SEMESTER VII

S. No	Category	Course Code	Course Title	L	T	P	C
Theory							
1	PC	AE20701	Aircraft Design	3	0	0	3
2	PC	AE20702	Unmanned Aerial Vehicle Systems	3	0	0	3
3	PC	AE20703	Avionics	3	0	0	3
4	PE	AE2035*	Professional Elective III	3	0	0	3
5	PE	AE2045*	Professional Elective IV	3	0	0	3
6	OE	AE2090*	Open Elective II	3	0	0	3
Practical							
7	PC	AE20704	UAV Systems Laboratory	0	0	2	1
8	PC	AE20705	Aircraft Design Project	0	0	4	2
9	EE	AE20706	Mini Project	0	0	6	3
			Total	**18**	**0**	**12**	**24**

SEMESTER VIII

S. No	Category	Course Code	Course Title	L	T	P	C
Theory							
1	PC	AE20801	Rockets and Missiles	3	0	0	3
2	PE	AE2055*	Professional Elective V	3	0	0	3
3	PE	AE2065*	Professional Elective VI	3	0	0	3
Practical							
4	EE	AE20802	Project Work	0	0	12	6
			Total	**9**	**0**	**12**	**15**
							Total Credits :165

AE20701 **AIRCRAFT DESIGN** 3 0 0 3

COURSE OBJECTIVES

To enable students to

- familiarize with the various configurations of airplanes
- familiarize with selection of proper power plant
- gain knowledge in performance parameters of airplanes
- expose the students with optimization of wing loading
- knowledge in structural design of airplanes.

UNIT I INTRODUCTION TO AIRCRAFT DESIGN 9

Conceptual design-Primary Functions of Aircraft Components, aircraft Configuration Alternatives, aircraft Classification and Design Constraints; Configuration Selection Process and Trade-Off Analysis Preliminary Design- Maximum Take-Off Weight Estimation, Wing Area and Engine Sizing.

UNIT II DESIGN OF WING AND TAIL 9

Wing Design- Number of Wings, Wing Vertical Location-Airfoil Section, Wing Incidence, Aspect Ratio, Taper Ratio, the Significance of Lift and Load Distributions, Sweep Angle, Twist Angle, Dihedral Angle, High-Lift Device; Aileron; Lifting; Accessories; Wing Design Steps- Tail Design, Aircraft Trim Requirements, A Review on Stability and Control, Canard or Aft Tail, Optimum Tail Arm, Horizontal Tail Parameters, Vertical Tail Design, Practical Design Steps

UNIT III DESIGN OF FUSELAGE AND PROPULSION SYSTEM 9

Fuselage Design-Fuselage Configuration Design and Internal Arrangement; Ergonomics-Cockpit Design, Passenger Cabin Design, Cargo Section Design, Optimum Length to Diameter Ratio, Other Fuselage Internal Segments, Lofting; Fuselage Design Steps - Propulsion System Design, Engine Type Selection, Number of Engines, Engine Location, Engine Installation, Propeller Sizing -Engine Performance, Engine Selection, Propulsion System Design Steps.

UNIT IV DESIGN OF LANDING GEAR AND CONTROL SURFACES 9

Landing Gear Design-Landing Gear Configuration-Fixed, Retractable, or Separable Landing Gear, Landing Gear Geometry, Landing Gear and Aircraft Center of Gravity, Landing Gear Mechanical Subsystems / Parameters, Landing Gear Design Steps, Landing Gear, Design of Control Surfaces-Configuration Selection of Control Surfaces -Handling Qualities -Aileron Design - Elevator Design - Rudder Design -Aerodynamic Balance and Mass Balance.

UNIT V AIRCRAFT STRUCTURAL WEIGHT ESTIMATION 9

Weight of Components- Sensitivity of Weight Calculation; Aircraft Major Components; Weight Calculation Technique- Aircraft Weight Distribution, Aircraft Center of Gravity Calculation, Centre of Gravity Range; Longitudinal Center of Gravity Location -Technique to Determine the Aircraft Forward and Aft Center of Gravity ; Weight Distribution Technique -Aircraft Mass Moment of Inertia.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- select proper airplane configuration for their design.
- install the power plant in proper location to generate required thrust.
- estimate complete performance and stability parameter such as range, endurance, static margin, centreof gravity of airplane etc.
- carry out design of wing and fuselage.
- demonstrate complete design procedure for an airplane.

TEXT BOOKS

1. Mohamm H.Sadraey., "Aircraft Design a system Engineering Approach", John Wiley and sons Ltd, First Edition, 2013
2. Raymer, D. P, "Aircraft Design: A Conceptual Approach", 6th Ed., Reston, Va.: AIAA, 2018.

REFERENCES

1. Darrol Stinton D, "Design of the Aeroplane" , Black Well Science ,2nd Edition,2001.
2. John P Fielding, "Introduction to Aircraft Design ", Cambridge University Press, 1999.
3. "Jane's All the world's Aircraft" Janes Information Group, 2017.
4. General Aviation Aircraft Design: Applied Methods And Procedures, Snorri Gudmundsson BScAE, MScAE, FAA DER(ret.) Assistant Professor of Aerospace Engineering, Embry-Riddle Aeronautical University , LPE, Second Edition2022

CO/PO MAPPING :

Mapping of Course Outcomes with Program Outcomes (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		Programmes Outcomes(POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	-	2	-	-	-	2	-	2	2	3	3
CO2	3	2	3	3	3	-	-	-	3	-	3	-	3	2
CO3	2	2	3	3	2	3	-	-	3	-	2	2	2	3
CO4	-	1	3	2	2	2	-	-	3	-	3	2	2	2
CO5	-	3	-	3	2	2	-	-	3	-	3	2	3	2

AE20702 UNMANNED AERIAL VEHICLE SYSTEMS 3 0 0 3

COURSE OBJECTIVES

To enable students to

- make the students to understand the basic concepts of UAV systems design.
- perform the structural components used in unmanned systems.
- understand fundamental concepts surrounding operating a UAS such
- understand the main systems integrated with sub system of UAV'S.
- apply the 3-Dimensional trajectory control algorithm navigate the pilotless vehicle.

UNIT I INTRODUCTION TO UAV 9

History of UAV - Classification, Introduction to Unmanned Aircraft Systems-; models and prototypes – System Composition, applications.

UNIT II 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 III AVIONICS HARDWARE 9

Autopilot – AGL, Pressure sensors, servos, accelerometer, gyros-actuators, power supply processor, integration, installation, configuration, and testing.

UNIT IV 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 V TESTING 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.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- design UAV system
- identify different hardware for UAV
- prepare preliminary design requirements for an unmanned aerial vehicle
- perform system testing for unmanned aerial vehicles
- integrate various systems of unmanned aerial vehicle

TEXT BOOKS

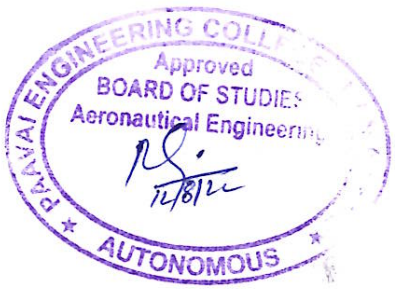
1. Paul G Fahlstrom, Thomas J Gleason, "Introduction to UAV Systems", UAV Systems, Inc, 1998
2. Reg Austin "Unmanned Aircraft Systems UAV design, development and deployment", Wiley, 2010.

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
4. Reg Austin , "Unmanned Air Systems: UAV Design, Development and Deployment", ISBN: 0470058196, 9781600867590, 9780470664803, 9780470058190, 1600867596, 2010.

CO/PO MAPPING :

Mapping of Course Outcomes with Program Outcomes (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		Programmes Outcomes(POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	3	-	-	-	-	-	-	1	2	2	-
CO2	2	2	2	3	-	-	-	-	-	2	2	-	2	-
CO3	-	2	3	2	2	-	-	-	-	-	-	2	-	-
CO4	3	2	3	2	-	-	-	-	-	-	-	-	1	-
CO5	2	1	2	3	-	-	-	-	-	2	-	3	-	-



AE20703	AVIONICS	3	0	0	3

COURSE OBJECTIVES

To enable students to

- understand the needs for avionics for both Civil and military aircraft
- introduce various digital electronic principles and working operations of digital circuit
- integrate the digital electronics with cockpit equipments
- understand the various principles in flight disk and cockpit panels
- study the communication and navigation equipment

UNIT I INTRODUCTION TO AVIONICS 9

Basics of Avionics- Basics of Cockpits, Need for Avionics in civil and military aircraft and space systems; Design Integrated Avionics Architecture - Military and Civil system; typical avionics System and Sub systems and Technologies.

UNIT II DIGITAL AVIONICS BUS ARCHITECTURE 9

Avionics Bus architecture – Data buses, MIL ,RS 232 , RS422 , RS 485,AFDX/ARINC 664 , MIL STD 1553 B ,ARINC 429 – ARINC 629 ; Aircraft system Interface.

UNIT III FLIGHT DECK AND COCKPITS 9

Control and display technologies- CRT, LED, LCD, EL and plasma panel; Touch screen – Direct voice input (DVI), ARINC 818-Civil cockpit and military cockpit; MFDS- PFDS, HUD, HMD, HMI.

UNIT IV AVIONICS SYSTEMS 9

Communication Systems – Navigation systems, Flight control systems; Radar electronic Warfare –Utility Systems Reliability and maintainability Fundamentals; Certification - Military and civil aircrafts.

UNIT V ON BOARD NAVIGATION SYSTEMS 9

Over view of navigational aids - Flight planning, Area navigation, required time of arrival, RNAV architecture , performance aspects; approach and landing challenges- regulatory and safety aspects, INS, GPS and GNSS characteristics.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- analyze the hardware required for aircraft.
- develop the knowledge about the digital avionics architecture
- discuss about the autopilot and cockpit display related concepts.
- elaborate the needs of avionics systems used in aircrafts.
- compare the communication and navigation techniques used in aircrafts.

TEXT BOOKS

1. R.P.G. Collinson, "Introduction to Avionics", Chapman and Hall Publications, 1996.
2. Spitzer, C.R. "Digital Avionics Systems", Prentice Hall, Englewood Cliffs, N.J., U.S.A., 1987.

