PAAVAI ENGINEERING COLLEGE, NAMAKKAL – 637 018

(AUTONOMOUS)

B.E- AERONAUTICAL ENGINEERRING

CURRICULUM-REGULATIONS 2019

(CHOICE BASED CREDIT SYSTEM)

(For the candidates admitted during the Academic Year 2019-2020 onwards)

SEMESTER V

S.No	Category	Course Code	Course Title	Course Mode	L	T	P	C
THEORY								
1.	PC	AE19501	Flight Mechanics	Theory	3	0	0	3
2.	PC	AE19502	Aerodynamics II	Theory	3	0	0	3
3.	PC	AE19503	Ramjet and Rocket Propulsion	Theory	3	1	0	4
4.	PC	AE19504	Aircraft Structures – II	Theory	3	1	0	4
5.	PC	AE19505	General Engineering Practices for Aircraft Maintenance	Theory	3	0	0	3
6.	PE	AE1915*	Professional Elective – I*	Theory	3	0	0	3
PRACTICAL								
7.	PC	AE19506	Propulsion laboratory	Practical	0	0	2	1
8.	PC	AE19507	Aircraft Structures -II Laboratory	Practical	0	0	2	1
9.	EE	EN19501	Career Development Laboratory-I	Practical	0	0	2	1
				TOTAL	**18**	**2**	**6**	**23**

SEMESTER VI

S.No	Category	Course Code	Course Title	Course Mode	L	T	P	C
THEORY								
1.	HS	BA19151	Entrepreneurship Development	Theory	3	0	0	3
2.	PC	AE19601	Finite Element Methods for Aeronautical Applications	Theory	3	0	0	3
3.	PC	AE19602	Composite Materials and Structures	Theory	3	0	0	3
4.	PC	AE19603	Experimental Stress Analysis	Theory	3	0	0	3
5.	PE	AE1925*	Professional Elective – II*	Theory	3	0	0	3
6.	OE	AE199**	Open Elective – I*	Theory	3	0	0	3
PRACTICAL								
7.	PC	AE19604	CAD and CAM Lab for Aeronautical Applications	Practical	0	0	2	1
8.	PC	AE19605	Aircraft Systems and Repair Laboratory	Practical	0	0	2	1
9.	EE	EN19601	Career Development Laboratory-II	Practical	0	0	2	1
				TOTAL	**18**	**0**	**6**	**21**

Professional Elective – I

S.No	Category	Course Code	Course Title	L	T	P	C
1.	PE	AE19151	Experimental Aerodynamics	3	0	0	3
2.	PE	AE19152	Vibrations and Elements of Aeroelasticity	3	0	0	3
3.	PE	AE19153	Aircraft Materials	3	0	0	3
4.	PE	BA19152	Principles of Management	3	0	0	3

Professional Elective – II

S.No	Category	Course Code	Course Title	L	T	P	C
1.	PE	AE19251	Aero Engine Maintenance and Repair	3	0	0	3
2.	PE	AE19252	Space Mechanics	3	0	0	3
3.	PE	AE19253	Additive Manufacturing	3	0	0	3
4.	PE	AE19254	Boundary Layer Theory	3	0	0	3

Open Elective - I

S.No	Category	Course Code	Course Title	L	T	P	C
1	OE	AE19901	Fundamentals of Aircraft Engineering	3	0	0	3
2	OE	AE19902	Wind Power Engineering	3	0	0	3

SEMESTER V

AE19501 FLIGHT MECHANICS 3 0 0 3

COURSE OBJECTIVES

To enable students to

- familiarize students with the cruising flight performance.
- describe the performance of flight under different maneuvering conditions.
- familiarize with various Aircraft motions and related stability.
- analyze the longitudinal, lateral, directional stability modes of an aircraft.
- familiarize with the concept of dynamic stability of Aircraft.

UNIT I PRINCIPLES OF FLIGHT 9

Physical properties and structure of the atmosphere; International Standard Atmosphere–Temperature, pressure and altitude relationship; Measurement of speed -True, Indicated and Equivalent air speed; Streamlined and bluff bodies; Various Types of drag in airplanes - Drag polar, Methods of drag reduction of airplanes.

UNIT II AIRCRAFT PERFORMANCE IN LEVEL, CLIMBING AND GLIDING 8

Straight and level flight; Thrust required and available; Power required and available; Effect of altitude on thrust and power; Conditions for minimum drag and minimum power required–Gliding and Climbing flight, Range and endurance.

UNIT III ACCELERATED FLIGHT 9

Take-off and landing performance; Turning performance - horizontal and vertical turn, Pull up and pull Down, maximum turn rate; V-n diagram with FAR regulations.

UNIT IV LONGITUDINAL STABILITY AND CONTROL 10

Degrees of freedom of a system–static and dynamic stability, static longitudinal stability; Contribution of individual components–neutral point, static margin, hinge moment, elevator control effectiveness; Power effects-elevator angle to trim, elevator angle per g, maneuver point, stick force gradient, aerodynamic balancing; Aircraft equations of motion; stability derivatives; stability quartic; Phugoid motion.

UNIT V LATERAL, DIRECTIONAL STABILITY AND CONTROL 9

Yaw and side slip; Dihedral effect; Contribution of various components - lateral control, aileron control power; Strip theory - aileron reversal, weather cock stability, directional control, rudder requirements, dorsal fin ; One engine inoperative condition; Dutch roll, spiral and directional divergence, autorotation and spin.

COURSE OUTCOMES TOTAL PERIODS 45

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

- predict the aerodynamic characteristics of the airplane, the engine performance and how flight
- altitude affects the airplane performance.
- design aircraft parameters according to the mission requirement.
- perform preliminary design computations to meet static stability and trim requirements
- identify the lateral and longitudinal modes and relate the important physical influences of aircraft properties on these modes.

TEXT BOOKS

1. Perkins, C.D., and Hage, R.E., "Airplane Performance stability and Control", John Wiley & Son:, Inc, NY,Fourth edition, 2017.
2. John David Anderson, Jr., 'Aircraft Performance and Design', First Edition, Tata McGraw Hill, 2010.

REFERENCES

1. Nelson, R.C., 'Flight Stability and Automatics Control', Second Edition, McGraw Hill,1997.
2. E. L. Houghton, P. W. Carpenter, Steven H Collicott, and Daniel T Valentine, 'Aerodynamic for Engineering Students', Sixth Edition, Butterworth-Heinemann, 2012.
3. L. J. Clancy, 'Aerodynamics', 6th edition, Sterling book house, 2006.
4. Barnes W. McCormick, 'Aerodynamics, Aeronautics and Flight Mechanics', Second Edition, John Wiley, New York, 1994.

CO - PO Mapping

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

AE19502 **AERODYNAMICS II** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- acquire the basic concepts of compressible flow
- understand the behavior of airflow both internal and external in compressible flow regime with particular emphasis on supersonic flows.
- know the theory behind the formation of shocks and expansion fans in Supersonic flows.
- obtain the potential flow in two-dimensional compressible flow.
- introduce the methodology of measurements in Supersonic flows.

UNIT I ONE DIMENSIONAL COMPRESSIBLE FLOW **10**

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

UNIT II NORMAL AND OBLIQUE SHOCKS **12**

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

UNIT III EXPANSION WAVES AND METHOD OF CHARACTERISTICS **8**

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

UNIT IV DIFFERENTIAL EQUATIONS OF MOTION FOR STEADY COMPRESSIBLE FLOWS **7**

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

UNIT V TRANSONIC FLOW OVER WING **8**

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

TOTAL PERIODS 45

COURSE OUTCOMES

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

- understand and apply the fundamental aspects of compressible flow
- understand and apply the fundamental aspects of compressible flow
- compute the calculations related to shock and expansion waves
- compute the equations for various parameters in two-dimensional compressible flow
- elaborate the visualization methods of flow properties

TEXT BOOKS

1. Anderson. J. D, "Modern Compressible Flow", McGraw;Hill and Co., 2002.
2. E. Radhakrishnan, "Gas Dynamics", Fifth Edition, PHI Learning Private Limited ; New Delhi, 2014.

REFERENCES

1.Shapiro. A. H., "Dynamics and Thermodynamics of Compressible Fluid Flow", Ronald Press, 1982.Zucrow. M.J. and Anderson, J. D., "Elements of Gas Dynamics", McGraw; Hill and Co., 1989.

2.J. D. Anderson, "Fundamentals of Aerodynamics", Fifth Edition, McGraw Hill Education India PrivateLimited,2010.

3.S.M. Yahya, "Fundamentals of Compressible Flow", New Age Science Ltd, 2009.

