



SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY
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SCHOOL OF MECHANICAL ENGINEERING

DEPARTMENT OF AERONAUTICAL ENGINEERING

1.2.1 New courses Introduced in 2022-2023

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1	SAEA4001	Fundamentals of Aerospace Technology	8
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7	SAEA3014	Boundary Layer Theory	20
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**SCHOOL OF MECHANICAL ENGINEERING
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.



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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 on SAEA3001 Theory of Elasticity.

(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.



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(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 – 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.



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



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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 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.



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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.

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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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. Wertz and Wiley J. 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.



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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

1. Ratandeep Singh, "Aviation Management", Kanishka Publishers, 2012.
2. "Aircraft Manual – Volume 1 and Volume 2", Sterling Book House.
3. Kathleen M. Sweet, "Aviation and Airport Security", Pearson Education, 2011.
4. "Aircraft Manual – Volume 1 and Volume 2", Sterling Book House, 2010.
5. 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. Hastlden, 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 – References 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 CELESTIALFRAMEANDELEMENTS

9 Hrs.

Newton's law of gravitation–gravitational anomalies–two body problem–Celestial frame and orbital elements –planetfixed frame –lamberts problem- perturbation acceleration-effects of Planetary oblations – effects of atmospheric drag –three body problem-equations of motion langrage 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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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.

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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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

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



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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.

UNIT2 SPACEVSEARTHENVIRONMENT

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 SYSTEMSAND 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.

UNIT4 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.

UNIT5 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 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. Into the Final Frontier: The Human Exploration of Space, 2012.
3. 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
4. Eckart, P. 1996. Jones, T., Sky Walking – An Astronaut's Memoir, Harper Collins, New York, NY, 2006
5. Mullane, M., Riding Rockets – The Outrageous Tales of a Space Shuttle Astronaut, Scribner, New York, NY, 2006



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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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