Department of Aerospace Engineering

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PERIYAR MANIAMMAI UNIVERSITY

VISION

- To be a University of global dynamism with excellence in knowledge and innovation ensuring social responsibility for creating an egalitarian society.

MISSION

- **UM1 :** Offering well balanced programmes with scholarly faculty and state-of-art facilities to impart high level of knowledge.
- **UM2:** Providing student - centered education and foster their growth in critical thinking, creativity, entrepreneurship, problem solving and collaborative work.
- **UM3:** Involving progressive and meaningful research with concern for sustainable development.
- **UM4:** Enabling the students to acquire the skills for global competencies.
- **UM5:** Inculcating Universal values, Self respect, Gender equality, Dignity and Ethics.
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CORE VALUES

- Student – centric vocation
- Academic excellence
- Social Justice, gender justice, equity, and equality.
- Skills and use of technology for global competency.
- Continual improvement
- Leadership qualities.
- Societal needs towards sustainability
- Learning, a life – long process
- Team work
- Entrepreneurship for all
- Rural development
- Basic, Societal, and applied research on Energy, Environment, and Empowerment.

DEPARTMENT OF AEROSPACE ENGINEERING

VISION

- To be Preeminent in Aerospace Engineering education by instilling a sense of responsibility for ethical practice and of concern for the environment and adapting to changes in societal needs thereby leading the wider Aerospace community with advances in the sub-disciplines in which we concentrate.

MISSION

- **DM 1:**Providing capable, motivated, and well-prepared students with highquality, that will enable them to reach their maximum potential in a technical world.
- **DM 2:**Significantly advance in knowledge, its application & integration in Aerospace and Aeronautical related disciplines.
- **DM 3:**Involve in research and development with advanced tools and techniques keeping eco-friendly and sustainability.
- **DM 4:**Serving the larger community by inculcating universal values and ethics through innovative projects.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO1: The graduates of the Program will be Successful professionals as aerospace engineers, experts in aerospace domain and allied industries.

PEO2: Graduates shall apply the acquired engineering knowledge to benefit the mankind by following ethical practices.

PEO3: The graduates of the Program will be able to critically analyze and carry out innovative and independent research.

PEO4: The graduates of the Program will be able to inculcate lifelong learning to cope with changing technologies.

PEO5: The graduates of the Program will be able to work towards the Nation development through imparting knowledge and skill.

MAPPING OF DEPARTMENT MISSION WITH UNIVERSITY MISSION

DM vs UM	UM1	UM2	UM3	UM4	UM5	Tot	Scaled to 0,1,2 and 3
DM1	**3**	**3**	**1**	**3**	**1**	**11**	**3**
DM2	**1**	**2**	**3**	**2**	**3**	**11**	**3**
DM3	**1**	**1**	**3**	**2**	**2**	**9**	**2**
DM4	**0**	**1**	**2**	**0**	**3**	**6**	**2**

GRADUATE ATTRIBUTES

1. **Knowledge base for Engineering:** Demonstrate competence in mathematics, natural sciences, engineering fundamentals and specialized engineering knowledge appropriate to the program.

2. **Problem Analysis :** Identify, formulate, analyze and solve diverse engineering problems.

3. **Design:** Solution for complicated open–ended engineering problems and design the components with appropriate standards to meet specified needs with proper attention to public health, safety, environment and society.

4. **Experimental Investigation:** Technical skills to conduct investigation, interpretation of observed data and provide solution for multifaceted problems.

5. **Modern Engineering tools usage**: Acquire, select, manipulate relevant techniques, resources and advanced engineering ICT tools to operate simple to complex engineering activities.

6. **Impact of engineering on society:** Provide a product / project for use by the public towards their health, welfare, safety and legal issues to serve the society effectively.

7. **Environment and Sustainability:** Design eco-friendly and sustainable products in demonstrating the technology development to meet present and future needs.

8. **High Ethical Standards:** Practice ethical codes and standards endorsed by professional engineers.

9. **Leadership and team work:** Perform as an individual and as a leader in diverse teams and in multi-disciplinary scenarios.

10. **Communication Skills:** Professional communication with the society to comprehend and formulate reports, documentation, effective delivery of presentation and responsible to clear instructions.

11. P**roject management and Finance:** Appropriate in incorporating finance and business practices including project, risk and change management in the practice of engineering by understanding their limitations.

12. **Life-long learners:** Update the technical needs in a challenging world in equipping themselves to maintain their competence.

PROGRAMMME OUTCOMES (POs)

PO	PROGRAMME OUTCOMES	GRADUATE ATTRIBUTES
PO_1	Apply the basic concepts of mathematics, science and Engineering in both Aerospace and other disciplines wherever it is required.	**Engineering knowledge**
PO_2	Proficient to analyze both technical and non technical problems in different perspective with full concentration and effort.	**Problem analysis**
PO_3	Design and develop creative smart solutions for various applications.	**Design / development of solutions**
PO_4	Investigate the situation and act accordingly to solve the complex & real time Engineering problems.	**Conduct investigations of complex problems**

PO_5	Utilize the most advanced modeling and Analysis software to design and Analyze fluid, structural, thermal, magnetic and aerospace related problems, which would save money, man power and time.	**Modern tool usage**
PO_6	Undertaking research projects by applying structural, material, propulsion and aerodynamic knowledge which would be practically useful for the societal needs.	**The engineer & society**
PO_7	Apply Engineering knowledge to develop innovative concepts for the business sustainability without exploiting the nature and the environment.	**Environment & sustainability**
PO_8	Show Professional ethics & responsibility in profession without any compromise in the rules & practices of working environment.	**Ethics**
PO_9	Capable to work as individual and as a team wherever it is required and depending upon the situation to expose their skill & knowledge in the competitive world.	**Individual & team work**
PO_{10}	Communicate effectively with international clients as user friendly and able to prepare and maintain records, files & documents upto the industry needs.	**Communication**
PO_{11}	Manage finance, variable technical and non technical projects in different working environment.	**Project management & finance**
PO_{12}	Engage in lifelong learning for the self improvement for the survival of the fittest.	**Lifelong learning**
PSO_1	Apply automation and control techniques for aerospace applications	
PSO_2	Analyze and apply aerodynamics and propulsion related aspects in Aerospace Engineering.	

MAPPING 'GAs' WITH 'POs'

PO vs GA	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO_{10}	PO_{11}	PO_{12}	PSO 1	PSO 2
GA_1	3													
GA_2		3												
GA_3			3										3	
GA_4				3										
GA_5					3									2
GA_6						3								1
GA_7							3							
GA_8								3						
GA_9									3					
GA_{10}										3				
GA_{11}											3			
GA_{12}												3		

B.TECH AEROSPACE ENGINEERING

CURRICULUM

Regulation 2015 Rev 1

SEMESTER I

S.No	SUBJECT CODE	SUBJECT NAME	L	T	P	C	H
1.	XMA101	Algebra, Differential Calculus and their applications	3	1	0	4	5
2.	XEM102	Engineering Mechanics	3	1	0	4	5
3.	XBE103	Electrical and Electronics Engineering Systems	3	1	1	5	7
4.	XAP104	Applied Physics	3	1	1	5	7
5.	XGS105	Study Skills	1	0	0	1	3
6.	XUM106	Human Ethics, Values, Rights and Gender Equality	1	0	0	1	3
		TOTAL	**14**	**4**	**2**	**20**	**30**

SEMESTER II

S.No	SUBJECT CODE	SUBJECT NAME	L	T	P	C	H
1.	XMA201	Calculus and Laplace Transforms	3	1	0	4	5
2.	XCP202	Computer Programming	3	0	1	4	5
3.	XBW203	Mechanical and Civil Engineering Systems	3	1	1	5	7
4.	XAC204	Applied Chemistry	3	1	1	5	7
5.	XEG205	Engineering Graphics	2	0	1	3	4
6.	XGS206	Speech Communication	1	0	0	1	3
		TOTAL	**15**	**3**	**4**	**22**	**31**

SEMESTER III

S.No	SUBJECT CODE	SUBJECT NAME	L	T	P	C	H
1.	XMA301	Transforms and Partial Differential Equations	3	1	0	4	5
2.	XAS302	Engineering Thermodynamics	3	1	0	4	5
3.	XAS303	Strength of Materials	2	1	1	4	5
4.	XAS304	Fluid Mechanics and Machinery	3	1	1	5	7
5.	XES305	Engineering Materials	3	0	0	3	3
6.	XEP306	Entrepreneurship Development	2	0	0	2	3
7.	XGS307	Interpersonal Communication	0	0	0	0	2
8.	XAS308	In-Plant Training - I	0	0	0	1	0
		TOTAL	**16**	**4**	**2**	**23**	**30**

SEMESTER IV

S.No	SUBJECT CODE	SUBJECT NAME	L	T	P	C	H
1.	XOR401	Operations Research	3	0	0	3	3
2.	XAS402	Introduction to Aircraft and Aerospace Vehicles	3	0	0	3	3
3.	XAS403	Incompressible Aerodynamics	3	0	1	4	5
4.	XAS404	Aircraft Propulsion	3	1	1	5	7
5.	XAS405	Fundamentals of Aircraft Structures	3	1	0	4	5
6.	XEE406	Economics for Engineers	3	0	0	3	3
7.	XGS407	Technical Communication	1	0	0	1	3
		TOTAL	**19**	**2**	**2**	**23**	**29**

SEMESTER V

S.No	SUBJECT CODE	SUBJECT NAME	L	T	P	C	H
1.	XMA501	Numerical Methods	2	1	0	3	4
2.	XAS502	Compressible Aerodynamics	2	1	0	3	4
3.	XAS503	Mechanics of Machines	3	0	1	4	5
4.	XAS504	Advanced Aircraft Structures	3	1	1	5	7
5.	XAS505	Professional Elective – I	2	1	0	3	4
6.	XTQ506	Total Quality Management	3	0	0	3	3
7.	XGS507	Business Communication	1	0	0	1	3
8.	XAS508	In-Plant Training - II	0	0	0	1	0
		TOTAL	**16**	**4**	**2**	**23**	**30**
Minor Course							
1.	XASMC1	Aircraft Systems and Instruments	1	0	0	0	1

SEMESTER VI

S.No	SUBJECT CODE	SUBJECT NAME	L	T	P	C	H
1.	XAS601	Open Elective - I	3	0	0	3	3
2.	XAS602	Mechanics of Space Vehicles	3	0	0	3	3
3.	XAS603	UAV Design	3	0	1	4	5
4.	XAS604	Flight Dynamics	3	1	1	5	7
5.	XAS605	Aerospace Propulsion	3	1	0	4	5
6.	XAS606	Professional Elective – II	3	0	0	3	3
7.	XUM607	Environmental Studies	0	0	0	0	3
8.	XGS608	Academic Writing	0	0	0	0	2
		TOTAL	**18**	**2**	**2**	**22**	**30**
Minor Course							
2.	XASMC2	Aero Engine Repair and Maintenance	1	0	0	0	1

SEMESTER VII

S.No	SUBJECT CODE	SUBJECT NAME	L	T	P	C	H
1.	XAS701	Open Elective - II	3	0	0	3	3
2.	XAS702	Avionics	3	0	1	4	5
3.	XAS703	Computational Fluid Dynamics	3	1	1	5	7
4.	XAS704	Professional Elective – III	3	0	0	3	3
5.	XAS705	Professional Elective – IV	3	0	0	3	3
6.	XUM706	Cyber Security	0	0	0	0	3
7.	XAS707	Project Phase - I	0	0	2	2	4
8.	XGS708	Career Development Skills	0	0	0	0	1
9.	XAS709	In-Plant Training - III	0	0	0	2	0
		TOTAL	**15**	**1**	**4**	**22**	**29**
Minor Course							
3.	XASMC3	Non Destructive Testing	1	0	0	0	1

SEMESTER VIII

S.No	SUBJECT CODE	SUBJECT NAME	L	T	P	C	H
1.	XAS801	Open Elective – III	3	0	0	3	3
2.	XAS802	Professional Elective – V	3	0	0	3	3
3.	XAS803	Professional Elective – VI	3	0	0	3	3
4.	XAS804	Project Phase II	0	0	12	12	24
		TOTAL	**9**	**0**	**12**	**21**	**33**

TOTAL CREDITS = 176

LIST OF ELECTIVES

OPEN ELECTIVE

S.No	SUBJECT CODE	SUBJECT NAME	L	T	P	C	H
1.	XASOE1	Elements of Aeronautics	3	0	0	3	3
2.	XASOE2	Air Transportation and Aircraft Maintenance	3	0	0	3	3
3.	XASOE3	Wind Tunnel Techniques	3	0	0	3	3

PROFESSIONAL ELECTIVE - I

S.No	SUBJECT CODE	SUBJECT NAME	L	T	P	C	H
1.	XAS505A	Heat Transfer	2	1	0	3	4
2.	XAS505B	Theory of Elasticity	2	1	0	3	4
3.	XAS505C	Control Systems	2	1	0	3	4
4.	XAS505D	Boundary Layer Theory	2	1	0	3	4
5.	XAS505E	Navigation Systems	2	1	0	3	4

PROFESSIONAL ELECTIVE – II

S.No	SUBJECT CODE	SUBJECT NAME	L	T	P	C	H
1.	XAS606A	Airframe Maintenance and Repair	3	0	0	3	3
2.	XAS606B	Elements of Satellite Technology	3	0	0	3	3
3.	XAS606C	Aircraft Rules and Regulations CAR I and II	3	0	0	3	3
4.	XAS606D	Sensors and Measurements	3	0	0	3	3
5.	XAS606E	Helicopter Maintenance	3	0	0	3	3

PROFESSIONAL ELECTIVE – III

S.No	SUBJECT CODE	SUBJECT NAME	L	T	P	C	H
1.	XAS704A	Space Weapons and Warfare	3	0	0	3	3
2.	XAS704B	Theory of Vibrations	3	0	0	3	3
3.	XAS704C	High Temperature Materials	3	0	0	3	3
4.	XAS704D	Wind Tunnel Techniques	3	0	0	3	3
5.	XAS704E	Aeroelasticity	3	0	0	3	3

PROFESSIONAL ELECTIVE – IV

S.No	SUBJECT CODE	SUBJECT NAME	L	T	P	C	H
1.	XAS705A	Experimental Stress Analysis	3	0	0	3	3
2.	XAS705B	Disaster Management	3	0	0	3	3
3.	XAS705C	Rockets and Missiles	3	0	0	3	3
4.	XAS705D	Fatigue and Fracture Mechanics	3	0	0	3	3
5.	XAS705E	Composite Materials	3	0	0	3	3

PROFESSIONAL ELECTIVE – V

S.No	SUBJECT CODE	SUBJECT NAME	L	T	P	C	H
1.	XAS802A	Spacecraft Power Systems	3	0	0	3	3
2.	XAS802B	Space Communication Systems	3	0	0	3	3
3.	XAS802C	Air Traffic Control and Aerodrome Design	3	0	0	3	3
4.	XAS802D	Missile Guidance and Control	3	0	0	3	3
5.	XAS802E	Air Transportation and Aircraft Maintenance	3	0	0	3	3

PROFESSIONAL ELECTIVE – VI

S.No	SUBJECT CODE	SUBJECT NAME	L	T	P	C	H
1.	XAS803A	Theory of Plates and Shells	3	0	0	3	3
2.	XAS803B	Automation and Control Engineering	3	0	0	3	3
3.	XAS803C	Cryogenics	3	0	0	3	3
4.	XAS803D	Hypersonic Aerodynamics	3	0	0	3	3
5.	XAS803E	Finite Element Method	3	0	0	3	3

XAS302	ENGINEERING THERMODYNAMICS	L	T	P	C
		3	1	0	4
		L	T	P	H
		3	2	0	5

Unit I BASIC CONCEPTS AND LAWS OF THERMODYNAMICS 9+6=15

Classical approach: Thermodynamics systems – Boundary – Control Volume – System and surroundings – Universe – Properties – State-Process – Cycle – Equilibrium – Work and heat transfer – Point and path functions – First law of thermodynamics for open and closed systems – First law applied to a control volume – SFEE equations [steady flow energy equation] – Second law of thermodynamics – Heat engines – Refrigerators and heat pumps – Carnot cycle – Carnot theorem – Clausius inequality – Concept of entropy – Principle of increase of entropy – Basic thermodynamic relations.