CO - PO Mapping

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

AE19503 RAMJET AND ROCKET PROPULSION 3 1 0 4

COURSE OBJECTIVES

To enable the students to

- understand theory in ramjet and scramjet propulsion.
- familiarize with various propulsion technologies associated with space launch vehicles, missiles and spaceprobes.
- gain sound fundamental knowledge in gas dynamics, thermo chemistry, heat transfer, and vehicle dynamicsas related to rocket motor/vehicle analysis.
- acquire an overview of various rocket technologies and applications.
- understand about the multi-stage launch vehicles, arc jets, nuclear thermal rocket motors, and ion thrusters

UNIT I RAMJET AND SCRAMJET PROPULSION 9+3

Operating principle of ramjet engine - Combustion in ramjet engine, Ramjet performance; Introduction to hypersonic air breathing propulsion - hypersonic vehicles and supersonic combustion, Need for supersonic combustion for hypersonic propulsion ;Salient features of scramjet engine and its applications for hypersonic vehicles ;Numerical problems.

UNIT II CHEMICAL ROCKET PROPULSION 9+3

Operating principle -Specific impulse of a rocket, Internal ballistics, Performance characteristics of rockets ; Numerical problems; Types of igniters; Ignition systems in liquid rockets; Rocket nozzle classification; Preliminary concepts in nozzle-less propulsion.

UNIT III SOLID PROPELLANT ROCKETS 9+3

Solid propellant rockets; Selection criteria of solid propellants; Important hardware components of solid rockets; Propellant grain design considerations; Erosive burning in solid propellant rockets; Combustion instability; Strand burner and T-burner; Applications and advantages of solid propellant rockets; Thrust termination techniques; Numerical problems.

UNIT IV LIQUID AND HYBRID PROPELLANT ROCKETS 9+3

Liquid propellant rockets - selection of liquid propellants, Propellant feed systems; Thrust vector control in liquid rockets; Cooling in liquid rockets; Numerical Problems; Introduction to hybrid rockets - combustion mechanism in hybrid propellant rockets, Relative advantages of liquid rockets over solid rockets, Applications and limitations.

UNIT V ADVANCED PROPULSION TECHNIQUES 9+3

Electric rocket propulsion - Types of electric propulsion techniques; Ion propulsion; Nuclear rocket; Solar sail; Current scenario of advanced propulsion projects worldwide.

TOTAL PERIODS: 45+15

COURSE OUTCOMES

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

- understand ramjet and hypersonic air breathing propulsion systems.
- gain familiarity in rocket propulsion systems.
- know the applications and principles of liquid and solid and liquid propulsion systems.

- gain knowledge about the advanced propulsion technique used for interplanetary
- understand the concepts behind advanced propulsion systems.

TEXT BOOKS

1. Sutton, G.P., "Rocket Propulsion Elements", John Wiley and Sons Inc., New York, 7th edition.
2. Kou.K.K and Summerfield.M., Fundamental Aspects of Solid Propellant Rockets, Progress in and Aeronautics, AIAA, Vol.90, 1982.

REFERENCE BOOKS

1. Barrere.M, "Rocket Propulsion", Elsevier Publishing Company, New York, 1960.
2. M. Mathur and R. P. Sharma, "Gas Turbines and Jet and Rocket Propulsion", Standard Publishers, New Delhi, 2005.
3. Gordon Oates, "Aero thermodynamics of Gas Turbine and Rocket Propulsion", AIAA Education Series
4. J.W.Cornelisse, H.F.R.Schoyer, K.F.Wakker, "Rocket Propulsion and Spaceflight Dynamics," Pitman, London. (1979)

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CO2	2	3	3	2	3	2	2	-	-	-	3	2	3	2
CO3	-	1	3	2	3	2	2	-	-	-	2	-	2	3
CO4	-	3	2	3	2	-	3	-	-	-	3	2	2	2
CO5	-	2	3	3	3	3	-	-	-	3	2	2	3	2

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AE19504 **AIRCRAFT STRUCTURES - II** **3 1 0 4**

COURSE OBJECTIVES

To enable students to

- introduce the various structural components of aircrafts
- familiarize with different section of beams subjected to various types of loading.
- know the theoretical and methodological approaches to design aircraft structures.
- provide the knowledge on the importance of structural analysis of aircraft.
- study the behavior of various aircraft structural components under different types of loads.

UNIT I UNSYMMETRICAL BENDING **9+3**

Bending of symmetric beams subject to skew loads; bending stresses in beams of unsymmetrical sections; generalized k-method; neutral axis method; principal axis method; Advantages and Disadvantages of three methods.

UNIT II SHEAR FLOW IN OPEN SECTIONS **9+3**

Thin walled beams; Concept of shear flow; shear centre; Elastic axis; one axis of symmetry; wall effective and ineffective in bending; unsymmetrical beam sections

UNIT III SHEAR FLOW IN CLOSED SECTIONS **9+3**

Bredt-Batho formula; Single and Multi-cell structures; approximate methods; Shear flow in single, multi-cell structures under torsion; Shear flow in single and multi-cell under bending with walls effective and ineffective.

UNIT IV BUCKLING OF PLATES **9+3**

Rectangular sheets under compression; Local buckling stress of thin walled sections; Crippling stresses by Needha's and Gerard's methods; Sheet stiffener panels - Effective width, inter rivet and sheet wrinkling failures.

UNIT V STRESS ANALYSIS OF WING AND FUSELAGE **9+3**

Aircraft loads; classification the V-n diagram; shear force and bending moment distribution over the aircraft wing and fuselage; shear flow in thin-webbed beams with parallel and non-parallel flanges; complete tension field beams; semi-tension field beam theory.

TOTAL PERIODS **45+15**

COURSE OUTCOMES

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

- analyze the response of structures due to unsymmetrical bending.
- identify and analyze structural problems commonly encountered in aircrafts.
- find the shear flow over the section
- determine the effect of a variety of loading and support conditions on the small deflection of beams
- identify various types of structural components and their loading pattern.

TEXT BOOKS

1. Megson, T.H.G., "Aircraft Structures for Engineering Students", Fifth Edition (Rev.), Butterworth; Heinemann, 2017.
2. David J. Peery, "Aircraft Structures (Dover Books on Aeronautical Engineering)", Dover Publications,2013.

REFERENCES

1. James M. Gere & Barry J Goodno,"Mechanics of Materials", cengage Learning Custom Publishing; 9th edition, 2019
2. Howard D Curtis, "Fundamentals of Aircraft Structural Analysis", WCB-McGraw Hill, 1997
3. Bruhn. E.H. "Analysis and Design of Flight vehicles Structures", Tri-state off set Company, USA, 2015.
4. Timoshenko. S. and Young D.H. "Elements of strength materials Vol. I and Vol. II"., T. Van Nostrand Co, Inc Princeton, N.J. 1990.

CO - PO Mapping

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

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AE19505 GENERAL ENGINEERING PRACTICES FOR AIRCRAFT MAINTENANCE 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- study about the various ground handling procedures of an aircraft
- know about the ground servicing of Aircraft Subsystems.
- learn the safety procedures and precautions requirements
- understand the inspection procedures
- introduce the basic hardware, materials, system processes involved in aircraft

UNIT I AIRCRAFT GROUND HANDLING AND SUPPORT EQUIPMENT 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 II GROUND SERVICING OF VARIOUS SUB SYSTEMS 8

Air conditioning and pressurization system and their maintenance; Oxygen and oil systems and their maintenance; Ground units and their maintenance.

UNIT III MAINTENANCE OF SAFETY 8

Shop safety; Electrical Safety; Fire Protection and Fire Safety; Safety Around - Compressed Gases, Hazardous Materials, Machine Tools; Flight Line Safety; Safety Around Airplanes and Helicopters; Environmental cleanliness; Precautions.

UNIT IV GENERAL INSPECTION 10

Process; Purpose; Types; Inspection intervals; Techniques; Checklist; Special inspection - Publications, bulletins, various manuals; FAR Air worthiness directives; Type certificate Data sheets; ATA Specifications

UNIT V 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.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- elaborate the ground handling operations of an aircraft
- carry out ground servicing of critical aircraft systems
- identify the safety requirements in the maintenance bay
- compute the effective inspection required for various parts of an aircraft
- compare the specifications standards of aircraft hardware systems

TEXT BOOKS

1. A and P Mechanics, "Aircraft Hand Book", F A A Himalayan Book House, New Delhi, 1996
2. A and P Mechanics," General Hand Book", F A A Himalayan Bok House, New Delhi, 1996

REFERENCES

1. Kroes Watkins Delp, "Aircraft Maintenance and Repair", McGraw Hill, New York, 1993
2. Larry Reithmeir, "Aircraft Repair Manual", Palamar Books, Marquette, 1992.
3. Dale Crane, Aviation Maintenance Technician: Power plants, 2nd edition, Aviation Supplies and Academics Inc,2005
4. General Hand Books of Airframe and Powerplant Mechanics, U. S. Dept. of Transportation,Federal Aviation Administration, the English Book Store, New Delhi 1995.

