DEPARTMENT OF
AEROSPACE ENGINEERING

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Board of Studies in Aerospace Engineering

CURRICULUM (From I – VIII Semesters) & SYLLABUS (From I –IV Semesters) **Regulation 2018**

(For the candidates admitted from 2018-19 onwards
Based on Outcome Based Education)

FOR

B.Tech (Aerospace Engineering)
DEGREE PROGRAMME

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 - centred 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.

CORE VALUES

- Student – centric vocation
- Academic excellence
- Social Justice, equity, equality, diversity, empowerment, sustainability
- Skills and use of technology for global competency.
- Continual improvement
- Leadership qualities.
- Societal needs
- Learning, a life – long process
- Team work
- Entrepreneurship for men and women
- 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	**DM1**	Providing capable, motivated, and well-prepared students with high quality, that will enable them to reach their maximum potential in a technical world.
	DM2	Significantly advance in knowledge, its application & integration in Aerospace and Aeronautical related disciplines.
	DM3	Involve in research and development with advanced tools and techniques keeping eco-friendly and sustainability.
	DM4	Serving the larger community by inculcating universal values and ethics through innovative projects.

Table: 1 Mapping of University Mission (UM) and Department Mission (DM)

	UM 1	UM 2	UM 3	UM 4	UM 5	Total	Scaled to 0,1,2 and 3
DM 1	**3**	**3**	**1**	**3**	**1**	**11**	**3**
DM 2	**1**	**2**	**3**	**2**	**3**	**11**	**3**
DM 3	**1**	**1**	**3**	**2**	**2**	**9**	**2**
DM 4	**0**	**1**	**2**	**0**	**3**	**6**	**2**

1-Low 2- Medium 3 – High

PROGRAMME EDUCATIONAL OBJECTIVES

Based on the mission of the department, the programme educational objectives is formulated as

PEO1	Provide education in Aerospace Engineering with global standards.
PEO2	Promote skills in Aerospace Engineering and interdisciplinary subjects.
PEO3	Develop the competency as per the requirement of reputed organizations.
PEO4	Create research and development activities through projects.
PEO5	Stimulate adaptability in the Nation development through imparting knowledge and skill.

Table: 2 Mapping of Program Educational Objectives (PEOs) with Department Mission (DM)

	DM 1	**DM 2**	**DM3**	**DM 4**
PEO 1	3	3	1	1
PEO 2	2	2	2	1
PEO 3	2	1	2	2
PEO 4	1	2	3	2
PEO 5	2	1	2	3
TOTAL	**10**	**9**	**10**	**9**

1- Low 2 – Medium 3-High

GRADUATE ATTRIBUTES

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling to complex engineering activities, with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning:** Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM OUTCOMES (POs)

PO	PROGRAM 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.	

Table 3 Mapping of Program Educational Objectives (PEOs) with Program Outcomes (POs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
PEO 1	3	3	3	1	1	1	2	1	1	1	1	1	3	1
PEO 2	2	3	3	3	3	2	3	1	0	1	1	1	3	1
PEO 3	2	3	3	3	3	3	3	2	1	3	2	0	3	3
PEO 4	3	3	3	3	2	3	3	2	1	0	0	2	3	0
PEO 5	2	2	3	2	1	3	3	2	2	0	0	2	2	1
TOT	**12**	**14**	**15**	**12**	**10**	**12**	**14**	**8**	**5**	**5**	**4**	**6**	**14**	**6**

1 - Low 2 – Medium 3 - High

STRUCTURE OF B.Tech AEROSPACE ENGINEERING PROGRAMME

S.No	Topic	Symbol	Credits
1.	Humanities and Social Sciences including Management	**HSMC**	**3**
2.	Basic Sciences	**BSC**	**27**
3.	Engineering Sciences including workshop, drawing, basics of Electrical/mechanical/computer etc.	**ESC**	**23**
5.	Professional Subjects: Subjects relevant to chosen specialization/branch	**PCC-AS**	**63**
6.	Professional Elective courses relevant to chosen specialization/branch	**PEC-AS**	**18**
7.	Open Subjects: Electives from other technical and/or emerging subjects	**OEC-AS**	**15**
8.	Project work, seminar and internship in industry or elsewhere	**PROJ-AS**	**12**
9.	Mandatory Courses [Environmental Sciences, Induction Program, Indian Constitution, Essence of Indian Traditional Knowledge]	**MC**	**0**
	Total		**161**

HUMANITIES & SOCIAL SCIENCES INCLUDING MANAGEMENT

Sl. No	Code No.	Subject	Semester	Credits
1.	XGS103	English	I	3
2.	XGS507	Essence of Indian Traditional knowledge	V	0
3.	XUM801	Cyber Security	VIII	0
	TOTAL			**3**

BASIC SCIENCE COURSES

Sl. No	Code No.	Subject	Semester	Credits
1.	XAC104	Applied Chemistry for Engineers	I	5
2.	XMA101	Mathematics I (Calculus and Linear Algebra)	I	4
3.	XAP204	Applied Physics for Engineers	II	6
4.	XMA201	Mathematics II (Calculus, Ordinary Differential Equations and Complex Variables)	II	4
5.	XAP306	Physics II (Optics and Waves)	III	4
6.	XMA301	Mathematics III (Transforms and Partial Differential Equations)	III	4
	TOTAL			**27**

ENGINEERING SCIENCE COURSES

Sl. No	Code No.	Subject	Semester	Credits
1.	XCP102	Programming for Problem Solving	I	5
2.	XWP105	Workshop Practices	I	3
3.	XBE203	Basic Electrical Engineering	I	5
4.	XEG205	Engineering Graphics and Design	II	3
5.	XES302	Engineering Materials	III	3
6.	XEM305	Engineering Mechanics	III	4
	TOTAL			**23**

PROFESSIONAL CORE COURSES

Sl. No	Code No.	Subject	Semester	Credits
1.	XAS303	Solid Mechanics	III	4
2.	XAS304	Fluid Mechanics and Machinery	III	3
3.	XAS401	Engineering Thermodynamics	IV	3
4.	XAS402	Introduction to Aircraft and Aerospace Vehicles	IV	3
5.	XAS403	Aerodynamics I	IV	4
6.	XAS404	Aircraft Structures I	IV	4
7.	XAS501	Aerodynamics II	V	4
8.	XAS502	Aircraft Structures II	V	5
9.	XAS503	Aerospace Propulsion	V	6
10.	XAS504	Elements of Satellite Technology	V	3
11.	XASM01	CATIA Software	V	1
12.	XAS601	Flight Dynamics	VI	4
13.	XAS602	Space Mechanics	VI	3
14.	XAS603	UAV Design	VI	5
15.	XAS604	Avionics	VI	4
16.	XASM02	Elements of Drone Technology	VI	1
17.	XAS701	Computational Fluid Dynamics	VII	5
	TOTAL			**63**

PROFESSIONAL ELECTIVE COURSES

Sl. No	Code No.	Subject	Semester	Credits
1.	XASE**	Professional Elective Course – I	IV	3
2.	XASE**	Professional Elective Course – II	V	3
3.	XASE**	Professional Elective Course – III	VI	3
4.	XASE**	Professional Elective Course – IV	VI	3
5.	XASE**	Professional Elective Course – V	VII	3
6.	XASE**	Professional Elective Course – VI	VII	3
	TOTAL			**18**

OPEN ELECTIVE COURSES

Sl. No	Code No.	Subject	Semester	Credits
1.	X**OE*	Open Elective I	V	3
2.	X**OE*	Open Elective II	VI	3
3.	X**OE*	Open Elective III	VII	3
4.	X**OE*	Open Elective IV	VIII	3
5.	X**OE*	Open Elective V	VIII	3
	TOTAL			**15**

SEMESTER-WISE STRUCTURE OF CURRICULUM

REGULATION – 2018

(Applicable to the students admitted from the Academic year 2018-19)

B.TECH AEROSPACE ENGINEERING

SEMESTER I

S.No	COURSE CODE	COURSE TITLE	L	T	P	C	H
1.	XMA101	Mathematics I (Calculus and Linear Algebra)	3	1	0	4	4
2.	XCP102	Programming for Problem Solving	3	0	4	5	7
3.	XGS103	English	2	0	2	3	4
4.	XAS104	Applied Chemistry for Engineers	3	1	2	5	6
5.	XWP105	Workshop Practices	1	0	4	3	5
		TOTAL				**20**	**26**

SEMESTER II

S.No	COURSE CODE	COURSE TITLE	L	T	P	C	H
1.	XMA201	Mathematics II (Calculus, Ordinary Differential Equations and Complex Variables)	3	1	0	4	4
2.	XES202	Environmental Sciences	3	0	0	0	3
3.	XBE203	Basic Electrical Engineering	3	1	2	5	6
4.	XAP204	Applied Physics for Engineers	3	1	4	6	8
5.	XEG205	Engineering Graphics and Design	1	0	4	3	5
		TOTAL				**18**	**26**