Unit II IC ENGINES AND AIR STANDARD CYCLES 9+6=15

Air standard cycles: Otto, diesel and dual cycles and comparison of efficiency – Working Principle of four stroke and two stroke engines – Working principle of spark ignition and compression ignition engines – Applications of IC engines – Normal and abnormal combustion.

Unit III GAS TURBINES 9+6=15

Open and closed cycle gas turbines – Ideal and actual cycles – Brayton cycle – Cycle with reheat, intercooling and regeneration – Application of gas turbines for aviation and power generation. reaction principle – Velocity diagrams

Unit IV AIR COMPRESSORS 9+6=15

Reciprocating and rotary– Rotary positive displacement compressors – Construction and working principle of centrifugal and axial flow compressors (qualitative treatment only).

Unit V REFRIGERATION AND AIR CONDITIONING 9+6=15

Unit of refrigeration – Basic functional difference between refrigeration and air conditioning – Various methods of producing refrigerating effects (RE) – Vapour compression cycle: P-H and T-S diagram – Saturation cycles – Effect of subcooling and super heating – (qualitative treatment only) – Air conditioning systems – Basic psychrometry – Simple psychrometric processes – Types of air conditioning systems – Selection criteria for a particular application (qualitative treatment only).

LECTURE:45 TUTORIAL: 30 TOTAL: 75

TEXT BOOKS

1. P.K.Nag, “Basic and Applied Engineering Thermodynamics”. Tata McGraw Hill, New Delhi, 2012

2. Cengel & Boles , “Thermodynamics – An Engineering Approach” ,, 7th Ed., McGraw Hill, 2011

REFERENCE BOOKS

1. Rogers and Mayhew, „Engineering Thermodynamics – Work and Heat Transfer‟, Addision Wesley, New Delhi, 1999.

2. Eastop and McConkey, „Applied Thermodynamics‟, Addision Wesley, New Delhi, 1999.

3. B.K.Sankaar, „Thermal Engineering‟, Tata McGraw Hill, New Delhi, 1998.

XAS303	STRENGTH OF MATERIALS	L	T	P	C
		2	1	1	4

		L	T	P	H
		2	2	2	6

UNIT I BASICS OF STRESS AND STRAIN OF SOLIDS 12

Rigid and deformable bodies - Stress and Strain – Hooke's Law – Stress-Strain relationship – Bars with varying cross sections - Elastic constants and their relationship –Composite bar - Thermal Stresses – Stresses due to freely falling weight.

UNIT II STRESSES IN BEAMS 12

Shear force and bending moment in beams – Cantilever, Simply supported and Overhanging beams- Bending stresses in straight beams-Shear stresses in bending of beams with rectangular, I & T cross sections.

UNIT III DEFLECTION OF BEAMS 12

Double integration method – McCauley's method - Area moment method – Conjugate beam method-Principle of super position-Castigliano's theorem.

UNIT IV TORSION 12

Torsion of circular shafts - Shear stresses and twist in solid and hollow circular shafts – Closely coiled helical springs.

UNIT V BI AXIAL STRESSES AND APPLICATIONS OF THIN SHELLS 12

Biaxial state of stresses - Stresses in thin circular cylinder and spherical shell under internal pressure and its applications – Volumetric Strain - Combined loading and its applications – Principal planes and Stresses – Mohr's circle.

TEXT BOOKS

1. Dr. R. K. Bansal. Edition -V "Strength of Materials" Publisher, Laxmi Publications, 2012.

2. Beer F. P. and Johnston R, "Mechanics of Materials" McGraw – Hill Book Co, Third Edition, 2002.

3. Ray Hulse, Keith Sherwin & Jack Cain, "Solid Mechanics", Palgrave ANE Books, 2004.

REFERENCE BOOKS

1. Timoshenko, S. P, "Elements of Strength of Materials", Tata McGraw – Hill, New Delhi, 1997.

2. Nash W. A, "Theory and problems in Strength of Materials", Schaum Outline Series, McGraw – Hill Book Co, New York, 1995.

List of Experiments

1. Study of Universal Testing Machine
2. Brinell's hardness test
3. Rockwell's hardness test
4. Tension test
5. Torsion test
6. Izod's impact test
7. Charpy's impact test
8. Deflection of beam apparatus
9. Testing of springs
10. Block compression test

LECTURE : 30 TUTORIAL : 30 PRACTICAL : 30 TOTAL: 90

XAS304	FLUID MECHANICS AND MACHINERY	L	T	P	C
		3	1	1	5
		L	T	P	H
		3	2	2	7

UNIT I DEFINITIONS AND FLUID PROPERTIES 9+6=15

Introduction to fluid - distinction between solid and fluid - basic definition - classification of fluids - dimensions and units - system of units - fluid properties - continuum concept of system and control volume.

UNIT II FLUID STATICS AND KINEMATICS 9+6=15

Pascal's law - centre of pressure - forces on curved surfaces - buoyance and floatation - pressure measurement by manometers - fluid kinematics - flow visualization - lines of flow - types of fluid flow - flow net - velocity measurements.

UNIT III FLUID DYNAMICS 9+6=15

Euler's equation - Bernoulli's equation - venturimeter - orifice meter - pitot tubes – Coefficient of discharge - mouth piece - Hagen poiseulli's equation - Darcy's equation for loss of head due to friction in pipe.

UNIT IV BOUNDARY LAYER AND FLOW THROUGH PIPES 9+6=15

Laminar boundary layer - turbulent boundary layer - boundary layer separation - development of laminar and turbulent flows in circular pipes - hydraulic grade line - losses in pipes - pipes in series and parallel - equivalent pipes - pipes in network - power transmission through pipes.

UNIT V HYDRAULIC MACHINES 9+6=15

Centrifugal pumps - components - heads and efficiencies of centrifugal pump - reciprocating pump - single acting - double acting - slip - discharge and power requirement - delivery - performance of pumps - non conventional pumping system – Introduction to water turbines.

LEC : 45 TUT : 30 PRAC: 30 TOT: 105

TEXT BOOKS

1. *Bansal, R.K., "Fluid Mechanics and Hydraulics Machines", Laxmi Publications (P) Ltd., New Delhi, 2013.*

2. *Domkundwar.V.M., "Fluid mechanics & Hydraulic machines: with Introduction to fluidics", Dhanpat Rai & Co. Pvt.Limited, Educational and Technical publishers,India, 2012.*

REFERENCE BOOKS

1. *Rathakrishnan. E, Fluid Mechanics, Prentice Hall of India (II Ed.), 2007.*

2. *Kumar. K.L., Engineering Fluid Mechanics (VII Ed.) Eurasia Publishing House(P) Ltd., New Delhi, 1995.*

LIST OF EXPERIMENTS

1. Calibration of venturimeter
2. Calibration of orifice meter
3. Verification of Bernoulli’s theorem
4. Study of pressure measurement with pitot static tube
5. Determination of pipe flow losses
6. Performance test on centrifugal pumps
7. Performance test on reciprocating pumps
8. Performance test on gear pumps

		L	T	P	C
XAS 402	**INTRODUCTION TO AIRCRAFT AND AEROSPACE VEHICLES**	3	0	0	3

L	T	P	H
3	0	0	3

Unit I **HISTORICAL EVOLUTION** **9**

History of aircraft and space vehicles - classifications of air vehicles - Components of an airplane - Developments in aerodynamics - materials - structures and propulsion over the years - space vehicles and their functions .

Unit II **EFFECTS OF ATMOSPHERE** **9**

Physical properties and structure of the atmosphere - Temperature - pressure and altitude relationships - Generation of lift - drag and moment - Aerofoil terminologies- Mach number - Maneuver - Effect of atmosphere on Aircraft and Space Vehicles.

Unit III **STRUCTURES AND MATERIALS** **9**

General types of construction - Typical wing and fuselage structure - Metallic and non-metallic materials - Use of aluminum alloy –Ceramics - composite materials - materials used for space vehicle construction – futuristic materials.

Unit IV **POWER PLANTS** **9**

Basic ideas about piston and jet engines - Use of propeller and jets for thrust production - Principles of operation of rocket - types of rockets and typical applications - Power plants used in Satellites.

Unit V **PERFORMANCE** **9**

Airplane take off and climbing process - Space vehicle performance and control - Effects of changes of power, altitude and weight – Directional, longitudinal and lateral stability and their control.

LECTURE: 45 **TUTORIAL: 0** **TOTAL: 45**

TEXT BOOKS

1. *Anderson, J.D.,* ***" Introduction to Flight",*** *7th Edition, McGraw-HILL, 2011.*

2. *Graham Swinerd,* ***"How Spacecraft Fly: Spaceflight Without Formulae",*** *Copernicus , 2009.*

3. *Kermode, A.C.,* ***"Flight without Formulae"****, 5th edition, Pearson Education,2008.*

4. *Shevell.R.S* ***"Fundamentals of Flights",*** *Pearson education 2004.*

REFERENCE BOOKS

1. *Jerry Jon Sellers, "**Understanding Space",**Mcgraw-Hill College, 4th edition, 2003.*
2. *Dale Crane,"**A Pilot's Guide to Aircraft and Their Systems",** Aviation Supplies & Academics Inc,2002*
3. *Michael J.Kroes,"**Aircraft Basic Science", Eighth Edition,** McGraw-Hill Professional,2013.*
4. *Pallet* ***"E.H.J aircraft instruments and principles",*** *Pitman &co 1933.*
5. *Mc kinley* ***"J.L and R.D Bent, Aircraft power plants",*** *McGraw-Hill,1993*

XAS403	INCOMPRESSIBLE AERODYNAMICS	L	T	P	C
		3	0	1	4

L	T	P	H
3	0	2	5

UNIT I REVIEW OF BASIC FLUID MECHANICS 7

Continuity, Momentum and Energy equations, Euler equation, incompressible Bernoulli's Equation – stream function – path function – circulation – velocity potential function.

UNIT II TWO DIMENSIONAL INCOMPRESSIBLE FLOWS 10

Elementary flows – uniform flow, source, sink, doublet, vortex and their combinations, Pressure and velocity distributions on bodies with and without circulation in ideal and real fluid flows - Karman – Trefftz profiles – ideal and real flow – magnus effect – D' Alembert paradox.

UNIT III CONFORMAL MAPPING 8

Classification of aerofoil - Transformation from circle to various shapes - Introduction to complex variable – complex potential function.

UNIT IV AIRFOIL AND WING THEORY 12

Thin aerofoil theory and its applications- concept of vortex flow - Vortex line, Horse shoe vortex, Biot Savart law, Lifting line theory and its limitations.

UNIT V APPLICATION OF INCOMPRESSIBLE FLOWS 8

Concepts of Boundary Layer, Blasius solution,- displacement, Momentum thickness, Flow over a flat plate, prandtl boundary layer equation.

TEXT BOOKS

1. Anderson, J.D., "Fundamentals of Aerodynamics", McGraw-Hill Book Co., New York, 1998.
2. Clancey, L.J., "Aerodynamics", Pitman, 1986

REFERENCE BOOKS

1. Houghton, E.L., and Carruthers, N.B., "Aerodynamics for Engineering students", Edward Arnold Publishers Ltd., London, 1989.
2. Milne Thomson, L.H., "Theoretical aerodynamics", Macmillan, 1985.

List of Experiments

1. Generation of lift and tip vortices.

2. Flow visualization in water flow channel

3. Flow visualization in smoke tunnel

4. Plot of rotor speed Vs velocity in a subsonic wind tunnel.

5. Pressure distribution over circular cylinder.

6. Pressure distribution over Symmetrical airfoil and estimation of CL and CD.

7. Pressure distribution over Un Symmetrical airfoil and estimation of CL and CD.

8. Pressure distribution over Cambered airfoil and estimation of CL and CD.

9. Use of Schlieren system to visualize shock.

10.Use of Shadow graph system to visualize shock.

Lecture:45 Tutorial:0 Practical:30 Total : 75

XAS404 AIRCRAFT PROPULSION L T P C

3	1	1	5
L	**T**	**P**	**H**
3	2	2	7

UNIT - I INTRODUCTION TO AIRCRAFT PROPULSION 9+6=15

Classification of aircraft power plants - Factors affecting thrust and power- Reciprocating engine - types of reciprocating engine - turbojet engine - turboprop engine -turbofan engine - turboshaft engine - ramjet engine- scramjet engine - pulsejet engine - thrust equation of jet engine.

UNIT - II INLETS AND DIFFUSERS 9+6=15

Subsonic and supersonic inlets –Modes of inlet operation - internal and external compression intakes - intake characteristic curves - mixed compression intakes - stability of intake operation

UNIT - III COMBUSTION CHAMBER 9+6=15

Classification of Combustion chambers - combustion mechanism - fuel injection- factors affecting combustion chamber performance and design – Flame tube cooling – Flame stabilization.

UNIT - IV TURBOMACHINERY 9+6=15

Axial compressor - velocity triangles - stalling - surging - stage losses - centrifugal compressor - Axial flow turbine - radial flow turbine - mixed flow turbine - fans and blowers - efficiencies - turbine blade cooling techniques - lubrication systems in turbo machinery.

UNIT - V NOZZLE 9+6=15

Over, under and optimum expansion in nozzles - fixed geometry nozzle - variable geometry nozzle - attachment of jet pipe - afterburner - types of thrust reverser - types of thrust vectoring - nozzle cooling.

TEXT BOOK:

1. Hill, P.G. and Peterson, C.R. “Mechanics and Thermodynamics of Propulsion” Addison – Wesley Longman INC, 1999.
2. Oates, G.C., “Aero thermodynamics of Aircraft Engine Components”, AIAA Education Series, New York, 1985.
3. Mathur, M.L. and Sharma, R.P., “Gas Turbine, Jet and Rocket Propulsion”, Standard Publishers & Distributors, Delhi, 1999.

REFERENCES:

1. Cohen, H. Rogers, G.F.C. and Saravanamuttoo, H.I.H. “Gas Turbine Theory”, Longman, 1989.
2. “Rolls Royce Jet Engine” – Third Edition – 1983.

List of Experiments

1. Valve Timing Diagram for single cylinder four stroke Diesel engine
2. Port Timing Diagram for single cylinder two stroke Petrol engine.
3. Retardation Test to find Frictional Power of a single cylinder Diesel Engine.
4. Determination of Flash Point and Fire Point (open Cup).
5. Determination of Flash Point (Closed Cup).
6. Study of an aircraft piston engine.
7. Study of an aircraft jet engine
8. Study of forced convection and free convection heat transfer over a flat plate.
9. Study of free jet.
10. Study of wall jet.

Lecture:45 Tutorial:30 Practical:30 Total : 105 Periods

XAS405	FUNDAMENTALS OF AIRCRAFT STRUCTURES	L	T	P	C
		3	1	0	4

		L	T	P	H
		3	2	0	5

UNIT I STATICALLY DETERMINATE STRUCTURES 8+4

Analysis of plane truss using method of joints- Space truss- Plane frames - Composite beam.