CO - PO Mapping

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CO2	2	2	1	2	2	-	-	-	-	-	-	2	3	2
CO3	2	3	2	2	3	-	-	-	-	-	-	2	2	3
CO4	3	3	2	2	3	-	-	-	-	-	-	2	2	2
CO5	2	2	2	2	3	-	-	-	-	-	-	2	3	2

COURSE OBJECTIVES

To enable the students to

- understand the basic concepts in aerospace propulsion.
- gain the knowledge about piston engine and jet engine components.
- familiarize student with a calibration test.
- learn the testing of different jets and velocity profile.

LIST OF EXPERIMENTS

1. Study of aircraft piston engine.
2. Piston engine dismantling procedures.
3. Piston engine reassembly procedures.
4. Study of aircraft gas turbine engine.
5. Engine starting procedures.
6. Velocity profiles of free jets.
7. Velocity profiles of wall jets.
8. Free convective heat transfer over a cylinder.
9. Forced convective heat transfer over a cylinder.
10. Determination of calorific value of Aviation Fuel.

TOTAL PERIODS 30

COURSE OUTCOMES

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

- analyze the performance of various aircraft piston and gas turbine engines components.
- compute the flow behavior of jets.
- identify various testing methods of variable area ducts, jet engine components.
- estimate the calorific value of various types of fuels.

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CO1	2	-	3	-	-	-	-	-	3	2	3	2	3	3
CO2	2	-	3	3	2	-	-	-	3	3	2	2	3	2
CO3	3	-	2	3	3	-	-	-	2	2	3	-	2	3
CO4	2	-	-	-	2	-	-	-	3	2	3	-	2	2

AE19506 **AIRCRAFT STRUCTURES - II LABORATORY** **0 0 2 1**

COURSE OBJECTIVES

To enable the students to

- understand the behavior of structural components with different loading conditions.
- know the shear center location of open and closed section
- find the fringe value of the material
- gain knowledge of tensioned specimen

LIST OF EXPERIMENTS

1. Determination of principle plane of unsymmetrical section
2. Determination of Shear centre location for Z sections
3. Determination of Shear centre location for open channel sections
4. Determination of Shear centre location for angle sections
5. Calibration of Photo - elastic materials using plane polariscope
6. Calibration of Photo - elastic materials using circular disc under compression
7. Calibration of Photo -elastic material using beam subjected to pure tension
8. Determination of forces in wire of hinged bar experiment
9. Wagner beam -Tension field beam with gauge mounting practices
10. Determine the acceleration and velocity by vibration test
11. Determination of elastic constant for composite tensile specimen
12. Fabrication of composite laminate

TOTAL PERIODS 30

COURSE OUTCOMES

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

- evaluate the numerical analysis of structural components.
- estimate the shear center of various section
- identify the fringe value of the materials
- perform calibration of photo elastic materials under different loads.

CO - PO Mapping

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CO1	3	-	3	3	3	-	-	-	2	-	2	-	3	3
CO2	3	-	1	2	2	-	-	-	3	3	3	-	3	2
CO3	3	-	2	2	3	-	-	-	2	2	2	2	2	3
CO4	3	-	2	2	2	-	-	-	3	2	2	1	2	2

EN19501 CAREER DEVELOPMENT LABORATORY I 0 0 2 1

OBJECTIVES

To enable the students to

- enhance their own potential strength and reduce weakness to survive in corporate world
- evaluate their own personality skills to face the interviews in a successful way
- solve the quantitative aptitude problems and improve their problem solving skills
- solve the quantitative aptitude in advance level tests to get placed in Tier 1 companies
- improve their reasoning skills to get placed in reputed companies.

UNIT I BASICS - SELF ANALYSIS 6

Introduction - Self Explorations-Who Am I; Know yourself; SWOT Analysis – Corporate resume building – Group Discussion: Level – 0 – Role Play: Team

UNIT II PERSONALITY DEVELOPMENT 6

Just A Minute (JAM): Level 0-Extempore – Johari Window Model – Goal Setting – Achievement worksheet – Group Discussion: Leve-1 - Mock Interview Practice: Level 0

UNIT III QUANTITATIVE APTITUDE - I 6

Number System - LCM & HCF - Square root & Cube root – Percentage - Time - Speed & Distance

UNIT IV QUANTITATIVE APTITUDE - II 6

Trains - Boats & Streams – Average – Ages - Area

UNIT V LOGICAL AND VERBAL REASONING 6

Series Completion: Number Series, Letter Series, Symbol Series - Blood Relation - Coding and Decoding - Logical Sequence – Analogy - Character Puzzles – Classification - Data Sufficiency

TOTAL PERIODS: 30

OUTCOMES

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

- demonstrate the interpersonal skills in group discussions.
- enhance their verbal and written ability.
- practice soft skills to excel in their jobs.
- compute problems based on quantitative aptitude.
- reveal their logical and verbal reasoning by scoring the expected percentage to get placed in reputed companies.

REFERENCE BOOKS

1. Agarwal, R.S." a modern approach to Verbal & Non Verbal Reasoning", S.Chand& Co Ltd, new delhi.
2. Abhijit Guha, "Quantitative Aptitude ", Tata;Mcgraw Hill.
3. Word Power Made Easy By Norman Lewis ,Wr.Goyal Publications.
4. Johnson, D.W. Reaching out ;Interpersonal Effectiveness and self actualization. Boston: Allyn

And Bacon.

5. Agarwal, R.S. " Objective General English", S.Chand&Co
6. Infosys Campus Connect Program ;students' guide for soft skills.

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

SEMESTER VI

BA1915 ENTREPRENEURSHIP DEVELOPMENT 3 0 0 3

COURSE OBJECTIVES

To enable students to

- understand the Management principles.
- build the entrepreneurial competencies & analyse the support rendered by government and other agencies in entrepreneurship development.
- understand the business opportunities & to prepare a Feasibility Report.
- propose a business plan.
- appraise & comprehend the various factors to be considered for launching a small business.

UNIT I BASICS OF MANAGEMENT 9

Management : Meaning, Definition, Nature & Importance ; Roles of management - Functions of Management - Levels of Management - Functional areas of Management : Marketing, Finance, Production, HRM, IT, R & D.

The Evolution & Development of Management Thought : Classical, Neo -classical, System and Contingency Approaches - An Overview.

UNIT II ENTREPRENEURIAL COMPETENCE & ENVIRONMENT 9

Entrepreneurial Competence: Entrepreneurship – Definition, Role and expectations – Entrepreneurial styles and types – Characteristics of the Entrepreneur - Entrepreneurial Competencies – Functions of an Entrepreneur.

Entrepreneurial Environment: Role of Socio-Cultural, Economic and Political Environment – Institutional Support for small entrepreneurs, Assistance Programme for Small Scale Units – Institutional Framework, Central and State Government Industrial Policies and Regulations.

UNIT III ENTREPRENEURIAL DEVELOPMENT 9

Ownership Structures – Proprietorship, Partnership, Company, Co-operative, Franchise.

Identification of Business Opportunity – Preparation of Feasibility Report – Financial and Technical Evaluation – Project Formulation – Common Errors in Project Formulation – Specimen Project Report

Entrepreneurial Development Programs — Role of SSI Sector in the Economy – IAS Units – Failure, Causes and Preventive Measures – Turnaround Strategies.

UNIT IV BUSINESS PLAN PREPARATION, FINANCING VENTURES 9

Business Plan : Business opportunities-SWOT, Business plan process, Feasibility Study, Functional plan- Marketing plan, Operational plan, Organizational plan, financial plan, Evaluation Criteria.

Financing ventures : sources of raising capital, seed funding, venture capital funding, funding opportunities for startups in India.

UNIT V WOMEN ENTREPRENEURSHIP & ENTREPRENEURSHIP IN VARIOUS SECTORS 9

Women Entrepreneurship: Growth of women Entrepreneurship – Problems faced by Women Entrepreneurs – Development of women Entrepreneurship.

Entrepreneurship in Informal Sector: Rural Entrepreneurship – Entrepreneurship in Sectors like

Agriculture, Tourism, Health care, Transport and allied services.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- implement the necessary managerial skills to become an entrepreneur.
- take up self-employment having been exposed to entrepreneurial environment.
- select a best business idea by using appropriate methods to assess its viability.
- formulate a business plan & deploy the resources for sustainable growth.
- analyse channels and means of launching a small business in any sector.

TEXT BOOKS

1. Khanka S.S, "Entrepreneurial Development", S. Chand & Company Limited, New Delhi, 2016.
2. Saravanavel. P, "Entrepreneurial Development", Ess Pee Kay Publishing House, Chennai, 2013.

