, 1983.
3. Sih C.G., “Mechanics of fracture.” Vol - I, Sijthoff and w Noordhoff International Publishing Co., Netherlands, 1989.

CO’s-PO’s & PSO’s MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CO1	3	3	2	2	2	-	-	-	-	-	2	3	2	2	-
CO2	3	3	3	3	2	-	-	-	-	-	-	3	3	2	-
CO3	3	3	3	2	2	-	-	-	-	-	2	3	2	2	2
CO4	3	3	3	3	2	-	-	-	-	-	2	3	-	-	2
CO5	3	3	3	3	2	-	-	-	-	-	2	3	-	2	2

U23AEP25 **SDG: 7,9,13**	**AEROSPACE MATERIALS**	**Category: PEC**			
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

1. To understand the elements of aerospace materials, mechanical behaviour of materials, ceramics and composites.
2. To explain the theory, concepts, principles and governing equations of solid mechanics.
3. To analyse the stresses in simple structures as used in the aerospace industry.
4. To learn the concepts of corrosion and heat treatment.
5. To acquire knowledge in high temperature materials and characterization.

UNIT 1	**ELEMENTS OF AEROSPACE MATERIALS**	**9**

Structure of solid materials – Atomic structure of materials – Crystal structure – Miller indices – Density – Packing factor – Space lattices – X-ray diffraction – Imperfection in crystals – general requirements of materials for aerospace applications.		
UNIT 2	**MECHANICAL BEHAVIOUR OF MATERIALS**	**9**
Linear and non-linear elastic properties – Yielding, strain hardening, fracture, Bauchinger's effect – Notch effect testing and flaw detection of materials and components – Comparative study of metals, ceramics plastics and composites.		
UNIT 3	**CORROSION & HEAT TREATMENT OF METALS AND ALLOYS**	**9**
Types of corrosion –Effect of corrosion on mechanical properties – Stress corrosion cracking –Corrosion resistance materials used for space vehicles. Heat treatment of carbon steels – aluminium alloys, magnesium alloys and titanium alloys – Effect of alloying treatment, heat resistance alloys –tool and die steels, magnetic alloys, powder metallurgy.		
UNIT 4	**CERAMICS AND COMPOSITES**	**9**
Introduction – physical metallurgy – modern ceramic materials – cermet - cutting tools – glass ceramic – production of semi-fabricated forms - Plastics and rubber – Carbon/Carbon composites, Fabrication processes involved in metal matrix composites - shape memory alloys – applications in aerospace vehicle design.		
UNIT 5	**HIGH TEMPERATURE MATERIALS & CHARACTERIZATION**	**9**
Classification, production and characteristics – Methods and testing – Determination of mechanical and thermal properties of materials at elevated temperatures – Application of these materials in Thermal protection systems of Aerospace vehicles – super alloys.		

COURSE OUTCOMES:

At the end of the course, students will be able to:

CO1: Understand the advanced concepts of aerospace materials.

CO2: Describe the necessary mathematical knowledge that are needed in understanding their significance and operation.

CO3: Explain various topics such as elements of aerospace materials, mechanical behaviour of materials, ceramics and composites.

CO4: Deploy the skills effectively in the understanding of aerospace materials.

CO5: Characterize high temperature materials.

L – 45 **T – 0** **P – 0** **TOTAL: 45 PERIODS**

TEXT BOOKS:

1. Martin, J.W., "Engineering Materials, Their properties and Applications", Wykedham Publications (London) Ltd, 1987.
2. Titterton.G., "Aircraft Materials and Processes", 5th Ed., Pitman Publishing Co., 1998.

REFERENCES:

1. Raghavan.V., "Materials Science and Engineering", Prentice Hall of India, 5th Ed., 2011.
2. Van Vlack.L.H., "Materials Science for Engineers", Addison Wesley, 1985.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CO1	3	3	2	2	2	-	-	-	-	-	2	3	2	2	-
CO2	3	3	3	3	2	-	-	-	-	-	-	3	3	2	-
CO3	3	3	3	2	2	-	-	-	-	-	2	3	2	2	2
CO4	3	3	3	3	2	-	-	-	-	-	2	3	-	-	2
CO5	3	3	3	3	2	-	-	-	-	-	2	3	-	2	2

U23AEP26 SDG:4,9	SMART MATERIALS IN AEROSPACE	Category: PEC			
		L	T	P	C
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

1. To introduce the fundamentals and classifications of smart materials relevant to aerospace applications.
2. To explore the functionality, integration, and control of smart materials in adaptive aerospace systems.
3. To familiarize students with modern aerospace systems using piezoelectric, shape memory, and magnetostrictive materials.

UNIT 1	**Introduction to Smart Materials**	**9**

Definition and need for smart materials in aerospace, Classification: Passive, active, multifunctional, Functional requirements and aerospace environments, Microstructure–property relationships, Role in performance enhancement and weight reduction

UNIT 2	**PIEZOELECTRIC AND ELECTROSTRICTIVE MATERIALS**	**9**

Piezoelectric effect: Direct and inverse, PVDF, PZT, and advanced ceramics, Actuation and sensing principles, Electrostriction in polymers, Aerospace applications: vibration control, sensors, morphing structures

UNIT 3	**SHAPE MEMORY ALLOYS (SMAS) AND POLYMERS**	**9**

Mechanism of shape memory effect, NiTi alloys: phase transformation and hysteresis, Shape memory polymers: comparison and use, Actuation mechanisms and limitations, Applications in morphing wings, self-healing systems

UNIT 4	**MAGNETOSTRICTIVE, ELECTROCHROMIC, AND OPTICAL MATERIALS**	**9**

Magnetostriction and Terfenol-D, Electrochromic materials for smart windows, Fiber optic sensors and strain sensing, Applications in aircraft structural health monitoring (SHM), Signal processing and integration

UNIT 5	**INTEGRATED SMART AEROSPACE SYSTEMS**	**9**

Smart skins, embedded sensors, and actuators, Vibration and noise control using smart materials,

Adaptive flight control surfaces, Case studies: F-18 wing panels, Boeing morphing wings, Future trends: nanomaterials, bioinspired materials, AI-based SHM
45 HOURS

COURSE OUTCOMES:

At the end of the course, students will be able to

CO1: Describe the types, properties, and significance of smart materials in aerospace systems.

CO2: Explain the working principles of piezoelectric and electrostrictive materials in sensing and actuation.

CO3: Analyze the behavior and applications of shape memory alloys and polymers in aerospace structures.

CO4: Evaluate the use of magnetostrictive, electrochromic, and fiber optic materials for structural health monitoring.

CO5: Assess integrated smart systems in aircraft, such as morphing wings, vibration control, and adaptive structures.

TEXTBOOKS:

1. Culshaw, B. (2022). Smart Structures and Materials (2nd Ed.). Artech House. ISBN: 9781630818062
2. Gandhi, M. V., & Thompson, B. S. (2021). Smart Materials and Structures. Springer. ISBN: 9783030657652

REFERENCES:

1. Rogers, C. A. (2020). Intelligent Materials and Structures: Current Developments and Applications. SPIE Press.
2. Dano, M. L. (2022). Shape Memory Alloys and Polymers for Aerospace Applications. Woodhead Publishing.
3. Aydin, M. (2022). Smart Materials for Aerospace Applications. Elsevier.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3

CO1	3	-	1	-	-	-	-	-	2	2		1	2	1	1
CO2	3	2	3	2	-	-	-	-	2	2	1	2	3	2	-
CO3	3	3	3	2	-	-	-	-	3	2	1	2	3	3	2
CO4	3	2	3	3	2	-	-	-	3	3	1	2	3	3	3
CO5	3	2	3	3	3	1	1	2	3	3	2	3	3	3	3

VERTICAL 3: PROPULSION AND HEAT TRANSFER

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	U23AEP31	Heat Transfer	PEC	3	0	0	3	3
2.	U23AEP32	Rocket Propulsion	PEC	3	0	0	3	3
3.	U23AEP33	Advanced Propulsion Systems	PEC	3	0	0	3	3
4.	U23AEP34	Design of Gas Turbine Engine Components	PEC	3	0	0	3	3
5.	U23AEP35	Cryogenic Engineering	PEC	3	0	0	3	3
6.	U23AEP36	Rockets and Missiles	PEC	3	0	0	3	3

U23AEP31 SDG: 9	HEAT TRANSFER	Category : PEC			
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

1. To introduce the fundamental principles and modes of heat transfer.
2. To develop analytical and problem-solving skills in steady and unsteady heat conduction.
3. To impart understanding of convective heat transfer mechanisms and their applications.
4. To provide knowledge of radiative heat transfer and surface energy exchange.
5. To expose students to practical applications like boiling, condensation, and heat exchangers.

UNIT 1	INTRODUCTION	9

Introduction to heat transfer – Modes of heat transfer: Conduction, Convection, and Radiation – Basic laws of thermodynamics relevant to heat transfer – Applications of heat transfer in engineering systems – Thermal conductivity and thermal diffusivity – Overview of dimensionless numbers.

UNIT 2	HEAT CONDUCTION	9

Fourier's law of heat conduction – Steady-state one-dimensional heat conduction in plane wall, cylinder, and sphere – Composite wall analysis – Thermal resistance and overall heat transfer coefficient – Critical radius of insulation – Heat generation in solids – Unsteady (transient) conduction – Lumped system analysis – Heisler and Grober charts – Numerical methods for conduction.

UNIT 3	CONVECTION HEAT TRANSFER	9

Basic concepts of convection – Newton's law of cooling – Free (natural) and forced convection – Laminar and turbulent flow in internal and external configurations – Thermal and hydrodynamic boundary layers – Dimensional analysis and important non-dimensional numbers (Re, Pr, Gr, Nu) – Empirical correlations for convective heat transfer – Heat exchangers: classification, LMTD and NTU methods

UNIT 4	RADIATION HEAT TRANSFER	9

Fundamentals of radiation – Nature and properties of thermal radiation – Blackbody and graybody concepts – Emissivity, absorptivity, reflectivity – Stefan–Boltzmann law, Planck's law, Wien's displacement law – Kirchhoff's law – View factor and its algebra – Radiation heat exchange between surfaces – Radiation shields and network analysis.

UNIT 5	**HEAT TRANSFER APPLICATIONS**	**9**

Boiling and condensation heat transfer – Pool boiling and film boiling regimes – Dropwise and filmwise condensation – Heat pipes – Extended surfaces (fins): types, efficiency, and effectiveness – Cooling of electronic devices – Heat transfer in refrigeration and air conditioning systems – Introduction to modern tools (MATLAB, ANSYS) for thermal system simulation – Case studies.

COURSE OUTCOMES:

At the end of the course, students would

CO1: Understand the basic modes of heat transfer and apply governing laws.

CO2: Analyze 1D and transient conduction in various geometries and materials.

CO3: Evaluate convective heat transfer in internal and external flows.

CO4: Apply radiation principles to compute energy exchange between surfaces.

CO5: Solve real-world thermal problems involving heat exchangers and phase change.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Holman, J.P., Heat Transfer, McGraw-Hill Education, 10th Edition, 2010.

2. Cengel, Y.A. and A.J. Ghajar, Heat and Mass Transfer: Fundamentals and Applications, McGraw-Hill, 5th Edition, 2015.

3. Incropera, F.P. and D.P. DeWitt, Fundamentals of Heat and Mass Transfer, Wiley, 7th Edition, 2011.

4. Nag, P.K., Heat and Mass Transfer, McGraw-Hill Education, 3rd Edition, 2011.

REFERENCES:

1. Sachdeva, R.C., Fundamentals of Engineering Heat and Mass Transfer, New Age International, 4th Edition, 2010.

2. Arpaci, V.S. and Larsen, P.S., Convection Heat Transfer, Prentice Hall, 1984.

3. Ozisik, M.N., Heat Transfer – A Basic Approach, McGraw-Hill, 1985.

4. Kreith, F. and Bohn, M.S., Principles of Heat Transfer, Cengage Learning, 7th Edition, 2010.

5. NPTEL course: Heat Transfer, IIT Kharagpur https://nptel.ac.in/courses/103105140

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2	PSO 3

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CO3	3	3	2	2	3	-	-	-	-	-	-	-	3	-	-
CO4	3	3		2	2	-	-	-	-	-	-	-	3	-	-
CO5	3	3	3	2	3	-	-	-	-	-	-	-	3	-	-

U23AEP32 **SDG:9,13**	**ROCKET PROPULSION**	**Category : PEC**			
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVE:

1.To make students Understand rocket performance parameters and internal ballistics.

2.To impart knowledge to students on Describe solid propellants, grain configurations, and combustion behaviour.

3.To learn the concepts of Apply concepts of liquid propulsion systems and thrust chamber design.

4.To learn the concepts of Analyse hybrid rocket combustion and performance.

5.To expose the students on the Evaluate multi-staging techniques and performance optimization.

