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INSTITUTE OF SCIENCE AND TECHNOLOGY
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SCHOOL OF MECHANICAL ENGINEERING

DEPARTMENT OF AERONAUTICAL ENGINEERING

1.1.2 Syllabus revision & new courses introduced in 2022-2023

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DEPARTMENT OF AERONAUTICAL ENGINEERING

BOARD OF STUDIES MEETING HELD ON 14.04.2022

Minutes of the Board of Studies meeting

Board of Studies meeting for the Department of Aeronautical Engineering held on 14th April 2022 in Aero CAD Lab with the following agenda:

1. Revision of Course "SAEA3001 Theory of Elasticity"
2. Revision of Course "SAEA3003 Airframe Maintenance and Repair Practices"
3. Revision of Course "SAEA1302 Aircraft Production Techniques"
4. Revision of Course "SAEA1304 Introduction to Aerodynamics"
5. Revision of Course "SAEA1305 Introduction to Aircraft Structures"
6. Revision of Course "SAEA1404 Avionics"
7. Introduction of a new course titled "Fundamentals of Aerospace Technology" as an Open Elective course.
8. Introduction of a new courses titled "Aviation Management", "Cryogenic Engineering", "Rocket and Space Mechanics", "Advanced Flight Dynamics" and "Plates and Shells" as Professional Elective course.

Welcome Address

At the outset, the Chair Person welcomed the members of BoS and placed the agenda for the deliberations of the members. The following deliberations were made as per the items of the circulated agenda.

1. Agenda item # 1 Modifications proposed for 2022 batch Bachelors of Engineering– Aeronautical Engineering students in SAEA3001 Theory of Elasticity.

Head of the department informed that the department teams have been working on the modification of curriculum and in this direction the following changes were made on SAEA3001 Theory of Elasticity.



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(a) Inclusion of the following topics in Unit V: Euler's column buckling load: clamped-free, clamped-hinged, clamped-clamped and pin-ended, Numerical Problem.

Resolutions: The External members considered the revision made and discussed regarding the revision. Dr. P. Boomadevi pointed out that the removal of topics was necessary. These topics are covered in applications of Aircraft Structures.

2. Agenda item # 2 Modifications proposed for 2022 batch Bachelors of Engineering– Aeronautical Engineering students in SAEA3003 Airframe Maintenance and Repair Practices.

Head of the department informed that the department teams have been working on the modification of curriculum and in this direction the following changes were made SAEA3003 Airframe Maintenance and Repair Practices.

(a) Inclusion of the following topics in Unit – IV: Calculation Of Weight Of Completed Repair; Effect Of Weight – Change On Surrounding Structure.

Resolutions: The External members considered the revision made and discussed regarding the revision. Dr. P. Boomadevi pointed out that the removal of topics was necessary. These topics are not covered in any of the core courses and it is very important to estimate the weight of the structure.

3. Agenda item # 3 Modifications proposed for 2022 batch Bachelors of Engineering– Aeronautical Engineering students in SAEA1302 Aircraft Production Techniques.

Head of the department informed that the department teams have been working on the modification of curriculum and in this direction the following changes were made SAEA1302 Aircraft Production Techniques.

(a) Inclusion of the following topics in Unit – II: Process and Theory of metal cutting and Unit – IV: Production processes – comparison – sand casting – mould, pattern, die –



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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.

(b)Exclusion of the following topics in Unit – IV: Casting; types of pattern, pattern material, pattern allowance, types of moulding, sand, defects in casting.

Resolutions: The External members considered the revision made and discussed regarding the revision. Dr. P. Boomadevi pointed out that the removal of topics was necessary. These topics are not covered in any of the core courses and it is very important to learn about the types of casting and pattern allowances comparative study.

4. Agenda item # 4 Modifications proposed for 2022 batch Bachelors of Engineering– Aeronautical Engineering students in SAEA1304 Introduction to Aerodynamics.

Head of the department informed that the department teams have been working on the modification of curriculum and in this direction the following changes were made SAEA1304 Introduction to Aerodynamics.

(a)Inclusion of the following topics in Unit – V: Theory of streamline, Stream function, velocity potential, relation between stream function and velocity potential, circulation. Basic elementary flows– Source, sink, free and forced vortex, uniform parallel flow.

(b)Exclusion of the following topics in Unit – V: Nature of turbulence, Separation of flow over bodies- stream lined and bluff bodies, Lift and Drag on cylinder.

Resolutions: The External members considered the revision made and discussed regarding the revision. Dr. P. Boomadevi pointed out that the removal of topics was necessary. These topics are not covered in any of the core courses and it is very important to learn about the nature of turbulence through potential flow theory and synthesize the modelling of bluff bodies.

5. Agenda item # 5 Modifications proposed for 2022 batch Bachelors of Engineering– Aeronautical Engineering students in SAEA1305 Introduction to Aircraft Structures.



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Head of the department informed that the department teams have been working on the modification of curriculum and in this direction the following changes were made SAEA1305 Introduction to Aircraft Structures.

- (a) Inclusion of the following topics in Unit – II: Combined direct and bending stresses in fore mentioned sections.
- (b) Inclusion of the following topics in Unit – III: Cantilever and overhanging beams.
- (c) Inclusion of the following topics in Unit – IV: Stresses in Thin-Walled Pressure Vessels.

Resolutions: The External members considered the revision made and discussed regarding the revision. Dr. P. Boomadevi pointed out that the removal of topics was necessary. These topics are not covered in any of the core courses and it is very important to learn about the combined effect of direct and bending stresses in I and T sections as thin-walled pressure vessels.

6. Agenda item # 6 Modifications proposed for 2022 batch Bachelors of Engineering– Aeronautical Engineering students in SAEA1404 Avionics.

Head of the department informed that the department teams have been working on the modification of curriculum and in this direction the following changes were made SAEA1404 Avionics.

- (a) Inclusion of the following topics in Unit – II: Open architecture definition of IMA cabinets – first-, second-, and third-generation Implementations.
- (b) Inclusion of the following topics in Unit – IV: Microwave Landing System (MLS).
- (c) Inclusion of the following topics in Unit – V: Air Traffic Control (ATC) transponder -Traffic Collision and Avoidance System

Resolutions: The External members considered the revision made and discussed regarding the revision. Dr. P. Boomadevi pointed out that the removal of topics was necessary. These topics are not covered in any of the core courses and it is very important to learn about the



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Airborne collision and avoidance system with MLS support and the third generation implementation of IMA Cabinets are important source.

7. Agenda item # 7: Introduction of a new course titled "Fundamentals of Aerospace Technology" as a Theory course in B.E-Aeronautical Engineering Curriculum

As suggested by the industry expert a new open elective theory course was introduced titled "Fundamentals of Aerospace Technology" as this course is very much important for real-time experience in the field of Aerospace technology connected to Manned and Unmanned space flight.

This initiative is appreciated by BoS members and after the discussion about the contents of the syllabus; the course was approved for inclusion as a theory open elective course in the Curriculum.

8. Agenda item # 8: Introduction of a new courses titled "Aviation Management", "Cryogenic Engineering", "Rocket and Space Mechanics", "Advanced Flight Dynamics" and "Plates and Shells" as Professional Elective courses in B.E-Aeronautical Engineering Curriculum

As suggested by the industry expert a new theory course was introduced titled "Aviation Management" as this course is very much important for real-time experience in the field of Aviation technology connected to Airfields and Aerodromes. "Cryogenic Engineering" was introduced as this course is highly required for the research in Jet propulsion and space flight requirements. "Rocket and Space Mechanics" was introduced that related to the previous course of "Cryogenic Engineering" as this course is highly required for space flight dynamics with the propulsive device concerned with cryogenics. "Advanced Flight Dynamics" was introduced to build the flight control system for the space vehicles and Aircraft vehicles with high utilization of Stability and control. "Plates and Shells" was introduced as a highly important course for the students to secure knowledge in the area of structural dynamics of spacecraft and aircrafts.

This initiative is appreciated by BoS members and after the discussion about the contents of the syllabus; the courses was approved for inclusion as a theory professional elective courses in the Curriculum.



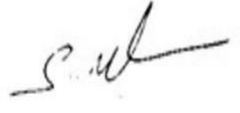
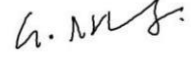
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The revised syllabus of the course is enclosed in Annexure-1.

Members present:

External Members	Signature	Internal Members	Signature
Dr. Paramasivam, Professor, Madras Institute of Technology, Chennai.		Dr.S. Prakash Dean/Faculty of Mechanical	
Er. James Michael Amulu, Senior Product Development Leader, SAP, Bangalore.		Dr.P. Boomadevi, Head/Aeronautical Engineering	
		Dr.A. Anderson Associate Professor/ Aeronautical Engineering	
		Dr. S. Manigandan Assistant Professor/ Aeronautical Engineering	
		Mr. G. Madhan Kumar Assistant Professor/ Aeronautical Engineering	



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ANNEXURE-1

SAEA3001	THEORY OF ELASTICITY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand the concepts and basics of Theory of Elasticity and its principles.
- To evaluate the characteristics of structural members.
- To know the basic methods to solve the solid mechanics problems.
- To discuss the structural mechanics and its applications.

UNIT 1 INTRODUCTION

9 Hrs.

Definition, notations and sign conventions for stress and strain – Stress - strain relations, Strain-displacement relations- Elastic constants. Coordinates and Tensors Transformation. Stress in Cartesian Coordinates. Principal Stresses and Principal Coordinates. Stress Ellipsoid.

UNIT 2 BASIC EQUATIONS OF ELASTICITY

9 Hrs.

Generalized Hooke's Law. Relationships between Elastic Moduli. Boundary-Value Problems in Elasticity. Navier's Equations. Beltrami-Michell's Equations. Saint-Venant's Principle.