REFERENCES

1. Donald L. Sexton & Raymond W.Smilor, "The Art and Science of Entrepreneurship", Ballinger Publishing Company, 2008.
2. Clifford M.Baumback & Joseph R.Mancuso, "Entrepreneurship and Venture Management", Prentice Hall, 1975.
3. Gifford Pinchot, "Intrapreneuring" Harper & Row Publishers, New York, 2005.
4. Mathew Manimala, "Entrepreneurship Theory at the Crossroads", Paradigms & Praxis, Biztrantra, 2nd Edition, 2015.
5. Prasanna Chandra, "Projects – Planning, Analysis, Selection, Implementation and Reviews", Tata McGraw-Hill, 2013.
6. P.C.Jain, "Handbook for New Entrepreneurs", EDII, Oxford University Press, New Delhi, 2012.

CO - PO Mapping

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

AE19601 FINITE ELEMENT METHODS FOR AERONAUTICAL APPLICATIONS 3 0 0 3

COURSE OBJECTIVES

To enable students to

- equip the students with the Finite Element Analysis fundamentals.
- understand the concept of stiffness matrix for bar truss problems using suitable boundary condition.
- understand the 2d structures plane stress and plane strain condition
- study 2d and 3d structures using isoparametric elements.
- acquire the basic knowledge of fluid flow and heat transfer problems.

UNIT I FUNDAMENTAL ASPECTS OF FEM 10

Introduction to methods of engineering analysis; Review of various approximate methods; Variational approach and weighted residual approach; Steps in Finite Element Method –Types, Process of discretization; Shape and Size of elements; Natural and Artificial Discretization; Advantageous and Disadvantageous.

UNIT II ONE DIMENSIONAL ELEMENTS 10

One dimensional linear bar element; Displacement and shape function; stiffness matrix; Finite Element Equation; Load or Force Vector; Numerical Problem; Truss element; Displacement and shape function; stiffness matrix; Finite Element Equation; Load or Force Vector; Numerical Problem.

UNIT III CONTINUUM ELEMENTS 8

Plane stress - plane strain and axisymmetric problems; Derivation of element matrices for constantand linear strain triangular elements and axisymmetric element

UNIT IV ISOPARAMETRIC ELEMENTS 10

Definitions; Shape function for 4, 8 and 9 nodal quadrilateral elements; stiffness matrix and consistent load vector; evaluation of element matrices using numerical integration.

UNIT V FIELD PROBLEM AND METHODS OF SOLUTIONS 7

Heat transfer problems; steady state fin problems; Guassian Quadrature Numerical Problems; Features of Software packages; sources of error.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- draw the flow chart of finite element steps and understand the convergence of the problem
- solve stiffness matrix for bar truss problems using suitable boundary condition.
- compute the 2d structures plane stress and plane strain condition
- model the 2d and 3d structures using isoparametric elements.
- solve fluid flow and heat transfer problems.

TEXT BOOKS

1. Reddy J.N."Introduction to Finite Element Method", 4th Edition, McGraw;Hill,2020
2. Tirupathi.R. Chandrupatla and Ashok D. Belegundu, "Introduction to Finite Elements in Engineering", Prentice Hall India, Fourth Edition, 2015.

REFERENCES

1. Larry J. Segerlind, "Applied finite element analysis", 2nd edition, John Wiley and Sons, Inc, 1985.Rao. S.S., "Finite Element Methods in Engineering," Butterworth and Heinemann, 2010.
2. Bathe, K.J. and Wilson, E.L., "Numerical Methods in Finite Elements Analysis", Prentice Hall of India,2016.
3. Krishnamurthy, C.S., "Finite Element Analysis", Tata McGraw Hill, 2017

CO - PO Mapping

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

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AE19602 COMPOSITE MATERIALS AND STRUCTURES 3 0 0 3

COURSE OBJECTIVES

To enable students to

- learn about the micro structures of composite.
- understand the concept of macro structure composite.
- gain the knowledge of laminate types and failure criteria.
- familiarize the sandwich construction.
- know the fabrication methods of composite.

UNIT I INTRODUCTION TO COMPOSITES 6

Definition ; Classification of composite materials - Advantages, limitations and application of composite materials; Properties and classifications of reinforcements and matrices; Factors contribute to mechanical performance of composites; Generalized Hooke's law.

UNIT II METHODS OF ANALYSIS 10

Micro mechanics - Mechanics of materials approach, elasticity approach to determine material properties; Macro mechanics – Stress-strain relations; Determination of material properties; Mechanical properties of Composites - Tensile test, compression test, flexural test, shear test and inter-laminar shear strength.

UNIT III LAMINATED PLATES 11

Governing differential equation for a general laminate, angle ply and cross ply laminates; stress-strain relations for a laminate; different types of laminates; failure criteria for composites.

UNIT IV SANDWICH CONSTRUCTIONS 9

Basic design concepts of sandwich construction; materials used for sandwich construction; failure modes of sandwich panels. Application of sandwich composites

UNIT V FABRICATION PROCESS AND REPAIR SCHEME 9

Various open and closed mould processes; Manufacture of fibers; types of resins and properties and applications ; importance of repair and different types of repair techniques in composites

TOTAL PERIODS 45

COURSE OUTCOMES

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

- identify the properties of fiber and matrix materials used in commercial composite materials.
- analyze the structural properties of composite materials.
- elaborate the conventional failure theories of composite materials.
- execute the concept of sandwich construction
- develop the knowledge in fabrication process.

TEXT BOOKS

1. Autar K Kaw, 'Mechanics of Composite Materials', CRC Press, 2nd edition, 2005.
2. Madhuji Mukhapadhyay, 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 and sons. Inc.New York, 3rd edition, 2006.
2. Robert Jones., "Mechanics of Composite materials" second edition., CRC press, 2015.
3. Michael F. Ashley, "Material Selection in Mechanical Design", 5th edition, Butterworth-Heiner, 2016
4. Allen Baker, Composite Materials for Aircraft Structures, AIAA Series, 2nd Edition, 2004.

CO - PO Mapping

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CO2	-	3	3	3	2	-	2	-	-	-	2	2	3	2
CO3	-	1	1	2	3	-	3	-	-	-	3	2	2	3
CO4	-	3	1	2	3	-	2	-	-	-	3	2	2	2
CO5	-	2	2	3	2	-	2	-	-	-	3	2	3	2

AE19603 EXPERIMENTAL STRESS ANALYSIS 3 0 0 3

COURSE OBJECTIVE:

To enable students to

- bring awareness on experimental method of finding the response of the structure to different types of load.
- analyze experimental data and develop appropriate, logical conclusions based on comparisons theoretical results and other experimental evidence.
- gain knowledge about the photo elastic materials and their testing.
- analyze the failure pattern in different materials.
- know about the various non-destructive testing methods

UNIT I EXTENSOMETERS AND DISPLACEMENT SENSORS 8

Principles of measurements - Accuracy, Sensitivity and range of measurements; Mechanical, Optical, Acoustical and Electrical extensometers and their uses; Advantages and disadvantages; Capacitance gauges; Laser displacement sensors.

UNIT II ELECTRICAL RESISTANCE STRAIN GAUGES 11

Principle of operation and requirements - Types and their uses, Materials for strain gauges, Calibration and temperature compensation, cross sensitivity; Wheatstone bridge and potentiometer circuits for static and dynamic strain measurements; Strain indicators; Rosette analysis - stress gauges, load cells, data acquisition, six component balances.

UNIT III PHOTOELASTICITY 10

Two-dimensional photo elasticity - Photo elastic materials, Concept of light, photo elastic effects, stress optic law, Transmission photo elasticity, Jones calculus, plane and circular polariscope; Interpretation of fringe pattern; Calibration of photo elastic materials; Compensation and separation techniques; Introduction to three-dimensional photo elasticity.

UNIT IV BRITTLE COATING AND MOIRE TECHNIQUES 8

Relation between stresses in coating and specimen; Use of failure theories in brittle coating; Moire method of strain analysis.

UNIT V NON-DESTRUCTIVE TESTING 8

Fundamentals of NDT; Acoustic Emission Technique; Radiography; Thermography; Ultrasonics; Eddy Currenttesting; Fluorescent Penetrant Testing,

COURSE OUTCOMES TOTAL PERIODS 45

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

- gain knowledge of stress and strain measurements in loaded components.
- acquire information's, the usage of strain gauges and photo elastic techniques of measurement.
- formulate and solve general three-dimensional problems of stress-strain analysis especially fundamental problems of elasticity.
- analyze the strain gauge data under various loading condition by using gauge rosette method.
- experimentally evaluate the location and size of defect in solid and composite materials by using various Non-destructive Testing methods.

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. Durelli. A.J., "Applied Stress Analysis", Prentice Hall of India Pvt Ltd., New Delhi, 1970
2. Hetenyi, M., "Hand book of Experimental Stress Analysis", John Wiley and Sons Inc., New York, 1972.
3. Max Mark Frocht, "Photo Elasticity", John Wiley and Sons Inc., New York, 1968
4. Pollock A.A., Acoustic Emission in Acoustics and Vibration Progress, Ed. Stephens R.W.B.,Chapman and Hall,1993.