UNIT II STATICALLY INDETERMINATE STRUCTURES 10+8

Propped Cantilever- Fixed-Fixed beams-Clapeyron's Three Moment Equation – Moment Distribution Method.

UNIT III ENERGY METHODS 8+6

Strain Energy due to axial, bending and Torsional loads – Castigliano's theorems- Maxwell's Reciprocal theorem - Unit load method.

UNIT IV COULMNS 11+6

Columns with various end conditions – Euler's Column curve – Rankine's formula - Column with initial curvature - Eccentric loading – South well plot – Beam column.

UNIT V APPLICATION TO AIRCRAFT STRUCTURAL PROBLEMS 8+6

Failure theories - application of Von-Mises theory to aircraft components –Fatigue failure and Creep Failure analysis.

LECTURE: 45 TUTORIAL: 30 TOTAL: 75

TEXT BOOKS

1. R. K. Rajput., Sixth Edition "Strength of Materials" Publisher, S Chand Publications, 2015.

2. Donaldson, B.K., "Analysis of Aircraft Structures – An Introduction", McGraw- Hill, 1993.

REFERENCE BOOKS

1. Bruhn.E.F. "Analysis and design of flight vehicle structures" Tri set of offset company, USA, 1973.

2. Timoshenko, S.,"Strength of Materials", Vol. I and II,Princeton D. Von Nostrand Co, 1990.

		L	T	P	C
XAS502	**COMPRESSIBLE AERODYNAMICS**	2	1	0	3
		L	**T**	**P**	**H**
		2	2	0	4

Unit I **ONE DIMENSIONAL COMPRESSILBLE FLOW** **6+6= 12**

Energy –Momentum - continuity and state equations -velocity of sound -Adiabatic steady state flow equations - Flow through converging and diverging passages - Performance under various back pressures - Mach waves and Mach angles

Unit II **NORMAL, OBLIQUE SHOCKS AND EXPANSION WAVES** **6+6= 12**

Prandtl equation and Rankine–Hugoniot relation - Normal shock -Oblique shocks and corresponding relations - shock polar - Flow past wedges and concave corners - Fanno and Rayleigh flow- Flow past convex corners

Unit III **DIFFERENETIAL EQUATIONS OF MOTION FOR A STEADY COMPRESSIBLE FLOWS** **6+6= 12**

Small perturbation potential theory - solutions for subsonic flows - Prandtl-Glauert affine transformation relations for subsonic flows, Linearized two dimensional flow theories - Methods of Characteristics

Unit IV **AIRFOIL IN HIGH SPEED FLOWS** **6+6= 12**

Lower and upper critical Mach numbers - drag divergence Mach number- Characteristics of swept wings -Effects of thickness, camber and aspect ratio of wings - Transonic area rule – super critical aerofoils -Tip effects.

Unit V **HIGH SPEED WIND TUNNELS AND FLOW VISUALIZATIONS** **6+6= 12**

Blow down, In-draft and induction tunnel layouts and their design features -Transonic, supersonic and hypersonic tunnels and their peculiarities - Helium and gun tunnels - Shock tubes - Optical meth

ods of flow visualization.

LECTURE: 30 **TUTORIAL: 30** **TOTAL: 60 Periods**

TEXT BOOKS

1. John.D.Anderson, “Modern Compressible Flows”. Tata McGraw Hill, New Delhi, 1999.

2. Rathakrishnan, E., “Gas Dynamics”, Prentice Hall of India, 2003.

REFERENCE BOOKS

1. McCornick.W.,“Aerodynamics,AeronauticsandFlightMechanics”,JohnWiley,1979

2. Zucrow and J.D.Anderson, “Elements of Gas dynamics” Tata McGraw Hill, New Delhi, 1999.

XAS503 **MECHANICS OF MACHINES**

L	T	P	C
2	1	1	4
L	**T**	**P**	**H**
2	2	2	6

UNIT I MECHANISMS **6+6**

Machine Structure – Kinematic link, pair and chain – Grueblers criteria – Constrained motion – Degrees of freedom - Slider crank and crank rocker mechanisms – Inversions – Applications – Kinematic analysis of simple mechanisms – Determination of velocity and acceleration.

UNIT II FRICTION **6+6**

Friction in screw and nut – Pivot and collar – Thrust bearing – Plate and disc clutches – Belt (flat and V) and rope drives. Ratio of tensions – Effect of centrifugal and initial tension – Condition for maximum power transmission – Open and crossed belt drive.

UNIT III GEARING AND CAMS **6+6**

Gear profile and geometry – Nomenclature of spur and helical gears – Gear trains: Simple, compound gear trains and epicylic gear trains - Determination of speed and torque - Cams – Types of cams – Design of profiles – Knife edged, flat faced and roller ended followers with and without offsets for various types of follower motions

UNIT IV BALANCING **6+6**

Static and dynamic balancing – Single and several masses in different planes –Balancing of reciprocating masses- primary balancing and concepts of secondary balancing – Single and multi-cylinder engines (Inline) – Balancing of radial V engine – direct and reverse crank method

UNIT V VIBRATIONS **6+6**

Free, forced and damped vibrations of single degree of freedom systems – Force transmitted to supports – Vibration isolation – Vibration absorption – Torsional vibration of shaft – Single and multi rotor systems – Geared shafts – Critical speed of shaft.

TEXT BOOKS

1. Rattan.S.S, “Theory of Machines”, Tata McGraw–Hill Publishing Co, New Delhi,2004.

REFERENCES

1. Ballaney.P.L, “Theory of Machines”, Khanna Publishers, New Delhi, 2002.

LIST OF EXPERIMENTS

1. Measurement of strain.
2. Measurement of cutting forces using Drill, Lathe and Milling Dynamometers.
3. Kinematics of gear trains – simple, compound, epicyclic, differential.
4. CAM Analysis – angle Vs displacement.
5. Governors - determination of characteristics and sensitivity.
6. Vibration analysis of mechanical systems.
7. Balancing of rotating masses.
8. Whirling of shaft.
9. Gyroscope.
10. Torsional vibration rotor systems

Lecture:30 Tutorial:30 Practical:30 Total : 90

XAS504	ADVANCED AIRCRAFT STRUCTURES	L	T	P	C
		3	1	1	5

		L	T	P	H
		3	2	2	7

UNIT I BENDING OF BEAMS 9+6=15

Elementary theory of bending – Introduction to semi-monocoque structures - Stresses in beams of symmetrical and unsymmetrical sections -Box beams – General formula for bending stresses principal axes method – Neutral axis method.

UNIT II SHEAR FLOW IN OPEN SECTIONS 9+6=15

Shear stresses in beams – Shear flow in stiffened panels - Shear flow in thin walled open tubes – Shear centre – Shear flow in open sections with stiffeners.

UNIT III SHEAR FLOW IN CLOSED SECTIONS 9+6=15

Shear flow in closed sections with stiffeners– Angle of twist - Shear flow in two flange and three flange box beams – Shear centre - Shear flow in thin walled closed tubes - Bredt-Batho theory – Torsional shear flow in multi cell tubes - Flexural shear flow in multi cell stiffened structures.

UNIT IV BUCKLING OF PLATES 9+6=15

Rectangular sheets under compression - Local buckling stress of thin walled sections - Crippling stresses by Needham's and Gerard's methods - Thin walled column strength-Sheet stiffener panels - Effective width, inter rivet and sheet wrinkling failures.

UNIT V STRESS ANALYSIS IN WING AND FUSELAGE 9+6=15

Procedure–Shear and bending moment distribution for semi cantilever and other types of wings and fuselage, thin webbed beam with parallel and non-parallel flanges – Shear resistant web beams - Tension field web beams (Wagner's).

TEXT BOOKS

1. E.F. Bruhn, "Analysis and Design of Flight Vehicle Structures", Tristate Offset Co., 1980.

2. Megson T.M.G, "Aircraft Structures for Engineering Students", Edward Arnold, 1995.

REFERENCE BOOKS

1. Peery, D.J. and Azar, J.J., Aircraft Structures, 2nd Edition, McGraw-Hill, New York, 1993.

2. Stephen P. Timoshenko & S.woinowsky Krieger, Theory of Plates and Shells, 2nd Edition, McGraw-Hill, Singapore, 1990.

3. Rivello, R.M., Theory and Analysis of Flight structures, McGraw-Hill, N.Y., 1993.

Laboratory:

Ex. No.	List of Experiments
1	Determination of Young's modulus of Steel or Aluminum.
2	Deflection of Beams with various end conditions.
3	Verification of Maxwell's Reciprocal theorem.
4	Column – Testing.
5	Determination of Membrane stresses in a thin cylinder under internal pressure.
6	Exercise on Riveted joints & repair work.
7	Exercise on composites & repair work.
8	Repair of Sandwich panels.
9	Patch repair welding using TIG.
10	Patch repair welding using MIG.

LECTURE: 45 TUTORIAL: 30 PRACTICAL:30 TOTAL: 105

XAS 509	AIRCRAFT SYSTEMS AND INSTRUMENTS	L	T	P	C
		1	0	0	0
		L	T	P	H
		1	0	0	1

Unit I AIRCRAFT SYSTEMS 3

Hydraulic systems and Controllers –Pneumatic systems – Landing Gear Systems – Shock absorbers.

Unit II AIRPLANE CONTROL SYSTEMS 3

Conventional Systems – Power assisted and fully powered flight controls – Power actuated systems – Digital fly by wire systems – Auto pilot system

Unit III ENGINE SYSTEMS 3

Fuel systems for Piston and Jet Engines - lubricating systems for Piston and jet engines – Starting and Ignition systems for Piston and Jet engines

Unit IV AIRCONDITIONING AND PRESSURIZING SYSTEM 3

Boot-strap air cycle system – Evaporative vapour cycle systems – Evaporation air cycle systems – Oxygen systems – Fire protection systems, Deicing and anti icing system.

Unit V AIRCRAFT INSTRUMENTS 3

Accelerometers, Air speed Indicators – Mach Meters – Altimeters - Gyroscopic Instruments– Tachometers – Thermocouples – Pressure gauge

LECTURE: 15 TUTORIAL: 0 TOTAL: 15

TEXT BOOKS

1. S. Nagabhushana, L.K.Sudha, Aircraft Instrumentation and Systems, I.K. International Publishing House Pvt. Ltd , 2010.

REFERENCE BOOKS

1. Pallet, E.H.J. **Aircraft Instruments & Principles**, Pitman & Co 1993

XAS602 MECHANICS OF SPACE VEHICLES

L	T	P	C
3	0	0	3

L	T	P	H
3	0	0	3

Unit I BASIC CONCEPTS **9**

The Solar System–References Frames and Coordinate Systems–The Celestial Sphere–The Ecliptic–MotionofVernalEquinox–SiderealTime–SolarTime–StandardTime–The Earth's Atmosphere.

Unit II THE GENERAL N-BODY PROBLEM **9**

The many body Problem–Lagrange–Jacobian Identity–The Circular Restricted Three Body Problem–Libration Points-Relative Motion in the N-body Problem–Two–Body Problem–Satellite Orbits – Relations Between Position and Time – Orbital Elements.

Unit III SATELLITEINJECTIONANDSATELLITEORBITPERT URBATIONS **10**

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 vibrations of Orbital Elements – General Perturbations Approach.

Unit IV INTERPLANETARY TRAJECTORIES **9**

Two Dimensional Interplanetary Trajectories –Fast Interplanetary Trajectories – Three Dimensional Interplanetary Trajectories – Launch of Interplanetary Spacecraft –Trajectory about the Target Planet.

Unit V BALLISTIC MISSILE TRAJECTORIESAND MATERIALS **8**

TheBoostPhase–TheBallisticPhase–TrajectoryGeometry-OptimalFlights–Timeof Flight–Re–entryPhase–ThePositionoftheImpactPoint–InfluenceCoefficients.Space Environment–Peculiarities–EffectofSpaceEnvironmentontheSelectionofSpacecraft Material.

LECTURE: 45 TUTORIAL: 0 TOTAL: 45

TEXT BOOKS

1. Cornelisse,J.W.,"RocketPropulsionandSpaceDynamic",W.H.Freeman&Co.,1984.

REFERENCE BOOKS

1. Sutton, G.P., "Rocket Propulsion Elements", John Wiley, 1993.
2. Van de Kamp, P., "Elements of Astro mechanics", Pitman, 1979.
3. ParkerE.R.,"MaterialsforMissilesandSpacecraft",McGraw-HillBookCo.Inc.

		L	T	P	C
XAS 603	**UAV DESIGN**	3	0	1	4
		L	**T**	**P**	**H**
		3	0	2	5

UNIT1: Introduction, basics, types and roles **9**

UAV attributes, manned vs unmanned, design considerations, acquisition & life cycle costs, UAS architecture, UAS components including the air vehicle, payload, data link and ground control station, categories and classifications, civil applications

UINIT 2: Sensors and its communications and data links. **9**

EO, IR, multispectral, Hyperspectral, LIDAR, SAR, small UAV sensors, atmospheric and weather effects, sensor data rates, future sensor trends, current state of data links, future needs of data links, line of sight fundamentals, beyond line of sight fundamentals, UAS communications failure.

UNIT 3: Conceptual design and solar/fuel cell propulsion. **9**

UAS design process, airframe design considerations, launch & recovery methods, propulsion considerations, communications, control & stability, ground control system, support equipment, transportation, solar cells & solar energy, solar aircraft challenges, solar wing design, past solar designs, energy storage methods & density, fuel cell basics & UAS integration

UNIT 4: Improving Reliability and UAV navigation system **9**

Fault Tolerant Control Architecture, Fault Detection & Identification, Reconfigurable Flight Controllers, Non-Adaptive Controllers, Adaptive Controllers, UAV Navigation, Satellite Navigation, Inertial Navigation, Sensor Fusion for Navigation, Image Navigation (Skysys).

UNIT 5: Swarming, Future UAS characteristics and roles **9**

Swarming Characteristics, Swarming Concepts, Emergent Behavior Characteristics Swarming Algorithms, Swarm Communications. Goals & Operational Issues, Space, Hypersonic, Submarine Launched, UCAS, Pseudo Satellites.

TEXT BOOKS

1. Thomas Gleason***, "Introduction to UAV Systems"***, 4th Edition Paul Fahlstrom
2. Dr.Jerry Le Mieux, ***Introduction to Unmanned Systems*** Air, Ground, Sea & Space.

REFERENCE BOOKS

1. Roskam, Jan, ***Airplane Flight Dynamics and Automatic Flight Control***, Part I, Design, Analysis, and Research Corporation, Lawrence, KS, 1994.

2. Bruhn, E. F., ***Analysis and Design of Flight Vehicle Structures***, Tri-State Offset Company, Cincinnati, OH, 1965.

3. P.C.Jain (ed.), ***Handbook for New Entrepreneurs***, EDII, Oxford University Press, New Delhi, 1999. Rae, William H. Jr., and Pope, Alan, Low-Speed Wind Tunnel Testing, Wiley-Interscience, NY, 1984.

4.Raymer, Daniel P., Aircraft Design: ***A Conceptual Approach, Fourth Edition***, American Institute of Aeronautics and Astronautics, Inc., Reston, VA, 2006

5. Austin, Reg. ***Unmanned Aircraft Systems UAVS Design, Development and Deployment***, John Wiley and Sons, Ltd., Blacksburg, VA, 2010.

