

B.E. AERONAUTICAL ENGINEERING REGULATIONS- 2019 CURRICULAM

SEMESTER 1										
Sl. No.	Course Type	Course Code	Course Title	L	T	P	C	Marks		Page No.
								CAE	ESE	
1	Theory	SMTA1101	Engineering Mathematics - I	3	*	0	3	50	50	1
2	Theory	SPHA1101	Physics for Engineers	3	1	0	4	50	50	3
3	Theory	SBTA1101	Environmental Science and Engineering	2	0	0	0	-	-	5
4	Theory	SCSA1103	Programming in C	3	*	0	3	50	50	6
5	Theory	SMEA1101	Engineering Graphics	1	0	4	3	50	50	8
6	Theory	SAEA1202	Fundamentals of Aeronautical Engineering	3	0	0	3	50	50	9
7	Practical	SPHA2101	Physics Lab	0	0	2	1	25	25	10
8	Practical	SCSA2104	Programming in C Lab	0	0	4	2	50	50	11
9	Practical	SMEA2101	Computer Aided Design Lab	0	0	4	2	50	50	12
Total Credits for Semester 1 - 21										
Total Marks for Semester 1 - 750										

SEMESTER 2										
Sl. No.	Course Type	Course Code	Course Title	L	T	P	C	Marks		Page No.
								CAE	ESE	
1	Theory	SHSA1101	Technical English	3	0	0	3	50	50	13
2	Theory	SMTA1201	Engineering Mathematics - II	3	0	0	3	50	50	17
3	Theory	SEEA1101	Basic Electrical and Electronics Engineering	3	0	0	3	50	50	18
4	Theory	SCYA1101	Engineering Chemistry	3	1	0	4	50	50	19
5	Theory	SMEA1202	Engineering Mechanics	3	*	0	3	50	50	21
6	Theory	SAEA1201	Aircraft Materials	3	0	0	3	50	50	22
7	Practical	SCYA2101	Engineering Chemistry Lab	0	0	2	1	25	25	24
8	Practical	SMEA2201	Workshop Practice	0	0	4	2	50	50	25
Total Credits for Semester 2 - 22										
Total Marks for Semester 2 - 750										

L - LECTURE HOURS, T - TUTORIAL HOURS, P - PRACTICAL HOURS, C - CREDITS

CAE - CONTINUOUS ASSESSMENT EXAMINATION,

ESE - END SEMESTER EXAMINATION

SEMESTER 3										
Sl. No.	Course Type	Course Code	Course Title	L	T	P	C	Marks		Page No.
								CAE	ESE	
1	Theory	SMTA1301	Engineering Mathematics – III	3	0	0	3	50	50	26
2	Theory	SAEA1301	Aero Engineering Thermodynamics	3	0	0	3	50	50	27
3	Theory	SAEA1302	Aircraft Production Techniques	3	0	0	3	50	50	28
4	Theory	SAEA1303	Aircraft Systems and Instruments	3	0	0	3	50	50	29
5	Theory	SAEA1304	Introduction to Aerodynamics	3	0	0	3	50	50	30
6	Theory	SAEA1305	Introduction to Aircraft Structures	3	0	0	3	50	50	31
7	Practical	SMEA2301	Fluid Mechanics and Machinery Lab	0	0	4	2	50	50	32
8	Practical	SAEA2301	Aircraft Structures Lab - I	0	0	4	2	50	50	33
Total Credits for Semester 3 – 22										
Total Marks for Semester 3 – 800										

SEMESTER 4										
Sl. No.	Course Type	Course Code	Course Title	L	T	P	C	Marks		Page No.
								CAE	ESE	
1	Theory	SMTA1401	Engineering Mathematics – IV	3	0	0	3	50	50	34
2	Theory	SMEA4003	INDUSTRY 4.0 FOR DESIGN AND MANUFACTURING	2	0	0	2	50	50	36
3	Theory	SAIC4003	UNIVERSAL HUMAN VALUES	3	0	0	3	50	50	37
4	Theory	SAEA1401	Aircraft Propulsion	3	0	0	3	50	50	39
5	Theory	SAEA1402	Aircraft Structures	3	0	0	3	50	50	40
6	Theory	SAEA1403	Low Speed Aerodynamics	3	0	0	3	50	50	41
7	Theory	SAEA1404	Avionics	3	0	0	3	50	50	42
8	Practical	SAEA2401	Aerodynamics Lab	0	0	4	2	50	50	44
9	Practical	SAEA2402	Aircraft Structures Labs - II	0	0	4	2	50	50	45
Total Credits for Semester 4 - 21										
Total Marks for Semester 4 - 800										