REFERENCES

1. Middleton, D.H. "Avionics Systems", Longman Scientific and Technical, Longman Group UK Ltd.,England, 1989
2. Brain Kendal, "Manual of Avionics", The English Book House, 3rd Edition, New Delhi, 1993
3. Jim Curren, "Trend in Advanced Avionics", IOWA State University, 1992.
4. Albert Helfrick, D., Principles of Avionics, Avionics Communications Inc., 7th edition,2012

CO/PO MAPPING :

Mapping of Course Outcomes with Program Outcomes (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		**Programmes Outcomes(POs)**												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	3	2	-	2	-	2	-	-	2	3	3
CO2	2	3	2	3	2	-	2	-	-	-	-	3	3	2
CO3	-	2	3	2	3	-	3	-	3	-	-	2	2	3
CO4	3	2	3	2	3	-	2	-	3	-	-	2	2	2
CO5	2	1	3	3	2	-	3	-	2	-	-	2	3	2

AE20704 **UAV SYSTEMS LABORATORY** **0 0 2 1**

COURSE OBJECTIVES

To enable students to

- design and analysis of payload
- understand the basic concepts of UAV & MAV.
- impart the knowledge of propeller balancing.
- apply the knowledge of drone flight controller programming.

LIST OF EXPERIMENTS

1. Payload and weight Estimation
2. Fixed wing UAV frame and Avionics component assembly
3. Calibration and estimation of Motor's Thrust with various ESC's and propellers
4. UAV control testing & Trimming Procedure using Transmitter and servo
5. Lithium Polymer Battery Testing, Balancing and maintenance.
6. RC Transmitter Resetting, Calibration and frequency Binding
7. Propeller Balancing Procedure
8. Fixed Wing UAV centre of gravity calculation and balancing
9. RC Simulator Testing and Calibration.
10. Study on various wing configuration

TOTAL PERIODS **30**

COURSE OUTCOMES

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

- ability to design and identify different hardware for UAV system
- prepare preliminary design requirements and perform system micro testing foe unmanned aerial vehicle
- integrate various systems of unmanned aerial vehicle & design micro aerial vehicle systems by considering practical limitations.
- ability to fabricate UAVs in different materials and configurations.

CO/PO MAPPING :

Mapping of Course Outcomes with Program Outcomes (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		**Programmes Outcomes(POs)**												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	3	2	-	2	-	2	-	-	2	3	3
CO2	2	3	2	3	2	-	2	-	-	-	-	3	3	2
CO3	-	2	3	2	3	-	3	-	3	-	-	2	2	3
CO4	3	2	3	2	3	-	2	-	3	-	-	2	2	2

AE20705 **AIRCRAFT DESIGN PROJECT** **0 0 4 2**

COURSE OBJECTIVES

To enable students to

- prepare comparative data sheet.
- understand the calculations of weight estimation.
- impart the knowledge wing, fuselage and landing gear design.
- draw the 3 view diagram.

LIST OF EXPERIMENTS

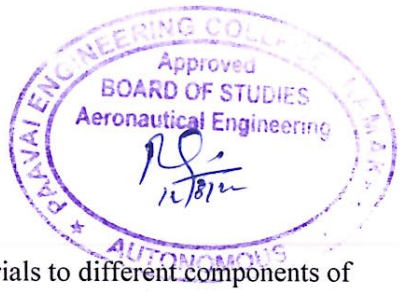
1. Comparative configuration study of different types of airplanes, specifications and performance details with reference to the design work under taken
2. Comparative study on specification and performance details of aircraft
3. Preliminary weight estimation.
4. Preliminary design of Wing –airfoil selection, fixing the geometry of wing
5. Fixing the Geometry of tail and control surfaces
6. Preparation of fuselage layout
7. Power plant selection
8. V-n diagram
9. Landing gear selection &design.
10. Preparation of a detailed design report with CAD drawings

TOTAL PERIODS **60**

COURSE OUTCOMES

At the end of this project, the students will be able to

- design aircraft and demonstrate the performance of the design.
- design aircraft wings, fuselage, loading gears.
- draw the V-n diagram
- apply the knowledge of aircraft structure to choose suitable materials to different components of aircraft.



CO/PO MAPPING :

Mapping of Course Outcomes with Program Outcomes (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		**Programmes Outcomes(POs)**												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	-	2	2	2	-	-	-	2	-	2	-	3	2
CO2	2	-	2	3	3	-	-	-	3	2	3	-	3	2
CO3	2	-	3	1	2	-	-	-	3	-	3	-	2	2
CO4	2	-	3	3	2	-	-	-	2	2	3	-	3	2

AE20706 **MINI PROJECT** **0 0 6 3**

COURSE OBJECTIVES

To enable students to

- make comprehensive use of the technical knowledge gained from previous courses
- understand technologies concerned with the project.
- apply project management skills (scheduling work, procuring parts and documenting expenditures and working within the confines of a deadline).
- analyze, develop, and demonstrate the proposed work.

GUIDELINES

The student in a group of 3 to 4 works on a topic approved by the Head of the Department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL PERIODS 90

COURSE OUTCOMES

At the end of this project, the students will be able to

- apply the basic concepts and technical knowledge gained in previous courses in the project work.
- carry out literature review; understand the current scenarios and technological level with respect to the project.
- apply project management skills.
- analyze, develop, and demonstrate the proposed project work.

CO/PO MAPPING :

Mapping of Course Outcomes with Program Outcomes (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		Programmes Outcomes(POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3

AE20801	ROCKETS AND MISSILES	3	0	0	3

COURSE OBJECTIVES

To enable students to

- gain knowledge on the aerodynamic characteristics of different classes of missiles.
- understand the aerodynamic forces of Rockets and Missiles.
- get introduced to the 1D and 2D motion of rockets in free space and in homogeneous gravitationalfield
- learn the various stage of Rockets and Missiles.
- introduce the various control methods of Rockets and Missiles

UNIT I 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 II AERODYNAMICS OF ROCKETS AND MISSILES 9

Airframe components of rockets and missiles – forces acting on a missile while passing through atmosphere ;classification of missiles – slender body aerodynamics ;Method of describing forces and moments – lift force and lateral moment ; lateral aerodynamic damping moment – longitudinal moment ;drag estimation – up wash and downwash in missile bodies ; rocket dispersion.

UNIT III ROCKET MOTION IN FREE SPACE AND GRAVITATIONAL FIELD 9

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 determine burn out velocity and altitude; estimation of culmination time and altitude- numerical problems

UNIT IV STAGING OF ROCKETS AND MISSILES 9

Design philosophy behind multi staging of launch vehicles and ballistic missiles – optimization of multistage vehicles; stage separation techniques in atmosphere and in space – stage separation dynamics and lateral separation, Characteristics; numerical problems.

UNIT V CONTROL OF ROCKETS AND MISSILES 9

Introduction to aerodynamic control and jet control methods- thrust control methods ; various types of jet control methods including secondary injection thrust vector control for launch vehicles ; Characteristics of aerodynamic control methods.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- classify the types of Rockets and Missiles
- analyze the forces and moments that act on a missile in atmosphere.
- perform the calculations pertaining to altitude and range covered by rockets in homogeneous gravitationalfield.

- compare the various stages of Rockets and Missiles
- classify the types of Rockets and Missiles

TEXT BOOKS

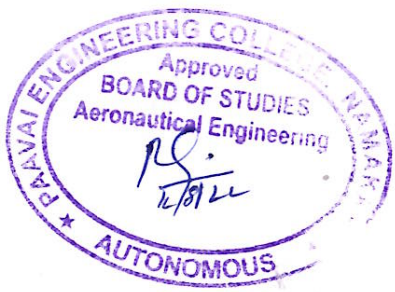
1. Cornelisse, J.W., "Rocket Propulsion and Space Dynamics", J.W. Freeman and Co., Ltd, London,1982
2. Sutton, G.P., "Rocket Propulsion Elements", John Wiley and Sons Inc., New York, 5th Edition, 1993.

REFERENCES

1. Parker, E.R., "Materials for Missiles and Spacecraft", McGraw Hill Book Co. Inc. 1982.
2. M. Mathur and R. P. Sharma, "Gas Turbines and Jet and Rocket Propulsion", Standard Publishers, New Delhi, 2005.
3. William E. Wiesel., "Spaceflight Dynamics", Aphelion Press,3rd Edition, 2010.
4. J. Mattingly, H. von Ohlin,"Elements of propulsion: gas turbines and rocket" second edition, 2006.

CO/PO MAPPING :

Mapping of Course Outcomes with Program Outcomes (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		Programmes Outcomes(POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	2	2	2	2	3	-	-	-	1	2	2	3
CO2	2	3	3	2	2	2	1	-	-	-	1	2	3	2
CO3	3	2	3	2	1	2	1	-	-	1	2	-	2	2
CO4	1	1	2	3	2	3	3	-	-	-	3	2	3	3
CO5	2	1	3	3	3	3	-	-	-	3	2	2	3	2



AE20802 **PROJECT WORK** **0 0 12 6**

COURSE OBJECTIVES

To enable students to

- make comprehensive use of the technical knowledge gained from previous courses
- understand technologies concerned with the project.
- apply project management skills (scheduling work, procuring parts and documenting expenditures and workingwithin the confines of a deadline).
- analyze, develop, and demonstrate the proposed work.

GUIDELINES

The student in a group of 3 to 4 works on a topic approved by the Head of the Department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL PERIODS 180

COURSE OUTCOMES

At the end of this project, the students will be able to

- apply the basic concepts and technical knowledge gained in previous courses in the project work.
- carry out literature review; understand the current scenarios and technological level with respect to the project.
- apply project management skills.
- analyze, develop, and demonstrate the proposed project work.

CO - PO Mapping

Mapping of Course Outcomes with Program Outcomes (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		Programmes Outcomes(POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3

AE20351 **CRYOGENIC ENGINEERING** **3 0 0 3**

COURSE OBJECTIVES

To enable students to

- understand the behaviour of materials at low temperatures
- learn about various liquefaction systems for refrigeration.
- familiarize the students for different cryogenic applications.
- develop skills for designing cryogenic systems including refrigeration, storage and transfer of cryogens, and instrumentation
- know the safety considerations for different types of fuels

UNIT I BASIC PRINCIPLES OF CRYOGENIC 9

Historical Background - Introduction to cryogenic propellants and their properties, Liquid hydrogen, Liquid helium, Liquid nitrogen and liquid oxygen; Theory behind the production of low temperature-Joule Thompson Effect.

