PAAVAI ENGINEERING COLLEGE, NAMAKKAL-637 018

(AUTONOMOUS)

B.E. AERONAUTICAL ENGINEERING

CURRICULUM

REGULATION 2015

SEMESTER V

Course Code	Course Title	L	T	P	C
AE15501	Aerodynamics II	3	0	0	3
AE15502	Aircraft General Engineering and Maintenance Practices	3	0	0	3
AE15503	Aircraft Structures II	3	2	0	4
AE15504	Flight Dynamics	3	0	0	3
AE15505	Rocket Propulsion	3	0	0	3
AE15506	Experimental Stress Analysis	3	0	0	3
AE15507	Aircraft Structures II Laboratory	0	0	2	1
AE15508	Propulsion laboratory	0	0	2	1
EN15501	Career Development Laboratory I	0	0	2	1

SEMESTER VI

Course Code	Course Title	L	T	P	C
AE15601	Composite Materials and Structures	3	0	0	3
AE15602	Air Traffic Control and planning	3	0	0	3
AE15603	Finite Element Method	3	2	0	4
AE1515*	Elective I	3	0	0	3
AE1525*	Elective II	3	0	0	3
BA15254	Principles of Management	3	0	0	3
AE15604	Aero CAD Laboratory	0	0	2	1
AE15605	Aircraft Engine and Structures Repair Laboratory	0	0	4	2
EN15601	Career Development Laboratory II	0	0	2	1

SEMESTER VI

ELECTIVE I

Course Code	Course Title	L	T	P	C
AE15151	Industrial Aerodynamics	3	0	0	3
AE15152	Experimental Aerodynamics	3	0	0	3
AE15153	Hypersonic Aerodynamics	3	0	0	3
AE15154	Boundary layer Theory	3	0	0	3

ELECTIVE II

Course Code	Course Title	L	T	P	C
AE15251	Aircraft Rules and Regulation	3	0	0	3
AE15252	Helicopter Maintenance	3	0	0	3
AE15253	Aero Engine Repair and Maintenance	3	0	0	3
AE15254	Airframe Maintenance and Repair	3	0	0	3

SEMESTER V

AE15501 **AERODYNAMICS II** **3 0 0 3**

COURSE OBJECTIVES

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

UNIT I FUNDAMENTAL ASPECTS OF COMPRESSIBLE FLOW 10

Aerodynamics variables and flow physics. Aerodynamic forces and moments. Definition of Compressible flow. Adiabatic steady state flow equations. Compressibility, continuity, momentum and energy equations for steady one dimensional flow, compressible Bernoulli's equation, area – mach number – velocity relation, mach Cone, mach angle. Choked flow. Numerical Problems

UNIT II INVISCID, COMPRESSIBLE FLOWS 8

One dimensional flow equations. Quasi-one dimensional flow. one dimensional isentropic flow through variable area duct, critical conditions, characteristic mach number, area-mach number relation, maximum discharge velocity,operating characteristics of nozzles, Isentropic flow through supersonic nozzle.

UNIT III SHOCK AND EXPANSION WAVES 10

Normal shock relations, Prandtl's relation, Hugoniot equation, Rayleigh Supersonic Pitot tube equation, Oblique shocks, θ-β-M relation, Shock Polar, Reflection of oblique shocks, Rayleigh flow, Fanno flow, Expansion waves, Prandtl-Meyer expansion, Attached and detached shocks, Introduction to viscous flow. Introduction to boundary-layers, shock wave boundary-layer interaction.

UNIT IV TWO DIMENSIONAL COMPRESSIBLE FLOW 10

Potential equation for 2-dimensional compressible flow, Linearisation of potential equation, perturbation potential, Linearised Pressure Coefficient, Linearised subsonic flow, Prandtl-Glauert rule, Linearised supersonic flow, Method of characteristics

UNIT V HIGH SPEED FLOWS 7

Critical Mach number, Drag divergence Mach number, Shock Stall, Supercritical Airfoil Sections, Transonic area rule, Swept wing, wave drag, Wind tunnels for transonic, Supersonic and hypersonic flows, shock tube, Gun tunnels, Supersonic flow visualization methods

TOTAL PERIODS 45

COURSE OUTCOMES

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

- understand and apply the fundamental aspects of compressible flow
- numerate the calculations in inviscid and 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 & Co., 2002.
2. Rathakrishnan., E,"Gas Dynamics", Prentice Hall of India, 2004.

REFERENCES

1. Shapiro, A. H., "Dynamics and Thermodynamics of Compressible Fluid Flow", Ronald Press, 1982.
2. Zucrow, M. J. and Anderson, J. D., "Elements of Gas Dynamics", McGraw- Hill & Co., 1989.
3. Oosthuizen,P.H., & Carscallen,W.E., "Compressible Fluid Flow", McGraw- Hill & Co.,1997.

WEB LINKS

1. http://nptel.ac.in/courses/101105059/
2. https://ocw.mit.edu/courses/aeronautics-and-astronautics/16-100-aerodynamics-fall-2005/lecture-notes/

AE15502 AIRCRAFT GENERAL ENGINEERING AND MAINTENANCE PRACTICES 3 0 0 3

COURSE OBJECTIVES

- To study about the various ground handling procedures of an aircraft
- To know about the ground servicing of Aircraft Subsystems.
- To learn the safety procedures and precautions requirements
- To understand the inspection procedures
- To 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 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

Hand tools – Precision instruments – Special tools and equipments in airplane maintenance shop– Identification terminology – Specification and correct use of various aircraft hardware (i.e. nuts, bolts,rivets, screws etc) American and British systems of specifications – Threads, gears, bearings, etc –Drills, tapes and reamers – Identification of all types of fluid line fittings Materials. Metallic and nonmetallic 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&P Mechanics, "Aircraft Hand Book", F A A Himalayan Book House, New Delhi, 1996
2. A&P Mechanics," General Hand Book", F A A Himalayan Bok House, New Delhi, 1996

REFERENCES

1. Kroes Watkins Delp, "Aircraft Maintenance and Repair", McGraw Hill, New York, 1993
2. Brimm D.J. and Bogges H.E., „Aircraft Maintenance", Pitman Publishing corp., New York, 1940.
3. Larry Reithmeir, „Aircraft Repair Manual", Palamar Books, Marquette, 1992.
4. Dale Crane, Aviation Maintenance Technician: Powerplants, 2nd edition, Aviation Supplies & Academics Inc,2005
5. Jeppesen Sanderson, Standard Aviation Maintenance Handbook, Jeppesen & Company, 2003

WEB LINKS

1. https://www.faa.gov/regulations_policies/handbooks_manuals/aircraft/amt_handbook/
2. https://www.faa.gov/regulations_policies/handbooks_manuals/aviation/phak/media/pilot_handbook.pdf

AE15503 **AIRCRAFT STRUCTURES II** **3 2 0 4**

COURSE OBJECTIVES

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

UNIT I UNSYMMETRICAL BENDING 13

Bending stresses in beams of unsymmetrical sections -K-method-Neutral axis method and Principle axis Method-Bending of symmetric sections with skew loads.