LIST OF EXPERIMENTS

1. Making of an airfoil section using given material.
2. Making of chuck glider using Coro/ Depron sheet.
3. Making of chuck glider using balsa wood.
4. Making a model of Commercial Aircraft using Foam sheet.
5. Study of electronic equipments used in Aero models.
6. Making a model of fighter Aircraft using Foam sheet.
7. Making/Assembly of RC aircraft flying model.
8. Testing of 4 channel / 6 channel / 9 channel transmitter operation using mode 1 and mode 2
9. Remote control simulation training.
10. Making and Testing of a water rocketry model.

LECTURE: 45 **PRACTICAL: 30** **TOTAL: 75**

XAS 604	FLIGHT DYNAMICS	L	T	P	C
		3	1	1	5
		L	**T**	**P**	**H**
		3	2	2	7

UNIT I CRUISING FLIGHT PERFORMANCE **15**

Forces and moments acting on a flight vehicle - Equation of motion of a rigid flight vehicle - Different types of drag - Drag polar of vehicles from low speed to high speeds - Variation of thrust, power with velocity and altitudes for air breathing engines. Performance of airplane in level flight - Power available and power required curves. Maximum speed in level flight - Conditions for minimum drag and power required.

UNIT II MANOEUVERING FLIGHT PERFORMANCE **15**

Range and endurance - Climbing and gliding flight (Maximum rate of climb and steepest angle of climb, minimum rate of sink and shallowest angle of glide) -Turning performance (Turning rate turn radius). Bank angle and load factor – limitations on turn - V-n diagram and load factor.

UNIT III STATIC LONGITUDINAL STABILITY **15**

Degree of freedom of rigid bodies in space - Static and dynamic stability - Purpose of controls in airplanes–Static, Longitudinal stability - Stick fixed stability - Basic equilibrium equation - Stability criterion - Influence of CG location - Power effects - Stick fixed neutral point - Stick free stability-Hinge moment coefficient - Stick free neutral points – Symmetric maneuvers - Stick force gradients - Stick force per 'g' - Aerodynamic balancing

UNIT IV LATERAL AND DIRECTIONAL STABILITY **15**

Dihedral effect - Lateral control - Coupling between rolling and yawing moments - Adverse yaw effects - Aileron reversal - Static directional stability - Weather cocking effect - Rudder requirements - One engine inoperative condition - Rudder lock.

UNIT V DYNAMIC STABILITY **15**

Introduction to dynamic longitudinal stability: - Modes of stability, effect of freeing the stick - Brief description of lateral and directional dynamic stability - Spiral, divergence, Dutch roll, autorotation and spin.

TEXTBOOKS

1. Perkins, C.D., and Hage, R.E., “Airplane Performance stability and Control”, John Wiley & Son:,Inc, NY, 1988.

2. Nelson, R.C. “Flight Stability and Automatic Control”, McGraw-Hill Book Co., 2004.

3. Mc Cornick. W., “Aerodynamics, Aeronautics and Flight Mechanics”, John Wiley, NY, 1979.

REFERENCES

1. Etkin, B., “Dynamics of Flight Stability and Control”, Edn. 2, John Wiley, NY, 1982.

2. Babister, A.W., “Aircraft Dynamic Stability and Response”, Pergamon Press, Oxford, 1980.

3. Dommasch, D.O., Sherby, S.S., and Connolly, T.F., “Aeroplane Aero dynamics”, Third Edition, Issac Pitman, London, 1981.

LIST OF EXPERIMENTS

To make the student work in groups and understand the Concepts involved in Aerodynamic design, Performance analysis and stability aspects of different types of airplanes, the following assignments are carried out:

1. Comparative studies of different types of airplanes and their specifications and performance details with reference to the design work undertaken.
2. Preliminary weight estimations and selection of design parameters.
3. Power plant selection.
4. Aerofoil selection.
5. Fixing the geometry of wing, tail and control surfaces.
6. Landing gear selection.
7. Preparation of layout drawing, construction of balance and three view diagrams of the airplane under consideration.
8. Drag estimation and performance calculations.
9. Stability Analysis.
10. V- n diagram.

Practical: 60 Periods Lecture: 45 Tutorial:30 Practical:30 Total : 105

XAS605	AEROSPACE PROPULSION	L	T	P	C
		3	1	0	4
		L	T	P	H
		3	2	0	5

UNIT I RAMJET AND SCRAMJET 9+8=17

Ramjet and scramjet: basic principle - geometry - diffuser - combustor - nozzle - performance and control - testing difficulties - thrust to weight ratio - combustion mechanism - propellant usage - advantages and disadvantages

UNIT II CHEMICAL ROCKETS 9+8=17

Solid rocket - different perforation - liquid rocket engine – gas pressure feed system - pump feed system - propellant tanks - hybrid rockets - performance analysis - fuel oxidizer combination - combustion instability - thrust vector control - nozzle selection.

UNIT III NUCLEAR ROCKET 9+7=16

Nuclear power in space - Nuclear pulse propulsion - Nuclear thermal rocket - direct nuclear rocket - nuclear electric rocket - solid core - liquid core - gas core - test firing - current trends - limitations.

UNIT IV ELECTRIC ROCKET 9+7=16

Ideal flight performance - electrothermal thrusters - non thermal electric thrusters - optimum flight performance - mission applications - electric space power supplies and power conditioning systems

UNIT V APPLICATION 9

Rocket propulsion - rocket boosters - military operations - missiles - spaceships - reentry vehicle - satellite propulsion - application in research - future concepts

` **LECTURE:45 TUTORIAL:30 TOTAL: 75 PERIODS**

TEXT BOOKS

1. George P.Sutton, Oscar Biblarz, "Rocket Propulsion Elements", seventh edition, Wiley India pvt.Ltd , 2014
2. T.W.Lee, "Aerospace Propulsion", Wiley India pvt.Ltd ,2013

REFERENCE BOOKS

1. C.D.Brown, "spacecraft propulsion", AIAA Education series, washington, DC,1996
2. R.G.Jahn, "Physics of electric propulsion", McGraw-Hill book company, New York, 1968

		L	T	P	C
XAS609	**AERO ENGINE MAINTENANCE AND REPAIR**	1	0	0	0
		L	**T**	**P**	**H**
		1	0	0	1

Unit I PISTON ENGINE COMPONENTS 3

Types of piston engines–Principles of operation–Function of components– Materials used–starting of engines – Details of carburetion and injection systems for small and large engines.

Unit II INSPECTIONS OF PISTON ENGINES 3

Inspection of all engine components– Daily and routine checks–Engine fuel, control and exhaust systems–Engine mount and super charger – Checks and inspection procedures.

Unit III OVERVIEW OF FAULT DIAGNOSTICS AND TESTING 3

Fault diagnostics - Tools for inspection–Tools for safety and for visual inspection. Engine testing procedures and schedule preparation Details of starting and operating procedures - Foreign Object Damage – Blade damage

Unit IV JET ENGINE COMPONENTS 3

Maintenance procedures of gas turbine engines–Troubleshooting and rectification procedures– Component maintenance procedures – Systems maintenance procedures

Unit V OVERHAUL PROCEDURES 3

Engine Overhaul procedures–Inspections and cleaning of components – Trouble Shooting – Condition monitoring of the engine on ground and at altitude–Engine health monitoring

LECTURE: 15 TUTORIAL: 0 TOTAL: 15

TEXT BOOK

1. Kroes &Wild, “Aircraft Power plants”, 7th Edition – McGraw Hill, 1994.

REFERENCES

1. Turbomeca, “Gas Turbine Engines”, The English Book Store, 1993.
2. United Technologies’ Pratt &Whitney, “The Aircraft Gas turbine Engine and its Operation”, The English Book, 1993.

XAS702	AVIONICS	L	T	P	C
		3	0	1	4
		3	0	2	5

UNIT I INTRODUCTION TO AVIONICS 9

Role for Avionics in Civil and Military Aircraft systems - Avionics sub-systems and design - defining avionics System/subsystem requirements - importance of 'ilities', Avionics system architectures.

UNIT II DIGITAL AVIONICS ARCHITECTURE 9

Avionics system architecture– Features and applications of Data buses MIL–STD 1553 B – ARINC 429 -ARINC 629 - SAFEbus /FlexRay - Time triggered communication protocol/controller Area network - AFDX - CSDB.

UNIT III DISPLAYS, I/O DEVICES AND POWER 9

Trends in display technology, Alphanumeric displays, character displays etc., Civil and Military aircraft cockpits, MFDs, MFK, HUD, HDD, HMD, DVI, HOTAS, Synthetic and enhanced vision, situation awareness, Panoramic/big picture display, virtual cockpit-Civil and Military Electrical Power requirement standards, comparing the Military and Civil Requirements and Tips for Power System Design.

UNIT IV AERIALS AND PROPAGATION 9

Antenna theory - various types of antenna for medium wave short wave - VHF -propagation at microwave frequencies - atmospheric attenuation - effects of precipitation - reflection - the voltage and current distribution along antenna of various length - characteristics of ground planes -Refraction and Diffraction phenomenon - clutter signals.

UNIT V SYSTEM ASSESSMENT, VALIDATION AND CERTIFICATION 9

Fault tolerant systems - Hardware and Software, Evaluating system design and Future architecture - Hardware assessment- FARs guide certification requirements-Fault Tree analysis – Failure mode and effects analysis – Criticality, damaging modes and effects analysis - Software development process models - Software Assessment and Validation -Civil and Military standards.

TEXT BOOKS

1. R.P.G. Collinson, *"Introduction to Avionics"*, Chapman & Hall Publications, 1996.
2. Myron Kayton and Walter R fried, Avionics Navigation Systems, John Wiley and Sons.
3. RF Hnasforde, Heywood and Company London: Radio Aids to Civil Aviation.

REFERENCE BOOKS

1. Middleton, D.H., Ed., "*Avionics Systems, Longman Scientific and Technical*", Longman Group UK Ltd.,England, 1919.
2. Spitzer, C.R., "*Digital Avionic Systems"*, Prentice Hall, Englewood Cliffs, N.J., USA., 1917.
3. Brain Kendal, "*Manual of Avionics*", The English Book House, 3rd Edition, New Delhi, 1993.

LIST OF EXPERIMENTS

1. Study of basic logic GATEs.
2. Study of installing and configuring of AFDX card in transmitting and receiving mode.
3. Study of Determination of gain for the given antenna.
4. Adder / Subtractor
5. Multiplexer / Demultiplexer
6. Encoder / Decoder
7. Interface programming with 4 digit 7 segment display and switches and LEDs
8. Study of MIL-STD 1553B Data bus
9. Digital to analog converter

LECTURE:45 PRACTICAL: 30 TOTAL: 75 PERIODS

XAS703	COMPUTATIONAL FLUID DYNAMICS	L	T	P	C
		3	1	1	5
		L	T	P	H
		3	2	2	7

UNIT I GOVERNING EQUATIONS AND BOUNDARY CONDITIONS 9+6=15

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

UNIT II FINITE DIFFERENCE AND FINITE VOLUME METHODS FOR DIFFUSION 9+6=15

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

UNIT III FINITE VOLUME METHOD FOR CONVECTION DIFFUSION 9+6=15

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

UNIT IV FLOW FIELD ANALYSIS 9+6=15

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

UNIT V TURBULENCE MODELS AND MESH GENERATION 9+6=15

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

LECTURE:45 TUT:30 PRAC:30 TOT: 105 PERIODS

TEXT BOOKS

1. H.K. Versteeg and W. Malalsekera “An Introduction to Computational Fluid Dynamics, The Finite Volume Method”, Longman Scientific & Technical, second edition 2009.

2. John D. Anderson Jr.,"Computational Fluid Dynamics ", Mcgraw-Hill Series, 2010.
3. Ghoshdastidar, P.S., "Computer Simulation of flow and heat transfer", Tata McGraw Hill Publishing Company Ltd., 1998.
4. C.A.J. Fletcher, "Computational Techniques for Fluid Dynamics 1" Springer Verlag,1995.
5. C.A.J. Fletcher, "Computational Techniques for Fluid Dynamics 2", Springer Verlag, 1995.

REFERENCE BOOKS

1. Gautam Biswas, Somenath Mukherjee,, "Computational Fluid Dynamics" Alpha Science International, 2014.
2. T. J. Chung, "Computational Fluid Dynamics", Cambridge University Press, 2002.
3. C. Hirch, "Numerical Computation of Internal and External Flows" Volume-2, John Wiley and Sons, 1994.

List of Experiments through software

1. Steady flow over Aerofoil.
2. Transient flow over blunt body.
3. Turbulent flow and Heat transfer in a mixed Elbow.
4. Simulation of air flow in Nozzle.
5. Fluid in a spinning bowl.
6. Chemical mixing and Gaseous combustion.
7. Natural convection in a square box.
8. Interaction of air through Rotor and stator in axial compressor.
9. Turbine blade cooling techniques.

		L	T	P	C
XAS710	**NON DESTRUCTIVE TESTING**	1	0	0	0
		L	**T**	**P**	**H**
		1	0	0	1

Unit I LIQUID PENETRANT AND MAGNETIC PARTICLE INSPECTION 3

Liquid penetrant method - Generation of Magnetic fields – Magnetic particle inspection method - equipments – Demagnetization

Unit II RADIOGRAPHY 3

Production of x-rays – Tube current and Voltage –Penetrating power — Radiation contrast and film contrast – exposure charts

Unit III EDDY CURRENT INSPECTION 3

Eddy current production – Inspection of magnetic materials – Inspection of non magnetic materials.

Unit IV ULTRASONIC TESTING 3

Production of ultrasonic waves – Different types of thickness measurements – Applications.

Unit V RECENT TECHNIQUES 3

Principles of holography- Principle of acoustic emission – Applications of holographic techniques

LECTURE: 15 TUTORIAL: 0 TOTAL: 15

TEXT BOOKS

1. Barry Hull and Vernon John, “Non Destructive Testing”, MacMillan, 1988.

REFERENCE BOOKS

1. Americal Society of Metals, Metals Hand Book, 9th Edition, Volume 11 (1980).

2. Holler, P., “New Procedures in Non Destructive Testing” Springer Verlag, 1983.

		L	T	P	C
		2	1	0	3
XAS505A	**HEAT TRANSFER**				
		L	**T**	**P**	**H**
		2	2	0	4

UNIT I FUNDAMENTALS **6**

Modes of heat transfer: Conduction – Convection – Radiation

UNIT II HEAT CONDUCTION **6+6=12**

Steady and unsteady state heat conduction in solids - Effect of variation of thermal conductivity on heat transfer in solids – conduction with heat generation – Heat transfer problems in infinite and semi-infinite solids – Critical radius *of* insulation-Extended surfaces - Application of numerical techniques.

UNIT III FREE AND FORCED CONVECTION **6+12=18**

Convection fundamentals: Basic equations, Boundary layer concept, Dimensional analysis

Free Convention: Laminar boundary layer equation-Free convection in atmosphere free convection on a vertical flat plate – Integral method-Empirical relation in free convection – External flows.

Forced convection: Forced convection - Laminar and turbulent convective heat transfer analysis in flows between parallel plates, over a flat plate and in a circular pipe. Empirical relations - numerical techniques in problem solving.

UNIT IV RADIATIVE HEAT TRANSFER AND HEAT EXCHANGERS **6+6=12**

Concept of black body-Intensity of radiation-Laws of Black body Radiation-Radiation from non-black surfaces- real surfaces – Radiation between surfaces-Radiation shape factors-Radiation shields. Heat exchangers: Types-overall heat transfer coefficient- LMTD- NTU method of heat exchanger Analysis.

UNIT V HEAT TRANSFER PROBLEMS IN AEROSPACE ENGINEERING **6+6=12**

Heat transfer problems in gas turbine combustion chambers - Rocket thrust chambers - Aerodynamic heating - Ablative heat transfer.