UNIT II REFRIGERATION AND GAS-LIQUEFACTION SYSTEMS 9

Basic principles of low temperature heat transfer ; Refrigeration system and its types; Cryogenicliquefaction process; Production of Low Temperatures ; Liquefaction systems-Various liquefaction cycles, Ideal, Linde Hampson.

UNIT III CRYO INSULATION AND DEVICES 9

Storage vessel - Thermal shields and insulation, Effect of size and shape of storage vessel on heat inleak, Vapor shielding, Vacuum insulation, Evacuated porous insulation, Solid foams, Multilayer insulation; Composite insulation heat exchangers for cryogenic applications; Cryogenic Instrumentation-strain, Displacement and position, Pressure, Flow, Liquid level, Density for cryogenic applications.

UNIT IV CRYOGENIC ROCKET SYSTEMS 9

Design concepts of cryogenic rockets - Selection of propellants and its challenges, Boil-off rate, Thrust and velocity gain; Specific impulse - Propellant feed system ; Tank pressurization and vent system - Two phase flow and heat transfer in reduced gravity ;Effect of cryogenic liquids on properties of aerospace materials.

UNIT V SUPERCONDUCTIVITY AND SAFETY 9

Matter at low temperatures - Electrical and Magnetic properties of Superconductors, Specific heat, thermal conductivity, Electrical conductivity and basic properties of Superconductors; Introduction Physiological hazards - Explosions and flammability ;Safety considerations for liquid hydrogen and liquid oxygen - General safety principles.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- get introductory knowledge of cryogenic Engineering.
- compare the refrigeration process for different liquefaction systems.

- detailed knowledge of cryo-coolers, on which research is going on worldwide.
- interest to embark on a research career in Cryogenic Engineering.
- acquire the knowledge about cryogenics safety considerations.

TEXT BOOKS

1. Haseldom, G., Cryogenic Fundamentals, Academic Press, 1971.
2. Barron, R. F., Cryogenic Systems, Oxford University, 1985

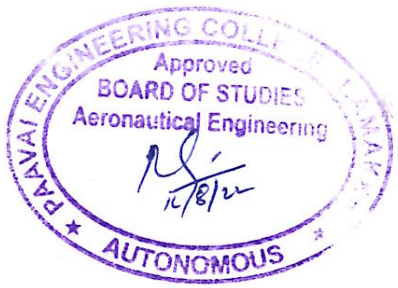
REFERENCES

1. Mamata Mukhopadhyay, "Fundamentals of Cryogenic Engineering", PHI Learning , 2013.
2. Thomas M. Flyn, "Cryogenic Engineering", Second Edition.
3. G.M Walker. "Cryocooler Part - 1 Fundamental", Plenum Press, New York and London,2001.
4. G.M Walker. "Cryocooler Part - 2", Plenum Press, New York and London, 2005

CO/PO MAPPING :

Mapping of Course Outcomes with Program Outcomes
(3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programmes Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	3	2	3	3	-	3	-	3	2	3	3
CO2	3	2	2	3	2	2	-	-	2	-	2	2	3	2
CO3	2	3	3	2	2	2	-	2	-	3	-	2	3	3
CO4	2	3	2	3	1	3	-	-	3	-	2	2	2	2
CO5	3	2	2	2	2	2	-	-	3	-	2	2	3	2



AE20352 **THEORY OF ELASTICITY** 3 0 0 3

COURSE OBJECTIVES

To enable students to

- improve the ability to use the principles of theory of elasticity in engineering problems.
- analyze some real problem and to formulate the conditions of theory of elasticity application.
- familiarize with the stress function approach in solving linear elasticity problems.
- execute a reasonable choice of parameters of the model (geometry, material properties, and boundary conditions).
- provide the foundation for pursuing other solid mechanics courses such as theory of plates and shells, elastic stability, composite structures and fracture mechanics.

UNIT I BASIC EQUATIONS OF ELASTICITY 9

Definition of Stress and Strain – Stress, Strain relationships; Equations of Equilibrium- Compatibility equations, Boundary Conditions; Saint Venant's principle; Principal Stresses- Stress Ellipsoid; Stress invariants

UNIT II PLANE STRESS AND PLANE STRAIN PROBLEMS 8

Airy's stress function- Bi-harmonic equations, Polynomial solutions, Simple two-dimensional problems in Cartesian coordinates like bending of cantilever and simply supported beams.

UNIT III PLANE STRESS AND PLANE STRAIN PROBLEMS 10

Equations of equilibrium; Strain - displacement relations; Stress – strain relations- Airy's stress function, Axi – symmetric problems, Introduction to Dunder's table, Curved beam analysis, Lame's, Kirsch, Michell's and Boussinesque problems – Rotating discs.

UNIT IV TORSION 9

Navier's theory- St. Venant's theory; Prandtl's theory on torsion- semi- inverse method and applications to shafts of circular, elliptical, equilateral triangular and rectangular sections; Membrane Analogy.

UNIT V INTRODUCTION TO THEORY OF PLATES AND SHELLS 9

Classical plate theory – Assumptions, Governing equations ;Boundary conditions – Navier's method of solution for simply supported rectangular plates ;Levy's method of solution for rectangular plates under different boundary conditions

TOTAL PERIODS 45

COURSE OUTCOMES

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

- formulate of governing equations and solution for torsion of non-circular sections.
- solve the governing equation for plate bending.
- formulate of governing equations and solution for torsion of non-circular sections.
- solve the governing equation for plate bending.
- formulate of governing equations and solution for torsion of non-circular sections.

TEXT BOOKS

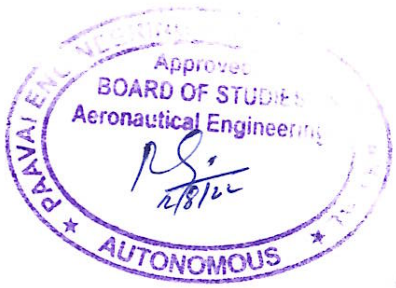
1. Timoshenko, S., and Goodier, T.N., "Theory of Elasticity", McGraw–Hill Ltd., Tokyo, 1990.
2. Ansel C Ugural and Saul K Fenster, "Advanced Strength and Applied Elasticity", 4th Edition, PrenticeHall, New Jersey, 2003.

REFERENCES

1. Enrico Volterra & J.H. Caines, "Advanced Strength of Materials", Prentice Hall New Jersey, 1991.
2. Sokolnikoff, I.S., "Mathematical Theory of Elasticity", McGraw–Hill New York, 1978.
3. Wng, C.T., "Applied Elasticity", McGraw–Hill Co., New York, 1993.
4. Barber, J. R., "Elasticity", Kluwer Academic Publishers, 2004.

CO/PO MAPPING :

Mapping of Course Outcomes with Program Outcomes (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		**Programme Outcomes (POs)**												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	3	2	3	3	-	-	-	3	2	-	2	2	2
CO2	1	3	2	2	2	-	-	-	1	2	-	1	2	2
CO3	2	2	3	2	2	-	-	-	-	-	-	3	2	2
CO4	3	2	2	3	2	-	-	-	-	-	-	3	2	3
CO5	2	2	2	2	2	-	-	-	-	-	-	3	3	3



AE20353 AIRCRAFT RULES AND REGULATIONS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the responsibility of owner/operator/CAR of aircraft
- learn the procedure for the preparation of aircraft maintenance and TBO
- enhance the knowledge on various procedures for issues and revalidation of organization certificates.
- understand the procedures for various classifications and inspection procedures.
- know the various logbook, documents used in aircrafts and its importance

UNIT I C.A.R SERIES 'A' and C.A.R. SERIES 'B' 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; Issue Approval Of Cockpit Check List, MEL; CDL - Deficiency list (MEL and CDL); Preparation and use of cockpit check list and emergency list.

UNIT II C.A.R. SERIES 'C' and C.A.R. SERIES 'D' 9

Defect recording- reporting, investigation, rectification and analysis, Flight report, Reporting and rectification of defects observed on aircraft; Analytical study of in-fight readings and recordings; Maintenance control by reliability Method and Aircraft Maintenance Programme- 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 periods and component TBOs - Initial and revisions.

UNIT III C.A.R. SERIES 'E' and C.A.R. SERIES 'F" 9

Approval of organizations in categories A, B, C, D, E, F, and 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 IV C.A.R. SERIES 'L' and C.A.R.SERIES 'M' 9

Issue of AME License- its classification and experience requirements, Complete Series ,C.A.R. Series 'M' Mandatory Modifications And Inspections; Mandatory Modifications / Inspections.

UNIT V C.A.R. SERIES 'X" 9

Registration Markings of aircraft; Weight and balance control of an aircraft; Provision of first aid kits and 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 tax permit.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- identify the various aviation standards in quality assurance ,safety rules and regulations
- differentiate the certification standards and licensing standards
- predict various aeronautical organization standards and regulations
- conclude the aviation laws and regulations related to each type of organization.
- analyze flight testing certification standards.

TEXT BOOK

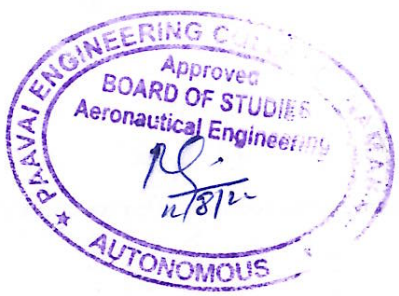
1. "Civil Aviation Requirements with Amendment(section 2 Airworthiness)",Published by DGCA,the English Book Store ,17-1,Connaught Circus,New Delhi,2000
2. FAA, Quality Regulations Document –Vs 13000.2C.

REFERENCES

1. "Aircraft Manual (India)"-Latest Edition .the English Book store, 17-1,Connaught Circus,New Delhi,2000.
2. Wg Cdr DP Sabharwal (Retd.), "Q and A –Objective and subjective for CARSection-2".
3. Ruwantissa Abeyratne, "Convention on International Civil Aviation: A Commentary", Springer International Publishing, 2014.
4. H. A. Wassenbergh "Post-War International Civil Aviation Policy and the Law of the air",Springer Netherlands ,1962.