6.To expose the students on the Design and assess rocket steering and control methods.

UNIT 1	**INTERNAL BALLISTICS OF ROCKETS**	**9**

Reaction principle – Rocket performance parameters – specific impulse – Schematic diagrams of olid, liquid and hybrid rocket propulsion systems – Equilibrium chamber pressure – Thrust equation, Characteristic velocity and thrust coefficient – Rocket performance assessment

UNIT 2	**SOLID ROCKET PROPULSION**	**9**

Selection criteria of solid propellants – Types of solid propellants – Propellant ingredients – Solid propellant regression rate and factors influencing the regression rate – Solid propellant grain configurations – Progressive, regressive and neutral burning of grains- Solid rocket igniters – Basics of solid propellant combustion and combustion instability – Erosive burning

UNIT 3	**LIQUID ROCKET PROPULSION**	**9**

Types of liquid propellant combinations – Gas pressure and turbopump fed pressurization systems for liquid propellant rockets – Liquid rocket injectors and water testing – Liquid rocket cooling methods – Basic aspects of thrust chamber design - Thrust control — Cryogenic rocket engines – Propellant slosh

UNIT 4	**HYBRID ROCKET PROPULSION**	**9**

Standard and reverse hybrid systems – Combustion mechanism in hybrid rockets –Limitations and applications of hybrid rockets – Solid grain configurations in hybrid rockets-Solid grain regression rate behavior along the grain length - Local regression rate estimation – Material combinations for hybrid rocket propellants- Estimation of hybrid rocket performance.

UNIT 5	**STAGING AND STEERING OF ROCKETS**	**9**

Need for multi-staging of rocket vehicles – different types of multi-staging - staging optimization methods – estimation of staging performance – stage separation methods in atmosphere and in space -steering methods for rockets – aerodynamic control-based steering –jet control-based steering – thrust vector control methods.

COURSE OUTCOMES:

At the end of the course, students would

CO1: Understand the principles of rocket propulsion and performance parameters.

CO2: Explain solid propellant types, grain configurations, and combustion behavior.

CO3: Apply concepts of liquid propulsion systems and thrust control methods.

CO4: Analyze hybrid rocket systems, combustion mechanisms, and performance.

CO5: Evaluate staging methods and optimize multi-stage rocket performance.

CO6: Assess and compare various rocket steering and control techniques.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. David H. Heiser and David T. Pratt., “Hypersonic Air breathing Propulsion”, AIAA Education Series, 1999
2. Mathur, M.L. and Sharma, R.P., “Gas Turbine, Jet and Rocket Propulsion”, Standard Publishers & Distributors, Delhi, 2nd edition 2014.
3. Sutton, G.P., “Rocket Propulsion Elements”, John Wiley & Sons; 8th Edition 2010.

REFERENCES:

01. Martin J. Chiaverini and Kenneth K. Kuo, “Fundamentals of Hybrid Rocket Combustion and Propulsion”, Progress in Astronautics and Aeronautics, 2007.

02. Ramamurthi K, "Rocket Propulsion", Macmillian publishers India Ltd, 1st edition, 2010.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CO1	3	2	2	1	2	1	-	-	-	1	-	1	2	1	-
CO2	3	2	1	1	2	1	-	-	-	1	-	1	2	1	-
CO3	3	2	1	1	2	1	-	-	-	1	-	1	2	1	-
CO4	3	2	1	1	2	1	-	-	-	1	-	1	2	1	-
CO5	2	1	1	-	1	1	-	-	-	-	-	1	2	1	-
CO6	2	2	3	2	3	2	-	-	-	-	3	3	3	3	3

U23AEP33 **SDG:7,9,11,13**	**ADVANCED PROPULSION SYSTEMS**	**Category: PEC**			
		L	T	P	C
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

1. To Understand the fundamental concepts of space propulsion.
2. Analyze the performance physics of ionized gases.
3. Evaluate the types of nuclear rockets and the basic concepts of nuclear propulsion systems.
4. Apply theoretical knowledge in radioisotope propulsion.
5. To realise the importance of advanced space propulsion concepts.

UNIT 1	**INTRODUCTION TO SPACE PROPULSION SYSTEMS**	**9**

Historical outline, Scramjet Propulsion-Scramjet Inlets; Scramjet Performance, Chemical rocket Propulsion-Tripropellants; Metalized Propellants; Free Radical Propulsion, Electric Propulsion, Micro propulsion - Micro Propulsion Requirements, MEMS and MEMS- Hybrid Propulsion Systems.

UNIT 2	**BASIC CONCEPTS OF IONIZED GASES**	**9**

Electromagnetic theory: electric charges and fields, currents, and magnetic fields, and applications to ionized gases. Atomic structure of gases - Ionization processes - Particle collisions in an ionized gas – Electrical conductivity of an ionized gas.

UNIT 3	**NUCLEAR ROCKET PROPULSION**	**9**

Nuclear Rocket Engine Design and Performance, Types of Nuclear Rockets, Overall Engine Design, Nuclear Rocket Performance, Component Design, Nuclear Rocket Reactors, General Design Considerations, Reactor Core Materials, Thermal Design, Mechanical Design, Nuclear Design, Shielding, Nuclear Rocket Nozzles.

UNIT 4	**RADIOISOTOPE PROPULSION**	**9**

Alternative Approaches, Direct Recoil Method, Thermal Heating Method, Basic Thruster Configurations, Propulsion System and Upper Stage, Relative Mission Capabilities, Primary Propulsion, Auxiliary Propulsion, Thruster Technology, Design Criteria, Performance, Safety, Heat Source Development, Radioisotope Fuel, Capsule Technology, General Considerations, Thermal Design, Fabrication and Non-Destructive Testing Techniques, Pressure Containment, Heat Source Simulation, Oxidation and Corrosion of Encapsulating Materials, Nozzle Performance.

UNIT 5	**ADVANCED SPACE PROPULSION CONCEPTS**	**9**

Introduction, General Consideration for Propulsion in Space, Power Supply, Propellant Storage and Handling Facilities, Electrostatic and Electromagnetic Thrusters, Advanced Electric Propulsion Systems for Space Vehicles, Sputtering, A Thrust Generation Mechanism, Sputtering Phenomena, Possible Performance of Sputtering Thrusters, Energy Efficiency of the Sputtering Process, Analyses of an Elementary Mission with Different Electric Thrusters, General Consideration, Performance Formula for Electric Thrusters, Optimization with Electric Thrusters

45 HOURS

COURSE OUTCOMES:

At the end of the course, students will be able to

CO1: Understand the basics and classification of space propulsion

CO2: Develop interest in the physics of ionized gases, their theories and particle collisions

CO3: Apply basic knowledge on the working, types and performance of nuclear rockets with their design considerations.

CO4: Develop the radioisotope propulsion with their performance studies

CO5: Create advanced methods of space propulsion systems with new thrust generation mechanisms.

TEXTBOOKS:

1. Czysz, Paul A., Bruno, Claudio, Chudoba, Bernd "Future Spacecraft Propulsion Systems and Integration", Springer, Praxis Publishing Ltd, 2018.
2. George W. Sutton, "Engineering Magneto hydrodynamics", Dover Publications Inc., New York, 2006.
3. George P. Sutton & Oscar Biblarz, "Rocket Propulsion Elements, John Wiley & Sons Inc., NewYork, 9th Edition, 2016.

REFERENCES:

1. Martin Tajmar, "Advanced Space Propulsion Systems" Springer Verlag GmbH, 2003.
2. Robert G. Jahn, "Physics of Electric Propulsion", McGraw-Hill Series, New York, 1968.
3. William J. Emrich, "Principles of Nuclear Rocket Propulsion" Elsevier Science, 2016.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	1	2	1	-	-	-	1	-	1	2	1	-
CO2	3	2	1	1	2	1	-	-	-	1	-	1	2	1	-
CO3	3	2	1	1	2	1	-	-	-	1	-	1	2	1	-
CO4	3	2	1	1	2	1	-	-	-	1	-	1	2	1	-
CO5	2	1	1	1	1	1	-	-	-	-	-	1	2	1	-

U23AEP34 SDG: 4,9,11	DESIGN OF GAS TURBINE ENGINE COMPONENTS	Category: PEC			
		L	T	P	C
		3	0	3	3

COURSE OBJECTIVE:

1. To understand the thermodynamic principles and operating cycle of gas turbine engines.
2. To analyze and design the individual components of gas turbine engines including compressors, combustors, turbines, and nozzles.
3. To evaluate the performance of gas turbine engines and optimize component interactions.
4. To understand the auxiliary systems and materials used in gas turbines.

UNIT 1	**INTRODUCTION**	**9**
Types of intakes – Intake performance – Axial and centrifugal compressors – Velocity triangles – Stage performance – Blade design – Cascade analysis – Compressor matching.		
UNIT 2	**INTAKE AND COMPRESSOR DESIGN**	**9**
Types of intakes – Intake performance – Axial and centrifugal compressors – Velocity triangles – Stage performance – Blade design – Cascade analysis – Compressor matching.		
UNIT 3	**COMBUSTOR DESIGN**	**9**
Combustion principles – Types of combustors – Flame stability – Combustion efficiency – Emissions – Cooling techniques – Liner materials and design.		
UNIT 4	**TURBINE DESIGN**	**9**
Turbine types – Velocity triangles – Stage loading and efficiency – Cooling of turbine blades – Blade materials – Losses – Turbine-compressor-power matching.		
UNIT 5	**NOZZLES AND ACCESSORIES**	**9**
Convergent and convergent-divergent nozzles – Afterburners – Thrust vectoring – Accessories: fuel system, lubrication, starting, and ignition systems – Engine materials and thermal barrier coatings.		

COURSE OUTCOMES:

At the end of the course, students would,

CO1: Understand gas turbine engine cycle and performance metrics.

CO2: Design and analyze axial/centrifugal compressors and turbines.

CO3: Evaluate combustion chamber performance and emission characteristics.

CO4: Perform nozzle analysis and integrate with afterburners.

CO5: Analyze overall engine operation, component matching, and accessory systems.

L – 45	**T – 0**	**P – 0**	**TOTAL: 45**

TEXT BOOKS:

1. Mattingly, J.D., Heiser, W.H., and Pratt, D.T., Aircraft Engine Design, AIAA Education Series, 3rd Edition, 2022.
2. Hill, P.G., and Peterson, C.R., Mechanics and Thermodynamics of Propulsion, Pearson, 2nd Edition, 2009.
3. Cohen, H., Rogers, G.F.C., and Saravanamuttoo, H.I.H., Gas Turbine Theory, Pearson Education, 7th Edition, 2017.

REFERENCES:

1. Lefebvre, A.H., and Ballal, D.R., Gas Turbine Combustion, CRC Press, 3rd Edition, 2020.
2. Walsh, P.P., and Fletcher, P., Gas Turbine Performance, Wiley-Blackwell, 3rd Edition, 2018.
3. El-Sayed, Ahmed, Fundamentals of Aircraft and Rocket Propulsion, Springer, 2017.
4. Cumpsty, N., and Heyes, A., Jet Propulsion, Cambridge University Press, 3rd Edition, 2015.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CO1	2	1	1	2	2	-	-	-	-	1	1	1	3	2	1
CO2	3	2	1	2	3	-	-	-	-	1	1	1	3	2	1
CO3	3	2	1	2	3	-	-	-	-	1	1	2	3	1	1
CO4	3	2	1	2	3	-	-	-	-	1	1	1	3	2	1
CO5	3	3	2	2	3	-	-	-	-	1	1	2	3	2	1

U23AEP35 **SDG: 7,9,13**	**CRYOGENIC ENGINEERING**	**Category: PEC**			
		L	**T**	**P**	**C**
		3	**0**	**3**	**3**

COURSE OBJECTIVE:

1. To understand the principles and applications of cryogenic systems and processes.
2. To study various methods of gas liquefaction and separation.
3. To analyze cryogenic insulation and storage systems.

4. To understand the behavior of cryogenic fluids and materials at low temperatures.
5. To explore cryogenic applications in aerospace, medicine, and industry.

UNIT 1	**INTRODUCTION TO CRYOGENICS**	9

Definition and importance of cryogenics – Applications in aerospace, medical, space, and industrial sectors – Low temperature properties of materials – Specific heat, thermal conductivity, compressibility, expansion and strength at cryogenic temperatures.

UNIT 2	**LIQUEFACTION SYSTEMS**	9

Production of low temperatures – Joule Thomson effect – Adiabatic expansion – Liquefaction of permanent gases – Linde, Claude, Heylandt, Kapitza, and Helium liquefaction systems – Efficiency and performance analysis.

UNIT 3	**GAS SEPARATION AND PURIFICATION**	9

Principles of gas separation – Air separation – Rectification column – Adsorption systems – Cryogenic distillation – Purification methods.