SEMESTER III

S.No	COURSE CODE	COURSE TITLE	L	T	P	C	H
1.	XMA301	Mathematics III (Transforms and Partial Differential Equations)	3	1	0	4	4
2.	XES302	Engineering Materials	3	0	0	3	3
3.	XAS303	Solid Mechanics	3	1	0	4	4
4.	XAS304	Fluid Mechanics and Machinery	2	1	0	3	3
5.	XEM305	Engineering Mechanics	3	1	0	4	4
6.	XAP306	Physics II (Optics and Waves)	3	1	0	4	4
		TOTAL				**22**	**22**

SEMESTER IV

S.No	COURSE CODE	COURSE TITLE	L	T	P	C	H
1.	XAS401	Engineering Thermodynamics	2	1	0	3	3
2.	XAS402	Introduction to Aircraft and Aerospace Vehicles	3	0	0	3	3
3.	XAS403	Aerodynamics I	3	0	2	4	5
4.	XAS404	Aircraft Structures I	3	1	0	4	4
5.	XASE**	Professional Elective Course I	3	0	0	3	3
6.	XCI406	Constitution of India	3	0	0	0	3
		TOTAL				**17**	**21**

SEMESTER V

S.No	COURSE CODE	COURSE TITLE	L	T	P	C	H
1.	XAS501	Aerodynamics II	3	1	0	4	4
2.	XAS502	Aircraft Structures II	3	1	2	5	6
3.	XAS503	Aerospace Propulsion	3	1	4	6	8
4.	XAS504	Elements of Satellite Technology	3	0	0	3	3
5.	XASE**	Professional Elective Course II	2	1	0	3	3
6.	X**OE*	Open Elective I	3	0	0	3	3
7.	XGS507	Essence of Indian Traditional knowledge	3	0	0	0	3
8.	XASM01	CATIA Software	1	0	0	1	1
		TOTAL				**25**	**31**

SEMESTER VI

S.No	COURSE CODE	COURSE TITLE	L	T	P	C	H
1.	XAS601	Flight Dynamics	3	1	0	4	5
2.	XAS602	Space Mechanics	3	0	0	3	3
3.	XAS603	UAV Design	3	0	4	5	6
4.	XAS604	Avionics	3	0	2	4	6
5.	XASE**	Professional Elective Course – III	3	0	0	3	3
6.	XASE**	Professional Elective Course – IV	3	0	0	3	3
7.	X**OE**	Open Elective II	3	0	0	3	3
8.	XASM02	Elements of Drone Technology	1	0	0	1	1
		TOTAL				**26**	**30**

SEMESTER VII

S.No	COURSE CODE	COURSE TITLE	L	T	P	C	H
1.	XAS701	Computational Fluid Dynamics	2	1	4	5	7
2.	XASE**	Professional Elective Course – V	3	0	0	3	3
3.	XASE**	Professional Elective Course – VI	2	1	0	3	3
4.	X**OE*	Open Elective III	3	0	0	3	3
5.	XAS705	Project Phase I	0	0	10	5	10
6.	XAS706	In-Plant Training	3	0	0	1	3
		TOTAL				**21**	**29**

SEMESTER VIII

S.No	COURSE CODE	COURSE TITLE	L	T	P	C	H
1.	XUM801	Cyber Security	3	0	0	0	3
2.	X**OE*	Open Elective IV	3	0	0	3	3
3.	X**OE*	Open Elective V	3	0	0	3	3
4.	XAS804	Project Phase II	0	0	12	6	12
		TOTAL				**12**	**21**

TOTAL CREDITS = 161

LIST OF ELECTIVES

PROFESSIONAL ELECTIVE COURSE – I

S.No	SUBJECT CODE	SUBJECT NAME	L	T	P	C	H
1.	XASE01	Aircraft Systems and Instruments	3	0	0	3	3
2.	XASE02	Sensors and Measurements	3	0	0	3	3
3.	XASE03	Control Systems	3	0	0	3	3
4.	XASE04	Airframe Maintenance and Repair	3	0	0	3	3
5.	XASE05	Theory of Elasticity	3	0	0	3	3

PROFESSIONAL ELECTIVE COURSE – II

S.No	SUBJECT CODE	SUBJECT NAME	L	T	P	C	H
1.	XASE06	Heat Transfer	2	1	0	3	3
2.	XASE07	Mechanics of Machines	2	1	0	3	3
3.	XASE08	Wind Tunnel Techniques	2	1	0	3	3
4.	XASE09	Theory of Vibrations	2	1	0	3	3
5.	XASE10	Composite Materials	2	1	0	3	3

PROFESSIONAL ELECTIVE COURSE – III

S.No	SUBJECT CODE	SUBJECT NAME	L	T	P	C	H
1.	XASE11	Space Weapons and Warfare	3	0	0	3	3
2.	XASE12	Navigation Systems	3	0	0	3	3
3.	XASE13	High Temperature Materials	3	0	0	3	3
4.	XASE14	Aircraft Rules and Regulations CAR I and II	3	0	0	3	3
5.	XASE15	Aeroelasticity	3	0	0	3	3

PROFESSIONAL ELECTIVE COURSE – IV

S.No	SUBJECT CODE	SUBJECT NAME	L	T	P	C	H
1.	XASE16	Experimental Stress Analysis	3	0	0	3	3
2.	XASE17	Aero Engine Maintenance and Repair	3	0	0	3	3
3.	XASE18	Automation and Control Engineering	3	0	0	3	3
4.	XASE19	Fatigue and Fracture Mechanics	3	0	0	3	3
5.	XASE20	Helicopter Maintenance	3	0	0	3	3

PROFESSIONAL ELECTIVE COURSE – V

S.No	SUBJECT CODE	SUBJECT NAME	L	T	P	C	H
1.	XASE21	Spacecraft Power Systems	3	0	0	3	3
2.	XASE22	Disaster Management	3	0	0	3	3
3.	XASE23	Air Traffic Control and Aerodrome Design	3	0	0	3	3
4.	XASE24	Missile Guidance and Control	3	0	0	3	3
5.	XASE25	Air Transportation and Aircraft Maintenance	3	0	0	3	3

PROFESSIONAL ELECTIVE COURSE – VI

S.No	SUBJECT CODE	SUBJECT NAME	L	T	P	C	H
1.	XASE26	Theory of Plates and Shells	2	1	0	3	3
2.	XASE27	Rockets and Missiles	2	1	0	3	3
3.	XASE28	Cryogenics	2	1	0	3	3
4.	XASE29	Hypersonic Aerodynamics	2	1	0	3	3
5.	XASE30	Finite Element Method	2	1	0	3	3

PROFESSIONAL COURSE TRACKS- AEROSPACE ENGINEERING [PEC-AS]

The following Seven Mandatory Professional Specialized Tracks offer electives in the respective Tracks:

Track	Professional Core Courses (PCC-AS)
I.	Aerodynamics
II.	Structures
III.	Propulsion
IV.	Space and Satellite Technology
V.	Aeronautics
VI.	Material Science

Track I

Sub. Code	Category	Name of the Course	Hours per week			C
			L	T	P	
XAS304	PCC	Fluid Mechanics	2	1	0	3
XAS403	PCC	Aerodynamics I	3	0	3	4
XAS502	PCC	Aerodynamics II	3	1	0	4
XAS701	PCC	Computational Fluid Dynamics	2	1	3	5
XASE08	PEC	Wind Tunnel Techniques	2	1	0	3
XASE29	PEC	Hypersonic Aerodynamics	2	1	0	3
		TOTAL	**14**	**5**	**6**	**22**

Track II

Sub. Code	Category	Name of the Course	Hours per week			C
			L	T	P	
XEM305	ESC	Engineering Mechanics	3	1	0	4
XAS303	PCC	Solid Mechanics	3	1	0	4
XAS404	PCC	Aircraft Structures I	3	1	0	4
XAS502	PCC	Aircraft Structures II	3	1	3	5
XASE26	PEC	Theory of Plates and Shells	2	1	0	3
XASE30	PEC	Finite Element Method	2	1	0	3
		TOTAL	**14**	**6**	**3**	**23**

Track III

Sub. Code	Category	Name of the Course	Hours per week			C
			L	T	P	
XAS401	PCC	Engineering Thermodynamics	2	1	0	3
XAS503	PCC	Aerospace Propulsion	3	1	3	6
XASE06	PEC	Heat Transfer	2	1	0	3
XASE17	PEC	Aero Engine Maintenance and Repair	3	0	0	3
XASE27	PEC	Rockets and Missiles	2	1	0	3
XASE28	PEC	Cryogenics	2	1	0	3
	TOTAL		**14**	**5**	**3**	**21**