CO/PO MAPPING :

Mapping of Course Outcomes with Program Outcomes (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		Programme Outcomes(POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	2	3	3	2	-	3	-	-	-	-	2	3	3
CO2	-	2	2	3	3	2	2	-	-	-	-	2	3	2
CO3	-	2	3	3	2	-	2	-	-	-	-	2	2	3
CO4	-	3	2	2	3	-	3	-	-	-	-	2	2	2
CO5	-	3	3	2	3	-	3	-	-	-	-	2	3	2



AE20354 COMPUTATIONAL FLUID DYNAMICS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- gain the basic flow equations, characteristics of mathematical model for a given flow.
- know the importance and significance of grid generation methods.
- understand the concepts of discretization, upwind differencing and implicit, explicit solutions
- familiarize with finite element techniques in computational fluid dynamics.
- learn with aerospace application in computational fluid analysis.

UNIT I GOVERNING EQUATIONS AND BOUNDARY CONDITIONS 9

Basics of computational fluid dynamics – Governing equations of fluid dynamics , Continuity, Momentum and Energy equations ;Chemical species transport – Physical boundary conditions ;Time-averaged equations for Turbulent Flow – Turbulent; Kinetic Energy Equations ; Mathematical behaviour of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations.

UNIT II FINITE DIFFERENCE AND FINITE VOLUME METHODS FOR DIFFUSION 9

Derivation of finite difference equations – Simple Methods ; General Methods for first and second order accuracy – Finite volume formulation for steady state One, Two and Three -dimensional diffusion problems; Parabolic equations –Explicit and Implicit schemes ; Example problems on elliptic and parabolic equations; Use of Finite Difference and Finite Volume methods.

UNIT III FINITE VOLUME METHOD FOR CONVECTION DIFFUSION 9

Steady one-dimensional convection and diffusion – Central, upwind differencing schemes properties of discretization schemes; Conservativeness- Boundedness, Transportiveness, Hybrid, Power-law, QUICK Schemes.

UNIT IV FLOW FIELD ANALYSIS 9

Finite volume methods -Representation of the pressure gradient term and continuity equation ; Staggered grid – Momentum equations ; Pressure and Velocity corrections – Pressure Correction equation, SIMPLE algorithm and its variants ; PISO Algorithms.

UNIT V TURBULENCE MODELS AND MESH GENERATION 9

Turbulence models- mixing length model, Two equation (k-Є) models; High and low Reynolds number models – Structured Grid generation ,Unstructured Grid generation ;Mesh refinement – Adaptive mesh , Software tools.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- elaborate the flow phenomena in a flow field with correspondence with elliptic, parabolic and hyperbolic equations.
- identify the steps involved in source and panel methods
- discretize a flow model for analysis.

- compute the values using weighted, variational and Galerkin method of finite volume technique.
- analyze the numerical methods of aerospace application in computational

TEXT BOOK

1. John F. Wendt (Editor), "Computational Fluid Dynamics - An Introduction", Springer — Verlag, Berlin,1992.
2. Fletcher, C.A.J., "Computational Techniques for Fluid Dynamics", Vols. I and II, Springer - Verlag,Berlin, 1988.

REFERENCES

1. Charles Hirsch, "Numerical Computation of Internal and External Flows", Vols. I and II. John Wiley and Sons, New York, 1988.
2. Anderson, Jr .D,"Fundamentals of Aerodynamics", McGraw-Hill, 2000.
3. Klaus A Hoffmann and Steve T. Chiang•. "Computational Fluid Dynamics for Engineers", Vols. I and II.
4. Engineering Education System. P.O. Box 20078, W. Wichita, K.S., 67208 - 1078 USA. 1993.

CO/PO MAPPING :

Mapping of Course Outcomes with Program Outcomes (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		Programme Outcomes(POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	3	-	-	-	-	-	-	1	2	2	-
CO2	2	2	2	3	-	-	-	-	-	2	2	-	2	-
CO3	-	2	3	2	2	-	-	-	-	-	-	2	-	-
CO4	3	2	3	2	-	-	-	-	-	-	-	-	1	-
CO5	2	1	2	3	-	-	-	-	-	2	-	3	-	-

PROFESSIONAL ELECTIVE –IV

AE20451 HIGH TEMPERATURE MATERIALS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- knowledge about basic concept of mechanical properties of materials.
- learn damage mechanism and failure of components of elevated temperature
- understand how the fracture is happen and also know their stress- strain relationship.
- familiar with the factors that influence the corrosion
- acquire knowledge about alloys and metals.

UNIT I INTRODUCTION TO HIGH TEMPERATURE MATERIALS & CREEP 9

Historical Development- requirements of HTM Factors influencing functional life of components at elevated temperatures; definition of creep curve -various stages of creep, metallurgical factors influencing various stages, effect of stress, temperatures and strain rate.

UNIT II DESIGN FOR CREEP RESISTANCE 9

Design of transient creep time- hardening, strain hardening, expressions of rupture life of creep, ductile and brittle materials, Monkman-Grant relationship.

UNIT III FRACTURE 9

Various types of fracture- brittle to ductile from low temperature to high temperature, cleavage fracture due to micro void coalescence; diffusion controlled void growth- fracture maps for different alloys and oxides.

UNIT IV OXIDATION AND HOT CORROSION 9

Oxidation; Pilling; Bed worth ratio; kinetic laws of oxidation – defect structure and control of Oxidation by alloy additions, hot gas corrosion deposit, modified hot gas corrosion, fluxing mechanisms, effect of alloying elements on hot corrosion, interaction of hot corrosion and creep, methods of combat hot corrosion.

UNIT V SUPER ALLOYS AND OTHER MATERIALS 9

Iron base; Nickel base super alloy; Cobalt base super alloys; composition control; solid solution strengthening,- precipitation hardening by gamma prime, grain boundary strengthening, TCP phase, embrittlement, solidfication of single crystals, Intermetallic's, high temperature ceramics.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- compute how creep will occur for different materials.
- design pattern for creep to reduce deformation while Applying stress.
- analyze stress- strain relationship for different kinds of materials.
- difference between oxidation and corrosion.
- identify the mechanical and chemical characters of alloys and other materials.

TEXT BOOK

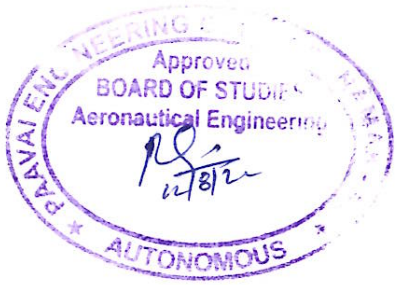
1. Raj. R., "Flow and Fracture at Elevated Temperatures", American Society for Metals USA, 1985.
2. Hertzberg R.W., "Deformation and Fracture Mechanics of Engineering materials", 4th Edition, John Wiley, USA, 1996.

REFERENCES

1. Boyle J.T, Spencer J, "Stress Analysis for Creep" ,Butterworth's, UK, 1983
2. Bressers.J, "Creep and Fatigue in High Temperature Alloys", Applied Science, 1981.
3. McLean D., "Directionally Solidified Materials for High Temperature Service", the Metals Society, USA, 1985.
4. Courtney T .H, "Mechanical Behaviour of Materials", McGraw-Hill, USA, 1990.

CO/PO MAPPING :

Mapping of Course Outcomes with Program Outcomes (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		Programme Outcomes(POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	3	-	-	-	-	-	-	1	2	2	-
CO2	2	2	2	3	-	-	-	-	-	2	2	-	2	-
CO3	-	2	3	2	2	-	-	-	-	-	-	2	-	-
CO4	3	2	3	2	-	-	-	-	-	-	-	-	1	-
CO5	2	1	2	3	-	-	-	-	-	2	-	3	-	-



AE20452 **WIND TUNNEL TECHNIQUES** 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the different types of wind tunnels.
- interpret the basic concepts of measuring setup of forces and moments on models during the wind tunnel testing.
- understand the application of various types of wind tunnels.
- learn the basic measurement procedure involving wind tunnel testing.
- understand the different types of wind tunnels.

UNIT I INTRODUCTION 8

General features -Types of wind tunnel, Low speed wind tunnel; High speed wind tunnel - Effuser, diffuser-test section, driving unit; special purpose tunnels

UNIT II LOW SPEED WIND TUNNELS 9

Classification of wind tunnel; Components of low speed wind tunnel - convergent section ; test section ; divergent section ; power plant- power losses energy ratio ,losses in cylindrical section ,losses in convergent cone ; honeycombs - guide vanes; losses due to open jet test section.

UNIT III HIGH SPEED WIND TUNNEL 9

Blow down type wind tunnels- Induction type tunnels, continuous supersonic wind tunnels, losses in supersonic wind tunnel; supersonic wind tunnel diffusers - effect of second throat; Calibration of wind tunnel Test section speed setting - horizontal buoyancy; flow angularities - turbulence measurements ;associated instrumentation - calibration of supersonic tunnels ; Mach number determination ;determination of test section noise.

UNIT IV WIND TUNNEL MEASUREMENTS 10

Pressure and velocity measurements - force measurements; three component and six component balances -internal balances.

UNIT V FLOW VISUALIZATION 9

Smoke and tuft grid techniques - Water flow visualization method; dye injection special techniques – optical methods of flow visualization.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- analyze the dimension of physical quantities using different methods.
- design and analyze different types of wind tunnel with respect to speed regions.
- apply the calibration procedure in wind tunnel based on speed, flow angularity and turbulence.
- compare the wind tunnel measurement techniques and their applications and limitations.
- check the flow around aerodynamic models using flow visualizations techniques

TEXT BOOK

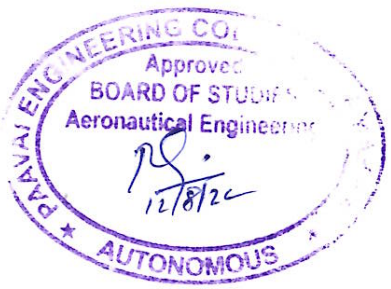
1. Rae, W.H. and Pope, A., "Low Speed Wind Tunnel Testing", John Wiley Publication, 1984.
2. NAL-UNI Lecture Series 12:" Experimental Aerodynamics", NAL SP 98 01 April 1998.

REFERENCES

1. Robert B Northrop, "Introduction to Instrumentation and Measurements", Second Edition, CRC Press,Taylor and Francis, 2006.
2. Antonio Viviani, Giuseppe Pezzella, "Aerodynamic and Aerothermodynamics Analysis of Space Mission Vehicles", Springer Aerospace Technology, 2015.
3. Pavian, Henry Christensen, "Experimental Aerodynamics", 1st edition, Pitman Publishing, 2001.
4. F Rathakrishnan, E., "Instrumentation, Measurements, and Experiments in Fluids", CRC Press - Taylor and Francis, 2007.