L - LECTURE HOURS, T – TUTORIAL HOURS, P – PRACTICAL HOURS, C – CREDITS

CAE – CONTINUOUS ASSESSMENT EXAMINATION

ESE – END SEMESTER EXAMINATION

SEMESTER 5										
Sl. No.	Course Type	Course Code	Course Title	L	T	P	C	Marks		Page No.
								CAE	ESE	
1	Theory	SAEA1501	Aircraft Performance	3	0	0	3	50	50	46
2	Theory	SAEA1502	Aerospace Propulsion	3	0	0	3	50	50	47
3	Theory	SAEA1503	Computational Fluid Dynamics for Aerospace Application	3	0	0	3	50	50	48
4	Theory	SAEA1504	Finite Element Methods for Aircraft Structures	3	0	0	3	50	50	49
5	Theory	SAEA1505	High Speed Aerodynamics	3	0	0	3	50	50	50
6	Theory		Open Elective - I (Humanities)	3	0	0	3	50	50	-
7	Practical	S 19 APT1	Professional Training	0	0	4	2	50	50	-
8	Practical	SAEA2501	Aircraft Systems and Instruments Lab	0	0	4	2	50	50	51
9	Practical	SAEA2502	Propulsion Lab	0	0	4	2	50	50	52
Total Credits for Semester 5 – 24										
Total Marks for Semester 5 – 900										

SEMESTER 6										
Sl. No.	Course Type	Course Code	Course Title	L	T	P	C	Marks		Page No.
								CAE	ESE	
1	Theory	SAEA1601	Aircraft Stability and Control	3	0	0	3	50	50	53
2	Theory	SAEA1602	Theory of Vibration and Aero Elasticity	3	0	0	3	50	50	54
3	Theory		Elective - I	3	0	0	3	50	50	-
4	Theory		Elective - II	3	0	0	3	50	50	-
5	Theory		Open Elective - II	3	0	0	3	50	50	-
6	Practical	SAEA2603	Aircraft Design Project Lab	0	0	4	2	50	50	55
7	Practical	SAEA2604	Aircraft Maintenance and Repair Lab	0	0	4	2	50	50	56
8	Project	S19APT2	Interdisciplinary Project	0	0	6	3	-	100	-
Total Credits for Semester 6 – 22										
Total Marks for Semester 6 – 800										

L - LECTURE HOURS, T – TUTORIAL HOURS, P – PRACTICAL HOURS, C – CREDITS

CAE – CONTINUOUS ASSESSMENT EXAMINATION

ESE – END SEMESTER EXAMINATION

SEMESTER 7										
Sl. No.	Course Type	Course Code	Course Title	L	T	P	C	Marks		Page No.
								CAE	ESE	
1	Theory	SAEA1701	Aircraft Composite Materials and Structures	3	0	0	3	50	50	57
2	Theory	SAEA1702	Unmanned Aerial Vehicle Design	3	0	0	3	50	50	58
3	Theory		Elective - III	3	0	0	3	50	50	-
4	Theory		Elective - IV	3	0	0	3	50	50	-
5	Theory		Open Elective - III	3	0	0	3	50	50	-
6	Practical	SAEA2701	Aircraft Composite Material Testing Lab	0	0	4	2	50	50	59
7	Project	S19APROJ1	Project Work (Phase – I)	0	0	6	3	50	50	-
Total Credits for Semester 7 – 20										
Total Marks for Semester 7 – 700										

SEMESTER 8										
Sl. No.	Course Type	Course Code	Course Title	L	T	P	C	Marks		Page No.
								CAE	ESE	
1	Theory		Elective - V	3	0	0	3	50	50	-
2	Theory		Elective - VI	3	0	0	3	50	50	-
3	Project	S19APROJ2	Project Work (Phase – II)	0	0	14	7	50	50	-
Total Credits for Semester 8 – 13										
Total Marks for Semester 8 – 300										

L - LECTURE HOURS, T – TUTORIAL HOURS, P – PRACTICAL HOURS, C – CREDITS

CAE – CONTINUOUS ASSESSMENT EXAMINATION

ESE – END SEMESTER EXAMINATION

LIST OF ELECTIVES

PROFESSIONAL ELECTIVE COURSES									
Sl. No.	Course Code	Course Title	L	T	P	C	Marks		Page No.
							CAE	ESE	
1	SMEA3001	Additive Manufacturing	3	0	0	3	50	50	53
2	SAEA3001	Theory of Elasticity	3	0	0	3	50	50	54
3	SAEA3002	Aviation Management	3	0	0	3	50	50	55
4	SAEA3003	Airframe Maintenance and Repair Practices	3	0	0	3	50	50	56
5	SAEA3004	Aircraft Design	3	0	0	3	50	50	57
6	SAEA3005	Industrial Aerodynamics	3	0	0	3	50	50	58
7	SAEA3006	Cryogenic Engineering	3	0	0	3	50	50	59
8	SAEA3007	Rocket and Space Mechanics	3	0	0	3	50	50	60
9	SAEA3008	Mechanical Behavior of Aircraft Materials	3	0	0	3	50	50	61
10	SAEA3009	Advanced Flight Dynamics	3	0	0	3	50	50	62
11	SAEA3010	Launch Vehicles and Spacecraft Propulsion	3	0	0	3	50	50	63
12	SAEA3011	Plates and Shells	3	0	0	3	50	50	64
13	SAEA3012	Missile Technology	3	0	0	3	50	50	65
14	SAEA3013	Airport Engineering	3	0	0	3	50	50	66
15	SAEA3014	Boundary layer Theory	3	0	0	3	50	50	67
16	SAEA3015	High Temperature Materials	3	0	0	3	50	50	68
17	SAEA3016	Flight Vehicles' Guidance and Control	3	0	0	3	50	50	69
18	SAEA3017	Manned Space Mission	3	0	0	3	50	50	70
19	SAEA3018	Helicopter Maintenance	3	0	0	3	50	50	71
20	SAEA3019	Orbital Mechanics	3	0	0	3	50	50	72
21	SAEA3020	HEAT TRANSFER TECHNIQUES	3	1	0	4	50	50	73