UNIT 4	**CRYOGENIC COMPONENTS AND SYSTEMS**	9

Cryogenic storage vessels – Transfer lines – Insulation types – Multilayer, Vacuum, and Foam insulations – Cryogenic instrumentation – Level, pressure, and flow measurement at low temperatures.

UNIT 5	**APPLICATIONS AND SAFETY IN CRYOGENICS**	9

Cryogenic applications in aerospace (propulsion, fuel storage), medical (MRI, cryosurgery), and industrial systems – Cryogenic safety – Hazards – Handling procedures – Codes and standards.

COURSE OUTCOMES:

At the end of the course, students would,

CO1: Understand the principles and importance of cryogenics and material behavior at low temperatures.

CO2: Analyze and compare different gas liquefaction systems.

CO3: Explain the operation of gas separation and purification methods.

CO4: Design and evaluate cryogenic insulation, storage, and instrumentation systems.

CO5: Apply cryogenic technologies in aerospace and industrial systems with emphasis on safety.

L – 45 T – 0 P – 0 TOTAL: 45 PERIODS

TEXT BOOKS:

1. Barron, R.F., *Cryogenic Systems*, Oxford University Press, 3rd Edition, 2023.
2. Timmerhaus, K.D. and Flynn, T.M., *Cryogenic Process Engineering*, Springer, 2nd Edition, 2021.
3. Bhatia, P.K., *Fundamentals of Cryogenic Engineering*, Khanna Publishing, Latest Edition, 2020.
4. Flynn, T.M., *Cryogenic Engineering*, CRC Press, Reprint Edition, 2021.

REFERENCES:

1. Scott, R.B., Cryogenic Engineering, Van Nostrand Reinhold, Reprint Edition, 2022.
2. Eliezer, S., and Eliezer, Y., The Fourth State of Matter: An Introduction to Plasma Science, CRC Press, 2020.
3. Yunus A. Çengel, Thermodynamics: An Engineering Approach (with Cryogenic Applications), McGraw-Hill, 9th Edition, 2021.
4. Valery V. Kostionok, Low Temperature and Cryogenic Refrigeration, Springer, 1st Edition, 2023.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CO1	2	1	2	2	2	-	-	-	-	1	1	1	3	2	1
CO2	3	2	2	3	3	-	-	-	-	1	1	1	3	2	1
CO3	3	2	2	2	3	-	-	-	-	1	1	2	3	2	1
CO4	3	2	2	3	3	-	-	-	-	1	1	1	3	2	1
CO5	3	3	2	3	3	-	-	-	-	1	1	2	3	2	1

U23AEP36 **SDG:4,9,13**	**ROCKETS AND MISSILES**	**Category: PEC**			
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVE:

1. Provide an understanding of the classification and characteristics of various rockets and missiles used in aerospace and defense.
2. Explain rocket motion and trajectory calculations in space and gravitational environments.
3. Introduce aerodynamic behavior and propulsion technologies in rockets and missiles.
4. Develop an understanding of multistage vehicles, thrust vector control, and staging dynamics.
5. Familiarize with the materials used in rockets and missiles under extreme operating conditions.

UNIT 1	**CLASSIFICATION OF ROCKETS AND MISSILES**	**9**

Various methods of classification of missiles and rockets – Basic aerodynamic characteristics of surface to surface, surface to air, air to surface and air to air missiles – Examples of various Indian space launch vehicles and missiles – Current status of Indian rocket programme with respect to international scenario.

UNIT 2	**ROCKET MOTION IN SPACE AND GRAVITATIONAL**	**10**

One Dimensional and Two-Dimensional rocket Motions in Free Space and Homogeneous Gravitational Fields – description of Vertical, Inclined and Gravity Turn Trajectories –Determination of range and Altitude Simple Approximations to Burnout Velocity and altitude-estimation of culmination time and altitude.

UNIT 3	**AERODYNAMICS AND PROPULSION OF ROCKETS AND**	**12**

Airframe Components of Rockets and Missiles – Forces Acting on a Missile While Passing Through Atmosphere –methods of Describing Aerodynamic Forces and Moments – Lateral Aerodynamic Moment – Lateral Damping Moment and Longitudinal Moment of a Rocket – lift and Drag Forces – Drag Estimation- Ignition System in rockets – types of Igniters – Igniter Design Considerations – Design Consideration of liquid Rocket Combustion Chamber– Elimination of Geysering Effect in Missiles –Combustion System of Solid Rockets.

UNIT 4	**STAGING AND CONTROL OF ROCKETS AND MISSILES**	**9**

Rocket Vector Control – Methods – Thrust determination – SITVC – Multistaging of rockets – Vehicle Optimization – Stage Separation Dynamics – Separation Techniques.

UNIT 5	**MATERIALS FOR ROCKETS AND MISSILES**	**5**

Selection of Materials - Special Requirements of Materials to Perform under Adverse Conditions.

COURSE OUTCOMES:

At the end of the course, students would

CO1: Classify rockets and missiles and describe examples including Indian launch vehicles.

CO2: Analyze one-dimensional and two-dimensional rocket motion in space and gravity fields.

CO3: Describe aerodynamic forces and propulsion systems in rockets and missiles.

CO4: Evaluate vector control methods and multistage rocket configurations.

CO5: Identify appropriate materials and their role in rocket and missile performance.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Sutton, G.P., et al., "Rocket Propulsion Elements", John Wiley & Sons Inc., New York,2017.
2. A. Bowdoin Van Riper,"Rockets and Missiles".,Greenwood Publication,2004.
3. Vinh, N.X, A. Busemann, and R. D Culp, 'Hypersonic and Planetary Entry Flight Mechanics', University of Michigan Press, Ann Arbor, 2013.

REFERENCES:

1. Cornelisse, J.W., "Rocket Propulsion and Space Dynamics", J.W., Freeman & Co. Ltd., London, 1982.
2. Parket, E.R., "Materials for Missiles and Spacecraft", McGraw-Hill Book Co. Inc., 1982.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	1	3	-	-
CO2	3	3	2	2	-	-	-	-	-	-	-	2	3	-	-
CO3	3	3	3	2	2	-	-	-	-	-	-	2	3	2	-
CO4	3	2	3	2	-	-	-	-	-	-	-	2	3	2	-
CO5	2	-	-	-	2	3	3	-	-	-	-	2	2	-	-

VERTICAL 4: COMPUTATIONAL ENGINEERING

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	U23AEP41	Numerical Methods in Fluid Dynamics	PEC	3	0	0	3	3
2.	U23AEP42	Computational Fluid Dynamics	PEC	3	0	0	3	3
3.	U23AEP43	Computer-Aided Design and Analysis	PEC	3	0	0	3	3
4.	U23AEP44	Finite Element Methods	PEC	3	0	0	3	3
5.	U23AEP45	Computational Heat Transfer	PEC	3	0	0	3	3
6.	U23AEP46	Turbulence Modeling	PEC	3	0	0	3	3

U23AEP41 SDG:4,9	NUMERICAL METHODS IN FLUID DYNAMICS	Category: PEC			
		L	T	P	C
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

1. Understand the complexity of general fluid dynamic equations in partial differential form in the mathematical nature of the equations.
2. Develop various complexity of general fluid dynamic equations under different flow conditions
3. Explore the stability on the basic aspects of finite differences and finite volume Methods
4. To impart knowledge to students on the basic aspects of finite element methods
5. To expose the students on obtaining solutions for a set of a large number of algebraic equations using the panel methods

UNIT 1	**MATHEMATICAL NATURE OF FLUID DYNAMIC EQUATIONS**	**9**

Governing equations of fluid dynamics and modelling of fluid flow – Eulerian and Lagrangian approaches – Mathematical nature of fluid dynamic equations – Classification of partial differential equations – General behavior of different classes of fluid dynamic equations.

UNIT 2	**BOUNDARY CONDITIONS**	**9**

Importance of boundary conditions in obtaining the numerical solution of fluid dynamic equations- Types of boundary conditions- Boundary conditions for momentum equations for viscous and inviscid flows – Boundary conditions for energy equation for different flow conditions – Practical examples – Symmetry and cyclic boundary conditions

UNIT 3	**INTRODUCTION TO FDM, FVM AND FEM**	**9**

Introduction to finite difference, finite volume and finite element methods and their areas of application-A brief description of implementing methodologies for finite difference method, finite volume method and finite element method – Illustration of the methods using simple one-dimensional fluid dynamic problems – Advantages and limitations of these methods

UNIT 4	**PANEL METHODS**	**9**

A brief description of source, sink and vortex flows – Application of panel methods – Methodology involved in implementing panel methods – Source panel method and its implementation - Solution methods for solving a set of large number of algebraic equations and their applications for panel methods.		
UNIT 5	**NUMERICAL METHODS FOR STEADY SUPERSONIC**	**9**
Two dimensional irrotational flow – Method of characteristics – Numerical methodology to obtain solution using method of characteristics for supersonic inviscid flows – Supersonic nozzle design using method of characteristics – Application of method of characteristics for axisymmetric irrotational flows – Description of Mc. Cormack's Predictor-corrector technique – Shock capturing and shock fitting techniques		
		45 HOURS

COURSE OUTCOMES:

At the end of the course, students will be able to

CO1: Understand the importance of numerical methods in finding solutions to complex engineering-flow problems

CO2: Develop interest in lifelong learning on numerical methods and apply the knowledge for the solution of aerospace related fluid dynamic problems

CO3: Acquire basic knowledge to learn modern engineering tools such as CFD software tools to solve and analyse the flow fields over the airplanes

CO4: Apply skills to develop algorithms for the solutions of supersonic flow problems pertaining to aerospace field

CO5: Create new computational techniques in computational methods such as FVM using the imparted knowledge

TEXTBOOKS:

1. Fletcher C.A.J. , "Computational Techniques for Fluid Dynamics 1" Springer Verlag, 1996.

REFERENCES:

1. Chung T. J., "Computational Fluid Dynamics", Cambridge University Press; 2nd edition, 2010.

2. Hirsch C., "Numerical Computation of Internal and External Flows" Volume-2, John Wiley and Sons, 1994.

3. Joel H. Ferziger & Milovan Peric, "Computational Methods for Fluid Dynamics" Springer; 3rd edition 2002.
4. John F Wendt , "Computational Fluid Dynamics – An Introduction", 3rd Edition, Springer-Verlag, Berlin Heidelberg, 2009.
5. Versteeg H.K. and Malalsekera W. "An Introduction to Computational Fluid Dynamics, The Finite Volume Method", PHI; 2nd edition 2007.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2	2	-	-	-	-	-	-	-	2	1	-
CO2	3	3	2	1	-	-	-	-	-	-	2	2	3	1	-
CO3	3	2	2	1	2	-	-	-	-	-	-	-	3	1	-
CO4	2	1	1	2	3	-	-	-	-	-	2	-	-	-	1
CO5	3	2	2	2	3	-	-	-	-	-	-	-	-	2	1

U23AEP42	**COMPUTATIONAL FLUID DYNAMICS**	**Category: PEC**			
SDG:		**L**	**T**	**P**	**C**
7,9,12,13		**3**	**0**	**0**	**3**

COURSE OBJECTIVE:

1. To introduce the fundamental concepts of Computational Fluid Dynamics (CFD).
2. To derive and discretize basic governing equations of fluid flow and heat transfer.
3. To expose students to numerical methods for solving partial differential equations.
4. To apply CFD techniques to practical engineering problems using modern tools.

UNIT 1	**INTRODUCTION TO CFD**	**9**

Basics of fluid dynamics – Governing equations – Continuity, momentum, and energy equations – General formulation and classification of PDEs – Physical and mathematical models.

UNIT 2	**DISCRETIZATION TECHNIQUES**	**9**

Finite difference method – Taylor series expansion – Central, forward, and backward differencing – Finite volume method – Integral and differential forms of conservation equations.

UNIT 3	**GRID GENERATION AND SOLUTION TECHNIQUES**	**9**

Structured and unstructured grids – Grid quality – Coordinate transformation – Solution of linear algebraic equations – Gauss elimination, Gauss-Seidel, and TDMA methods.

UNIT 4	**CONVECTION AND DIFFUSION MODELLING**	**9**

Steady one-dimensional convection and diffusion – Upwind, central differencing schemes – QUICK scheme – Boundary conditions – Consistency, stability, and convergence.

UNIT 5	**APPLICATIONS OF CFD**	**9**

Flow over flat plate, airfoil, and cylinder – Internal flows – Heat transfer in ducts – Introduction to turbulence modelling – Case studies using CFD software.

COURSE OUTCOMES:

At the end of the course, students would,

CO1: Understand the governing equations of fluid flow and heat transfer.

CO2: Apply discretization techniques to develop numerical models.

CO3: Generate computational grids and solve discretized equations.

CO4: Implement CFD techniques to solve flow and heat transfer problems.