CO - PO Mapping

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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

AE19604 CAD AND CAM LAB FOR AERONAUTICAL APPLICATIONS 0 0 2 1

COURSE OBJECTIVES

To enable the students to

- familiarize the knowledge of modeling software package and tools used
- design and draft the different aircraft components and aircraft control system
- gain the knowledge on operations using CNC machine
- understand the principles behind geometric dimensioning

LIST OF EXPERIMENTS

1. Draw and modeling of riveted and welded joints.
2. Draw and modeling of airfoil sections.
3. Draw and modeling of various structural components of wing.
4. Draw and modeling of various structural components of fuselage.
5. Layout of Landing gear structure.
6. Layout of aircraft conventional control system components (cam, bell crank, push pull rod and gears)
7. Drafting three views of a typical aircraft
8. Draw and modeling of truss and beam.
9. Study of basic principles of geometric dimensioning and tolerance.
10. Study of Facing, Turning and Drilling operations in CNC

TOTAL PERIODS 30

COURSE OUTCOMES

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

- identify the tools used in modeling software.
- design various aircraft components and control systems
- acquire the knowledge on operations using CNC machine
- understand fundamentals of geometric dimensions and tolerance.

CO - PO Mapping

Mapping of Course Outcomes with Program Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
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CO1	1	-	2	-	3	-	-	-	1	-	2	2	3	3
CO2	1	-	2	-	1	-	-	-	2	1	2	2	3	2
CO3	1	-	2	-	3	-	-	-	2	2	1	2	2	3
CO4	1	-	2	1	3	-	-	-	2	2	-	2	2	2

COURSE OBJECTIVES

To enable students to

- gain the knowledge of the maintenance procedures followed for aircraft engine overhaul.
- impart the knowledge of the repair procedures followed in Airframe maintenance.
- study about welding of aircraft components
- learn about the repair and inspection works that are done on an aircraft.

LIST OF EXPERIMENTS

1. Aircraft Jacking Up and Leveling procedure.
2. Control System Rigging check procedure.
3. Brake Torque Load Test on wheel brake units.
4. Landing gear retraction test.
5. Engine (Piston Engine) - cleaning, visual inspection, NDT checks.
6. Riveted patch repairs.
7. Tube bending and flaring
8. Welded single & double V- joints.
9. Study on MIG, TIG & PLASMA welding of aircraft components; Welded patch repair
10. Aircraft wood gluing - Single scarf joint and Double scarf joint

COURSE OUTCOMES TOTAL PERIODS 30

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

- perform repair and maintenance procedures of aircraft engine overhaul.
- execute repair and maintenance of airframe structures.
- perform welding of aircraft components.
- carry out wood repairs and tube repairs

CO - PO Mapping

Mapping of Course Outcomes with Program Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
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CO4	3	-	2	1	3	-	-	-	2	2	3	2	2	2

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EN19601 CAREER DEVELOPMENT LABORATORY II 0 0 2 1

OBJECTIVES

To enable the students to

- understand the corporate lifestyle and culture to grab the employment opportunities
- enrich the skills required to crack the interviews
- solve the aptitude questions quickly to improve the level of performance in written test
- articulate the skills required in Group Discussion to increase the possibilities to get selected in companies
- refine their verbal ability to achieve the task on time in their workplaces

UNIT I CORPORATE READINESS 6

Writing Skills: Email Writing - Paragraph writing -Time Management – Stress Management – JAM: Level 1 - Self Introduction – JAM: Level 2 – Buddy Presentation - Role Play: Individual

UNIT II INTERVIEW SKILLS 6

Group Discussion: Level II – Group Discussion: Level III – General – Interview Techniques - Selection process - Grooming - Dress code - Body Language – Mock Interview Practice: Level 1

UNIT III QUANTITATIVE APTITUDE - III 6

Simplification - Time and work - Pipes and cisterns - Ratio and Proportion - Partnership

UNIT IV QUANTITATIVE APTITUDE - IV 6

Simple interest and Compound interest - Profit and loss - Permutation and combination Probability - Calendar

UNIT V LOGICAL AND VERBAL REASONING 6

Seating arrangement – Direction - Arithmetic reasoning – Syllogisms - Making Judgments - Statements and conclusions - Matching definition - Cause and effect

TOTAL PERIODS: 30

OUTCOMES

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

- place in reputed companies by making themselves ready for corporate expectation.
- use the required skills to attend an interview and group discussion.
- showcase the presentation skills in an interview.
- calculate the quantitative aptitude questions within the stipulated time.
- display their logical and verbal reasoning skills in corporate placement.

REFERENCE BOOKS

1. Agarwal, R.S." a modern approach to Verbal & Non Verbal Reasoning", S.Chand& Co Ltd, new delhi.
2. Abhijit Guha, "Quantitative Aptitude ", Tata;Mcgraw Hill.
3. Word Power Made Easy By Norman Lewis ,Wr.Goyal Publications.
4. Johnson, D.W. Reaching out ;Interpersonal Effectiveness and self actualization. Boston: Allyn

And Bacon.

5. Agarwal, R.S. " Objective General English", S.Chand & Co
6. Infosys Campus Connect Program ;students' guide for soft skills.
7. Mitra ,barun.k, " Personalaity Development & Softskills " , Oxford University.

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

PROGRAMME ELECTIVE I

AE19151 EXPERIMENTAL AERODYNAMICS 3 0 0 3

COURSE OBJECTIVE:

To enable students to

- provide extensive treatment of the operating principles and limitations of pressure and temperature measurements.
- cover both operating and application procedures of hot wire anemometer.
- describe flow visualization techniques and to highlight in depth discussion of analogue methods.
- Measure various pressure, velocity and temperature values.
- acquire knowledge on special flows and perform uncertainty calculations.

UNIT I BASIC MEASUREMENTS IN FLUID MECHANICS 7

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 II WIND TUNNEL MEASUREMENTS 10

Characteristic features - operation and performance of low speed, transonic, supersonic and special tunnels; Power losses in a wind tunnel; Instrumentation and calibration of wind tunnels; Turbulence; Wind tunnel balance - Wire balance, Strut type, Platform type, Yoke type, Pyramid type; Strain gauge balance - Balance calibration.

UNIT III FLOW VISUALIZATION AND ANALOGUE METHODS 9

Visualization techniques -Smoke tunnel , Hele - Shaw apparatus; Interferometer ; Fringe Displacement method; Schlieren system; Shadowgraph; Hydraulic analogy; Hydraulic jumps; Electrolytic tank.

UNIT IV PRESSURE, VELOCITY AND TEMPERATURE MEASUREMENTS 9

Pitot-static tube characteristics; Velocity measurements; Hot-wire anemometry; Constant current and Constant temperature Hot-Wire anemometer; Pressure measurement techniques; Pressure transducers; Temperature measurements.

UNIT V SPECIAL FLOWS AND UNCERTAINTY ANALYSIS 10

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.

TOTAL PERIODS 45

COURSE OUTCOMES:

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

- gain knowledge on measurement techniques in aerodynamic flow.
- acquire information on basics of wind tunnel measurement systems know specific instruments for flow parameter measurement like pressure, velocity

- use measurement techniques involved in Aerodynamic testing.
- analyze the model measurements, Lift and drag measurements through various techniques and testing of different models.
- apply the Wind tunnel boundary corrections and Scale effects.

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. Bradsaw "Experimental Fluid Mechanics", Elsevier, 2nd edition, 1970.
2. Pope, A., and Goin, L., "High Speed Wind Tunnel Testing", John Wiley, 1985.
3. Pavian, Henry Christensen, "Experimental Aerodynamics", 1st edition, Pitman Publishing, 1940.
4. G P Russo, "Aerodynamic Measurements: From Physical Principles to Turnkey Instrumentation", Woodhead publishing, 1990.

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

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AE19152 VIBRATION AND ELEMENTS OF AEROELASTICITY 3 0 0 3

COURSE OBJECTIVE:

To enable students to

- study the effect of time dependent forces on mechanical systems
- learn the Eigen value and vector problems
- understand about the natural characteristics of continuous system.
- Familiarize with the Approximate Methods
- study the Aero elastic effects of aircraft wing.

UNIT I SINGLE DEGREE OF FREEDOM SYSTEMS 10

Introduction to simple harmonic motion - D'Alembert's principle, free vibrations, damped vibrations, forced vibrations, with and without damping; Support excitation; Transmissibility; vibration measuring instruments.

UNIT II DAMPED, FORCED VIBRATIONS OF 1 DOF SYSTEM 10

Damped vibrations - Forced Vibrations, with and without damping; Support excitation; Vibration measuring instruments; helicopter vibration and methods for measurement and control.

