SATHYABAMA
INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)
Accredited with "A" Grade by NAAC
Jeppiaar Nagar, Rajiv Gandhi Salai, Chennai - 600 119.
Phone: 044 - 2450 3150 / 51 / 52 / 54 / 55 Fax: 044 - 2450 2344
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SAEA1202	FUNDAMENTALS OF AERONAUTICAL ENGINEERING	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand the concepts of flight vehicles.
- To evaluate the performance of air vehicles in International standard atmosphere.
- To know the basic functions of aircraft systems and instruments.
- To discuss the structural ,aerodynamics and propulsive aspects of airplanes.

UNIT 1 HISTORY OF FLIGHTS **9 Hrs.**

Early flying vehicles – hot air balloons – heavier than air flying machines- ornithopters – early airplanes by Wright brothers, biplanes and monoplanes, developments in aerodynamics, materials, structures and propulsion over the years.

UNIT 2 BASICS OF AERODYNAMICS AND FLIGHT MECHANICS **9 Hrs.**

Physical properties and structure of the atmosphere, temperature, pressure and altitude relationships, Equations of motions, evolution of lift, drag and moment, aerofoil theory, Mach number, Reynolds number flight maneuvers.

UNIT 3 AIRCRAFT CONFIGURATIONS, SYSTEMS AND INSTRUMENTS **9 Hrs.**

Early Airplanes- Pre Wright Brothers era, Wright Flyer, Components of an Airplane and their functions.Classifications of flight vehicles, Components of an airplane and their functions, Conventional control, powered control, basic instruments for flying - typical systems for control actuation.

UNIT 4 AIRFRAMES AND MATERIALS **9 Hrs.**

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 5 PROPULSION SYSTEMS **9 Hrs.**

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

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, students will be able to
CO1 - Recall history and evolution of air vehicles.
CO2 - Compare the flight performance with variations of earth atmospheric properties.
CO3 - Understand the working of aircraft systems and instruments.
CO4 - Recognize the functions of major aircraft components.
CO5 - Understand the construction of structural components and suitable materials for it.
CO6 - Study of propulsion system.

TEXT / REFERENCE BOOKS

1. Kermode,A.C., 'Flight without Formulae', McGraw Hill, 2010.
2. Shevell,R.S., Fundamentals of flights, Pearson education, 2013.
3. Anderson.J.D., Introduction to Flight, McGraw Hill, 2014.
4. McKinley.J.L. and R.D. Bent, Aircraft Power Plants, McGraw Hill, 1993.
5. Pallet.E.H.J. Aircraft Instruments & Principles, Pitman & Co 1933..

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SAEA1302	AIRCRAFT PRODUCTION TECHNIQUES	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To gain in depth knowledge of fundamentals of Aircraft Engineering tools and to study the various measurement tools for aircraft production.
- To discuss conventional and non-conventional machine tools used in Aircraft production.
- To understand Lathe and Special purpose machines.

UNIT 1 AIRCRAFT GENERAL ENGINEERING TOOLS AND MEASUREMENTS **9 Hrs.**

Aircraft tools, vice, hammers, chisels, files, hacksaw, marking tools-surface plate, scriber, punch, vblock, angle plate, tri- square; marking out; tools-inspection, maintenance & safety precautions. Linear measurements – non-precision & precision instruments; Angular measurements - non-precision & precision instruments; Taper measurements, surface measurements & Gauges.

UNIT 2 LATHE AND SPECIAL PURPOSE LATHES **9 Hrs.**

Process – theory of metal cutting, lathe- constructional features, cutting tool, geometry, various operations, taper turning methods, thread cutting methods,; capstan and turret lathes; Automats – single spindle, multi spindle, automatic screw type.

UNIT 3 CONVENTIONAL MACHINE TOOLS **9 Hrs.**

Machine tools; principle operation, construction and working of shaper, planer, slotter machines; Milling Machines - types, milling cutters – Hole making; drilling – reaming, boring, taping**.**

UNIT 4 CASTING AND METAL JOINING PROCESS **9 Hrs.**

Casting; types of pattern, pattern material, pattern allowance, types of moulding, sand, defects in casting. Production processes – comparison – sand casting – mould, pattern, die – pattern Allowances – materials – types – steps involved in core function and core making – runner, riser, gate-purpose – construction, principle of die-casting, shell moulding, investment casting, centrifugal casting. Types of joining process, welding process - Construction and applications of gas and arc welding, equipment used, flame characteristics, filler, flux materials – soldering and brazing – rivets; purpose, types, classification, riveting tools.