CO5: Analyze flow and thermal characteristics using commercial CFD tools.

L – 45 **T – 0** **P – 0** **TOTAL: 45 PERIODS**

TEXT BOOKS:

1. Versteeg, H.K., and Malalasekera, W., An Introduction to Computational Fluid Dynamics: The Finite Volume Method, Pearson Education, 3rd Edition, 2022.
2. Muralidhar, K., and Sundararajan, T., Computational Fluid Flow and Heat Transfer, Narosa Publishing, 4th Edition, 2023.
3. Ferziger, J.H., Perić, M., and Street, R.L., Computational Methods for Fluid Dynamics, Springer, 5th Edition, 2021.

4. Blazek, J., Computational Fluid Dynamics: Principles and Applications, Elsevier, 3rd Edition, 2020.

REFERENCES:

1. Anderson, J.D., Computational Fluid Dynamics: The Basics with Applications, McGraw-Hill, Reprint 2023.
2. Tu, J., Yeoh, G.H., and Liu, C., Computational Fluid Dynamics: A Practical Approach, Butterworth-Heinemann, 4th Edition, 2023.
3. Patankar, S.V., Numerical Heat Transfer and Fluid Flow, CRC Press, Reprint 2022.
4. Tannehill, J.C., Anderson, D.A., and Pletcher, R.H., Computational Fluid Mechanics and Heat Transfer, Taylor & Francis, 4th Edition, 2020.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	2	2	2	3	-	-	-	-	1	1	1	3	2	1
CO2	3	3	2	3	3	-	-	-	-	1	1	2	3	2	2
CO3	3	3	3	3	3	-	-	-	-	1	1	2	3	2	2
CO4	3	3	3	3	3	-	-	-	-	1	2	3	3	3	2
CO5	3	3	3	3	3	-	-	-	-	2	2	3	3	3	3

U23AEP43 SDG:4,9	**COMPUTER AIDED DESIGN AND ANALYSIS**	**Category: PEC**			
		L	T	P	C
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

1. Understand the fundamentals of computer-aided design (CAD) and analysis tools.
2. Apply solid modeling techniques to create 3D models and assemblies.
3. Analyze engineering components using simulation tools like Finite Element Analysis (FEA).
4. Design engineering solutions integrating CAD and analysis tools.

UNIT 1	**INTRODUCTION**	**9**

Introduction to CAD – Geometric Modelling: Introduction – types of geometric modelling – wire frame – surface and solid modelling. Wireframe entities – types of curves and its mathematical representation - line- circle- ellipse parabola- Cubic spline- Bezier and B-spline (Only Basic treatment). Solid modelling entities - Solid modelling techniques- CSG and BREP - Operations performed in CSG and BREP - Extrude- sweep - linear and Nonlinear- revolve		
UNIT 2	**GRAPHIC CONCEPTS (2D and 3D)**	**9**
Transformations - translation- scaling- reflection- rotation. Concatenated transformation. Inverse transformation. Hidden line removal - Z-Buffer algorithm- brief description of shading and colour rendering techniques. Manipulation and editing of entities - selection methods – dragging - clipping trimming- stretching- offsetting- pattern- copying- deleting - regenerating- measuring.		
UNIT 3	**SOFTWARE PACKAGES AND RECENT TECHNOLOGY**	**9**
All about popular commercial solid modelling packages — their salient features- technical comparison- modules and Tools available- brief outline of Data exchange standards. Brief outline of feature technology - classification of features- design by features- applications of features- its advantages- and limitations		
UNIT 4	**FUNDAMENTALS**	**9**
Introduction to finite element method - principle- Steps involved in FEA - nodes- element and their types- shape function-constraints, forces and nodal displacements-stiffness matrix- solution techniques.		
UNIT 5	**ANALYSIS**	**9**
Stages of FEA in a CAD environment - Pre-processor- solver and postprocessor. Pre-processing -FEA modelling - geometry generation- node generation- element generation- boundary constraintsload constraints- - mesh generation and refining. Solving - performing the actual analysis. Post processing - Types of 0/P available- interpretation of results.		
		45 HOURS

COURSE OUTCOMES:

At the end of the course, students will be able to

CO1: Understand the views and read engineering drawings.

CO2: Identify various techniques for drawing solid components using 2D/3D software.

CO3: Analyze the solid models created in computer.

CO4: Design and Compare the relation between 2D drafting and 3D models.

CO5: Create the graphical models for further engineering applications.

TEXTBOOKS:

1. Chairs Mcmahon and Jimmie Browne, "CAD / CAM: Principles, Practice and Manufacturing Management", Prentice Hall, 2nd Ed., 1999.
2. Ibrahim Zoid., "CAD / CAM", Theory and Practice, TMH, 2001.
3. Radhakrishnan, P., "CAD / CAM / CIM", New Age International, 2000.

REFERENCES:

1. Chandupatla and Bolagundu., "Introduction to Finite Element Methods in Engineering", Pearson Education India, 4th Ed., 2015.

2. Mikell P. Groover, "CAD/CAM: Computer-Aided Design and Manufacturing", PHI, 2003.

3. Newman and Sproull, R.F., "Principles of interactive Computer Graphics", TMH,1997.r.5. Versteeg H.K. and Malalsekera W. "An Introduction to Computational Fluid Dynamics, The Finite Volume Method", PHI; 2nd edition 2007.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2	2	-	-	-	-	-	-	-	2	1	-
CO2	3	3	2	1	-	-	-	-	-	-	2	2	3	1	-
CO3	3	2	2	1	2	-	-	-	-	-	-	-	3	1	-
CO4	2	1	1	2	3	-	-	-	-	-	2	-	-	-	1
CO5	3	2	2	2	3	-	-	-	-	-	-	-	-	2	1

U23AEP44 **SDG-9,7,11**	**FINITE ELEMENT METHOD**	**Category : PEC**			
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVE:

- To give exposure various methods of solution and in particular the finite element method. Gives exposure to the formulation and the procedure of the finite element method and its application to varieties of problems.

UNIT 1	**INTRODUCTION**	**9**
Review of various approximate methods – Rayleigh Ritz's, Galerkin and finite difference methods – Governing equation and convergence criteria of finite element method.		
UNIT 2	**DISCRETE ELEMENTS**	**9**
Bar element with uniform section and varying section – Mechanical and thermal loading – Truss analysis – Beam element – Problems for various loading and boundary conditions – Use of local and natural coordinates.		
UNIT 3	**CONTINUUM ELEMENT**	**9**
Plane stress, Plane strain and axisymmetric problems – Constant strain Triangular elements Stiffness matrix - Introduction to Linear strain triangular element – Axisymmetric load vector.		
UNIT 4	**ISOPARAMETRIC ELEMENT**	**9**
Introduction to isoparametric elements – Shape function for 4, 8 and 9 nodal quadrilateral elements – Stiffness matrix and consistent load vector – Gaussian Integration.		
UNIT 5	**FIELD PROBLEMS**	**9**
One dimensional Heat transfer problems – Steady state heat transfer in fin – Derivation of element matrices for two dimensional problems – Torsion problems. formulation to 3 D problems in stress analysis, convergence requirements, Mesh generation. techniques such as semi-automatic and fully Automatic use of softwares such as		

COURSE OUTCOMES:

At the end of the course, students would

CO1: Identify the mathematical model for simple and complex engineering problems using FEM approach.

CO2: Calculate stress, strain, and displacement value of simple 1-D problems.

CO3: Solve complex axisymmetric problems under various boundary conditions.

CO4: Apply finite element concept to Isoperimetric Element.

CO5: Analyse heat transfer and torsional problems.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Finite Element Methods: Basic Concepts and applications/Alavala/PHI
2. Introduction to Finite Elements in Engineering, Chandrupatla, Ashok and Belegundu /Pearson

REFERENCES:

1. An Introduction to the Finite Element Method / J. N. Reddy/ Mc Graw Hill
2. Finite Element Analysis / SS Bhavikatti / New Age
3. Finite Element Method/ Dixit/Cengage

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CO1	3	3	2	2	2	-	-	-	-	-	-	3	3	1	1
CO2	3	3	2	2	2	-	-	-	-	-	-	3	3	1	1
CO3	3	2	2	2	2	-	-	-	-	-	-	3	3	1	1
CO4	3	2	2	2	2	-	-	-	-	-	-	3	3	1	1
CO5	3	3	2	2	2	-	-	-	-	-	-	3	3	1	1

U23AEP45 **SDG: 7,9,12**	**COMPUTATIONAL HEAT TRANSFER**	**Category: PEC**			
		L	**T**	**P**	**C**
		3	**0**	**3**	**3**

COURSE OBJECTIVE:

1. To introduce the fundamental principles of heat transfer with a computational perspective.
2. To apply numerical techniques for solving conduction, convection, and radiation problems.
3. To expose students to stability, convergence, and discretization schemes.
4. To enable students to model and simulate heat transfer in complex systems using computational tools.

UNIT 1	**INTRODUCTION**	**9**

Review of heat transfer equations – Classification of PDEs – Boundary and initial conditions – Introduction to numerical methods – Error analysis – Taylor series.

UNIT 2	**NUMERICAL HEAT CONDUCTION**	**9**
One and two-dimensional steady and unsteady heat conduction – Explicit and implicit methods – Crank-Nicolson scheme – ADI method – Stability and convergence analysis.		
UNIT 3	**NUMERICAL CONVECTION**	**9**
Governing equations for convection – Upwind, central differencing and hybrid schemes – Stream function-vorticity formulation – SIMPLE algorithm for pressure-velocity coupling.		
UNIT 4	**NUMERICAL RADIATION HEAT TRANSFER**	**9**
Radiative heat transfer equation – Radiation properties – View factor calculations – Discrete transfer method – Monte Carlo method – Radiation in participating media.		
UNIT 5	**APPLICATIONS USING CFD TOOLS**	**9**
Case studies on conduction, convection, and radiation problems using commercial CFD software – Validation and verification – post-processing and visualization.		

COURSE OUTCOMES:

At the end of the course, students would,

CO1: Understand heat transfer principles and numerical formulation of thermal problems.

CO2: Solve conduction and convection problems using finite difference and volume methods.

CO3: Analyze radiative heat transfer using numerical techniques.

CO4: Implement computational algorithms for thermal systems.

CO5: Apply commercial tools to simulate real-world heat transfer problems.

L – 45 **T – 0** **P – 0** **TOTAL: 45 PERIODS**

TEXT BOOKS:

1. Jaluria, Y., ‘Computer Methods for Engineering with MATLAB Applications’, Taylor & Francis, 2nd Edition, 2021.

2. Patankar, S.V., ‘Numerical Heat Transfer and Fluid Flow’, CRC Press, Reprint 2022.

3. Minkowycz, W.J., Sparrow, E.M., and Murthy, J.Y., ‘Handbook of Numerical Heat Transfer’, Wiley, 3rd Edition, 2020.

4. Muralidhar, K. and Sundararajan, T., ‘Computational Heat Transfer’, Narosa Publishing House, 4th Edition, 2023.

REFERENCES:

1. Versteeg, H.K., and Malalasekera, W., 'An Introduction to Computational Fluid Dynamics: The Finite Volume Method', Pearson Education, 3rd Edition, 2022.
2. Incropera, F.P., and DeWitt, D.P., 'Fundamentals of Heat and Mass Transfer', Wiley, 8th Edition, 2023.
3. Tu, J., Yeoh, G.H., and Liu, C., 'Computational Fluid Dynamics: A Practical Approach', Elsevier, 4th Edition, 2023.
4. Anderson, J.D., 'Computational Heat Transfer and Fluid Flow', McGraw-Hill, Reprint 2022.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CO1	3	3	2	2	2	-	-	-	-	1	1	1	3	2	1
CO2	3	3	3	2	3	-	-	-	-	1	1	2	3	2	2
CO3	3	3	3	2	3	-	-	-	-	1	1	2	3	2	2
CO4	3	3	3	3	3	-	-	-	-	1	1	2	3	2	2
CO5	3	3	3	3	3	-	-	-	-	1	1	2	3	3	3

U23AEP46 **SDG:7,9,11,13**	**TURBULANCE MODELING**	**Category: PEC**			
		L	T	P	C
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

1. To introduce the fundamental concepts and governing equations of turbulent flows.
2. To equip students with knowledge of turbulence modeling strategies used in Computational Fluid Dynamics (CFD).
3. To prepare students for practical modeling of turbulence in aerospace applications like wings, jets, and boundary layers.