UNIT II SHEAR FLOW IN OPEN SECTIONS 16

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 16

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 16

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 IN WING AND FUSELAGE 14

Shear resistant web beams – Tension field web beams (Wagner Beam) – Shear and bending moment distribution for cantilever and semi-cantilever types of beams – loads on aircrafts – lift distribution – V-n diagram – Gust loads.

TOTAL PERIODS 75

COURSE OUTCOMES

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

- analyze the response of structures due to unsymmetrical bending.
- identify and analyze structural problems commonly encountered in aircrafts.
- understand the theory behind the failure of various structures.
- determine the effect of a variety of loading and support conditions on the small deflection of beams and plates
- identify various types of structural components and their loading pattern.

TEXT BOOKS

1. Megson, T.H.G., "Aircraft Structures for Engineering Students", 4th edition Butterworth Heinemann, (2002).
2. Bruhn. E.H. "Analysis and Design of Flight vehicles Structures", Tri – state off set company, USA, (1985).

REFERENCES

1. Peery, D.J., and Azar, J.J., “Aircraft Structures”, 2nd edition, McGraw–Hill, N.Y., (1993).
2. Rivello, R.M., “Theory and Analysis of Flight Structures”, McGraw-Hill, (1993).
3. Michael Chun-Yung Niu, "Airframe Structural Design: Practical Design Information and Data on Aircraft Structures", 2nd edition, Adaso/Adastra Engineering Center, (2006).
4. Howard D Curtis, "Fundamentals of Aircraft Structural Analysis", WCB-McGraw Hill, (1997)
5. Lakshmi Narasaiah G," Aircraft Structures", BSP Books Pvt.Ltd-Hyderabad.

WEB LINKS

1. http://nptel.ac.in/courses/105106049/65
2. https://pritamashutosh.wordpress.com

AE15504 **FLIGHT DYNAMICS** **3 0 0 3**

COURSE OBJECTIVES

- To acquire the necessary background for understanding the physical behavior of flight during maneuvers.
- To familiarize the application various of aircraft components towards the stability and control.
- To study and understand about various longitudinal stability characters.
- To impart students with a sound fundamental in using importance of aileron and rudder controls
- To understand the basic concepts of special maneuvers like spin, Dutch roll, auto rotation and spiral divergence.

UNIT I CRUISING FLIGHT PERFORMANCE 9

Forces and moments acting on a flight vehicle - Equation of motion of a rigid flight vehicle – Different types of drag –estimation of parasite drag co-efficient by proper area method- Drag polar of vehicles from low speed to high speeds - Variation of thrust, power with velocity and altitudes for air breathing engines . Performance of airplane in level flight - Power available and power required curves. Maximum speed in level flight – Conditions for minimum drag and power required.

UNIT II MANOEUVERING FLIGHT PERFORMANCE 9

Range and endurance - Climbing and gliding flight (Maximum rate of climb and steepest angle of climb, and load minimum rate of sink and shallowest angle of glide) -Turning performance (Turning rate turn radius). Bank angle factor – limitations on turn - V-n diagram and load factor.

UNIT III STATIC LONGITUDINAL STABILITY 9

Degree of freedom of rigid bodies in space - Static and dynamic stability - Purpose of controls in airplanes - Inherently stable and marginal stable airplanes – Static, Longitudinal stability - Stick fixed stability – Basic equilibrium equation - Stability criterion - Effects of fuselage and nacelle - Influence of CG location – Power effects - Stick fixed neutral point - Stick free stability-Hinge moment coefficient - Stick free neutral points-Symmetric maneuvers - Stick force gradients - Stick _ force per 'g' - Aerodynamic balancing.

UNIT IV LATERAL AND DIRECTIONAL STABILITY 9

Dihedral effect - Lateral control - Coupling between rolling and yawing moments - Adverse yaw effects - Aileron reversal - Static directional stability - Weather cocking effect - Rudder requirements – One engine inoperative condition - Rudder lock.

UNIT V DYNAMIC STABILITY 9

Introduction to dynamic longitudinal stability: - Modes of stability, effect of freeing the stick – Brief description of lateral and directional. Dynamic stability - Spiral, divergence, Dutch roll, auto rotation and spin.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- analyze the performance of an aircraft under various operating conditions.
- compute the various load factor performance.
- improve the aspect of stability and control of an aircraft.
- compare the various abnormal conditions during flight.

- elaborate the static and dynamic response of aircraft for both voluntary and involuntary changes in flight conditions.

TEXT BOOKS

1. Perkins, C.D., and Hage, R.E., "Airplane Performance stability and Control", John Wiley & Son:,Inc, NY, 1988.
2. Nelson, R.C. "Flight Stability and Automatic Control", McGraw-Hill Book Co., 2004.

REFERENCES

1. Etkin, B., "Dynamics of Flight Stability and Control", Edn. 2, John Wiley, NY, 1982
2. Babister, A.W., "Aircraft Dynamic Stability and Response", Pergamon Press, Oxford, 1980.
3. Dommasch, D.O., Sherby, S.S., and Connolly, T.F., "Aeroplane Aero dynamics", Third Edition,Issac Pitman, London, 1981.
4. Mc Cornick. W., "Aerodynamics, Aeronautics and Flight Mechanics", John Wiley, NY, 1979.

WEB LINKS

1. http://nptel.ac.in/courses/101106041/
2. http://nptel.ac.in/courses/101106043/1
3. http://nptel.ac.in/courses/101106042/

AE15505 **ROCKET PROPULSION** **3 0 0 3**

COURSE OBJECTIVES

- To study in detail about fundamentals of chemical rockets, rocket propulsion and advanced propulsion techniques
- To acquire an overview of various rocket technologies and applications.
- To impart students with a sound fundamental in gas dynamics, thermo chemistry, heat transfer, and vehicle dynamics as related to rocket motor/vehicle analysis.
- To familiarize students with a sound fundamental in analyzing /designing various rocket propulsion systems such as liquid propellant rocket motors, solid propellant rocket motors.
- To understand about the multi-stage launch vehicles, arc jets, solid core nuclear thermal rocket motors, and ion thrusters.