UNIT 3 2D AND 3D PROBLEMS OF ELASTICITY

9 Hrs.

Plane stress and plain strain problems - Airy's stress function in polar and Cartesian coordinates. Biharmonic equations – 2- D Problems Cantilever and simply supported beams. Torsion of a Circular Shaft. Bending of a Prismatic Bar. Thermo Elasticity-General Approach- Plane Thermoplastic Problem in Polar Coordinates.

UNIT 4 TORSION

9 Hrs.

Torsion of a uniform circular shaft. Torsion of Elliptical and Triangular Sections Bars. Torsion of Hollow Bars. Prandtl's Theory-Membrane analogy.

UNIT 5 THERMAL STRESS AND ELASTIC STABILITY

9 Hrs.

Thermo elastic stress strain relations, equations of equilibrium, thermal stresses in thin circular discs and in long circular cylinders. Euler's column buckling load: clamped-free, clamped-hinged, clamped-clamped and pin-ended, Numerical Problem.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, students will be able to

- CO1 - Recall history and basics of Theory of Elasticity and its principles.
- CO2 - Compare the mathematical modeling and numerical methods.
- CO3 - Understand the working methodology of Theory of Elasticity.
- CO4 - Recognize the various functions of approximation methods.
- CO5 - Analyze the quality of structural grids and suitable shapes and methods for it.
- CO6 - Distinguish the problems application based.

TEXT / REFERENCE BOOKS

1. Timoshenko S.P. and J.N. Goodier, Theory of Elasticity, McGraw-Hill, 2010.
2. Sechler E, "Elasticity in Engineering" John Wiley & Sons Inc., New York, 1980.
3. Ugural, A.C and Fenster, S.K, Advanced Strength and Applied Elasticity, Prentice hall, 2003
4. Wang, C.T. Applied elasticity, McGraw Hill 1993.
5. Enrico Volterra and Caines, J.H, Advanced strength of Materials, Prentice Hall, 1991.

Added Content



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SAEA3003	AIRFRAME MAINTENANCE AND REPAIR PRACTICES	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To make the students to understand the Airframe components and the tools used to maintain the components. Defect investigation, methods to carry out investigation and the detailed maintenance and practice procedures.

UNIT 1 SAFETY PRACTICES

9 Hrs.

Safety – Importance of Flight Safety, Maintenance of Ground Support Equipments, refueling, de-refueling, fire equipments, Hazardous materials storage and handling, Environmental and shop cleanliness – precautions, Aircraft furnishing -practices, Equipments, Hazard zones. **Repair schemes; Fabrication of replacement patches; Tools - power/hand; Repair techniques; Peening - Close tolerance fasteners; Sealing compounds; forming/shaping; Calculation of weight of completed repair**

UNIT 2 REVIEW OF HYDRAULIC AND PNEUMATIC SYSTEM

9 Hrs.

Trouble shooting theory and Procedure, Inspection and maintenance of Hydraulic, Pneumatic, Fuel, Landing gear, Inspection and maintenance of Air conditioning, Pressurization systems Oxygen, De-icing, Fire Protection Installation and maintenance of instruments – Handling - Testing – Inspection, Position and warning system Auxiliary Power Units (APUs).

UNIT 3 AIRCRAFT JACKING, ASSEMBLY AND RIGGING

9 Hrs.

Airplane, Jacking and Weighing and C.G. Location .Rigging of control surfaces – Inspection, maintenance. Helicopter flight controls, Tracking and balancing of main rotor.

UNIT 4 MAINTENANCE OF AIRCRAFT STRUCTURAL COMPONENTS

9 Hrs.

Equipments Used In Welding Shop And Their Maintenance – Ensuring Quality Welds – Welding Jigs And Fixtures – Soldering And Brazing – Laser Welding. Sheet Metal Repair And Maintenance: Selection Of Materials; Repair Schemes; Fabrication Of Replacement Patches; Tools – Power/Hand; Repair Techniques; Peening – Close Tolerance Fasteners; Sealing Compounds; Forming/Shaping; **Calculation Of Weight Of Completed Repair; Effect Of Weight – Change On Surrounding Structure.** Sheet Metal Inspection – N.D.T. Testing. Riveted Repair Design – Damage Investigation – Reverse Engineering.

UNIT 5 PLASTICS AND COMPOSITES IN AIRCRAFT

9 Hrs.

Review of Types of Plastics Used In Airplanes – Maintenance And Repair of Plastic Components – Repair of Cracks, Holes Etc., Various Repairs Schemes – Scopes.

Cleaning of Fibre Reinforced Plastic (FRP) Materials Prior To Repair; Break Test – Repair Schemes; FRP/Honeycomb Sandwich Materials; Laminated FRP Structural Members And Skin Panels; Tools/Equipment; Vacuum-Bag Process. Special Precautions – Autoclaves.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, students will be able to

- CO1 - Understanding importance of Flight Safety, Maintenance of Aircraft Equipments.
- CO2 - Understanding Hydraulic and pneumatic system.
- CO3 - Understanding Aircraft Jacking, Assembling and Rigging procedures.
- CO4 - Understanding the maintenance of Aircraft structural components.
- CO5 - Analysis of plastic and composite materials used in aircraft.
- CO6 – Familiarize in handling the composite material repair works.

TEXT / REFERENCE BOOKS

1. Larry Reithmeir, Aircraft Repair Manual – Palamar Books, Marquette, 2012.
2. BrimmD.J.Bogges H.E., Aircraft Maintenance – Pitman Publishing Corp. New York, 2011.
3. Howard Curtis, Antonio Fillippone, Aerospace Engineering Reference, Butterworth – Heinmann, 2012.
4. Micheal .J. Kroes, James .R. Rardon, Aircraft : Basic Science with Student Study Guide, McGraw Hill, 2011.
5. Delp. Bent and Mckinely “Aircraft Maintenance Repair”, McGraw Hill, New York, 1987.

 Added Content

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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, scribe, punch, v-block, 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, tapping.

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.

Added Content

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SAEA 1304	INTRODUCTION TO AERODYNAMICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand the concepts of fluids and its properties.
- To evaluate the performance of fluids and fluid flows in International standard atmosphere.
- To know the basic functions of fluids and fluid flows and measuring instruments.
- To discuss fluid properties in the basis of the structural, aerodynamics.

UNIT 1 FLUID PROPERTIES & EQUATIONS OF MOTION

9 Hrs.

Properties of fluids—Specific gravity, specific weight, viscosity, compressibility, vapor pressure and gas laws – capillarity and surface tension. Flow characteristics: concepts of system and control volume. Application of control volume to continuity equation, energy equation, momentum equation and Bernoulli's principle and its applications— Orifice meter, venturimeter, pitot –tube.

UNIT 2 DIMENSIONAL ANALYSIS AND FLUID FLOW IN CLOSED CONDUITS

9 Hrs.

Dimensional Analysis Buckingham Pi - theorem, Derivations and applications of important dimensionless numbers, basic modeling and similitude. Pipe friction, Darcy-Weisbach equation and chezy's formula, Pipe losses - Major and Minor losses - Problems of parallel, series and branched pipes.

UNIT 3 FLUID FLOW OVER BODIES AND BOUNDARY LAYER THEORY

9 Hrs.

Boundary layer theory-boundary layer development on a flat plate, displacement thickness, momentum thickness, Energy thickness, momentum integral equation, drag on flat plate.

UNIT 4 PUMPS AND TURBINES

9 Hrs.

Impact of jets Centrifugal Pumps, Hydraulic Turbines: Classification of hydraulic turbines – Working principle of Pelton wheel, Francis and Kaplan turbines –velocity triangles- Propeller fundamentals.

UNIT 5 BASIC AERODYNAMICS

9 Hrs.

Types of flow - velocity field and acceleration. Viscous fluid flow - Laminar and turbulent flow. Nature of turbulence, Separation of flow over bodies- stream lined and bluff bodies, Lift and Drag on cylinder Theory of streamline, Stream function, velocity potential, relation between stream function and velocity potential, circulation. Basic elementary flows— Source, sink, free and forced vortex, uniform parallel flow.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, students will be able to

- CO1 - Estimate the governing equations of fluid flow through the identification of fluid properties.
- CO2 - Illustrate the fluid flow problems theoretically through dimensional analysis and losses in pipes.
- CO3 - Compile the combinations of elementary flow models utilized for solving the practical flow problems.
- CO4 - Solve the boundary layer problems for streamlined and bluff bodies.
- CO5 - Discriminate the different types of pumps and its performance curves.
- CO6 - Analogize the different types of hydraulic turbines and its characteristics.

TEXT / REFERENCE BOOKS

1. Bansal.R.K., "Fluid Mechanics & Hydraulics Machines", 9th Edition, Laxmi Publications, 2010.
2. Kumar, K.L., Fluid Mechanics, 2nd Edition, Tata McGraw-Hill, New Delhi,2012.
3. Irving H. Shames, Fluid Mechanics, 3rd Edition, McGraw-Hill, 2012.
4. Robert W. Fox and Alan T. McDonald, Introduction to Fluid Mechanics, 5th Edition, John Wiley and Sons, Inc., U.K.
5. Douglas. J. F., Gasiorek. J. M., Swaffield. J. A., "Fluid Mechanics ELBS", 4th Edition, Prentice Hall, 2000.

Added Content

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SAEA1305	INTRODUCTION TO AIRCRAFT STRUCTURES	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- At the end of this course, the student will have knowledge about the behavior of aircraft structural members.
- Subjected to various types of forces. The subject can be mastered best by solving numerous problems.