UNIT 5 SURFACE FINISHING AND PROTECTIVE COATING **9 Hrs.**

Grinding process; cylindrical grinding, surface grinding, center less grinding – honing, lapping, super finishing, polishing, buffing and hobbing. Metallic Coatings; electro plating, galvanizing, tin coating, anodizing. Organic Finishes; primers, oil paint, brushing, spraying and rubber base coatings, Additive Technology.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Choose the appropriate aircraft tools and precision measurements for Aircraft Production
CO2 - Compare the working principles and various features of Conventional and special purpose Lathe.
CO3 - Demonstrate the Constructional and operational features of shapers, planners, millers and boring machines.
CO4 - Suggest a suitable casting process and metal joining process for Aircraft Applications.
CO5 - Choose the appropriate Surface finishing process for Aircraft Production
CO6 - Aggregate the appropriate coating techniques used for aircraft components

TEXT / REFERENCE BOOKS

1. Khanna. O.P. Lal. M., Production Technology – Dhanpat Rai Publication, New Delhi, 1997.
2. Champman W.A.J., Production Technology, 4th Edition, Arnold Publisher, New Delhi, 1994.
3. HajraChoudhury S.K. Elements of Workshop Technology, Vol.1 & 2, Media Promoters & Publisher Pvt Ltd, Mumbai.

4. Keshu, S.C., Ganapathy K.K., Aircraft Production Techniques – Interline Publishing House, Bangalore.

SAE A1401	AIRCRAFT PROPULSION	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To introduce the concepts of applying Aero thermodynamics to air breathing propulsion.
- To familiarize the student's ability to analyze the concepts of compressor.
- To understand the basics of Axial Turbine.
- To understand the basics of Ramjet and Scramjet.

UNIT 1 THERMODYNAMICS OF AIR BREATHING PROPULSION **9 Hrs.**

History and classifications of Aero engines, Working of gas turbine engine – Thrust equation – Factors affecting thrust – Engine performance parameters – Efficiency, Specific fuel consumption, Methods of thrust augmentation – The propeller, turboprop, turbofan and turbojet engines characteristics.

UNIT 2 INLETS, COMBUSTION CHAMBER AND NOZZLES **9 Hrs.**

Introduction-Subsonic inlets-Supersonic inlets-Modes of Inlet operation- Gas turbine combustors-Types of combustion chamber-Fuel injector- Flame Tube cooling-Flame Stabilization-Flame holders- Theory of flow in isentropic nozzles – Losses in nozzles –Nozzle efficiency—nozzle choking –Over expanded and under expanded nozzles – Ejector and variable area nozzles.

UNIT 3 AIR COMPRESSOR **9 Hrs.**

Compressor and its classification- Centrifugal compressor - Work and compression ratio - Performance characteristics- Centrifugal compressor staging- Axial compressor-Work and compression ratio- Degree of reaction- Characteristic performance of a single stage axial compressor- Characteristic performance of a multistage axial compressor- Cascading of axial compressor-Compressor efficiency.

UNIT 4 AXIAL TURBINES **9 Hrs.**

Axial turbine stage -Velocity triangles and Power output - Elementary theory - Vortex theory-Limiting Factors of gas turbine design-Turbine performance- Turbine Blade cooling- Axial flow Turbine and compressor matching.

UNIT 5 RAMJET AND SCRAMJET **9 Hrs.**

Operating principle of RAMJET engine- RAMJET with afterburner- RAMJET performance-SCRAMJET working principle- Problems faced in supersonic combustion. RAMJET and SCRAMJET engine working principle and performance characteristics.

Max 45 Hrs.

COURSE OUTCOME

On completion of the course, student will be able to

CO1 - Interpret the performance and characteristics of turboprop, turbofan and turbojet.

CO2 - Measure the performance of inlets and nozzles and its modes of operation with respect to Mach number regimes.

CO3 - Compile the process and performance of combustion chambers and its cooling methods.