UNIT I DEFINITIONS AND FUNDAMENTALS 9

Operating principle of chemical rockets. Definitions: Rocket thrust, Exhaust velocity, Specific Impulse, Vehicle acceleration, Effective exhaust velocity, Characteristic velocity, Mass ratio, Propellant mass fraction, Burning time, Total impulse. Thrust coefficient, Isentropic flow throw nozzles, Rocket nozzle classifications. Under and over expanded nozzles, Optimum expansion. Numerical Problems.

UNIT II IGNITION SYSTEMS IN ROCKETS 9

Types of solid propellant rocket igniters – Pyrotechnic igniters and pyrogen igniters. Igniter Design spreading Considerations: Igniter mass and chamber volume, Ignition Chain: Ignition delay, mode of heat transfer, flame Deflagration and Detonation. Hypergolic ignition. Ignition systems in liquid rockets.

UNIT III SOLID PROPELLANT ROCKETS 9

Selection criteria of solid propellants – Important hardware components of solid rockets. Propellant grain design considerations. Burn rate. Internal ballistics - Pressure-time curve. Starting transient, erosive burning, Rocket performance considerations – Staging of rockets. Thrust vector control. Thrust termination techniques, Numerical problems.

UNIT IV LIQUID PROPELLANT ROCKETS 9

Liquid propellant rocket engine fundamentals. Liquid propellants. Propellant feed systems. Selection of liquid propellants. Valves and pipe lines. Thrust chambers. Injectors, combustion chamber and nozzle, Combustion Instability. Secondary injection thrust vector control in liquid rockets – Cooling in liquid rockets. Numerical Problems. Introduction to hybrid rockets – Relative advantages of liquid rockets over solid rockets. Types of Rocket tests. Rocket exhaust plumes.

UNIT V ADVANCED PROPULSION TECHNIQUES 9

Cryogenic rockets, Satellite thrusters, Electric rockets, Ion propulsion techniques, Nuclear rockets – Types, Solar sail, Anti-matter propulsion, Preliminary Concepts in nozzle less propulsion.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- analyze the fluid flow in a rocket nozzle
- compute the preliminary heat transfer calculations in a rocket nozzle

- design various rocket motor systems to satisfy a wide range of applications
- elaborate about the solid-core nuclear thermal rockets, arc jets, and ion thrusters
- analyze a rocket engine system to determine its specific impulse and performance.

TEXT BOOKS

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

REFERENCES

1. Barrere.M, Rocket Propulsion, Elsevier Publishing Company, New York, 1960 .
2. Hill, P.G. & Peterson, C.R. "Mechanics & Thermodynamics of Propulsion" 2nd Edition Pearson Education, 1999.
3. Gordon Oates, "Aero thermodynamics of Gas Turbine and Rocket Propulsion", AIAA Education Series, New York, 1989.
4. bJ.W.Cornelisse, H.F.R.Schoyer, K.F.Wakker, "Rocket Propulsion and Spaceflight Dynamics," Pitman, London. (1979)

WEB LINKS

1. http://nptel.ac.in/courses/112106073/
2. http://nptel.ac.in/courses/101104019/
3. http://www.nptelvideos.in/2012/12/rocket-propulsion.html

AE15506 EXPERIMENTAL STRESS ANALYSIS 3 0 0 3

COURSE OBJECTIVES

- To understand the relation between the mechanics theory and experimental stress analysis.
- To bring consciousness on experimental method of finding the response of the structure to different types of load.
- To establish the fundamental concepts and newly experimental techniques.
- To use the experimental techniques on the practical problems.
- To know the fundamental aspects of different non destructive testing techniques

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 12

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 balance.

UNIT III PHOTOELASTICITY 11

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

UNIT IV BRITTLE COATING AND MOIRE TECHNIQUES 7

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

UNIT V NON – DESTRUCTIVE TESTING 7

Fundamentals of NDT, Acoustic Emission Technique, Radiography, Thermography, Ultrasonic, Eddy Current testing, Fluorescent Penetrant Testing,

TOTAL PERIODS 45

COURSE OUTCOMES

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

- elaborate the various experimental techniques which is used to determine the structural properties
- execute the physics of strain measurement techniques.
- analyse the principles and techniques of photoelastic measurement to perform a structural analysis.
- perform the Moire method of analysis
- describe the different method of NDT and its applications.

TEXT BOOKS

1. Dr. Sadhu Singh, "Experimental stress analysis", Khanna Publications.(1989).
2. Dally, J.W., and Riley, W.F., "Experimental Stress Analysis", College House Enterprises, New York, (2005).

REFERENCES

1. Srinath, L.S., Raghava, M.R., Lingaiah,K., Garagesha,G. Pant B. and Ramachandra,K., "Experimental Stress Analysis", Tata McGraw-Hill, NewDelhi,(1984).
2. Ramesh K, "Digital Photoelasticity, Advanced Techniques and Applications", Springer,(2000).
3. Jindal U C, "Experimental Stress Analysis", 1st edition, Pearson, (2012).
4. Allesandro Freddi, Giorgio Olmi, Luca Cristofolini, "Experimental Stress Analysis for Materials and Structures", Springer, (2015).
5. Srinivas J, "Stress Analysis and Experimental Techniques An Introduction", Alpha Science Int'l Ltd, (2011).

WEB LINKS

1. http://nptel.ac.in/courses/112106068/
2. https://swayam.gov.in/course/1309-experimental-stress-analysis-an-overview

AE15507 AIRCRAFT STRUCTURES II LABORATORY 0 0 2 1

COURSE OBJECTIVES

- To experimentally study the bending of beams, shear centre, photoelastic techniques and study on vibration of beams.

LIST OF EXPERIMENTS

1. Unsymmetrical bending of Z-section beams
2. Shear centre location for open channel sections
3. Shear centre location for closed D-sections
4. Constant strength beam
5. Flexibility matrix for cantilever beam
6. Beam with combined loading
7. Calibration of Photo- elastic materials using plane and circular polariscope
8. Stresses in circular discs and beams using photo elastic techniques
9. Determination of natural frequencies of different materials with boundary conditions
10. Wagner beam – Tension field beam with gauge mounting practices

TOTAL PERIODS 30

COURSE OUTCOMES

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

- compute the location of shear centre
- analyze the stresses in circular discs and beams using photo elastic techniques
- explain the vibration of beams.

AE15508 **PROPULSION LABORATORY** **0 0 2 1**

COURSE OBJECTIVES

- To understand the basic concepts and carryout experiments in aerospace propulsion.