UNIT III MULTI DEGREES OF FREEDOM SYSTEMS 8

Two degrees of freedom systems - Static and Dynamic couplings, vibration absorber, Principal co-ordinates, Principal modes and orthogonal condition; Eigen value problems; Hamilton's principle; Lagrangean equation and application.

UNIT IV CONTINUOUS SYSTEMS AND APPROXIMATE METHODS 9

Vibration of elastic bodies; Vibration of strings; Longitudinal, Lateral and Torsional vibrations; Rayleigh method; Holzer Method; Stodolas method; matrix iteration method..

UNIT V ELEMENTS OF AEROELASTICITY 8

Concepts; Coupling; Aeroelastic instabilities and their prevention; Basic ideas on wing divergence - loss and reversal of aileron control; Flutter and its prevention.

COURSE OUTCOMES TOTAL PERIODS 45

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

- understand the single degree vibrating system
- solve multi-degree vibrating systems
- differentiate types of vibrations according to dampness and particle motion.
- use numerical techniques for vibration problems
- understand the formation of Aileron reversal, flutter and wing divergence

TEXT BOOKS:

1. Grover. G.K., "Mechanical Vibrations", 7th Edition, Nem Chand Brothers, Roorkee, India, 2003
2. Leonard Meirovitch, "Elements of Vibration Analysis". McGraw Hill International Edition,2007
3. Thomson W T, 'Theory of Vibration with Application' ; CBS Publishers, 1990.

REFERENCES:

1. Bisplinghoff R.L., Ashely H and Hogman R.L., "Aeroelasticity", Addision Wesley Publication, New Tork, 1983.
2. Den Hartog, "Mechanical Vibrations" Crastre Press, 2008.
3. TSE. F.S., Morse, I.F., Hinkle, R.T., "Mechanical Vibrations" - Prentice Hall, New York, 1984.
4. William W Seto, "Mechanical Vibrations" - McGraw Hill, Schaum Series.
5. William Weaver, Stephen P. Timoshenko, Donovan H. Yound, Donovan H. Young. 'Vibration Problems in Engineering' - John Wiley and Sons, New York, 2001

CO - PO Mapping

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

AE19153 **AIRCRAFT MATERIALS** **3 1 0 3**

COURSE OBJECTIVES

To enable students to

- To learn different material properties, defects and equipment, procedure to perform various destructive and non-destructive tests.
- To familiarize about various strengthening and hardening mechanisms of materials.
- To understand materials used in aircraft construction; Aluminium, Magnesium and Titanium, Steel, Copper alloys and Super alloys.
- To learn about composites, sandwich structures and adhesives.
- To understand about material characterization.

UNIT I MECHANICAL BEHAVIOUR OF ENGINEERING 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; physical metallurgy; general requirements of materials for aerospace applications

UNIT II STRENGTHENING MECHANISMS IN 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; Creep and fatigue; Comparative study of metals, ceramics plastics and composites.

UNIT III 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.

UNIT IV CERAMICS AND COMPOSITES 9

Introduction ; powder metallurgy; modern ceramic materials; cermets ; 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, open and close mould processes.

UNIT V 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; High temperature material characterization

TOTAL PERIODS 45

COURSE OUTCOMES

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

- understand the mechanical behaviour of engineering materials
- understand strengthening mechanisms in materials
- gain knowledge of ferrous & non ferrous materials in aircraft
- understand composites and adhesives
- understand the basics of nano materials and material characterization

TEXT BOOKS

1. V Rajendran, "Material Science" Tata Mc Graw; Hill, New Delhi 2011
2. Titterton.G., Aircraft Materials and Processes, Pitman Publishing Co., 2004

REFERENCES

1. V. Raghavan, "Material Science & Engineering: A first course", Sixth Edition 2015.
2. Lalith Gupta "Advanced Composite Materials ", Himalaya Book House, Delhi, 2006
3. Marc Andre Meyers and Krishna Kumar Chawla, "Mechanical behavior of materials",Prentice;Hall,
4. R. W. Hertzberg, "Deformation and Fracture Mechanics of Engineering Materials", 4th Edition.

CO - PO Mapping

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

BA19152 **PRINCIPLES OF MANAGEMENT** **3 0 0 3**

OBJECTIVES

To enable the students to

- have an insight into the evolution of Management.
- have an understanding about the nature & purpose of planning.
- get to know the nuances of organizing in Management.
- know the need for communication in directing human resource.
- learn the process of controlling.

UNIT I INTRODUCTIONTO MANAGEMENTANDORGANIZATIONS 9

Definition of Management; Science or Art; Manager Vs Entrepreneur; types of managers; managerial roles and skills; Evolution of Management - Scientific, human relations, system and contingency approaches; Types of Business organization - Sole proprietorship, partnership, company; public and private sector enterprises; Organization culture and Environment - Current trends and issues in Management; Case studies

UNIT II PLANNING 9

Nature and purpose of planning; planning process; types of planning; objectives – setting objectives , policies ; Planning premises; Introduction to Strategic Management; Planning Tools and Techniques– Decision making steps and process; Case studies.

UNIT III ORGANISING 9

Nature and purpose ; Formal and informal organization - organization chart , organization structure, types ; Line and staff authority; Departmentalization; delegation of authority - centralization and decentralization, Job Design; Human Resource Management - HR Planning, Recruitment, selection, Training and Development, Performance Management ,Career planning and management; Case studies

UNIT IV DIRECTING 9

Foundations of individual and group behaviour - motivation, motivation theories, motivational techniques, job satisfaction, job enrichment; Leadership - types and theories of leadership, communication, process of communication, barrier in communication, effective communication, communication and IT; Case studies

UNIT V CONTROLLING 9

System and process of controlling ; budgetary and non-budgetary control techniques - use of computers and IT in Management control ; Productivity problems and management ; control and performance; direct and preventive control; reporting; Case studies

TOTAL PERIODS: 45

OUTCOMES

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

- have acquaintance about the evolution & the current trends in Management
- frame plans for business and domestic tasks.

- identify the types of organizations and the need for delegation of authority.
- identify the right channel to be used in communication.
- know the application of the control system in the controlling process.

TEXT BOOKS

1. Harold Koontz, Heinz Weirich& Mark V.Camice.'Essentials of Management : An international innovation & Leadership perspective', TMH, 11th edition, 2020.
2. Tripathi P.C, Reddy P.N, 'Principles of Management', Mcgraw Hill Education India, 6th Edition.

REFERENCE BOOKS

1. Callie Daum, Principles of Management, Vibrant Publishers, Mumbai, Second edition, January 2020
2. Dr. Radha. S, Dr. Pandian P, Gnanasekaran.G, Principles of Management, Charulatha Publications Private Limited, 2019.
3. Dr. Suraj Kumar Debanth, Dr. Sarada Prasad Datta, Principles of Management, Tee Dee Publications, January 2020
4. Prasad L.M, 'Principles & Practice of Management', Sultan Chand & Sons, 10th Edition, 2021.
5. Ramasamy .T, Principles of Management, Divya Stationery Mart, 2019.

CO - PO Mapping

Mapping of Course Outcomes with Program Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	Programme Outcomes (POs)												PSOs	
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CO1	-	-	3	-	-	3	2	2	3	3	2	3	-	-
CO2	-	-	2	-	-	3	3	3	2	2	3	2	-	-
CO3	-	-	3	-	-	2	3	2	3	3	2	2	-	-
CO4	-	-	3	-	-	3	2	3	3	3	2	3	-	-
CO5	-	-	2	-	-	2	2	3	2	2	3	3	-	-

PROGRAMME ELECTIVE II

AE19251 AERO ENGINE MAINTENANCE AND REPAIR 3 0 0 3

OBJECTIVES

To enable the students to

- study about the various classification of piston engines.
- know about the inspection procedures applicable for piston engines.
- understand the use of tools and instruments for inspection of piston engines.
- gain knowledge about the Jet engine components.
- introduce the overhauling processes involved in Jet engine.

UNIT I CLASSIFICATION OF PISTON ENGINE COMPONENTS 10

Types of piston engines; principles of operation ; Function of components - materials used, details of starting the engines, details of carburetion and injection systems for small and large engines; Ignition system components - spark plug details, engine operation conditions at various altitudes, maintenance and inspection check to be carried out.

UNIT II INSPECTION OF PISTON ENGINES 8

Inspection and maintenance and troubleshooting; Inspection of all engine components - daily and routine checks, overhaul procedures; Compression testing of cylinder; Special inspection schedules - engine fuel, control and exhaust systems; Engine mount and super charger; Checks and inspection procedures.

