SRI SATYA SAI UNIVERSITY OF TECHNOLOGY AND MEDICAL SCIENCES SCHOOL OF ENGINEERING

Outcome based Curriculum for

Undergraduate Degree Courses in Engineering & Technology

Department of Aeronautical Engineering

Semester -V

AEA-501 Aircraft Structure- II

AEA-501	**Aircraft Structure- II**	**2L:1T:0P**	**3 credits**	**3Hrs/Week**

Course Preambles:

To provide the behavior of loads experience of aircraft indigenous components.

- To provide the students adopt with various methods for analysis of aircraft wings and fuselage.
- To provide conception design of major aircraft structural components.
- To provide the better understate the low weight structures..

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Ability to understand loads acting an aircraft.
- Ability to identify& resolve the structural design& its limitations.
- Ability to improvise distribution their loads on aircraft member with safer limits.
- Ability to understand the design of low weight to high strength panel member.
- Ability to analyze the aircraft real structural components such as wings and fuselage.

Unit 1: Fundamentals of Structural Analysis (10 hours)

Basic Elasticity: stress, notation for forces and stresses , equation of equilibrium, plane stress, Boundary conditions, determination of stresses on inclined planes, principal stresses, strain, Compatibility equations, plane strain, determination of strains on inclined planes principal Strains, stress-strain relationship.

Unit 2: Bending of Thin Walled Beams (10 hours)

Bending of open and closed thin walled beams: Symmetrical bending, unsymmetrical bending, deflection due to bending, calculation of section properties, application of bending theory, temperature effects, and numerical problems.

Unit 3: Shear Flow (8 hours)

Torsion of beams: torsion of closed section beams, torsion of multi-cell section, shear center, properties of shear center, numerical problems.

Unit 4: Introduction to Controller Design (10 hours)

Bredt-Batho formula, Shear flow in open section, Shear flow in closed section, shear flow in boom section, combination of open and close section.

Unit 5: Airworthiness and Airframe Loads (10 hours)

Airworthiness, factor of safety-flight envelope, load factor determination, loads on an aircraft, safe life and fail safe structure, fatigue, creep and relaxation, materials used in an aircraft.

References:

- Megson T.H.G., Aircraft Structure for engineering students, Edward Arnold.
- Perry D.J. and Azar J.J., Aircraft Structures, McGraw hill.

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AEA-501 Aircraft Structure- II

AEA-501	**Aircraft Structure- II**	**0L:0T:1P**	**1 Credits**	**2 Hrs/week**

List of Experiments:

- Verification of Maxwell's Reciprocal theorem & principle of superposition.
- Shear center location for open sections.
- Deflection of beams with various end conditions for different load.
- Shear center location for closed sections.

Lab Outcome:

- Student able to understand Shear center location for open sections, close sections.
- Student can measure the loading condition of beams with various end conditions for different load.

Department of Aeronautical Engineering

AEA-502 Aerodynamics-II

AEA-502	Aerodynamics-II	2L:1T:0P	3 Credits	3Hrs/Week

Course Preambles:

- To introduce the concepts of compressibility,
- To make the student understand the theory behind the formation of shocks and expansion fans in Supersonic flows.
- To introduce the methodology of measurements in Supersonic flows.

Course Outcomes:

- Calculate the compressible flow through a duct of varying cross section.
- Use quasi one-dimensional theory to analyze compressible flow problems.
- Estimate fluid properties in Rayleigh and Fanno type flows.
- Estimate the properties across normal and oblique shock waves.

Unit 1: Fundamental Aspects of Compressible Flow: (10 Hours)
Compressibility, Continuity, Momentum and energy equation, Calorically perfect gas, Mach number, speed of sound –Velocity relation, Mach cone, Mach angle, One dimensional Isentropic flow through variable area duct, Static and Stagnation properties, Critical conditions, Characteristic Mach number, Area-Mach number relation, Maximum discharge velocity.