UNIT 1 CONCEPT OF SIMPLE STRESSES AND STRAINS

9 Hrs.

Concept of stress and strain, Hooke's law-Tension, Compression, and Shear, stress-strain diagram-Poisson's ratio, elastic constants and their relationship- Deformation of simple and compound bars. Principal plane, principal stress, maximum shearing stress - Uniaxial, biaxial state of stress-Mohr's circle for plane stresses. **Clapeyron's 3 moment equation and moment distribution method for indeterminate beams.**

UNIT 2 ANALYSIS OF BEAMS

9 Hrs.

Types of beams and loads-shear force and bending moment diagrams for cantilevers, simply supported and overhanging beams. Theory of pure bending- assumptions in the simple bending theory, Flexure formula: its application to beams of rectangular, circular and channel, I&T Sections, **Combined direct and bending stresses in fore mentioned sections.**

UNIT 3 DEFLECTION OF BEAMS

9 Hrs.

Differential Equation of the Elastic Axis-Deflection and slope of beams-Double Integration, Area Moment and Macaulay's methods for simply supported, **Cantilever and overhanging beams.**

UNIT 4 STRESSES IN SHAFTS, HELICAL SPRINGS AND THIN PRESSURE VESSELS

9 Hrs.

Torsion of Circular Shafts-Shear Stresses and Twist in Solid and Hollow Shafts. Close and open Coil Helical springs. **Stresses in Thin Walled Pressure Vessels.**

UNIT 5 COLUMNS AND FAILURE THEORIES

9 Hrs.

Columns- Member subjected to combined bending and axial loads, Euler's theory, Crippling load, Rankine's theory. Failure theories - Maximum Stress theory - Maximum Strain Theory - Maximum Shear Stress Theory - **Distortion Theory - Maximum Strain energy theory**

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Infer the stress and strain relationship through direct method and Mohr's circle method.
- CO2 - Analyse the shear force and bending moment for beams and sections.
- CO3 - Deduct the deflection of beams through moment-area and Macaulay's method.
- CO4 - Simplify the twisting moment and stresses in solid shafts and thin-walled pressure vessels.
- CO5 - Evaluate the crippling load of the column through Rankine's and Euler's Theory.
- CO6 - Distinguish the different types of failure theories subjected to stress, strain, distortion and energy.

TEXT / REFERENCE BOOKS

1. Malhotra, D.R. and Gupta, H.C., "The Strength of Materials", Satya Prakashan Tech. India Publications, New Delhi, 2011.
2. Kazimi, S.M.A., "Solid Mechanics", Tata McGraw Hill, 1976. Dym, C.L. and Shames I.H., "Solid Mechanics", McGraw Hill, Kogakusha, Tokyo, 2012.
3. Timoshenko, S., Young, "Elements of Strength of Material", Vol. I & II, T. Van Nostrand Co Inc, Princeton, N.J. 2012.
4. Ferdinand P. Beer, and Russell Johnston, E., "Mechanics of Materials", SI Metric Edition, McGraw Hill, 2011.
5. Rajput, R.K., "Strength of materials", Fourth Edition, S. Chand Limited, 2007.

Added Content

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SAEA1404	AVIONICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To introduce the basic of avionics and its need for civil and military aircrafts.
- To impart knowledge about the avionic architecture and various avionics data buses.
- To gain more knowledge on various avionics subsystems.

UNIT 1 DISPLAY TECHNOLOGY

9 Hrs.

Basics of Avionics-Basics of Cockpits-Need for Avionics in civil and military aircraft and space systems –Attitude Direction Indicator-The Horizontal Situation Indicator-altimeter-Airspeed Indicator (ASI) –glass cockpit-Display system architectures- Electronic flight instrument systems - CRT-The Active Matrix Liquid Crystal Display-Large area HDD-Three-dimensional and four-dimensional display formats -Touch screen.

UNIT 2 AVIONICS TECHNOLOGY

9 Hrs.

Avionics Bus architecture–Data buses MIL–Aircraft system Interface Digital data buses -integration of aircraft systems - Fiber-optic buses-avionics packaging – LRU-Integrated Modular Avionics-System design-Open architecture definition of IMA cabinets – first-, second-, and third-generation Implementations.

UNIT 3 SENSORS

9 Hrs.

Air data - Air Data and Inertial Reference Systems (ADIRS) -Magnetic sensing - Magnetic Heading Reference System (MHRS) - Inertial navigation -Inertial platforms- Nature of Radar and Applications, Simple form of Radar Equation, Radar Block Diagram and Operation, Prediction of Range Performance, Minimum Detectable Signal, Radar Receivers Radar sensors -Radar altimeter - Doppler radar -Weather radar.

UNIT 4 NAVIGATION AND LANDING AIDS

9 Hrs.

Basic navigation - Radio navigation - Oceanic crossings - Inertial navigation - Satellite navigation – GPS -Terrain Awareness and Warning System - Satellite navigation systems- Instrument Landing System-Transponder Landing System -Microwave Landing System (MLS)

UNIT 5 COMMUNICATIONS AIDS

9 Hrs.

Radio Frequency spectrum -Communications systems-HF-VHF-Satellite communications-Air Traffic Control (ATC) transponder -Traffic Collision and Avoidance System- Airborne early warning -Ground surveillance -Electronic warfare principles.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Analyse the functions of different cockpit display technologies in aircrafts systems.
- CO2 - Illustrate the avionics bus architecture in aircraft system interface.
- CO3 - Relate the air data sensors, antennas and Radar system utilized in aircrafts.
- CO4 - Distinguish the different navigation systems for landing gears used in aircrafts.
- CO5 - Compare the different communication technologies utilized in ATC system.
- CO6 - Suggest the airborne surveillance system followed for navigation aids..

TEXT / REFERENCE BOOKS

1. Collinson R.P.G. "Introduction to Avionics", Chapman & Hall Publications, 2011.
2. N.S. Gopalakrishnan & T.G. Ajitha, Principles of Intellectual Property, Eastern Book Company, 2nd ed., 2014.
3. Civil Avionics Systems, Ian Moir, Allan G Sea bridge, Professional Engineering Publishing Limited, London, UK, 2013.
4. Myron Kyton, Walfred Fried, Avionics Navigation systems, 2nd Edition, John Willy & Sons, 1997.
5. Albert D Helfrick, Modern Aviation Electronics, 2nd Edition, PHI, 1994.

Added Content



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SAEA4001	Fundamentals of Aerospace Technology	L	T	P	C
		3	0	0	3

UNIT1 BASIC PROPERTIES OF ATMOSPHERE

9Hrs.

Heat, Temperature, and Temperature Scales - The Electromagnetic Spectrum - Composition of the Atmosphere - Layers in the atmosphere are defined by temperature profiles, How pressure varies in the atmosphere - Principal weather instruments – Earth's Radiation Belts.

UNIT2 CLASSIFICATION OF AEROSPACE VEHICLES

9Hrs.

Fixed wing Aircraft – Classification of Aircraft, Aircraft as a Space Launcher assistance – Rotorcraft – Classification of Rotorcraft – Missiles – Classification of Missiles, Missile technology missions – Space Vehicles – classification of space vehicles.

UNIT3 SATELLITE MISSION AND CONFIGURATION

9Hrs.

Mission Overview – Requirements for different missions – Spacecraft configuration - Spacecraft Bus–Payload–Requirements and constraints– Initial configuration decisions and Trade-offs–Spacecraft configuration process– Broad design of Spacecraft Bus–Subsystem layout–Types of Satellites–Constellations– Applications

UNIT4 FUNDAMENTALS OF MISSILE SYSTEMS

9Hrs.

History of guided missile for defence applications- Classification of missiles– The Generalized Missile Equations of Motion- Coordinate Systems- Lagrange's Equations for Rotating Coordinate Systems- Rigid-Body Equations of Motion-missile system elements, missile ground systems.

UNIT5 SPACE ENVIRONMENT

9Hrs.

Peculiarities of space environment and its description– effect of space environment on materials of spacecraft structure and astronauts- manned space missions – effect on satellite life time

Max.45Hrs.

TEXT/REFERENCEBOOKS

2. Cornelisse, J.W., "Rocket Propulsion and Space Dynamics", J.W. Freeman &Co.,Ltd, London, 1982
3. Siouris, G.M. "Missile Guidance and control systems", Springer, 2003.
4. James R.Wertzand WileyJ.Larson," Space Mission Analysis and Design", (Third Edition),1999.
5. Charles D.Brown, "Spacecraft Mission Design", AIAA Education Series, Published by AIAA, 1998
6. Van de Kamp, "Elements of astromechanics", Pitman Publishing Co., Ltd., London, 1980.

New Course



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SAEA3002	AVIATION MANAGEMENT	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To study the operation and safety standards of civil and military aircrafts.
- To understand the duties and responsibilities of national and international regulatory bodies.
- To understand the International law regime for Airline Investment and freedoms of Air.

UNIT 1 INTRODUCTION

9 Hrs.

Introduction to Aviation Management – Aviation – Aviation Sector in India - Civil Aviation – Airport – Air Traffic Control – International Air Transport Association (IATA) – Fact Sheet – IATA at the Air Transport Industry - IATA Industrial Priorities – IATA Partners – IATA Corporate and Corporate Governance Structure – IATA Human Capital – IATA Committee's.

UNIT 2 CIVIL AVIATION AND REGULATORY AGENCIES

9 Hrs.

International Civil Aviation Organization – Aerosol Aviation Services Corporation – Aviation Management Consulting Group - AOPA – International Association of Airport Executives – Federal Aviation Interactive Reporting Systems - Inter Agency Committee for Aviation Policy – Active Level of Services Reviews – Aircraft Engineers International Affiliation.

UNIT 3 AVIATION LAW

9 Hrs.

The Distinctiveness and Content of International Aviation Law - Introduction to the Chicago Convention – The Geneva Convention (1948) - The Tokyo Convention (1963)- The Hague Convention (1970)- The Montreal Convention (1971) - The Cape Town Convention (2001), Public and Private International Aviation Law - The Freedoms of the Air - The International Law Regime for Airline Investment - The International Law Regime for Aircraft Financing.

UNIT 4 AIRCRAFT MANAGEMENT SAFETY STANDARDS

9 Hrs.

Air Safety – FAA Aviation Safety Draft Documents – Aircraft Management Interagency Committee for Aviation Policy Safety Standards – Aircraft Management Safety Standards Guidelines for Federal Flight Programmes – National Transportation Safety Board – Airline Water Supplies.

