



SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

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Jeppiaar Nagar, Rajiv Gandhi Salai, Chennai - 600 119.

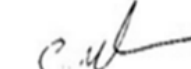
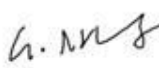
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SCHOOL OF MECHANICAL ENGINEERING
DEPARTMENT OF AERONAUTICAL ENGINEERING
BOARD OF STUDIES MEETING HELD ON 17.12.2021

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, Professor, Aeronautical Engineering	
		Dr. S. Manigandan, Assistant Professor, Aeronautical Engineering	
		Mr. G. Madhan Kumar, Assistant Professor, Aeronautical Engineering	



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Minutes of the Board of Studies meeting

Board of Studies meeting for the Department of Aeronautical Engineering was held on 27th June 2020 through virtual mode (zoom) with the following agenda:

1. Introduction of a new course titled **"Fundamentals of Aerospace Technology"** as a Theory course in B.E-Aeronautical Engineering Curriculum

Welcome Address

Dr.S.Prakash, Dean, school of Mechanical Engineering chaired the meeting and welcomed all the members to the BOS meeting. He also introduced the Academic staff members Sathyabama Institute of science and Technology. At the outset, he informed the members about the academic activities and newly introduced courses in this curriculum. Having confirmed the quorum of the meeting, the agenda of the meeting was taken up for discussion. The following points were discussed during the meeting:

Agenda1:

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

The industry expert and academic Expert suggested that the new Theory course introduced titled "Fundamentals of Aerospace Technology" is very much important for basic understanding of satellites, missile systems and space environment. This would be helpful for the students for understanding the unmanned ariel vehicles and Aerospace vehicles.

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 course in the Curriculum.

The syllabus of the course was enclosed in Annexure-1

Vote of Thanks

Dr.P. Boomadevi thanked the expert members for accepting the invitation for attending the BoS meeting. She thanked them for their valuable suggestions on the agenda items presented. She also thanked Dr.S. Prakash, Dean/Chair and Dr.A. Anderson, Professor for their contribution towards the conduct of this BoS meeting.

Dean/Chair



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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.45 Hrs.

TEXT/REFERENCEBOOKS

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



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SCHOOL OF MECHANICAL ENGINEERING

DEPARTMENT OF AERONAUTICAL ENGINEERING

BOARD OF STUDIES MEETING HELD ON 27.06.2020

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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Board of Studies meeting for the Department of Aeronautical Engineering was held on 27th June 2020 through virtual mode (zoom) with the following agenda:

1. Introduction of a new course titled “**Aircraft Design Project Lab**” as a Laboratory in B.E-Aeronautical Engineering Curriculum
2. Introduction of a new course titled “Industry 4.0 for Design and Manufacturing” in B.E-Aeronautical Engineering Curriculum

Welcome Address

Dr.S.Prakash, Dean, school of Mechanical Engineering chaired the meeting and welcomed all the members to the BOS meeting. He also introduced the Academic staff members Sathyabama Institute of science and Technology. At the outset, he informed the members about the academic activities and newly introduced courses in this curriculum. Having confirmed the quorum of the meeting, the agenda of the meeting was taken up for discussion. The following points were discussed during the meeting:

Agenda1:

Introduction of a new course titled “Aircraft Design Project Lab” as an Laboratory in B.E-Aeronautical Engineering Curriculum

As suggested by the industry expert Er. James Michael Amulu, the new lab course was titled “Aircraft Design Project Lab” will be very much important for real time experience in field of Aircraft design.

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

The syllabus of the course was enclosed in Annexure-I



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Agenda 2: Introduction of a new course titled “Industry 4.0 for Design and Manufacturing” in 4th Semester of B.E-Aeronautical Engineering Curriculum

BoS external members stressed the importance of Industry 4.0 for Design and Manufacturing in the Aeronautical and Aerospace industries and as per their advice the new course titled “Industry 4.0” was included in the curriculum.

BoS members approved the introduction of the new course titled “Industry 4.0 for Design and Manufacturing ” as a core course in 4th semester after careful discussion of the contents in the syllabus

The syllabus of the course was enclosed in Annexure-1

Vote of Thanks

Dr.P. Boomadevi thanked the expert members for accepting the invitation for attending the BoS meeting. She thanked them for their valuable suggestions on the agenda items presented. She also thanked Dr.S. Prakash, Dean and Dr.A. Anderson, Associate Professor for their contribution towards the conduct of this BoS meeting.


Dean/CHAIR



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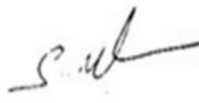
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SCHOOL OF MECHANICAL ENGINEERING
DEPARTMENT OF AERONAUTICAL ENGINEERING
BOARD OF STUDIES MEETING HELD ON 21.12.2020

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	
Madras Flying Club, Chennai		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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Minutes of the Board of Studies meeting

Board of Studies meeting for the Department of Aeronautical Engineering was held on 21st December 2020 through virtual mode (zoom) with the following agenda:

1. Introduction of a new course titled "Heat Transfer Techniques" as core elective in B.E-Aeronautical Engineering Curriculum

Welcome Address

Dr.S.Prakash, Dean, school of Mechanical Engineering chaired the meeting and welcomed all the members to the BOS meeting. He also introduced the Academic staff members Sathyabama Institute of science and Technology. At the outset, he informed the members about the academic activities and newly introduced courses in this curriculum. Having confirmed the quorum of the meeting, the agenda of the meeting was taken up for discussion. The following points were discussed during the meeting:

Introduction of a new course titled "Heat Transfer Techniques" as a Professional core Elective in B.E-Aeronautical Engineering Curriculum

As suggested by the Academic Expert a new theory course was introduced as a Professional core Elective titled "Heat Transfer Techniques" as this course is very much important in Aero engine division and flow through nozzles for Aerospace Applications.

This initiative is appreciated by BoS members and after a discussion about the contents of the syllabus; the course was approved for inclusion as a core elective in the Curriculum. BoS members approved the syllabus. The syllabus of the course is enclosed in Annexure-1

Vote of Thanks

Dr.P. Boomadevi thanked the expert members for accepting the invitation for attending the BoS meeting. She thanked them for their valuable suggestions on the agenda items presented. She also thanked Dr.S. Prakash, Dean/Chair and Dr.A. Anderson, Associate Professor for their contribution towards the conduct of this BoS meeting.

Dean/CHAIR



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SAEA2603	AIRCRAFT DESIGN PROJECT LAB	L	T	P	Credits	Total Marks
		0	-	4	2	100

COURSE OBJECTIVES

- To classify the types of Aircrafts and its data collection.
- To estimate the weight of an Aircraft pertaining to preliminary hand calculations
- To select the appropriate airfoil, wing tail, control surface and power plant for the preliminary design Aircraft.
- To analyze the performance of the preliminary design Aircraft.
- To perform the structural analysis of the preliminary design Aircraft.
- To design the landing gear opted for the newly designed Aircraft.

SUGGESTED LIST OF EXPERIMENTS

1. Data collection.
2. Preliminary weight estimation.
3. Airfoil selection, Wing tail and control surfaces
4. Power plant selection
5. Balance diagram.
6. Drag estimation.
7. Rate of climb calculations at various altitudes, Turn performance
8. Range and Endurance, Takeoff and landing distance calculation
9. Stability calculations
10. V-n diagram
11. Wing and fuselage Design.
12. Shear force and bending moment diagrams of various aircraft structures.
13. Structural weight distribution.
14. Landing gear Design.
15. Detailed CAD drawings of wing, fuselage ,tail surfaces and control surfaces and their stress analysis using structural software
16. Detailed Design project report.

COURSE OUTCOMES

At the end of the course, student will be able to:

- CO1: Categorize the types of Aircraft and its specifications to perform the conceptual design of new Aircraft.
- CO2: Estimate the gross weight and payload weight of an Aircraft for the preliminary designed Aircraft.
- CO3: Deduct the appropriate selection of airfoil, wing-tail configuration for the preliminary Aircraft.
- CO4: Analyze the preliminary designed Aircraft's performance and its control.
- CO5: Evaluate the structural analysis of airframe parts of the preliminary designed Aircraft.
- CO6: Design the appropriate landing gear that suits the preliminary designed Aircraft.



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SMEA4003	INDUSTRY 4.0 FOR DESIGN AND MANUFACTURING	L	T	P	Credits	Total Marks
		2	-	0	2	100

COURSE OBJECTIVES

- To enable students understand the fundamentals and the contributing technologies of Industry 4.0.
- To make the students evaluate the suitability of Industry 4.0 technologies for the design and manufacturing sectors.
- To help the students implement the Industry 4.0 technologies to diverse applications.

UNIT 1 CONTRIBUTING TECHNOLOGIES

8 hrs

Brief introduction to the industrial revolutions. Contributing technologies to Industry 4.0: Additive manufacturing, Digital twin, Internet of things, Smart sensors, AR and VR, Artificial intelligence, Cloud computing, Block chain, Big data and analytics. Challenges and opportunities.

UNIT 2 ADVANCED CAD TECHNOLOGIES

8 hrs

Introduction to CAD. Enabling technologies: Digital twin, AR/VR, AI. Cloud computing, Touch/Voice/Motion enabled CAD, Customized CAD, Cloud based CAD, Digital twin and live simulation.

UNIT 3 SMART MANUFACTURING SYSTEMS

8 hrs

Enabling technologies: AI, Cloud computing, Robotics, IoT. Digital manufacturing: CNC, Cloud based manufacturing, IoT based manufacturing, Advanced CNC programming. Additive manufacturing. Micro electro mechanical systems. Robotics: Robotic automation, Collaborative robots, Autonomous robots, Swarm robots, and Modular robots.

UNIT 4 SMART FACTORY ENABLERS

8 hrs

Enabling technologies. Smart energy: Improving energy efficiency with data, Smart grids. Clean energy. Smart logistics. Smart Inspection. Smart decision making.

UNIT 5 AUTONOMOUS VEHICLES

8 hrs

Introduction: Traditional mobility versus autonomous driving, Levels of automation, and challenges. Enabling technologies. Self-propelled vehicles, Drones, Unmanned aerial vehicles, Space crafts

UNIT 6 CASE STUDIES

5 hrs

Case studies related to Industry 4.0 applications, such as, transportation, energy, infrastructure, manufacturing, and product design sectors.

Max. 45 Hrs.

COURSE OUTCOMES

At the end of the course, the students will be able to:

CO1: Justify how the digitalization technologies are advantageous to the design and manufacturing industries.

CO2: Use the advanced CAD technologies to create the CAD models.