OPEN ELECTIVE COURSES									
Sl. No.	Course Code	Course Title	L	T	P	C	Marks		Page No.
							CAE	ESE	
1	SALA4001	Intellectual Property Law	3	0	0	3	50	50	A1
2	SAEA4002	Fundamentals of Aerospace Technology	3	0	0	3	50	50	A2
3	SBAA4001	Fundamentals of Management	3	0	0	3	50	50	A3
4	SBAA4002	Principles of Management and Professional Ethics	3	0	0	3	50	50	A4
5	SBTA4001	Biology for Engineers	3	0	0	3	50	50	A5
6	SBMA4001	Neurology	3	0	0	3	50	50	A6
7	SBMA4002	Modelling of Physiological Systems	3	0	0	3	50	50	A7
8	SBMA4003	Drug Delivery System	3	0	0	3	50	50	A8
9	SBMA4004	Fundamentals of Mechatronics	3	0	0	3	50	50	A9
10	SBMA4005	Virtuality and Augmented Reality	3	0	0	3	50	50	A10
11	SBMA4006	Medical Optics and Laser Applications	3	0	0	3	50	50	A11
12	SBMA4007	Forensic Science	3	0	0	3	50	50	A12
13	SBMA4008	Artificial Intelligence and Expert Systems	3	0	0	3	50	50	A13
14	SBMA4009	Human Factors in Engineering and Design	3	0	0	3	50	50	A14
15	SCHA4001	Corrosion Engineering	3	0	0	3	50	50	A15
16	SCHA4002	Energy Engineering	3	0	0	3	50	50	A16
17	SCHA4003	Environmental Impact Assessment	3	0	0	3	50	50	A17
18	SCHA4004	Environmental Pollution and Control	3	0	0	3	50	50	A18
19	SCIA4001	Disaster Management	3	0	0	3	50	50	A19
20	SCSA4001	R Programming	3	0	0	3	50	50	A20
21	SCSA4002	5 G Networks	3	0	0	3	50	50	A21
22	SECA4001	Software Tools for Engineering Applications	3	0	0	3	50	50	A22
23	SMEA4001	Resource Management Techniques	3	0	0	3	50	50	A23
24	SMEA4002	Wind and Solar Energy	3	0	0	3	50	50	A24

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CAE – CONTINUOUS ASSESSMENT EXAMINATION,

ESE – END SEMESTER EXAMINATION

Semester	Theory Courses (including elective courses)			Practical Courses (including PT and project)		
	Total no.	Total Credits	Total Marks	Total no.	Total Credits	Total Marks
1	6	16	500	3	5	250
2	6	19	600	2	3	150
3	6	18	600	2	4	200
4	6	17	600	2	4	200
5	6	18	600	3	6	300
6	5	15	500	3	7	300
7	5	15	500	2	5	200
8	2	6	200	1	7	100
Overall Total	42	124	4100	17	41	1700

Overall total credits for B.E Aeronautical Engineering	165
Overall total marks for B.E Aeronautical Engineering	5800

SAEA1303	AIRCRAFT SYSTEMS AND INSTRUMENTS	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 - Describe the basic concepts of various hydraulic and pneumatic systems components in aircraft.
- CO2 - Recognize various types of Aircraft instruments.
- CO3 - Understanding the basics of various fuel and pressurizing system.
- CO4 - Understanding the working principle of Modern Flight Control Systems.
- CO5 - Understanding gyroscopic instruments in aircraft production.
- CO6 - Understanding the Flight Instrument and Navigation Instruments used in aircraft Production.

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
5. General Hand Books of Airframe and Power plant Mechanics", U.S. Dept. of Transportation, Federal Aviation Administration, .the English Book Store, New Delhi, 1995.

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 grid, 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 - Recall history and evolution of computational fluid dynamics.
- CO2 - Compare the mathematical modeling and numerical methods.
- CO3 - Understand the working methodology of various computational fluid methods.
- CO4 - Recognize the various functions of major turbulence models.
- CO5 - Analyze the quality of structural grids and suitable shapes and methods for it.
- CO6 - Distinguish the problems application based.

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.

PRACTICAL SAEA2603	AIRCRAFT DESIGN PROJECT LAB	L	T	P	Credits	Total Marks
		0	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.

SAEA2602	AIRCRAFT MAINTENANCE AND REPAIR LAB	L	T	P	Credits	Total 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 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 the 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.

SAEA1702	UNMANNED AERIAL VEHICLE DESIGN	L	T	P	Credits	Total 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 - Understand the working principles of Unmanned Aerial Vehicle.
- CO2 - Comprehend the sound foundation in the Aerodynamics and Airframe characteristics. CO3 - Learn the operation of Avionics Hardware.
- CO4 - Understand the concept of Communication payloads.
- CO5 - Understand the principle and performance of control and navigation. CO6 - Applying the importance of Digital image processing 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.
7. Skafidas, "Microcontroller Systems for a UAV", KTH, TRITA-FYS 2002:51 ISSN 0280-316 X.34, 2002.
8. Kimon P. Valavanis, "Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy", Springer, 2007.