CO4 - Design the compressor blades by utilizing the elementary theory of compressors.

CO5 - Analyze the different types of turbines and its elementary theory of blades.

CO6- Estimate the stage performance and overall turbine performance for matching the compressors and turbines

TEXT / REFERENCE BOOKS

1. Philip Hill and Carl Peterson, "Mechanics and thermodynamics of propulsion", Pearson India, second edition 2010.
2. V.Ganesan., "Gas Turbines", Tata McGraw-Hill Education, third edition, 2010.
3. Cohen.H, Rogers.G.F.C. and Saravanamuttoo.H.I.H, "Gas turbine theory". Pearson education, fifth edition, 2001.
4. Rathakrishnan E., "Fundamentals of Engineering Thermodynamics", Prentice-Hall India, 2012.
5. Saeed Farokhi, "Aircraft Propulsion", John Wiley & Sons, Inc ., 2009.

6. Rolls Royce Jet Engine – 5thEdition – 1996.

SAEA1403	LOW SPEED AERODYNAMICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To introduce the concepts of mass, momentum and energy conservation relating to aerodynamics.
- To make the student understand the concept of vorticity, irotationality, theory of airfoils and wing sections.
- To introduce the basics of viscous flow.

UNIT 1 REVIEW OF BASIC AERODYNAMICS **9 Hrs.**

Atmosphere- Air speeds- Aerodynamic definitions Types of Drag- General Aerodynamic characteristics of airfoil sections- Complex potential-Singularities-Equations of Vortex-doublet and Rankine oval - Lift and Drag on cylinder and Aero foil.

UNIT 2 LOW SPEED FLOW **9 Hrs.**

Models of the fluid: control volumes and fluid elements. Continuity, Momentum and energy equations. Substantial derivative, incompressible Bernoulli's equation. Conformal mapping, Kutta-Joukowski transformation and Joukowski airfoil sections. Blausius integral theorem.

UNIT 3 AIRFOIL AND CONFORMAL TRANSFORMATION **9 Hrs.**

Airfoils Nomenclature and NACA series, Airfoil Characteristics, Vortex sheet, Kelvin Circulation theorem Thin aerofoil theory and its applications. Joukowski transformation and its application to fluid flow problems.

UNIT 4 WING THEORY **9 Hrs.**

Introduction to Finite wing, Downwash and Induced Drag, Biot -Savart law and Helmhotz's theorems, Horse shoe vortex, Prandtl's Classical Lifting line theory and its limitations.

UNIT 5 VISCOUS FLOW **9 Hrs.**

Derivation of Navier-Stokes equation for two-dimensional flows, boundary layer approximations, laminar boundary equations and boundary conditions, Blasius solution, qualitative features of boundary layer flow under pressure gradients, Integral method, aspects of transition to turbulence, turbulent boundary layer properties over a flat plate at low speeds. Separation of flow over bodies stream lined and bluff bodies.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Review of Complex potential, singularities, equation of Vortex-doublet and Rankine oval on cylinders and Aero foil.

CO2 - Interpret the continuity, Momentum and Energy equation for Low-speed flow

CO3 - Derive the Vortex sheet, Kelvin Circulation theorem Thin aerofoil theory, Joukowski transformation and its application to fluid flow problems

CO4 – Estimation of Drag, Biot -Savart law and Helmhotz's theorems, Horse shoe vortex, Prandtl's Classical Lifting line theory and its limitations

CO5 - Simplify the boundary layer equations through integral method and Blasius solution.

CO6 - Examine the effect of turbulence and various turbulence modelling for aircraft models.

TEXT / REFERENCE BOOKS

1. Aerodynamics for. Engineering Students. Sixth Edition. E.L. Houghton. P.W. Carpenter. Steven H. Collicott. Daniel T. Valentine, 2013 Elsevier, Ltd.
2. Bertin, John J., Aerodynamics for Engineers, Pearson Education Inc., 2002.
3. John J. Bertin, Russell M. Cummings, "Aerodynamics for Engineering students", Sixth Edition, Pearson, 2013.
4. Anderson J.D., "Fundamentals of Aerodynamics", Sixth Edition, McGraw Hill Book Co., New York, 2017.

5. Schlichting H., "Boundary layer theory" , Seventh Edition, McGraw Hill, NewYork 2014.