UNIT 5 GLOBAL VERSUS DOMESTIC AVIATION INDUSTRY

9 Hrs.

Overview of Contemporary Global Industry – Airline Industry Profitability – Present State of the Air Transport Industry – Aviation Industry – Global Aviation Industry – Indian Aviation- Case Studies

Max. 45 Hrs.

COURSE OUTCOME

On completion of the course, students will be able to

- CO1 - Know the history of aviation and its developments.
- CO2 - Understand the growth of Indian aviation sector and globalization.
- CO3 - Distinguish the public and private International Aviation Law.
- CO4 - Understand the safety standards followed by aviation industries for safety.
- CO5 - Understand the profitability, financing and leasing in aviation.
- CO6 – Analyze the present state of the Air Transport Industry in India.

TEXT / REFERENCE BOOKS

- Ratandeep Singh, "Aviation Management", Kanishka Publishers, 2012.
- "Aircraft Manual – Volume 1 and Volume 2", Sterling Book House.
- Kathleen M. Sweet, "Aviation and Airport Security", Pearson Education, 2011.
- "Aircraft Manual – Volume 1 and Volume 2", Sterling Book House, 2010.
- Senguttuvan P.S, "Fundamentals of Air Transport Management", Excel Books, First Edition 2006.

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SAEA3006	CRYOGENIC ENGINEERING	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To enrich the students in the field of Cryogenic Engineering and its Applications.
- To learn the various Refrigeration processes, Equipment, Instruments, gas separation and Purification processes.

UNIT 1 CRYOGENIC FLUIDS AND MATERIAL PROPERTIES

9 Hrs.

Cryogenic Engineering – Properties of cryogenic fluids – Oxygen, Nitrogen, Argon, Neon, Fluorine, Helium, Hydrogen, Properties of Solids – Mechanical, Thermal, and Electrical-Super conductivity, Cryogenic applications.

UNIT 2 CRYOGENIC REFRIGERATION AND GAS LIQUEFACTION

9 Hrs.

Principle – Joule Thomson Expansion, Cascade processes, Ortho para hydrogen conversion, cold gas refrigerators, Linde- Hampson cycles, Claude and cascaded systems, magnetic cooling, Stirling Cycle, Pulse Tube refrigeration.

UNIT 3 CRYOGENIC EQUIPMENTS AND REQUIREMENTS

9 Hrs.

Cryogenics- Heat Exchangers, Compressors, Expanders, Effect of various parameters in performance and system optimization. Insulation and Storage equipment for cryogenic fluids, industrial storage and transfer of cryogenic fluids.

UNIT 4 GAS SEPARATION AND PURIFICATION

9 Hrs.

Ideal gas, Mixture characteristics – composition diagrams – gas separation – Principle of Rectification process– principle and working of air separation, principle and working of gas purification.

UNIT 5 CRYOGENIC INSTRUMENTATION

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.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, students will be able to

- CO1 - Describe the basic concepts of various cryogenic fluids and materials.
- CO2 - Understand the cryogenic refrigeration and gas liquefaction.
- CO3 - Understanding the working principles of cryogenic equipment.
- CO4 - Understanding the working of gas separation and purification.
- CO5 - Understanding the instrumentation of cryogenic technology
- CO6 - To design the cryogenic system based on the application.

TEXT / REFERENCE BOOKS

1. Randal F. Barron, Cryogenic Systems, McGraw Hill, 2010.
2. Cryogenic Engineering, Van Nostrand Co. Inc. 2011.
3. Klaus D. Timmerhaus, Richard Palmer Reed, Cryogenic Engineering: 50 years of progress, Springer, 2011.
4. Hastliden, C., "Cryogenic Fundamentals", Academic Press, 2001.
5. Walker, "Cryocoolers", Plenum Press, 2000.

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SAEA3007	ROCKET AND SPACE MECHANICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand the concepts of launch vehicles and spacecraft.
- To evaluate the performance of rocket aerodynamics.
- To know the basic functions motion in space.
- To discuss fluid properties in the basis of motion control and space dynamics.

UNIT 1 ROCKETS SYSTEM

9 Hrs.

Ignition System in rockets – types of Igniters – Igniter Design Considerations – Design Consideration of liquid Rocket Combustion Chamber, Injector Propellant Feed Lines, Valves, Propellant Tanks Outlet and Helium Pressurized and Turbine feed Systems – Propellant SLOSH and Propellant Hammer – Elimination of Geysering Effect in Missiles – Combustion System of Solid Rockets.

UNIT 2 AERODYNAMICS OF ROCKETS AND MISSILES

9 Hrs.

Airframe Components of Rockets and missiles – Classification of rockets and missiles – methods of Describing Aerodynamic Forces and Moments – Lateral Aerodynamic Moment – Lateral Damping Moment and Longitudinal Moment of a Rocket – lift and Drag Forces – Drag Estimation – Rocket Dispersion – Numerical Problems.

UNIT 3 MOTION IN SPACE AND GRAVITATIONAL FIELD

9 Hrs.

One Dimensional and Two Dimensional Rocket Motions in Free Space and Homogeneous Gravitational Fields – Forces Acting on a Rocket While Passing Through Atmosphere – description of Vertical, Inclined and Gravity Turn Trajectories – Approximations to Burnout Velocity.

UNIT 4 STAGING AND CONTROL

9 Hrs.

Rocket Vector Control – Methods – Thrust determination – SITVC – Multistaging of rockets – Vehicle Optimization – Stage Separation Dynamics – Separation Techniques. Selection of Materials.

UNIT 5 SPACE DYNAMICS

9 Hrs.

The Solar System – Reference Frames and Coordinate Systems – The Celestial Sphere – The Ecliptic – Motion of Vernal Equinox – Sidereal Time – Solar Time – Standard Time – The Earth's Atmosphere. Two body Problem – Libration Points – R Satellite Orbits – Relations Between Position and Time – Orbital Elements. Time and Keplerian orbits, Keplerian orbits in space, Perturbed orbits.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, students will be able to

- CO1 - Study the applications of the conservation laws to flow.
- CO2 - Understand the importance of dimensional analysis and numerical problems.
- CO3 - Understand the importance of gravitational field.
- CO4 - Understand the properties of selection of materials.
- CO5 - Analyze the staging control.
- CO6 - Distinguish the basics of fluid statics and fluid dynamics for propulsion.

TEXT / REFERENCE BOOKS

1. G.P. Sutton: Rocket Propulsion Elements, Wiley, New York, 2006.
2. C.D. Brown: Spacecraft Propulsion, AIAA Education Series, AIAA Inc., Washington DC, 1996.

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SAEA3009	ADVANCED FLIGHT DYNAMICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To familiarize the student's ability to analyze the concepts of advance flight dynamics.

UNIT 1 INTRODUCTION TO ATMOSPHERIC AND SPACE FLIGHT

9 Hrs.

Modelling and simulation of Atmosphere and Space flight -attitude and kinematics of of ordinate frames – basic definitions of vector-coordinate systems and rotation matrix-Euler axis and principal angle-Euler angles-Euler symmetric parameters (quaternion)-Rodrigues parameters – Gibbs vectors-attitude kinematics.

UNIT 2 CELESTIAL FRAME AND ELEMENTS

9 Hrs.

Newton's law of gravitation –gravitational anomalies –two body problem – Celestial frame and orbital elements –planet fixed frame –lamerts problem- perturbation acceleration-effects of Planetary oblations – effects of atmospheric drag –three body problem-equations of motion langrange solution-restricted three body problem.

UNIT 3 ATMOSPHERIC AND SPACE FLIGHT TRAJECTORIES

9 Hrs.

Atmospheric and Space trajectories – equations of motion –airplane flight paths- long range cruising flight -steady wind on airplane-take off manoeuvre-rocket ascent trajectories.

UNIT 4 ROTATIONAL MOTION AND CONTROL SYSTEMS

9 Hrs.

Euler equation for a rotational motion-rotational kinematic energy-principal body frame –torque free rotation of spacecraft – implementation of control systems elements-single axis closed loop attitude control-multi axis closed loop attitude control- Six-degrees of freedom simulation.

UNIT 5 FLIGHT SIMULATOR AS A TRAINING DEVICE AND RESEARCH TOOL

9 Hrs.

Introduction, advantage of simulator, the effectiveness of Simulator - wing rock motion of aircraft simulation. The Data sources, Validation, in- flight simulators.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Understand the working principles of flight motion and celestial bodies in space.
- CO2 - Comprehend the sound foundation in the design principles of celestial frame and elements.
- CO3 - Learn the operation of trajectories.
- CO4 - Should be able to understand the concept of control systems.
- CO5 - Understand the principle and performance of flight simulator.
- CO6 - Applying the importance of Advance flight dynamics to Aerospace.

TEXT / REFERENCE BOOKS

1. Ashishtewari, Atmospheric and space flight dynamics: modeling and simulation with Matlab and Simulink, Birkhauser, spinger international edition, 2011.
2. Automatic Control of Atmospheric and Space Flight Vehicles: Design and Analysis with MATLAB® and Simulink® (Control Engineering) 2011 Edition.
3. Pamadi, B. "Performance, stability, Dynamics and Control of Airplanes", AIAA 2004.
4. Etkin, B. and Reid L.D. "Dynamics of Flight-Stability and Control" 3rd edition, John Wiley, 1996.
5. Stengel, R.F. "Flight dynamics" Princeton University Press, Princeton, N.J., USA, 2004.
6. Kaplan, Marshall H., Modern Spacecraft Dynamics and Control, John Wiely & Sons, New York. 1976.

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AEA3011	PLATES AND SHELLS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand the concepts of plates and shells.
- To evaluate the characteristics of structural members.
- To know the basic methods to solve the solid mechanics problems.
- To discuss the structural mechanics and its applications.