CO3: Use the smart manufacturing technologies to produce the components and products.

CO4: Recommend the enabling technologies to make various factory operations smarter.

CO5: Choose the suitable sensors and technologies to the future autonomous vehicles, drones and space crafts.

CO6: Prepare a report with the challenges faced currently, the enabling technologies to become smarter, and the steps needed for the effective implementation for the given case study.

TEXT / REFERENCE BOOKS

1. Flavio Craveiro, Jose Pinto Duarte, Helena Bartolo and Paulo Jorge Bartolo, "Additive manufacturing as an enabling technology for digital construction: A perspective on Construction 4.0", Automation in Construction, Vol.103, pp. 251- 267, 2019.
2. Klaus Schwab, "Fourth Industrial Revolution", Random House USA Inc, New York, USA, 2017.
3. Oliver Grunow, "Smart Factory and Industry 4.0. The current state of Application Technologies", Studylab Publications, 2016
4. Alasdair Gilchrist, "Industry 4.0: Industrial Internet of Things", Apress, 2016
5. Sang C. Suh, U. John Tanik, John N Carbone, Abdullah Eroglu, "Applied Cyber-Physical Systems", Springer Publications, New York, 2013.



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Elective SAEA3020	HEAT TRANSFER TECHNIQUES	L	T	P	Credits	Total Marks
		3	1	0	4	100

COURSE OBJECTIVES

- To learn the various modes of heat transfer and understand the basic concepts of mass transfer
- To understand the applications of various experimental heat transfer correlations in engineering applications.
- To discuss the thermal analysis and sizing of heat exchangers
- To understand the concepts of high speed flow heat transfer

UNIT 1 INTRODUCTION AND CONDUCTION HEAT TRANSFER

9 Hrs.

Basic modes of heat transfer – One dimensional steady state heat conduction – Cartesian, cylindrical and spherical coordinates – Composite medium – Critical thickness – Effect of variation of thermal conductivity – Extended surfaces. Conduction with heat generation. Unsteady state heat conduction – Heat transfer analysis of Lumped system, Semi infinite and infinite solids – Use of Transient Temperature charts - Applications of numerical techniques.

UNIT 2 CONVECTIVE HEAT TRANSFER

9 Hrs.

Introduction-Forced convection-Development of velocity and thermal boundary layer by a flow on a vertical flat plate – Laminar and turbulent convective heat transfer analysis in flows over a flat plate, circular pipe and spherical surface. Free convective heat transfer over vertical flat plate, cylinders and spheres – Empirical relations, applications of numerical techniques in problem solving.

UNIT 3 RADIATIVE HEAT TRANSFER

9 Hrs.

Introduction – Physical mechanism of radiation – Radiation properties – Characteristics of surfaces Emissivity – Radiation shape factor – Heat exchange between non-black bodies – Radiation shields.

UNIT 4 HEAT EXCHANGERS

9 Hrs.

Classification of heat exchangers – Temperature distribution – Overall heat transfer coefficient – Heat exchange analysis – LMTD Method and E-NTU Method.

UNIT 5 HEAT TRANSFER IN HIGH SPEED FLOW

9 Hrs

High-Speed flow heat transfer - Heat transfer in gas turbine combustion chamber-ablative heat transfer-Aerodynamic heating – Rocket thrust chambers - Numerical treatment.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1: Compare the various modes of heat transfer and analyse the conduction heat transfer in various systems in both steady and unsteady state conditions

CO2: Distinguish natural and forced convection phenomena and measure the heat transfer coefficient in external and internal fluid flow problems.

CO3: Apply the laws of radiation, analyse the radiation exchange between surfaces and the effect of radiation shields

CO4: Distinguish the types of heat exchangers and design the heat exchanger with LMTD and NTU approach

CO5: Describe the principles of high speed flow heat transfer and analyse the heat transfer problems in gas turbine combustion chamber

CO6: Describe the application of high speed flow heat transfer in aerospace components and analyse the heat transfer by numerical methods.

TEXT / REFERENCE BOOKS

1. Incropera, F.P. and Dewitt, D.P., Fundamentals of Heat and Mass Transfer, 7th Edition, John Wiley, 2011.
2. Holman, J.P., Heat Transfer, 10th Edition, Tata McGraw-Hill, 2010.
3. Cengel, Y.A., Heat Transfer - A Practical Approach, 2nd Edition, McGraw-Hill, 2002.
4. Sachedva, R.C., Fundamentals of Heat and Mass Transfer, 4th Edition, New Age International, 2012
5. Desmond E. Winterbone and Ali Turan; Advanced Thermodynamics for Engineers, Elsevier Ltd, 2015
6. Bengt Sunden and Juan Fu., Heat Transfer in Aerospace Applications, Academic Press, 2016
7. Yang, Y., Habiballah, M., Popp, M., Hulka, J., Liquid Rocket Thrust Chambers (Progress in Astronautics and Aeronautics), American Institute of Aeronautics and Astronautics, 2004



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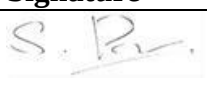
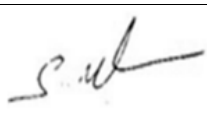


SCHOOL OF MECHANICAL ENGINEERING

DEPARTMENT OF AERONAUTICAL ENGINEERING

BOARD OF STUDIES MEETING HELD ON 14.12.2019

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	
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Board of Studies meeting for the Department of Aeronautical Engineering was held on 14th December 2019 in Aero CAD Lab with the following agenda:

1. Introduction of a new course titled "SAEA1303 Aircraft Systems and Instruments" as Theory in B.E-Aeronautical Engineering Curriculum
2. Introduction of a new course titled "SAEA1503 Computational fluid dynamics for Aerospace applications" as Theory in B.E-Aeronautical Engineering Curriculum.
3. Introduction of a new course titled "SAEA1702 Unmanned Aerial Vehicle Design" as Theory in B.E-Aeronautical Engineering Curriculum.
4. Introduction of new Elective theory courses in B.E-Aeronautical Engineering Curriculum.

Welcome Address

At the onset of the meeting, Dr.S.Prakash, Dean, school of Mechanical Engineering welcomed the members of BoS and placed the agenda for the deliberations of the members. The following decisions were made as per the items of the circulated agenda.

Introduction of a new courses titled "SAEA1303 Aircraft Systems and Instruments, SAEA1503 Computational fluid dynamics for Aerospace applications and SAEA1702 Unmanned Aerial Vehicle Design" as core courses in B.E-Aeronautical Engineering Curriculum

Introduction of new Elective core courses

SMEA3001 Additive Manufacturing

SAEA3014 Boundary layer theory

SAEA3015 High-temperature Materials

SAEA3016 Flight vehicles Guidance and

Control SAEA3017 Manned space mission

SAEA3019 Orbital Mechanics

As suggested by the Academic Expert new theory courses and professional core electives were introduced as core courses are very much important in Aircraft systems and



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maintenance division, flow through nozzles for Aerospace Applications, aerodynamic heating of thermal insulated space capsules and space ships, and Unmanned Aerial systems installation and calibration of sensors utilized in Unmanned Aerial Vehicles.

This initiative is appreciated by BoS members and after a discussion about the contents of the syllabus; the course was approved for inclusion as core courses in the Curriculum. BoS members accepted the changes and approved the syllabus. The syllabus of the course is enclosed in Annexure-1

Vote of Thanks

Dr.P.Boomadevi thanked the expert members for accepting the invitation for attending the BoS meeting. She thanked them for their valuable suggestions on the agenda items presented. She also thanked Dr.S.Prakash, Dean/Chair and Dr.A.Anderson, Associate Professor for their contribution towards the conduct of this BoS meeting

Dean/CHAIR



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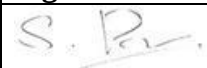
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SCHOOL OF MECHANICAL ENGINEERING
DEPARTMENT OF AERONAUTICAL ENGINEERING
BOARD OF STUDIES MEETING HELD ON 15.06.2019

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. P. Gunasekaran, Assistant Professor, Aeronautical Engineering	



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Board of Studies meeting for the Department of Aeronautical Engineering was held on 15th June 2019 in Aero CAD Lab with the following agenda:

1. Introduction of a new course titled "SMEA2201 Workshop Practice" as Laboratory in B.E-Aeronautical Engineering Curriculum
2. Introduction of a new course titled "SAIC4001 Industry 4.0" as Theory in B.E-Aeronautical Engineering Curriculum.
3. Introduction of a new course titled "S19APT2 Interdisciplinary project" as a practical course in the B.E-Aeronautical Engineering Curriculum.
4. Introduction of a new course titled "SAEA2602 Aircraft Engine Maintenance and Repair Lab" as Laboratory in the B.E-Aeronautical Engineering Curriculum.

Welcome Address

Dr.S.Prakash welcomed the members of BoS and placed the agenda for the deliberations of the members. The following decisions were made as per the items of the circulated agenda.

Introduction of new courses titled "SMEA2201 Workshop Practice, SAIC4001 Industry 4.0, S19APT2 Interdisciplinary project and SAEA2602 Aircraft Engine Maintenance and Repair Lab" as core courses in B.E-Aeronautical Engineering Curriculum

As suggested by the Academic Expert new theory courses and laboratory courses were introduced as core courses are very much important in Aircraft Engine repair and maintenance division, current trends in the handling of equipment in Industries Manufacturing sectors of aerospace industries, and manufacturing of space ships, and Unmanned Aerial Vehicles.



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This initiative is appreciated by BoS members and after a discussion about the contents of the syllabus; the course was approved for inclusion as core courses in the Curriculum. BoS members accepted and approved the syllabus. The syllabus of the course is enclosed in Annexure-1

Vote of Thanks

Dr.P.Boomadevi thanked the expert members for accepting the invitation for attending the BoS meeting. She thanked them for their valuable suggestions on the agenda items presented. She also thanked Dr.S.Prakash, Dean/Chair and Dr.A.Anderson, Associate Professor for their contribution towards the conduct of this BoS meeting

Dean/CHAIR



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SAEA1303	AIRCRAFT SYSTEMS AND INSTRUMENTS (For Aeronautical)	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To impart knowledge of the hydraulic and pneumatic systems components.
- To understand the types of instruments and its operation including navigational instruments to the students.