UNIT 1	**FUNDAMENTALS OF TURBULENCE**	**9**

Nature and origin of turbulence, Statistical description: mean, fluctuations, PDFs, Types of turbulent flows (free shear, wall-bounded), Coherent structures in turbulence, Relevance in aerospace (boundary layers, wake turbulence)		
UNIT 2	**GOVERNING EQUATIONS AND RANS MODELING**	**9**
Reynolds decomposition, Derivation of RANS equations, Reynolds stresses and closure problem, Boussinesq approximation, Eddy viscosity concept		
UNIT 3	**TURBULENCE MODELS**	**9**
Algebraic models: Mixing length, Baldwin-Lomax, One-equation models: Spalart-Allmaras, Two-equation models: k–ε, k–ω, SST, Near-wall modeling and wall functions, Applications in external aerodynamics		
UNIT 4	**TURBULENCE IN CFD TOOLS**	**9**
Implementing turbulence models in CFD solvers, Boundary conditions and mesh requirements, Grid independence for turbulent flows, CFD case studies (airfoils, diffusers, pipes)		
UNIT 5	**ADVANCED TURBULENCE MODELING**	**9**
Limitations of RANS, Large Eddy Simulation (LES): filtering, sub-grid scale modeling, Direct Numerical Simulation (DNS): feasibility and limitations, Hybrid models (DES, DDES), Future directions in turbulence modeling		
		45 HOURS

COURSE OUTCOMES:

At the end of the course, students will be able to

CO1 Explain the physical characteristics of turbulent flows and identify their significance in aerodynamics.

CO2 Derive and interpret Reynolds-averaged Navier-Stokes (RANS) equations and turbulent stress models.

CO3 Compare various turbulence models (zero-equation, one-equation, and two-equation models) and their applicability.

CO4 Apply turbulence models in CFD software for aerospace applications.

CO5 Evaluate turbulence modeling results and understand advanced models such as LES and DNS.

TEXTBOOKS:

1. Wilcox, D. C. (2006). Turbulence Modeling for CFD (3rd ed.). DCW Industries.
2. Pope, S. B. (2000). Turbulent Flows. Cambridge University Press.

REFERENCES:

1. Versteeg, H. K., & Malalasekera, W. (2007). An Introduction to Computational Fluid Dynamics (2nd ed.). Pearson.
2. Schlichting, H., & Gersten, K. (2016). Boundary Layer Theory (9th ed.). Springer.
3. Ferziger, J. H., Perić, M., & Street, R. L. (2020). Computational Methods for Fluid Dynamics (4th ed.). Springer.

ONLINE COURSES:

1. https://nptel.ac.in/courses/101106060
2. https://www.ansys.com/resourceenter#t=ResourceCenterTab&sort=relevancy&numberOfResults=50

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	1	-	-	-	-	-	-	-	-	-	3	2	-
CO2	3	3	2	2	-	-	-	-	-	-	-	-	3	2	-
CO3	3	3	3	2	-	-	-	-	1	1	-	1	3	2	-
CO4	3	3	3	3	2	-	-	-	2	2	1	1	3	3	2
CO5	3	3	2	3	2	-	-	-	2	2	1	2	3	3	3

VERTICAL 5: AVIONICS AND CONTROL SYSTEMS

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	U23AEP51	Air Traffic Control	PEC	3	0	0	3	3
2.	U23AEP52	Navigation and Communications Systems	PEC	3	0	0	3	3
3.	U23AEP53	Control Engineering	PEC	3	0	0	3	3
4.	U23AEP54	Avionics	PEC	3	0	0	3	3
5.	U23AEP55	Design of UAV Systems	PEC	3	0	0	3	3
6.	U23AEP56	Flight Control Systems	PEC	3	0	0	3	3

U23AEP51 SDG: 4,9	AIR TRAFFIC CONTROL	Category: PEC			
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To study the procedure of the formation of aerodrome and its design and air traffic control.

UNIT 1	BASIC CONCEPTS	9

Objectives of air traffic control systems - Parts of ATC services – Scope and Provision of ATCs – VFR& IFR operations Classification of ATS air spaces – Various kinds of separation – Altimeter setting procedures – Establishment, designation and identification of units providing ATS – Division of responsibility of control.

UNIT 2	AIR TRAFFIC SYSTEMS	9

Area control service, assignment of cruising levels - minimum flight altitude - ATS routes and significant points – RNAV and RNP – Vertical, lateral, and longitudinal separations based on time /distance –ATC clearances – Flight plans – position report. Automatic Dependent Surveillance Broadcast (ADS-B).

UNIT 3	FLIGHT INFORMATION SYSTEMS	9

Radar service, Basic radar terminology – Identification procedures using primary / secondary radar – performance checks – use of radar in area and approach control services – assurance control and coordination between radar / non radar control – emergencies – Flight information and advisory service – Alerting service – Co-ordination and emergency procedures – Rules of the air.

UNIT 4	AERODROME DATA	9

Aerodrome data - Basic terminology – Aerodrome reference code – Aerodrome reference point –Aerodrome elevation – Aerodrome reference temperature – Instrument runway, physical Characteristics; length of primary / secondary runway – Width of runways – Minimum distance between parallel runways etc. – obstacles restriction.

UNIT 5	NAVIGATION AND OTHER SERVICES	9

Visual aids for navigation Wind direction indicator – Landing direction indicator – Location and characteristics of signal area – Markings, general requirements – Various markings – Lights, general requirements – Aerodrome beacon, identification beacon – Simple approach lighting system and various lighting systems – VASI & PAPI - Visual aids for denoting obstacles; object to be marked and lighter – Emergency and other services.

TOTAL HOURS	45

COURSE OUTCOMES:

At the end of the course, Students would,

CO1: Understanding the Objective and requirement of air traffic control systems

CO2: Knowledge about types of air traffic control system.

CO3: Knowledge in flight information systems and rules of air traffic systems.

CO4: Knowledge about aerodrome related data's

CO5: Knowledge indirection indicator systems for air navigation.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. AIP (India) Vol. I & II, "The English Book Store", 17-1, Connaught Circus, New Delhi.
2. "PANS – RAC – ICAO DOC 4444", Latest Edition, The English Book Store, 17-1,Connaught Place, New Delhi.

REFERENCES:

1. Agarwal, B.D., and Broutman, L.J., "ATCP" John Wiley & Sons, 3rd edition, July 2006.

2. Allen Baker, ATCP, AIAA Series, 2ndEdition, 2004.

3. Calcote, L R. "The Analysis of traffic control", Von – Nostrand Reinhold Company, New York 1998

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	1	1	-	-	-	1	1	1	1	3	2	1
CO2	3	2	2	1	2	-	-	-	1	1	1	1	3	2	1
CO3	3	2	2	1	2	-	-	-	1	1	1	1	3	2	1

CO4	3	2	2	1	2	-	-	-	1	1	1	1	3	2	1
CO5	3	2	2	-	2	2	2	1	1	1	1	1	3	2	1

U23AEP52 **SDG-4**	**NAVIGATION AND COMMUNICATION SYSTEM**	**Category : PEC**			
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVE:

1. To introduce various types of navigation systems.
2. To understand the dead reckoning navigation system and its error correction.
3. To know satellite navigation and hybrid navigation system integration
4. To learn the concepts of radio transmitters and receivers
5. To acquire knowledge about weather radar systems and DME

UNIT 1	**INERTIAL NAVIGATION SYSTEMS**	**9**

Introduction to navigation – Types -INS components- transfer function and errors - Earth in inertial space - Coriolis Effect – INS Mechanization. Platform and Strap down – Navigation algorithms - INS system block diagram, Different co-ordinate systems – Transformation Techniques - Schuler Tuning – compensation errors - Gimbal lock - Initial calibration and Alignment Algorithms

UNIT 2	**RADIO NAVIATION & SATELLITE NAVIGATION**	**9**

Different types of radio navigation- ADF, VOR, DME - Doppler – Hyperbolic Navigations -LORAN, DECCA and Omega – TACAN. Introduction to GPS -system description -basic principles -position and velocity determination signal Structure -DGPS, Introduction to Kalman filtering-Estimation and mixed mode navigation Integration of GPS and INS-utilization of navigation systems in aircraft.

UNIT 3	**RADIO TRANSMITTERS AND RECEIVERS**	**9**

Functions of a Radio transmitter, Microphones, types, Block diagram explanation of a Radio transmitter, Modulation and its types and Antenna, Antenna couplers, Qualities of a good Radio receiver, Block diagram of a simple radio receiver and super heterodyne receive

UNIT 4	**AIRCRAFT COMMUNICATION SYSTEMS**	**9**

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 5	**WEATHER RADAR SYSTEM AND DME**	**9**

Introduction, Description and types of Radar, Primary and Secondary Radar, Weather Radar Description, Analog radar Principal units of Analog radar system. Aircraft weather radar, transmitter-receiver, Indicator, Control panel, Antenna, Radome and wave guide. Radome maintenance and radar safety.

COURSE OUTCOMES:

At the end of the course,

CO1. Students will understand the advanced concepts of Aircraft Navigation

CO2.To provide the necessary mathematical knowledge those are needed in modeling the navigation process and methods. CO3.The students will have an exposure on various Navigation systems such as Inertial Measurement systems, Radio Navigation Systems, Satellite Navigation – GPS.

CO4.Landing aids and will be able to deploy these skills effectively in the analysis and understanding of navigation systems in an aircraft.

CO5. Learn and apply the principles of Radar and its related components.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Aircraft Electricity and electronics by Thomas K Eismin (Fifth edition-1994, McGraw- Hill Book Co)

REFERENCES:

1. 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)

CO's-PO's & PSO's MAPPING

CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO3**
CO1	2	2	3	3	2	2	2	2	1	3	1	2	3	1	1
CO2	3	3	3	2	2	1	1	1	1	1	3	1	3	1	1

CO3	3	2	2	2	2	1	2	3	2	1	2	2	3	1	1
CO4	3	3	3	3	-	-	1	2	1	1	3	1	1	3	1
CO5	3	3	2	2	2	1	1	1	2	3	1	2	3	1	1

U23AEP53 **SDG 4,9**	**CONTROL ENGINEERING**	**Category : PEC**			
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVE:

1. To learn how to model control systems and study how they behave using basic tools in both time and frequency domains.
2. To understand what makes a system stable and learn different ways to check stability.
3. To get introduced to digital (sampled) control systems used in modern technology.
4. To learn the concept of stability through practical examples and simple methods.
5. To understand how digital controllers work and how to design them using tools like MATLAB and Simulink.

UNIT 1	**Introduction to Control Systems**	**9**

Historical review of control systems – Open loop and closed loop systems – Mathematical modeling of mechanical, electrical, thermal, pneumatic and hydraulic systems – Series and parallel systems – Analogies between mechanical and electrical systems – Transfer function – Block diagram representation and reduction – Introduction to MATLAB and Simulink

UNIT 2	**Time Domain Analysis**	**9**

Standard test signals – Time response of first and second order systems – Time domain specifications – Steady-state error – Error constants – Concept of stability – Routh-Hurwitz stability criterion – Root locus technique – Construction and analysis using root locus

UNIT 3	**Frequency Domain Analysis**	**9**

Frequency response analysis – Bode plots – Polar plots – Nyquist plots – Gain margin and phase margin – Stability in frequency domain – Nyquist stability criterion – Design specifications in frequency domain – MATLAB-based frequency analysis

UNIT 4	**Sampled Data and Digital Control Systems**	**9**
Sampling and reconstruction – Discrete-time signals and systems – Z-transform and inverse Z-transform – Modeling of digital control systems – Stability using Jury's test – Introduction to digital controllers – Use of microcontrollers and Arduino in control systems		
UNIT 5	**Controller Design and Modern Applications**	**9**
Introduction to P, PI, PD and PID controllers – Tuning of PID controllers – Implementation using MATLAB/Simulink – Adaptive and predictive control (overview) – Applications in robotics, automation and smart systems – Case studies		

COURSE OUTCOMES:

At the end of the course, students would

CO1: Understand the fundamentals of control systems and develop mathematical models for physical systems using appropriate analogies.

CO2: Analyze time domain specifications and assess the performance and stability of control systems using standard techniques.

CO3: Interpret frequency response characteristics and apply Bode, Nyquist, and polar plots to evaluate system stability and performance.

CO4: Examine the behavior of discrete-time control systems using Z-transform and assess their stability using Jury's test.

CO5: Design and tune PID controllers and implement them using modern tools like MATLAB/Simulink for real-time and practical applications.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Nagrath, I.J. and M. Gopal, Control Systems Engineering, New Age International Publishers, 5th Edition, 2009.
2. Ogata, K., Modern Control Engineering, Pearson Education, 5th Edition, 2010.
3. Nise, N.S., Control Systems Engineering, John Wiley & Sons, 6th Edition, 2011.
4. Kuo, B.C. and F. Golnaraghi, Automatic Control Systems, McGraw-Hill Education, 9th Edition, 2009.

REFERENCES:

1. Azzo, J.J.D. and C.H. Houpis, Feedback Control System Analysis and Synthesis, McGraw-Hill International, 3rd Edition, 1998.