CO/PO MAPPING :

Mapping of Course Outcomes with Program Outcomes (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		Programme Outcomes(POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	3	3	-	-	-	3	2	-	2	3	2
CO2	1	3	2	2	2	-	-	-	1	2	-	1	2	3
CO3	2	2	2	3	1	-	-	-	-	-	-	3	2	3
CO4	3	2	3	3	2	-	-	-	-	-	-	3	2	3
CO5	3	2	1	2	2	-	-	-	-	-	-	3	3	3



AE20453 **HEAT TRANSFER** 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the governing equations of the with and without governing equations
- understand the convection mode of heat transfer and overall heat transfer coefficient
- gain knowledge about the radiation heat transfer of white body, gray body and block body
- gain knowledge about the different types of find and pin.
- understand the gas turbine engine heat transfer.

UNIT I CONDUCTION 9

Governing Equation in Cartesian- Cylindrical and Spherical coordinates ;1-D steady state heat conduction with and without heat generation; Composite wall- Electrical analogy ; Critical thickness of insulation – Heat transfer from extended surface ; Effect of temperature on conductivity- 1-D Transient analysis.

UNIT II CONVECTION 12

Review of basic Equations of fluid flow - Dimensional analysis, Forced convection, Laminar flow over flat plate and flow through pipes; Flow across tube banks- Turbulent flow over flat plate and flow through pipes ; Free convection – Heat transfer from vertical plate using integral method ; Empirical relations ;Types of heat exchangers ; Overall heat transfer coefficient ; LMTD and NTU methods of analysis.

UNIT III RADIATION 9

Basic definitions – Concept of black body ; Laws of black body radiation- Radiation between black surfaces , Radiation heat exchange between grey surfaces ;Radiation shielding ; Shape factor Electrical network analogy in thermal radiation systems.

UNIT IV NUMERICAL METHODS IN HEAT TRANSFER 9

1-D and 2-D Steady and unsteady state heat conduction – Composite walls-heat generation; Variable thermal conductivity- Extended surfaces analysis using finite difference method; Convective heat transfer; Stream function - Vorticity method; Creeping flow analysis-Convection-diffusion 1-D, 2-D Analysis using finite difference approximation; Numerical methods applicable to radiation heat transfer.

UNIT V HEAT TRANSFER PROBLEMS IN AEROSPACE ENGINEERING 6

Heat transfer problems in gas turbines; Rocket thrust chambers; Aerodynamic heating; Ablative heat transfer.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- classify the difference between various modes of Heat Transfer and the Resistance Concept used in Heat Conduction
- make use of the basic methods in Conduction and understand the concept of Lump Parameter analysis andwhen it is applicable and earn the concepts of boundary layer.
- apply various correlation used in Convective Heat Transfer and Understand the concepts of black Body, grey Body, View factor, Radiation shielding
- construct the design/size Heat Exchanger and understand the concept of Mass transfer, its types

and lawsassociated with it.

- apply various technique used for high-speed flow heat transfer

TEXT BOOK

1. P K NAG ,"Heat and Mass Transfer Third Edition", Tata Mc Graw Hill Education Private Limited, New Delhi
2. Sachdeva,S.C., "Fundamentals of Engineering Heat and Mass Transfer", Wiley Eastern Ltd., New Delhi,1981.

REFERENCES

1. Lienhard, J.H , "A Heat Transfer Text Book", Prentice Hall Inc., 1981.
2. Mathur, M. and Sharma, R.P, "Gas Turbine and Jet and Rocket Propulsion", Standard Publishers, New Delhi,1988.
3. Sutton, G.P, "Rocket Propulsion Elements", John Wiley and Sons, Fifth Edition, 1986.
4. Yunus,A.Cengel, "Heat Transfet-A Practical Approach", Tata McGraw Hill, Second edition, 2003.

CO/PO MAPPING :

Mapping of Course Outcomes with Program Outcomes (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		Programme Outcomes(POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	3	3	-	-	-	3	2	-	2	2	2
CO2	3	2	2	3	2	-	-	-	1	2	-	1	2	3
CO3	3	2	2	3	1	-	-	-	-	-	-	3	2	3
CO4	3	2	3	3	2	-	-	-	-	-	-	3	2	3
CO5	3	1	2	2	2	-	-	-	-	-	-	2	3	3

BA20253 **INTELLECTUAL PROPERTY RIGHTS** 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- know the concept of Intellectual Property Rights.
- learn the procedure for Intellectual Property Right Registration.
- gain insight into the legislation of Intellectual Property Rights.
- know the provisions in Cyber Laws.
- learn the measures taken to enforce Intellectual Property Rights.

UNIT I INTRODUCTION 9

Introduction to IPRs- Basic concepts and need for Intellectual Property ,Patents, Copyrights, Geographical Indications; IPR in India and Abroad – Genesis and Development ,the way from WTO to WIPO –TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations; Important examples of IPR.

UNIT II REGISTRATION OF IPRs 9

Meaning and practical aspects of registration of Copy Rights- Trademarks, Patents; Geographical Indications- TradeSecrets and Industrial Design registration in India and Abroad.

UNIT III AGREEMENTS AND LEGISLATIONS 9

International Treaties and Conventions on IPRs- TRIPS Agreement; PCT Agreement- Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act.

UNIT IV DIGITAL PRODUCTS AND LAW 9

Digital Innovations and Developments as Knowledge Assets – IP Laws, Cyber Law and Digital Content Protection; Unfair Competition – Meaning and Relationship between Unfair Competition and IP Laws; Case Studies.

UNIT V ENFORCEMENT OF IPRs 9

Infringement of IPRs; Enforcement Measures; Emerging issues – Case Studies.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- manage Intellectual Property portfolio to enhance the value of the firm.
- gain knowledge on registration IPRs
- identify the appropriate legal solutions to problems pertaining to Intellectual Property Rights.
- apply Cyber Laws for seeking solution to Cyber Crimes .
- enforce IPR in a successful way

TEXT BOOK

1. Barati S. Dole, Dilip Sarwate, Management Perspectives on Intellectual Property Rights, Vishwakarma Publications, 1st Edition, 2016.
2. Intellectual Property Laws – A Bare Act, Professional Book Publishers, First Edition, January 2018.

REFERENCES

1. S.V.Satakar, " Intellectual Property Rights and Copy Rights", Ess Ess Publications, New Delhi, 2002
2. V.Scople Vinod, "Managing Intellectual Property", Prentice Hall of India Pvt Ltd, 2012.
3. Narayanan.P, Intellectual Property Law, Eastern Law House, 3rd Edition, December 2020.
4. Acharya.N.K, Text Book of Intellectual Property Rights, Asia Law House, 8th Edition, January 2021.

CO/PO MAPPING :

Mapping of Course Outcomes with Program Outcomes (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		**Programme Outcomes(POs)**												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	3	2	3	3	-	-	-	-	-	2	-	-	2
CO2	1	3	2	2	2	-	-	-	2	-	-	-	2	-
CO3	2	2	2	3	1	-	-	-	-	2	-	-	-	2
CO4	3	2	3	3	2	-	-	-	-	-	-	-	-	-
CO5	3	2	1	2	2	-	-	-	-	-	2	-	-	2

PROFESSIONAL ELECTIVE –V

AE20551	FATIGUE AND FRACTURE	3	0	0	3

COURSE OBJECTIVES

To enable the students to

- provide the basic knowledge on the mechanics of elastic and Plastic deformation
- creep, Fracture and fatigue failure, as applied to metals, composites,
- ceramics provide a thorough introduction to the principles of fracture mechanics.
- provide practical examples of the application of fracture mechanics to design and Life prediction
- apply stress analysis to calculate the crack driving force in linear and nonlinear materials and formulate appropriate fracture criteria for stationary and growing cracks

UNIT I FATIGUE OF STRUCTURES 8

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 maximum stress, minimum stress, mean stress, stress amplitude, stress ratio; constant amplitude fatigue, variable amplitude.

UNIT II 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 III PHYSICAL ASPECTS OF FATIGUE AND FRACTURE 12

Phase in fatigue life - Crack initiation, Crack growth ; Final Fracture ; Dislocations -fatigue fracture surfaces ,Strength and stress analysis of cracked bodies ; Potential energy and surface energy - Griffith's theory ,Irwin , Orwin extension of Griffith's theory to ductile materials ; Effect of thickness on fracture toughness - stress intensity factors for typical geometries.

UNIT IV FATIGUE DESIGN AND TESTINIG 8

Safe life and Fail-safe design philosophies - Importance of Fracture Mechanics in aerospace structures; application to composite materials and structures.

UNIT V FUNDAMENTALS OF FAILURE ANALYSIS 8

Common causes of failures- Principles of failure analysis, Fracture mechanics approach to failure problems, Techniques of failure analysis; Service failure mechanisms- ductile and brittle fracture, fatigue fracture, wear failures, fretting failures, environment induced failures, high temperature failure; Faulty heat treatment and design failures; processing failures (forging, casting, machining).

TOTAL PERIODS 45

COURSE OUTCOMES

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

- explain the need and importance of fatigue analysis.
- analyze the fatigue life a component based on its S-N data
- define the physical phases in a fatigue life of a component.
- recognize the mechanics of the propagation of cracks during fracture in a material.
- distinguish the fatigue based design philosophies and classify the materials based on their fatigue life.

TEXT BOOK

1. Prasanth Kumar ,"Elements of fracture mechanics" – Wheeter publication, 1999.
2. Barrois W, Ripely, E.L., "Fatigue of aircraft structure", Pegamon press. Oxford, 1983

REFERENCES

1. Sin, C.G., "Mechanics of fracture" Vol. I, Sijthoff and w Noord hoff International Publishing Co., Netherlands, 1989
2. Knott, J.F., "Fundamentals of Fracture Mechanics", Buterworth & Co., Ltd., London, 1983
   Subra suresh, "Fatigue of materials", II edition, 1998.
3. F.C.Campbell, "Fatigue and Fracture", ASM International, USA, First Printing , 2012.
4. T. L. Anderson, "Fracture mechanics: Fundamentals and applications", III edition, 2004

CO/PO MAPPING :

Mapping of Course Outcomes with Program Outcomes (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		Programme Outcomes(POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3	-	-	-	-	-	-	1	2	3	2
CO2	2	3	2	3	-	-	-	-	-	2	2	-	2	3
CO3	-	2	3	2	2	-	-	-	-	-	-	2	-	2
CO4	3	2	3	2	2	-	-	-	-	-	-	-	1	-
CO5	2	1	3	3	-	-	-	-	-	2	-	3	-	-

AE20552 NANO SCIENCE AND TECHNOLOGY 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- knowledge about the basic concepts of nanomaterials and science behind it.
- understand several preparation methods of nanoparticles
- exposure in the carbon-based nanomaterials and their synthesis process.
- knowledge characterization techniques for morphological behavior, chemical analysis and surface analysis
- understand the benefits of application of nano materials in wide range spectrum.