UNIT 1 AIRCRAFT SYSTEMS

9 Hrs.

Hydraulic Systems – Types of Hydraulic oil -and its properties. Study of Typical Workable System – Components– Hydraulic System Components – Modes of Operation – Pneumatic Systems – Advantages – Working Principles –Components, case studies in modern aircrafts

UNIT 2 LANDING GEAR SYSTEMS

9 Hrs

Landing Gear Systems – Classification – Purpose and types of Shock Absorbers. construction and its operation– LG - Retraction/extension Mechanism. Brake System types, components and advantages, antiskid system. Conventional and tubeless tires construction, advantages and common defects, modern advancements in tyre technologies. Brake systems.

UNIT 3 FUEL AND PRESSURIZING SYSTEM

9 Hrs.

Fuel system – Layout, Types of fuel tanks, locations, control pressure, sequence of fuel consumption, Basic Air Cycle Systems – Vapour Cycle Systems. Pressurization system – Principle-components-limitation-Oxygen systems – Fire Protection Systems, Deicing and Anti Icing Systems.

UNIT 4 AIRPLANE CONTROL SYSTEMS

9 Hrs

Conventional Systems –Modern Flight Control Systems Control Actuation Digital Fly by Wire systems - Autopilot System. Active Control Technology – CCV, The Control Problem, Principles of actuation systems, Types of actuation systems.

UNIT 5 AIRCRAFT INSTRUMENTS

9 Hrs.

Flight Instrument and Navigation Instruments – Accelerometers, Air data instruments-airspeed, altitude, Vertical speed indicators. Static Air temperature, Angle of attack, Air Speed Indicators – Mach Meters – Altimeters – Gyroscopic Instruments – principles and Operation and types– Study of Various Types of Engine Instruments – Tachometers – Temperature Gauges – Pressure Gauges – Operation and Principles.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Choose the suitable hydraulic and pneumatic systems for different modes of operation in aircraft systems.
- CO2 - Illustrate the functions of landing gear systems possessing retraction/ extension mechanism of an aircraft.
- CO3 - Scrutinize the airplane control systems and control actuation systems utilized in control surfaces.
- CO4 - Categorize the different types of fuel systems and environmental control systems of aircraft components.
- CO5 - Recommend the types of flight navigation instruments used in aircraft.
- CO6 - Recommend the types of gyroscopic and engine instruments to be used in aircrafts.

TEXT / REFERENCE BOOKS

1. Mekinly, J.L. and Bent, R.D., "Aircraft Power Plants", McGraw Hill, 1993.
2. Pallet, E.H.J., "Aircraft Instruments & Principles", Pitman & Co., 1993.
3. Treager, S., "Gas Turbine Technology", McGraw Hill, 1997.
4. Mckinley, K.L., and Bent, R.D., "Aircraft Maintenance & Repair", McGraw Hill 1993



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SAEA1503	COMPUTATIONAL FLUID DYNAMICS FOR AEROSPACE APPLICATION	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- > To understand the concepts of fluid dynamics computationally.
- > To evaluate the characteristics of flows.
- > To know the basic methods of various computational methods.
- > To discuss the structural grid generation and turbulence models.

UNIT 1 INTRODUCTION

9 Hrs.

Historical Background-of Computations - Classification of Partial Differential Equations- Introduction to Navier-Stokes System of Equations. Comparison of numerical, analytical and experimental.

UNIT 2 FINITE DIFFERENCE METHODS AND SOLUTIONS

9 Hrs.

Finite Difference Methods-Finite Element Methods - Finite Volume Methods, Neumann Boundary Conditions, Dirichlet Boundary Conditions Burgers' Equation- Coordinate Transformation for Arbitrary Geometries.

UNIT 3 INCOMPRESSIBLE VISCOUS FLOWS AND COMPRESSIBLE FLOWS

9 Hrs.

Pressure Correction Methods -Semi-Implicit Method for Pressure-Linked Equations -Pressure Implicit with Splitting of Operators -Marker-and-Cell (MAC) Method.

UNIT 4 STRUCTURED AND UNSTRUCTURED GRID GENERATION

9 Hrs.

Grid Generation: Introduction, Types of grids, Factors affecting the grid, Grid transformation, Prandtl-Mayer expansion waves, Stretched grids. Numerical grid generation; basic ideas; transformation and mapping.

UNIT 5 COMPUTING TECHNIQUES AND APPLICATION

9 Hrs.

Domain Decomposition Methods- Multigrid Methods- Parallel Processing- Turbulence Models- Zero-Equation Models-One- Equation Models -Two-Equation Models -Second Order Closure Models (Reynolds Stress Models) - Algebraic Reynolds Stress Models -Compressibility Effects-Direct Numerical Simulation- RANS- LES.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, students will be able to

CO1 - Apply Partial Differential equation, Navier stokes system of equation for Aerospace applications

CO2 - Apply the Finite Difference Methods, Finite Element Methods, Finite Volume Methods, Neumann Boundary Conditions, Dirichlet Boundary Conditions Burgers' Equation, Coordinate Transformation for Arbitrary Geometries.

CO3 - Derive the Incompressible Viscous flows and Compressible flows for aerospace applications CO4 - Analyse the Structured and Unstructured Grid generation, transformation and Mapping

CO5 - Apply the Domain Decomposition Methods and Multigrid Methods for Turbulence Models, Zero-Equation Models, One-Equation Models and Two-Equation Models

CO6 - Apply the Domain Decomposition Methods and Multigrid Methods for Second Order Closure Models, Algebraic Reynolds Stress.

TEXT / REFERENCE BOOKS

1. Chung T.J Computational fluid dynamics, second edition –Cambridge University press USA, 2010.
2. Suhas V Patankar, "Numerical Heat Transfer and Fluid Flow", Taylor and Francis, 2011.
3. Principles of Computational Fluid Dynamics by P. Wesseling., 2011.
4. Shaw C T, "Using Computational Fluid Dynamics" Prentice Hall, 1992.
5. Anderson.J.D.Jr. "Computational Fluid Dynamics: An Introduction", 3rd Edition, 2012

SAEA1702	UNMANNED AERIAL VEHICLE	L	T	P	Credits	Total
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	DESIGN					Marks
		3	0	0	3	100

COURSE OBJECTIVES

- > To introduce the concepts of applying aerodynamics to UAV Design.
- > To familiarize the student's ability to analyse the concepts of Avionics.
- > To understand the basics of navigation in UAV Design.
- > To understand the basics of Image Processing.

UNIT 1 INTRODUCTION TO UAV

9 Hrs.

History of UAV –classification –basic terminology- The Systemic Basis of UAV-System Composition-Conceptual Phase- Preliminary Design-Selection of the System- Some Applications of UAV- Characteristics Of Aircraft Types.

UNIT 2 BASICS OF AERODYNAMICS AND AIRFRAME CHARACTERISTICS OF UAV

9 Hrs.

Lift-induced Drag - Parasitic Drag - Rotary-wing Aerodynamics - Response to Air Turbulence- Airframe – dynamics – modelling- structures –wing design- engines types-equipment maintenance and management-control surfaces- specifications.

UNIT 3 AVIONICS HARDWARE

9 Hrs.

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

UNIT 4 COMMUNICATION PAYLOADS, CONTROLS AND NAVIGATION

9 Hrs.

Payloads-Telemetry-tracking-Aerial photography-controls-PID feedback-radio control frequency, range – SAS-flight director- commands and videos-elements of control loops-flight computer, - Sensors- Waypoints navigation.

UNIT 5 DIGITAL IMAGE PROCESSING FOR UAV

9 Hrs.

Principles of digital aerial photography- Sensors for aerial photography - Photo-interpretation, objective analysis and image quality - Image Recognition - Image Classification – Image Fusion – Colour Image Processing - Video Motion Analysis.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Summarise the various stages for designing the Unmanned Aerial Vehicle
- CO2 - Comprehend the sound foundation in the Aerodynamics and Airframe characteristics
- CO3 - Choose the various Avionics Hardware based on the UAV application
- CO4 - Choose the Communication payloads, Controls and Navigation for UAV
- CO5 - Apply the Digital Aerial Photography techniques for UAV
- CO6 - Apply the Digital image processing techniques for UAV

TEXT / REFERENCE BOOKS

1. Kimon P. Valavanis, George J. Vachtsevanos, " Handbook of Unmanned Aerial Vehicles " Volume Set- FIRST Edition, ISBN-13: 978-9048197064, 2015.
2. R. Jha. "Theory, Design, and Applications of Unmanned Aerial Vehicles".1st Edition, 2015.
3. Jane's Unmanned Aerial Vehicles and Targets, Jane's Information Group; ASIN: 071 061 2575,1999.
4. Alex Elliott,"Build Your Own Drone Manual: The practical guide to safely building, operating and maintaining an Unmanned Aerial Vehicle (UAV)".2016.
5. R. Said and H. Chayeb, "Power supply system for UAV", KTH, 2002.
6. Robert C. Nelson, Flight Stability and Automatic Control, McGraw -Hill, Inc, 1998

SMEA3001	ADDITIVE MANUFACTURING	L	T	P	Credits	Total Marks
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		3	0	0	3	100
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COURSE OBJECTIVES

- > Exploit technology used in additive manufacturing.
- > Understand importance of additive manufacturing in advance manufacturing process.
- > Acquire knowledge, techniques and skills to select relevant additive manufacturing process.
- > Explore the potential of additive manufacturing in different industrial sectors.
- > Apply 3D printing technology for additive manufacturing.

UNIT 1 INTRODUCTION

9 Hrs.

Overview, Basic principle need and advantages of additive manufacturing, Procedure of product development in additive manufacturing, Classification of additive manufacturing processes, Materials used in additive manufacturing, Challenges in Additive Manufacturing.

UNIT 2 ADDITIVE MANUFACTURING PROCESSES

9 Hrs.

Z-Corporation 3D-printing, Stereolithography apparatus (SLA), Fused deposition modeling (FDM), Laminated Object Manufacturing (LOM), Selective deposition lamination (SDL), Ultrasonic consolidation, Selective laser sintering (SLS), Laser engineered net shaping (LENS), Electron beam free form fabrication (EBFFF), Electron beam melting (EBM), Plasma transferred arc additive manufacturing (PTAAM), Tungsten inert gas additive manufacturing (TIGAM), Metal inert gas additive manufacturing (MIGAM).

UNIT 3 ADDITIVE MANUFACTURING MACHINES AND SYSTEMS

9 Hrs.

Axes, Linear motion guide ways, Ball screws, Motors, Bearings, Encoders/ Glass scales, Process Chamber, Safety interlocks, Sensors. Introduction to NC/CNC/DNC machine tools, CNC programming and introduction, Hardware Interpolators, Software Interpolators, Recent developments of CNC systems for additive manufacturing.