Unit 2: Shock and Expansion Waves (10 Hours)
Normal shock relations, Prandtl's relation, Huguenot equation, Rayleigh Supersonic Pitot tube equation, Moving normal shock waves, Oblique shocks, Θ-β-M relation, Shock Polar, Reflection of oblique shocks, left running and right running waves, Interaction of oblique shock waves, slip line, Rayleigh flow, Fanno flow, Expansion waves, Prandtl-Meyer expansion, Maximum turning angle, Simple and nonsimple regions, operating characteristics of Nozzles.

Unit 3: Two Dimensional Compressible Flow (10 Hours)
Potential equation for 2-dimensional compressible flow, Linearization of potential equation, perturbation potential, Linearized Pressure Coefficient, Linearized subsonic flow, Prandtl-Glauert rule, Linearized supersonic flow, Method of characteristics.

Unit 4: High Speed Flow Over Airfoils, Wings and Airplane (40 Hours):
Supercritical Airfoil Sections, Transonic area rule, Swept wing, Airfoils for supersonic flows, Lift, drag, Pitching moment and Centre of pressure for supersonic profiles, Shock expansion theory, wave drag, supersonic wings, Design considerations for supersonic aircrafts.

Unit 5: Special Topics (6 Hours)
Shock-Boundary layer interaction, Wind tunnels for transonic, Supersonic and hypersonic flows, shock tube, Gun tunnels, Supersonic flow visualization, Introduction to Hypersonic Flows.

References:

1. Anderson, J. D, Modern Compressible Flow, McGraw-Hill & Co., 2002.
2. Rathakrishnan, E, Gas Dynamics, Prentice Hall of India, 2004.

AEA-502	**Aerodynamics-II**	**0L:0T:1P**	**1 Credits**	**2 Hrs/week**

List of Experiments:

- The lift and drag over an NACA-0012 Aerofoil
- Study of shock tube
- Study of supersonic aircraft vehicle.
- Shock wave generation over the spacecraft.
- Study of subsonic compressible flow.

Lab Outcome:

- Student able to understand subsonic compressible flow, supersonic aircraft vehicle, Shock wave generation, shock tube and can make test the drag over an NACA-0012 Airfoil.

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AEA-503 Aircraft Propulsion –II

AEA-503	Aircraft Propulsion –II	2L:1T:0P	3 Credits	3Hrs/Week

Course Preambles:

To impart make students understand theory in non-air-breathing and hypersonic propulsion methods to students so that they are familiar with various propulsion technologies associated with space launch vehicles, missiles and space probes.

Course Outcomes:

- Understanding ramjet and hypersonic air breathing propulsion systems.
- To get familiarity in rocket propulsion systems.
- Knowing the applications and principles of liquid and solid-liquid propulsion systems.
- To gain knowledge about the advanced propulsion technique used for interplanetary mission.

Unit 1: Aircraft Gas Turbines: **(10 Hours)**

Impulse and Reaction Types of gas turbines – Velocity triangles and power output – Elementary theory Vortex theory – Choice of blade profile, pitch and chord – Estimation of stage performance– Limiting factors in gas turbine design- Overall turbine performance – Methods of blade cooling –Matching of turbine and compressor – Numerical problems.

Unit 2: Ramjet Propulsion: (10 Hours)

Operating principle – Sub critical, critical and supercritical operation – Combustion in ramjet Engine – Ramjet performance – Sample ramjet design calculations – Introduction to scramjet Preliminary concepts in supersonic combustion – Integral ram- rocket- Numerical problems.

Unit 3: Fundamentals of Rocket Propulsion: (10 Hours)

Operating principle – Specific impulse of rocket - Rocket nozzle classification – Rocket performance considerations – Numerical Problems.

Unit 4: Advanced Propulsion Techniques: (8Hours)

Solid propellant rockets – Selection criteria of solid propellants – Important hardware components of solid rockets – Propellant grain design considerations – Liquid propellant rockets– Selection of liquid propellants – Thrust control in liquid rockets – Cooling in liquid rockets –Limitations of hybrid rockets.

Unit 5: State Space Analysis: **(10 Hours)**

Electric rocket propulsion – Ion propulsion techniques – Nuclear rocket – Types – Solar sail- Preliminary Concepts in nozzle less propulsion.