UNIT I NANO SCALE MATERIALS 9

Introduction-Feynman's vision; national nanotechnology initiative (NNI) - past, present, future; classification of nanostructures - nano scale architecture ; effects of the nanometer length scale -changes to the system total energy, and the system structures; effect of nano scale dimensions on various properties -magnetic properties of nanoscale materials ; differences between bulk and nano materials and their physical properties.

UNIT II NANOMATERIALS SYNTHESIS METHODS 9

Top down processes - mechanical milling, nanolithography and types based on radiations; Bottom up process - chemical vapor deposition, plasma enhanced CVD; colloidal and sol-gel methods -template based growth of nano materials; ordering of nano systems; self-assembly and self-organization - DC sputtering and RF sputtering process.

UNIT III CHARACTERIZATION TECHNIQUES 9

General classification of characterization methods - analytical and imaging techniques ; microscopy techniques -electron microscopy, scanning electron microscopy, transmission electron microscopy, atomic force microscopy - diffraction techniques ; X-ray spectroscopy ; thermo gravimetric analysis of nano materials.

UNIT IV SEMICONDUCTOR NANOSTRUCTURES 9

Quantum confinement in semiconductor nanostructures - quantum wells, quantum wires, quantum dots, super lattices; epitaxial growth of nanostructures-MBE, metal organic VPE; LPE - carbon nano tubes-structure, synthesis and electrical properties ,applications ; fuel cells - quantum efficiency of semiconductor nano materials.

UNIT V NANOMACHINES AND NANODEVICES 9

Micro electromechanical systems (MEMS) and Nano electromechanical systems (NEMS)-fabrication; actuators organic FET- principle, description, requirements, integrated circuits ; basic processes- carrier injection, excitons; optimization - organic photovoltaic cells, nano motors ,bio nano particles, nano objects ;applications of nano materials in biological field.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- classify the size dependant properties of different nanomaterials
- explain different experimental methods used for the preparation of nanomaterials
- analyse the data using different characterization techniques
- illustrate the different techniques to synthesize semiconductor nanostructures and utilize them for application.
- identify the impact of nano materials and their applications in Nano devices

TEXT BOOK

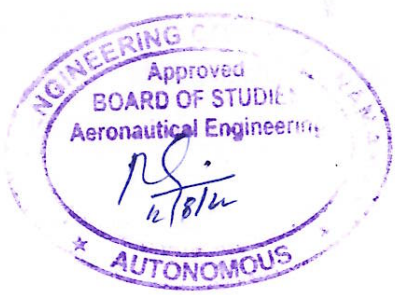
1. Willam A. Goddard, Donald W.Brenner, "Handbook of Nanoscience, Engineering, and Technology", CRC Press, 2012.
2. Charles P. Poole Jr and. Frank J. Owens, "Introduction to Nanotechnology", Wiley Interscience, 2007.

REFERENCES

1. Guozhong Cao,Y.Wang, "Nanostructures and Nanomaterials-Synthesis, Properties and Applications", Imperials College Press, 2011
2. T. Pradeep, "NANO: The Essentials Understanding Nanoscience and Nanotechnology", McGraw - Hill Education (India) Ltd, 2012..
3. Robert W. Kelsall, Ian W. Hamley, Mark Geoghegan, "Nanoscale Science and Technology", John Wiley and Sons Ltd, 2006.
4. Ping Sheng, Zikang Tang, "Nano Science and Technology Novel Structures and Phenomena", CRC Press, 2003.

CO/PO MAPPING :

Mapping of Course Outcomes with Program Outcomes (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		**Programme Outcomes(POs)**												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	-	2	3	3	2	-	3	-	-	-	-	2	3	3
CO2	-	2	2	3	3	2	2	-	-	-	-	2	3	2
CO3	-	2	3	3	2	-	2	-	-	-	-	2	2	3
CO4	-	3	2	2	3	-	3	-	-	-	-	2	2	2
CO5	-	3	3	2	3	-	3	-	-	-	-	2	3	2



AE20553 AIRFRAME MAINTENANCE AND REPAIR 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- familiarize with various types of airframe repairs and inspection procedures.
- impart knowledge on the materials used for airframe components.
- understand assembling and disassembling of airframe components
- identify the hydraulic and pneumatic components of airplanes
- gain knowledge on safety procedures followed for repairing of airplanes.

UNIT I MAINTENANCE OF AIRCRAFT STRUCTURAL COMPONENTS 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; Peening - Close tolerance fasteners; Sealing compounds; forming/shaping; Calculation of weight of completed repair; Effect of weight - change on surrounding structure.

UNIT II PLASTICS AND COMPOSITES IN AIRCRAFT 9

Review of types of plastics used in airplanes maintenance and repair of plastic components repair of cracks- holes etc., various repair schemes scopes, Inspection and repair of composite components special precautions autoclaves, Inspection of damage classification repair or replacement sheet metal inspection N.D.T; Testing riveted repair design-damage investigation.

UNIT III 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 IV 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; fire protection systems; ice protection system ; rain removal system position and warning system auxiliary power units (APUs).

UNIT V SAFETY PRACTICES 9

Hazardous materials storage and handling; Aircraft furnishing practices – shooting; Theory and practices; equipments.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- identify and apply the principles of function and safe operation to aircraft as per FAA.
- demonstrate the general airframe structural repairs, the structural repair manual and structural control programme
- perform airframe structural component inspection, corrosion repair and non-destructive inspection

- carry out aircraft component disassembly, reassembly and troubleshooting
- acquire knowledge on aircraft safety practices and handling of hazardous materials

TEXT BOOK

1. Kroes, Watkins, Delp, "Aircraft Maintenance and Repair ", McGraw Hill, New York, 7th Edition, 2013.
2. "General Hand Books of Airframe and Powerplant Mechanics", U. S. Dept. of Transportation, Federal Aviation Administration, the English Book Store, New Delhi 1995.

REFERENCES

1. Brimm D.J. Bogges H.E., "Aircraft Maintenance ", Pitman Publishing corp., NewYork, 2009.
2. Delp. Bent and Mckinely "Aircraft Maintenance Repair", McGraw Hill, New York, 1987.
3. Larry Reithmeir, "Aircraft Repair Manual ", Palamar Books, Marquette, 1992.
4. L. McKinley and R. D. Bent, "Aircraft Maintenance & Repair", Tata McGraw-Hill, 2010.

CO/PO MAPPING :

Mapping of Course Outcomes with Program Outcomes (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		Programme Outcomes(POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	-	1	-	2	3	1	-	-	1	2	2	3
CO2	2	2	-	1	3	2	3	1	-	-	1	2	3	2
CO3	-	2	-	2	3	1	2	3	-	1	2	-	2	2
CO4	3	2	-	2	1	1	2	3	-	-	3	2	3	3
CO5	1	1	-	1	2	1	3	3	-	3	2	2	3	2

AE20554 AIRCRAFT CONTROL SYSTEMS ENGINEERING 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- familiarize with mathematical modelling of systems, open loop and closed loop systems and analysis in timedomain and frequency domain.
- get introduced to sampled data control system.
- impart the knowledge on the concept of stab.
- impart knowledge on the various methods to analyze stability in both time and frequency domain.
- understand the concepts state models for linear continuous time systems.

UNIT I INTRODUCTION 9

Historical review- Simple pneumatic; hydraulic and thermal systems; Series and parallel system, Analogies, mechanical and electrical components, Development of flight control systems.

UNIT II OPEN AND CLOSED LOOP SYSTEMS 9

Feedback control systems – Control system components; Block diagram representation of control systems - Reduction of block diagrams, Signal flow graphs, Output to input ratios

UNIT III CHARACTERISTIC EQUATION AND FUNCTIONS 9

Response of systems to different inputs viz- Step impulse, pulse, parabolic and sinusoidal inputs, Time response of first and second order systems; steady state errors and error constants of unity feedback circuit.

UNIT IV CONCEPT OF STABILITY 9

Necessary and sufficient conditions- Routh-Hurwitz criteria of stability, Root locus and Bode techniques; Concept and construction; frequency response.

UNIT V STATE VARIABLE ANALYSIS 9

Introduction – Concepts of state, state variables and state model; State models for linear continuous time systems – Solution of state equations; Applications

TOTAL PERIODS 45

COURSE OUTCOMES

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

- identify the characteristics, uses and limitations of classical and modern feedback control methods
- acquire knowledge on open and closed loop systems
- distinguish between the responses of different order systems for various step inputs
- apply the concepts of time response and frequency responses for the practical systems
- acquire in-depth knowledge of PID control and state-space representation

TEXT BOOK

1. Kuo, B.C, "Automatic control systems", Prentice-Hall of India Pvt. Ltd., New Delhi, 2017.
2. Naresh K Sinha, "Control Systems", New Age International Publishers, New Delhi, 2008.

REFERENCES

1. Nagrath I.J & Gopal M, "Control System Engineering", New Age International Publishers, 4th Edition, 2006.
2. OGATO, "Modern Control Engineering", Prentice-Hall of India Pvt. Ltd., New Delhi, 5th Edition, 2010.
3. U.A Bakshi , "Control Systems", Technical Publications ,Fifth edition ,2014.
4. M.N.Bandyopadhyay," Control Engineering", PHI Learning Pvt, Seventh edition, 2009.

CO/PO MAPPING :

Mapping of Course Outcomes with Program Outcomes (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		Programme Outcomes(POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	3	2	1	-	-	-	-	-	2	1	-	3	2
CO2	-	2	2	1	3	-	-	-	-	2	1	-	3	2
CO3	-	2	1	2	3	-	-	-	-	-	2	-	2	3
CO4	-	2	3	2	1	-	-	-	-	2	3	-	1	2
CO5	-	1	1	1	2	-	-	-	-	2	2	-	1	3

PROFESSIONAL ELECTIVE-VI

AE20651 INDUSTRIAL AERODYNAMICS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- introduction the basic concepts of wind energy collectors
- understand the aerodynamics of ground vehicles
- gain the basic concepts of building aerodynamics
- build up necessary features for induced vibrations
- acquire knowledge about the industrial gas turbines

UNIT I WIND ENERGY COLLECTORS 9

Types of winds- Causes of variation of winds, Atmospheric boundary layer, Effect of terrain on gradient height; Horizontal axis and vertical axis machines, Power coefficient, Betz coefficient by momentum theory.