UNIT 1 INTRODUCTION

9 Hrs.

Classical Plate Theory - Assumptions – Differential Equations – Boundary Conditions. Plate and Shell Structures in Aerospace Vehicles. Flexural rigidity of plates. Flexural rigidity of shells.

UNIT 2 PLATES OF VARIOUS SHAPES

9 Hrs.

Navier's Method of Solution for Simply Supported Rectangular Plates – Levy's Method of Solution for Rectangular Plates under Different Boundary Conditions – Circular plates. Pure bending of plates. Isotropic and orthotropic flat plates.

UNIT 3 EIGEN VALUE ANALYSIS

9 Hrs.

Stability and Free Vibration Analysis of Rectangular Plates. Method of calculation of critical loads. Buckling of simply supported rectangular plates uniformly compressed in one direction. Buckling of uniformly compressed rectangular plates simply supported along two opposite sides perpendicular to the direction of compression and having various edge conditions along the other two sides. Critical values of compressive stress.

UNIT 4 BENDING OF THIN SHELLS

9 Hrs.

Deformation of an element of a shell. Expression for components of normal stresses. Flexural rigidity of shell. Basic Concepts of Shell Type of Structures – Membrane and Bending Theories for Circular Cylindrical Shells.

UNIT 5 APPROXIMATE METHODS

9 Hrs.

Rayleigh – Ritz, Galerkin Methods – Finite Difference Method – Application to Rectangular Plates for Static, Free Vibration and Stability Analysis.

Max 45 Hrs.

COURSE OUTCOMES

On completion of the course, students will be able to.

- CO1 - Recall concept and evolution of plates and shell.
- CO2 - Compare the mathematical modeling and numerical methods.
- CO3 - Understand the working methodology of various finite element methods.
- CO4 - Recognize the various functions of approximation methods.
- CO5 - Analyze the quality of structural grids and suitable shapes and methods for it.
- CO6 - Distinguish the problems application based.

TEXT / REFERENCE BOOKS

1. Flugge, W. Stresses in Shells, Springer – Verlag, 1985.
2. Timoshenko, S.P. and Gere, J.M., Theory of Elastic Stability, McGraw Hill Book Co., 1986.
3. Harry Kraus, 'Thin Elastic Shells', John Wiley and Sons, 1987.
4. Gural, A. C. Stresses in Plates and Shells. 2nd ed. New York, NY: McGraw Hill, 1998.
5. Timoshenko, S.P. Winowsky. S., and Kreger, Theory of Plates and Shells, McGraw Hill Book Co., 1990.

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SCHOOL OF MECHANICAL ENGINEERING
DEPARTMENT OF AERONAUTICAL ENGINEERING
BOARD OF STUDIES MEETING HELD ON 12.12.2022

Minutes of the Board of Studies meeting

Board of Studies meeting for the Department of Aeronautical Engineering held on 12th December 2022 in Aero CAD Lab with the following agenda:

1. Revision of Course "SAEA1403 Low Speed Aerodynamics"
2. Revision of Course "SAEA1402 Aircraft Structures"
3. Revision of Course "SAEA1401 Aircraft Propulsion"
4. Revision of Course "SAEA1502 Aerospace Propulsion"
5. Revision of Course "SAEA3004 Aircraft Design"
6. Revision of Course "SAEA2502 Propulsion Lab"
7. Introduction of a new courses titled "Boundary Layer Theory", "High Temperature Materials", "Flight Vehicles Guidance and Control", "Orbital Mechanics", "Manned Space Mission" and "Missile Technology" as Professional Elective courses.

Welcome Address

At the outset, the Chair Person welcomed the members of BoS and placed the agenda for the deliberations of the members. The following deliberations were made as per the items of the circulated agenda.

1. Agenda item # 1 Modifications proposed for 2022 batch Bachelors of Engineering– Aeronautical Engineering students in SAEA1403 Low Speed Aerodynamics

Head of the department informed that the department teams have been working on the modification of curriculum and in this direction the following changes were made on SAEA1403 Low Speed Aerodynamics.

(a) Inclusion of the following topics in Unit V: Derivation of Navier-Stokes equation for two-dimensional flows, boundary layer approximations, laminar boundary equations and



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boundary conditions, Blasius solution, qualitative features of boundary layer flow under pressure gradients, Integral method.

Resolutions: The External members considered the revision made and discussed regarding the revision. Dr. P. Boomadevi pointed out that the removal of topics was necessary. These topics are highly essential for Aero dynamist to simplify Navier-Stokes equation in all turbulence models.

2. Agenda item # 2 Modifications proposed for 2022 batch Bachelors of Engineering– Aeronautical Engineering students in SAEA1402 Aircraft Structures.

Head of the department informed that the department teams have been working on the modification of curriculum and in this direction the following changes were made SAEA1402 Aircraft Structures.

(a) Inclusion of the following topics in Unit – V: Structural layout of the Airplane and components, loads acting on major components such as wing, fuselage, tails, landing gear etc., Concept of allowable stress and margin of safety

Resolutions: The External members considered the revision made and discussed regarding the revision. Dr. P. Boomadevi pointed out that the removal of topics was necessary. These topics are not covered in any of the core courses and it is very important to synthesize the structural layout of Airplane components.

3. Agenda item # 3 Modifications proposed for 2022 batch Bachelors of Engineering– Aeronautical Engineering students in SAEA1401 Aircraft Propulsion

Head of the department informed that the department teams have been working on the modification of curriculum and in this direction the following changes were made SAEA1401 Aircraft Propulsion.



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(a) Inclusion of the following topics in Unit – V: Operating principle of RAMJET engine- RAMJET with afterburner- RAMJET performance- SCRAMJET working principle- Problems faced in supersonic combustion.

(b) Exclusion of the following topics in Unit – V: Impulse and reaction blading of gas turbines – Velocity triangles and power output – Elementary theory – Choice of blade profile pitch and chord – Estimation of stage performance.

Resolutions: The External members considered the revision made and discussed regarding the revision. Dr. P. Boomadevi pointed out that the removal of topics was necessary. These topics are not covered in any of the core courses and it is very important to learn about the performance of RAMJET and SCRAMJET.

4. Agenda item # 4 Modifications proposed for 2022 batch Bachelors of Engineering– Aeronautical Engineering students in SAEA1502 Aerospace Propulsion.

Head of the department informed that the department teams have been working on the modification of curriculum and in this direction the following changes were made SAEA1502 Aerospace Propulsion.

(a) Inclusion of the following topics in Unit – IV: Arc-jet thruster - Ion thruster - Hall Effect Thruster - Magneto plasma dynamic thruster- Nuclear rockets - Solar sail. Unit – V: : MEMS and MEMS- Hybrid Propulsion System

Resolutions: The External members considered the revision made and discussed regarding the revision. Dr. P. Boomadevi pointed out that the removal of topics was necessary. These topics are not covered in any of the core courses and it is very important to learn about the classification of electrostatic and electrothermal thrusters.

5. Agenda item # 5 Modifications proposed for 2022 batch Bachelors of Engineering– Aeronautical Engineering students in SAEA3004 Aircraft Design.



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Head of the department informed that the department teams have been working on the modification of curriculum and in this direction the following changes were made SAEA3004 Aircraft Design.

(a) Inclusion of the following topics in Unit – III: Structural aspects of design of airplane, Bending moment and shear force diagram. Design principles of all metal stressed skin wings for civil and military application, features of light airplanes using advanced composite materials.

(b) Exclusion of the following topics in Unit – III: Cockpit and aircraft passenger cabin layout for different categories, types of associated structure, features of light airplanes using advanced composite materials.

Resolutions: The External members considered the revision made and discussed regarding the revision. Dr. P. Boomadevi pointed out that the removal of topics was necessary. These topics are not covered in any of the core courses and it is very important to learn about the wing and fuselage structural components in addition to advanced composite materials influencing the structure.

6. Agenda item # 6 Modifications proposed for 2022 batch Bachelors of Engineering– Aeronautical Engineering students in SAEA2502 Propulsion Lab.

Head of the department informed that the department teams have been working on the modification of curriculum and in this direction the following changes were made SAEA2502 Propulsion Lab.

(a) Inclusion of the following experiments: “Evaluation of performance of gas turbine engine”, “Study of piston and turbojet engine propellers”.

Resolutions: The External members considered the revision made and discussed regarding the revision. Dr. P. Boomadevi pointed out that the removal of topics was necessary. These topics are not covered in any of the core courses and it is very important to gain experience on gas turbine engine with afterburner.



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7. Agenda item # 7: Introduction of a new courses titled "Boundary Layer Theory", "High Temperature Materials", "Flight Vehicles Guidance and Control", "Orbital Mechanics", "Manned Space Mission" and "Missile Technology" as Professional Elective courses in B.E- Aeronautical Engineering Curriculum.

As suggested by the industry expert a new theory courses were introduced titled "Boundary Layer Theory" as this course is very much important for real-time experience in the field of Aerodynamics connected to study of wall effects in bluff bodies.

The industry expert also interested to present about the professional elective courses are as follows:

"High Temperature Materials" was introduced as this course is highly required for the research in manufacturing of high carbon steels and super alloys for spacecraft and aircraft engines requirements.

"Flight Vehicles Guidance and control" was introduced as this course is highly relevant with autonomous flight vehicle control system and non-autonomous flight control system with suitable guidance systems.

"Orbital Mechanics" was introduced that this course related to the previous course of "Flight Dynamics" since this course is highly required for space flight dynamics with n body problem.

"Manned Space Mission" was introduced to ensure the space flight control and execution for the space life habitat.

"Missile Technology" was introduced as a highly important course for the students to secure knowledge in missile dynamics and control and missile subsystems for different targeting systems.

This initiative is appreciated by BoS members and after a discussion about the contents of the syllabus; the course revision was approved for inclusion as core course in the Curriculum.



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BoS members accepted the changes and approved the syllabus.

The revised syllabus of the course is enclosed in Annexure-1.