Lecture:30 Periods; **Tutorial: 30 Periods;** **Total: 60Periods**

TEXT BOOKS

1 Sachdeva, S.C. Fundamentals of Engineering, Heat and Mass Transfer, Wiley Eastern LtD., New Delhi, 1981.

2. Lienhard, J.H., " A Heat Transfer Text Book ", Prentice Hall Inc., 1981.

3. Holman, J.P., " Heat Transfer ", McGraw Hill Book Co., Inc., New York, 6th Edn., 1991.

REFERENCES

1. Sutton, G.P., " Rocket Propulsion Elements ", John Wiley and Sons, 5th Edn.1986.

2. Mathur, M.and Sharma, R.P., " Gas Turbine and Jet and Rocket Propulsion " , Standard Publishers, NewDelhi 1988.

XAS505B	THEORY OF ELASTICITY	L	T	P	C
		2	1	0	3

		L	T	P	H
		2	2	0	4

UNIT I BASIC EQUATIONS OF ELASTICITY 6+6=12

Stress-Strain – Stress Strain relationships - Equations of Equilibrium, Compatibility equations and strains, Boundary Conditions, St. Venant's principle – Principal Stresses Stress Ellipsoid - Stress invariants.

UNIT II PLANE STRESS AND PLANE STRAIN PROBLEMS 6+6=12

Airy's stress function, Bi-harmonic equations, Polynomial solutions, Simple two dimensional problems in Cartesian coordinates like bending of cantilever and simply supported beams.

UNIT III POLAR COORDINATES 6+6=12

Equations of equilibrium, Strain displacement relations, Airy's stress function, Axi-symmetric problems, Kirsch, Michell's and Boussinesque problems – Rotating discs.

UNIT IV TORSION 6+6=12

Navier's theory, St. Venant's theory, Prandtl's theory on torsion, Semi- inverse method and applications to shafts of circular, elliptical, equilateral triangular and rectangular sections.

UNIT V THEORY OF PLATES 6+6=12

Classical plate theory – Assumptions – Governing equations – Boundary conditions – Navier's method of solution for simply supported rectangular plates – Levy's method of solution for rectangular plates under different boundary conditions.

LECTURE: 30 TUTORIAL: 30 TOTAL: 60

TEXT BOOKS

1. Timoshenko, S., and Goodier, T.N., Theory of Elasticity, McGraw – Hill Ltd., Tokyo, 1990.
2. Ansel C Ugural and Saul K Fenster, 'Advanced Strength and Applied Elasticity',4th Edition, Prentice Hall, New Jersey, 2003.

REFERENCE BOOKS

1. Wang, C.T., Applied Elasticity, McGraw – Hill Co., New York, 1993.
2. Sokolnikoff, I.S., Mathematical Theory of Elasticity, McGraw – Hill New York, 1978.

XAS505C **CONTROL SYSTEMS**

L	T	P	C
2	1	0	3
L	T	P	H
2	2	0	4

UNIT I INTRODUCTION 6+6=12

Historical review - Simple pneumatic, hydraulic and thermal systems, Series and parallel systems, Analogies - Mechanical and electrical components, Development of flight control systems.

UNIT II OPEN AND CLOSED LOOP SYSTEMS 6+6=12

Feedback control systems – Block diagram representation of control systems, Reduction of block diagrams, Output to input ratios, Signal flow graph.

UNIT III CHARACTERISTIC EQUATION AND FUNCTIONS 6+6=12

Laplace transformation, Response of systems to different inputs viz., Step input, impulse, ramp, parabolic and sinusoidal inputs, Time response of first and second order systems, steady state errors and error constants of unity feedback circuit.

UNIT IV CONCEPT OF STABILITY 6+6=12

Necessary and sufficient conditions, Routh – Hurwitz criteria of stability, Root locus and Bode techniques, Concept and construction, frequency response.

UNIT V SAMPLED DATA SYSTEMS 6+6=12

Introduction to digital control system, Digital Controllers and Digital PID Controllers.

Lecture: 30 Periods; Tutorial: 30 Periods; Total: 60 Periods

TEXT BOOKS

1. Ogato, “Modern Control Engineering”, Prentice – Hall of India Pvt. Ltd. New Delhi, 1998.

2. Gopal.M. “Control Systems, Principles and design” – Tata McGraw-Hill Publication, New Delhi, 2000.

REFERENCES

1. Azzo, J.J.D. and C.H. Houpis, “Feed back control system analysis and synthesis”, McGraw – Hill International, 3rd Edition, 1998.

2. Kuo, B.C., “Automatic control systems”, Prentice – Hall of India Pvt. Ltd., New Delhi, 1998.

3. Houpis, C.H. and Lamont, G.B., “Digital Control Systems”, McGraw-Hill Book Co.

XAS505D **BOUNDARY LAYER THEORY**

L	T	P	C
2	1	0	3

L	T	P	H
2	2	0	4

Unit I FUNDAMENTAL EQUATIONS OF VISCOUS FLOW 6+6=12

Fundamental equations of viscous flow, Conservation of mass, Conservation of Momentum-Navier-Stokes equations, Energy equation, Mathematical character of basic equations, Dimensional parameters in viscous flow, Non dimensional basic equations and boundary conditions, vorticity considerations, creeping flow and boundary layer flow

Unit II SOLUTIONS OF VISCOUS FLOW EQUATIONS 6+6=12

Solutions of viscous flow equations, Couette flows, Hagen-Poisuelle flow, Flow between rotating concentric cylinders, Combined Couette-Poiseuille Flow between parallel plates, Creeping motion, Stokes solution for an immersed sphere, Development of boundary layer, Displacement thickness, momentum and energy thickness.

Unit III LAMINAR BOUNDARY LAYER EQUATIONS 6+6=12

Laminar boundary layer equations, Flat plate Integral analysis of Karman – Integral analysis of energy equation – Laminar boundary layer equations – boundary layer over a curved body-Flow separation- similarity solutions, Blasius solution for flat-plate flow, Falkner–Skan wedge flows, Boundary layer temperature profiles for constant plate temperature –Reynold's analogy, Integral equation of Boundary layer –Pohlhausen's method – Thermal boundary layer calculations

Unit IV TURBULENT BOUNDARY LAYER 6+6=12

Turbulence-physical and mathematical description, Two-dimensional turbulent boundary layer equations — Velocity profiles – The law of the wall – The law of the wake – Turbulent flow in pipes and channels – Turbulent boundary layer on a flat plate – Boundary layers with pressure gradient, Eddy Viscosity, mixing length Turbulence modeling

Unit IV COMPRESSIBLE BOUNDARY LAYERS 6+6=12

Compressible boundary layer equations, Recovery factor, similarity solutions, laminar supersonic Cone rule, shock-boundary layer interaction

LECTURE: 30 TUTORIAL: 30 TOTAL: 60

TEXT BOOKS

1. White, F. M., Viscous Fluid Flow, McGraw-Hill & Co., Inc., New York., 1985.

REFERENCE BOOKS

1. Schlicting, H., Boundary Layer Theory, McGraw-Hill, New York, 1979.

2. Reynolds, A, J., Turbulent Flows Engineering, John Wiley and Sons, 1980.

XAS505E	NAVIGATION SYSTEMS	L	T	P	C
		2	1	0	3

		L	T	P	H
		2	2	0	4

UNIT I AIR NAVIGATION 6+6=12

The Aircraft, Aids of Navigation VOR, ADF, ILS, MLS,GCA, DME, TACAN - Doppler and basics of Celestial Navigation, Their limitations and uses - Weather, Air Traffic Control, Communications, GPS, TACAS, ATC Interrogation Radar.

UNIT II INSTRUMENTS 6+6=12

Functions of navigational Instruments - The Speed Indicator - The Rate of Climb indicator - The Altimeter - The magnetic Compass - The Turn and Bank indicator - The Directional Gyro - The Artificial Horizon - Radio, Radar Altimeter - Mach meter - Fluxgate Compass ADI, HIS and RMI.

UNIT III AIR NAVIGATION COMPUTERS AND RADIO NAVIGATION 6+6=12

Function and Usefulness - The Slide Rule Side - The Wind Triangle Side - Principles of radio transmission and reception; properties of electromagnetic waves - classification of frequency bands, elementary knowledge of Radar.

UNIT IV INERTIAL NAVIGATION 6+6=12

Autonomous Strap down Inertial Navigation, Reference Frames, MEMS based Inertial sensors, Integrated Inertial Sensors.

UNIT V PRACTICE OF NAVIGATION 6+6=12

Details of Navigation. Preparation of Charts for use in Flight Pilotage - Contact Instrument Flying - Future Air Navigation system(FANS), Cruise controls, Flight planning using charts and tables, Extended Range Operations, Aircraft Performance.

Lecture : 30 Tut: 30 TOTAL : 60

Text Books

1. Fundamentals of Inertial Sensors and Navigation, Amitava Bose , K N Bhat,Thomas Kurian

2.The Air Pilot's Manual, Flying Training Vol.3, Airlife Publishing

3. J E Hitercock, Navigation for Pilots, Airlife Publishing 1997

References :

1. R B Underdown, Ground Studies for Pilots, Vol.3, Blackwell

2. Trevor Thom, Air Navigation, Airlife Publishing

3. A E Bramson and N H Birch, Radio Navigation for Pilots, Airlife Publishing 1984.

XAS 606A	AIRFRAME MAINTENANCE AND REPAIR	L	T	P	C
		3	0	0	3

		L	T	P	H
		3	0	0	3

Unit I **WELDING IN AIRCRAFT STRUCTURAL COMPONENTS** **9**

Equipments used in welding shop - Ensuring quality welds -Welding jigs and fixtures - Soldering and brazing. Maintenance and Repair of Sheet metal: Selection of materials; Repair schemes; Fabrication of replacement patches; Tools: power/hand; Repair techniques; Close tolerance fasteners; Sealing compounds; Forming/shaping.

Unit II **PLASTICS AND ADVANCED COMPOSITES IN AIRCRAFT** **9**

Review of plastics used in airplanes -Maintenance and repair of plastic components - Repair of cracks, holes etc., various repairs schemes - Scopes. Cleaning of Fibre Reinforced Plastic (FRP) materials; Break test; Repair Schemes; FRP/honeycomb sandwich materials; Vacuum-bag process - Special precautions - Autoclaves.

Unit III **AIRCRAFT JACKING, ASSEMBLY AND RIGGING** **9**

Airplane jacking, rigging, weighing and C.G. Location. Balancing of control surfaces –Inspection and maintenance.

Unit IV **REVIEW OF HYDRAULIC AND PNEUMATIC SYSTEM** **9**

Trouble shooting and maintenance practices – Inspection and maintenance of landing gear, air-conditioning and pressurization systems. Inspection and maintenance of Fire protection systems - Ice protection system -Rain removal system -Position and warning system.

Unit V **SAFETY PRACTICES** **9**

Hazardous materials storage and handling, Aircraft furnishing practices - Equipments. Trouble shooting. Theory and practices.

LECTURE: 45 **TUTORIAL: 0** **TOTAL: 45**

TEXT BOOKS

1. Kroes, Watkins, Delp, ***" Aircraft Maintenance and Repair ",*** McGraw Hill, New York, 1992

REFERENCE BOOKS

1. Larry Reithmeir, ***" Aircraft Repair Manual "***, Palamar Books, Marquette, 1992.

2. Brimm D.J. Bogges H.E., ***" Aircraft Maintenance "***, Pitman Publishing corp., New York, 1940.

XAS606B	ELEMENTS OF SATELLITE TECHNOLOGY	L	T	P	C
		3	0	0	3
		L	T	P	H
		3	0	0	3

UNIT I INTRODUCTION TO SATELLITE SYSTEMS **9**

Common satellite applications and missions – Typical spacecraft orbits – Definition of spin the three axis stabilization-Space environment – Launch vehicles – Satellite system and their functions.

UNIT II ORBITAL MECHANICS **9**

Orbital velocity – escape velocity – Period of revolution - Time and coordinate systems – Orbital equation – Orbit determination and prediction – satellite trajectories - GPS systems and application for satellite/orbit determination

UNIT III SATELLITE STRUCTURES & THERMAL CONTROL **9**

Satellite mechanical and structural configuration – Structural materials and fabrication – The need of thermal control: externally induced thermal environment – Internally induced thermal environment - Heat transfer mechanism – Thermal control systems: active and passive methods.

UNIT IV SPACECRAFT CONTROL **9**

Control requirements: attitude control - type of control maneuvers – Stabilization schemes: spin stabilization, gravity gradient methods, 3 axis stabilization – Commonly used control systems: mass expulsion systems, momentum exchange systems, gyro and magnetic torque - magnetometers and inertial sensors.

UNIT V POWER SYSTEM AND BUS ELECTRONICS **9**

Solar panels: Silicon and Ga-As cells – Space battery systems – battery types, characteristics and efficiency parameters – Power electronics. **Telemetry and tele-command systems:** TM & TC functions - generally employed communication bands (UHF/VHF, S, L, Ku, Ka etc), their characteristics and applications - Onboard computer.

TOTAL: 45 PERIODS

TEXT BOOKS

1. E.F. Bruhn ,Analysis and Design of Flight Vehicle Structures, Tri-State off set company, USA,1980.

2. Rilay, FF , Space Systems Engineering, McGraw Hill, 1982.

3. Vertregt.M.,Principles of Astronautics, Elsvier Publishing Company, 1985.

4. Introduction Space Flight, Francis J. Hale Prentice Hall, 1994.

5. Space Vehicle Design, Michael D. Griffin and James R. French, AIAAEducation Series, 1991.

REFERENCES

1. Lewis H. Abraham ,Structural Design of Missiles & Space Craft, McGrawHill, 1992.

2. Richard.F, Filipowsky Eugen I Muehllorf , Space Communications Systems, Princtice Hall, 1995.

4. Hughes, P.C. Space Craft Altitude Dynamics, Wilsey, 1986.

5. Gebmart, Heat Transfer, McGraw Hill, Martin J. Communication Satellite Systems, McGraw Hill, 1978.

XAS606C	AIRCRAFT RULES AND REGULATION CAR I AND II	L	T	P	C
		3	0	0	3
		L	T	P	H
		3	0	0	3

UNIT I CAR SERIES 'A' **9**

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 - CAR SERIES 'B' - Issue approval of cockpit check list - MEL -CDL: Deficiency list (MEL & CDL); Preparation and use of cockpit check list and emergency list.

UNIT II CAR SERIES 'C' AND 'D' **11**

CAR SERIES 'C' - Defect recording - reporting - investigation - rectification and analysis - Flight report - Reporting and rectification of defects observed on aircraft - Analytical study of in-fight readings & recordings - Maintenance control by reliability Method.

CAR SERIES 'D' – Aircraft Maintenance Programmes - Reliability Programme (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 III CAR SERIES 'F' **8**

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.

UNIT IV CAR SERIES 'L and M' **8**

Issue of AME License - its classification and experience requirements - Complete Series 'L'. CAR SERIES 'M' Mandatory Modifications / Inspections.

UNIT V CAR SERIES 'X' **9**

CAR SERIES 'X' – 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 taxi permit - Procedure for issue of type approval of aircraft components and equipment including instruments.

LECTURE:45 TUTORIAL:0 TOTAL: 45 PERIODS

TEXT BOOKS

1. Civil Aviation Requirements with latest Amendment (section 2 Airworthiness)", Published by DGCA. The English Book Store, 17-1 Connaught Circus, New Delhi.
2. Lloyd Dingle ,"Aircraft Engineering Principles",A Butterworth-Heinemann Title; 1st edition edition,2004

REFERENCE BOOKS

1. Aircraft Manual (India) ", Volume - Latest Edition, The English Book Store, 17-1, Connaught Circus, New Delhi.
2. Aeronautical Information Circulars (relating to Airworthiness) ", from DGCA.