Track IV

Sub. Code	Category	Name of the Course	Hours per week			C
			L	T	P	
XAS504	PCC	Elements of Satellite Technology	3	0	0	3
XAS602	PCC	Space Mechanics	3	0	0	3
XASE11	PEC	Space Weapons and Warfare	3	0	0	3
XASE12	PEC	Navigation Systems	3	0	0	3
XASE21	PEC	Spacecraft Power Systems	3	0	0	3
XASE27	PEC	Rockets and Missiles	2	1	0	3
XASM01	PCC	CATIA Software	1	0	0	1
	TOTAL		**18**	**1**	**0**	**19**

Track V

Sub. Code	Category	Name of the Course	Hours per week			C
			L	T	P	
XAS402	PCC	Introduction to Aircraft and Aerospace Vehicles	3	0	0	3
XAS601	PCC	Flight Dynamics	3	1	0	4
XAS603	PCC	UAV Design	3	0	3	5
XASM02	PCC	Elements of Drone Technology	1	0	0	1

XASE01	PEC	Aircraft Systems and Instruments	3	0	0	3
XASE04	PEC	Airframe Maintenance and Repair	3	0	0	3
XASE14	PEC	Aircraft Rules and Regulations CAR I and II	3	0	0	3
XASE20	PEC	Helicopter Maintenance	3	0	0	3
XASE23	PEC	Air Traffic Control and Aerodrome Design	3	0	0	3
XASE25	PEC	Air Transportation and Aircraft Maintenance	3	0	0	3
		TOTAL	**19**	**1**	**3**	**31**

Track VI

Sub. Code	**Category**	**Name of the Course**	**Hours per week**			**C**
			L	**T**	**P**	
XAS302	ESC	Engineering Materials	3	0	0	3
XASE05	PEC	Theory of Elasticity	3	0	0	3
XASE09	PEC	Theory of Vibrations	2	1	0	3
XASE10	PEC	Composite Materials	2	1	0	3
XASE13	PEC	High Temperature Materials	3	0	0	3
XASE15	PEC	Aeroelasticity	3	0	0	3
XASE16	PEC	Experimental Stress Analysis	3	0	0	3
XASE19	PEC	Fatigue and Fracture Mechanics	3	0	0	3
		TOTAL	**22**	**2**	**0**	**24**

OPEN ELECTIVE COURSE (Offered to other department)

S.No	**SUBJECT CODE**	**SUBJECT NAME**	**L**	**T**	**P**	**C**	**H**
1.	XASOE1	Elements of Aeronautics	3	0	0	3	3
2.	XASOE2	Fundamentals of Rockets and Missiles	3	0	0	3	3

XAS303 SOLID MECHANICS

L	T	P	C	H
3	1	0	4	4

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Describe*** the concepts of stress and strain at a point and ***express*** the stress-strain relationship for homogenous, isotropic materials.	Cognitive	Remember, Understand
CO2	***Draw*** and ***explain*** shear force and bending moment diagrams for cantilever, simply supported and over hanging beams.	Cognitive	Remember, Apply
CO3	***Calculate*** bending stress and shear stress in beams**.**	Cognitive	Apply
CO4	***Select*** the beam specimen, ***Express*** deflection equation.	Cognitive	Understand, Apply
CO5	***Measure*** rotation of rod due to torsion & test the springs, ***Express*** torsion.	Cognitive	Understand, Apply
CO6	***Classify*** principal stresses; ***explain*** the stresses, strains associated with thin-wall spherical and cylindrical pressure vessels.	Cognitive	Apply, Analyze

UNIT I BASICS OF STRESS AND STRAIN OF SOLIDS 9+3

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 9+3

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 9+3

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

UNIT IV TORSION **9+3**

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 **9+3**

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. Rajput R K, Edition -VI "Strength of Materials" Publisher, S Chand, 2015.

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

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.

E – References

1. nptel.ac.in/courses/112107147

LECTURE: 45 TUTORIAL: 15 PRACTICAL: 0 TOTAL HOURS:60

Table 1: Mapping of COs with POs:

CO Vs PO	CO1	CO2	CO3	CO4	CO5	CO6	Total	Scaled to 0,1,2 and 3
PO_1	3	2	1	1	3	2	12	2
PO_2	2	1	3	3	2	2	13	2
PO_3	1	2	2	2	2	2	11	2

PO_4	0	1	2	2	2	2	9	2
PO_5	0	1	2	2	3	1	9	2
PO_6	0	0	1	1	1	1	4	1
PO_7	0	0	0	0	0	0	0	0
PO_8	0	0	0	0	0	0	0	0
PO_9	0	0	0	0	0	1	1	0
PO_{10}	0	0	0	0	0	0	0	0
PO_{11}	0	0	0	0	1	1	2	1
PO_{12}	0	0	0	0	0	1	1	0
PSO_1	0	0	0	0	0	0	0	0
PSO_2	0	0	0	0	0	2	2	1

1-6 → 1, 7-12 → 2, 13-18 → 3

0 – No Relation, 1 – Low Relation, 2 – Medium Relation, 3 – High Relation

XAS304 FLUID MECHANICS AND MACHINERY

L	T	P	C	H
2	1	0	3	3

COURSE OUTCOMES		DOMAIN	LEVEL
CO_1	***Describe*** the basic definitions and fluid properties	Cognitive	Remember
CO_2	***Express*** the ideas of fluid statics and kinematics.	Cognitive	Understand
CO_3	***Illustrate*** various fluid dynamics equations.	Cognitive	Analyze
CO_4	***Describe*** flow in venturi-meter and orifice meter.	Cognitive	Analyze
CO_5	***Assess*** flow through pipes and ***measure*** the losses in pipes.	Cognitive	Evaluate
CO_6	***Compare*** *and* ***describe*** the performance of centrifugal and reciprocating pump.	Cognitive	Evaluate Remember

UNIT I DEFINITIONS AND FLUID PROPERTIES 6+3

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 6+3

Pascal's law - centre of pressure - forces on curved surfaces - buoyancy 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 6+3

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 6+3

Laminar boundary layer - turbulent boundary layer - boundary layer separation - development of

laminar and turbulent flows in circular pipes - losses in pipes.

UNIT V HYDRAULIC MACHINES 6+3

Centrifugal pumps and reciprocating pump- components; - single and double acting – slip mechanism – discharge – types of water turbines.

LECTURE : 30 TUTORIAL:15 TOTAL: 45 Hours

TEXT BOOKS

1. Bansal, R.K., "Fluid Mechanics and Hydraulics Machines", Laxmi Publications (P) Ltd., New Delhi, 2013.
2. Frank.M. White., "Fluid mechanics", McGraw Hill series, Seventh Edition, 2011.

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.

E – References

1. https://nptel.ac.in/courses/112105171/

Mapping of CO with PO

CO Vs PO	CO1	CO2	CO3	CO4	CO5	CO6	Total	Total /6
PO_1	3	3	3	3	3	3	18	3
PO_2	3	3	3	3	2	2	16	3
PO_3	2	2	2	2	2	2	12	2

PO_4	2	2	2	2	2	2	12	2
PO_5	0	0	1	2	2	2	7	1
PO_6	2	2	2	2	2	2	12	2
PO_7	2	2	2	2	2	2	12	2
PO_8	0	0	0	0	0	0	0	0
PO_9	2	2	2	2	2	2	12	2
PO_{10}	0	0	0	0	0	0	0	0
PO_{11}	0	0	0	0	0	0	0	0
PO_{12}	1	1	1	1	1	1	6	1
PSO_1	2	2	2	2	2	2	12	2
PSO_2	2	1	1	1	1	1	7	1

XAS401 ENGINEERING THERMODYNAMICS **L T P C H**

2 1 0 3 3

COURSE OUTCOMES		**DOMAIN**	**LEVEL**
CO_1	***Describe*** the laws of thermodynamics and their application to a wide range of systems.	Cognitive	Remember
CO_2	***Analyze*** the work and heat interactions associated with a prescribed process path and to perform thermodynamic analysis of a flow system. An ability to evaluate entropy changes and familiarity with calculations of the efficiencies of heat engines and other related engineering devices.	Cognitive	Analyze
CO_3	***Assess*** the efficiency and mean effective pressure of different thermodynamic air standard cycles.	Cognitive	Evaluate
CO_4	***Describe*** the pure substance (an ideal gas) and its applications in various flow and non flow process, and ability to evaluate the efficiencies.	Cognitive	Remember
CO_5	***Describe*** the construction and working principle of different types of compressors.	Cognitive	Remember
CO_6	***Compare*** the different refrigeration and air-conditioning systems and able to calculate the COP /cooling load for various applications.	Cognitive	Evaluate

Unit I BASIC THERMODYNAMICS 6+3=9

Systems, Zeroth, First and Second laws - concept of entropy change in non-flow processes - SFEE equations [steady flow energy equation] – Heat engines – Refrigerators and heat pumps - Basic thermodynamic relations.