Members present:

External Members	Signature	Internal Members	Signature
Dr. Paramasivam, Professor, Madras Institute of Technology, Chennai.		Dr.S. Prakash Dean/Faculty of Mechanical	
Er. James Michael Amulu, Senior Product Development Leader, SAP, Bangalore.		Dr.P. Boomadevi, Head/Aeronautical Engineering	
		Dr.A. Anderson Associate Professor/ Aeronautical Engineering	
		Dr. S. Manigandan Assistant Professor/ Aeronautical Engineering	
		Mr. G. Madhan Kumar Assistant Professor/ Aeronautical Engineering	



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ANNEXURE-1

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, irrotationality, 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.

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 Helmholtz'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 Helmholtz'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

- Aerodynamics for Engineering Students. Sixth Edition. E.L. Houghton. P.W. Carpenter. Steven H. Collicott. Daniel T. Valentine, 2013 Elsevier, Ltd.
- Bertin, John J., Aerodynamics for Engineers, Pearson Education Inc., 2002.
- John J. Bertin, Russell M. Cummings, "Aerodynamics for Engineering students", Sixth Edition, Pearson, 2013.
- Anderson J.D., "Fundamentals of Aerodynamics", Sixth Edition, McGraw Hill Book Co., New York, 2017.
- Schlichting H., "Boundary layer theory", Seventh Edition, McGraw Hill, New York 2014.
- Enrico Volterra and Caines, J.H, Advanced strength of Materials, Prentice Hall, 1991.

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SAEA1402	AIRCRAFT STRUCTURES	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To provide the students various methods for analysis of aircraft wings and fuselage.
- To provide the behavior of major aircraft structural components.

UNIT 1 STATICALLY DETERMINATE AND INDETERMINATE STRUCTURE

9 Hrs.

Truss: Analysis of plane truss–Method of joints–3D Truss. - Load transmission in multiple span beam- Clapeyron's Three Moment Equation.

UNIT 2 ENERGY METHODS

9 Hrs.

Strain Energy due to axial, bending and Tensional loads-Castigliano's theorem-Maxwell's Reciprocal theorem, Unit load method, The principle of virtual work- application to beams, trusses, -redundant center.

UNIT 3 UNSYMMETRICAL BENDING

9 Hrs.

Bending stresses in beams of unsymmetrical sections– Bending of symmetric sections with skew loads.

Ductile and brittle materials – maximum principal stress theory - maximum principal strain theory - maximum shear stress theory

UNIT 4 SHEAR FLOW IN OPEN AND CLOSED SECTIONS

9 Hrs.

Concept of shear flow, shear centre, Elastic axis. With one axis of symmetry, with wall effective and ineffective in bending, unsymmetrical beam sections. Bredt–Batho formula, Shear flow in single & multi cell structure under torsion.

UNIT 5 STRESS ANALYSIS IN WING AND FUSELAGE

9 Hrs.

Structural lay out of the Airplane and components, loads acting on major components such as wing, fuselage, tails, landing gear etc., Concept of allowable stress and margin of safety. Procedure–Shear and bending moment distribution for semi cantilever and other types of wings and fuselage, thin webbed beam. With parallel and nonparallel flanges, Shear resistant web beams, Tension field web beams(Wagner's).

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Analyze the trusses and beams using method of joints and moment distribution method.
- CO2 - Evaluate the stresses using energy methods in trusses, beams, frames and rings of the aircraft structure.
- CO3 - Estimate the bending stresses in beams under skew loads and calculate the nonlinear stress distributions during unsymmetrical bending cases.
- CO4 - Analyse the shear flow and shear centre for open and closed loop sections.
- CO5 - Estimate the stress analysis in airplane wing and its components.
- CO6 - Evaluate the stress analysis in airplane fuselage and its components., fuselage, tails, landing gear.

TEXT / REFERENCE BOOKS

- Megson, T.M.G., "Aircraft Structures for Engineering Students", Edward Arnold, 2012.
- Bruhn. E.H. "Analysis and Design of Flight vehicles Structures", Tri-stateoff set Company, USA, 2015.
- Millard V.Barton, "Fundamentals of Aircraft Structures" Prentice Hall, 2012.
- Timoshenko, S., "Strength of Materials", Vol.I and II, Princeton D. Von Nostrand Co, 2012.
- Donaldson, B.K., "Analysis of Aircraft Structures– An Introduction", McGraw-Hill, 2011.

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SAEA1401	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 REACTION TURBINES

9 Hrs.

Operating principle of RAMJET engine- RAMJET with afterburner- RAMJET performance- SCRAMJET working principle- Problems faced in supersonic combustion. Impulse and reaction blading of gas turbines – Velocity triangles and power output – Elementary theory – Choice of blade profile pitch and chord – Estimation of stage performance.

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

2. Philip Hill and Carl Peterson, "Mechanics and thermodynamics of propulsion", Pearson India, second edition 2010.
3. V. Ganesan., "Gas Turbines", Tata McGraw-Hill Education, third edition, 2010.
4. Cohen. H., Rogers. G. F. C. and Saravanamuttoo. H. I. H., "Gas turbine theory". Pearson education, fifth edition, 2001.
5. Rathakrishnan E., "Fundamentals of Engineering Thermodynamics", Prentice-Hall India, 2012.
6. Saeed Farokhi, "Aircraft Propulsion", John Wiley & Sons, Inc., 2009.
7. Rolls Royce Jet Engine – 5th Edition – 1996.

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SAEA1502	AEROSPACE PROPULSION	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To introduce the concepts of applying Aero thermodynamics to non air breathing propulsion.
- To familiarize the student's ability to analyze the concepts of Advance Propulsion.
- To understand the basics of Solid Propellant, Liquid Propellant and Cryogenics.
- To understand the basics of Micro propellants.

UNIT 1 FUNDAMENTALS OF ROCKET PROPULSION

9 Hrs.

History and evolution of rockets - Rocket principle and Rocket equation - Classification of rockets - Mass ratio of rocket- Rocket Nozzles - Classifications - Nozzle Performance - Nozzle area ratio - Mass flow rate Characteristic velocity - Thrust coefficient-Performance parameters and Efficiencies of rocket - Staging and Clustering.

UNIT 2 SOLID PROPELLANT ROCKET

9 Hrs.

Hardware components and its functions - Mechanism of burning - Ignition system and igniter types- Propellant grain configuration and its applications - Burn rate - Factors influencing burn rates-Burn rate index for stable operation - Action time and burn time - **Design of Solid Propellant rocket.**

UNIT 3 LIQUID AND CRYOGENIC PROPELLANT ROCKET

9 Hrs.

Classifications - Hardware components and its functions-Propellant feed systems and Turbo pump feed system - Injectors and types - Thrust chamber and its cooling-Cryogenic propulsion system, **Special features of cryogenic systems. Thermo- physical Properties of Cryogenic Propellants; Geysering Phenomenon.**

UNIT 4 ADVANCE PROPULSION TECHNIQUES

9 Hrs.

Hybrid propellant rocket and gelled propellants - Electrical rockets - Electro-thermal, Electro-static and Electro-magnetic propulsion system- **Arc-jet thruster - Ion thruster - Hall Effect Thruster - Magneto plasma dynamic thruster- Nuclear rockets - Solar sail.**

UNIT 5 MICRO PROPULSION SYSTEM

9 Hrs.

Recent Micro Spacecraft Developments; Micro propulsion Options; Primary Set of Micro propulsion Requirements; Chemical Propulsion Options; Review of Electric Propulsion Technologies for Micro and Nano- satellites; Emerging Technologies: **MEMS and MEMS- Hybrid Propulsion System.**

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Analise the Evolution of rockets with working principles, equation, performance parameters, efficiencies and its classification

CO2 - Discriminate the sound foundation in the design principles of solid propellants Rockets.

CO3 - Differentiate the operation various types of Liquid and Cryogenic Propellant Rocket.

CO4 - Distinguish the Working principles of hybrid rocket propellant rockets, Electrical, Electro thermal, Nuclear, Ion and Solar sail

CO5 - Compare the Working principle and performance of. Micro Spacecraft propulsion system

CO6 - Review of Electric Propulsion Technologies for Micro and Nano- satellites; Emerging Technologies: MEMS and MEMS- Hybrid Propulsion System.

TEXT / REFERENCE BOOKS

- George P. Sutton and Oscar Biblarz. "Rocket Propulsion Elements" 9th Edition, Wiley Publication, 2016.
- Ramamurthi.K. "Rocket propulsion" Macmillan Publishing Co, India. 1st Edition. 2010.
- Hill.P.G. and Peterson.C.R. "Mechanics and thermodynamics of propulsion" 2nd Edition .Pearson Education, 1999.
- V.Ganesan., "Gas Turbines", Tata McGraw-Hill Education, 3rd Edition, 2010.
- Philip Hill and Carl Peterson, "Mechanics and thermodynamics of propulsion", Pearson India, 2nd Edition, 2010.
- Cohen.H, Rogers.G.F.C. and Saravanamuttoo.H.I.H, "Gas turbine theory". Pearson education, 5th Edition, 2001.
- Saeed Farokhi, "Aircraft Propulsion", John Wiley & Sons, Inc ., 2009.

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SAEA3004	AIRCRAFT DESIGN	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand the concepts of air vehicle design.
- To estimate aerodynamic, propulsive and gravitational forces for design.
- To select airframe components and power plant.
- To analyze the performance, stability and control of the airplane.

UNIT 1 INTRODUCTION

9 Hrs.

Introduction, Aircraft Design Requirements, specifications, role of users, Aerodynamic and Structural consideration, Airworthiness requirements and standards-classifications of airplanes, relative merits and demerits. Special features of modern airplane, Weight-estimation based on mission requirements.

UNIT 2 AERODYNAMIC DESIGN AND PERFORMANCE

9 Hrs.

Basics of Wing Design, Selection of airfoil selection, influencing factors. Span wise load distribution and Planform shapes of airplane wing. Wing drag estimation. High lift devices, Air Loads in Flight, Symmetrical measuring loads in flight, Basic flight loading conditions, Load factor, Velocity - Load factor diagram, gust load and its estimation.