References:

- Anderson J.D. Introduction to flight, McGraw Hill Education (India) Pvt. Ltd.
- Ganesan V. Gas Turbines, McGraw Hill Education (India) Pvt. Ltd.
- Sutton, G.P., ―Rocket Propulsion Elements‖, John Wiley & Sons Inc., New York, 5thEdn.

AEA-503	**Aircraft Propulsion –II**	**0L:0T:1P**	**1 Credits**	**2 Hrs/week**

List of Experiments:

- Water Rocket
- Water jet study
- Calorific value estimation
- Ignition Delay Measurement
- Identification of burning rate

Lab Outcome:

- Student able to understand can measure Ignition Delay, Burning rate, Calorific value, and can develop the Water Rocket, Water jet study.

Program Elective - I

AEA-504 (A) Basics Aircraft Maintenance & Repair

AEA-504 (A)	**Basics Aircraft Maintenance & Repair**	**3L:1T:0P**	**4 Credits**	**4Hrs/Week**

Course Preambles:

- To make the students to familiarize with the Aircraft maintenance procedure an practice.
- Must have knowledge of basics of Aeronautics and its components.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Apply maintenance procedure to Aircraft Structure
- Identify the Aircraft components and faults
- Apply nondestructive testing procedures to identify the defects
- Apply overhauling procedure to new aircraft.

Unit 1: Welding in Aircraft Structure (12 Hours)

Equipment used in welding shop and their maintenance – Ensuring quality welds –Welding jigs and fixtures – Soldering and brazing.

Sheet Metal Repair and Maintenance (12 Hours)

Inspection of damage – Classification – Repair or replacement – Sheet metal inspection – N.D.T. Testing – Riveted repair design, Damage investigation.

Unit 2: Plastics and Composites in Aircraft (12 Hours)

Review of types of plastics used in airplanes – Maintenance and repair of plastic components – Repair of cracks, holes etc., various repair schemes – Scopes. Inspection and Repair of composite components – Special precautions.

Unit 3: Aircraft Jacking and Rigging (12 Hours)

Airplane jacking and weighing and C.G. Location. Balancing of control surfaces –Inspection maintenance. Helicopter flight controls. Tracking and balancing of main rotor.

Unit 4: Synchronous Machines (12 Hours)

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. Position and warning system.

Unit 5: Computer aided Design (CAD): (12 Hours)

Hazardous materials storage and handling, Aircraft furnishing practices – Equipment‘s. Trouble Shooting - Theory and practices.

References:

- Larry Reithmeir, ―Aircraft Repair Manual‖, Palamar Books, Marquette, 1992.
- BRIMM D.J. BOGGES H.E., ―Aircraft Maintenance‖, Pitman Publishing corp. New York. Electrical machines and equipment design exercise examples using Ansoft’s Maxwell 2D machine design package.

Department of Aeronautical Engineering

AEA-504 (B) Theory of Vibration

AEA-504 (B)	Theory of Vibration	3L:1T:0P	4 Credits	4Hrs/Week

Course Preambles:

- To study the effect of time dependent forces on mechanical systems and to get the natural characteristics of system with more degree of freedom systems.
- To study the vibration and aero elastic effects of aircraft wing.

Course Outcomes

- Gaining understanding of single and multi-degree vibrating systems
- Ability to use numerical techniques for vibration problems
- Knowledge acquired in aero elasticity and fluttering.
- Differentiate types of vibrations according to dampness and particle motion.
- Solve Rayleigh and Holzer method to find natural frequency of an object

Unit 1: Introduction (12 hours)

Types of vibrations, S.H.M, principle of super position applied to Simple Harmonic Motions. Beats, Fourier theorem and simple problems.

Unit 2: Maxwell's Equations (12 hours)

Single degree of freedom systems. Undamped free vibration, natural frequency of free vibration, spring and Mass elements, effect of mass of spring, Compound Pendulum. Single degree of freedom systems, different types of damping, concept of critical damping and its importance, study of response of viscous damped systems for cases under damping, critical and over damping, Logarithmic decrement.