UNIT 4 PRE-PROCESSING IN ADDITIVE MANUFACTURING

9 Hrs.

Preparation of 3D-CAD model, Reverse engineering, Reconstruction of 3D-CAD model using reverse engineering, Part orientation and support generation, STL Conversion, STL error diagnostics, Slicing and Generation of codes for tool path, Surface preparation of materials.

UNIT 5 POST-PROCESSING IN ADDITIVE MANUFACTURING

9 Hrs.

Support material removal, surface texture improvement, accuracy improvement, aesthetic improvement, preparation for use as a pattern, property enhancements using non-thermal and thermal techniques, Brief information on characterization techniques used in additive manufacturing, Applications of additive manufacturing in rapid prototyping, rapid manufacturing, rapid tooling, repairing and coating.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, students will be able to

- CO1 - Able to define the various process used in Additive Manufacturing.
 CO2 - Able to analyse and select suitable process and materials used in Additive Manufacturing.
 CO3 - Able to identify, analyse and solve problems related to Additive Manufacturing.
 CO4 - Able to apply knowledge of additive manufacturing for various real-life applications.
 CO5 - Able to apply technique of CAD and reverse engineering for geometry transformation in Additive Manufacturing.
 CO6 - Understand the basic concept of additive manufacturing application.

TEXT/REFERENCE BOOKS

1. Gibson, I, Rosen, D W. and Stucker ,B., Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing, Springer, 2010.
2. Chua C.K., Leong K.F., and Lim C.S., "Rapid prototyping: Principles and applications", Third Edition, World Scientific Publishers, 2010.
3. Chee Kai Chua, Kah Fai Leong, 3D Printing and Additive Manufacturing: Principles and Applications: Fourth Edition of Rapid Prototyping, World Scientific Publishers, 2014
4. Gebhardt A., "Rapid prototyping", Hanser Gardener Publications, 2003. Kenneth G. Budinski & Michael K. Budinski, "Engineering Materials: Properties and Selection", 9th Edition, Pearson, 2009, 792 pages

SAEA3014	BOUNDARY LAYER THEORY	L	T	P	Credits	Total
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						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 VISCIOUS 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

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

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

SAEA3016	FLIGHT VEHICLES' GUIDANCE	L	T	P	Credits	Total
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	AND CONTROL					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 FLIGHT VECHICE'S TRANSFORMATION

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.

SAEA3017	MANNED SPACE MISSIONS	L	T	P	Credits	Total Marks
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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. 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

SAEA3019	ORBITAL MECHANICS	L	T	P	Credits	Total Marks
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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.

SMEA2201	WORKSHOP PRACTICE	L	T	P	Credits	Total Marks
		0	0	4	2	100



SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

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COURSE OBJECTIVE

- To provide the students with hands on experience on different trades of engineering like Plumbing work, fitting, carpentry, Foundry, welding and sheet metal.

A. PLUMBING WORKS

- Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, and elbows in household fittings.
- Study of pipe connections requirements for pumps and turbines.
- Preparation of plumbing line sketches for water supply and sewage works.
- Hands-on-exercise: Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.
- Demonstration of plumbing requirements of high-rise buildings.

B. CARPENTRY

- Handling of carpentry tools, A practice in marking, sawing planning and chiseling to size. Making simple joints such as half-lap, dove-tail and mortise and tenon joints.
- Use of modern materials such as plywood, chip board, novapan, laminated sheet (Demonstration only).

C. FITTING

Use of fitting tools-practice in marketing, fitting to size and drilling-making of simple mating and profiles such as V, Square, Dove-tail, Half-round joints.

D. WELDING

- Electric Arc Welding
 - Study on Edge preparation techniques for Arc welding
 - List of Welding Exercises
 - Lap Joint 2. Butt Joint 3. Fillet Joint 4. Tee Joint 5. V Joint 6. Corner Joint
- Study on gas welding and gas cutting.
- Study on TIG & MIG welding.

E. FOUNDRY

- Sand testing - Grain fineness - Permeability test.
- Study on Pattern Allowances.
- Preparation of green sand moulding
 - Flanges 2. Glands 3. Bush 4. Dumbbell
- Metal casting technique (Demonstration only).

F. SHEET METAL

- Tools and equipments– practice.
- Making rectangular tray, hopper, scoop, etc.
- Mini project - Fabrication of a small cabinet, dust bin, etc.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Work with various components used in fluid flow pipelines and to make connections for various applications suitably.
CO2 - Handle carpentry tools for wood working.
CO3 - Perform various fitting operations.
CO4 - Make precise weld joints using arc and gas welding processes.
CO5 - Make mould precisely and to place runner, riser at suitable places also they understand how to provide various allowances.
CO6 - Handle sheet metal tools for making various sheet metal components.

SAIC4001	INDUSTRY 4.0	L	T	P	Credits	Total
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						Marks
		3	0	0	3	100

UNIT 1 ADVANCED TECHNOLOGY AND ADVANCED MATERIALS

7 Hrs.

Advanced electro-optical sensing technology-active, passive multi-spectral and hyper spectral imaging; electronic beam steering; vacuum technology, surface and coating technology, health care technology, Nanotechnology- Nanomechanics, Nano optoelectronics; energy storage technology-next generation Li-based Batteries, Hydrogen storage, solar photovoltaic's, Flexible electronics. Intellectual Property Rights - case studies governing/pertaining to Materials/Technology.

UNIT 2 TRANSFORMING TECHNOLOGIES IN BIOENGINEERING

7 Hrs.

Establishment of smart biotechnology factory, Artificial intelligence in Bioprocess technology, Omics – Big data analysis through automation, 3D bio printing for tissue engineering. Simulation tools, RSM and Box model. Cyber physical system based telemedicine, diagnosis and therapeutics through real time biosensors. Bionanotechnology. Intellectual Property rights (IPR): Case Studies.

UNIT 3 ADVANCEMENTS IN SUSTAINABLE BUILT ENVIRONMENT

7 Hrs.

Introduction – Technological developments in Architectural, Engineering and Construction (AEC) - Building Information Modelling (BIM) using Cloud computing technology and Internet of things (IoT) – Unmanned Aerial Vehicles, sensors – Additive manufacturing in construction – Concrete 3D printing - Materials used - Lightweight and functionally graded structures - Net Zero Energy buildings, Bioswales, Biofiltration pond, Ecosan systems- Recent developments in Waste water Management, Air pollution control, waste disposal - Integration of energy, water and environmental systems for a sustainable development- Emerging Technologies: Robot Highway-Vertical farming - Intellectual Property rights: Case studies.

UNIT 4 SMART MANUFACTURING

8 Hrs.

Smart factories and interconnection, Smart Manufacturing – automation systems, Additive Manufacturing, Smart grids, Micro Electro Mechanical Systems (MEMS), Stealth technology, Metal Finishing, Self propelled vehicles, e mobility, Green fuels, drones – unmanned aerial vehicles(UAVs), aerodynamics. Robotic Automation and Collaborative Robots – Augmented reality and haptics, engineering cybernetics and artificial intelligence (AI), Disruptive Technologies – Frugal Innovations – Emerging Technologies - Autonomous Robots, Swam Robot, Modular Robotics, Space craft, Intellectual Property Rights (IPR): Case Studies.

UNIT 5 SMART WORLD

8 Hrs.

Smart Sensors and IIOT, Smart grid, Hybrid renewable energy systems, Electronics in Smart city, Integration of Sensors in Robots and Artificial Intelligence, 5G Technology, Communication protocols, Human-Machine Interaction, Virtual Reality, Quantum Computing: Changing trends in transistor technology: Processor, Emerging Trends: Deep Space, Swarm Robots, Cyborg, Geofencing, Pervasive Computing, Intellectual Property Rights- Case Studies.

UNIT 6 CYBER PHYSICAL SYSTEMS

8 Hrs.

Introduction to Cyber Physical Systems (CPS), Architecture of CPS, Data science and technology for CPS, Prototypes of CPS, Emerging applications in CPS including social space, crowd sourcing, healthcare and human computer interactions, Industrial Artificial Intelligence, Networking systems for CPS applications, Wearable cyber physical systems and applications, Domain applications of CPS: Agriculture, Infrastructure, Disaster management, Energy, Transportation, Intellectual Property Rights (IPR) : Case Studies

TEXT / REFERENCE BOOKS

1. William D. Callister, "Materials Science and Engineering, An Introduction, John Wiley and Sons Inc. Singapore, 2001.
2. V. Raghavan, "Physical Metallurgy: Principle and Practice, Prentice Hall India Pvt Ltd, 2006.
3. Flavio Craveiro, Jose Pinto Duarte, Helena Bartolo and Paulo Jorge Bartolo, "Additive manufacturing as an enabling technology for digital construction: A perspective on Construction 4.0", Automation in Construction, Vol. 103, pp. 251-267, 2019.
4. Klaus Schwab, "Fourth Industrial Revolution", Random House USA Inc, New York, USA, 2017.
5. Oliver Grunow, "SMART FACTORY AND INDUSTRY 4.0. The current state of Application Technologies", Studylab Publications, 2016
6. Alasdair Gilchrist, "INDUSTRY 4.0: Industrial Internet of Things", Apress, 2016
7. Sang C. Suh, U. John Tanik, John N Carbone, Abdullah Eroglu, "Applied Cyber-Physical Systems", Springer Publications, New York, 2013.

SAEA2604	AIRCRAFT ENGINE MAINTENANCE	L	T	P	Credits	Total
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	AND REPAIR LAB					Marks
		0	0	4	2	100

COURSE OBJECTIVE

- To make the students to understand the Airframe components and the tools used to maintain the components.

SUGGESTED LIST OF EXPERIMENTS

1. Performing the stripping of a piston Engine procedures.
2. Engine(Piston Engine) – cleaning, visual inspection, NDT checks.
3. Piston Engine Components – dimensional checks.
4. Piston Engine reassembly procedures.
5. Estimation of the propeller pitch setting.
6. Performing the stripping of a Jet Engine.
7. Jet Engine – Identification of components & defects, NDT checks and dimensional checks.
8. Performing the Jet Engine – reassembly.
9. Training and Performing the ground run engine of propeller powered aircraft.
10. Perform the startup procedure for a piston powered aircraft.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Perform the study of Aircraft Piston and its components.
- CO2 – Examine the damages through Inspection checks.
- CO3 – Demonstrate the procedure for Engine stripping
- CO4 – Evaluate the propeller pitch and twist.
- CO5 – Perform the propeller efficiency of the piston engine aircraft.
- CO6 – Elucidate the engine startup procedures.