Unit II AIR STANDARD CYCLES AND IC ENGINES 6+3=9

Otto, Diesel, Dual and Brayton cycles – Air standard efficiency -Mean effective pressure –Two and four stroke IC Engines – P-V & T-S diagrams.

Unit III GAS TURBINES 6+3=9

Open and closed cycle gas turbines – Ideal and actual cycles – Brayton cycle – Cycle with reheat, inter-cooling and regeneration – Application of gas turbines in aviation – Velocity diagrams.

Unit IV AIR COMPRESSORS 6+3=9

Positive displacement compressors – Construction and working principle of centrifugal, diagonal (mixed flow) and axial compressors.

Unit V REFRIGERATION AND AIR CONDITIONING 6+3=9

Principles of refrigeration, Air conditioning - Heat pumps - Vapour compression – Vapour absorption types - Coefficient of performance, Properties of refrigerants - Basic functional difference between refrigeration and air conditioning – Various methods of producing refrigerating effects (RE).

LECTURE:30 TUTORIAL: 15 TOTAL: 45 Hours

TEXT BOOKS

1. Nag P K, "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. Sankaar B K, „Thermal Engineering", Tata McGraw Hill, New Delhi, 1998.

E – References

1. https://nptel.ac.in/courses/112105123/

Mapping of CO with PO

CO Vs PO	CO1	CO2	CO3	CO4	CO5	CO6	Total	Total /6
PO_1	3	3	3	3	3	3	18	3
PO_2	3	3	3	3	3	3	18	3
PO_3	0	2	0	0	2	2	6	1
PO_4	1	1	1	1	1	1	6	1
PO_5	0	0	0	0	0	0	0	0
PO_6	1	1	1	1	1	1	6	1
PO_7	2	2	2	2	2	2	12	2
PO_8	0	0	0	0	0	0	0	0
PO_9	2	2	2	2	2	2	12	2
PO_{10}	0	0	0	0	0	0	0	0
PO_{11}	0	0	0	0	0	0	0	0
PO_{12}	1	1	1	1	1	1	6	1
PSO_1	1	1	1	1	1	1	6	1
PSO_2	0	0	0	0	0	0	0	0
Total	14	16	14	14	16	16	**90**	**15**

XAS402 INTRODUCTION TO AIRCRAFT AND AEROSPACE VEHICLES

L	T	P	C	H
3	0	0	3	3

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Generalize*** the historical background of Aviations and ***List out*** the Aircraft/ Spacecraft components.	Cognitive	Remember, Understand
CO2	***Recall*** the important physical properties of atmosphere and ***Indicate*** the effects of atmosphere on aircraft and space flight systems.	Cognitive	Remember, Understand
CO3	***Explain*** the construction of aircraft structures and materials used in aircraft components.	Cognitive	Understand
CO4	***Recall*** materials used in spacecrafts and ***explain*** the power plants used in aircrafts.	Cognitive	Remember, Understand
CO5	***Write*** a case study report on power plants and ***Discuss*** about the power plants used in rockets and satellites**.**	Affective, Cognitive	Respond, Understand
CO6	***Use*** basic principles of mechanics and ***apply*** in flight performance.	Affective, Cognitive	Respond, Understand, Apply

Unit I INTRODUCTION 9

History of aircraft and spacecrafts - classifications of aircrafts - Components of an airplane – Forces and Moments acting in aircraft and spacecraft - Space vehicles and their functions- Basic flight instruments.

Unit II EFFECTS OF ATMOSPHERE 9

Physical properties and structure of the atmosphere – Temperature, Density, pressure with altitude relationships - Effect of atmosphere on Aircraft and Space Vehicles - Mach number- Aerofoil terminologies -Evolution of lift, drag and moment.

Unit III STRUCTURES AND MATERIALS 9

Wing and fuselage construction – aluminium and steel alloys - composite materials - materials used for space vehicles – futuristic materials.

Unit IV POWER PLANTS 9

Basic ideas about piston and gas turbine engines – Operating principle of rocket - Types of rocket propulsion – Power generation in Satellites.

Unit V PERFORMANCE 9

Various maneuvers of aircraft – Turning performance – Types of drag - Various ceilings.

LECTURE: 45 TUTORIAL: 0 TOTAL: 45 Hours

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..

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

E – References

1. https://nptel.ac.in/courses/101105059/

Mapping of COs with POs:

CO Vs PO	CO1	CO2	CO3	CO4	CO5	CO6	Total	Scaled to 0,1,2 and 3
PO_1	1	3	3	3	3	3	16	3
PO_2	0	1	1	2	2	2	8	2
PO_3	0	0	0	0	1	1	2	1
PO_4	0	0	0	0	0	0	0	0
PO_5	0	0	0	0	0	0	0	0
PO_6	0	1	2	2	2	2	9	2
PO_7	0	1	1	1	1	1	5	1
PO_8	0	0	0	0	0	0	0	0
PO_9	0	0	1	1	1	1	4	1
PO_{10}	0	0	0	0	0	0	0	0
PO_{11}	0	0	0	0	0	0	0	0
PO_{12}	0	0	0	0	0	0	6	1
PSO_1	0	0	0	0	2	2	4	1
PSO_2	0	0	1	2	2	2	7	2

1-6=**1**, 7-12=**2**, 13-18=**3**

0 – No Relation, 1 – Low Relation, 2 – Medium Relation, 3 – High Relation

XAS403 AERODYNAMICS I

L	T	P	C	H
3	0	2	4	5

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Recall*** the Bernoulli's , Euler Theorem and ***Study*** of Basic Equations of Fluid flow	Cognitive	Remember Understand
CO2	***Explain*** various flows and ***Calibrate*** the wind tunnel	Cognitive Psychomotor	Understand Analyze Mechanism
CO3	***Express*** combinational stream functions for various flows and ***Calibrate*** pressure distribution over Cylinder.	Cognitive Psychomotor	Understand Analyze Mechanism
CO4	***Explain*** Kutta Transformations and ***Calibrate*** pressure distribution over various models	Cognitive Psychomotor	Understand Analyze Mechanism
CO5	***Sketch*** the flow visualization over the models, ***Explain*** Lifting line theory and ***Present*** solution to real time problems.	Cognitive Psychomotor Affective	Understand Analyze Mechanism Respond
CO6	***Display*** the Boundary Layer Flow over models and ***Discuss*** Navier stokes's Equation.	Cognitive Psychomotor	Remember Understand

UNIT I REVIEW OF BASIC FLUID MECHANICS 7

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

UNIT II TWO DIMENSIONAL INCOMPRESSIBLE FLOWS 10

Elementary flows – uniform flow, source, sink, vortex and their combinations, Pressure and velocity distributions on bodies with and without circulation in ideal and real fluid flows.

UNIT III CONFORMAL MAPPING 8

Classification of aerofoil - Transformation from circle to various shapes - Karman – Trefftz profiles – ideal and real flow – Magnus effect – D' Alembert paradox.

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 VISCOUS FLOWS 8

Concepts of boundary Layer- Blasius theorem- displacement, Momentum thickness - Flow over a flat plate.

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.

E – References

1. https://nptel.ac.in/courses/101105059/

List of Experiments

1. Flow visualization in water flow channel.

2. Flow visualization in smoke tunnel

3. Study of Low speed subsonic wind tunnel

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

5. Find the Pressure distribution over circular cylinder and plot it.

6. Enumerate and plot Pressure distribution over Symmetrical airfoil and estimation of C_L and C_D.

7. Enumerate and plot Pressure distribution over Un Symmetrical airfoil and estimation of C_L and C_D.

8. Enumerate and plot Pressure distribution over Cambered airfoil and estimation of C_L and C_D.

9. Study of Schlieren system to visualize shock.

10. Study of Shadow graph system to visualize shock.

Lecture:45 Tutorial:0 Practical:45 Total : 90 Hours

CO –PO Mapping;

CO Vs PO	CO1	CO2	CO3	CO4	CO5	CO6	Total	Scaled to 0,1,2 and 3
PO_1	3	3	3	3	3	3	15	2
PO_2	2	3	3	3	3	3	16	3
PO_3	1	2	2	3	3	3	11	2
PO_4	3	3	3	3	3	3	15	2
PO_5	0	2	2	2	3	3	9	1
PO_6	0	3	3	3	2	2	13	2
PO_7	1	2	2	2	2	2	9	1
PO_8	0	2	2	0	0	0	4	1
PO_9	0	3	3	0	0	0	6	1
PO_{10}	0	0	0	0	0	0	0	0
PO_{11}	0	0	0	0	0	0	0	0
PO_{12}	3	3	3	3	2	2	16	3
PSO_1	0	0	0	0	0	0	0	0
PSO_2	2	2	2	2	1	1	10	2

XAS404 AIRCRAFT STRUCTURES I

L	T	P	C	H
3	1	0	4	4

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Recall*** engineering mechanics and ***solve*** member forces in statically determinate structures.	Cognitive	Remember, Apply
CO2	***Draw*** and ***explain*** shear force and bending moment diagrams for statically indeterminate beams.	Cognitive	Remember, Understand
CO3	***Discuss*** and ***analyze*** the behavior of elastic structures subjected to combined loads, including bending, torsion and axial loads.	Cognitive	Understand, Analyze
CO4	***Explain*** and ***Use*** Euler's formula for various columns to find out critical load. ***Distinguish*** Euler's formula and Rankine's formula.	Cognitive	Understand, Apply
CO5	***Explain*** the real time application of columns.	Cognitive	Understand
CO6	***List*** the theories of failure and ***explain*** them and then ***utilize*** the failure theories to investigate the engineering structures. ***Uses*** of failure theories in Aircraft structures.	Cognitive, Psychomotor, Affective	Understand, Set, Receive

UNIT I STATICALLY DETERMINATE STRUCTURES 8+2

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

UNIT II STATICALLY INDETERMINATE STRUCTURES 10+4

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

UNIT III ENERGY METHODS 8+3

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

UNIT IV COULMNS 11+3

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

UNIT V FAILURE THEORIES 8+3

Types of failure theories – Principal stress theory – Principal strain theory – Shear stress theory – Shear strain energy theory – Strain energy theory –Fatigue and Creep Failure analysis.