UNIT III TOOLS AND INSTRUMENTS FOR INSPECTION OF PISTON ENGINES 10

Symptoms of failure - fault diagnostics, case studies of different engine systems, tools and equipment requirements for various checks and alignment during overhauling; Tools for inspection - tools for safety and for visual inspection; Methods and instruments for non destructive testing techniques; Equipments for replacement of part and their repair; Engine testing - engine testing procedures and schedule preparation; Online maintenance

UNIT IV CLASSIFICATION OF JET ENGINE COMPONENTS 9

Materials used in jet engine - details of starting and operation procedures; Gas turbine engine inspection and checks - use of instruments for online maintenance; Special inspection procedures - foreign object damage, blade damage; Maintenance procedure of gas turbine engines, trouble shooting and rectification procedures , component maintenance procedures, systems maintenance procedures; Gas turbine testing procedures – test schedule preparation, storage of engines, preservation and depreservation procedures.

UNIT V OVERHAULING 8

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.

TOTAL PERIODS: 45

OUTCOMES

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

- analyse the components and functions of piston Engine.
- compare the various piston engines.
- conduct the maintenance processes of piston engines.
- determine the various parts and functions of jet engine in an aircraft.
- perform the overhauling procedures followed for Jet engine.

TEXT BOOKS

1. Krores and Wild, "Aircraft Power plants", 7th edition – TATA McGraw Hill,New Delhi, 2010.
2. Turbomeca, "Gas Turbine Engines", The English Book Store, New Delhi, 1993.

REFERENCE BOOKS

1. United Technologies' Pratt and Whitney, "The Aircraft Gas turbine engine and its Operation ",(latest edition) The English Store, New Delhi, 2005.
2. Treager, Aircraft: "Gas Turbine Engine Technology", Tata McGraw-Hill, 2002.
3. Ralph .D. Bent, James .L. McKinsley, "Aircraft and Powerplants", Gregg Division, McGraw Hill.
4. Dale Crane, "Aviation Maintenance Technician: Powerplants," 2nd edition, Aviation Supplies and Academics Inc,2005.

CO - PO Mapping

Mapping of Course Outcomes with Program Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
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CO1	1	2	2	1	-	-	-	-	2	-	-	3	2	2
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CO3	2	2	3	2	-	-	-	-	3	-	-	2	2	3
CO4	2	2	2	2	-	-	-	-	3	-	-	1	3	2
CO5	2	1	3	1	-	-	-	-	2	-	-	1	3	2

AE19252 **SPACE MECHANICS** **3 0 0 3**

COURSE OBJECTIVES

To enable students to

- introduce concepts of orbital mechanics.
- categorize the bodies with respect to position and time.
- know the concept of satellite injection.
- identify the trajectory computation for interplanetary travel.
- know the fundamental flight of ballistic missiles.

UNIT I SPACE ENVIRONMENT **8**

Peculiarities of space environment and its description; Effect of space environment on materials of spacecraft structure and astronauts; Manned space missions; Effect on satellite life time

UNIT II BASIC CONCEPTS AND THE GENERAL N; BODY PROBLEM **10**

The solar system - reference frames and coordinate systems, terminology related to the celestial sphere and its associated concepts; Kepler's laws of planetary motion and proof of the laws ; Newton's universal law of gravitation - many body problem; Lagrange-Jacobi identity - circular restricted three body problem; libration points.

UNIT III SATELLITE INJECTION AND SATELLITE PERTURBATIONS **10**

General aspects of satellite injection - satellite orbit transfer , various cases; Orbit deviations due to injection errors; Special and general perturbations; Cowell's method and Encke's method; Method of variations of orbital elements

UNIT IV INTERPLANETARY TRAJECTORIES **8**

Two-dimensional interplanetary trajectories; Fast interplanetary trajectories; Three dimensional interplanetary trajectories; Launch of interplanetary spacecraft; Trajectory estimation about the target planet

UNIT V BALLISTIC MISSILE TRAJECTORIES **9**

Introduction to ballistic missile trajectories - boost phase, ballistic phase, trajectory geometry, optimal flights, time of flight, re-entry phase; Position of impact point; Influence coefficients.

TOTAL PERIODS **45**

COURSE OUTCOMES

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

- Ability to perform satellite injection, satellite perturbations and trajectory control
- Apply orbital mechanics to control ballistic missile
- Estimate the trajectory/orbit of a space vehicle or a satellite in a suitable coordinate system.
- Calculate the delta-v required for transferring a spacecraft from one orbit to another
- Perform orbit perturbation analysis for satellite orbits.

TEXT BOOKS

1. Cornelisse, J.W., "Rocket Propulsion and Space Dynamic", W.H. Freeman & Co., 2012.
2. Parker, E.R., "Materials for Missiles and Spacecraft", Mc.Graw Hill Book Co. Inc., 1982

REFERENCES

1. Sutton, G.P., "Rocket Propulsion Elements", John Wiley, 2019.
2. John E. Prussing ,Bruce A.conway., "Orbital Mechanics" Oxford press USA 2nd edition
3. Howard D. Curtis., "Orbital Mechanics for Engineering Students", Elsevier, 2015.
4. Francis J Hale., "Introduction to Space Flight", Prentice Hal., 2013.

CO - PO Mapping

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CO2	3	2	2	3	2	2	-	-	2	-	2	2	3	2
CO3	2	3	3	2	2	2	2	-	2	-	3	-	2	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

PAAVAI ENGINEERING COLLEGE, NAMAKKAL
Approved
BOARD OF STUDIES
Aeronautical Engineering
30/07/21
AUTONOMOUS

AE19253 ADDITIVE MANUFACTURING 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- exploit technology used in additive manufacturing.
- understand importance of additive manufacturing in advance manufacturing process
- acquire knowledge, techniques and skills to select relevant additive manufacturing process
- explore the potential of additive manufacturing in different industrial sectors
- apply 3D printing technology for additive manufacturing.

UNIT I INTRODUCTION 9

Rapid prototyping system - practical applications; Basic operations; CAD Model; Translator supports – slice, merge, prepare, build, cleaning, finishing; Benefits of Rapid prototyping comparison with conventional manufacturing process.

UNIT II STEREO LITHOGRAPHY FUNDAMENTALS 9

Rapid prototyping process; The Stereo Lithography apparatus (SLA) - data gathering , data analysis, part preparation, part building; Initial consideration in part building - selecting the resin, selecting system, verifying part1 files, slicing, slicer solution, slice units; Post processing fundamentals - part removal , cleaning, post curing, part finishing.

UNIT III RAPID PROTOTYPING TECHNOLOGIES 9

Types; Selective Laser Sintering (SLS); Solid Ground Curing (SGC); Laminated Object Manufacturing (LOM); Fused Deposition Modeling (FDM); Three-Dimensional Printing (TDP).

UNIT IV CASE STUDIES 9

Rapid prototyping for rapid products; Exhaust manifold; Investment cast prototypes; Texas Instruments, USA; RP & Mini automotive; Medicine.

UNIT V TRENDS IN RAPID PROTOTYPING 9

Laser Engineering Net Shaping (LENS); Ballistic particle manufacturing; Rapid tooling Magic's - Mimics; Application of rapid prototyping in medical field; Future development; Rapid prototyping in Indian scene– advances in rapid prototyping, research development in rapid prototyping.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- define the various process used in Additive Manufacturing
- analyze and select suitable process and materials used in Additive Manufacturing.
- identify, analyze and solve problems related to Additive Manufacturing.
- apply knowledge of additive manufacturing for various real-life applications
- understand the basic concept of additive manufacturing application.

TEXT BOOKS

1. Gibson, I, Rosen, D W. and Stucker ,B., Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing, Springer, 2010.
2. Chua C.K., Leong K.F., and Lim C.S., "Rapid prototyping: Principles and applications", Third Edition, World Scientific Publishers, 2010.

REFERENCE BOOKS

1. Chee Kai Chua, Kah Fai Leong, 3D Printing and Additive Manufacturing: Principles and Applications: Fourth Edition of Rapid Prototyping, World Scientific Publishers, 2014
2. Gebhardt A., "Rapid prototyping", Hanser Gardener Publications, 2003.Kenneth G. Budinski & Michael K. Budinski, "Engineering Materials: Properties and Selection", 9th Edition, Pearson, 2009, 792 pages
3. Donald E La course, Handbook of Solid Modelling, McGraw Hill Inc., NewYork,2012
4. Rapid Automated Prototyping: An Introduction Industrial Press Inc., New York.
5. Dickens PM, Research Developments in rapid prototyping, Journal of Engineering Manufacture, pp261;265,2010.

CO - PO Mapping

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CO1	2	3	2	3	3	-	-	-	3	2	-	2	3	2
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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

AE19254 **BOUNDARY LAYER THEORY** **3 0 0 3**

COURSE OBJECTIVES

To enable students to

- gain knowledge about the concepts of basic flow equations.
- impart knowledge on the growth of boundary layer.
- understand the various boundary layer profile.
- gain knowledge on the wake formation.
- understand about various boundary layer control techniques.