2. Gopal, M., Digital Control and State Variable Methods, McGraw-Hill Education, 4th Edition, 2012.

3. Dorf, R.C. and R.H. Bishop, Modern Control Systems, Pearson Education, 12th Edition, 2011.

4. Sivanagaraju, S. and S. Satyanarayana, Control Systems, Pearson Education, 1st Edition, 2010.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2	PSO 3
CO1	3	2	-	-	2	-	-	-	-	-	-	-	1	-	-
CO2	3	3	-	-	3	-	-	-	-	-	-	-	1	-	-
CO3	3	3	-	-	3	-	-	-	-	-	-	-	1	-	-
CO4	3	3	-	2	3	-	-	-	-	-	-	-	1	-	-
CO5	2	3	3	2	3	-	-	-	-	-	-	-	1	-	-

U23AEP54 SDG 4,9	**AVIONICS**	**Category: PEC**			
		L	**T**	**P**	**C**
		3	0	0	3

COURSE OBJECTIVE:

1. To learn about the subsystems of avionics systems.
2. To impart knowledge about the avionic architecture and various avionics data buses
3. To gain more knowledge on display technology and aircraft data entry system
4. To learn about the different types of navigation systems used in aviation.
5. • To gain knowledge about the software assessment and autopilot.

UNIT 1	**INTRODUCTION TO AVIONICS**	**9**

Need for avionics in civil and military aircraft – integrated avionics and weapon systems – typical avionics

subsystems, Avionics top down design approach – Introduction to Microprocessor and memories, Overview of Avionics in Rafale fighter jet.		
UNIT 2	**DIGITAL AVIONICS ARCHITECTURE**	**9**
Avionics system architecture – data buses – MIL-STD-1553B – ARINC – 429 – ARINC – 629 .		
UNIT	**FLIGHT DECKS AND COCKPITS**	**9**
Control and display technologies: CRT, LED, LCD– Touch screen – Direct voice input (DVI) – Civil and Military Cockpits: MFDS, HUD, HMD, HDD, MFK, HOTAS.		
UNIT	**INTRODUCTION TO NAVIGATION SYSTEMS**	**9**
Radio navigation – VOR/DME, Hyperbolic navigation-LORAN and OMEGA, Landing system-ILS, MLS, Inertial Navigation Systems (INS)– Satellite navigation systems – GPS.		
UNIT	**SOFTWARE ASSESSMENT AND AUTO PILOT**	**9**
Fault tolerant systems -Software Assessment and Validation -Civil and Military standards - Certification of Civil Avionics. Auto pilot – Basic principles, Longitudinal and lateral auto pilot, A320 fly-by-wire system detailed case study.		
	TOTAL HOURS	**45**

COURSE OUTCOMES:

At the end of the course, Students would,

CO1: Students will be able to explain the basic principles of avionics systems.

CO2: Be able to learn the principle of digital avionics systems.

CO3: Able to know the practical and working of flight deck equipment.

CO4: Identify the different types of navigation systems and their applications.

CO5: Students will be able to analyze the performance of autopilot systems.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Collinson. R.P.G. "Introduction to Avionics", Chapman and Hall, 1996.
2. Spitzer, C.R. "Digital Avionics Systems", Prentice-Hall, Englewood Cliffs, N.J., U.S.A. 1993.

REFERENCES:

1. Albert Helfrick.D., "Principles of Avionics", Avionics Communications Inc., 2004.
2. Spitzer. C.R. "The Avionics Hand Book", CRC Press, 2000.
3. Pallet.E.H.J., "Aircraft Instruments and Integrated Systems", Longman Scientific.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	2	1	2	1	1	1	2	2	2	2	3	2	2
CO2	2	2	2	1	3	1	1	1	2	2	2	2	3	2	3
CO3	2	2	3	1	3	2	1	1	2	3	2	2	2	3	3
CO4	2	2	2	2	3	1	1	1	2	2	2	2	3	2	3
CO5	2	2	2	2	3	1	1	1	2	2	2	2	3	3	3

U23AEP55 **SDG-4,9,11,13**	**DESIGN OF UAV SYSTEMS**	**Category : PEC**			
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVE:

1. To expose students to concepts needed in modelling and analysing an unmanned system.
2. To expose students to the design and development of UAV.
3. To expose students to the type of payloads used in UAV.
4. To study path planning
5. To understand the avionics hardware used in the UAV

UNIT 1	**INTRODUCTION TO UAV**	**9**

History of UAV –classification – Introduction to Unmanned Aircraft Systems--models and prototypes System Composition-applications

UNIT 2	**THE DESIGN OF UAV SYSTEMS**	**9**

Introduction to Design and Selection of the System- Aerodynamics and Airframe Configurations- Characteristics of Aircraft Types- Design Standards and Regulatory Aspects-UK,USA and Europe-

Design for Stealth--control surfaces-specifications.		
UNIT 3	**AVIONICS HARDWARE**	**9**
Autopilot — AGL-pressure sensors-servos-accelerometer –gyros-actuators- power supply- processor, integration, installation, configuration, and testing		
UNIT 4	**COMMUNICATION PAYLOADS AND CONTROLS**	**9**
Payloads-Telemetry-tracking-Aerial photography-controls-PID feedback-radio control frequency range –modems-memory system-simulation-ground test-analysis-trouble shooting		
UNIT 5	**THE DEVELOPMENT OF UAV SYSTEMS**	**9**
Waypoints navigation-ground control software- System Ground Testing- System In-flight Testing- Future Prospects and Challenges-Case Studies – Mini and Micro UAVs.		

COURSE OUTCOMES:

At the end of the course, students would

CO1: Design UAV system

CO2: Explain UAV design principles, configurations, and regulatory standards.

CO3: Demonstrate the use of avionics hardware in UAV integration and testing..

CO4: Determine the natural frequency and damping ratio of phugoid and short period motions.

CO5: Analyze UAV communication systems, payloads, and control mechanisms.

CO6: Design solutions for mini/micro UAVs considering current trends and challenges

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Paul G Fahlstrom, Thomas J Gleason, “Introduction to UAV Systems”, UAV Systems, Inc, 1998
2. Reg Austin “Unmanned Aircraft Systems UAV design, development and deployment”, Wiley, 2010.

REFERENCES:

1. Dr. Armand J. Chaput, “Design of Unmanned Air Vehicle Systems”, Lockheed Martin Aeronautics Company, 2001
2. Kimon P. Valavanis, “Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy”, Springer, 2007
3. Robert C. Nelson, Flight Stability and Automatic Control, McGraw-Hill, Inc, 1998.

CO’s-PO’s & PSO’s MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CO1	3	1	1	2	-	-	-	-	-	-	-	1	1	-	-
CO2	2	-	-	-	-	1	-	-	-	-	-	-	2	-	-
CO3	2	3	1	-	-	1	-	-	-	-	-	1	1	1	-
CO4	3	2	-	-	-	1	1	-	-	-	-	-	1	1	-
CO5	2	-	1	1	3	-	-	-	1	-	-	1	-	-	-
CO6	2	2	3	2	3	2	-	-	-	-	3	3	3	3	3

U23AEP56 **SDG: 7,9**	**FLIGHT CONTROL SYSTEMS**	**Category: PEC**			
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVE:

1. To understand the basic purpose and types of flight control systems used in aircraft.
2. To learn about different control surfaces and how they help in controlling the aircraft.
3. To study various actuation systems and how automatic flight control systems work.
4. To know about modern fly-by-wire systems and their role in today's aircraft.

UNIT 1	**INTRODUCTION TO FLIGHT CONTROL SYSTEMS**	**9**

Purpose of flight control systems – Primary and secondary flight controls – Conventional systems – Hydraulic, mechanical, and manual flight control systems – Introduction to fly-by-wire systems.

UNIT 2	**CONTROL SURFACE DESIGN AND EFFECTIVENESS**	**9**

Types of control surfaces – Ailerons, elevators, rudders – Aerodynamic balancing – Control surface sizing – Hinge moments – High-lift devices and their control.

UNIT 3	**ACTUATION SYSTEMS**	**9**

Types of actuators – Mechanical, hydraulic, electro-hydraulic, and electro-mechanical actuators – Servo mechanisms – Redundancy – Power control units – Feedback systems in actuators.

UNIT 4	**AUTOMATIC FLIGHT CONTROL SYSTEMS**	**9**

Stability augmentation systems – Control augmentation systems – Autopilot – Flight director systems – Yaw dampers – Mach trim – Load alleviation – System architecture.

UNIT 5	**FLY-BY-WIRE SYSTEMS AND MODERN TRENDS**	**9**

Principles of fly-by-wire – Components – Signal transmission and redundancy – Digital flight control systems – Examples from modern aircraft – Future trends in flight control systems.

COURSE OUTCOMES:

At the end of the course, students would,

CO1: Understand the fundamentals of flight control system architecture and functions.

CO2: Analyze the design and effectiveness of various aircraft control surfaces.

CO3: Demonstrate knowledge of different actuation systems and their integration in aircraft.

CO4: Evaluate the working principles of automatic flight control and stability augmentation systems.

CO5: Assess the architecture and applications of fly-by-wire and advanced digital control systems.

L – 45 **T – 0** **P – 0** **TOTAL: 45 PERIODS**

TEXT BOOKS:

1. Blake, W.B., *Flight Control Systems*, 2nd Edition, American Institute of Aeronautics and Astronautics, 2022.
2. Moir, I., Seabridge, A., *Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration*, 4th Edition, Wiley, 2023.
3. Nelson, R.C., *Flight Stability and Automatic Control*, 3rd Edition, McGraw Hill Education, 2022.
4. Etkin, B., Reid, L.D., *Dynamics of Flight: Stability and Control*, 5th Edition, Wiley, 2023.

REFERENCES:

1. Stevens, B.L., Lewis, F.L., Johnson, E.N., *Aircraft Control and Simulation*, 4th Edition, Wiley, 2023.
2. Schmidt, D.K., *Modern Flight Dynamics*, McGraw Hill, 2022.
3. Roskam, J., *Airplane Flight Dynamics and Automatic Flight Controls*, DAR corporation, 2023.
4. McLean, D., *Automatic Flight Control Systems*, 3rd Edition, Prentice Hall, 2022.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CO1	3	2	3	-	2	-	-	-	-	-	-	3	2	-	3
CO2	3	3	2	-	2	-	-	-	-	-	-	2	2	-	3
CO3	3	2	3	2	3	-	-	-	-	-	-	3	3	-	3
CO4	3	2	3	3	3	-	-	-	-	-	-	3	3	-	3
CO5	3	3	3	3	3	-	-	-	-	-	-	3	3	-	3

VERTICAL 6: AIRCRAFT MAINTENANCE

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	U23AEP61	Airframe Maintenance and Repair	PEC	3	0	0	3	3
2.	U23AEP62	Aircraft General Engineering and Maintenance Practices	PEC	3	0	0	3	3
3.	U23AEP63	Aircraft Engine Maintenance and Repair	PEC	3	0	0	3	3
4.	U23AEP64	Civil Aviation Regulations	PEC	3	0	0	3	3
5.	U23AEP65	Non-Destructive Testing and Evaluation	PEC	3	0	0	3	3
6.	U23AEP66	Air Transport Engineering and Maintenance Technologies	PEC	3	0	0	3	3

U23AEP61 SDG:7,9	AIRFRAME MAINTENANCE AND REPAIR	Category: PEC			
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

1. Provide foundational knowledge on maintenance and repair techniques for aircraft structural components.
2. Introduce students to the properties, applications, and repair methods of plastics and composite materials used in aircraft.
3. Familiarize learners with procedures involved in aircraft jacking, assembly, rigging, and control surface balancing.
4. Develop understanding of the hydraulic and pneumatic systems, including associated maintenance practices in aircraft.
5. Emphasize the importance of safety practices, hazard management, and standard procedures in aircraft maintenance.

UNIT 1	**MAINTENANCE OF AIRCRAFT STRUCTURAL**	**9**

Equipments used in welding shop and their maintenance - Ensuring quality welds - Welding jigs and fixtures - Soldering and brazing – laser welding- Sheet metal repair and maintenance: Selection of materials; Repair schemes; Fabrication of replacement patches; Tools - power/hand; Repair techniques; Sheet metal inspection - N.D.T. Riveted repair design - Damage investigation - Reverse engineering.

UNIT 2	**PLASTICS AND COMPOSITES IN AIRCRAFT**	**9**

Review of types of plastics used in airplanes - Maintenance and repair of plastic components - Repair of cracks and holes - various repairs schemes - Scopes. Cleaning of fibre reinforced plastic (FRP) materials prior to repair; FRP/honeycomb sandwich materials; laminated FRP structural members and skin panels; Tools/equipment; Vacuum-bag process. Special precautions – Autoclaves.

UNIT 3	**AIRCRAFT JACKING, ASSEMBLY AND RIGGING**	**9**

Airplane jacking and weighing and C.G. Location. Balancing of control surfaces – Inspection maintenance. Helicopter flight controls. Tracking and balancing of main rotor.