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

COURSE OBJECTIVES

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

UNIT 1 VISCOUS FLOW EQUATIONS

9 Hrs.

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

UNIT 2 LAMINAR BOUNDARY LAYER

9 Hrs.

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

UNIT 3 TURBULENT BOUNDARY LAYER

9 Hrs.

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

UNIT 4 APPROXIMATE SOLUTION TO BOUNDARY LAYER EQUATIONS

9 Hrs.

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

UNIT 5 THERMAL BOUNDARY LAYER

9 Hrs.

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

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Apply the basic fundamentals of Different types of Boundary layer thickness.
- CO2 - Analyze the behavior of the fluid flow under static condition.
- CO3 - Understand the basics of Different types of flow such as Laminar, turbulent and compressible flow, Incompressible flow, Viscid and Inviscid flow.
- CO4 - Basics of Boundary layer Control.
- CO5 - Flow through pipe of different types of flow.
- CO6 - Importance of non-dimensional numbers.

TEXT / REFERENCE BOOKS

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

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

COURSE OBJECTIVES

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

UNIT 1 CREEP

9 Hrs.

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

UNIT 2 DESIGN FOR CREEP RESISTANCE

9 Hrs.

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

UNIT 3 FRACTURE

9 Hrs.

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

UNIT 4 OXIDATION AND HOT CORROSION

9 Hrs.

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

UNIT 5 SUPERALLOYS AND OTHER MATERIALS

9 Hrs.

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

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, students will be able to

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

TEXT /REFERENCE BOOKS

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

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

COURSE OBJECTIVES

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

UNIT 1 GUIDANCE

9 Hrs.

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

UNIT 2 FLIGHTVECHICE'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		T	P	Credits	Total Marks
			0	0	3	100

COURSE OBJECTIVES

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

UNIT 1 FUNDAMENTALS OF SPACE MISSIONS

9 Hrs.

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

UNIT 2 SPACE VS EARTH ENVIRONMENT

9 Hrs.

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

UNIT 3 LIFE SUPPORT SYSTEMS AND COUNTERMEASURES

9 Hrs.

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

UNIT 4 MISSION LOGISTICS AND PLANNING

9 Hrs.

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

UNIT 5 SUBSYSTEMS

9 Hrs.

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

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

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

TEXT / REFERENCE BOOKS

1. Larson, W. J. and Pranke, L. K., Human Spaceflight: Mission Analysis and Design, McGraw-Hill Higher Education, Washington, DC, 1999
2. McNamara, Bernard. 2010.
2. Into the Final Frontier: The Human Exploration of Space (Brooks/Cole Publishing), 2012.
3. Larson, W. J. and Pranke, L. K., Human Spaceflight: Mission Analysis and Design, McGraw-Hill Higher Education, Washington, DC, 1999
- 2 McNamara, Bernard. 2013.
4. Into the Final Frontier: The Human Exploration of Space, 2012.
5. 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.

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 shaper 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

B.E. AERONAUTICAL ENGINEERING REGULATIONS- 2015 CURRICULAM

SEMESTER 1

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C	PAGE No.
THEORY							
1.	SHS1101	English for Science and Technology /					1
	SCH1101	Environmental Science and Engineering	3	0	0	3	10
2.	SMT1101	Engineering Mathematics – I	3	1	0	4	2
3.	SPH1101	Physics of Engineering Materials	3	0	0	3	3
4.	SCY1101	Engineering Chemistry	3	0	0	3	4
5.	SME1101	Engineering Mechanics	3	1	0	4	5
6.	SAE1101	Fundamentals of Aeronautical Engineering	3	0	0	3	6
PRACTICAL							
7.	SPH4051	Engineering Physics Lab	0	0	2	1	7
8.	SCY4051	Engineering Chemistry Lab	0	0	2	1	8
9.	SME4051	Engineering Graphics – I	1	0	2	2	9
TOTAL CREDITS							24

SEMESTER 2

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C	PAGE No.
THEORY							
1.	SHS1101	English for Science and Technology/					1
	SCH1101	Environmental Science and Engineering	3	0	0	3	10
2.	SMT1105	Engineering Mathematics – II	3	1	0	4	11
3.	SPH1102	Physics for Electronics Devices					13
	SPH1103	Engineering Physics /					12
	SPH1 104	Applied Biophysics	3	0	0	3	14
4.	SCY1102	Chemistry of Electronic Materials					15
	SCY1103	Chemistry of Industrial Materials					16
	SCY1104	Bio-organic Chemistry					17
	SCY1105	Physical Chemistry	3	0	0	3	18
5.	SCS1102	Fundamentals of programming /					19
	SCS1202	Object Oriented Programming	3	0	0	3	20
6.	SAE1102	Aircraft Production Techniques	3	0	0	3	21
PRACTICAL							
7.	SCS4101	Programming in C Lab	0	0	4	2	22
8.	SAE4051	Aircraft Production Technology Lab	0	0	4	2	23
TOTAL CREDITS							23