LIST OF EXPERIMENTS

1. Velocity profiles of free jets.
2. Velocity profiles of wall jets.
3. Study of an aircraft piston engine.
4. Study of an aircraft jet engine compressor.
5. Study of jet engine combustion chamber.
6. Study of jet engine turbine.
7. Study of forced convective heat transfer over a flat plate.
8. Study of free convective heat transfer over a flat plate

TOTAL PERIODS 30

COURSE OUTCOMES

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

- explain with various aircraft piston and gas turbine engines
- compute the flow behavior of jets
- elaborate the various testing methods of variable area ducts, jet engine components

EN15501 CAREER DEVELOPMENT LABORATORY I 0 0 2 1

COURSE OBJECTIVES

- To understand their capabilities and enhance their grooming and showcasing his/ her capabilities to a prospective employer
- To provide opportunity for the students to become acquainted with corporate opportunities relevant to their academic learning
- To articulate their thoughts on a given topic – in english and also to make decent write ups in English on any given topic
- To practice and score well in Aptitude tests conducted by corporates / prospective Employers
- To prepare for any group discussion evaluation or presenting their credentials during a face- to-face interview leading to selection and employment
- To become a knowledgeable person on the various evaluation processes leading to employment.

UNIT I PERSONALITY DEVELOPMENT 1 6

Introduction – self explorations – character building – self esteem- self confidence- positive thinking – leadership qualities- time management.

UNIT II PERSONALITY DEVELOPMENT 2 6

Grooming- role play – good etiquettes - extempore - writing skills: email, paragraph – team building- body language - non verbal communication

UNIT III QUANTITATIVE APTITUDE (QA) 1 6

Time , speed & distance -- simple interest & compound interest – percentage – height & distance – time & work – number systems – L.C.M & H.C.F – ratio proportion- area – directions.

UNIT IV LOGICAL REASONING (LR) 1 6

Analogies - letter & symbol series – number series – cause & effect – essential part – verbal reasoning.

UNIT V VERBAL REASONING (VR) 1 6

Blood relation – venn diagrams – analogy – character puzzles – logical sequence – classifiction –verification of truth – seating arrangement

TOTAL PERIODS 30

COURSE OUTCOMES

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

- demonstrate aptitude & reasoning skills
- enhance verbal & written ability.
- improve his/her grooming and presentation skills.
- interact effectively on any recent event/happenings/ current affairs.
- be a knowledgeable person on the various evaluation processes leading to employment and face the same with Confidence.

REFERENCES

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 ,W.R.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.

AE15601 COMPOSITES MATERIALS AND STRUCTURES 3 0 0 3

COURSE OBJECTIVES

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

UNIT I MICROMECHANICS 10

Introduction - advantages and application of composite materials – types of reinforcements and matrices - micro mechanics – mechanics of materials approach, elasticity approach – fiber volume ratio – mass fraction – density of composites - effect of voids in composites.

UNIT II MACROMECHANICS 8

Generalized Hooke's Law - Plane stress and plane strain- elastic constants for anisotropic, orthotropic an isotropic materials -macro mechanics – stress-strain relations with respect to natural axis, arbitrary axis failure theories of a lamina.

UNIT III LAMINATED PLATES 10

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 10

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 7

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 – autoclave and non-auto clave methods.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course, 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. R. M. Jones, "Mechanics of Composite Materials", 2nd Edition, Taylor & Francis publication,2014.
2. Prof.R.Velmurugan, "e-Book on Composite Materials", IIT Madras.

REFERENCES

1. R.F. Gibson," Principles of composite material mechanics",3rd Edition, CRC press.2015
2. Dr.K.V.Nagendra Gopal,"e-Book on Composite Structures", IIT Madras.
3. D. Agarwal, L. J. Broutman and K. Chandrashekhara, "Analysis and Performance of Fiber Composites", 3rd Edition, John Wiley & Sons.

WEB LINKS

1. http://nptel.ac.in/courses/101104010/
2. http://www.ae.iitkgp.ernet.in/ebooks/chapter1.html

AE15602 AIR TRAFFIC CONTROL AND PLANNING 3 0 0 3

COURSE OBJECTIVES

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

UNIT I BASIC CONCEPTS 9

Objectives of ATS - parts of ATC service - scope and provision of ATCS -VFR & 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. Comparison of various ATC services.

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

Flight Information, Alerting Services, Coordination, Emergency Procedures and Rules of the Air Radar service basic radar terminology - identification procedures using primary / secondary radar - performance checks use of radar in area and approach control services - assurance control and coordination between radar and non radar control - emergencies - flight information and advisory service - alerting service and emergency procedures - rules of the air. Study about communication between aircraft and ATC.

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 etc – obstacles restriction. Comparison between domestic and international airports.

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 & 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 this course, students will be able to

- exhibit the concept of air traffic rules and clearance procedures for airline operation.
- analyze the various air traffic data for air traffic services.

- elaborate the influence of aerodrome design factors for service establishments.
- gain knowledge on aerodrome design.
- compare the different services of Air Traffic Control.

TEXT BOOKS

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

REFERENCES

1. Nolan M. S, “Fundamentals Air Traffic Control”, Latest Edition, YESDEE Publishers, 2010
2. Seth B. Young, Alexander T. Wells, “Airport Planning and Management” McGraw-Hill Education, New Delhi,2011.

WEB LINKS

1. http://nptel.ac.in/courses/105101008/downloads/cete_40.pdf
2. http://nptel.ac.in/courses/105107123/40
3. http://nptel.ac.in/courses/108105057/Pdf/Lesson-28.pdf

AE15603 **FINITE ELEMENT METHOD** **3 2 0 4**

COURSE OBJECTIVES

- To equip the students with the finite element analysis fundamentals.
- To understand the concept of numerical analysis of structural components.
- To study domain discretization, polynomial interpolation, application of boundary conditions, assembly of global arrays, and solution of the resulting algebraic systems.
- To acquire the basic knowledge of Isoparametric Element Formulation.
- To apply the numerical approximations to common structures and solid boundary value problems

UNIT I UNSYMMETRICAL BENDING 15

Review of various approximate methods – variational approach and weighted residual approach application to structural mechanics problems. finite difference methods- – Governing equation and convergence criteria of finite element method.

UNIT II DISCRETE ELEMENTS 16

Bar elements, uniform section, mechanical and thermal loading, varying section, 2D and 3D truss element. Beam element - problems for various loadings and boundary conditions – 2D and 3D Frame elements - longitudinal and lateral vibration. Use of local and natural coordinates.