LECTURE: 45 TUTORIAL: 15 TOTAL: 60

TEXT BOOKS

1. Rajput R K., 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.

E – References

1. https://nptel.ac.in/courses/101104069/21

Mapping of COs with POs:

CO Vs PO	CO1	CO2	CO3	CO4	CO5	CO6	Total	Scaled to 0,1,2 and 3
PO_1	3	3	2	3	3	2	16	3
PO_2	2	1	1	2	2	3	11	2
PO_3	2	1	1	2	2	3	11	2
PO_4	2	1	1	3	3	3	13	3
PO_5	3	0	0	3	3	3	12	2

PO_6	0	0	0	0	0	3	3	1
PO_7	0	0	0	0	0	0	0	0
PO_8	0	0	0	0	0	0	0	0
PO_9	0	0	0	0	0	2	2	1
PO_{10}	0	0	0	0	0	0	0	0
PO_{11}	0	0	0	1	1	2	4	1
PO_{12}	0	0	0	0	0	1	1	0
PSO_1	0	0	0	0	0	0	0	0
PSO_2	0	0	0	0	0	1	1	0

1-5 → 1, 6-10 → 2, 11-15 → 3

0 – No Relation, 1 – Low Relation, 2 – Medium Relation, 3 – High Relation

XASE01 AIRCRAFT SYSTEMS AND INSTRUMENTS

L	T	P	C	H
3	0	0	3	3

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Explain*** the components and concepts of various aircraft systems.	Cognitive	Understand
CO2	***Compare*** the basic and modern control systems.	Cognitive	Understand
CO3	Study the ***functions*** of fuel system and ***Examine*** the auxiliary Aircraft power plant systems.	Cognitive	Understand, Analyze
CO4	***Outline*** the needs of Air-conditioning systems and cabin pressurization system.	Cognitive	Understand
CO5	***Differentiate*** the use of flight instruments and Navigation Instruments.	Cognitive	Analyze
CO6	***Inspect*** the needs of engine instruments and their operations.	Cognitive	Analyze

UNIT I AIRCRAFT SYSTEMS 9

Hydraulic systems –basic principle – components – hydraulic systems controllers – modes of operation – pneumatic systems – working principles – typical pneumatic power system – brake system – components, landing gear systems – classification – shock absorbers – Extension, retractable mechanism.

UNIT II AIRPLANE CONTROL SYSTEMS 8

Conventional Systems – power assisted and fully powered flight controls – power actuated systems – engine control systems – push pull rod system – operating principles – digital fly by wire systems – auto pilot system, active control technology.

UNIT III ENGINE SYSTEMS 8

Fuel, lubricating, starting and ignition systems in piston and jet engines- multi-engine fuel systems -types of valves used in gas turbine engines.

UNIT IV AIRCONDITIONING AND PRESSURIZING SYSTEM 9

Basic air cycle systems – vapour cycle systems, 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 11

Flight instruments and navigation instruments – accelerometers, air speed indicators – mach meters – altimeters - gyroscopic instruments– principles and operation – study of various types of engine instruments – digital tachometers – temperature gauges – pressure gauge – operation and principles.

LECTURE: 45 TUTORIAL: 0 PRACTICAL: 0 TOTAL: 45

TEXT BOOKS

1. Nagabhushana S, L.K.Sudha. “Aircraft Instrumentation and systems” ISBN-13: 978-9380578354- I.K. International Publishing House Pvt.Ltd.

2. Mekinley, J.L. and R.D. Bent, "Aircraft Power Plants", McGraw Hill 1993.

3. Pallet, E.H.J, "Aircraft Instruments & Principles", Pitman & Co 1993.

REFERENCE BOOKS

1. Roy Lanagton, Chuck Clark etc., “Aircraft Fuel Systems” Publication Wiley.

2. Mckinley, J.L. and Bent R.D. "Aircraft Maintenance & Repair", McGraw Hill, 1993.

3. Handbooks of “Airframe and Power plant Mechanics” US dept. of Transportation, Federal, Aviation Administration, The English Book Store, New Delhi, 1995.

E – References

1. “Instrument Landing Systems (ILS)” Author: Michael Feramez.

2. Nolan, Chap-2, Navigation Systems- Enroute

3. Jan Rohac “Aircraft and Spacecraft Instrumentation” Lecture Notes- EFIS, EICAS, ECAM.

4. nptel.ac.in/

Mapping of COs with POs:

CO Vs PO	CO1	CO2	CO3	CO4	CO5	CO6	Total	Scaled to 0,1,2 and 3
PO_1	3	2	2	2	2	1	12	3
PO_2	2	2	3	2	2	2	13	3
PO_3	1	2	3	3	1	1	11	3
PO_4	0	1	2	3	1	1	8	2
PO_5	0	1	2	1	0	1	5	1
PO_6	1	2	3	2	2	2	12	3
PO_7	0	1	3	2	2	1	9	2
PO_8	1	2	1	1	1	1	7	2
PO_9	1	2	2	1	1	1	8	2
PO_{10}	0	0	1	1	1	0	3	1
PO_{11}	1	0	0	0	0	0	1	1
PO_{12}	2	2	3	2	2	2	13	3
PSO_1	0	1	2	1	2	1	7	2
PSO_2	1	0	3	0	0	1	5	1

1-5 → 1, 6-10 → 2, 11-15 → 3

0 – No Relation, 1 – Low Relation, 2 – Medium Relation, 3 – High Relation

XASE02 SENSORS AND MEASUREMENTS

L	T	P	C	H
3	0	0	3	3

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Classify*** the types of measurement system and its classifications.	Cognitive	Understand
CO2	***Explain*** the concepts of Strain gauges	Cognitive	Understand
CO3	***Explain*** the physical principles and characteristics of different types of displacement, pressure and temperature sensors and transducer.	Cognitive	Understand
CO4	***Classify*** the photo and piezo electric sensors applications.	Cognitive	Understand
CO5	***Express*** the working principle and its characteristics of different bridge circuits used in signal conditioning and to know about the signal analyzer.	Cognitive	Understand
CO6	***Discuss*** the working principle of display and recording devices.	Cognitive	Understand

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.

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

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

E – References

1. https://nptel.ac.in/courses/112103174/3

Mapping of COs with POs:

CO Vs PO	CO1	CO2	CO3	CO4	CO5	CO6	Total	Scaled to 0,1,2 and 3
PO_1	3	3	3	3	3	3	18	3
PO_2	1	1	1	1	1	1	6	1

PO_3	1	1	1	1	1	1	6	1
PO_4	2	2	2	2	2	2	12	2
PO_5	0	0	0	0	0	0	0	0
PO_6	1	1	1	1	1	1	6	1
PO_7	0	0	0	0	0	0	0	0
PO_8	1	1	1	1	1	1	6	1
PO_9	2	2	2	2	2	2	12	2
PO_{10}	0	0	0	0	0	0	0	0
PO_{11}	1	1	1	1	1	1	6	1
PO_{12}	1	1	1	1	1	1	6	1
PSO_1	3	3	3	3	3	3	18	3
PSO_2	0	0	0	0	0	0	0	0

1-6 → 1, 7-12 → 2, 13-18 → 3

0 – No Relation, 1 – Low Relation, 2 – Medium Relation, 3 – High Relation

XASE03 CONTROL SYSTEMS

L	T	P	C	H
3	0	0	3	3

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Identify*** the basic elements, derive the transfer function and ***Construct*** the transfer function of Simple pneumatic, hydraulic and thermal systems.	Cognitive	Remember
CO2	***Explain*** the performance of open and closed loop system.	Cognitive	Understand
CO3	***Describe*** the Time domain and ***show*** the response of time.	Cognitive	Remember Understand
CO4	***Explain*** Frequency domain.	Cognitive	Understand
CO5	***Construc***t *and* ***verify*** the frequency response.	Cognitive	Apply
CO6	***Describe*** the digital control systems.	Cognitive	Remember

UNIT I INTRODUCTION 9

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 9

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 9

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 9

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

UNIT V SAMPLED DATA SYSTEMS 9

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

Lecture: 45 Tutorial: 0 Total: 45 Hours

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, “Feedback 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.