UNIT II GROUND VEHICLE AERODYNAMICS 9

Power requirement and drag coefficients of automobiles- Effects of cut back angle, Aerodynamics of cars, trains and hovercraft, and vehicle aerodynamics.

UNIT III 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.

UNIT IV FLOW INDUCED VIBRATIONS 9

Effect of Reynolds number on wake formation of bluff shapes- Vortex induced vibrations, Buffeting, Vortex Shedding, Galloping and flutter.

UNIT V INDUSTRIAL GAS TURBINES 9

Working of gas turbines- Special features of industrial and stationary gas turbines as compared to aircraft gas Turbines, applications of gas turbine.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- exhibit the basic components and functions of wind energy collectors.
- elaborate the aerodynamic performance of ground vehicles.
- analyze about the aerodynamics of various building
- identify the effects and functions of induced vibrations
- classify the subsystem of Industrial turbines.

TEXT BOOK

1. T.Yomi Obidi, "Ground Vehicle Aerodynamics with Applications", SAE International, 2014.
2. Lawson, "Building Aerodynamics", Cambridge University Press, 2010.

REFERENCES

1. Tomnmichi Nakamura, Shigehiko Kaneko, "Flow-Induced Vibrations: Classifications and Lessons from Practical Experiences", Second Edition, Academic Press, 2013
2. A.R. Jha, "Wind Turbine Technology", CRC Press,2010
3. Scorer R.S, "Environmental Aerodynamics", Ellis Harwood Ltd, England, 1978
4. Sovran, M(ed) , "Aerodynamic drag mechanism of bluff bodies and road vehicles", Plenum Press, N.Y,1978.

CO/PO MAPPING :

Mapping of Course Outcomes with Program Outcomes (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		**Programme Outcomes(POs)**												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	3	2	3	-	2	-	-	-	-	-	-	-
CO2	3	3	2	3	2	-	2	-	-	-	3	2	3	2
CO3	2	2	3	2	3	-		-	-	-	-	2	2	3
CO4	3	2	3	2	3	-	2	-	-	-	3	2	2	2
CO5	3	1	3	2	3	-	2	-	-		2	2	3	2

AE20652 AVIATION MANAGEMENT AND AIR SAFETY ENGINEERING 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- familiarize the Civil aviation, Airport terminologies, airport planning, management and operations
- provide the knowledge of infrastructure, condition monitoring and control aids.
- provide knowledge on Safety Regulations and Aviation Security
- study and understand the technologies in Air Safety Maintenance
- learn about technological advancement in aviation security.

UNIT I INTRODUCTION 9

History of Aviation- Development of Air transportation in India, Major players in Airline Industry; Market potential of Indian Airline Industry- Current challenges in Airline Industry; Competition in Airline Industry – Role of ICAO and IATA in Air transportation ; Airport terminology - Classification of aerodromes ; Classification of airports.

UNIT II AIRPORT MANAGEMENT AND AIRLINE OPERATIONS 9

Airport Management -Airport planning, Airport Operations ; Organization structure of Airports Sectors - Global and Indian scenario of Airport management ; DGCA – AAI Airline Operations ; Airline Terminal Management- Flight Information Counter/Reservation and Ticketing-Check In/Issue of Boarding pass; Customs and Immigration formalities-Security Clearance; Baggage- Handling, Handling of CIP,VIP and VVIP; Introduction to Airport cargo management.

UNIT III INSTITUTIONAL FRAMEWORK AND CONTROLLING 10

Role of DGCA – Slot allocation ; Methodology followed by ATC and DGCA ; Role of Air Traffic Control - Importance of Air Traffic Control ; Flight rules - Automation in Air Traffic Control aids; GPS Air Traffic Control - Aerodrome standards and Air Traffic Services -Air Safety -Design standards and type certification ,Flight crew standards, training and licensing.

UNIT IV AIR SAFETY 10

Rules of air avoidance of collision – lights to be displayed by aircraft ; Visual and instrument flight rules – Distress urgency and safety signals ; Hijacking – Security Measures , Screening; Metal Detectors –X-ray Inspections, Trace- Detection Techniques ; Aviation regulations -threat warnings ; Civil Aviation Security -Airborne Aircraft Security.

UNIT V TECHNOLOGICAL IMPROVEMENTS ON AVIATION SAFETY AND SECURITY 7

Technological Improvements on Aviation Safety and Security Introduction; Microwave Holographic Imaging -Body or Fire Security Scanner; New Generation of video Security Systems –Bio simmer , Biometric Systems.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- understand Aviation and Airport Management
- know the Airport Infrastructure and its maintenance procedures.
- gain knowledge about Air traffic control and GPS systems
- understand the requirement of Air Safety and the supporting systems
- get familiarity in technologies in Aircraft maintenance.

TEXT BOOK

- Rangwala. "Airport Engineering", Charotar Publishing House Pvt., 15th edition 2015.
- M.S Nolan, "Fundamentals Air Traffic Control", Latest Edition, YESDEE Publishers, 2010.

REFERENCES

1. Alexender.T. Wells, Seth young, "principles of airport management",excel books, 2007. R2 – P.S.Senguttuvan –Fundamentals of Airport Transport Management –McGraw Hill 2003
2. Richard H.Wood ,"Aviation Safety Programs-A management hand book"–Jeppesen anderson Inc,1991
3. Kathleen M. Sweet , "Aviation and Airport Security" ,Pearson Education Inc., Second edition, 2009.
4. Seth B. Young, Alexander T. Wells, "Airport Planning and Management" McGraw- Hill Education, New Delhi, 2011.

CO/PO MAPPING :

Mapping of Course Outcomes with Program Outcomes (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		Programme Outcomes(POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3	2		2		2			2	3	3
CO2	2	3	2	3	2		2					3	3	2
CO3	-	2	3	2	3		3		3			2	2	3
CO4	3	2	3	2	3		2		3			2	2	2
CO5	2	1	3	3	2		3		2			2	3	2

AE20653 AIR TRAFFIC CONTROL AND PLANNING 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- study the procedure of the formation of aerodrome and its design.
- learn about the various maintenance activities for airport maintenance.
- understand the air traffic control, procedure and air traffic service.
- familiarize the procedure of the formation of aerodrome and its design and air traffic control.
- acquire the knowledge about various navigation and lighting facilities.

UNIT I BASIC CONCEPTS 9

Objectives of ATS - Parts of ATC service , Scope and Provision of ATCs , VFR and IFR operations ; Classification of ATS air spaces ; Varies kinds of separation – Altimeter setting procedures , Establishment; designation and identification of units providing ATS –Division of responsibility of control.

UNIT II AIR TRAFFIC SERVICES 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.

UNIT III FLIGHT INFORMATION ALERTING SERVICES COORDINATION, EMERGENCY PROCEDURE AND RULES OF THE AIR 9

Secondary radar – performance checks, use of radar in area and approach control services ; assurance control and co-ordination between radar non radar control –emergencies ; Flight information and advisory service – Alerting service ;Co-ordination and emergency procedures ; Rules of the air.

UNIT IV AERODROME DATA, PHYSICAL CHARACTERISTICS AND OBSTACLE RESTRICTION 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 ;obstacles restriction; Comparison between domestic and international airport.

UNIT V VISUAL AIDS FOR NAVIGATION, VISUAL AIDS FOR DENOTING OBSTACLES EMERGENCY 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 and PAPI - Visual aids for denoting obstacles; object to be marked and lighter – Emergency and other services.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- exhibit the concept of air traffic rules and clearance procedure for airline operation.
- analyze the various air traffic data for air traffic services
- elaborate the influence of aerodrome design factors for service establishment.
- gain knowledge on aerodrome design.
- compare the different services of Air Traffic Control.

TEXT BOOK

1. Virendra Kumar and Sathish Chandra, "Airport Planning and Design", Galgotia publications Pvt Ltd,New Delhi, 2012.
2. Aeronautical Information Publication (India) Vol I and II, the English book store,17-1, Connaught New Delhi. 2006SS.

REFERENCES

1. Nolan M.S, "Fundamentals Air Traffic Control ", Last Edition ,YESDEE Publishers ,2010.
2. Seth B.Young, Alexander T.Wells, "Airport Planning and Management" McGraw-Hill Education New2011.
3. Smith David , "Air Traffic Control Handbook" ,Crecy Publishing 2014.
4. "Air Traffic Management", ICAO Doc 4444 ATM/501,15th edition 2007.

CO/PO MAPPING :

Mapping of Course Outcomes with Program Outcomes (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		Programme Outcomes(POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	2	3	3	2	-	3	-	-	-	-	2	3	3
CO2	-	2	2	3	3	2	2	-	-	-	-	2	3	2
CO3	-	2	3	3	2	-	2	-	-	-	-	2	2	3
CO4	-	3	2	2	3	-	3	-	-	-	-	2	2	2
CO5	-	3	3	2	3	-	3	-	-	-	-	2	3	2

BA20252 **DISASTER MANAGEMENT** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- exposure to disasters, their significance and types.
- ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction.
- understanding of approaches of Disaster Risk Reduction (DRR).
- enhance awareness of institutional processes in the country.
- develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity.

UNIT I INTRODUCTION TO DISASTERS **9**

Definition- Disaster, Hazard, Vulnerability; Resilience, Risks – Disasters; Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc ; Classification- Causes, Impacts including social, economic, political, environmental, health, psychosocial; Differential impacts- in terms of caste, class, gender, age, location, disability ; Global trends in disasters urban disasters, pandemics, complex emergencies, Climate change; Dos and Don'ts during various types of Disasters.

UNIT II EMERGENCY RESPONSE ACTION BY AN AIRLINE **9**

Composition of Airline Emergency Response Team – Emergency Notification Action; Responsibilities of Emergency Response Coordinator ;Quick Response Checklist – General Instructions ;Initial Response Team – Responsibilities of Initial Response Team ; Composition Of Initial Response Team , Spokes Person ,Responsibilities of Spokes Person ; Non schedule flight – Meaning , Documents to be Maintained at Office Responsibilities of Airline's Reception.