UNIT III CONTINUUM ELEMENTS 14

Plane stress, plane strain and axisymmetric problems. Derivation of element matrices for constant and linear strain triangular elements and axisymmetric element.

UNIT IV ISOPARAMETRIC ELEMENTS 14

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 HEAT TRANSFER PROBLEM AND METHODS OF SOLUTIONS 16

Heat transfer problems, steady state fin problems, derivation of element matrices for two dimensional problems, torsion problems. bandwidth- elimination method and method of factorization for solving simultaneous algebraic equations – Features of software packages, sources of error.

TOTAL PERIODS 75

COURSE OUTCOMES

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

- exhibit the basic finite element formulation techniques.
- compute the mathematical and physical principles underlying the FEM as applied to solid mechanics, dynamics, and thermal analysis.
- derive equations in finite element methods for 1D, 2D and 3D Problems.
- formulate and solve basic problems in heat transfer, solid mechanics.
- analyze more complex problems (in solid mechanics or thermal analysis) using the commercial FEM code ANSYS.

TEXT BOOKS

1. Reddy J.N. “An Introduction to Finite Element Method”, Third Edition, McGraw-Hill, (2005)

2. Chandrupatla T. R., and Belegundu A.D, “Introduction to Finite Elements Engineering”, 3rd Edition, Pearson Education (2002).
3. M. J. Fagan “Finite Element Analysis : Theory and Practice” Pearson Education Limited (1992)

REFERENCES

1. Robert D Cook, David S Malkus, Michael E Plesha “Concepts and applications of finite element analysis”, 4th edition, John Wiley and Sons, Inc., (2008).
2. Tirupathi.R. Chandrupatla and Ashok D. Belegundu, “Introduction to Finite Elements in Engineering”, Prentice Hall India, Fourth Edition, (2011).
3. Rao. S.S., "Finite Element Methods in Engineering," Butterworth and Heinemann, 2001Data on Aircraft Structures", 2nd edition, Adaso/Adastra Engineering Center, (2006).
4. Bathe, K.J. and Wilson, E.L., "Numerical Methods in Finite Elements Analysis", Prentice Hall of India, 1985.
5. Larry J. Segerlind, „Applied finite element analysis“, 2nd edition, John Wiley and Sons, Inc.(1985).

WEB LINKS

1. http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT-KANPUR/FiniteElementMethod
2. https://www.nafems.org

BA15254 PRINCIPLES OF MANAGEMENT 3 0 0 3

COURSE OBJECTIVES

- To acquire the basic knowledge on history and development of management.
- To know the planning activities in management.
- To understand organizing, dimensions of organization structure, and choosing the right structural form.
- To know how to manage human resources.
- To understand various methods and techniques of control.

UNIT I INTRODUCTION TO MANAGEMENT 9

Management: Meaning, Scope, Managerial Roles. Management: Science, Art or Profession; Universality of Management, Ancient roots of management theory; Classical schools of management thought; Behavioral School, Quantitative School; Systems Approach, Contingency Approach; Contemporary Management thinkers & their contribution.

UNIT II PLANNING 9

Characteristics of planning, Planning Process; Types of plans; Decision making, Decision making tools, Group decision making, Forecasting & MBO.

UNIT III ORGANIZING 9

Organizational structure and design; types of organizational structures; authority, delegation, decentralization and reengineering; Organization Size, Technology, Environment, Power-control; choosing the right structural Form.

UNIT IV MANAGING HUMAN RESOURCES 9

Human resource planning, Recruitment, selection, training & development, performance appraisal, managing change, compensation and employee welfare, Leadership theory, Motivation Theory, Communication.

UNIT V CONTROLLING 9

Nature of organizational control; control process; Methods and techniques of control; Designing control systems.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- demonstrate history and development of management thought.
- exhibit the planning activities in management.
- know organizing, dimensions of organization structure, and choosing the right structural form.
- gain knowledge how to manage human resources.
- develop various methods and techniques of control.

TEXT BOOKS

1. Heinz Weihrich, Mark V. Cannice, Management a Global & Entrepreneurial Perspective, Tata McGraw-Hill Education, 2010.
2. James A.F. Stoner & R. Edward Freeman, Management, Prentice-Hall of India Private Limited, New Delhi, 2010.

REFERENCES

1. John R. Schermerhorn, Jr., Daniel G. Bachrach, Management, Wiley India, 13/e, 2015.
2. Joseph L Massie, Essentials of Management, Prentice-Hall India, New York, 4/e, 2013.
3. S.A.Sherlekar, Management, Himalaya Publications, Mumbai, 1/e, 2012.
4. L.M. Prasad, Principles of Management, Sultan Chand & Sons, New Delhi, 9/e, 2015.
5. Peter Drucker, Management, Harper Row, 2005.

WEB LINKS

1. https://www.slideshare.net/ersmbalu/principles-of-management-lecture-notes
2. https://mbaexamnotes.com/principles-of-management.html
3. https://www.cliffsnotes.com/study-guides/principles-of-management

AE15604 **AERO CAD LABORATORY** **0 0 2 1**

COURSE OBJECTIVES

- To develop skill to use software to create 2D and 3D models.

LIST OF EXPERIMENTS

1. Design of riveted joints (Lap joint).
2. Design of riveted joints (Butt joint with single and double straps).
3. Design of welded joints.
4. Layout and Analysis typical wing structure.
5. Layout and Analysis typical fuselage structure.
6. Computer aided modeling of typical aircraft wing.
7. Computer aided modeling of typical fuselage structure.
8. Computer aided modeling of landing gear
9. Three view diagram of a typical aircraft
10. Layout of control systems

TOTAL PERIODS 30

COURSE OUTCOMES

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

- design the riveted joints
- prepare the layout of aircraft component
- develop the model aircraft component using software

AE15605 AIRCRAFT ENGINE AND STRUCTURES REPAIR LABORATORY 0 0 4 2

COURSE OBJECTIVES

- To give training on riveting, patchwork, welding and carpentry

LIST OF EXPERIMENTS

1. Dismantling of a piston engine
2. Engine (Piston Engine) - cleaning, visual inspection, NDT checks.
3. Piston Engine Components - dimensional checks.
4. Piston – Engine reassembly.
5. Engine starting procedures.
6. Aircraft wood gluing-single & double scarf joints
7. Welded single & double V-joints.
8. Fabrication of Composite Materials
9. Riveted Patch repairs
10. Tube bending and flaring
11. Study on MIG, TIG & PLASMA welding of aircraft components

TOTAL PERIODS 60

COURSE OUTCOMES

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

- explain the engine components
- obtain the repair work of airframe
- analyze riveted joints

EN15601 CAREER DEVELOPMENT LABORATORY II 0 0 2 1

COURSE OBJECTIVES

- To enhance career competency and employability skills
- To demonstrate effective leadership and interpersonal skills
- To improve professional capabilities through advanced study and researching current market strategy.
- To develop problem solving and decision making capabilities

UNIT I CORPORATE READINESS 6

Business Communication – Inter and Intra Personal skills – Business Etiquettes – Corporate ethics – Communication media Etiquette.