E- References

1. https://onlinecourses.nptel.ac.in/noc18_ee41/preview

2. https://nptel.ac.in/courses/108101037/

COs versus POs mapping:

CO/ PO	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
CO1	2	1	1	1	0	0	1	1	0	1	0	1	2	0
CO2	2	2	1	1	1	1	1	1	1	1	0	2	2	1
CO3	2	3	3	3	2	2	1	1	1	1	1	2	2	1
CO4	2	3	3	3	2	2	1	1	1	1	1	2	2	1
CO5	2	3	3	3	2	2	1	1	1	1	1	2	2	1
CO6	2	1	1	1	1	1	1	1	1	1	0	1	2	1
Total	12	13	12	12	8	8	6	6	5	6	3	10	12	5
Scaling	2	2	2	2	1	1	1	1	1	1	1	2	2	1

XASE04 AIRFRAME MAINTENANCE AND REPAIR

L	T	P	C	H
3	0	0	3	3

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Recall*** different equipments used in welding shop, ***Explain*** various repair techniques used in sheet metal.	Cognitive	Remember Understand
CO2	***List out*** types of plastics used in airframes and its maintenance.	Cognitive	Remember
CO3	***Describe*** the cleaning process of fiber reinforced plastic (FRP) materials.	Cognitive	Understand
CO4	***Discuss*** the various leveling procedure of jacking, weighing and assembly.	Cognitive	Remember
CO5	***Review*** of hydraulic, pneumatic system their trouble shooting and maintenance practice.	Cognitive	Remember
CO6	***Discuss*** the safety practices of material storage and handling.	Cognitive	Understand

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 Fiber 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.

E – References

1. https://nptel.ac.in/courses/101106035/lec55.pdf

Mapping of COs with POs:

CO Vs PO	CO1	CO2	CO3	CO4	CO5	CO6	Total	Scaled to 0,1,2 and 3
PO_1	3	3	3	3	3	3	18	3
PO_2	2	2	2	1	2	1	10	2
PO_3	1	2	2	0	1	1	7	2

PO_4	0	1	1	2	1	1	6	1
PO_5	0	0	0	0	0	0	0	0
PO_6	2	1	1	0	1	0	5	1
PO_7	1	2	2	1	1	0	7	2
PO_8	1	1	1	2	1	2	8	2
PO_9	1	2	2	1	1	0	7	2
PO_{10}	0	0	0	0	0	0	0	0
PO_{11}	0	0	0	0	0	0	0	0
PO_{12}	0	0	0	0	0	2	2	1
PSO_1	0	0	0	0	0	0	0	0
PSO_2	1	2	2	0	1	1	7	2

1-6 → 1, 7-12 → 2, 13-18 → 3

0 – No Relation, 1 – Low Relation, 2 – Medium Relation, 3 – High Relation

XASE05 THEORY OF ELASTICITY

L	T	P	C	H
3	0	0	3	3

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Recall*** strength of material and use stress-strain relationship to ***calculate*** the displacements.	Cognitive	Remember, Apply
CO2	***Distinguish*** plane stress and plane strain problems.	Cognitive	Understand
CO3	***Use*** of Airy's stress function in elastic structures.	Cognitive	Apply
CO4	***Apply*** and ***Analyze*** Navier's theory, St. Venant's theory and Prandtl's theory on torsion.	Cognitive	Apply, Analyze
CO5	***State*** classical plate theory.	Cognitive	Remember
CO6	***Apply*** Navier's theory for plates.	Cognitive	Apply

UNIT I BASIC EQUATIONS OF ELASTICITY 9

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 9

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 9

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

UNIT IV TORSION 9

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 9

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: 45 TUTORIAL: 0 TOTAL: 45

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.

E –References

1. https://onlinecourses.nptel.ac.in/noc18_ce18/preview
2. https://nptel.ac.in/courses/105108070/

Mapping of CO with PO

CO Vs PO	CO1	CO2	CO3	CO4	CO5	CO6	Total	Scaled to 0,1,2 and 3
PO_1	3	3	3	2	2	2	15	3
PO_2	2	3	2	2	2	2	13	2
PO_3	1	3	1	1	1	1	8	1
PO_4	1	2	1	1	1	1	7	1
PO_5	3	3	3	0	3	3	15	2
PO_6	1	2	0	0	0	0	3	1
PO_7	0	2	0	0	2	2	6	1
PO_8	0	2	0	0	0	0	2	0
PO_9	0	1	0	0	0	0	1	0
PO_{10}	0	0	0	0	0	0	0	0
PO_{11}	0	0	0	0	0	0	0	0
PO_{12}	0	2	0	0	0	0	2	0
PSO_1	0	0	0	0	0	0	0	0
PSO_2	0	0	0	0	0	0	0	0

DEPARTMENT OF
AEROSPACE ENGINEERING

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Board of Studies in Aerospace Engineering

CURRICULUM (From I – VIII Semesters) & SYLLABUS (From I –IV Semesters) **Regulation 2018**

(For the candidates admitted from 2018-19 onwards
Based on Outcome Based Education)

FOR

B.Tech (Aerospace Engineering)
DEGREE PROGRAMME

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 - centred 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.

CORE VALUES

- Student – centric vocation
- Academic excellence
- Social Justice, equity, equality, diversity, empowerment, sustainability
- Skills and use of technology for global competency.
- Continual improvement
- Leadership qualities.
- Societal needs
- Learning, a life – long process
- Team work
- Entrepreneurship for men and women
- 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	**DM1**	Providing capable, motivated, and well-prepared students with high quality, that will enable them to reach their maximum potential in a technical world.
	DM2	Significantly advance in knowledge, its application & integration in Aerospace and Aeronautical related disciplines.
	DM3	Involve in research and development with advanced tools and techniques keeping eco-friendly and sustainability.
	DM4	Serving the larger community by inculcating universal values and ethics through innovative projects.

Table: 1 Mapping of University Mission (UM) and Department Mission (DM)

	UM 1	UM 2	UM 3	UM 4	UM 5	Total	Scaled to 0,1,2 and 3
DM 1	**3**	**3**	**1**	**3**	**1**	**11**	**3**
DM 2	**1**	**2**	**3**	**2**	**3**	**11**	**3**
DM 3	**1**	**1**	**3**	**2**	**2**	**9**	**2**
DM 4	**0**	**1**	**2**	**0**	**3**	**6**	**2**

1-Low 2- Medium 3 – High

PROGRAMME EDUCATIONAL OBJECTIVES

Based on the mission of the department, the programme educational objectives is formulated as

PEO1	Provide education in Aerospace Engineering with global standards.
PEO2	Promote skills in Aerospace Engineering and interdisciplinary subjects.
PEO3	Develop the competency as per the requirement of reputed organizations.
PEO4	Create research and development activities through projects.
PEO5	Stimulate adaptability in the Nation development through imparting knowledge and skill.

Table: 2 Mapping of Program Educational Objectives (PEOs) with Department Mission (DM)

	DM 1	**DM 2**	**DM3**	**DM 4**
PEO 1	3	3	1	1
PEO 2	2	2	2	1
PEO 3	2	1	2	2
PEO 4	1	2	3	2
PEO 5	2	1	2	3
TOTAL	**10**	**9**	**10**	**9**

1- Low 2 – Medium 3-High

GRADUATE ATTRIBUTES

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling to complex engineering activities, with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning:** Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM OUTCOMES (POs)

PO	PROGRAM 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.	