L - LECTURE HOURS, T – TUTORIAL HOURS, P – PRACTICAL HOURS, C – CREDITS

SEMESTER 3

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C	PAGE No.
THEORY							
1	SMT1201	Engineering Mathematics – III	3	1	0	4	24
2	SME1206	Dynamics of Machinery	3	1	0	4	25
3	SAE1201	Avionics	3	0	0	3	26
4	SAE1202	Aircraft Electrical and Electronics Systems	3	0	0	3	27
5	SAE1203	Introduction to Aerodynamics	3	1	0	4	28
6	SAE1204	Introduction to Aircraft Structures	3	1	0	4	29
PRACTICAL							
7.	SME4054	Fluid Mechanics and Machinery Lab	0	0	4	2	30
8.	SAE4052	Aircraft Structures Lab	0	0	4	2	31
TOTAL CREDITS							26

SEMESTER 4

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C	PAGE No.
THEORY							
1	SMT1204	Engineering Mathematics – IV /					32
	SMT1206	Number Theory and Linear Algebra /					33
	SMT1207	Graph Theory /					34
	SMT1208	Applied Statistics/					35
	SMT1209	Foundations of Mathematics	3	1	0	4	36
2	SME1201	Engineering Thermodynamics	2	1	0	3	37
3	SAE1205	Aerodynamics - I	3	1	0	4	38
4	SAE1206	Aircraft Control Engineering	2	1	0	3	39
5	SAE1207	Aircraft Systems and Instruments	3	0	0	3	40
6	SAE1208	Aircraft Performance	2	1	0	3	41
PRACTICAL							
7	SAE4053	Aircraft Component Design and Drawing Lab	0	0	4	2	42
8	SAE4054	Aerodynamics Lab	0	0	4	2	43
9	S26PT1	Professional Training - 1	0	0	10	5	44
TOTAL CREDITS							29

SEMESTER 5

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C	PAGE No.
THEORY							
1.	SME1306	Theory of Vibrations	3	0	0	3	45
2.	SAE1301	Aerodynamics – II	3	1	0	4	46
3.	SAE1302	Aircraft Propulsion	3	0	0	3	47
4.	SAE1303	Aircraft Structures	3	1	0	4	48
5.	SAE1304	Aircraft Stability and Control	3	1	0	4	49
6.	SAE1305	Experimental Aerodynamics	3	0	0	3	50

PRACTICAL

SEMESTER 8								
Sl. No.	COURSE CODE	COURSE TITLE	L T P C				PAGE No.	
THEORY								
1	SBA1101	Principles of Management and Professional Ethics	3	0	0	3	65	
2	SAE1403	Aviation Management	3	0	0	3	66	
3		Elective - 4	3	0	0	3		
B.E. / B.Tech		xxv	REGULATIONS					

4

S26PROJ

Project Work (Phase -
1 & 2)

0 0 30 15

TOTAL CREDITS 24

TOTAL CREDITS FOR THE PROGRAMME 195

ELECTIVE COURSES (GROUP A)

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C	PAGE No.
1	SME1607	Computational Fluid Dynamics	3	0	0	3	67
2	SME1614	Experimental Stress Analysis	3	0	0	3	68
3	SME1620	Theory of Elasticity	3	0	0	3	69
4	SAE1601	Advanced Flight Dynamics	3	0	0	3	71
5	SAE1602	Aero Elasticity	3	0	0	3	72
6	SAE1607	Hypersonic Aerodynamics	3	0	0	3	73
7	SAE1608	Helicopter Aerodynamics	3	0	0	3	74
8	SAE1610	Industrial Aerodynamics	3	0	0	3	75
9	SAE1613	Plates and Shells	3	0	0	3	76
10	SAE1616	Mechanical Behavior of Aircraft Materials	3	0	0	3	77

**ELECTIVE COURSES
(GROUP B)**

1	SME1609	Cryogenic Engineering	3	0	0	3	70
2	SAE1603	Airframe Maintenance and Repair Practices	3	0	0	3	78
3	SAE1604	Airline Operations and Management	3	0	0	3	79
4	SAE1605	Airport Engineering	3	0	0	3	80
5	SAE1606	Civil Aircraft Rules and Regulations	3	0	0	3	81
6	SAE1609	Helicopter Maintenance	3	0	0	3	82
7	SAE1611	Launch Vehicles and Spacecraft Propulsion	3	0	0	3	83
8	SAE1612	Missile Technology	3	0	0	3	84
9	SAE1614	Spacecraft Technology	3	0	0	3	85
10	SAE1615	UAV System Design	3	0	0	3	86

SAE1308	AIRCRAFT DESIGN	L	T	P	Credits	Total Marks
	(For Aeronautical)	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

10 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.
- Lebedenski A.A, "Notes on airplane design", Part-I, I.I.Sc., Bangalore

SAE1605	AIRPORT ENGINEERING	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

To know about the airport planning, airport design and air traffic control

COURSE OUTCOMES

CO1: Describes the structure of the Airport and its infrastructure coming under AAI and IAAI.

CO2: Construct the Airport infrastructure as per FAA and ICAO standards.

CO3: Design of the airport terminal infrastructure as per FAA Pavement design methods and joints in cement concrete pavements.

CO4: Design of the runway lightning, marking centerline and sign operation for aircraft taxiway guidance system.

CO5: Develop the Air Traffic Control by Network control method in airports for landing the aircrafts in touch down point.