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SCHOOL OF MECHANICAL ENGINEERING
DEPARTMENT OF AERONAUTICAL ENGINEERING
BOARD OF STUDIES MEETING HELD ON 15.12.2018

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.J.Alexander Head/Aeronautical, Engineering	
		Dr.A.Anderson, Associate Professor/ Aeronautical Engineering	
		Mr. S. Manigandan, Assistant Professor/ Aeronautical Engineering, Aeronautical Engineering	



Minutes of the Board of Studies meeting

Board of Studies meeting for the Department of Aeronautical Engineering was held on 15th Dec 2018 in Aero CAD Lab with the following agenda:

1. Introduction of a new course titled "SAE4051 Aircraft Production Technology Lab" as Laboratory in B.E-Aeronautical Engineering Curriculum
2. Introduction of a new course titled "SAE1308 Aircraft Design" as Theory in B.E-Aeronautical Engineering Curriculum.
3. Introduction of a new course titled "S26PT2 Professional Training - 2" as an internship training course in the B.E-Aeronautical Engineering Curriculum.
4. Introduction of a new course titled "SBA1101 Principles of Management and professional ethics" as theory in the B.E-Aeronautical Engineering Curriculum.

Welcome Address

Dr.S.Prakash, Chairman, Board of Studies chaired the meeting and welcomed all the members to the Board of Studies meeting in the department of Aeronautical Engineering. Dr.Paramasivam, Professor, Madras Institute of technology, Chennai and Er. James Michael Amulu, Senior Product Development leader, SAP, Bangalore have attended the meeting. The discussion on the items mentioned in the agenda was taken up by the Chairman, Board of Studies and the following resolutions mentioned in the subsequent paragraphs. Further, Dr.Alexander, Head of the Department, Department of Aeronautical Engineering presented the agenda. The following decisions were made as per the items of the circulated agenda.

Introduction of new courses titled "SAE4051 Aircraft Production Technology Lab, SAE1308 Aircraft Design, S26PT2 Professional Training – 2 and SBA1101 Principles of Management and professional ethics" as core courses in B.E-Aeronautical Engineering Curriculum.



As suggested by the Academic Expert new theory courses and laboratory courses were introduced as core courses are very much important in the Aircraft Engine manufacturing division, current trends in the handling Aircraft design in Industries, Opportunities for training and industrial projects in design sectors of aerospace industries, and Ethics followed in Aerospace industries.

This initiative is appreciated by BoS members and after a discussion about the contents of the syllabus; the course was approved for inclusion as core courses in the Curriculum. BoS members accepted the changes and approved the syllabus. The syllabus of the course is enclosed in Annexure-1

Vote of Thanks

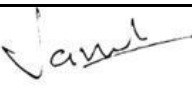
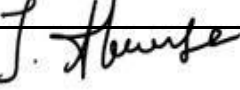
Dr.Alexander thanked the expert members for accepting the invitation for attending the BoS meeting. He thanked them for their valuable suggestions on the agenda items presented. He also thanked Dr.S.Prakash, Dean/Chair and Dr.A.Anderson, Associate Professor for their contribution towards the conduct of this BoS meeting.

Dean/CHAIR



SCHOOL OF MECHANICAL ENGINEERING
DEPARTMENT OF AERONAUTICAL ENGINEERING
BOARD OF STUDIES MEETING HELD ON 17.06.2018

Members present:

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



Minutes of the Board of Studies meeting

Board of Studies meeting for the Department of Aeronautical Engineering held on 17th June 2018 in Aero CAD Lab with the following agenda:

1. Introduction of a new course titled "SAE1606 Civil Aircraft Rules and Regulations" as an elective course in B.E-Aeronautical Engineering Curriculum.
2. Introduction of a new course titled "SME1206 Dynamics of Machinery" as Theory in B.E-Aeronautical Engineering Curriculum.
3. Introduction of a new course titled "SAE1604 Airline Operations and Management" as an elective course in the B.E-Aeronautical Engineering Curriculum.
4. Introduction of a new course titled "SAE1202 Aircraft Electrical and Electronics system" as theory in the B.E-Aeronautical Engineering Curriculum.

Welcome Address

Dr.S.Prakash welcomed the members of BoS and placed the agenda for the deliberations of the members. The following decisions were made as per the items of the circulated agenda.

Introduction of new courses titled "SME1206 Dynamics of Machinery and SAE1202 Aircraft Electrical and Electronics system" as core courses in B.E-Aeronautical Engineering Curriculum.

Introduction of new core electives

SAE1606 Civil Aircraft Rules and Regulations

SAE1604 Airline Operations and Management

As suggested by the Academic Expert new theory courses and laboratory courses were introduced as core courses are very much important in the Aircraft Engine design division,



current trends in the handling of Avionics hub in Industries, Opportunities for training in Airfields, Civil Aviation and Military Aviation Organization.

This initiative is appreciated by BoS members and after a discussion about the contents of the syllabus; the course was approved for inclusion as core courses in the Curriculum. BoS members accepted the changes and approved the syllabus. The syllabus of the course is enclosed in Annexure-1

Vote of Thanks

Dr.Alexander thanked the expert members for accepting the invitation for attending the BoS meeting. He thanked them for their valuable suggestions on the agenda items presented. He also thanked Dr.S.Prakash, Dean/Chair and Dr.A.Anderson, Associate Professor for their contribution towards the conduct of this BoS meeting.

Dean/CHAIR



SAE4051	AIRCRAFT PRODUCTION TECHNOLOGY LAB (For Aeronautical)	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1: Join two parts using the lap-, tee- and V- weld joints using the electric arc welding equipment.

CO2: Develop the V-joint and dove tail joint using the fitting tools.

CO3: Perform the external machining operations (facing, turning, knurling, grooving and thread cutting) using a conventional lathe.

CO4: Perform the internal machining operations (drilling, reaming and internal thread cutting) using a conventional lathe.

CO5: Perform the eccentric turning operation using a four jaw chuck in a conventional lathe.

CO6: Perform the taper turning operations using the compound rest swivel method and attachment method.

LIST OF EXPERIMENTS

Lathe Machine

1. Study of lathe and precision tools
2. Facing, Step, taper and turning
3. Internal and external thread cutting
4. Eccentric turning
5. Grooving & knurling
6. Drilling & Boring

Milling Machine

- Spur gears

Shaping machine

- Key way & Angular cutting

Radial Drilling Machine

- Drilling and Taping

Grinding Machine

- Cylinder grinding



SAE1308	AIRCRAFT DESIGN (For Aeronautical)	L	T	P	Credits	Total Marks
		2	1	0	3	100

COURSE OBJECTIVES

To get clear cut idea about aerodynamic design, aircraft structural design and power plant design

COURSE OUTCOMES

CO1: Identify the type of aircraft design specifications and estimate the overall takeoff weight.

CO2: Calculate the design load factor for cruise and stall conditions of the aircraft to be designed.

CO3: Plot the shear force and bending moment diagram for the aircraft wing to be designed.

CO4: Select the appropriate power plant for the aircraft to be designed and estimation of thrust.

CO5: Design of supersonic aircraft wings and its optimization technique to achieve the desired performance.

CO6: Interpret the design features of V/STOL and rotary wing aircrafts

UNIT 1 PRELIMINARY DESIGN

11 hrs

Introduction, Aircraft Design Requirements, specifications, role of users, Aerodynamic and Structural Consideration, Importance of weight. Airworthiness requirements and standards Classifications of airplanes. Special features of modern airplane, Airplane Weight Estimation, Weight estimation based on type of airplane, trends in wing loading, weight-estimation based on mission requirements, iterative approach.

UNIT 2 AERODYNAMIC DESIGN AND PERFORMANCE

10 hrs

Basics of Wing Design, Selection of airfoil selection, influencing factors. Span wise load distribution and plan form shapes of airplane wing. Stalling, take-off and landing considerations. 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, Structural limits

UNIT 3 STRUCTURAL DESIGN

7 hrs

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

UNIT 4 POWER PLANT DESIGN

7 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

7 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 Hours

TEXT / REFERENCE BOOKS

1. Raymer D.P. "Aircraft Conceptual design", AIAA Series, 1988.
2. Corning G. "Supersonic & Subsonic Airplane Design", II Edition, Edwards Brothers Inc., Michigan, 1953
3. Bruhn E.F, "Analysis and Design of Flight Vehicle Structures", Tristate Offset Co., U.S.A., 1980.
4. Torenbeek E, "Synthesis of Subsonic Airplane Design", Delft University Press, London, 1976.
5. Lebedenski A.A, "Notes on airplane design", Part-I, I.I.Sc., Bangalore



SBA1101	PRINCIPLES OF MANAGEMENT AND PROFESSIONAL ETHICS (For Aeronautical)	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OUTCOMES:**On completion of the course, student will be able to:**

CO 1: Acquire familiarity towards Evolution of Management, principles of F.W.Taylor & Henry Fayol, Organizational structures and basics of management including concepts of MBO & MBE.

CO 2: Gains knowledge on the types of business organization, designing a layout for a plant, and the safety measure to overcome industrial accidents.

CO 3: Recognizes the importance of studying individual and group behavior at workplace and its effect on performance in organization.

CO 4: Develop expertise knowledge on the impact of Leadership Communication and Group dynamics in industry.

CO5: Learn the basics of ethical behavior and corporate social responsibility practiced in industries.

CO 6: To solve cases business, to do a role play based on the knowledge gained from the subject and also apply the gained knowledge in industries in real life situations.

UNIT I MANAGEMENT FUNCTIONS & STRUCTURE**9 hrs**

Management - Definition -Role of managers- Levels of management-Basic Function - Contribution of Taylor Fayol. Types of structures - Line, staff, Functional, Committee and Project & Matrix - Structures. Departmentalization - Centralization - Decentralization - Span of control. Management by COURSE OBJECTIVES (MBO)- Management by Exception (MBE).

UNIT II MANAGEMENT OF ORGINASATION**9 hrs**

Forms of Business / Industrial Ownership - Sole Trader, Partnership, Joint stock Company, Performance Appraisal - Basic Principles - Pitfalls - Methods to Overcome. Industrial Safety - Causes of Accidents - Cost of Accidents - Measures to avoid Accidents. Plant Layout & Maintenance - Need, Types & Managerial Aspects.

UNIT III ORGANISATIONAL BEHAVIOUR**9 Hrs.**

Organisational Behaviour - Definition - Nature & Scope - Contributing Disciplines - Importance of OB to Managers. Personality - Definition - Theories - Factors Influencing Personality. Motivation - Definition - Theories.Transaction Analysis. Morale & Job Satisfaction - Factors Influencing Job Satisfaction.