XAS 606D

SENSORS AND MEASUREMENTS

L	T	P	C
3	0	0	3

L	T	P	C
3	0	0	3

Unit I **SCIENCE OF MEASUREMENT** **7**

Introduction to measurement Systems – Instrumentation – Classification and Characteristics of Transducers – Static and Dynamic – Errors in Measurements – Calibration.

Unit II **DISPLACEMENT, PRESSURE,TEMPERATURE SENSORS** **11**

Strain Gauge: Gauge factor, sensing elements, configuration, unbounded strain gage, strain gauge as displacement & pressure transducers: force summing devices, capacitive transducer, inductive transducer, LVDT, Passive types: RTD materials & range, relative resistance vs. temperature characteristics, thermistor characteristics - active type: Thermocouple

Unit III **PHOTO ELECTRIC AND PIEZO ELECTRIC SENSORS** **9**

Phototube, Photo Multiplier Tube (PMT), photovoltaic, photoconductive cells, photo diodes, phototransistor, comparison of photoelectric transducers, spectro-photometric applications of photo electric transducers. Piezoelectric active transducer and

Unit IV **SIGNAL CONDITIONING & SIGNAL ANALYSER** **9**

AC and DC Bridges –Wheatstone bridge, Kelvin, Maxwell, Hay, Schering -Pre-amplifier – impedance matching circuits – isolation amplifier. Spectrum analyzer

Unit V **DISPLAY AND RECORDING DEVICES** **9**

Digital voltmeter – Multi meter – CRO – block diagram, CRT – vertical & horizontal deflection system, DSO, LCD monitor, PMMC writing systems, servo recorders, photographic recorder, magnetic tape recorder, X–Y recorder, thermal recorder.

Lecture:45 **Total : 45**

TEXT BOOKS:

1. Albert D.Helfrick and William D. Cooper. Modern Electronic Instrumentation and Measurement Techniques", Prentice Hall of India, 2007.

REFERENCES:

1. Ernest o Doebelin and dhanesh N manik, Measuremet systems, Application and design ,5th edition ,McGraw-Hill, 2007.

2. Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw-Hill, New Delhi, 2007.

3. Leslie Cromwell, “Biomedical Instrumentation and measurement”, Prentice hall of India, New Delhi, 2007.

4. John G. Webster, “Medical Instrumentation Application and Design”, John Wiley and sons, New York, 2004

XAS 606E	HELICOPTER MAINTENANCE	L	T	P	C
		3	0	0	3
		L	**T**	**P**	**H**
		3	0	0	3

Unit I **HELICOPTER FUNDAMENTAL** **5**

Basic directions – Ground handling, bearing – Gears.

Unit II **MAIN ROTOR SYSTEM** **9**

Head maintenance – blade alignment – Static main rotor balance – Vibration – Tracking – Span wise dynamic balance – Blade sweeping –Electronic balancing – Dampener maintenance – Counter weight adjustment – Auto rotation adjustments – Mast & Flight Control Rotor - Mast – Stabilizer, dampeners – Swash plate flight control systems collective – Cyclic – Push pull tubes – Torque tubes – Bell cranks – Mixer box – Gradient unit control boosts – Maintenance & Inspection control rigging.

Unit III **MAIN ROTOR TRANSMISSIONS** **12**

Engine transmission coupling – Drive shaft – Maintenance clutch – Free wheeling units – Spray clutch – Roller unit – Torque meter – Rotor brake – Maintenance of these components – vibrations – Mounting systems – Transmissions.

Unit IV **POWER PLANTS & TAIL ROTORS** **12**

Fixed wing power plant modifications – Installation – Different type of power plant maintenance. Tail rotor system – Servicing tail rotor track – System rigging.

Unit V **AIRFRAMES AND RELATED SYSTEMS** **7**

Fuselage maintenance – Airframe Systems – Special purpose equipment

LECTURE: 45 **TUTORIAL: 0** **TOTAL: 45**

TEXT BOOK

1. Jeppesen, “Helicopter Maintenance”, Jeppesons and Sons Inc., 2000.

REFERENCES

1. “Civil Aircraft Inspection Procedures”, Part I and II, CAA, English Book House, New Delhi, 1986.

2. Larry Reithmier, “Aircraft Repair Manual”, Palamar Books Marquette,1992.

XAS704A	SPACE WEAPONS AND WARFARE	L	T	P	C
		3	0	0	3

		L	T	P	H
		3	0	0	3

UNIT I INTRODUCTION 9

Fundamentals concepts in missile trajectories and satellite orbits – Bombardment satellites – directed energy weapons – general characteristics – use of laser for missile targets – kinetic energy weapons above the atmosphere – weapons against terrestrial targets – conventional weapons against terrestrial targets.

UNIT II EMPLOYMENT & COMMAND 9

Functions and tasks – component and sequence about commanding space weapon systems Advantages with respect to access and reach, responsiveness, distance and difficulty in defending against the weapons – Limitations and uses and implications.

UNIT III BALLISTIC MISSILE DEFENCE 9

Introduction to ballistic missile defence – Theatre Ballistic Missiles (TBM) – Classification – threat assessment – limitations and uncertainties - Threat analysis for Boost phase interception – Typical assessment errors.

UNIT IV ARCHITECTURE AND EXTERNAL CUEING 9

Selection of defended assets and threat scenario – defence system qualities and constraints – defence architecture process and development – External cueing process and uses – calculation of launch point – cued acquisition – Defence planning using external cueing – Radar degraded performance multiple radars and cue sources – system characteristics and use of cues.

UNIT V INTERCEPTION GUIDANCE AND INTERCEPTION OF MANEUVERING 9

Proportional navigation geometry – proportional navigation linearized system and zero miss distance proportional navigation – optimal guidance law – mathematical modeling of pursuit – evasion – solution with constrained evader – stochastic analysis.

LECTURE: 45 TUTORIAL: 0 TOTAL: 45

TEXT BOOKS

1. Sean Edwards ,Space weapons and Earth wars , Bob Preston, Dand J Johnson and Jennifer Gross, 2002, RAND Publications, USA

REFERENCE BOOKS

1. Ben-Zion Naveh and AzrialLorber ,Theatre Ballistic Missile Defense, Progress in Astronautics and Aeronautics, Volume 192, published by AIAA, USA 2001.

XAS704B	THEORY OF VIBRATIONS	L	T	P	C
		3	0	0	3
		L	T	P	H
		3	0	0	3

Unit I **SINGLE DEGREE OF FREEDOM SYSTEMS, TWO DEGREE OF FREEDOM SYSTEMS** **9**

Free and forced vibrations; Damping-classification and damped systems. Vibration measurements. Vibration isolation - Free, forced, damped and undamped motions, Use of influence coefficients, matrix methods and Lagrange's equation, Phenomenon of beat, Dynamic absorbers–applications.

Unit II **EXPERIMENTAL METHODS IN VIBRATION ANALYSIS** **9**

Vibration instruments, vibration exciters, transducers and measurement devices, analyzers, vibration tests- free and forced vibration tests.

Unit III **VIBRATION OF CONTINUOUS SYSTEMS** **9**

Transverse, flexural, torsional vibration of beams, timoshenko beam, Hamilton principle, vibration of plates, collocation method, myklested – prohl method.

Unit IV **TRANSIENT VIBRATIONS** **10**

Duhamel's integral, method of step input, phase plane method, method of laplace transformation, drop test spectra by laplace transformations.

Unit V **NON LINEAR VIBRATIONS** **8**

Non-linear vibrations and superposition principle, examples of non-linear vibrations, method of dealing with non-linear vibrations, phase plane trajectories, method of direct integration, perturbation method, iteration method, Fourier series.

LECTURE: 45 **TUTORIAL: 0** **TOTAL: 45**

TEXT BOOKS

1. Theory of vibration with applications:
2. Theory and practice of mechanical vibrations:

REFERENCE BOOKS

1. Mechanical vibration *:- S. S. Rao (Addison Wesley)*
2. Vibration and noise for Engineers :-*KewalPujara (DhanpatRai and Co.)*
3. Mechanical vibrations :- *G. K. Grover and Nigam (Nemchand and sons)*
4. An introduction to mechanical vibrations :-*Steidel (John Wiley)*
5. Elements of vibration analysis :-*Meirovitch (TMH)*

XAS704C	HIGH TEMPERATURE MATERIALS	L	T	P	C
		3	0	0	3
		L	T	P	H
		3	0	0	3

UNIT I CREEP 9

Crystal structure – 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**–**Introduction to creep map.

UNIT II DESIGN FOR CREEP RESISTANCE 9

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

UNIT III FRACTURE 9

Various types of fracture, brittle to ductile from low temperature to high temperature ,cleavage fracture, and ductile fracture due to micro void coalescence **– D**iffusion controlled void growth; fracture maps.

UNIT IV OXIDATION AND HOT CORROSION 9

Oxidation, Pilling - Bedworth 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, interaction of hot corrosion and creep, methods of combat hot corrosion.

UNIT V SUPERALLOYS AND OTHER MATERIALS 9

Iron base, Nickel base and Cobalt base super alloys, composition control, solid solution strengthening, precipitation hardening by gamma prime, grain boundary strengthening, TCP phase, embrittlement, solidification of single crystals, Intermetallics, high temperature ceramics.

Total: 45 PERIODS

TEXT BOOKS

1. Raj. R, " Flow and Fracture at Elevated Temperatures", American Society for Metals USA, 1985.

2. Courtney T.H, " Mechanical behavior of Materials", McGraw-Hill, USA, 1990.

REFERENCE BOOKS

1. Boyle J. T, Spencer J, "Stress Analysis for creep", Butterworths, UK, 1983.

2. McLean D., "Directionally Solidified Materials for High Temperature Service", The Metals Society, USA 1985.

		L	T	P	C
XAS704D	**WIND TUNNEL TECHNIQUES**	3	0	0	3
		L	**T**	**P**	**H**
		3	0	0	3

Unit I PRINCIPLES OF MODEL TESTING 9

Buckingham pi Theorem – Non dimensional numbers – Scale effect – Geometric Kinematic and Dynamic similarities - dimensional analysis

Unit II WIND TUNNELS 9

Classification – special problems of testing in subsonic, transonic, supersonic and hypersonic speed regions – Layouts – sizing and design parameters.

Unit III CALIBRATION OF WIND TUNNELS 9

Test section speed – Horizontal buoyancy – Flow angularities – Turbulence measurements – Associated instrumentation – Calibration of supersonic tunnels – power requirement

Unit IV WIND TUNNEL MEASUREMENTS 10

Steady and Unsteady Pressure and velocity measurements – PIV – LDV - Force measurements – Hot wire Anemometer - Three component and six component balances – Internal balances – Principles of Hotwire Anemometer.

Unit V FLOW VISUALIZAITON 8

Smoke and Tuft grid techniques – Dye injection special techniques – Optical methods of flow visualization

LECTURE: 45 TUTORIAL: 0 TOTAL: 45

TEXT BOOKS

1.Rae, W.H. and Pope, A., Low Speed Wind Tunnel Testing, John Wiley Publication, 1984.

2.R.C. Pankhurst and D.W. Holder , "Wind-tunnel Technique"Pitman Publishing; New impression edition 1968.

REFERENCE BOOKS

1.Pope, A., and Goin, L., High Speed Wind Tunnel Testing, John Wiley, 1985.

2.Bradsaw, "Experimental Fluid Mechanics",Pergamon Press; 2nd edition,1970.

XAS704E	AEROELASTICITY	L	T	P	C
		3	0	0	3

		L	T	P	H
		3	0	0	3

Unit I INTRODUCTION TO AEROELASTICITY 9

Stability versus response problems – The aeroelastic triangle of forces – Aeroplasticity in Aircraft Design – Prevention of aeroelastic instabilities.

Unit II DIVERGENCE OF A LIFTING SURFACE 9

Simple two dimensional idealizations-Strip theory – Freedom integral equation of the second kind – Exact solutions for simple rectangular wings – 'Semi rigid' assumption and approximate solutions – Generalized coordinates – Successive approximations – Numerical approximations using matrix equations.

Unit III STEADY STATE AERO-ELASTIC PROBLEMS 9

Loss and reversal of aileron control – Critical aileron reversal speed – Aileron efficiency – Semi rigid theory and successive approximations – Lift distribution – Rigid and elastic wings.

Unit IV FLUTTER PHENOMENON 9

Non-dimensional parameters – Stiffness criteria – Dynamic mass balancing – Model experiments – Dimensional similarity – Flutter analysis – Two dimensional thin airfoils in steady incompressible flow – Quasi-steady aerodynamic derivatives – Galerkin method for critical speed – Stability of disturbed motion – Torsion flexure flutter – Solution of the flutter determinant – Methods of determining the critical flutter speeds – Flutter prevention and control.

Unit V AEROELASTIC PROBLEMS 9

Galloping of transmission lines and flow induced vibrations of tall slender structures and suspension bridges - Problems in Aircraft's structure - Problems in Aerospace vehicles - Disasters - Prevention and Control.

LECTURE: 45 TUTORIAL: 0 TOTAL: 45

TEXT BOOKS

1. Y.C. Fung, ***"An Introduction to the Theory of Aeroelasticity"***, John Wiley & Sons Inc., New York,1985
2. R.L. Bisplinghoff, H.Ashley, and R.L. Halfmann, ***"Aeroelasticity"***, II Edition Addison Wesley Publishing Co., Inc., 1987

1 **REFERENCE BOOKS**

1. E.G. Broadbent, ***"Elementary Theory of Aeroelasticity"***, Bun Hill Publications Ltd., 1986.

2 R.H. Scanlan and R.Rosenbaum, ***"Introduction to the study of Aircraft Vibration and Flutter"***.Macmillan Co., New York, 1981.

XAS705A

L	T	P	C
3	0	0	3
L	T	P	H
3	0	0	3

EXPERIMENTAL STRESS ANALYSIS

UNIT I MEASUREMENTS 6

Principles of Measurements, Accuracy, Sensitivity and range of measurements.

UNIT II EXTENSOMETERS 9

Mechanical, Optical Acoustical and Electrical extensometers and their uses, Advantages and disadvantages.

UNIT III ELECTRICAL RESISTANCE STRAIN GAUGES 10

Principle of operation and requirements, Types and their uses, Materials for strain gauge. Calibration and temperature compensation, cross sensitivity, Rosette analysis, Wheatstone bridge and potentiometer circuits for static and dynamic strain measurements, strain indicators.

UNIT IV PHOTOELASTICITY 10

Two dimensional photo elasticity, Concept of light – Photo elastic effects, stress optic law, Interpretation of fringe pattern, Compensation and separation techniques, Photo elastic materials. Introduction to three dimensional photo elasticity.

UNIT V NON – DESTRUCTIVE TESTING 10

Fundamentals of NDT, Radiography, Ultrasonic, Magnetic particle inspection, Fluorescent penetrant technique, Eddy current testing, Acoustic Emission Technique

L: 45 T: 0 Total: 45

TEXT BOOKS

1. Srinath,L.S.,Raghava,M.R.,Lingaiah,K.,Garagesha,G.,PantB.,andRamachandra, K., "Experimental Stress Analysis", Tata McGraw-Hill, 1984.
2. Dr. Sadhu singh, Experimental Stress Analysis, khanna publishers, 2009

REFERENCES

1. Dally, J.W., and Riley, W.F., "Experimental Stress Analysis", McGraw-Hill Inc., 1998.

2. Hetyenyi,M.,“HandbookofExperimentalStressAnalysis”,JohnWileyandSonsInc., 1972.
3. PollockA.A.,“AcousticEmissioninAcousticsandVibrationProgress”,Ed.Stephens R.W.B., Chapman and Hall, 1993.