CO6: Develop the Air Traffic Control by Tower control Flight service station for landing and takeoff the aircrafts.

UNIT 1 INTRODUCTION

10 Hrs.

Significance of Air Transport -Economic Significance - History of Aviation - Air Transportation in India – Indian Airlines Corporation - Air India - International Corporation - International – Airport Authority of India - (IAAI) – Civil Aviation – Open Sky Policy – Airport Terminology - Component Parts of Airplane – Characteristics of The Jet Aircraft – Civil and Military Aircrafts Classification of Aerodromes. Classification Of Airports – Flying Activities - Aircraft Characteristics - Dimensional Standards - Landing Gear Configurations - Aircraft Weight - Engine Types - Wind Speed And Direction - Payload And Range -Runway Performance - Air Traffic Management - Flight Service Stations - Airspace Classifications And Airways - Area Navigation - Air Traffic Separation Rules - Longitudinal Separation - Lateral Separation In The Airspace - Navigational Aids - Ground-Based Systems

UNIT 2 AIRPORT PLANNING

10 Hrs.

The Airport System Plan - Master Plan - Project Plan - Continuing Planning Process - Levels Of Forecasting - Forecasting Methods - Time Series Method - Market Share Method - Econometric Modeling - Airport Design Standards – ICAO Standards - FAA Standards - Airport – Surveys –types Of Surveys - drawings - Capacity – Improving –Traffic Forecast – Planning – Airport Site Selection – Different Conditions - Zoning Laws – Airport Architecture - Environmental- Factors - Runway Orientation - Head Wind, - Cross Wind - Component- Wind rose – Runway Length – Corrections - Geometric Design Of Runways - Balanced Field - Concept - Airport Capacity – Runway – Patterns- Runway Types - Geometric Design Of Runway Intersection – Layout Of Taxiways Arrangement, Geometric Standards For Taxiway - Gradient - Exit Taxiways Air Traffic Control – Angle Of Turn, Compound Curve - Occupancy Time – Shape Of Taxiway – Loading Aprons – Holding Aprons - Configuration - Entry Runway - Holding Bays - Location – Peak Demands – Simple Problems - Capacity And Delay - Formulation Of Runway Capacity Through - Formulation Of Ultimate Capacity - Hourly Capacity -Parameters Required For Runway Capacity - Computation Of Delay On Runway Systems -Graphical Methods For Approximating - Simulation Models - Gate Capacity - Analytical Models For Gate Capacity.

UNIT 3 TERMINAL AREA DESIGN

9 Hrs.

Terminal Building Design Objectives – Passenger Flow – Parking – Size Of Apron – Hangars - Jet Blast – Typical Airport Layouts-Military Layouts – Types Of Pavements – Design Factors – Design Of Flexible, Rigid Pavements – LCN Method – Pavement failures – Maintenance ,Evaluation Of Airport Pavements – The CBR test - The Plate Bearing Test - Young's Modulus (E Value) - Effect Of Frost On Soil Strength -Subgrade Stabilization - FAA Pavement Design Methods –Aircrafts-Pavement Classification – Joints In Cement Concrete Pavements - Pumping – Design –Pavements – Drainage – Importance Of Grading –Basic Requirements Of Airport Drainage- Surface Drainage – Design Procedure – Subsurface Drainage – Types Of Pipes

UNIT 4 AIRPORT LIGHTING, MARKING, AND SIGNAGE

8 Hrs.

The Requirements For Visual Aids - The Airport Beacon - The Aircraft Landing Operation - Alignment Guidance - Height Information - Approach Lighting -Visual Approach Slope Aids - Visual Approach Slope Indicator Precision Approach Path - Threshold Lighting - Runway Lighting - Runway Edge Lights - Runway Centerline And Touchdown Zone Lights - Runway Stop Bar - Runways - Runway Designators -Runway Threshold Markings – Different Types Of Markings - Taxiway Guidance Sign System - Signing Conventions - SignOperation

UNIT 5 AIR TRAFFIC CONTROL

8 Hrs.

Importance – Air Traffic Control – Flight Rules - Meaning,- Responsibility – Type Of Control – Air Traffic Control Network –Control - Towers – Flight Service Stations - Air Traffic Control Aids — GPS Air Traffic Control-Free Flight Types - Heliports- Stolports – Planning Of Heliport Ports – Characteristics of Stolports- Planning of StolPorts

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Airport Engineering ,Rangwala , Charotar Publishing House Pvt. Ltd . Anand 388 001 India , 14th Edition ,2014
2. Planning And Design Of Airports, Fifth Edition Robert Horonjeff, Francis Mckelvey, William Sproule, Seth Young ,McGraw Hill Pvt Ltd, New Delhi, 2013
3. Airport Engineering: Planning, Design And Development Of Development Of 21st Century Airports, Norman J. Ashford, Saleh Mumayiz, Paul H. Wright - 2011 - 4th Edition,
4. Airport Planning &Design ,S. K. Khanna, M. G. Arora , NemChand Publishers ,New Delhi ,1999

SAE1606	CIVIL AIRCRAFT RULES AND REGULATIONS	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