Unit 3: Forced Vibration & Vibration Measuring Instruments (12 hours)

Single degree of freedom systems, steady state solution with viscous damping due to harmonic force. Solution by Complex algebra, reciprocating and rotating unbalance, vibration isolation, transmissibility ratio. Due to harmonic excitation and support motion. Vibration of elastic bodies– Vibration of strings – Longitudinal, lateral and torsional Vibration.

Unit 4: Systems with two Degrees of Freedom (12 hours)

Introduction, principle modes and Normal modes of vibration, co-ordinate coupling, Generalized and principal co-ordinates, free vibration in terms of initial conditions. Geared systems. Forced Oscillations-Harmonic excitation. Applications: a) Vehicle suspension. b) Dynamic vibration absorber. c) Dynamics of reciprocating Engines. Continuous Systems: Introduction, vibration of string, longitudinal vibration of rods, Torsional vibration of rods, Euler's equation for beams.

Unit 5: Waveguides (12 hours)

Introduction, Influence coefficients, Maxwell reciprocal theorem, Dunkerley's equation. Orthogonally of principal modes, Method of matrix iteration-Method of determination of all the natural frequencies using sweeping matrix and Orthogonally principle. Holzer's method, Stodola method.

Reference:

1. Theory of Vibrations W.T.Thomson.
2. Theory of Vibrations Grover & Nigam

Department of Aeronautical Engineering

AEA-505 (A) Nano science & Technology

AEA-505 (A)	**Nano science & Technology**	**3L:1T:0P**	**4 Credits**	**4Hrs/Week**

Course Preambles

To foundational knowledge of the Nano science and related fields.2.To make the students acquire an understanding the Nano science and Applications 3. To help them understand in broad outline of Nano science and Nanotechnology.

Course Outcomes

After completing this course students will be able to:

- Learn about the background on Nano science
- Understand the synthesis of nanomaterial's and their application and the impact of nanomaterial's on environment
- Apply their learned knowledge to develop Nanomaterial's.

Unit 1: Bonding in Atoms (12 hours)

Giant molecular solids. Electronic conduction, system classification confined to one, two or three dimension and their effect on properties, top-down and bottom-up processes.

Unit II: Characterization (12 hours)

Characterization using scanning electron microscopy (SEM), electro probe microanalysis (EPMA), transmission electron microscopy (TEM) including energy dispersive X-ray (EDX) analysis, electron energy loss spectroscopy (EELS), Auger electron spectroscopy (AES), low energy electron diffraction (LEED), reflection high energy electron diffraction (RHEED).

Unit 3: Technique-1 (12 hours)

When photons are used as probes, generally electrons/photons are emitted and are analyzed as light microscopy including confocal and two photon microscopy, X-ray diffraction (XRD), X-ray fluorescence (XRF), X-ray absorption spectroscopy (XAS), infrared spectroscopy (IR), Raman spectroscopy (Raman), Luminescence, and X-ray photo electron spectroscopy (XPS). Proximal probe technique to monitor the interaction between a localized probe and a sample surface.

Unit 4: Technique-2 (12 hours)

Atomic force microscopy (AFM), scanning tunneling microscopy (STM) and scanning tunneling spectroscopy (STS). There is also position-sensitive atom probe (POSAP) spectroscopy. Inorganic nanostructures, optical properties, exactions, pn junctions, phonons, quantum confinement, quantum dots, colloidal quantum dots, characterization and application like biopolymer tagging and light emitting semiconductor quantum dots, Nano magnetism in technology and the challenges.

Unit 5: Chemistry (12 hours)

Chemistry of carbon, light emission from organic molecules, fluorescence and electroluminescence, synthetic metals, carbon nanotubes, Nano cuboids, grapheme, carbon quantum dots. Carbon Nano tube as Nano test tube for quantum dot synthesis, functionalized Nano particles for biological applications, bio mineralization. DNA as a nanotechnology building block, directed assembly using biomolecules., molecular motors, biological motors, artificial photosynthesis, solar energy transduction.

Reference:

- Nano scale science and technology, John Wiley & Sons., 2005.
- Electron Microscopy and analysis, 2nd ed. Taylor and Francis, 2000.