UNIT II INTERVIEW SKILLS 6

Resume building – Group discussions – Presentation skills – Entrepreneur skills – Psychometric assessment – Mock interview.

UNIT III QUANTITATIVE APTITUDE (QA) 2 6

Profit and Loss – Clock – Power and Square roots – Train – Boats and streams – Probability – Calendars – Permutations and Combinations - Partnership – Simplification – Pipes and Cisterns – Puzzles.

UNIT IV LOGICAL REASONING (LR) 2 6

Statements and Assumptions – Matching Definitions – Logical Games – Making judgments – Statements and conclusions – Verbal classifications.

UNIT V VERBAL REASONING (VR) 2 6

Syllogisms – Data sufficiency – Dice – Series completion – Character puzzles – cube and cuboids – Arithmetic Reasoning.

TOTAL PERIODS 30

COURSE OUTCOMES

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

- develop team work capabilities
- boost their problem solving skills
- enhance the transformation from college to corporate.

REFERENCES

1. Agarwal, r.s.” a modern approach to verbal & non verbal reasoning”, , S.Chand & co ltd, New Delhi.
2. Abhijit guha, “quantitative aptitude for competitive examinations “, Tata Mcgraw hill
3. .Word power made easy by norman lewis ,wr.goyal publications.
4. Johnson, d.w. (1997). Reaching out – interpersonal effectiveness and self Actualization -- Boston: Allyn and bacon.
5. Infosys Campus Connect Program – students’ guide for soft skills.

ELECTIVE I

AE15151 INDUSTRIAL AERODYNAMICS 3 0 0 3

COURSE OBJECTIVES

- To introduce the basic concepts of wind energy collectors
- To understand the aerodynamics of ground vehicles
- To gain the basic concepts of building aerodynamics
- To build up necessary features for induced vibrations
- To 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.

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.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course, 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 BOOKS

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

REFERENCES

1. Tomomichi Nakamura, Shigehiko Kaneko, "Flow-Induced Vibrations: Classifications and Lessons fromPractical Experiences", Second Edition, Academic Press, 2013.
2. A. R. Jha, "Wind Turbine Technology", CRC Press, 2010.

WEB LINKS

1. http://www.wind-power-program.com/betz.htm
2. https://ntl.bts.gov/DOCS/ch2.html

AE15152 EXPERIMENTAL AERODYNAMICS 3 0 0 3

COURSE OBJECTIVES

- To introduce the students about the practical elements of experimental aerodynamics and to develop an appreciation for how aerodynamic data are acquired.
- To gain a working knowledge of experimental test facilities, techniques and equipment commonly used in the field of experimental aerodynamics
- To present the flow visualization techniques involved in aerodynamic testing
- To understand the instruments which is used to measure the physical properties such velocity, pressure and temperature
- To provide the students with an opportunity to apply modern instrumentation and measurement techniques to the acquisition of aerodynamic data and understand the inherent limitations of each technique.

UNIT I BASIC MEASUREMENTS IN FLUID MECHANICS 10

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 - Experiments on Taylor –Proudman theorem and Ekman layer.

UNIT II WIND TUNNEL MEASUREMENTS 8

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 – Principle and application and uses.

UNIT III FLOW VISUALIZATION AND ANALOGUE METHODS 10

Visualization techniques – Smoke tunnel – Hele-Shaw apparatus - Interferometer – Fringe-Displacement method – Shadowgraph - Schlieren system – Background Oriented Schliren (BOS) System –Hydraulic analogy – Hydraulic jumps – Electrolytic tank.

UNIT IV PRESSURE, VELOCITY AND TEMPERATURE MEASUREMENTS 10

Pitot-Static tube characteristics - Velocity measurements - Hot-wire anemometry – Constant current and Constant temperature Hot-Wire anemometer – Hot-film anemometry – Laser Doppler Velocimetry (LDV) – Particle Image Velocimetry (PIV) – Pressure Sensitive Paints – Pressure measurement techniques. Pressure transducers, Temperature measurements.

UNIT V DATA ACQUISITION SYSTEMS AND UNCERTAINTY ANALYSIS 7

Data acquisition and processing – Signal conditioning - Estimation of measurement errors – Uncertainty Calculation. Uses of uncertainty analysis.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- execute the basic measurements used in aerodynamics
- operate different types of wind tunnels and calibration of the instruments associated with them.
- elaborate the various instruments used in wind tunnel.

- identify the various instruments used to measure the air properties
- analyze the uncertainty situations by using instruments.

TEXT BOOKS

1. F 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. Pavian, Henry Christensen, "Experimental Aerodynamics", 1st edition, Pitman Pub, 2006.
2. G P Russo, "Aerodynamic Measurements: From Physical Principles to Turnkey Instrumentation", Woodhead publishing, 2011
3. Rae W.H., and Pope A., "Low Speed Wind Tunnel Testing", John Wiley Publication, 2014.

WEB LINKS

1. http://nptel.ac.in/courses/101106040/
2. http://soliton.ae.gatech.edu/labs/windtunl/

AE15153 HYPERSONIC AERODYNAMICS 3 0 0 3

COURSE OBJECTIVES

- To introduce the basic concepts of hypersonic aerodynamics
- To understand the methods for hypersonic inviscid flows
- To know about the viscous hypersonic flow theory
- To build up necessary features for viscous interactions in hypersonic flows
- To study about the high temperature effects in hypersonic flows

UNIT I FUNDAMENTALS OF HYPERSONIC AERODYNAMICS 9

Introduction to hypersonic aerodynamics – differences between hypersonic aerodynamics and supersonic aerodynamics - concept of thin shock layers and entropy layers – hypersonic flight paths – hypersonic similarity parameters – shock wave and expansion wave relations of inviscid hypersonic flows.

UNIT II SIMPLE SOLUTION METHODS FOR HYPERSONIC INVISCID FLOWS 9

Local surface inclination methods – Newtonian theory – modified Newtonian law – tangent wedge and tangent cone and shock expansion methods – approximate methods - hypersonic small disturbance theory – thin shock layer theory.

