SCHOOL OF ENGINEERING

SRI SATYA SAI UNIVERSITY OF TECHNOLOGY AND MEDICAL SCIENCES

7th Semester Syllabus - AICTE Pattern

Undergraduate Degree Courses in Engineering & Technology

Bachelor of Engineering (Aeronautical Engineering)

AEA-701 Computational Fluid Dynamics

AEA-701	**Computational Fluid Dynamics**	**3L:0T:0P**	**3 Credits**	**3Hrs/Week**

Course Preamble:

- To introduce Governing Equations of viscous fluid flows
- To introduce numerical modeling and its role in the field of fluid flow and heat transfer
- To enable the students to understand the various discretization methods, solution procedures and turbulence modeling.
- To create confidence to solve complex problems in the field of fluid flow and heat transfer by using high speed computers.

Couse Outcomes:

- Upon completion of this course, the students can able
- To create numerical modeling and its role in the field of fluid flow and heat transfer
- To use the various discretization methods, solution procedures and turbulence modeling to solve flow and heat transfer problems.

Unit1: Governing Equations and Boundary Conditions (10 Hours)

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

Unit 2: Finite Difference and Finite Volume Methods for Diffusion (10 Hours)

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

Unit 3: Finite Volume Method for Convection Diffusion (10 Hours)

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

Unit4: Flow Field Analysis (10 Hours)

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

Unit 5: Turbulence Models and Mesh Generation (10 Hours)

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

References:

- Versteeg, H.K., and Malalasekera, W.,"An Introduction to Computational Fluid Dynamics: The finite volume Method", Pearson Education Ltd. Second Edition–2007.
- Ghoshdastidar, P.S.,"Computer Simulation of flow and heat transfer", Tata McGraw Hill Publishing Company Ltd., 1998.

AEA-701	Computational Fluid Dynamics	0L:0T:1P	1 Credits	2Hrs/Week

List of Experiment:

- Introduction to Modeling and Simulation Software to Aerodynamic problems.
- Solution for the one dimensional wave equations using explicit method of Lax Using Finite Difference Method (code development)
- Solution for the one dimensional Heat Conduction Equation using Explicit Method using Finite Difference Method (Code Development)
- Generation of the Algebraic Grid (Code Development)
- Generation of the Elliptic Grids (Code Development)
- Numerical Simulation of flow over an airfoil using commercial software Packages.
- Numerical Simulation of supersonic flow over a Wedge using commercial Software packages.
- Numerical Simulation of flat Plate Boundary Layer using commercial Software packages.
- Numerical Simulation of laminar flow through pipe using commercial Software packages.
- Numerical Simulation of flow past cylinder using Commercial Software packages.

Lab Outcome:
Student can able to do the coding for Boundary Layer, laminar flow through pipe, Heat Conduction, supersonic flow over a Wedge, flow over an airfoil and make simulation for various structures.

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Bachelor of Engineering (Aeronautical Engineering)

AEA-702 Rockets and Missile

AEA-702	**Rockets and Missile**	**3L:0T:0P**	**3 Credits**	**3Hrs/Week**

Course Preamble:

To give exposure on important topics like rocket motion, rocket aerodynamics and staging & control of rockets to students to enrich their knowledge in the area of missile flight

Couse Outcomes:

- Knowledge in types of rockets and missiles with respect to Indian & international scenario
- Gaining information's on aerodynamics of rocket and missiles
- Knowledge on stages and remote control of rockets missiles.

Unit 1: Classification of Rockets and Missiles (10 Hours)

Various methods of classification of missiles and rockets–Basic aerodynamic characteristics of surface to surface, surface to air, air to surface and air to air missiles–Examples of various Indian space launch vehicles and missiles–Current status of Indian rocket programme with respect to international scenario.

Unit 2: Aerodynamics of Rockets and Missile (10 Hours)

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

Unit 3: Rocket Motion in Free Space and Gravitational Field (10 Hours)

One dimensional and two-dimensional rocket motions in free space and homogeneous gravitational fields–description of vertical, inclined and gravity turn trajectories–determination of range and altitude–simple approximations to determine burn out velocity and altitude–estimation of culmination time and altitude.

Unit 4: Staging of Rockets and Missiles (10 Hours)

Design philosophy behind multi staging of launch vehicles and ballistic missiles–optimization of multistage vehicles–stage separation techniques in atmosphere and in space–stage separation dynamics and lateral separation characteristics.

Unit 5: Control of Rockets and Missiles (10 Hours)

Introduction to aerodynamic and jet control methods–various types of aerodynamic control methods for tactical and short range missiles-aerodynamic characteristics-various types of thrust vector control methods including secondary injection thrust vector control for launch vehicles and ballistic missiles.

References:

- Sutton, G.P., "Rocket Propulsion Elements", John Wiley & Sons Inc., New York, 5thEdition, 1993.
- Parker, E.R., "Materials for Missiles and Spacecraft", McGraw Hill Book Co. Inc. 1982.