UNIT 4	**REVIEW OF HYDRAULIC AND PNEUMATIC SYSTEM**	**9**

Trouble shooting and maintenance practices - Service and inspection - Inspection and maintenance of landing gear systems. - Inspection and maintenance of air-conditioning and pressurization system, water and waste system. Installation and maintenance of Instruments - handling - Testing -Inspection. Inspection and maintenance of auxiliary systems - Rain removal system - Position and warning system - Auxiliary Power Units (APUs).

UNIT 5	**SAFETY PRACTICES**	**9**

Hazardous materials storage and handling, Aircraft furnishing practices - Equipments. Trouble shooting. Theory and practices.

COURSE OUTCOMES:

At the end of the course, students would

CO1: Demonstrate knowledge of aircraft structural repair techniques, including welding and sheet metal repair.

CO2: Perform inspection and maintenance of plastic and composite airframe components.

CO3: Carry out aircraft jacking, weighing, assembly, rigging, and rotor balancing.

CO4: Inspect and maintain hydraulic, pneumatic, and auxiliary systems in aircraft.

CO5: Follow aviation safety protocols and troubleshoot common maintenance issues.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Kroes, Watkins, Delp, "Aircraft Maintenance and Repair", McGraw Hill, New York, 1992.

2. Hajra Choudhury, “Elements of Workshop Technology”, Vol. I and II, Media Promoters and Publishers Pvt., Ltd., Mumbai, 2018.

3. Nagendra Parashar B.S. and Mittal R.K., “Elements of Manufacturing Processes”, Prentice- Hall of India Private Limited, 2011.

4. Delp. Bent and Mckinely “Aircraft Maintenance Repair”, McGraw Hill, New York, 1987.

REFERENCES:

1. Brimm D.J. Bogges H.E., "Aircraft Maintenance", Pitman Publishing corp., New York, 1940.

2. Delp. Bent and Mckinely “Aircraft Maintenance Repair”, McGraw Hill, New York, 1987.

3. *Larry Reithmeir, "Aircraft Repair Manual", Palamar Books, Marquette, 1992.*

4. “Aviation Maintenance Technician Handbook - Airframe”, Vol.2,”, U.S.Dept. of Transportation, Federal Aviation Administration, Flight Standards Service, 2012.

5. Aviation Maintenance Technician Handbook-Power plant, FAA, Aviation Supplies & Academics, 2012, Vol. 2.

CO's-PO's & PSO's MAPPING															
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO3**
CO1	3	2	-	2	2	2	2	2	1	1	-	-	2	-	-
CO2	3	2	-	2	1	2	2	1	1	1	-	-	2	-	-
CO3	-	2	-	2	2	2	2	1	1	1	-	-	2	-	-
CO4	3	2	-	2	2	2	2	1	2	1	-	-	2	-	-
CO5	3	2	-	2	1	2	3	1	1	1	-	-	2	-	-

U23AEP62 **SDG:7,9,12**	**AIRCRAFT GENERAL ENGINEERING AND MAINTENANCE PRACTICES**	**Category: PEC**			
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVE:

1. Introduce students to aircraft ground handling operations and the use of ground support equipment.
2. Familiarize with ground servicing techniques for essential aircraft systems like air-conditioning, oxygen, and oil systems.
3. Develop awareness of shop safety, tool usage, and standard aircraft maintenance processes.
4. Provide understanding of aircraft inspection procedures, relevant documentation, and regulatory frameworks.
5. Equip students with knowledge of aircraft hardware and materials, and their role in safe and effective maintenance practices.

UNIT 1	**AIRCRAFT GROUND HANDLING AND SUPPORT**	**9**
Mooring, jacking, leveling and towing operations – Preparation – Equipment – precautions –Engine starting procedures – Piston engine, turboprops and turbojets – Engine fire extinguishing –Ground power unit.		
UNIT 2	**GROUND SERVICING OF VARIOUS SYSTEMS**	**8**
Air conditioning and pressurization – Oxygen and oil systems – Ground units and their maintenance.		
UNIT 3	**MAINTENANCE OF SAFETY AND AIRCRAFT SYSTEM**	**9**

Shop safety – Environmental cleanliness – Precautions- Hand tools – Precision instruments –Special tools and equipments in an airplane maintenance shop – Identifiation terminology		
UNIT 4	**INSPECTION**	**9**
Process – Purpose – Types – Inspection intervals – Techniques – Checklist – Special inspection –Publications, bulletins, various manuals – FAR Air worthiness directives – Type certificate Data sheets – ATA Specifications		
UNIT 5	**AIRCRAFT HARDWARE, MATERIALS, SYSTEM PROCESSES**	**10**
Specification and correct use of various aircraft hardware (i.e. nuts, bolts, rivets, screws) –American and British systems of specifications – Threads, gears, bearings, – Drills, tapes and reamers – Identification of all types of fluid line fittings. Materials, metallic and non-metallic Plumbing connectors – Cables – Swaging procedures, tests, Advantages of swaging over splicing.		

COURSE OUTCOMES:

At the end of the course, students would

CO1: Perform aircraft ground handling operations, including jacking, mooring, engine starting, and fire safety procedures.

CO2: Demonstrate servicing and maintenance of aircraft systems with proper use of ground support tools and units.

CO3: Apply safe practices in the maintenance workshop and handle special tools and equipment effectively.

CO4: Interpret and perform various types of aircraft inspections using manuals, checklists, and regulatory references.

CO5: Identify, select, and utilize aircraft hardware and materials as per international specifications and perform mechanical processes such as swaging.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Kroes Watkins Delp, "Aircraft Maintenance and Repair", McGraw Hill, New York, 1993
2. Jeppesen Sanderson, *Aviation Maintenance Technician – General Textbook*, Jeppesen, 2011.
3. Federal Aviation Administration (FAA), *Aviation Maintenance Technician Handbook – General*, U.S. Dept. of Transportation, 2012.

REFERENCES:

1. A&P Mechanics, "Aircraft Hand Book", F A A Himalayan Book House, New Delhi, 1996

2. A&P Mechanics," General Hand Book", F A A Himalayan Bok House, New Delhi, 1996

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CO1	2										-	-	2	-	-
CO2	2		1				1		1		-	-	2	-	-
CO3	3	1					1		1	1	2	1	3	2	1
CO4	3	1							1		-	-	2	1	1
CO5	2										-	-	2	2	1

U23AEP63 **SDG:7,9,12,13**	**AIRCRAFT ENGINE MAINTENANCE AND REPAIR**	**Category: PEC**			
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVE:

1. Provide in-depth knowledge of piston, jet engines, and propeller systems, including their design, operation, and performance.
2. Familiarize students with inspection, servicing, and testing procedures of aircraft engines and components.
3. Develop skills in diagnostics, troubleshooting, and use of non-destructive testing (NDT) tools and techniques.
4. Enable students to understand and perform engine overhaul procedures, including component inspection, cleaning, balancing, and maintenance scheduling.
5. Introduce students to engine health monitoring systems, online maintenance tools, and field-level corrective actions.

UNIT 1	**PISTON ENGINES**	**9**

Carburation and Fuel injection systems - Ignition system components - spark plug detail – Engine operating conditions at various altitudes - Induction, Exhaust, and cooling system - Inspection and maintenance -

troubleshooting - engine components - Daily and routine checks – Compression testing of cylinders - Special inspection schedules - Checks and inspection procedures

UNIT 2	**Jet Engines**	**9**

Types of jet engines – Fundamental principles- Bearings and seals - Inlets - compressors- turbines - exhaust section – classification and types of lubrication and fuels- Inspection and Maintenance- permissible limits of damage and repair criteria - internal inspection - compressor washing- field balancing of compressor fans- Component & Systems maintenance procedures - instruments for online maintenance - Foreign Object Damage (FOD) - Blade damage

UNIT 3	**Propellers**	**9**

Propeller theory - operation, construction assembly and installation - Pitch change mechanism - Damage and repair criteria - General Inspection procedures - Checks on constant speed propellers - Pitch setting, Propeller Balancing, Blade cuffs, Governor/Propeller operating conditions – Damage and repair criteria.

UNIT 4	**INSPECTION AND TESTING**	**9**

Symptoms of failure - Fault diagnostics - Tools and equipments requirements for various checks and alignment during overhauling - Tools for inspection - Tools for safety and for visual inspectionMethods and instruments for non-destructive testing techniques - Equipment for replacement of parts and their repair. Engine testing: Engine testing procedures and schedule preparation – Online maintenance.

UNIT 5	**OVERHAULING**	**9**

Engine Overhaul - Overhaul procedures - Inspections and cleaning of components – Repairs schedules for overhaul - Balancing of Gas turbine components. Trouble Shooting: Procedures for trouble shooting - Condition monitoring of the engine on ground and at altitude - engine health monitoring and corrective methods.

COURSE OUTCOMES:

At the end of the course, students would

CO1: Identify and explain the operating principles, systems, and components of piston engines, including fuel systems, ignition, and cooling.

CO2: Analyze the construction, performance, and maintenance procedures of jet engines, and assess permissible damage and repair methods.

CO3: Demonstrate understanding of propeller theory, balancing, pitch change mechanisms, and apply general inspection and repair procedures.

CO4: Use appropriate diagnostic tools and NDT methods for inspecting engines, identifying failures, and ensuring safety during maintenance.

CO5: Perform engine overhauling, troubleshooting, and apply techniques for engine health monitoring both on ground and at altitude.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Thomas Wild, "Aircraft Power plants", 9th edition TATA McGraw Hill,New Delhi, 2018.
2. Ahmed F. El-Sayed, Aircraft Propulsion and Gas Turbine Engine, 2nd Edition, 2017.
3. Turbomeca, “Gas Turbine Engines ", The English Book Store ", New Delhi, 1993.

REFERENCES:

1. Dale Crane,"Aviation Maintenance Technician - Powerplants", 2nd Edition,Aviation Supplies & Academics, Incorporated, 2011.
2. United Technologies’ Pratt and Whitney, "The Aircraft Gas turbine engine and its Operation",The English Store, New Delhi, 2005.
3. "Federal Aviation Administration, Aviation Maintenance Technician Handbook- Powerplant",Volumes 1 and 2, Newcastle, WA: Aviation Supplies & Academics, 2012.

CO’s-PO’s & PSO’s MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CO1	3	2	–	–	1	–	–	–	–	–	–	1	3	2	–
CO2	3	3	2	2	2	–	–	–	–	–	–	2	3	2	2
CO3	3	2	2	–	2	–	–	–	–	–	–	1	2	3	2
CO4	2	3	2	2	3	1	2	–	–	–	–	2	3	3	2
CO5	2	3	3	3	3	2	2	–	–	–	–	2	3	3	3

U23AEP64 SDG:9,11,12,13 ,16	CIVIL AVIATION REGULATIONS	Category: PEC			
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

1. To familiarize students with the various Civil Aviation Requirements (CAR) as stipulated by the DGCA for maintaining and certifying airworthiness of aircraft.
2. To develop an understanding of the responsibilities of operators, procedures for documentation, defect reporting, and mandatory modifications.
3. To impart knowledge on the process of aircraft maintenance, defect monitoring, licensing of AMEs, and approval of organizations.
4. To educate students on the flight testing and certification procedures to ensure continued airworthiness.
5. To emphasize the significance of regulatory compliance in ensuring safety and reliability in aviation operations.

UNIT 1	**C.A. R SERIES 'A' - PROCEDURE FOR CIVIL AIR WORTHINESS REQUIREMENTS**	**9**

Responsibilities of operators / owners; Procedure of CAR issue, amendments etc., Objectives and targets of airworthiness directorate; Airworthiness regulations and safety oversight of engineering activities of operators. C.A.R. SERIES 'B' - ISSUE Approval of cockpit check list, MEL, and CDL - Deficiency list (MEL & CDL); Preparation and use of cockpit check list and emergency list.

UNIT 2	**C.A.R. SERIES 'C' - DEFECT RECORDING, MONITORING, INVESTIGATION**	**9**

Defect recording, reporting, investigation, rectification and analysis; flight report; reporting and rectification of defects observed on aircraft; analytical study of in-fight readings & recordings; maintenance control by reliability method. C.A.R. SERIES 'D' - and Aircraft Maintenance Programmes: reliability programme (engines); aircraft maintenance programme & their approval; on condition maintenance of reciprocating engines; TBO - revision programme; maintenance of fuel and oil uplift and consumption records - light aircraft engines; fixing routine maintenance Total Hours and component tbos initial & revisions.