UNIT IV GROUP DYNAMICS**9 Hrs.**

Group - Definition - Types - Determinants of Group Cohesiveness. Communication - Process - Barriers -Effective Communication. Leadership-Definition- leadership styles- Theories of leadership - Factors Contributing to Effective Leadership. Trade Unions- Role of Trade Union in Organizations - Types and Functions of Trade Unions.

UNIT V PROFESSIONAL ETHICS**9 Hrs.**

Ethics in Workplace - Formulation of Ethics - Managerial Ethics - Managing Ethical Behaviour - Codes of Ethics Encouraging Ethical Behaviour - Ethical Leadership - Ethical Decision making. Corporate Social Responsibility (CSR) -Intellectual Property Rights (IPR)- Meaning- Laws relating to Intellectual Property Rights (IPRs)

Max. 45 Hours**TEXT / REFERENCE BOOKS**

1. Gupta C.B., "Management Theory and Practice", 14th Edition, Sultan Chand & Sons, 2009.
2. Prasad L.M., "Principle & Practice of Management", 7th Edition, Sultan Chand & Sons, 2008.
3. Aswathappa, "Organisational Behaviour", 8th Edition, Himalaya Publishing House, 2010
4. Prasad L.M., "Organisational Behaviour", 4th Edition, Sultan Chand & Sons, 2008.
5. Harold Koontz, "Principles of Management", 1st Edition, Tata McGraw Hill, 2004.



SME1206	DYNAMICS OF MACHINERY (Common to Mech, M&P, Aero & Auto)	L	T	P	Credits	Total Marks
		3	1	0	4	100

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1: Analyze the principles of static & dynamic forces and flywheels.

CO2: Examine the basics of friction, balancing of rotating and reciprocating unbalanced systems.

CO3: Design the single degree free and damped vibration systems.

CO4: Analyze the forced vibration systems.

CO5: Compute the process parameters of gyroscopes.

CO6: Examine different types of governors and their applicability.

UNIT I INTRODUCTION**12 Hrs**

Static and Dynamic Force Analysis (Demonstration of models in video show)- Theory and analysis of Compound Pendulum, Concept of equivalent length of simple pendulum, Bifilar suspension, Trifilar suspension - Inertia force and Inertia torque- Turning moment diagrams -Fly Wheels - Flywheels of punching presses. Dynamics of reciprocating engines: Two mass statically and with dynamism equivalent system, correction couple, static and dynamic force analysis of reciprocating engine mechanism (analytical method only), Crank shaft torque, Introduction to T- θ diagram.

UNIT II BALANCING AND FRICTION**12 Hrs**

Tending plane, resistance of screw and nuts, pivot and collar, uniform force, uniform wear, friction circle and friction axis border friction, film lubrication Friction in journal bearing-friction circle, Balancing Of Reciprocating Masses - Balancing of Multi-cylinder inline, V-engines- Balancing a single cylinder engine- Balancing of linkages - Balancing machines-Field balancing of discs and rotors Balancing of rotating masses single and multiple - single and different planes, use analytical and graphical methods.

UNIT III ONE DOF FREE VIBRATION**12 Hrs**

Introduction - vibration - measuring instruments. Free Vibration of spring mass system - oscillation of pendulums Harmonic motion, periodic motion, vibration terminology, complex method of representing harmonic vibration, Fourier series and harmonic analysis, Mathematical modeling for vibrations springs in series and parallel, differential equation of motion, solution of differential equation Transverse and torsional vibrations of two and three rotor systems, critical speeds.

UNIT IV TWO DOF FORCED VIBRATION**12 Hrs**

Vibration isolation and transmissibility, elementary treatment of two degree of freedom systems torsional vibrations of single rotor and two rotor systems, transverse Vibration of simply supported beam energy method, Rayleigh's and Dunkerley method. Vibration damper; Properties of vibrating system, flexibility matrix, stiffness matrix, reciprocity theorem. Disturbance caused by unbalance - Support motion -transmissibility

UNIT V PRECESSION AND GOVERNORS**12 Hrs**

Gyroscopes and gyroscopic effects-Effect of precession motion on the stability of moving vehicles such as motor car, motor cycle, aero planes and ships, gyroscopic couple, (Demonstration of models in video show). Governors: types and applications; Watt, porter and proell governors, spring loaded governors - Hartnell and Hartung with auxiliary springs. Sensitiveness, isochronisms and hunting.

Max.60 Hrs**REFERENCE BOOKS:**

1. S. S. Rattan, Theory of Machines, 3rd Ed., Tata McGraw Hill, 2009
2. John Hannah and Stephens R.C., "Mechanics of Machines", Viva Low-Prices Student Edition, 1999
3. T. Bevan. Theory of Machines, CBS Publishers and Distributors, 1984
4. Khurmi, R.S., "Theory of Machines", 14th Edition, S Chand Publications, 2005
5. Benson H. Tongue, "Principles of Vibrations", Oxford University Press, 2nd Edition, 2007



SAE1202	AIRCRAFT ELECTRICAL AND ELECTRONIC SYSTEMS (For Aeronautical)	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

To study the basics of Electronics and electrical systems used for aircrafts.

COURSE OUTCOMES

CO1: Functions of diodes, transistors, stable, bi-stable and bus systems in aircraft electronic systems.

CO2: Inspect the type of generators, motors and batteries used in Aircraft power generation systems.

CO3: Examine the components of AC and DC power generators in Aircraft electrical systems.

CO4: Discover the components of power distribution system used in larger commercial aircrafts.

CO5: Assess the lightning technologies utilized in Aerodrome and Airport for passenger mobility.

CO6: Select the cabin pressurization system technologies suitable for passenger comfortability.

UNIT 1 INTRODUCTION**5 Hrs.**

Electrical fundamentals - Electronic fundamentals -Semiconductor theory - Diodes - 2.3 Transistors-Digital fundamentals-Logic gates-Combinational logic systems – Mono stable devices - Bistable devices - Decoders - Encoders – Multiplexers - Bus systems-microprocessors – microcontrollers – Computers

UNIT 2 GENERATORS AND MOTORS BATTERIES & POWER SUPPLIES 9 Hrs.

Description and applications of single - phase and three - phase motors. Connection and starting of three - phase induction motors by star - delta starter. Motors used for driving pumps, compressors, centrifuge, Generator and motor principles - AC generators - Three -phase generation and distribution - AC motors - Practical aircraft generating systems – Storage cells - Lead -acid batteries - Nickel-cadmium batteries - Lithium batteries - Nickel-metal hydride batteries- Battery locations - Battery venting - Battery connections - Regulators - External power - Inverters - Transformer rectifier units - Transformers - Auxiliary power unit (APU) - Emergency power - Wiring and circuit protection - Construction and materials - specifications - Shielding/screening - Circuit protection - Electrical and magnetic fields - Electromagnetic interference - EMI reduction

UNIT 3 AC POWER GENERATION DC POWER GENERATION BASICS 12 Hrs.

Types of alternator – alternator rectifier unit – constant speed alternator – wild frequency alternator – brush less alternator – alternator control unit - synchronizing of alternator – charging and cooling - Disconnection and connection GCU: - Line contactors/ Transfer contactors Static invertors- testing the operation. Auto transformers. Current transformers- differential protection APU – purpose – operation – starting of engine– precautions to be observed before starting — limitations of starting APU. DC generators – construction – Starter generator – checking and testing of generator parts – functional check of generator on aircraft. Paralleling of DC buses. TRUs and DC power generation.

UNIT4 DISTRIBUTION OF POWER SUPPLIES**12 Hrs.**

single engine/general aviation - Twin engine general aviation aircraft - Larger aircraft systems - Split bus system - Parallel bus system - Split/parallel bus system - Standby and essential power - Battery charging - Control and protection - Load shedding - Fire and overheat protection - Engine/APU fire detection - Cargo bay/baggage area - Fire extinguishing

UNIT 5 CABIN SYSTEMS & LIGHTS**7 Hrs**

Lighting technologies - Flight compartment lights - Passenger cabin lights - Exterior lights - Passenger address system - Galley equipment -In-flight entertainment (IFE) - Satellite communications -Multiplexing - Fiber optics -Air conditioning -Pressurization Air stairs

Max. 45 Hours**TEXT / REFERENCE BOOKS**

1. Aircraft Electrical and Electronic Systems : Principles, operation and maintenance , Mike Tooley and David Wyatt ,
2. Butterworth-Heinemann is an imprint of Elsevier USA , First edition, 2009
3. EHJ Pallet: A/C Electrical system
4. Theraja B.L. Electrical Technology
5. Bent Mckinley: A/C Electricity and Electronics
6. Mehta VK Basic Electronics;S Chand and Co., New Delhi



SAE1604	AIRLINE OPERATIONS AND MANAGEMENT (For Aeronautical)	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To get idea about airline scheduling, airspace management and to get knowledge objectives of International Civil Aviation Organization.

COURSE OUTCOMES

CO1: Utilize the functions of aviation technology transformation and classify the types of aviation industries.

CO2: Select the standard aircraft possessing best operating cost and moderate passenger capacity for economic class.

CO3: Outline the principles of airline scheduling for preparing flight plans in line with aircraft maintenance practices.

CO4: Interpret the functions of Airspace management for the aircraft other than takeoff and landing handling airport infrastructure.

CO5: Summarize the growth and development of civil aviation organizations in different nations.

CO6: Categorize the growth and development of DGCA rules and regulatory for civil aviation companies.

UNIT 1 INTRODUCTION

9 Hrs.

Introduction to Transportation–Modes–Modal Competition– The Economic Importance–Transportation and Economic Development–Transport as a Factor of Production–International Transportation– Importance of International Transportation–Logistics Management–Concepts and Types of Aviation–History of Civil Aviation Industry–Aviation Technology Transformation (1930 – 2003) –Scope of Aviation

UNIT 2 AIRLINE ECONOMICS

9 Hrs.

Forecasting – Fleet Size, Fleet Planning, The Aircraft Selection Process, Operating Cost, Passenger Capacity, Load Factor Etc. – Passenger Fare and Tariffs – Influence of Geographical, Economic Political Factors on Routes and Route selection. Aircraft Selection Process – Fleet Commonality, Factors affecting choice of fleet, Route Selection and Capital Acquisition – Valuation & Depreciation – Budgeting, Cost Planning – Aircrew Evaluation –Route Analysis – Aircraft Evaluation.