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AEA-702	**Rockets and Missile**	**0L:0T:1P**	**1 Credits**	**2Hrs/Week**

List of Experiment:

- Determination of heat of combustion of Liquid fuels
- To determine flash point and fire point of diesel, Pensky-Martins Apparatus.
- To determine the effect of temperature on Kinematic Viscosity of glycerin by Redwood Viscometer.
- Proximate Analysis of wax and coke.
- To determine the calorific value of solid fuel using Bomb Calorimeter.

Lab Outcome:

Student can able to identify heat of combustion of Liquid fuels, Proximate Analysis of wax and coke, and able to calculate the value of flash point, calorific value and viscosity of fuel.

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Program Elective-IV

AEA-703 (A) Air Traffic Control and Planning

AEA-703 (A)	**Air Traffic Control and Planning**	**3L:0T:1P**	**3 credits**	**3Hrs/Week**

Course Preamble:

To study the procedure of the formation of aerodrome and its design and air traffic control.

Couse Outcomes:

- Understanding the requirement of air traffic control systems and types of air traffic control system.
- Knowledge in flight information systems and rules of air traffic systems.
- Knowledge indirection indicator systems for air navigation.

Unit 1: Basic Concepts (10 Hours)

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

Unit 2: Air Traffic Systems (10 Hours)

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

Unit3: Flight Information Systems (10 Hours)

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 co-ordination between radar / non radar control – emergencies – Flight information and advisory service – Alerting service – Co-ordination and emergency procedures – Rules of the air.

Unit 4: Aerodrome Data (10 Hours)

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.

Unit 5: Navigation and Other Services (10 Hours)

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.

References:

- Aircraft Manual (India) Volume I", latest Edition – The English Book Store, 17-1, Connaught Place, New Delhi.
- PANS – RAC – ICAO DOC 4444", Latest Edition, The English Book Store, 17-1, Connaught Place, New Delhi.

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AEA-703 (B) Flight Instrumentation

AEA-703 (B)	**Flight Instrumentation**	**3L:0T:1P**	**3 credits**	**3Hrs/Week**

Course Preamble:

- To familiarize the available basic concepts of Flight instruments to the engineers.
- To Understand the necessary knowledge that are needed in significance and operations of Flight instruments

Couse Outcomes:

- The students will also have an exposure to various topics such as measurement concepts, air data sensors and measurements, Flight Management Systems, and other instruments pertaining to gyroscopic measurements and Engine data measurements.
- Student will be able to deploy these skills effectively in understanding and analyzing the instrumentation methods in avionics engineering.

Unit 1: Measurement Science and Displays (10 Hours)

Instrumentation brief review-Concept of measurement-Errors and error estimation- Functional elements of an instrument system –Transducers - classification - Static and dynamic characteristics- calibration - classification of aircraft instruments - Instrument displays panels and cockpit layout.

Unit 2: Air Data Instruments and Synchro Transmission Systems (10 Hours)

Air data instruments-airspeed, altitude, Vertical speed indicators. Static Air temperature, Angle of attack measurement, Synchronous data transmission system

Unit3: Gyroscopic Instruments (10 Hours)

Gyroscope and its properties, gyro system, Gyro horizon, Direction gyro-direction indicator, Rate gyro-rate of turn and slip indicator, Turn coordinator, acceleration and turning errors.

Unit4: Aircraft Compass Systems &Flight Management System (10 Hours)

Direct reading compass, magnetic heading reference system-detector element, monitored gyroscope system, DGU, RMI, deviation compensator. FMS- Flight planning-flight path optimization-operational modes-4D flight management

Unit5: Power Plant Instruments (10 Hours)

Pressure measurement, temperature measurement, fuel quantity measurement, engine power and control instruments-measurement of RPM, manifold pressure, torque, exhaust gas temperature, EPR, fuel flow, engine vibration, monitoring.

References:

- Doeblin.E.O, “Measurement Systems Application and Design”, McGraw-Hill, New York, 1999.
- HarryL.Stilz, “Aerospace Telemetry”, Vol I to IV, Prentice-Hall Space Technology Series.
- Murthy, D.V.S., “Transducers and Measurements”, McGraw-Hill, 1995
- Pallet, E.H.J. “Aircraft Instruments & Integrated systems”, Longman Scientific and Technical, McGraw-Hill, 1992.

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Open Core Elective-III

AEA-704 (A) UAV System

AEA-704 (A)	**UAV System**	**3L:0T:0P**	**3 Credits**	**3Hrs/Week**

Course Preamble:

- To make the students to understand the basic concepts of UAV systems design.

Couse Outcomes:

- Ability to design UAV system
- Ability to identify different hardware for UAV.

Unit 1: Introduction to UAV (10 Hours)

History of UAV–classification–Introduction to Unmanned Aircraft Systems--models and prototypes–System Composition-applications

Unit 2: The Design of UAV Systems (10 Hours)

Introduction to Design and Selection of the System-Aerodynamics and Airframe Configurations Characteristics of Aircraft Types Design Standards and Regulatory Aspects UK,USA and Europe-Design for Stealth--control surfaces-specifications.