UNIT 3 STRUCTURAL DESIGN

9 Hrs.

Structural aspects of design of airplane, Bending moment and shear force diagram. Design principles of all metal stressed skin wings for civil and military application, features of light airplanes using advanced composite materials. Cockpit and aircraft passenger cabin layout for different categories, types of associated structure, features of light airplanes using advanced composite materials.

UNIT 4 INTEGRATION OF WING, FUSELAGE, EMPENNAGE AND POWER PLANT

9 Hrs.

Estimation of Horizontal and Vertical tail volume ratios. Choice of power plant and various options of locations, considerations of appropriate air -intakes. Integration of wing, fuselage, empennage and power plant. Estimation of center of gravity.

UNIT 5 ADVANCED DESIGN CONCEPTS

9 Hrs.

Supercritical Wings, relaxed static Stability, controlled configured vehicles, V/STOL aircraft and, rotary wing vehicles. Layout peculiarities of supersonic aircraft – optimization of wing loading to achieve desired performance – loads on undercarriages and design requirements.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, students will be able to

- CO1 - Understand the concepts of design through preliminary design.
- CO2 - Estimate the gross weight of the aircraft using statistical data.
- CO3 - Evaluate aerodynamic and performance parameters for design.
- CO4 - Understand the Structural aspects of airplane design.
- CO5 - Analyze the stability and performance by CG calculation and engine characteristics.
- CO6 - Understand the advanced design concepts.

TEXT / REFERENCE BOOKS

1. D.P. Raymer, "Aircraft Conceptual design", AIAA Series, 2012.
2. G. Corning, "Supersonic & Subsonic Airplane Design", II Edition, Edwards Brothers Inc., Michigan 2010.
3. E.F. Bruhn, "Analysis and Design of Flight Vehicle Structures", Tristate Offset Co., U.S.A., 2011.
4. E. Torenbeek, "Synthesis of Subsonic Airplane Design", Delft University Press, London, 1976.
5. A.A. Lebedenski, "Notes on airplane design", Part-I, I.I.Sc., Bangalore.



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SAEA2502	PROPULSION LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVES

- To familiarize with basic aero engineering thermodynamics.
- To familiarize Aircraft engine components.
- To familiarize Aerospace propulsion.
- To familiarize Computational analysis in propulsion.

SUGGESTED LIST OF EXPERIMENTS

1. Determination of heat of combustion of aviation fuel
2. Determination of free jet characteristics and velocity profile.
3. Determination of wall jet characteristics and velocity profile.
4. Determination of axial flow compressor performance.
5. Estimation of pressure distribution in Convergent nozzle passage.
6. Estimation of pressure distribution in Divergent nozzle passage.
7. Study of Aircraft piston and Turbojet engine propeller.
8. Study of free convective heat transfer over a square plate.
9. Study of forced convective heat transfer over a cylindrical duct.
10. Evaluation of performance of Gas turbine Engine.

COURSE OUTCOME

On completion of the course, student will be able to

CO1: Estimate the flash point and fire point of the aviation fuel.

CO2: Evaluate the characteristics of free jet, wall jet and axial flow compressor.

CO3: Demonstrate the pressure distribution of Convergent and Divergent Nozzle.

CO4: Perform the study of Aircraft piston and Turbojet engine

CO5: Evaluate the free and forced convection heat transfer.

CO6: Elucidate the performance of Gas turbine Engine.

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SAEA3014	BOUNDARY LAYER THEORY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand the importance of boundary layer in Aerodynamics.
- To understand various types of boundary layers and their applications.

UNIT 1 VISCOUS FLOW EQUATIONS

9 Hrs.

Navier-Stokes Equations, Creeping motion, Couette flow, Poiseuille flow through ducts, Ekman drift.

UNIT 2 LAMINAR BOUNDARY LAYER

9 Hrs.

Development of boundary layer – Estimation of boundary layer thickness, Displacement thickness - Momentum and energy thicknesses for two dimensional flow – Two dimensional boundary layer equations – Similarity solutions - Blasius solution.

UNIT 3 TURBULENT BOUNDARY LAYER

9 Hrs.

Physical and mathematical description of turbulence, two-dimensional turbulent boundary layer equations, Velocity profiles – Inner, outer and overlap layers, Transition from laminar to turbulent boundary layers, turbulent boundary layer on a flat plate, mixing length hypothesis.

UNIT 4 APPROXIMATE SOLUTION TO BOUNDARY LAYER EQUATIONS

9 Hrs.

Approximate integral methods, digital computer solutions – Von Karman – Polhausen method.

UNIT 5 THERMAL BOUNDARY LAYER

9 Hrs.

Introduction to thermal boundary layer – Heat transfer in boundary layer - Convective heat transfer, importance of non dimensional numbers – Prandtl number, Nusselt number, Lewis number etc.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Apply the basic fundamentals of Different types of Boundary layer thickness.

CO2 - Analyze the behavior of the fluid flow under static condition.

CO3 - Understand the basics of Different types of flow such as Laminar, turbulent and compressible flow, Incompressible flow, Viscid and Inviscid flow.

CO4 - Basics of Boundary layer Control.

CO5 - Flow through pipe of different types of flow.

CO6 - Importance of non-dimensional numbers.

TEXT / REFERENCE BOOKS

1. Schlichting H., "Boundary Layer Theory", McGraw Hill, New York, 2010.
2. Frank White, Viscous Fluid flow, McGraw Hill, 2011.
3. Reynolds A.J., "Turbulent flows in Engineering", John Wiley & Sons, 2013.
4. Ronald L., Panton, "Incompressible fluid flow", John Wiley & Sons, 1984.

New Course



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SAEA3015	HIGH TEMPERATURE MATERIALS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To learn damage mechanism and failure of components of elevated temperatures.
- To know the basic functions of creep and fracture of materials.
- To discuss the oxidation and hot corrosion.

UNIT 1 CREEP

9 Hrs.

Factors influencing functional life of components at elevated temperatures, definition of creep curve, various stages of creep, metallurgical factors influencing various stages, effect of stress, temperature and strain rate.

UNIT 2 DESIGN FOR CREEP RESISTANCE

9 Hrs.

Design of transient creep time, hardening, strain hardening, expressions of rupture life of creep, ductile and brittle materials, Monk man-Grant relationship.

UNIT 3 FRACTURE

9 Hrs.

Various types of fracture, brittle to ductile from low temperature to high temperature, cleavage fracture, ductile fracture due to micro void coalescence-diffusion controlled void growth; fracture maps for different alloys and oxides.

UNIT 4 OXIDATION AND HOT CORROSION

9 Hrs.

Oxidation, Pilling, Bed worth ratio, kinetic laws of oxidation- defect structure and control of oxidation by alloy additions, hot gas corrosion deposit, modified hot gas corrosion, fluxing mechanisms, effect of alloying elements on hot corrosion.

UNIT 5 SUPERALLOYS AND OTHER MATERIALS

9 Hrs.

Iron base, Nickel base and Cobalt base super alloys, composition control, solid solution strengthening, precipitation hardening by gamma prime, grain boundary strengthening.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, students will be able to

- CO1 - Recall the basics of materials.
- CO2 - Understand the behavior of creep and fracture.
- CO3 - Understand the oxidation and hot corrosion.
- CO4 - Recognize the functions of super alloys.
- CO5 - Analyze the ductile and brittle materials.
- CO6 - Analyze the temperature strain rate.

TEXT /REFERENCE BOOKS

1. Raj. R., "Flow and Fracture at Elevated Temperatures", American Society for Metals USA, 2011.
2. Hertzberg R.W., "Deformation and Fracture Mechanics of Engineering materials", 4th Edition, John Wiley, USA, 2012.
3. Courtney T.H., "Mechanical Behaviour of Materials", McGraw Hill, USA, 2012.
4. Boyle J.T, Spencer J, "Stress Analysis for Creep", Butterworths, UK, 2013.
5. Bressers.J., "Creep and Fatigue in High Temperature Alloys", Applied Science, 1981.
6. McLean D., "Directionally Solidified Materials for High Temperature Service", The Metals Society, USA, 1985.



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SAEA3016	FLIGHT VEHICLES' GUIDANCE AND CONTROL	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand the concepts of guidance and control of flight vehicles.
- To evaluate the performance of flight vehicle's transformation.
- To know the basic functions of navigation.
- To discuss the methodology of modeling of aerospace vehicles.

UNIT 1 GUIDANCE

9 Hrs.

Over view of flight vehicles: The initial conceptual sketches, L / D estimation. Initial takeoff weight build-up, empty weight estimation, historical trends, fuel fraction estimation, mission profiles, mission segment weight fractions, Review of governing equations of motion for aerospace vehicles, Linear systems analysis of aerospace systems, Applications - aircraft, spacecraft, missiles, launch vehicles.

UNIT 2 FLIGHTVECHICE'STRANSFORMATION

9 Hrs.

Introduction to the concepts of navigation guidance and control: General principles of early conventional navigation systems. Geometric concepts of navigation. Reference frames. Direction cosine matrix, Euler angles, Transformation of angular velocities, Quaternion representation in co-ordinate transformation. Comparison of transformation methods.

UNIT 3 NAVIGATION

9 Hrs.

Navigation: Navigation computation and error modeling, Inertial navigation systems, External navigation aids - GPS, Doppler radar, Star trackers, Multi-sensor fusion.

UNIT 4 PERFORMANCE

9 Hrs.

Guidance: Guidance mission and performance, Guidance algorithm - guidance laws, single-dual-multi-mode guidance, Advanced guidance system design.