UNIT 3 PRICIPLES OFAIRLINES SCHEDULING

9 Hrs.

Equipment Maintenance, Flight Operations and Crew Scheduling, Ground Operations and Facility Limitations Equipment and Types of Schedule – Hub & Spoke Scheduling, Advantages / Disadvantages & Preparing Flight Plans – Aircraft Scheduling in Line with Aircraft Maintenance Practices

UNIT 4 AIRSPACE MANAGEMENT

9 Hrs.

Aircraft Characteristics – Airport Capacity Management – Terminal Management – Apron Management– Size of Airport Infrastructure – Airports and their Economics in National Economic Growth and Development Indian Scenario–GlobalEmergingTrendsofAirportInfrastructureIndustry–GlobalStudyonAirportPerformance– Modern Aviation Infrastructure Business Trend – Airspace Management – Airports and Airspace Congestion Issues – Regulatory Management

UNIT 5 GROWTH &DEVELOPMENT

9 Hrs.

International Civil Aviation Organization (ICOA)–Introduction– Objectives –Strategic Planning– Annexes– International Air Transport Association(IATA)– Aims– Two Tier Systems– Growth and Development– World Trade Organization –World Tourism Organization –Federal Aviation Administration (FAA) –Civil Aviation Authority (CAA)–EASA (European Aviation Security Agency) – Director General of Civil Aviation (DGCA) – Functions –Concepts of Bilateral, Multilateral and Plurilateral in Air Trade Agreements–Major Factors that Converge Private Sector Initiatives –Modern Airline Trends–Liberalization in Air Transport –Potential Paths Further Liberalization –Privatization in Indian Civil Aviation Industry – Deregulation in Indian Air Pocket – Airport Internalization – Basic Principle behind Privatization– Airport –Privatization–FormsofAirport–Privatization–Airport-Privatization Models–Causes–Objectives–Airport Ownership and Governance Models– Airport Privatization in India–Road Map for the Civil Aviation Sector

Max. 45 Hours

TEXT / REFERENCE BOOKS

- Allan Rossmore, Airline Operations, An Inside View 2000,2 ,illustrated ,Kellmark Aeronautics, Incorporated,2000.
- Massoud Bazargan, Airline operations and scheduling, Ashgate Publishing Limited, Hampshire, England,2008.
- Alexander T.Wells, Seth B.Young, Airport planning &management, McGraw-Hill,2004.
- P.S.Senguttuvan,“Fundamentals of Air Transport Management”,Excel Books,First Edition 2006
- John G. Wensveen, Air Transportation: A Management Perspective, Ashgate Publishing Company, 2007



SAE1606	CIVIL AIRCRAFT RULES AND REGULATIONS (For Aeronautical)	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

To get knowledge about the rules and regulations of civil Aircrafts

COURSE OUTCOMES

CO1: Describes the CAR series A procedure for civil air worthiness regulations and safety of engineering activities.

CO2: Extend the CAR series B to CAR series C for cockpit and voice recording system for black box.

CO3: Examine the aircraft maintenance programmes and engine reliability are approved through CAR series D.

CO4: Outline the procedure for registration of aircraft and certification of airworthiness through CAR series E, F, L and M.

CO5: List the flight testing of aircraft registration marking through CAR series T.

CO6: List the aircraft log book and Indian document application for aircraft registration through CAR series X.

UNIT 1 SERIES A

9 Hrs.

C.A.R. SERIES 'A' – procedure for civil air worthiness requirements and responsibility operators vis-à-vis air worthiness directorate -Responsibilities of operators / owners- Procedure of CAR issue, amendments etc., Objectives and targets of airworthiness directorate; Airworthiness regulations and safety oversight of engineering activities of operators.

UNIT 2 SERIES B AND C

9 Hrs.

C.A.R. SERIES 'B' – issue approval of cockpit check list, MEL, CDL: deficiency list (MEL & CDL); Preparation and use of cockpit checklist and emergency list. C.A.R. SERIES 'C' – defect recording, monitoring, investigation and reporting -Defect recording, reporting, investigation, rectification and analysis; Flight report; Reporting and rectification of defects observed on aircraft; Analytical study of in-flight readings & recordings; Maintenance control by reliability Method.

UNIT 3 SERIES D

9 Hrs

C.A.R. SERIES 'D' – aircraft maintenance programmes- Reliability Programmes (Engines); Aircraft maintenance programme & their approval; On condition maintenance of reciprocating engines; TBO – Revision programme; Maintenance of fuel and oil uplift and consumption records – Light aircraft engines; Fixing routine maintenance periods and component TBOs – Initial & revisions.

UNIT 4 CAR SERIES E, F, L AND M

9 Hrs.

C.A.R. SERIES 'E' – APPROVAL OF ORGANISATIONS - Approval of organizations in categories A, B, C, D, E, F, & G - Requirements of infrastructure at stations other than parent base.- C.A.R. SERIES 'F' – AIR WORTHINESS AND CONTINUED AIR WORTHINESS: Procedure relating to registration of aircraft; Procedure for issue / revalidation of Type Certificate of aircraft and its engines / propeller; Issue / revalidation of Certificate of Airworthiness; Requirements for renewal of Certificate of Airworthiness. C.A.R. SERIES 'L' & 'M' Issue of AME Licence, its classification and experience requirements, Mandatory Modifications / Inspections.

UNIT 5 SERIES 'T' & 'X'

9 Hrs.

C.A.R. SERIES 'T' & 'X' - Flight testing of (Series) aircraft for issue of C of A; Flight testing of aircraft for which C of A had been previously issued. Registration Markings of aircraft; Weight and balance control of an aircraft; Provision of first aid kits & Physician's kit in an aircraft; Use furnishing materials in an aircraft; Concessions; Aircraft log books; Document to be carried on board on Indian registered aircraft; Procedure for issue of tax permit; Procedure for issue of type approval of aircraft components and equipment including instruments.

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. "Aircraft Manual (India) Volume" – Latest Edition, The English Book Store, 17-1, Connaught Circus, New Delhi.
2. Advisory Circulars from DGCA 2012.
3. "Civil Aviation Requirements with latest Amendment (Section 2 Airworthiness)" – Published by DGCA, The English Book Store, 17-1, Connaught Circus, New Delhi 2010.
4. Aeronautical Information Circulars (relating to Airworthiness) from DGCA 2012



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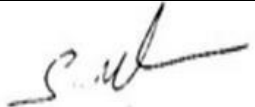
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BOARD OF STUDIES MEETING HELD ON 16.12.2017

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.J.Alexander, Head/Aeronautical Engineering	
		Dr.A.Anderson, Associate Professor/ Aeronautical Engineering	
		Mr.S. Manigandan, Assistant Professor/ Aeronautical Engineering	



Minutes of the Board of Studies meeting

Board of Studies meeting for the Department of Aeronautical Engineering was held on 16th Dec 2017 in Aero CAD Lab with the following agenda:

1. Introduction of a new course titled "SAEX1037-Aircraft Navigation, Guidance and Control" as an elective course in B.E-Aeronautical Engineering Curriculum.
2. Introduction of a new course titled "SAEX1021-Rockets and Missiles" as core Theory course in B.E-Aeronautical Engineering Curriculum.

Welcome Address

Dr.S.Prakash welcomed the members of BoS and placed the agenda for the deliberations of the members. The following decisions were made as per the items of the circulated agenda.

Introduction of new courses titled "SAEX1037-Aircraft Navigation, Guidance and Control and SAEX1021-Rockets and Missiles" as core courses in B.E-Aeronautical Engineering Curriculum.

As suggested by the Academic Expert new theory courses and elective courses were introduced as core courses are very much important in the Flight Navigation and guidance Unit, International Civil Aviation Organization communication radio controller, flight planning charts, aeronautical charts and its utilization. Dr.Paramasivam stated that the suggested the elective courses is very much important in study of Rocket engines, classification of missiles, operating conditions for rockets and missiles carrying propellants and Manoeuvring in high speeds.

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

The syllabus of the course is enclosed in Annexure-1

Vote of Thanks

The meeting concluded with a vote of thanks by Dr.Alexander, Head of the department, Department of Aeronautical Engineering. He thanked the expert members for accepting the invitation and attending the BoS meeting. He also thanked Dr.S.Prakash, Dean/Chair and Dr.A.Anderson, Associate Professor for their contribution towards the conduct of this BoS meeting.

A handwritten signature in black ink, appearing to read 'S. Prakash', is enclosed in a thin black rectangular border.

Dean/CHAIR



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BOARD OF STUDIES MEETING HELD ON 22.06.2017

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.J.Alexander Head/Aeronautical, Engineering	
		Dr.A.Anderson, Associate Professor/ Aeronautical Engineering	
		Mr. S. Manigandan, Assistant Professor/ Aeronautical Engineering, Aeronautical Engineering	



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Minutes of the Board of Studies meeting

Board of Studies meeting for the Department of Aeronautical Engineering held on 22nd June 2017 in Aero CAD Lab with the following agenda:

1. Introduction of a new courses "SAEX4001-Aero CAD Lab – I" as a Laboratory in B.E-Aeronautical Engineering Curriculum.
2. Introduction of a new courses "SAEX4004-Aero Modelling Lab" as a Laboratory in B.E-Aeronautical Engineering Curriculum.
3. Introduction of a new elective courses in B.E-Aeronautical Engineering Curriculum.

Welcome Address

Dr.S.Prakash welcomed all the members who were present for the meeting and placed the agenda for the deliberations of the members. The following decisions were made as per the items of the circulated agenda.

Introduction of new courses titled "SAEX4001-Aero CAD Lab – I and SAEX4004-Aero Modelling Lab" as Laboratory courses in B.E-Aeronautical Engineering Curriculum.

Introduction of new elective courses titled "SAEX1036-Advanced Control System Design for Aerospace Vehicles and SAEX1038-Flight Control Systems Design" as core electives in B.E-Aeronautical Engineering.

Er. James Michael Amulu suggested that the laboratory courses introduced will help the students to have an hands on experience in design of Aircraft components and systems, Fabrication of Aero model and Aerobatic model RC's, Calibration and testing of RC model and its units.

Dr.Paramasivam suggested some corrections in the syllabus and stated that the control system subjects will be helpful for the students to know about the Flight control system Unit, Advanced control systems used in Aerospace vehicles with wireless data transfer communication.

This initiative is appreciated by BoS members and after a discussion about the contents of the syllabus; the course was approved for inclusion as core courses in the Curriculum. BoS members accepted the changes and approved the syllabus. The syllabus of the course is enclosed in Annexure-1

Vote of Thanks

The meeting concluded with a vote of thanks by Dr.Alexander, Head of the department, Department of Aeronautical Engineering. He thanked the expert members for accepting the invitation and attending the BoS meeting. He also thanked Dr.S.Prakash, Dean/Chair and Dr.A.Anderson, Associate Professor for their contribution towards the conduct of this BoS meeting.