Unit 3: Avionics Hardware (10 Hours)

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

Unit 4: Communication Payloads and Controls (10 Hours)

Payloads-Telemetry-tracking-Aerial photography-controls-PID feedback-radio control frequency range –modems-memory system-simulation-ground test-analysis-trouble shooting

Unit 5: The Development of UAV Systems (10 Hours)

Waypoints navigation-ground control software-System Ground Testing System In-flight Testing Future Prospects and Challenges-Case Studies–Mini and Micro UAVs.

References:

- Reg Austin "Unmanned Aircraft Systems UAV design, development and deployment", Wiley,2010.
- Robert C. Nelson, Flight Stability and Automatic Control, McGraw-Hill, Inc, 1998.

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AEA-704 (B) Fatigue and Fracture

AEA-704 (B)	**Fatigue and Fracture**	**3L:0T:0P**	**3 credits**	**3Hrs/Week**

Course Preamble:

- To understand the basic concepts involved in fatigue analysis and to study the importance of fracture mechanics in aerospace applications.

Couse Outcomes:

- Ability to apply mathematical knowledge to define fatigue behaviors
- Ability to perform fatigue design
- Ability to analyses the fracture due to fatigue

Unit 1: Fatigue of Structures (10 Hours)

S.N. curves-Endurance limits-Effect of mean stress, Goodman, Gerber and Soderberg relations and diagrams-Notches and stress concentrations- Neubers stress concentration factors-Plastic stress concentration factors-Notched S.N. curves–Fatigue of composite materials.

Unit 2: Statistical Aspects of Fatigue Behaviour (10 Hours)

Low cycle and high cycle fatigue-Coffin-Mansons relation-Transition life-cyclic strain hardening and softening-Analysis of load histories-Cycle counting techniques-Cumulative damage-Miners theory-Other theories.

Unit 3: Physical Aspects of Fatigue (10 Hours)

Phase in fatigue life-Crack initiation-Crack growth-Final Fracture-Dislocations-fatigue fracture surfaces.

Unit 4: Fracture Mechanics (10 Hours)

Strength of cracked bodies-Potential energy and surface energy-Griffith□s theory-Irwin-Orwinextension of Griffith□s theory to ductile materials-stress analysis of "cracked bodies-Effect of thickness on fracture toughness"-stress intensity factors for typical 'geometries.

Unit 5: Fatigue Design and Testing (10 Hours)

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

References:

- Prasanth Kumar, "Elements of fracture mechanics",Wheeter publication, 1999.
- Barrois W, Ripely, E.L., "Fatigue of aircraft structure,"Pergamon press. Oxford, 1983.

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AEA-705 Projects Stage-I

AEA 705	**Project Stage-I**	**0L:0T:10P**	**5 credits**	**10Hrs/Week**

Course Outcomes:

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

- Design and validate electrical algorithms for optimum solution
- Analyze the dynamic response and the calibration of few instruments
- Build projects as per industry and society demands.

Guidelines:

- Minor Project should cater to a small system required in laboratory or real life.
- 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.

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AEA-706 Self Study/GD/Seminar

AEA-706	**Self-Study/GD/Seminar**	**0L:0T:1P**	**1 Credits**	**2Hrs/Week**

Course Preamble:

The main Preamble is to improve the mass communication and convincing/understanding skills of students and to give the students an opportunity to exercise their rights to express themselves. The evaluation will be done based on their presentation work and group discussion.

Couse Outcomes:

In terms of **content**, students will be able to do the following:

Presentation Skills

They will be able to make use of visual, audio and audio-visual material to support their presentation, and will be able to speak cogently with or without notes. Students will present either in groups or as individuals.

Discussion Skills

Students will be able to judge when to speak and how much to say, speak clearly and audibly in a manner appropriate to the subject, ask appropriate questions, use evidence to support claims, respond to a range of questions, take part in meaningful discussion

Listening Skills

Students will demonstrate that they have paid close attention to what others say and can respond constructively. Through listening attentively, they will be able to build on discussion fruitfully, supporting and connecting with other discussants. They will be able to follow academic discussions, infer meanings that are not overt, and take notes from a discussion or presentation.

Argumentative Skills and Critical Thinking

Students will develop persuasive speech, present information in a compelling, well-structured, and logical sequence, respond respectfully to opposing ideas, show depth of knowledge of complex subjects, and develop their ability to synthesize, evaluate and reflect on information.

Questioning

Through asking appropriate questions, students will demonstrate their understanding of discussions and spark further discussion.

Interdisciplinary Inquiry

Students will be able to reach across diverse disciplines to apply theories, methods and knowledge bases from multiple fields to a single question or problem.

Engaging with Big Questions

Students will engage with important questions that stimulate discussion and debate.

Studying Major Works

Students will engage with works that are widely held to be significant in the field of study, while recognizing cultural diversity and the ever-changing nature of what is regarded as important.