UNIT III VISCOUS HYPERSONIC FLOW THEORY 9

Boundary layer equations for hypersonic flow – hypersonic boundary layers – self similar and non self similar boundary layers – solution methods for non self similar boundary layers – aerodynamic heating and its adverse effects on airframe.

UNIT IV VISCOUS INTERACTIONS IN HYPERSONIC FLOWS 9

Introduction to the concept of viscous interaction in hypersonic flows - Strong and weak viscous interactions - hypersonic viscous interaction similarity parameter – introduction to shock wave boundary layer interactions.

UNIT V HIGH TEMPERATURE EFFECTS IN HYPERSONIC FLOWS 9

Nature of high temperature flows – chemical effects in air – real and perfect gases – Gibb's free energy and entropy - chemically reacting boundary layers – recombination and dissociation.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- exhibit the components and functions hypersonic aerodynamics
- carry out the aerodynamic performance of hypersonic inviscid flows
- elaborate the viscous hypersonic flow theory
- identify the effects and functions of viscous interactions in hypersonic flows
- analyze the effects in hypersonic flows

TEXT BOOKS

1. John D. Anderson. Jr., "Hypersonic and High Temperature Gas Dynamics", Mc.Graw hill Series,New York, 1996.

REFERENCES

1. John D. Anderson. Jr., "Modern Compressible flow with historical Perspective", Mc.Graw Hill Publishing Company, New York, 1996.

2. John T. Bertin, “Hypersonic Aerothermodynamics”, published by AIAA Inc., Washington. D.C.,1994.

WEB LINKS

1. http://nptel.ac.in/courses/101103003/
2. https://arc.aiaa.org/doi/abs/10.2514/3.25879

AE15154 BOUNDARY LAYER THEORY 3 0 0 3

COURSE OBJECTIVES

- introduce the basic concepts of equations of viscous flow
- understand the methods for solutions of viscous flow equations
- attain the knowledge about the laminar boundary layer equations
- build up necessary features for turbulent boundary layer equations
- study about the boundary layers equations

UNIT I FUNDAMENTAL EQUATIONS OF VISCOUS FLOW 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 SOLUTIONS OF VICOUS FLOW EQUATIONS 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 BOUNDARY LAYER EQUATIONS 9

Laminar boundary layer equations, Flat plate Integral analysis of Karman – Integral analysis of energy equation – Laminar boundary layer equations – boundary layer over a curved body-Flow separation- similarity solutions, Blasius solution for flat-plate flow, 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 LAYEREQUATIONS 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, Eddy Viscosity, mixing length , Turbulence modeling

UNIT V COMPRESSIBLE BOUNDARY LAYERS EQUATIONS 9

Compressible boundary layer equations, Recovery factor, similarity solutions, laminar supersonic Cone rule, shock-boundary layer interaction

TOTAL PERIODS 45

COURSE OUTCOMES

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

- exhibit the basic components and functions equations of viscous flow
- carry out the solutions of viscous flow equations
- write the basic boundary layer equations
- identify the effects and functions of turbulent boundary layer equations
- analyze the effects in boundary layers equations

TEXT BOOKS

1. Reynolds, A, J., Turbulent Flows Engineering, John Wiley and Sons, 1980.

REFERENCES

1. White, F. M., Viscous Fluid Flow, McGraw-Hill & Co., Inc., New York., 2005.
2. Schlicting, H., Boundary Layer Theory, McGraw-Hill, New York, 2000.

WEB LINKS

1. http://nptel.ac.in/courses/112104118/ui/Course_home-9.htm
2. https://lecturenotes.in/topic/755/fluid-mechanics-and-hydraulic-machines/boundary-layer-theory/

AE15251 AIRCRAFT RULES AND REGULATION 3 0 0 3

COURSE OBJECTIVES

- To build up necessary background for understanding the civil air rules and regulations which are being followed by directorate general of civil aviation.
- To understand the procedure for issue of civil aviation requirements.
- To learn the objective and target of airworthiness directorate of civil aviation requirements.
- To introduce the students about civil aircraft safety rules and regulations which are being followed by directorate general of civil aviation and FAA.
- To study various civil flight safety operational procedures.

UNIT I AIRWORTHINESS 9

Responsibilities of operators - owners- procedure of CAR issue, amendments - objectives and targets of airworthiness directorate - airworthiness regulations and safety oversight of engineering activities of operators.C.A.R. Series - "B" Issue Approval of Cockpit Check List, MEL, CDL: Deficiency list (MEL & CDL). Preparation and use of cockpit checklist and emergency list

UNIT II C.A.R. SERIES C: DEFECT RECORDING, MONITORING, INVESTIGATION AND REPORTING 9

Defect recording, reporting, investigation, rectification and analysis; flight report; reporting and rectification of defects observed on aircraft; analytical study of in-flight readings & recordings; maintenance control by reliability method. Case study: Comparison between aircraft reliability and Maintainability. C.A.R. Series D Reliability and Aircraft Maintenance Program Reliability Program (engines); aircraft maintenance program & their approval; on condition maintenance of reciprocating engines; TBO revision program; maintenance of fuel and oil uplift and consumption records light aircraft engines; fixing routine maintenance periods.

UNIT III C.A.R. SERIES E: APPROVAL OF ORGANISATIONS 9

Approval of organizations in categories A,B,C,D,E,F,&G Requirements of infrastructure at stations other than parent base. C.A.R. Series F Air Worthiness and Continued Air Worthiness. Procedure relating to registration of aircraft; Procedure for issue / revalidation of Type Certificate of aircraft and its engines / propeller; Issue / revalidation of Certificate of Airworthiness; Requirements for renewal of Certificate of Airworthiness.

UNIT IV C.A.R. SERIES :L - M 9

Issue of AME License, its classification and experience requirements, Mandatory Modifications / Inspections

UNIT V C.A.R. SERIES T:X 9

Flight testing of (Series) aircraft for issue of C of A; Flight testing of aircraft for which C of A had been aid kits previously issued. Registration Markings of aircraft; Weight and balance control of an aircraft; Provision of first & 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; Procedure for Issue of type approval of aircraft components and equipment including instruments.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- demonstrate the necessity, scope and provisions of civil aviation rules for safer operation.

- elaborate the procedures for acquiring approval to run the airline organizations.
- analyze the documents related to airworthiness certification for continued operation.
- classify the various Aeronautical organization standards and regulations.
- develop the certification standards and licensing standards

TEXT BOOKS

1. Aeronautical Information Circulars (relating to Airworthiness) from DGCA 7 AAI, 2000 and 2006
2. Aircraft Manual (India) Volume Latest Edition, The English Book Store, 17-1, Connaught Circus, New Delhi.