A handwritten signature in black ink, appearing to read 'S. Prakash', is written over a horizontal line.

Dean/CHAIR



SAEX 1029	AIRCRAFT NAVIGATION, GUIDANCE AND CONTROL	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT I INERTIAL SENSORS

10 hrs

Gyroscopes-Mechanical-electromechanical-Ring Laser gyro- Fiber optic gyro, Accelerometers

UNIT II INERTIAL NAVIGATION SYSTEMS

10 hrs

INS components: transfer function and errors-The earth in inertial space, the coriolis effect-Mechanisation. Platform and Strap down, INS system block diagram, Different co-ordinate systems, Schuler loop, compensation errors, Gimbal lock, Alignment.

UNIT III RADIO NAVIGATION

10 hrs

Different types of radio navigation- ADF, VOR/DME- Doppler –LORAN, DECCA and Omega – TACAN

UNIT IV APPROACH AND LANDING AIDS

10 hrs

ILS, MLS, GLS - Ground controlled approach system - surveillance systems-radio altimeter, RNAV, Modern Navigation Aids

UNIT V SATELLITE NAVIGATION & HYBRID NAVIGATION

10 hrs

Introduction to GPS -system description -basic principles -position and velocity determination-signal structure-DGPS, Introduction to Kalman filtering-Estimation and mixed mode navigation-Integration of GPS and INS-utilization of navigation systems in aircraft

(Computational problems must be given as assignments for each unit)

REFERENCES:

1. Myron Kyton, Walfred Fried, 'Avionics Navigation Systems', John Wiley & Sons, 2nd edition, 1997
2. Nagaraja, N.S. "Elements of Electronic Navigation", Tata McGraw-Hill Pub. Co., New Delhi, 2nd edition, 1975.
3. George M Siouris, 'Aerospace Avionics System; A Modern Synthesis', Academic Press Inc., 1993.
4. Albert Helfrick, 'Practical Aircraft Electronic Systems', Prentice Hall Education, Career & Technology, 1995.
5. Albert D. Helfrick, 'Modern Aviation Electronics', Second Edition, Prentice Hall Career & Technology, 1994.
6. Sen, A.K. & Bhattacharya, A.B. "Radar System and Radar Aids to Navigation", Khanna Publishers, 1988.
7. Slater, J.M. Donnel, C.F.O and others, "Inertial Navigation Analysis and Design", McGraw-Hill Book Company, New York, 1964.



SAEX1021	ROCKETS AND MISSILES	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT I ROCKETS SYSTEM

10 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 Slash and Propellant Hammer - Elimination of Geysering Effect in Missiles - Combustion System of Solid Rockets.

UNIT II AERODYNAMICS OF ROCKETS AND MISSILES

10 hrs

Airframe Components of Rockets and Missiles - Forces Acting on a Missile While Passing Through Atmosphere- Classification of 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 - Body Upwash and Downwash in Missiles - Rocket Dispersion - Numerical Problems.

UNIT III ROCKET MOTION IN FREE SPACE AND GRAVITATIONAL FIELD 10 hrs

One Dimensional and Two Dimensional rocket Motions in Free Space and Homogeneous Gravitational Fields - description of Vertical, Inclined and Gravity Turn Trajectories - Determination of range and Altitude Simple Approximations to Burnout Velocity.

UNIT IV STAGING AND CONTROL OF ROCKETS AND MISSILES

10 hrs

Rocket Vector Control – Methods, SITVC termination, Thrust determination, Multi staging of rockets - Vehicle Optimization - Stage Separation Dynamics - Separation Techniques, Types of aerodynamics control in missiles

UNIT V MATERIALS FOR ROCKETS AND MISSILES

10 hrs

Selection of Materials - Special Requirements of Materials to Perform under Adverse Conditions.

(Computational problems must be given as assignments for each unit)

TEXT BOOK:

1. Sutton, G.P., et al., "Rocket Propulsion Elements", John Wiley & Sons Inc., New York, 1993.

REFERENCE BOOKS:

1. Mathur, M., and Sharma, R.P., "Gas Turbines and Jet and Rocket Propulsion", Standard Publishers, New Delhi 1998.
2. Cornelisse, J.W., "Rocket Propulsion and Space Dynamics", J.W., Freeman & Co. Ltd., London, 1982.
3. Parket, E.R., "Materials for Missiles and Spacecraft", McGraw-Hill Book Co. Inc., 1982



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SAEX4001	AERO CAD LAB – I Using any Softwares like PRO/E, CATIA, Solid Works, ANSYS, MSC / Nastran	L	T	P	Credits	Total Marks
		0	0	3	3	100

LIST OF EXPERIMENTS:

1. Modelling of various components using any modelling software
2. Static analysis on cantilever beam
3. Static analysis of forces in a simply supported beam
4. Static analysis- Plane truss
5. 2-D static stress analysis
6. 3-D static stress analysis
7. Stress distribution in a shrink fit
8. Natural frequencies of a spring mass system
9. Stress and modal analysis of a cylinder under pressure
10. Stress distribution and natural frequencies in indeterminate structure
11. Analysis of a model airplane wing



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SAEX4004	Aero Modelling Lab	L	T	P	Credits	Total Marks
		0	0	3	3	100

LIST OF EXPERIMENTS:

1. Study about historical background of airplanes
2. Component of airplanes and its function
3. Construction of glider
4. Construction of wings
5. Construction of Fuselage
6. Construction of tail plane
7. Assembly of a plane
8. Mounting of engine and controls
9. Training in flight manoeuvring through computer simulation
10. Testing of trainer flight model



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SAEX 1036	ADVANCED CONTROL SYSTEM DESIGN FOR AEROSPACE VEHICLES	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT I INTRODUCTION

10 hrs

Introduction and Motivation for Modern Control Design- Review of Classical Control Systems- Introduction to Basic Flight Mechanics and Flight Control Systems.-State Space Representation of Dynamical Systems.

UNIT II NON LINEAR SYSTEMS

10 hrs

Linearization of Nonlinear Systems, Linearized Flight Mechanics-Review of Matrix Theory-time Response of Dynamical Systems in State Space form-Stability of Linear Systems-Controllability and Observability of Linear Systems.

UNIT III CONTROL SYSTEM DESIGN

10 hrs

Pole Placement Control Design.-Pole Placement Observer Design - Static Optimization -Optimal Control Formulation; Linear Quadratic Regulator (LQR) Design- Application of Linear Control Theory to Autopilot Design of Aircrafts and Missiles-Gain Scheduling and Dynamic Inversion Design.

UNIT IV STABILITY ANALYSIS & LYAPUNOV THEORY

10 hrs

Stability Analysis of Nonlinear Systems Using Lyapunov Theory-Neuro-Adaptive Design for Nonlinear Systems-Advanced Nonlinear Control of Aerospace Vehicles Using Dynamic Inversion and Neuro-Adaptive Design.

UNIT V NONLINEAR CONTROL DESIGN

10 hrs

Nonlinear Control Design Using Back-stepping-An Overview of LQ Observer and Kalman Filtering-Nonlinear Observer Design.

(Computational problems must be given as assignments for each unit)

REFERENCES

1. N. S. Nise: Control Systems Engineering, 4th Ed., Wiley, 2004.
2. K. Ogata: Modern Control Engineering, 3rd Ed., Prentice Hall, 1999.
3. B. Friedland: Control System Design, McGraw Hill, 1986.
4. E. Bryson and Y-C Ho: Applied Optimal Control, Taylor and Francis, 1975
5. Mathukumalli Vidyasagar, Nonlinear systems analysis, 2nd Edition, SIAM, 2002
6. Hassan K. Khalil, Nonlinear systems, Macmillan Pub. Co., 1992



SAEX 1038	FLIGHT CONTROL SYSTEM DESIGN	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT I INTRODUCTION TO CONTROL SYSTEM DESIGN & FCS

10 hrs

Open vs. Closed Loop Control - Analogue, Digital and Logical Control - Industrial Controllers - Control System Design Objectives - Control System Design Cycle - Introduction to Flight Control Systems - History of FCS - Guidance, Navigation and Control - Flight Control Channels - Flight Control Methods - SAS vs. Autopilot

UNIT II AERODYNAMIC CONSIDERATIONS OF FLIGHT CONTROL SYSTEMS

10 hrs

Static and Dynamic Stability - Stability and Maneuverability - Static Margin - Variations of the Center of Pressure - Hinge Moment - Aeroelastic Effects- Control System Performance - Canard Control - Wing Control - Tail Control - Fin Configuration Effects- Side Jet Control-Thrust -Vector Control - Variation of Mass and CG

UNIT III SENSORS & ACTUATORS

10 hrs

Flight Control Sensors – Accelerometers- Gyroscopes-Angle of attack vane - Other sensors - Sensor Selection-Flight Control Actuators- Servomechanism- Reversible vs. Irreversible –Mechanisms-Hydraulic Actuators-Pneumatic Actuators- Electric Actuators

UNIT IV CONTROLLER DESIGN

10 hrs

An Overview of Controller Design-Design Using Frequency Response-Design Using Root Locus-Pole Placement Methods-Linearization and Transfer Functions of Flying Vehicles- Coordinate Systems-Equations of Motion-Roll, Pitch and Yaw Transfer Functions-Design of Aerodynamic Control System for Missiles-STT vs. BTT -Lateral Control System Design for STT-Roll Control- Control System Design for BTT-MIMO Based Design-Design of Single Channel Flight Control Systems

UNIT V AIRCRAFT CONTROL SYSTEM DESIGN

10 hrs

Longitudinal Control-Lateral Control- Attitude Control Systems -Flight Path Control Systems- Active Control Systems -Thrust Vector Control - Classifications and Applications - Mathematical Modeling - Control Architectures - Controller Design- Miscellaneous Topics - Sensitivity Analysis-Man in the Loop considerations-Parameter Optimization

(Computational problems must be given as assignments for each unit)

TEXT BOOKS:

1. Garnell, P., "Guided Weapon Control Systems", 2nd Edition, Pergamon Press, 1980.
2. McLean, D., "Automatic Flight Control Systems", Prentice Hall International (UK) Ltd, 1990.
3. Blakelock, J. H.; Automatic Control of Aircraft and Missiles, 2nd Edition, John Wiley & Sons, 1990.