UNIT III EMERGENCY RESPONSE ACTIVITIES **9**

Ground Operations – Meaning, Responsibilities of Ground Operations Head during Emergency, Quick Response Checklist, Airport Manager, Meaning, Responsibilities of Airport Manager during Emergency, Quick Response Checklist; Response during Occurrence at Respective Airport Location ; Response during occurrence outside the Respective Airport Location – Airline Passenger list to release to Public ; Airline Passenger List only for an Airline – Travel arrangements.

UNIT IV EMERGENCY RESPONSE PROCEDURES **9**

Operational Control Centre (OCC) – Meaning ; Responsibilities of OCC – Quick Response Checklist ;Duty Officer (OCC) ; Responsibilities of Duty officer (OCC) ; Crisis Management Centre – Responsibilities of Crisis Management Centre ; Director Operations ; Responsibilities of Director Operations ; Quick Response Checklist – Director Inflight Services ; Responsibilities of Director Inflight Services–Quick Response Checklist ; Head Finance – Quick Response Check List ; Responsibilities of Medical Team - Responsibilities of Head Finance ,Summary of Responsive Action ; GO Team – Members , Hospital Assistance Team ; GO Kit –Components of GO Kit ; Responsibility of the Manager to Manage GO Kit – Extra needs during an Accident ; Crisis Management Activation – Crisis management and Family Assistance Programme GH.

UNIT V CRISIS MANAGEMENT AND FAMILY NOTIFICATION GUIDELINES 9

Family Assistance Program – Public Relations ; Corporate Communication Coordinator – Responsibilities , Press Release ; Media Centre Programme ; Airline Emergency Response Team -Responsibilities , Interaction with Government Agencies ; Family Notification Process ; Preparation and Release of Passenger Checklist – Mentally Assistance help to Family Victims , Disposal of Victim's Personal effect , Selfcare during Emergency ; General Guidelines of Family Notification - Requirement for Quality Assurance Quality audit- ISO 9000 Quality standard Reliability.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- differentiate the types of disasters, causes and their impact on environment and society
- assess vulnerability and various methods of risk reduction measures as well as mitigation.
- draw the hazard and vulnerability profile of India, Scenarios in the Indian context, disaster damage assessment and management.
- apply knowledge about existing global frameworks and existing agreements and role of community insuccessful Disaster Risk Reduction
- evaluate DM study including data search, analysis and presentation as a case study.

TEXT BOOK

1. Srivastava A.K., "A Text Book of Disaster Management" , Scientific Publishers, March 2021
2. Palanivel Kathiresan, Saravanavel .J, Sh Gunasekaran, "Disaster Management", Allied Publishers Pvt Ltd., NewDelhi, February 2015.

REFERENCES

1. Kumar P, "Disaster Management", Oak Bridge Publications, First Edition (Jan 2021)
2. Sulphey.M.M, "Disaster Management", PHI Learning, April 2017.
3. Mukherjee.S, Upadhaya.S, " Disaster Management", Kisalaya Publications Pvt. Ltd., India, 1st Edition, 2014.
4. Jagbir Singh, "Disaster Management – Future Challenges & Opportunities", Dream Tech Press, 2020.

CO/PO MAPPING :

Mapping of Course Outcomes with Program Outcomes (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		Programme Outcomes(POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	2	3	3	2	-	3	-	-	-	-	2	3	3
CO2	-	2	2	3	3	2	2	-	-	-	-	2	3	2
CO3	-	2	3	3	2	-	2	-	-	-	-	2	2	3
CO4	-	3	2	2	3	-	3	-	-	-	-	2	2	2
CO5	-	3	3	2	3	-	3	-	-	-	-	2	3	2

OPEN ELECTIVE-II

AE20903 PRINCIPLES OF UNMANNED AERIAL VEHICLE 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the kinematics and dynamics of fixed wing unmanned aerial vehicle
- understand the kinematics and dynamics of multirotor micro aerial vehicle.
- gain knowledge on navigational system
- design flight controls for UAV
- design collision free navigation system

UNIT I KINEMATICS AND DYNAMICS OF FIXED WING UNMANNED AERIAL VEHICLE 10

Introduction- Aerial Robot, Modeling and Dynamics Formulation; Frame Rotations and Representations-Euler angles, Quaternion Dynamics of a Fixed-Wing Unmanned Aerial Vehicle.

UNIT II KINEMATICS AND DYNAMICS OF MULTIROTOR 10

Micro Aerial Vehicle (MMAV) - Propeller Theory-Thrust and Drag moment, Dynamics of a Multirotor Micro Aerial Vehicle (MMAV); Mathematical modelling of Multirotor Micro Aerial Vehicle.

UNIT III STATE ESTIMATION 9

Navigational Sensors-Inertial Sensors; Magnetometer-Pressure Sensor, GPS-Camera based Navigation; Kalman Filter-Position and velocity analysis, Inertial Navigation Systems; Attitude estimation

UNIT IV FLIGHT CONTROLS 8

PID Control–Lateral control of MMAV using PID, LQR Control ; Design of LQR servo control in MATLAB; Linear Model Predictive; Control-Design and Implementation of a Linear MPC for MAV.

UNIT V MOTION PLANNING 8

Holonomic Vehicle Boundary Value Solver- Dubins Airplane model Boundary Value Solver; Collision-free Navigation; Structural Inspection Path Planning.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- acquire knowledge on kinematics and dynamics of fixed wing unmanned aerial vehicle
- identify the kinematics and dynamics of multirotor
- identify the sensor susedin UAVs
- perform test on the flight control systems
- plan the motion of the UAVs.

TEXT BOOK

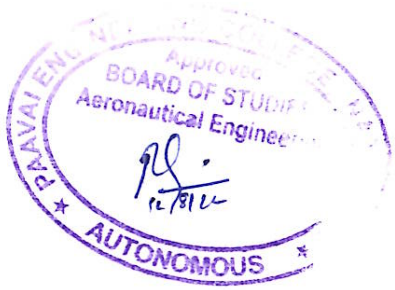
1. R. Beard, and T. W. McLain, 'Small Unmanned Aircraft: Theory and Practice", Princeton University.
2. R.C. Nelson, "Flight Stability and Automatic Control", McGraw Hill, New York 1998.

REFERENCES

1. L.R. Newcome., "Unmanned Aviation, a Brief History of Unmanned Aerial Vehicles", American Institute of Aeronautics and Astronautics, Reston 2004.
2. Kuo, B.C., "Automatic Control Systems", Prentice Hall, 1991.
3. Garvit Pandya, "Basics of Unmanned Aerial Vehicles", Notion Press, 1st edition 2021.
4. Reg Austin , "UAVS Design, Development and Deployment "(Aerospace Series Book 55) 1st Edition 2011

CO/PO MAPPING :

Mapping of Course Outcomes with Program Outcomes (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		**Programme Outcomes(POs)**												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	3	2	-	2	-	2	-	-	2	3	3
CO2	2	3	2	3	2	-	2	-	-	-	-	3	3	2
CO3	-	2	3	2	3	-	3	-	3	-	-	2	2	3
CO4	3	2	3	2	3	-	2	-	3	-	-	2	2	2
CO5	2	1	3	3	2	-	3	-	2	-	-	2	3	2



AE20904 **AIRCRAFT SAFETY** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- impart the knowledge of human factors and spatial disorientation
- study the cause of runway incursion
- gain knowledge of weather-related problems in low and high altitudes
- learn about the various mid air collision issues and rectification procedures
- know about various air crash investigation reports by NTSB

UNIT I HUMAN FACTORS **9**

Judgment and Decision Making – Accurate Situation Assessment and Situational Awareness ; Crew Resource Management – Crew effectiveness; Spatial Disorientation – Types of Spatial Disorientation; International Case Study- Singapore Airlines Flight 006.

UNIT II RUNWAY INCURSIONS **9**

Runway Incursion severity categories – Reported Runway Incursions by Severity; Distribution by Aircraft type and Combination; Case Study-Pan American and KLM airlines air crash.

UNIT III WEATHER FORECAST **9**

Air Masses and Fronts – Types of Fronts; Cloud Formations – Low, Medium, High clouds; thunderstorms – Aircraft performance in Heavy rains ; Icing conditions ; Types of Clouds ; Turbulence; Case Study- China Airlines Flight CI-012.

UNIT IV MID AIR COLLISIONS **9**

Mid air collision avoidance – Eye brain connection, Eye movement ; Distant visual Acuity – Cockpit creates monocular visual areas ; Effective scanning based on sectors – Enhancing visual skills; Case Study - A Cessna 340 and a North American T-6.

UNIT V AIR CRASH INVESTIGATION - CASE STUDIES **9**

Korean Air Flight 801; TWA Flight 427 and a Cessna 441; Northwest Flights 1482 and 299; USAir Flight 1016 ; Aeromexico Flight 498 and a Piper Cherokee.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- compare the features of various human factors.
- describe the principle and avoidance of runway incursion
- analyze the various weather problems during VFR and IFR flight.
- acquire and interpret data of various mid air collisions.
- acquire knowledge of old air crash and investigation procedure.

TEXT BOOK

1. Krause, Shari Stamford, "Air Safety/ Accident Investigation, analysis and applications", Tata McGraw Hill, New Delhi, 2009.
2. Ferguson M, "Aviation Safety –A balanced Industry Approach", Cengage India,2005

REFERENCES

1. Stephen J. Wright, "Aviation safety & Security", Taylor & Francis Ltd, CRC Pres 1st edition, 2021.
2. Stephen K. Cusick , "Commercial Aviation Safety" ,McGraw Hill Education; Sixth edition,2017.
3. Richard Wood/Robert Sweginnis "Aircraft accident Investigation", Endeavor Books; 2nd Edition,2006.
4. Brandon W. Wild Gary M. Ullrich "Aviation Safety- The Basics", book boon.1st Edition, 2015.

CO/PO MAPPING :

Mapping of Course Outcomes with Program Outcomes (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		Programme Outcomes(POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3	2	-	2	-	2	-	-	2	3	3
CO2	2	3	2	3	2	-	2	-	-	-	-	3	3	2
CO3	-	2	3	2	3	-	3	-	3	-	-	2	2	3
CO4	3	2	3	2	3	-	2	-	3	-	-	2	2	2
CO5	2	1	3	3	2	-	3	-	2	-	-	2	3	2