UNIT 3	**C.A.R. SERIES 'E' - APPROVAL OF ORGANISATIONS**	**9**

Approval of organizations in categories A, B, C, D, E, F, & G; Requirements of infrastructure at stations other than parent base. C.A.R. SERIES 'F' - air worthiness and continued air worthiness: Procedure relating to registration of aircraft; Procedure for issue / revalidation of Type Certificate of aircraft and its engines /

propeller; Issue / revalidation of Certificate of Airworthiness; Requirements for renewal of Certificate of Airworthiness.

UNIT 4	**C.A.R. SERIES 'L' - AIRCRAFT MAINTENANCE ENGINEE**	**9**

Issue of AME License, its classification and experience requirements, Complete Series 'L'. C.A.R. SERIES 'M' MANDATORY MODIFICATIONS AND INSPECTIONS: Mandatory Modifications /Inspections.

UNIT 5	**C.A.R. SERIES 'T' - FLIGHT TESTING OF AIRCRAFT**	**9**

Flight testing of (Series) aircraft for issue of C of A; Fight testing of aircraft for which C or A had been previously issued. C.A.R. SERIES 'X' - MISCELLANEOUS REQUIREMENTS: Registration Markings of aircraft; Weight and balance control of an aircraft; Provision of first aid kits & Physician's kit in an aircraft; Use furnishing materials in an aircraft; Concessions; Aircraft log books; Document to be carried on board on Indian registered aircraft; Procedure for issue of taxy permit; Procedure for issue of type approval of aircraft components and equipment including instruments.

COURSE OUTCOMES:

At the end of the course, students would

CO1: Explain the procedures and responsibilities of civil airworthiness as per CAR Series 'A' and 'B'.

CO2: Analyze defect recording, reporting, and maintenance practices in accordance with CAR Series 'C' and 'D'.

CO3: Demonstrate understanding of organizational approval procedures and airworthiness certifications as per CAR Series 'E' and 'F'.

CO4: Interpret licensing requirements of AMEs and mandatory modifications under CAR Series 'L' and 'M'.

CO5: Evaluate flight testing protocols and miscellaneous regulatory requirements under CAR Series 'T' and 'X'.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. "Aircraft Manual (India) ", Volume - Latest Edition, The English Book Store, 171, Connaught Circus, New Delhi.
2. Aeronautical Information Circulars (relating to Airworthiness) ", from DGCA. "

REFERENCES:

1. "Civil Aviation Requirements with latest Amendment (Section 2 Airworthiness) ", Published by DGCA, The English Book Store, 17-1, Connaught Circus, New Delhi.

2. "Aeronautical Information Circulars (relating to Airworthiness) ", from DGCA. Advisory Circulars ", form DGCA.

3. Advisory Circulars ", form DGCA. as Managers – Consulting Engineers Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership Sample Code of Conduct .

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CO1	3	2	1	–	1	–	–	1	–	–	2	1	3	1	1
CO2	3	2	1	–	1	–	–	1	–	–	2	1	3	1	1
CO3	3	3	1	1	1	–	–	2	–	–	2	2	3	1	1
CO4	3	2	1	–	2	–	–	1	–	–	2	2	3	1	1
CO5	3	3	1	1	2	–	–	1	–	3	–	2	3	1	1

U23AEP65 **SDG:9,12,13**	**NON-DESTRUCTIVE TESTING AND EVALUATION**	**Category: PEC**			
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVE:

1. To introduce the fundamental concepts, principles, advantages, and limitations of various Non-Destructive Testing (NDT) methods.
2. To impart knowledge of surface NDT methods such as Liquid Penetrant Testing (LPT) and Magnetic Particle Testing (MPT).
3. To provide an understanding of advanced NDT techniques such as Thermography and Eddy Current Testing (ECT) with their instrumentation and applications.
4. To explain the principles and practical applications of Ultrasonic Testing (UT) and Acoustic Emission (AE) techniques.
5. To develop a clear knowledge of Radiographic Testing (RT) methods including X-Ray imaging and Computed Tomography (CT) for defect detection.

UNIT 1	**INTRODUCTION TO NDT & VISUAL TESTING**	**9**

Concepts of Non-destructive testing-relative merits and limitations-NDT Versus mechanical testing, Fundamentals of Visual Testing – vision, lighting, material attributes, environmental factors, visual perception, direct and indirect methods – mirrors, magnifiers, boroscopes and fibroscopes – light sources and special lighting.

UNIT 2	**SURFACE NDE METHODS**	**9**

Liquid Penetrant Testing - Principles, types and properties of liquid penetrants, developers, advantages and limitations of various methods, Testing Procedure. Magnetic Particle Testing- Theory of magnetism, inspection materials Magnetisation methods, Interpretation and evaluation of test indications, Principles and methods of demagnetization, Residual magnetism.

UNIT 3	**THERMOGRAPHY AND EDDY CURRENT TESTING**	**9**

Thermography- Principles - Contact and non-contact inspection methods - Advantages and limitation - Instrumentations and methods, applications - Eddy Current Testing - Generation of eddy currents, Properties of eddy currents, Eddy current sensing elements- Types of arrangement, Applications, advantages, Limitations, Interpretation/Evaluation.

UNIT 4	**ULTRASONIC TESTING (UT) AND ACOUSTIC EMISSION (AE)**	**9**

Ultrasonic Testing-Principle, Transducers, transmission and pulse-echo method, straight beam and angle beam, instrumentation, data representation, A/Scan, B-scan, C-scan. Phased Array, Ultrasound, Time of Flight Diffraction. Acoustic Emission Technique –Principle, AE parameters, Applications.

UNIT 5	**RADIOGRAPHY (RT)**	**9**

Principle, interaction of X-Ray with matter, imaging, film and film less techniques, types and use of filters and screens, geometric factors, Inverse square, law, characteristics of films. Fluoroscopy- Xero-Radiography, Computed Radiography, Computed Tomography.

COURSE OUTCOMES:

At the end of the course, students would

CO1: Explain the principles, advantages, limitations, and comparison of Non-Destructive Testing (NDT) methods with mechanical testing.

CO2: Apply the knowledge of Liquid Penetrant and Magnetic Particle Testing methods for surface defect detection.

CO3: Describe Thermography and Eddy Current Testing techniques with their instrumentation, working principles, and limitations.

CO4: Illustrate the working of Ultrasonic and Acoustic Emission Testing techniques, their instrumentation, and data interpretation.

CO5: Explain the principles and procedures of Radiographic Testing methods including film and film-less techniques.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Baldev Raj, T.Jayakumar, M.Thavasimuthu "Practical Non-Destructive Testing", Narosa Publishing House, 2014.
2. Ravi Prakash, "Non-Destructive Testing Techniques", 1st revised edition, New Age International Publishers, 2010.
3. J. Prasad and C. G. K. Nair, Non-Destructive Test and Evaluation of Materials, Tata McGraw- Hill Education, 2nd edition, 2011.
4. Barry Hull and Vernon John,"Nondestructive Testing", Macmillan, 1989.

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1. Paul E Mix, "Introduction to Non-destructive testing: a training guide", Wiley, 2nd Edition New Jersey, 2005

2. ASM Metals Handbook," Non-Destructive Evaluation and Quality Control", American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17.

3.Charles, J. Hellier, "Handbook of Non-destructive evaluation", McGraw Hill, New York 2001.

4. ASNT, American Society for Non-Destructive Testing, Columbus, Ohio, NDT Handbook, Vol.1, Leak Testing, Vol. 2, Liquid Penetrant Testing, Vol. 3, Infrared and Thermal Testing Vol. 4, Radiographic Testing, Vol. 5, Electromagnetic Testing, Vol. 6, Acoustic Emission Testing, Vol. 7, Ultrasonic Testing.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CO1	2	2	2	3	–	–	2	2	–	–	–	2	1	2	-
CO2	3	1	2	2	–	–	2	2	–	–	–	2	2	2	1
CO3	3	2	1	2	–	–	2	2	–	–	–	2	2	2	-

CO4	3	1	2	2	–	–	2	2	–	–	–	2	2	2	2
CO5	3	3	2	2	–	–	2	2	–	–	–	2	2	2	1

U23AEP66 **SDG:4,9**	**AIR TRANSPORT ENGINEERING AND MAINTENANCE TECHNOLOGIES**	**Category: PEC**			
		L	T	P	C
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

1. To provide an in-depth understanding of air transport operations, infrastructure, and aircraft maintenance systems.
2. To introduce maintenance practices, documentation standards, and technological tools used in commercial aviation.
3. To develop awareness of regulatory frameworks, airworthiness requirements, and safety protocols in aircraft maintenance.

UNIT 1	**INTRODUCTION TO AIR TRANSPORT INDUSTRY**	**9**

History and development of air transport, ICAO, IATA, DGCA, FAA, EASA – roles and responsibilities, Air transport economics: Airlines, airports, and infrastructure, Airport planning, ground operations, and ATC basics, international aviation trends and challenges

UNIT 2	**AIRCRAFT MAINTENANCE TYPES AND SCHEDULES**	**9**

Line maintenance vs base maintenance, Scheduled and unscheduled maintenance, A, B, C, D checks: Purpose and intervals, Maintenance human factors, Reliability-centered maintenance

UNIT 3	**MRO OPERATIONS AND LOGISTICS**	**9**

Structure of MRO organizations, Manpower and materials management, Hangar planning and layout Tools, testing equipment, GSE, Maintenance cost drivers and planning

UNIT 4	**MAINTENANCE ENGINEERING AND DOCUMENTATION**	**9**

Aircraft maintenance manuals (AMM), IPC, SRM, MPD, MEL, Task cards and maintenance tracking Predictive and condition-based maintenance, CAMO and maintenance IT systems (AMOS, RAMCO, TRAX), Digital records and e-logbooks

UNIT 5	**REGULATORY FRAMEWORK AND SAFETY STANDARDS**	**9**
Airworthiness directives and service bulletins, Quality assurance and audits, Safety Management Systems (SMS), Human factors and maintenance error decision aids (MEDA), Role of AI, IoT, and big data in aviation maintenance		
		45 HOURS

COURSE OUTCOMES:

At the end of the course, students will be able to

CO1: Understand the structure and functioning of the air transport system and global aviation network.

CO2: Explain various aircraft maintenance types, their schedules, and their impact on safety and efficiency.

CO3: Analyze the functions of Maintenance, Repair, and Overhaul (MRO) organizations and their resource planning.

CO4: Apply maintenance tracking systems, documentation standards, and predictive maintenance tools.

CO5: Discuss aviation safety standards, airworthiness regulations, and the role of technology in improving reliability.

TEXTBOOKS:

1. Kinnison, H. A., & Siddiqui, T. (2023). Aviation Maintenance Management (3rd ed.). McGraw-Hill Education.
2. Wells, A. T., & Rodrigues, C. C. (2020). Commercial Aviation Safety (6th ed.). McGraw-Hill Education.

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1. Stolzer, A. J., Halford, C. D., & Goglia, J. J. (2020). Safety Management Systems in Aviation (3rd ed.). Routledge.
2. Moir, I., & Seabridge, A. (2012). Aircraft Systems: Mechanical, Electrical, and Avionics Subsystems Integration (3rd ed.). Wiley. (Still the latest edition)

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	1	-	-	-	2	-	-	2	2	-	1	1	2	1
CO2	3	3	2	-	-	2	-	-	2	2	1	2	3	2	2
CO3	2	3	3	2	-	1	-	-	3	3	2	2	3	3	3
CO4	3	3	3	3	2	2	-	-	3	3	2	2	3	3	3
CO5	2	2	2	2	1	3	2	2	3	3	3	3	3	3	3

SUSTAINABLE DEVELOPMENT GOALS

SDG	Short Form	Full Form
1	No Poverty	End poverty in all its forms everywhere
2	Zero Hunger	End hunger, achieve food security and improved nutrition, And promote sustainable agriculture
3	Good health and well being	Ensure healthy lives and promote well-being for all at all Ages
4	Quality education	Ensure inclusive and equitable quality education and Promote lifelong learning opportunities for all
5	Gender Equality	Achieve gender equality and empower all women and girls
6	Clean water and sanitation	Ensure availability and sustainable management of water and sanitation for all
7	Affordable and clean energy	Ensure access to affordable, reliable, sustainable and modern energy for all
8	Decent work and Economic Growth	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
9	Industry, Innovation and	Build resilient infrastructure, promote inclusive and

	Infrastructure	sustainable industrialization and foster innovation
10	Reducing Inequality	Reduce income inequality within and among countries
11	Sustainable cities and communities	Make cities and human settlements inclusive, safe, Resilient and sustainable
12	Responsible consumption and production	Ensure sustainable consumption and production patterns
13	Climate action	Take urgent action to combat climate change and its impacts by regulating emissions and promoting developments in renewable energy
14	Life below water	Conserve and sustainably use the oceans, seas and marine Resources for sustainable development
15	Life on Land	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and Halt biodiversity loss
16	Peace, justice and string Institutions	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
17	Partnerships for the goals	Strengthen the means of implementation and revitalize the Global partnership for sustainable development