AEA-505(B) Heat and Mass Transfer

AEA-505 (B)	Heat and Mass Transfer	3L:1T:0P	4 Credits	4Hrs/Week

Course Preambles:

- To study the effect of time dependent forces on mechanical systems and to get the natural characteristics of system with more degree of freedom systems.
- To study the vibration and aero elastic effects of aircraft wing.

Course Outcomes:

- Gaining understanding of single and multi-degree vibrating systems
- Ability to use numerical techniques for vibration problems
- Knowledge acquired in aero elasticity and fluttering.
- Differentiate types of vibrations according to dampness and particle motion.
- Solve Rayleigh and Holzer method to find natural frequency of an object.

Unit 1: Fundamentals (12 Hours)

Modes of heat transfer: Conduction –Convection – Radiation

Unit 2: Heat Conduction (12 Hours)

Steady and unsteady state heat conduction in solids - Effect of variation of thermal conductivity on heat transfer in solids –conduction with heat generation –Heat transfer problems in infinite and semi-infinite solids–Critical radius of insulation-Extended surfaces-Application of numerical techniques.

Unit 3: Free and Forced Convection (12 Hours)

Convection fundamentals: Basic equations, Boundary layer concept, Dimensional analysis Free Convention: Laminar boundary layer equation- Free convection in atmosphere free Convection on a vertical flat plate –Integral method - Empirical relation in free convection – External flow. Forced convection: Forced convection - Laminar and turbulent convective heat transfer analysis in flows between parallel plates, over a flat plate and in a circular pipe. Empirical relations - numerical techniques in problem solving.

Unit 4: Radiative Heat Transfer and Heat Exchangers (12 Hours)

Concept of black body-Intensity of radiation-Laws of Black body Radiation-Radiation from non-black surfaces- real surfaces –Radiation between surfaces-Radiation shape factors-Radiation shields. HEAT EXCHANGERS: Types-overall heat transfer coefficient- LMTD-NTU method of heat exchanger Analysis.

Unit 5: Ac-dc bidirectional boost converter (6 Hours)

Heat transfer problems in gas turbine combustion chambers - Rocket thrust chambers Aerodynamic heating - Ablative heat transfer.

References:

- Sachdeva, S.C. Fundamentals of Engineering, Heat and Mass Transfer, Wiley Eastern Ltd., New Delhi, 1981.
- 2.Lienhard, J.H., ―A Heat Transfer Text Book‖, Prentice Hall Inc., 1981.
- 3.Holman, J.P., ―Heat Transfer‖, McGraw-Hill Book Co., Inc., New York, 6th Edn, 1991.

Department of Aeronautical Engineering

AEA 506 Industrial Training-I

AEA 506	**Industrial Training-I**	**0L:0T:4P**	**2 Credits**	**4Hrs/Week**

Course Outcomes:

At the end of this course students will demonstrate the ability to

- Analyze the dynamic response and the calibration of few instruments
- Learn about various measurement devices, their characteristics, their operation and their limitations.
- Understand statistical data analysis
- Understand computerized data acquisition.
- Conceive a problem statement either from rigorous literature survey or from the requirements raised from need analysis.
- Design, implement and test the prototype/algorithm in order to solve the conceived problem.
- Write comprehensive report on Minor project work.

Guidelines:

- The Minor-project is a team activity having 3-4 students in a team. This is electronic product design work with a focus on electronic circuit design.
- The Minor project may be a complete hardware or a combination of hardware and software.
- The software part in Minor project should be less than 50% of the total work.
- Minor Project should cater to a small system required in laboratory or real life.
- It should encompass components, devices, analog or digital ICs, micro controller with which functional familiarity is introduced.
- After interactions with course coordinator and based on comprehensive literature survey/ need analysis, the student shall identify the title and define the aim and Preambles of Minor project.
- Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and submit the proposal within first week of the semester.
- The student is expected to exert on design, development and testing of the proposed work as per the schedule.
- Art work and Layout should be made using CAD based PCB simulation software. Due considerations should be given for power requirement of the system, mechanical aspects for enclosure and control panel design.