XAS705C	ROCKETSAND MISSILES	L	T	P	C
		3	0	0	3
		L	T	P	H
		3	0	0	3

UNIT I ROCKETS SYSTEM 10

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 13

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 ROCKETMOTION 10

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 OFROCKET VEHICLES 7

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

UNIT V MATERIALS FOR ROCKETS ANDMISSILES 5

Selection of Materials – Special Requirements of Materials to Perform under Adverse Conditions

.

Total: 45 Periods

TEXT BOOKS

1. Sutton, G.P., et al., “Rocket Propulsion Elements”, John Wiley & Sons Inc., 1993.

REFERENCES

1. Mathur, M., and Sharma, R.P., “Gas Turbines and Jet and Rocket Propulsion”, Standard Publishers, 1998.
2. Cornelisse,J.W.,“RocketPropulsionandSpaceDynamics”,J.W.,Freeman&Co.Ltd., 1982.
3. Parket,E.R.,“MaterialsforMissilesandSpacecraft”,McGraw-HillBookCo.Inc., 1982.

XAS705D	FATIGUE AND FRACTURE MECHANICS	L	T	P	C
		3	0	0	3
		L	T	P	H
		3	0	0	3

UNITI FATIGUE OF STRUCTURES 7

S.N.curves-Endurance limits-Effect of mean stress, Goodman, Gerberand Soderberg relations and diagrams-Notches and stress concentrations-Neuber's stress concentration factors - Plastic stress concentration factors - Notched S.N. curves.

UNITII STATISTICAL ASPECTS OF FATIGUE BEHAVIOUR 10

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

UNIT III PHYSICAL ASPECTS OF FATIGUE 10

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

UNITIV FRACTUREMECHANICS 10

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

UNITV FATIGUE DESIGNANDTESTINIG 8

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

Total: 45 Periods

TEXT BOOKS

1. Prasanth Kumar, "Elements of Fracture Mechanics", Wheeter Publication, 1999.
2. Barrois W, Ripely, E.L., "Fatigue of aircraft structure", Pregamon press. Oxford, 1983.

REFERENCES

1. Sin, C.G., “Mechanics of fracture” Vol. I, Sijthoff and w Noordhoff International Publishing Co., 1989.
2. Knott,J.F.,“FundamentalsofFractureMechanics”,Buterworth&Co.,Ltd.,1983

XAS705E **COMPOSITE MATERIALS**

L	T	P	C
3	0	0	3
L	T	P	H
3	0	0	3

UNITI MICRO-MECHANICS **9**

Introduction - Advantages and application of composite materials – reinforcements and matrices - Micro mechanics – Mechanics of materials approach, elasticity approach to determine material properties – Fibre Volume ratio – Mass fraction –Effect of voids, hygro thermal effects on a lamina.

UNIT II MACRO-MECHANICS **9**

Generalized Hooke's Law - Elastic constants for anisotropic, orthotropic and isotropic materials - Macro Mechanics – Stress-strain relations with respect to natural axis, arbitrary axis – Determination of material properties – Experimental Characterization of lamina.

UNIT III LAMINATED PLATES **9**

Governing differential equation for a unidirectional lamina and general laminate, angle ply and cross ply laminate, Failure criteria for composites.

UNIT IV FABRICATION PROCESS **9**

Various open and closed mould processes, Manufacture of fibers, Types of resins and their properties and applications, Netting analysis.

UNIT V SANDWICH CONSTRUCTIONS **9**

Basic design concepts of sandwich construction - Materials used for sandwich construction - Failure modes of sandwich panels - Bending stress and shear flow in composite beams.

Lecture: 45 Periods; Tutorial: 0 Periods; Total: 45 Periods

TEXT BOOKS

1. Jones, R.M., "Mechanics of Composite Materials," Taylor & Francis, II Edition, 2000.

2. Madhuji Mukhapadhyay, Mechanics of Composite Materials and Structures, University Press, 2004

REFERENCES

1. Agarwal, B.D., and Broutman, L.J., "Analysis and Performance of Fibre Composites," John Wiley and sons. Inc., New York, 1995.

2. Lubin, G., Handbook on Advanced Plastics and Fibre Glass, Von Nostrand Reinhold Co., New York, 1989.

3. Autar K Kaw, ‘Mechanics of Composite Materials’, CRC Press, 1997.

4. Calcote, L R. “The Analysis of laminated Composite Structures”, Von – Nostrand Reinhold Company, New York 1998

5. Allen Baker, Composite Materials for Aircraft Structures, AIAA Series, II Edition, 1999.

XAS802A	SPACECRAFT POWER SYSTEM	L	T	P	C
		3	0	0	3
		L	T	P	H
		3	0	0	3

UNIT I SPACECRAFT ENVIRONMENT & DESIGN CONSIDERATION 9

Orbit definition /Mission Requirements of LEO, GEO, GTO & HEO, Lunar orbits, IPO with respect to Power Generation – Power System Elements - Solar aspect angle Variations.

UNIT II POWER GENERATION 9

Study of Solar spectrum - Solar cells - Solar Panel design - Solar Panel Realization – Solar Panel testing - Effects of Solar cells and panels (IR, UV, Particles)

UNIT III ENERGY STORAGE TECHNOLOGY 10

Types of batteries – Primary & Secondary batteries - Nickel Cadmium - Nickel-Hydrogen – Nickel metal hydride - Lithium-ion –Lithium Polymer - Silver Zinc– Electrical circuit model – Performance characteristics of batteries - Application of batteries in launch vehicles and satellites – Fuel Cell – Polymer Electrolyte membrane Fuel Cell – Regenerative Fuel Cell.

UNIT IV POWER CONVERTERS 9

DC to DC converters – Basic Convertors - Buck, Boost, Buck- boost converter –Derived converters: Fly back converter – Transformer coupled forward converter – Push-Pull converter - CUKs convertor– Resonant converter – Voltage and current regulators.

UNIT V POWER CONTROL, CONDITIONING AND DISTRIBUTION 8

Solar Array Regulators – Battery changing schemes – Protection Schemes - Distribution – Harness - Thermal Design - EMI/EMC/ESD/Grounding schemes for various types of circuits and systems.

LECTURE:45 TUTORIAL:0 TOTAL:45 PERIODS

TEXT BOOKS

1. P R K Chetty, ‘Spacecraft Power Systems’, 1978.
2. Patel, Mukund R, ‘Spacecraft Power Systems’ CRC Press Boca Raton, 2005.
3. Hyder, A k et.al, ‘ Space Power Technologies’ Imperial College Press London,2000.

REFERENCE BOOKS

1. Fortescue, Peter et.al, ‘ Spacecraft Systems Engineering’ John Wiley England,2003.

XAS802B	SPACE COMMUNICATION SYSTEMS	L	T	P	C
		3	0	0	3
		L	T	P	H
		3	0	0	3

UNIT I ELEMENTS OF SATELLITE COMMUNICATION 9

Satellite Systems - Orbital description and Orbital mechanics of LEO - MEO and GSO - Placement of a Satellite in a GSO - Satellite: description of different Communication subsystems, Bandwidth allocation.

UNIT II TRANSMISSION, MULTIPLEXING, MULTIPLE ACCESS AND CODING 9

Different modulation and Multiplexing Schemes - Multiple Access Techniques FDMA - TDMA - CDMA and DAMA Coding Schemes - Satellite Packet Communications.

UNIT III SATELLITE LINK DESIGN 9

Basic link analysis - Interference analysis - Rain induced attenuation and interference - Ionospheric characteristics - Link Design with and without frequency reuse.

UNIT IV SATELLITE TELEMETRY, TRACKING AND TELECOMMAND 11

Introduction to telemetry systems - Aerospace transducer - signal conditioning – multiplexing methods - Analog and digital telemetry - Command line and remote control system - Application of telemetry in spacecraft systems - Base Band Telemetry system - Computer command & Data handling - Satellite command system-Issues.

UNIT V APPLICATIONS 7

VSAT and its Technology - Networks MSS-AMSS - MMSS

LECTURE:45 TUTORIAL:0 TOTAL: 45 PERIODS

TEXT BOOKS

1. Wilbur L. Pritchard and Joseph A.Sciulli, Satellite Communication Systems Engineering, Prentice
   Hall, New Jersey, 1986.
2. Timothy Pratt and Charles W.Bostain, Satellite Communications, John Wiley and Sons, 1986.
3. Tri T Ha, Digital Satellite Communication, Macmillan Publishing Company, 1986.
4. Kadish, Jules E, Satellite Communications Fundamentals, Artech House, Boston 2000.

REFERENCE BOOKS

1. Lida,Takashied.,Satellite communications:System and its design technology, Ohmsha Tokyo 2000.
2. Maral, Gerard,Satellite communications systems: Systems, techniques and technology, John Wiley, Newyork 2002.
3. Elbert, Bruce R, Satellite communication applications handbook, Artech house Boston 2004.

XAS802C	**AIR TRAFFIC CONTROL AND AERODROME DESIGN**	**L**	**T**	**P**	**C**
		3	0	0	3
		L	**T**	**P**	**H**
		3	0	0	3

Unit I **BASIC CONCEPTS** **8**

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

Unit II **AIR TRAFFIC SERVICES** **9**

Area control service, assignment of cruising levels minimum flight altitude ATS routes and significant points – RNAV and RNP – Vertical, lateral and longitudinal separations based on time / distance –ATC clearances – Flight plans – position report.

Unit III **FLIGHT INFORMATION ALERTING SERVICES** **9**

Radar service, Basic radar terminology – Identification procedures using primary / secondary radar – performance checks – use of radar in area and approach control services – assurance control and co-ordination between radar / non radar control – emergencies – Flight information and advisory service – Alerting service – Co-ordination and emergency procedures – Rules of the air.

Unit IV **AERODROME DATA** **9**

Aerodrome data - Basic terminology – Aerodrome reference code – Aerodrome reference point – Aerodrome elevation – Aerodrome reference temperature – Instrument runway, physical Characteristics; length of primary/secondary runway – Width of runways – Minimum distance between parallel runways etc. – obstacles restriction.

Unit V **VISUAL AIDS AND OTHER SERVICES** **10**

Visual aids for navigation Wind direction indicator – Landing direction indicator – Location and characteristics of signal area – Markings, general requirements – Various markings – Lights, general requirements – Aerodrome beacon, identification beacon – Simple approach lighting system and various lighting systems – VASI & PAPI - Visual aids for denoting

obstacles; object to be marked and lighter.

LECTURE: 45 TUTORIAL: 0 TOTAL: 45

TEXT BOOKS

1. AIP (India) Vol. I & II, “The English Book Store”, 17-1, Connaught Circus, New Delhi.
2. Seth Young, Alexander T. Wells, "Airport Planning and Management",2011.
3. Norman J. Ashford, Saleh Mumayiz, "Airport Engineering: Planning, Design and Development of 21st Century Airports, 2011.

REFERENCE BOOKS

1. “Aircraft Manual (India) Volume I”, latest Edition – The English Book Store, 17-1, Connaught Circus, New Delhi.

2. “PANS – RAC – ICAO DOC 4444”, Latest Edition, The English Book Store, 17-1, Connaught Circus, New Delhi.

XAS802D	MISSILE GUIDANCE AND CONTROL	L	T	P	C
		3	0	0	3

		L	T	P	H
		3	0	0	3

UNIT I MISSILE SYSTEMS INTRODUCTION 8

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

UNIT II MISSILE AIRFRAMES, AUTOPILOTS AND CONTROL 9

Missile aerodynamics- Force Equations, Moment Equations, Phases of missile flight. Missile control configurations. Missile Mathematical Model. Autopilots — Definitions, Types of Autopilots, Example Applications. Open-loop autopilots. Inertial instruments and feedback. Autopilot response, stability, and agility- Pitch Autopilot Design, Pitch-Yaw-Roll Autopilot Design.

UNIT III MISSILE GUIDANCE LAWS 10

Tactical Guidance Intercept Techniques, Derivation of the Fundamental Guidance Equations, explicit, Proportional Navigation, Augmented Proportional Navigation, beam riding, bank to turn missile guidance, Three-Dimensional Proportional Navigation, comparison of guidance system performance, Application of Optimal Control of Linear Feedback Systems.

UNIT IV STRATEGIC MISSILES 10

Introduction, The Two-Body Problem, Lambert's Theorem, First-Order Motion of a Ballistic Missile ,Correlated Velocity and Velocity-to-Be-Gained Concepts, Derivation of the Force Equation for Ballistic Missiles, Atmospheric Reentry, Ballistic Missile Intercept, Missile Tracking Equations of Motion, Introduction to Cruise Missiles , The Terrain-Contour Matching (TERCOM) Concept.

UNIT V WEAPON DELIVERY SYSTEMS 8

Weapon Delivery Requirements, Factors Influencing Weapon Delivery Accuracy, Unguided Weapons, The Bombing Problem, Guided Weapons, Integrated Flight Control in Weapon Delivery, Missile Launch Envelope and Mathematical Considerations pertaining to the accuracy of weapon delivery Computations.

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LECTURE: 45 TUTORIAL: 0 TOTAL: 45

TEXT BOOKS

1. Siouris, G.M. "Missile Guidance and control systems", Springer, 2003.

2. Garnell, P., "Guided Weapon Control Systems", 2nd Edition, Pergamon Press, 1980.

REFERENCE BOOKS

1. Blakelock, J. H.; Automatic Control of Aircraft and Missiles, 2nd Edition, John Wiley & Sons, 1990.

2. Fleeman, Eugene L.; Tactical Missile Design, First Edition, AIAA Education series, 2001.

3. Joseph Ben Asher and Isaac Yaesh “Advances in Missile Guidance Theory” AIAA Educationseries, 1998.

XAS802E	AIR TRANSPORTATION AND AIRCRAFT MAINTENANCE	L	T	P	C
		3	0	0	3

		L	T	P	H
		3	0	0	3

UNIT I INTRODUCTION **9**

Development of air transportation, comparison with other modes of transport - Role of IATA, ICAO The general aviation industry airline - Factors affecting general aviation, use of aircraft, airport: airline management and organization - levels of management, functions of management.

UNIT II AIRLINE ECONOMICS **9**

Forecasting Fleet size, Fleet planning, the aircraft selection process, operating cost, passenger capacity, load factor etc. - Passenger fare and tariffs

Fleet Planning: The aircraft selection process - Fleet commonality, factors affecting choice of fleet, route selection and Capital acquisition - Budgeting - Route analysis - Aircraft evaluation.

UNIT III PRINCIPLES OF AIRLINES SCHEDULING **9**

Equipment maintenance, Flight operations and crew scheduling, Ground operations and facility limitations equipments and types of schedule - hub and spoke scheduling, advantages / disadvantages and preparing flight plans

UNIT IV AIRCRAFT RELIABILITY **9**

Aircraft reliability - The maintenance schedule and its determination - Condition monitoring maintenance - Extended range operations - Ageing aircraft maintenance.

UNIT V TECHNOLOGY IN AIRCRAFT MAINTENANCE **9**

Airlines scheduling - Product support and spares - Equipments and tools for aircraft maintenance - Aircraft weight control - On board maintenance systems - Engine health monitoring - Helicopter maintenance.

Lecture: 45 Periods; **Total: 45Periods**

TEXT BOOKS

1. Fedric, J.H., *Airport Management*, English Book House, New Delhi-I.

2. Gene Krope., *Airline Procedures*, English Book House, New Delhi-I.

REFERENCE BOOKS

1. Wilson and Bryon, *Air Transportation*, English Book House, New Delhi-I.

2. Philip Lockin D, *Economics of Transportation*, English Book House, New Delhi-I.

3. *Indian Aircraft Manual*, Published by DGGA, English Book House, New Delhi-I.