REFERENCES

1. Advisory Circulars from DGCA 2003 & 2010.
2. Civil Aviation Requirements with latest Amendment (Section 2 Airworthiness) - Published by DGCA, The English Book Store, 17- 1,Connaught Circus, New Delhi 2000.

WEB LINKS

1. http://nptel.ac.in/course.php
2. http://dgca.nic.in/rules/car-ind.htm

AE15252 HELICOPTER MAINTENANCE 3 0 0 3

COURSE OBJECTIVES

- To introduce the basic concepts of helicopter
- To understand the rotor system and maintenance
- To learn the transmission and maintenance
- To study about the different type of power plants
- To build up necessary knowledge on structure maintenance

UNIT I HELICOPTER FUNDAMENTALS 9

Basic directions -ground handling, bearing -gears construction -Construction of fuselage and tail Structures

UNIT II MAIN ROTOR SYSTEM 9

Head maintenance - blade alignment - static main rotor balance - vibration - tracking - span wise dynamic balance - blade sweeping -electronic balancing -dampener maintenance - counter weight adjustment - auto rotation adjustments - mast & flight control rotor - mast- stabilizer, dampeners - swash plate flight control systems collective - cyclic - push pull tubes -torque tubes- bell cranks - mixer box -gradient unit control boosts - maintenance & inspection control rigging

UNIT III MAIN ROTOR TRANSMISSIONS 9

Engine transmission coupling- drive shaft - maintenance clutch- freewheeling units -spray clutch roller unit - torque meter - rotor brake -maintenance of these components -vibrations – mounting systems- transmissions.

UNIT IV POWER PLANTS AND TAIL ROTORS 9

Fixed wing power plant modifications - installation - different type of power plant maintenance. Tail rotor system - servicing tail rotor track - system rigging

UNIT V AIRFRAMES AND RELATED SYSTEMS 9

Fuselage and tail structures maintenance-Gust effect on Tail rotor structures-Safety on In and Around Helicopter

TOTAL PERIODS 45

COURSE OUTCOMES

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

- elaborate the basic maintenance in helicopter
- analyze the rotor assembly and maintenance
- exhibit the transmission in rotor
- classify the various types of power plant
- demonstrate the helicopter structure and safety

TEXT BOOKS

1. U.S Department of Transportation, FAA - Basic helicopter handbook - 2013.
2. Jeppesen, "Helicopter Maintenance", Jeppesons and Sons Inc., 2000.

REFERENCES

1. U.S department of Transportation, FAA, Airframe and power plant mechanics, 2008.
2. "Civil Aircraft Inspection Procedures - Part I & II", CAA, English Book House - Delhi, 1986.
3. Larry Reithmier, "Aircraft Repair Manual", Palamar Books Marquette, 2002.

WEB LINKS

1. https://www.faa.gov/regulations_policies/handbooks_manuals/aviation/helicopter_flying_handbook
2. http://www.helicoptermaintenancemagazine.com/

AE15253 AERO ENGINE REPAIR AND MAINTENANCE 3 0 0 3

COURSE OBJECTIVES

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

UNIT I CLASSIFICATION OF PISTON ENGINE COMPONENTS 9

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 9

Inspection and maintenance and troubleshooting – inspection of all engine components – daily and routine checks – overhaul procedures – compression testing of cylinders – 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 9

Symptoms of failure – fault diagnostics – case studies of different engine systems – 1: 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

12 types of jet engines – principles of operation – materials used – details of starting and operation procedures – gas turbine engine inspection & checks – use of instruments for online maintenance – special inspection procedures: foreign object damage -blade damage – etc. 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 9

Engine Overhaul - Overhaul procedures - Inspections and cleaning of components – Repairs schedules for overhaul - Balancing of Gas turbine components. Trouble Shooting: Procedures for trouble shooting - Condition monitoring of the engine on ground and at altitude - engine health monitoring and corrective methods.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- classify the components and functions of piston Engine
- carry out the inspection in piston engine
- identify the tools and instruments applicable for maintenance 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.

REFERENCES

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 & Powerplants", Gregg Division, McGraw Hill, 1985
4. Dale Crane, "Aviation Maintenance Technician: Powerplants," 2nd edition, Aviation Supplies & Academics Inc,2005

WEB LINKS

1. https://www.faa.gov/regulations_policies/handbooks_manuals/aircraft/media/FAA-H-8083-32-AMT-Powerplant-Vol-1.pdf
2. https://www.faa.gov/regulations_policies/handbooks_manuals/aircraft/media/FAA-H-8083-32-AMT-Powerplant-Vol-2.pdf

AE15254 AIRFRAME MAINTENANCE AND REPAIR 3 0 0 3

COURSE OBJECTIVES

- To build up necessary background for understanding welding in aircraft structural components
- To understand the uses of plastics and composites in aircraft
- To learn the objective and target of airplane jacking and weighing and C.G. location.
- To introduce the trouble shooting and maintenance practices
- To study various hazardous materials storage and handling

UNIT I WELDING IN AIRCRAFT STRUCTURAL COMPONENTS 9

Equipment's used in welding shop and their maintenance ensuring quality welds welding jigs and fixtures soldering and brazing

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., and 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 equipment's. Trouble shooting - theory and practices

TOTAL PERIODS 45

COURSE OUTCOMES

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

- identify the scope and provisions in welding in aircraft structural components
- elaborate the procedures for acquiring plastics and composites in aircraft
- analyze the airplane jacking and weighing operations.
- demonstrate about the various Trouble shooting and maintenance practices
- handle the hazardous materials storage

TEXT BOOKS

1. Kroes, Watkins, Delp, "Aircraft Maintenance and Repair", Tata McGraw-Hill, New Delhi,2010
2. McKinley.L and R. D. Bent, "Aircraft Maintenance & Repair", Tata McGraw-Hill, 2010.

REFERENCES

1. General Hand Books of Airframe and Powerplant Mechanics, U. S. Dept. of Transportation, Federal Aviation Administration, the English Book Store, New Delhi 2006.
2. Larry Reithmeir, "Aircraft Repair Manual", Palamar Books, Marquette, 2007.
3. Brim D.J.andBogges H.E., "Aircraft Maintenance", Pitman Publishing.

WEB LINKS

1. https://www.faa.gov/regulations_policies/handbooks_manuals/aircraft/amt_airframe_handbook
2. http://www.jdrr.yolasite.com/aeronautical.php