Table 3 Mapping of Program Educational Objectives (PEOs) with Program Outcomes (POs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
PEO 1	3	3	3	1	1	1	2	1	1	1	1	1	3	1
PEO 2	2	3	3	3	3	2	3	1	0	1	1	1	3	1
PEO 3	2	3	3	3	3	3	3	2	1	3	2	0	3	3
PEO 4	3	3	3	3	2	3	3	2	1	0	0	2	3	0
PEO 5	2	2	3	2	1	3	3	2	2	0	0	2	2	1
TOT	**12**	**14**	**15**	**12**	**10**	**12**	**14**	**8**	**5**	**5**	**4**	**6**	**14**	**6**

1 - Low 2 – Medium 3 - High

STRUCTURE OF B.Tech AEROSPACE ENGINEERING PROGRAMME

S.No	Topic	Symbol	Credits
1.	Humanities and Social Sciences including Management	**HSMC**	**3**
2.	Basic Sciences	**BSC**	**27**
3.	Engineering Sciences including workshop, drawing, basics of Electrical/mechanical/computer etc.	**ESC**	**23**
5.	Professional Subjects: Subjects relevant to chosen specialization/branch	**PCC-AS**	**63**
6.	Professional Elective courses relevant to chosen specialization/branch	**PEC-AS**	**18**
7.	Open Subjects: Electives from other technical and/or emerging subjects	**OEC-AS**	**15**
8.	Project work, seminar and internship in industry or elsewhere	**PROJ-AS**	**12**
9.	Mandatory Courses [Environmental Sciences, Induction Program, Indian Constitution, Essence of Indian Traditional Knowledge]	**MC**	**0**
	Total		**161**

HUMANITIES & SOCIAL SCIENCES INCLUDING MANAGEMENT

Sl. No	Code No.	Subject	Semester	Credits
1.	XGS103	English	I	3
2.	XGS507	Essence of Indian Traditional knowledge	V	0
3.	XUM801	Cyber Security	VIII	0
	TOTAL			**3**

BASIC SCIENCE COURSES

Sl. No	Code No.	Subject	Semester	Credits
1.	XAC104	Applied Chemistry for Engineers	I	5
2.	XMA101	Mathematics I (Calculus and Linear Algebra)	I	4
3.	XAP204	Applied Physics for Engineers	II	6
4.	XMA201	Mathematics II (Calculus, Ordinary Differential Equations and Complex Variables)	II	4
5.	XAP306	Physics II (Optics and Waves)	III	4
6.	XMA301	Mathematics III (Transforms and Partial Differential Equations)	III	4
	TOTAL			**27**

ENGINEERING SCIENCE COURSES

Sl. No	Code No.	Subject	Semester	Credits
1.	XCP102	Programming for Problem Solving	I	5
2.	XWP105	Workshop Practices	I	3
3.	XBE203	Basic Electrical Engineering	I	5
4.	XEG205	Engineering Graphics and Design	II	3
5.	XES302	Engineering Materials	III	3
6.	XEM305	Engineering Mechanics	III	4
	TOTAL			**23**

PROFESSIONAL CORE COURSES

Sl. No	Code No.	Subject	Semester	Credits
1.	XAS303	Solid Mechanics	III	4
2.	XAS304	Fluid Mechanics and Machinery	III	3
3.	XAS401	Engineering Thermodynamics	IV	3
4.	XAS402	Introduction to Aircraft and Aerospace Vehicles	IV	3
5.	XAS403	Aerodynamics I	IV	4
6.	XAS404	Aircraft Structures I	IV	4
7.	XAS501	Aerodynamics II	V	4
8.	XAS502	Aircraft Structures II	V	5
9.	XAS503	Aerospace Propulsion	V	6
10.	XAS504	Elements of Satellite Technology	V	3
11.	XASM01	CATIA Software	V	1
12.	XAS601	Flight Dynamics	VI	4
13.	XAS602	Space Mechanics	VI	3
14.	XAS603	UAV Design	VI	5
15.	XAS604	Avionics	VI	4
16.	XASM02	Elements of Drone Technology	VI	1
17.	XAS701	Computational Fluid Dynamics	VII	5
	TOTAL			**63**

PROFESSIONAL ELECTIVE COURSES

Sl. No	Code No.	Subject	Semester	Credits
1.	XASE**	Professional Elective Course – I	IV	3
2.	XASE**	Professional Elective Course – II	V	3
3.	XASE**	Professional Elective Course – III	VI	3
4.	XASE**	Professional Elective Course – IV	VI	3
5.	XASE**	Professional Elective Course – V	VII	3
6.	XASE**	Professional Elective Course – VI	VII	3
	TOTAL			**18**

OPEN ELECTIVE COURSES

Sl. No	Code No.	Subject	Semester	Credits
1.	X**OE*	Open Elective I	V	3
2.	X**OE*	Open Elective II	VI	3
3.	X**OE*	Open Elective III	VII	3
4.	X**OE*	Open Elective IV	VIII	3
5.	X**OE*	Open Elective V	VIII	3
	TOTAL			**15**

SEMESTER-WISE STRUCTURE OF CURRICULUM

REGULATION – 2018

(Applicable to the students admitted from the Academic year 2018-19)

B.TECH AEROSPACE ENGINEERING

SEMESTER I

S.No	COURSE CODE	COURSE TITLE	L	T	P	C	H
1.	XMA101	Mathematics I (Calculus and Linear Algebra)	3	1	0	4	4
2.	XCP102	Programming for Problem Solving	3	0	4	5	7
3.	XGS103	English	2	0	2	3	4
4.	XAS104	Applied Chemistry for Engineers	3	1	2	5	6
5.	XWP105	Workshop Practices	1	0	4	3	5
		TOTAL				**20**	**26**

SEMESTER II

S.No	COURSE CODE	COURSE TITLE	L	T	P	C	H
1.	XMA201	Mathematics II (Calculus, Ordinary Differential Equations and Complex Variables)	3	1	0	4	4
2.	XES202	Environmental Sciences	3	0	0	0	3
3.	XBE203	Basic Electrical Engineering	3	1	2	5	6
4.	XAP204	Applied Physics for Engineers	3	1	4	6	8
5.	XEG205	Engineering Graphics and Design	1	0	4	3	5
		TOTAL				**18**	**26**

SEMESTER III

S.No	COURSE CODE	COURSE TITLE	L	T	P	C	H
1.	XMA301	Mathematics III (Transforms and Partial Differential Equations)	3	1	0	4	4
2.	XES302	Engineering Materials	3	0	0	3	3
3.	XAS303	Solid Mechanics	3	1	0	4	4
4.	XAS304	Fluid Mechanics and Machinery	2	1	0	3	3
5.	XEM305	Engineering Mechanics	3	1	0	4	4
6.	XAP306	Physics II (Optics and Waves)	3	1	0	4	4
		TOTAL				**22**	**22**

SEMESTER IV

S.No	COURSE CODE	COURSE TITLE	L	T	P	C	H
1.	XAS401	Engineering Thermodynamics	2	1	0	3	3
2.	XAS402	Introduction to Aircraft and Aerospace Vehicles	3	0	0	3	3
3.	XAS403	Aerodynamics I	3	0	2	4	5
4.	XAS404	Aircraft Structures I	3	1	0	4	4
5.	XASE**	Professional Elective Course I	3	0	0	3	3
6.	XCI406	Constitution of India	3	0	0	0	3
		TOTAL				**17**	**21**

SEMESTER V

S.No	COURSE CODE	COURSE TITLE	L	T	P	C	H
1.	XAS501	Aerodynamics II	3	1	0	4	4
2.	XAS502	Aircraft Structures II	3	1	2	5	6
3.	XAS503	Aerospace Propulsion	3	1	4	6	8
4.	XAS504	Elements of Satellite Technology	3	0	0	3	3
5.	XASE**	Professional Elective Course II	2	1	0	3	3
6.	X**OE*	Open Elective I	3	0	0	3	3
7.	XGS507	Essence of Indian Traditional knowledge	3	0	0	0	3
8.	XASM01	CATIA Software	1	0	0	1	1
		TOTAL				**25**	**31**

SEMESTER VI

S.No	COURSE CODE	COURSE TITLE	L	T	P	C	H
1.	XAS601	Flight Dynamics	3	1	0	4	5
2.	XAS602	Space Mechanics	3	0	0	3	3
3.	XAS603	UAV Design	3	0	4	5	6
4.	XAS604	Avionics	3	0	2	4	6
5.	XASE**	Professional Elective Course – III	3	0	0	3	3
6.	XASE**	Professional Elective Course – IV	3	0	0	3	3
7.	X**OE**	Open Elective II	3	0	0	3	3
8.	XASM02	Elements of Drone Technology	1	0	0	1	1
		TOTAL				**26**	**30**

SEMESTER VII

S.No	COURSE CODE	COURSE TITLE	L	T	P	C	H
1.	XAS701	Computational Fluid Dynamics	2	1	4	5	7
2.	XASE**	Professional Elective Course – V	3	0	0	3	3
3.	XASE**	Professional Elective Course – VI	2	1	0	3	3
4.	X**OE*	Open Elective III	3	0	0	3	3
5.	XAS705	Project Phase I	0	0	10	5	10
6.	XAS706	In-Plant Training	3	0	0	1	3
		TOTAL				**21**	**29**

SEMESTER VIII

S.No	COURSE CODE	COURSE TITLE	L	T	P	C	H
1.	XUM801	Cyber Security	3	0	0	0	3
2.	X**OE*	Open Elective IV	3	0	0	3	3
3.	X**OE*	Open Elective V	3	0	0	3	3
4.	XAS804	Project Phase II	0	0	12	6	12
		TOTAL				**12**	**21**