UNIT I FUNDAMENTALEQUATIONSOFVISCOUSFLOW 9

Fundamental equations of viscous flow - Conservation of mass, Conservation of Momentum, Navier stokes equations, Energy equation; Mathematical character of basic equations; Dimensional parameters in viscous flow; Non-dimensionalising the basic equations and boundary conditions - vorticity considerations, creeping flow, boundary layer flow.

UNIT II SOLUTIONSOFVISCOUSFLOWEQUATIONS 9

Solutions of viscous flow equations - Couette flows, Hagen-Poisuelle flow, Flow between rotating concentric cylinders; Combined Couette-Poiseuille Flow between parallel plates; Creeping motion; Stokes solution for an immersed sphere; Development of boundary layer - displacement thickness, momentum and energy thickness.

UNIT III LAMINAR BOUNDARYLAYER 9

Laminar boundary layer equations - Flat plate Integral analysis of Karman–Integral analysis of energy equation; Boundary layer over a curved body; Flow separation similarity solutions; Falkner–Skan wedge flows; Boundary layer temperature profiles for constant plate temperature; Reynold's analogy; Integral equation of Boundary layer –Pohlhausen method; Thermal boundary layer calculations.

UNIT IV TURBULENT BOUNDARY LAYER 9

Turbulence-physical and mathematical description; Two-dimensional turbulent boundary layer equations - Velocity profiles; The law of the wall ; The law of the wake; Turbulent flow in pipes and channels; Turbulent boundary layer on a flat plate; Boundary layers with pressure gradient.

UNIT V BOUNDARYLAYER CONTROL 9

Boundary layer control in laminar flow; Methods of Boundary layer control - Motion of the solid wall, Acceleration of the boundary layer , Suction, Injection of different gas; Prevention of transition; Cooling of the wall.

COURSE OUTCOMES **TOTAL PERIODS 45**

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

- capable of identifying the flow types.
- manipulate the growth of boundary layer thickness.
- capable of evaluating the effect of boundary layer.

- understand the effect of wake in turbulent flow.
- acquire knowledge on control of boundary layer growth

TEXT BOOKS:

1.White,F.M., Viscous Fluid Flow, McGraw;Hill &Co.Inc.,New York 2008.

2.NASA Technical reports, Numerical Simulation of Boundary Layers, 1986.

REFERENCES:

1.Schlicting,H.,BoundaryLayer Theory,McGraw;Hill,New York,2016.

2. Reynolds,A,J.,TurbulentFlowsEngineering,JohnWileyandSons,1980.

3.Stephen B.Pope,Turbulent flows, Cambridge University Press, 2008.

4. Ian John Sobey, Introduction to Interactive Boundary Layer Theory, Oxford press2000

CO - PO Mapping

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

OPEN ELECTIVE (OE)

OPEN ELECTIVE I

AE19901 FUNDAMENTALS OF AIRCRAFT ENGINEERING 3 0 0 3

OBJECTIVES

To enable the students to

- understand the historical evaluation of airplanes
- acquire the necessary knowledge on aircraft classifications and configurations.
- have an exposure on various topics such as aircraft structures and materials.
- study the various types of power plants used in aircrafts
- identify and differentiate various aircraft systems.

UNIT I HISTORY OF AIRCRAFT 9

Early Developments - Ornithopters, Balloon Flight; Sir George Cayley - The true inventor of Airplane; the Interregnum; Otto Lilienthal -The Glider Man; Percy Pilcher - Extending the Glider Tradition; Wilbur and Orville Wright - Inventors of First Practical Airplane; Aeronautical Triangle - Langley, Wrights and Glenn Curtiss; Problem of Propulsion; Faster and Higher, biplanes and monoplanes

UNIT II AIRCRAFT CONFIGURATIONS 9

Different types of flight vehicles – classifications; Components of an airplane and their functions; Conventional control, Powered control; Basic instruments for flying; Typical systems for control actuation.

UNIT III AIRPLANE STRUCTURES AND MATERIALS 9

General types of construction - Monocoque, semi-monocoque and geodesic constructions; Typical wing and fuselage structure; Metallic and non-metallic materials; Use of aluminium alloy, titanium, stainless steel and composite materials; Stresses and strains - Hooke's law , Stress-strain diagrams, elastic constants.

UNIT IV AIRCRAFT POWER PLANTS 9

Basic ideas about piston, turboprop and jet engines; Use of propeller and jets for thrust production; Comparative merits; Principles of operation of rocket - types of rockets and typical applications; Exploration into space.

UNIT V AIRCRAFT SYSTEMS 9

Hydraulic and pneumatic systems and their applications; Environment control system - oxygen system; Fuel system; Cockpit instrumentation and displays; Communication systems; Navigation systems; Power generation systems - engine driven alternators, auxiliary power module, ram air turbine; Power conversion, distribution and management.

TOTAL PERIODS: 45

OUTCOMES

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

- learn the history of aircraft & developments over the years
- identify the types & classifications of components and control systems.
- explain the methods of aircraft construction and characteristics of aircraft materials.
- differentiate the types of jet engines and rocket engine.
- appraise & comprehend the various factors to be considered for launching a small business.

TEXT BOOKS

1. John D. Anderson, "Introduction to Flight", McGraw-Hill Education, 2016
2. Lalit Gupta and O P Sharma, "Fundamentals of Flight Vol-I to Vol-IV", Himalayan Books, 2006

REFERENCE BOOKS

1. A.C. Kermode, "Flight without formulae", Pearson Education India, 1989
2. Nelson R.C., "Flight stability and automatic control", McGraw-Hill International Editions, 1998
3. Ian Moir, Allan Seabridge, "Aircraft Systems: Mechanical, Electrical and Avionics Subsystems integration", John Wiley and Sons, 2011
4. Sutton G.P., "Rocket Propulsion Elements", John Wiley, New York, 9th Ed., 2017

CO - PO Mapping

Mapping of Course Outcomes with Program Outcomes **(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak**														
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CO3	3	2	3	2	3	-	-	-	-	-	-	2	2	2
CO4	-	2	2	2	3	-	-	-	-	-	3	2	3	2
CO5	3	2	2	2	2	-	-	-	-	-	-	2	3	2

AE19902 **WIND POWER ENGINEERING** **3 0 0 3**

COURSE OBJECTIVES

To enable students to

- familiarize how wind is generated and possible ways of extracting the same.
- gain knowledge on how to estimate the resource potential..
- learn the operation of a wind electric generator and wind turbine.
- acquire basic knowledge on rotor craft stability and control.
- study the performance and stability aspects of Helicopter under different operating conditions.

UNIT I INTRODUCTION TO WIND ENERGY **8**

Background, Motivations, and Constraints - Historical perspective, wind speed variation; Modern wind Turbines - Components and geometry.

UNIT II WIND CHARACTERISTICS AND RESOURCES **9**

General characteristics of the wind resource; Atmospheric boundary layer characteristics; Wind data analysis and resource estimation.

UNIT III AERODYNAMICS OF WIND TURBINES **9**

Forces from wind, Lift and drag forces; Airfoils; 1-D Momentum theory; Ideal horizontal axis wind turbine with wake rotation; Blade element theory; General rotor blade shape performance prediction.

UNIT IV WIND TURBINE DESIGN AND CONTROL **9**

Brief design overview - Introduction; Wind turbine control systems; Typical grid; Connected turbine operation; Basic concepts of electric power; Power transformers.

UNIT V ENVIRONMENTAL AND SITE ASPECTS **10**

Overview; Wind turbine siting; Installation and operation; Wind farms; Overview of wind energy economics; Electromagnetic interference; Noise.

TOTAL PERIODS **45**

COURSE OUTCOMES

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

- analyze the historical development of wind turbine, its components and classifications
- understand the characteristics of winds and atmospheric boundary layers.
- analyze the methods to measure the performance of wind turbines using different theories.
- analyze the wind turbine and its sub system design required for the operation of wind turbine turbines.
- evaluate the environmental factors which infer the operation of wind farms and methods for sustainable operations.

TEXT BOOKS

1. Emil Simiu & Robert H Scanlan, "Wind effects on structures ; Fundamentals and Applications to Design", John Wiley & Sons Inc New York, 2019.
2. Ahmad Hemami, "Wind Turbine Technology", Cengage learning,Cananda, 2012.

REFERENCES

1. Tom Lawson, "Building Aerodynamics", Imperial College Press London, 2001.
2. G P Russo, "Aerodynamic Measurements: From Physical Principles to Turnkey Instrumentation", Woodhead publishing, 2011.
3. N J Cook, "Design Guides to wind loading of buildings structures ; Part I & II", Butterworths London, 1985.
4. "IS: 875 (1987) Part III Wind loads, Indian Standards for Building codes",1987.

CO - PO Mapping

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

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