B.E. AERONAUTICAL ENGINEERING REGULATIONS-2010-CURRICULAM

SEMESTER I

Sl. No.	SUBJECT CODE	SUBJECT TITLE	L	T	P	C	Page No.
THEORY							
1	SMTX 1001	Engineering Mathematics – I	3	1	0	4	1
2	SCHX 1001	Environmental Science & Engineering	3	0	0	3	2
3	SPHX 1001	Physics of Materials	3	0	0	3	3
4	SCYX 1001	Engineering Chemistry	3	0	0	3	4
5	SCSX 1002	Programming in C	3	0	0	3	5
6	SMEX 1001	Engineering Graphics	2	1	0	3	6
7	SMEX 1002	Engineering Mechanics	2	1	0	3	7
PRACTICALS							
8	SCSX 4002	Programming in C Lab	0	0	4	2	8
9	SPR 4002	CAD Lab – I	0	0	4	2	8
TOTAL CREDITS						26	

SEMESTER II

Sl. No.	SUBJECT CODE	SUBJECT TITLE	L	T	P	C	Page No.
THEORY							
1	SMTX 1002	Engineering Mathematics – II	3	1	0	4	9
2	SHSX 1001	English For Science & Technology	3	0	0	3	10
3	SPHX 1002	Applied Physics	3	0	0	3	11
4	SCYX 1003	Chemistry of Industrial Materials	3	0	0	3	12
5	SCSX 1003	Programming in C++	3	0	0	3	13
6	SEEX 1002	Basic Electrical & Electronics Engineering	2	1	0	3	14
7	SAEX 1001	Aircraft Production Techniques	3	0	0	3	15
PRACTICALS							
8	SPRX4007	Production Technology Lab - I	0	0	4	2	16
9	SCSX4007	Programming in C++ Lab	0	0	4	2	16
TOTAL CREDITS						26	

L - Lecture hours; T - Tutorial hours; P - Practical hours; C - Credits

SEMESTER III

SI. No.	SUBJECT CODE	SUBJECT TITLE	L	T	P	C	Page No.
THEORY							
1	SMTX 1009	Engineering Mathematics – III	3	1	0	4	17
2	SMEX 1004	Engineering Thermodynamics	3	0	0	3	18
3	SMEX 1005	Fluid Mechanics & Machinery	3	0	0	3	19
4	SAEX 1002	Solid Mechanics	3	0	0	3	20
5	SMEX 1007	Machine Drawing	3	0	0	3	21
6	SAEX 1003	Introduction to Aeronautics	3	0	0	3	22
7	SAEX 1004	Mechatronics & Microprocessors	3	0	0	3	23
PRACTICALS							
8	SAEX 4001	Aero CAD Lab - I	0	0	4	2	24
9	SPRX 4003	Strength of Materials Lab	0	0	2	1	24
10	SPRX 4004	Fluid Mechanics & Machinery Lab	0	0	2	1	24
TOTAL CREDITS						26	

SEMESTER IV

SI. No.	SUBJECT CODE	SUBJECT TITLE	L	T	P	C	Page No.
THEORY							
1	SMTX 1010	Engineering Mathematics – IV	3	1	0	4	25
2	SAEX 1005	Modern Avionics	3	0	0	3	26
3	SPRX 1005	Mechanics of Machines	3	1	0	4	27
4	SAEX 1006	Aerodynamics	3	0	0	3	28
5	SAEX 1007	Aircraft Structures – I	2	1	0	3	29
6	SAEX 1008	Aircraft Systems & Instruments	3	0	0	3	30
PRACTICALS							
7	SAEX 4002	Aerodynamics Lab	0	0	4	2	31
8	SAEX 4003	Avionics Lab	0	0	2	1	31
9	SAEX 4004	Aero Modeling Lab	0	0	2	1	31
TOTAL CREDITS						24	

SEMESTER V

Sl. No.	SUBJECT CODE	SUBJECT TITLE	L	T	P	C	Page No.
THEORY							
1	SMTX 1011	Applied Numerical Methods	3	1	0	4	32
2	SAEX 1009	Supersonic Aerodynamics	3	0	0	3	33
3	SAEX 1010	Aircraft Structures – II	3	1	0	4	34
4	SAEX 1011	Experimental Stress Analysis	3	0	0	3	35
5	SAEX 1012	Aircraft Performance	3	0	0	3	36
6	SAEX 1013	Airframe Maintenance and Repair Practices	3	0	0	3	37
7	SAEX 1014	Control Systems for Aircraft	3	0	0	3	38
PRACTICALS							
8	SAEX 4005	Aircraft Structures – lab	0	0	4	2	39
9	SAEX 4006	Computation Lab	0	0	2	1	39
10	SAEX 4007	Aircraft Systems Lab	0	0	2	1	39
TOTAL CREDITS						27	

SEMESTER VI

Sl. No.	SUBJECT CODE	SUBJECT TITLE	L	T	P	C	Page No.
THEORY							
1	SMEX 1017	Resource Management Techniques	3	0	0	3	40
2	SAEX 1015	Aircraft Stability and Control	3	0	0	3	41
3	SAEX 1016	Propulsion – I	3	0	0	3	42
4	SAEX 1017	Finite Element Methods	3	1	0	4	43
5		Elective I	3	0	0	3	
6		Elective II	3	0	0	3	
PRACTICALS							
8	SAEX 4008	Aircraft Structural Repair & Practice Lab	0	0	4	2	44
9	SAEX 4009	Propulsion Lab	0	0	4	2	44
TOTAL CREDITS						23	