UNIT 5 MODELLING

9 Hrs.

Modeling of Aerospace vehicles: Linear system analysis, Stabilization and Control of space crafts, Missile control systems and Autopilots, Launch vehicle flight control systems. Longitudinal and lateral autopilots for aircraft. Radar systems command and housing guidance system.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, students will be able to

- CO1 - Recall basics of flight mechanics.
- CO2 - Understand the basic working principle of guidance and control of flight vehicles.
- CO3 - Understand the working of flight transformation in various planes.
- CO4 - Recognize the functions guidance algorithm.
- CO5 - Understand the missile control system.
- CO6 - Distinguish the basics of functions of radar and launch vehicle flight control system.

TEXT / REFERENCE BOOKS

1. Flight without Formulae by A.C Kermode, Pearson Education, 10th Edition, 2011.
2. Mechanics of Flight by A.C Kermode, Pearson Education, 5th Edition, 2012.
3. Fundamentals of Flight, Shevell, Pearson Education, 2nd Edition, 2013.
4. 'Modern Navigation, Guidance and Control Processing, Ching-Fang Lin, Prentice Hall Inc., Englewood Cliffs, New Jersey, 2011.
5. 'Guided Weapon Control Systems', Garnele P, Pergamon, 1980.



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SAEA3017	MANNED SPACE MISSIONS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- Know the advanced concepts of manned space missions to the engineers.
- Understand the space and environment and its conditions.
- Apply the concept of life supporting devices.

UNIT 1 FUNDAMENTALS OF SPACE MISSIONS

9 Hrs.

The physics of space, Current missions: space station, Moon mission and Mars missions, Engineering challenges on Manned vs. unmanned missions, Scientific and technological gains from space programs, Salient features of Apollo and Space station missions, space shuttle mission.

UNIT 2 SPACE VS EARTH ENVIRONMENT

9 Hrs.

Atmosphere: Structure and Composition, Atmosphere: Air Pressure, Temperature, and Density, Atmosphere: Meteoroid, Orbital Debris & Radiation Protection, Human Factors of Crewed Spaceflight, Safety of Crewed Spaceflight, Magnetosphere, Radiation Environment: Galactic Cosmic Radiation (GCR), Solar Particle Events (SPE), Radiation and the Human Body, Impact of microgravity and g forces on humans, space adaptation syndrome.

UNIT 3 LIFE SUPPORT SYSTEMS AND COUNTERMEASURES

9 Hrs.

Life Support Systems and Space Survival Overview, Environment Controlled Life Support Systems (ECLSS), Human / Machine Interaction, Human Factors in Control Design, Crew Accommodations.

UNIT 4 MISSION LOGISTICS AND PLANNING

9 Hrs.

Group Dynamics: Ground Communication and Support, Space Resources and Mission Planning - Space Mission Design: Rockets and Launch Vehicles - Orbital Selection and Astrodynamics, Entry, Descent, Landing, and Ascent, Designing and Sizing Space elements, Transfer, Entry, Landing, and Ascent Vehicles, Designing, Sizing, and Integrating a Surface Base, Planetary Surface Vehicles.

UNIT 5 SUBSYSTEMS

9 Hrs.

Spacecraft Subsystems: Space Operations, Space Architecture, Attitude Determination and Control- Designing Power Systems, Extravehicular Activity (EVA) Systems, Space Robotics, Mission Operations for Crewed Spaceflight - Command, Control, and Communications Architecture.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Understand the working principles of basic control system.
- CO2 - Comprehend the sound foundation in the various subsystems.
- CO3 - Learn the advanced concepts of manned space missions to the engineers.
- CO4 - Understand the space and environment and its conditions.
- CO5 - Understand the the principle and performance of various subsystems.
- CO6 - Applying the importance of the mission logistics and planning.

TEXT / REFERENCE BOOKS

1. Larson, W. J. and Pranke, L. K., Human Spaceflight: Mission Analysis and Design, McGraw- Hill Higher Education, Washington, DC, 1999
2. McNamara, Bernard. 2010.
3. Into the Final Frontier: The Human Exploration of Space, 2012.
4. Connors, M.M., Harrison, A.A., and Akins, F.R. 2005. Living Aloft: Human Requirements for Extended Spaceflight, University Press of the Pacific, Honolulu, Hawaii: ISBN: 1- 4102- 1983- 6
5. Eckart, P. 1996.
6. Jones, T., Sky Walking – An Astronaut's Memoir, Harper Collins, New York, NY, 2006
7. Mullane, M., Riding Rockets – The Outrageous Tales of a Space Shuttle Astronaut, Scribner, New York, NY, 2006

New Course



SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)

Accredited "A" Grade by NAAC | 12B status by UGC | Approved by AICTE

www.sathyabama.ac.in

SAEA3019	ORBITAL MECHANICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand the concepts of satellite injection.
- To evaluate the satellite perturbations, trajectory computation.
- To know the basic functions of travel and flight of ballistic missiles.
- To discuss the stages of separation.

UNIT 1 BASIC CONCEPTS

9 Hrs.

The solar system -Reference frames and coordinate systems –The celestial sphere -The ecliptic -Motion of vernal equinox – Sidereal time-Solar time-Standard time-The earth's atmosphere. Types of orbit.

UNIT 2 THE GENERAL N-BODY PROBLEM

9 Hrs.

The Many body problem - Lagrange - Jacobi identity - The circular restricted three body problem – Libration points-Relative Motion in the N-body problem-The two-body problem-Satellite orbits - Relations between position and time-Orbital elements.

UNIT 3 SATELLITE INJECTION AND SATELLITE ORBIT PERTURBATIONS

9 Hrs.

General aspects of satellite injections-Satellite orbit transfer-Various cases-Orbit deviations due to injection errors-Special and general perturbations-Cowell's Method - Encke's method – Method of variations of orbital elements General perturbations approach.

UNIT 4 INTERPLANETARY TRAJECTORIES BALLISTIC MISSILE -TRAJECTORIES

11 Hrs.

Two-dimensional inter planetary trajectories –Fast interplanetary trajectories –Three dimensional interplanetary trajectories- Launch of interplanetary spacecraft –Trajectory about the target planet. The boost phase-The ballistic phase -Trajectory geometry -Optimal flights -Time of flight-Re-entry phase – The position of the impact point Influence coefficients.

UNIT 5 MATERIALS FOR SPACE CRAFT

7 Hrs.

Space environment-Peculiarities -Effect of space environment on the selection of materials of spacecraft.
Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, students will be able to

- CO1 - Study the basic concepts of orbits and its types.
- CO2 - Understand the satellite perturbations, trajectory computation.
- CO3 - Understand the importance of missile performance.
- CO4 - Understand the properties control system.
- CO5 - Analyze the trajectory calculations and materials.
- CO6 - Distinguish the basics of fluid statics and fluid dynamics for propulsion.

TEXT / REFERENCE BOOKS

1. George .P.Sutton , Oscar Biblarz "Rocket Propulsion Elements", Wiley Publishers 8th Edition, 2010.
2. J.ohn H. Blakelock, "Automatic control of aircraft and missiles", 2nd Edition, Wiley Publishers, 2011.
3. George.M.Siouris "Missile guidance and control systems", Springer 2nd Edition, 2004.
4. Tactical and Strategic Missile Guidance, 5th Edition, Paul Zarchan, Progress in Astronautics and Aeronautics, AIAA, 2007, ISBN-10: 1-56347-874-9.
5. Missile Guidance and Control Systems, George M. Siouris, Springer-Verlag, 2004, ISBN: 0-387-00726.



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SAEA3012	MISSILE TECHNOLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand the concepts of missiles.
- To evaluate the performance of fluids and fluid flows in International standard atmosphere.
- To know the basic functions of missile control systems.
- To discuss the stages of separation.

UNIT 1 MISSILE SYSTEMS

9 Hrs.

Introduction - history - classification - missile system elements - missile ground systems - radars – launchers - coordinate frames - basics of trajectory dynamics - Missile equations of motion- coordinate systems – Rigid body equations of motion - D - Alembert principle.

UNIT 2 MISSILE CONTROL SYSTEMS

9 Hrs.

Introduction - Roll stabilization – Root locus for roll stabilization system - Transfer function - control of aerodynamic missiles – Missile auto pilot – boost autopilot - Transfer function for a ballistic type missile - Van guard control system – block diagram – root locus - Alternate control system.

UNIT 3 PROPULSION

9 Hrs.

Principles of jet propulsion and rocketry - nozzle theory and characteristic parameters - rockets solid and liquid propellant - Ramjet and Turbo jet engines – evaluation of flight performance – forces acting on vehicle - basic relations of motion - multi stage vehicles.

UNIT 4 NAVIGATION, GUIDANCE AND CONTROL

9 Hrs.

Navigation - types - INS - GPS - radar based terrain mapping, guidance - explicit – Proportional Navigation guidance – Augmented Proportional Navigation guidance – Comparison of guidance system performance - Autopilot – control surfaces and actuators – Back to turn missile guidance.

UNIT 5 MISSILE TRAJECTORY CALCULATIONS

9 Hrs.

Vertical, inclined and gravity turn trajectories – determination of range and altitude ballistic missile intercept – missile tracking equations of motion – numerical computation of ballistic trajectories – Dynamics of stage separation.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, students will be able to

- CO1 - Study the applications of the conservation laws to flow
- CO2 - Understand the importance of missile coordinate system
- CO3 - Understand the importance of missile performance
- CO4 - Understand the properties control system
- CO5 - Analyze the trajectory calculations
- CO6 - Distinguish the basics of fluid statics and fluid dynamics for propulsion

TEXT / REFERENCE BOOKS

1. George .P.Sutton ,Oscar Biblarz "Rocket Propulsion Elements", Wiley publishers 8th Edition ,2010
2. John H. Blakelock, "Automatic control of aircraft and missiles", 2nd Edition, Wiley publishers 2011.
3. George M.Siouris, "Missile guidance and control systems", Springer 2nd Edition, 2004.
4. Tactical and Strategic Missile Guidance, 5th Edition, Paul Zarchan, Progress in Astronautics and Aeronautics, AIAA, 2007, ISBN-10: 1-56347-874-9.
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