4. Alexander T Wells, *Air Transportation*, Wadsworth Publishing Company, California, 1993.

5. Friend, C.H., *Aircraft Maintenance Management*, English Book House, New Delhi-I.

XAS803A	THEORY OF PLATES AND SHELLS	L	T	P	C
		3	0	0	3
		L	T	P	H
		3	0	0	3

UNIT I INTRODUCTION 9

Plate and shell structures in aerospace vehicles- Different materials – safe life and failure – Applications.

UNIT II SMALL DEFLECTION THEORY OF PLATES 10

Bending of thin plates-isotropic and orthotropic flat plates of different geometry – rectangular, square and skew plates-circular plates-different edge conditions-biharmonic equation for plate deflections.

UNIT III SHEAR DEFORMATION AND LARGE DEFLECTION 9

Assumptions-shear deformation – Analysis of flat plates – Analysis of curved plates and applications.

UNIT IV STABILITY OF PLATES 9

Different factors affecting stability of plates -Instability of Plates-different edge conditions – Numerical problems -Applications.

UNIT V SHELLS 8

Basic concepts – Deformation – Membrane theory of shells applied to shells of form of surface of revolution. General theory of cylindrical shells – Circular cylindrical shells – spherical shells and conical shells.

LECTURE:45 TUTORIAL:0 TOTAL: 45 PERIODS

TEXT BOOKS

1. W.Flugge, “Stresses in Shells”, II Edition Springer Verlag Co., New York, 1983.

2. A.L.Goldenvizier, “Theory of Elastic Thin Shells”, Pergamon Press, New York, 1981.

3. H.Kraus, Thin Elastic Shells”, John Wiley & Sons, Inc., New York, 1987.

REFERENCE BOOKS

1. S.P. Timoshenko and S.W.Krieger, “Theory of Plates and Shells”, II Edition McGraw-Hill, Kogakusha Ltd., Tokyo, 1989.

XAS803B	AUTOMATION AND CONTROL ENGINEERING	L T P C 3 0 0 3 L T P H 3 0 0 3

Unit I **AUTOMATION AND BUILDING BLOCKS** **9**

Automation, Reasons for Automation, Basic Elements of Automated system, advanced Automation functions, Levels of automation, Manual switches,Limit switches, Proximity switches, Fibre optics, Analyzers, Solenoids, Relays, Drives and types, Fundamentals of Manufacturing: Production operations and Automation Strategies, Production concept and Mathematical Models, Functions of Manufacturing.

Unit II **DETROIT-TYPE AUTOMATION** **9**

Automated Flow lines, Methods of transport, Transfer Mechanisms, Buffer storage, Automation for Machining operations, Design and Fabrication considerations, Analysis of Automated Flow Lines: Introduction and terminology.

Unit III **ANALYSIS OF TRANSFER LINES WITH/WITHOUT STORAGE** **9**

Lines. Assembly systems and line balancing: Assembly process, Assembly systems, Manual assembly Lines, the line balancing problems, Methods of line balancing, computerized line balancing methods.

Unit IV **LOGIC DIAGRAMS** **9**

Logic net works, Ladder Logic Diagrams, Timers, Response diagram. Programmable Logic controllers: Introduction, PLC cycle, PLC internal features, PLC programming.

Unit V **APPLICATION PROGRAMS** **9**

Advantages and Disadvantages of PLCs, Online Computer Control: Process control computers, Levels of implementations, Control strategies, Process interface, Interrupters, Process Computer Programming.

Total **45 hours**

Text Books:

1. Vishwanadhan. PHI , Performance Modelling of Automated Manufacturing Systems
2. Webb, McMillan, Principles and applications of PLC, by 1992.
3. Mikell P Grover, Automation Production systems and CIM, Person Education, Asia

Reference Books:

1. C Ray Asfahl , Robotics and Manufacturing Automation, John Wiley and Sons Inc, Second edition.

XAS803C	CRYOGENICS	L	T	P	C
		3	0	0	3
		L	T	P	H
		3	0	0	3

UNIT I INTRODUCTION TO CRYOGENICS 9

Historical Background - Introduction to cryogenic propellants - Liquid hydrogen, liquid helium, liquid nitrogen and liquid oxygen and their properties.

UNIT II PRODUCTION OF LOW TEMPERATURE 9

Theory behind the production of low temperature - Expansion engine heat exchangers - Cascade process Joule Thompson Effect - Magnetic effect - Ortho and H2 - Helium4 and Helium 3.

UNIT III EFFICIENCY OF CRYOGENIC SYSTEMS 9

Types of losses and efficiency of cycles - specific amount of cooling - The fraction liquefied – Cooling coefficient of performance - Thermodynamic efficiency – The energy balance Method.

UNIT IV CYCLES OF CRYOGENIC PLANTS 9

Classification of cryogenic cycles - The structure of cycles - Throttle expansion cycles - Expander cycles - Thermodynamic analysis - Numerical problems.

UNIT V APPLICATION 9

Cryogenic liquids in missile launching and space simulation - Storage of cryogenic liquids - Effect of cryogenic liquids on properties of aerospace materials – Cryogenic loading problems - Zero gravity problems associated with cryogenic propellants - Phenomenon of tank collapse - Elimination of Geysering effect in missiles.

TEXT BOOKS

1. Haseldom, G., *Cryogenic Fundamentals*, Academic Press, 1971.

2. Barron, R. F., *Cryogenic Systems*, Oxford University, 1985.

REFERENCE BOOKS

1. Parner, S. F., *Propellant Chemistry*, Reinhold Publishing Corpn., New York.

2. Mukho padhyay Mamata,"Fundamentals of Cryogenic Engineering",PHI (2010).

		L	T	P	C
XAS803D	**HYPERSONIC AERODYNAMICS**	3	0	0	3
		L	**T**	**P**	**H**
		3	0	0	3

Unit I FUNDAMENTALS OF HYPERSONIC AERODYNAMICS 9

Introduction to hypersonic aerodynamics – differences between hypersonic aerodynamics and supersonic aerodynamics – concept of thin shock layers and entropy layers – hypersonic flight paths – hypersonic similarity parameters – shock wave and expansion wave relations of inviscid hypersonic flows.

Unit II SIMPLE SOLUTION METHODS FOR HYPERSONIC INVISCID FLOWS 9

Local surface inclination methods-Newtonian theory-modified Newtonian law-tangent wedge and tangent cone and shock expansion methods-approximate theory-thin shock layer theory.

Unit III VISCOUS HYPERSONIC FLOW THEORY 9

Boundary layer equation for hypersonic flow-hypersonic boundary layers-self similar and non self similar boundary layers-solution methods for non self similar boundary layers- aerodynamic heating.

Unit IV VISCOUS INTERACTIONS IN HYPERSONIC 9

Introduction to the concept of viscous interaction in hypersonic flows-strong and weak viscous interactions-hypersonic viscous interaction similarity parameter-introduction to shock wave boundary layer interactions.

Unit V INTRODUCTION TO HIGH TEMPERATURE EFFECTS 9

Nature of high temperature flows-chemical effects in air-real and perfect gases-Gibb's free energy and entropy-chemically reacting mixtures-recombination and dissociation.

LECTURE: 45 TUTORIAL: 0 TOTAL: 45

TEXT BOOKS:

1. John. D. Anderson. Jr., "Hypersonic and High Temperature Gas Dyanmics", Mc. Graw hill Series, New York, 1996.

REFERENCES:

1.John. D. Anderson. Jr ., "Modern compressible flow with historical perspective", Mc. Graw Hill Publishing Company, New York, 1996.\

2.John. T Bertin, "Hypersonic Aerothermodynamics", published by AIAA Inc., Washington. D.C., 1994.

XAS803E	FINITE ELEMENT METHOD	L	T	P	C
		3	0	0	3

		L	T	P	H
		3	0	0	3

UNIT I INTRODUCTION 9

Review of various approximate methods – Raleigh Ritz's, Galerkin and finite difference methods- Governing equation and convergence criteria of finite element method.

UNIT II DISCRETE ELEMENTS 9

Bar elements, uniform section, mechanical and thermal loading, varying section, trusses analysis. Beam element - problems for various loadings and boundary conditions - longitudinal and lateral vibration. Use of local and natural coordinates.

UNIT III CONTINUUM ELEMENTS 9

Plane stress, Plane strain and axisymmetric problems, constant and linear strain, triangular elements, stiffness matrix, axisymmetric load vector.

UNIT IV ISOPARAMETRIC ELEMENTS 9

Definitions, Shape function for 4, 8 and 9 nodal quadrilateral elements, Stiffness matrix and consistent load vector, Gaussian integration.

UNIT V FIELD PROBLEM 9

Steady state Heat transfer problems, Derivation of element matrices for two dimensional problems, Torsion problems.

LECTURE: 45 TUTORIAL: 0 TOTAL: 45

TEXT BOOKS

1. Tirupathi.R. Chandrapatha and Ashok D. Belegundu – Introduction to FiniteElements in Engineering – Printice Hall India, Third Edition, 2003.
2. Rao. S.S., Finite Element Methods in Engineering, Butterworth and Heinemann, 2001.

REFERENCE BOOKS

1. Reddy J.N. – An Introduction to Finite Element Method – McGraw Hill – 2000.
2. Krishnamurthy, C.S., Finite Element Analysis, Tata McGraw Hill, 2000.
3. Bathe, K.J. and Wilson, E.L., Numerical Methods in Finite Elements Analysis, Prentice Hall of India, 1985.

OPEN ELECTIVES

		L	T	P	C
XASOE1	**ELEMENTS OF AERONAUTICS**	3	0	0	3

L	T	P	H
3	0	0	3

Unit I HISTORICAL EVOLUTION 9

History of aircrafts - Different types of air vehicles – classifications - Components of an airplane - Developments in aerodynamics - materials - structures and propulsion over the years.

Unit II EFFECTS OF ATMOSPHERE 9

Physical properties and structure of the atmosphere - Temperature - pressure and altitude relationships - Evolution of lift - drag and moment - Aerofoil terminologies- Mach number - Maneuver - Effect of atmosphere on Aircraft.

Unit III STRUCTURES AND MATERIALS 9

General types of construction - Typical wing and fuselage structure - Metallic and non-metallic materials - Use of aluminum alloy –Ceramics - composite materials – futuristic materials.

Unit IV POWER PLANTS 9

Basic ideas about piston and jet engines – classification of gas turbine engines - Use of propeller and jets for thrust production

Unit V PERFORMANCE 9

Airplane maneuvers – aircraft performance - Effects of changes of power, altitude and weight.

LECTURE: 45 TUTORIAL: 0 TOTAL: 45

TEXT BOOKS

1. *Anderson, J.D.,* ***" Introduction to Flight",*** *7th Edition, McGraw-HILL, 2011.*

2. *Kermode, A.C.,* ***"Flight without Formulae"****, 5th edition, Pearson Education,2008*

3. *Shevell.R.S* ***"Fundamentals of Flights",*** *Pearson education 2004.*

REFERENCE BOOKS

1. *Michael J.Kroes,"**Aircraft Basic Science", Eighth Edition,** McGraw-Hill Professional,2013.*

2.*Dale Crane,"**A Pilot's Guide to Aircraft and Their Systems",** Aviation Supplies &Academics Inc,2002*

4. *Mc kinley **"J.L and R.D Bent, Aircraft power plants",** McGraw-Hill,1993*

5.*Pallet **"E.H.J aircraft instruments and principles",** Pitman &co 1933.*

XASOE2	AIR TRANSPORTATION AND AIRCRAFT MAINTENANCE	L	T	P	C
		3	0	0	3

		L	T	P	H
		3	0	0	3

UNIT I INTRODUCTION **9**

Development of air transportation, comparison with other modes of transport - Role of IATA, ICAO The general aviation industry airline - Factors affecting general aviation, use of aircraft, airport: airline management and organization - levels of management, functions of management.

UNIT II AIRLINE ECONOMICS **9**

Forecasting Fleet size, Fleet planning, the aircraft selection process, operating cost, passenger capacity, load factor etc. - Passenger fare and tariffs

Fleet Planning: The aircraft selection process - Fleet commonality, factors affecting choice of fleet, route selection and Capital acquisition - Budgeting - Route analysis - Aircraft evaluation.

UNIT III PRINCIPLES OF AIRLINES SCHEDULING **9**

Equipment maintenance, Flight operations and crew scheduling, Ground operations and facility limitations equipments and types of schedule - hub and spoke scheduling, advantages / disadvantages and preparing flight plans

UNIT IV AIRCRAFT RELIABILITY **9**

Aircraft reliability - The maintenance schedule and its determinations - Condition monitoring maintenance - Extended range operations - Ageing aircraft maintenance.

UNIT V TECHNOLOGY IN AIRCRAFT MAINTENANCE **9**

Airlines scheduling - Product support and spares - Equipments and tools for aircraft maintenance - Aircraft weight control - On board maintenance systems - Engine monitoring - Turbine engine oil maintenance - Turbine engine vibration monitoring in aircraft - Current capabilities of NDT - Helicopter maintenance.

Lecture: 45 Periods; **Total: 45Periods**

TEXT BOOKS

1. Fedric, J.H., *Airport Management*, English Book House, New Delhi-I.

2. Gene Krope., *Airline Procedures*, English Book House, New Delhi-I.

REFERENCE BOOKS

1. Wilson and Bryon, *Air Transportation*, English Book House, New Delhi-I.

2. Philip Lockin D, *Economics of Transportation*, English Book House, New Delhi-I.

3. *Indian Aircraft Manual*, Published by DGGA, English Book House, New Delhi-I.

4. Alexander T Wells, *Air Transportation*, Wadsworth Publishing Company, California, 1993.

5. Friend, C.H., *Aircraft Maintenance Management*, English Book House, New Delhi-I.

		L	T	P	C
XASOE3	**WIND TUNNEL TECHNIQUES**	3	0	0	3
		L	**T**	**P**	**H**
		3	0	0	3

Unit I PRINCIPLES OF MODEL TESTING 9

Buckingham pi Theorem – Non dimensional numbers – Scale effect – Geometric Kinematic and Dynamic similarities - dimensional analysis

Unit II WIND TUNNELS 9

Classification – special problems of testing in subsonic, transonic, supersonic and hypersonic speed regions – Layouts – sizing and design parameters.

Unit III CALIBRATION OF WIND TUNNELS 9

Test section speed – Horizontal buoyancy – Flow angularities – Turbulence measurements – Associated instrumentation – Calibration of supersonic tunnels – power requirement

Unit IV WIND TUNNEL MEASUREMENTS 10

Steady and Unsteady Pressure and velocity measurements – PIV – LDV - Force measurements – Hot wire Anemometer - Three component and six component balances – Internal balances – Principles of Hotwire Anemometer.

Unit V FLOW VISUALIZAITON 8

Smoke and Tuft grid techniques – Dye injection special techniques – Optical methods of flow visualization

LECTURE: 45 TUTORIAL: 0 TOTAL: 45

TEXT BOOKS

1.Rae, W.H. and Pope, A., Low Speed Wind Tunnel Testing, John Wiley Publication, 1984.

2.R.C. Pankhurst and D.W. Holder , "Wind-tunnel Technique "Pitman Publishing; New impression edition 1968.

REFERENCE BOOKS

1.Pope, A., and Goin, L., High Speed Wind Tunnel Testing, John Wiley, 1985.

2.Bradsaw, "Experimental Fluid Mechanics", Pergamon Press; 2nd edition,1970.