SEMESTER VII

SI. No.	SUBJECT CODE	SUBJECT TITLE	L	T	P	C	Page No.
THEORY							
	SBAX 1001	Principles of Management & Professional Ethics	3	0	0	3	45
	SMEX 1018	Heat and Mass Transfer	3	1	0	4	46
	SAEX 1018	Propulsion – II	3	0	0	3	47
	SAEX 1019	Theory of Vibrations	3	1	0	4	48
		Elective – III	3	0	0	3	
		Elective – IV	3	0	0	3	
PRACTICALS							
	SAEX 4010	Aircraft Design Project	0	0	4	2	44
TOTAL CREDITS						22	

SEMESTER VIII

SI. No.	SUBJECT CODE	SUBJECT TITLE	L	T	P	C	Page No.
THEORY							
	SAEX 1020	Aircraft Composite Materials	3	0	0	3	49
	SAEX 1021	Rockets and Missiles	3	0	0	3	50
	SAEX 1022	Aircraft Engine Maintenance & Repair Practices	3	0	0	3	51
PRACTICALS							
	SAEX 4011	Composite Structures Lab	0	0	2	1	52
	SAEX 4012	Aircraft Engine Repair and Maintenance Lab	0	0	2	1	52
	S26X PROJ	Project Work & Viva Voce	0	0	30	15	52
TOTAL CREDITS						26	
TOTAL CREDITS FOR THE COURSE						200	

LIST OF ELECTIVES

Note: ONE SUBJECT IS TO BE CHOSEN FROM EACH GROUP COMPULSORILY

Sl. No.	SUBJECT CODE	SUBJECT TITLE	L	T	P	C	Page No.
Group I: AERODYNAMICS							
1	SAEX 1023	Computational Fluid Dynamics	3	0	0	3	53
2	SAEX 1024	Wind Tunnel Techniques	3	0	0	3	54
3	SAEX 1025	Aircraft Design	3	0	0	3	55
4	SAEX 1026	Helicopter Aerodynamics	3	0	0	3	56
5	SAEX 1027	Advanced Flight Dynamics	3	0	0	3	57
Group II: AIRCRAFT MAINTENANCE							
6	SAEX 1028	Helicopter Maintenance	3	0	0	3	58
7	SAEX 1029	Air Transportation and Aircraft Maintenance	3	0	0	3	59
8	SAEX 1030	Aircraft Rules and Regulations	3	0	0	3	60
9	SAEX 1031	Airline Operations and Management	3	0	0	3	61
10	SAEX 1032	Aircraft Maintenance Management	3	0	0	3	62
Group III: AIRCRAFT STRUCTURES							
11	SAEX 1033	Computer Aided Design and Analysis	3	0	0	3	63
12	SAEX 1034	Aircraft Materials	3	0	0	3	64
13	SAEX 1035	Aeroelasticity	3	0	0	3	65
Group IV: AVIONICS AND AEROSPACE							
14	SAEX 1036	Advanced Control System Design for Aerospace Vehicles	3	0	0	3	66
15	SAEX 1037	Aircraft Navigation, Guidance and Control	3	0	0	3	67
16	SAEX 1038	Flight Control Systems Design	3	0	0	3	68
17	SAEX 1039	Unmanned Aircraft Systems	3	0	0	3	69
18	SAEX 1040	Robotics Engineering	3	0	0	3	70
19	SAEX 1041	Cryogenics	3	0	0	3	71
20	SAEX 1042	Spacecraft Technology	3	0	0	3	72
21	SAEX 1043	Launch Vehicles and Spacecraft Propulsion	3	0	0	3	73
22	SAEX1044	Orbital Mechanics	3	0	0	3	74

SAEX4001	AERO CAD LAB - I	L	T	P	Credits	Total Marks
		0	0	4	2	100

Using any Softwares like PRO/E, CATIA, Solid Works, ANSYS, MSC / Nastran

1. *Modeling of various components using any modeling 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*

SAEX4004	AERO MODELLING LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

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

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.

SAEX1036	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
7. Shankar Sastry, Nonlinear systems: analysis, stability, and control, Springer, 1999

SAEX1029	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.

SAEX1038	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.

REFERENCE:

1. Siouris, G.M. "Missile Guidance and control systems", Springer, 2003.
 2. Fleeman, Eugene L.; Tactical Missile Design, First Edition, AIAA Education series, 2001.
- Roskam, Jan; Airplane flight dynamic and Automatic flight control, 3th Printing, Design, Analysis and Research Corporation, 2001.

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.

SUGGESTED 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

1. Spur gears

Shaping machine

1. Key way & Angular cutting

Radial Drilling Machine

1. Drilling and Taping

Grinding Machine

Cylinder grinding

SAE1604	AIRLINE OPERATIONS AND MANAGEMENT	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–TransportasaFactorof Production– InternationalTransportation–Importanceof 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.

2. Massoud Bazargan, Airline operations and scheduling, Ashgate Publishing Limited, Hampshire, England, 2008.

3. Alexander T. Wells, Seth B. Young, Airport planning & management, McGraw-Hill, 2004.

4. 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.