TOTAL CREDITS = 161

LIST OF ELECTIVES

PROFESSIONAL ELECTIVE COURSE – I

S.No	SUBJECT CODE	SUBJECT NAME	L	T	P	C	H
1.	XASE01	Aircraft Systems and Instruments	3	0	0	3	3
2.	XASE02	Sensors and Measurements	3	0	0	3	3
3.	XASE03	Control Systems	3	0	0	3	3
4.	XASE04	Airframe Maintenance and Repair	3	0	0	3	3
5.	XASE05	Theory of Elasticity	3	0	0	3	3

PROFESSIONAL ELECTIVE COURSE – II

S.No	SUBJECT CODE	SUBJECT NAME	L	T	P	C	H
1.	XASE06	Heat Transfer	2	1	0	3	3
2.	XASE07	Mechanics of Machines	2	1	0	3	3
3.	XASE08	Wind Tunnel Techniques	2	1	0	3	3
4.	XASE09	Theory of Vibrations	2	1	0	3	3
5.	XASE10	Composite Materials	2	1	0	3	3

PROFESSIONAL ELECTIVE COURSE – III

S.No	SUBJECT CODE	SUBJECT NAME	L	T	P	C	H
1.	XASE11	Space Weapons and Warfare	3	0	0	3	3
2.	XASE12	Navigation Systems	3	0	0	3	3
3.	XASE13	High Temperature Materials	3	0	0	3	3
4.	XASE14	Aircraft Rules and Regulations CAR I and II	3	0	0	3	3
5.	XASE15	Aeroelasticity	3	0	0	3	3

PROFESSIONAL ELECTIVE COURSE – IV

S.No	SUBJECT CODE	SUBJECT NAME	L	T	P	C	H
1.	XASE16	Experimental Stress Analysis	3	0	0	3	3
2.	XASE17	Aero Engine Maintenance and Repair	3	0	0	3	3
3.	XASE18	Automation and Control Engineering	3	0	0	3	3
4.	XASE19	Fatigue and Fracture Mechanics	3	0	0	3	3
5.	XASE20	Helicopter Maintenance	3	0	0	3	3

PROFESSIONAL ELECTIVE COURSE – V

S.No	SUBJECT CODE	SUBJECT NAME	L	T	P	C	H
1.	XASE21	Spacecraft Power Systems	3	0	0	3	3
2.	XASE22	Disaster Management	3	0	0	3	3
3.	XASE23	Air Traffic Control and Aerodrome Design	3	0	0	3	3
4.	XASE24	Missile Guidance and Control	3	0	0	3	3
5.	XASE25	Air Transportation and Aircraft Maintenance	3	0	0	3	3

PROFESSIONAL ELECTIVE COURSE – VI

S.No	SUBJECT CODE	SUBJECT NAME	L	T	P	C	H
1.	XASE26	Theory of Plates and Shells	2	1	0	3	3
2.	XASE27	Rockets and Missiles	2	1	0	3	3
3.	XASE28	Cryogenics	2	1	0	3	3
4.	XASE29	Hypersonic Aerodynamics	2	1	0	3	3
5.	XASE30	Finite Element Method	2	1	0	3	3

PROFESSIONAL COURSE TRACKS- AEROSPACE ENGINEERING [PEC-AS]

The following Seven Mandatory Professional Specialized Tracks offer electives in the respective Tracks:

Track	Professional Core Courses (PCC-AS)
I.	Aerodynamics
II.	Structures
III.	Propulsion
IV.	Space and Satellite Technology
V.	Aeronautics
VI.	Material Science

Track I

Sub. Code	Category	Name of the Course	Hours per week			C
			L	T	P	
XAS304	PCC	Fluid Mechanics	2	1	0	3
XAS403	PCC	Aerodynamics I	3	0	3	4
XAS502	PCC	Aerodynamics II	3	1	0	4
XAS701	PCC	Computational Fluid Dynamics	2	1	3	5
XASE08	PEC	Wind Tunnel Techniques	2	1	0	3
XASE29	PEC	Hypersonic Aerodynamics	2	1	0	3
		TOTAL	**14**	**5**	**6**	**22**

Track II

Sub. Code	Category	Name of the Course	Hours per week			C
			L	T	P	
XEM305	ESC	Engineering Mechanics	3	1	0	4
XAS303	PCC	Solid Mechanics	3	1	0	4
XAS404	PCC	Aircraft Structures I	3	1	0	4
XAS502	PCC	Aircraft Structures II	3	1	3	5
XASE26	PEC	Theory of Plates and Shells	2	1	0	3
XASE30	PEC	Finite Element Method	2	1	0	3
		TOTAL	**14**	**6**	**3**	**23**

Track III

Sub. Code	Category	Name of the Course	Hours per week			C
			L	T	P	
XAS401	PCC	Engineering Thermodynamics	2	1	0	3
XAS503	PCC	Aerospace Propulsion	3	1	3	6
XASE06	PEC	Heat Transfer	2	1	0	3
XASE17	PEC	Aero Engine Maintenance and Repair	3	0	0	3
XASE27	PEC	Rockets and Missiles	2	1	0	3
XASE28	PEC	Cryogenics	2	1	0	3
	TOTAL		**14**	**5**	**3**	**21**

Track IV

Sub. Code	Category	Name of the Course	Hours per week			C
			L	T	P	
XAS504	PCC	Elements of Satellite Technology	3	0	0	3
XAS602	PCC	Space Mechanics	3	0	0	3
XASE11	PEC	Space Weapons and Warfare	3	0	0	3
XASE12	PEC	Navigation Systems	3	0	0	3
XASE21	PEC	Spacecraft Power Systems	3	0	0	3
XASE27	PEC	Rockets and Missiles	2	1	0	3
XASM01	PCC	CATIA Software	1	0	0	1
	TOTAL		**18**	**1**	**0**	**19**

Track V

Sub. Code	Category	Name of the Course	Hours per week			C
			L	T	P	
XAS402	PCC	Introduction to Aircraft and Aerospace Vehicles	3	0	0	3
XAS601	PCC	Flight Dynamics	3	1	0	4
XAS603	PCC	UAV Design	3	0	3	5
XASM02	PCC	Elements of Drone Technology	1	0	0	1

XASE01	PEC	Aircraft Systems and Instruments	3	0	0	3
XASE04	PEC	Airframe Maintenance and Repair	3	0	0	3
XASE14	PEC	Aircraft Rules and Regulations CAR I and II	3	0	0	3
XASE20	PEC	Helicopter Maintenance	3	0	0	3
XASE23	PEC	Air Traffic Control and Aerodrome Design	3	0	0	3
XASE25	PEC	Air Transportation and Aircraft Maintenance	3	0	0	3
		TOTAL	**19**	**1**	**3**	**31**

Track VI

Sub. Code	**Category**	**Name of the Course**	**Hours per week**			**C**
			L	**T**	**P**	
XAS302	ESC	Engineering Materials	3	0	0	3
XASE05	PEC	Theory of Elasticity	3	0	0	3
XASE09	PEC	Theory of Vibrations	2	1	0	3
XASE10	PEC	Composite Materials	2	1	0	3
XASE13	PEC	High Temperature Materials	3	0	0	3
XASE15	PEC	Aeroelasticity	3	0	0	3
XASE16	PEC	Experimental Stress Analysis	3	0	0	3
XASE19	PEC	Fatigue and Fracture Mechanics	3	0	0	3
		TOTAL	**22**	**2**	**0**	**24**

OPEN ELECTIVE COURSE (Offered to other department)

S.No	**SUBJECT CODE**	**SUBJECT NAME**	**L**	**T**	**P**	**C**	**H**
1.	XASOE1	Elements of Aeronautics	3	0	0	3	3
2.	XASOE2	Fundamentals of Rockets and Missiles	3	0	0	3	3

XAS303 SOLID MECHANICS

L	T	P	C	H
3	1	0	4	4

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Describe*** the concepts of stress and strain at a point and ***express*** the stress-strain relationship for homogenous, isotropic materials.	Cognitive	Remember, Understand
CO2	***Draw*** and ***explain*** shear force and bending moment diagrams for cantilever, simply supported and over hanging beams.	Cognitive	Remember, Apply
CO3	***Calculate*** bending stress and shear stress in beams**.**	Cognitive	Apply
CO4	***Select*** the beam specimen, ***Express*** deflection equation.	Cognitive	Understand, Apply
CO5	***Measure*** rotation of rod due to torsion & test the springs, ***Express*** torsion.	Cognitive	Understand, Apply
CO6	***Classify*** principal stresses; ***explain*** the stresses, strains associated with thin-wall spherical and cylindrical pressure vessels.	Cognitive	Apply, Analyze

UNIT I BASICS OF STRESS AND STRAIN OF SOLIDS 9+3

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 9+3

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 9+3

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

UNIT IV TORSION **9+3**

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 **9+3**

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. Rajput R K, Edition -VI "Strength of Materials" Publisher, S Chand, 2015.

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

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.

E – References

1. nptel.ac.in/courses/112107147

LECTURE: 45 TUTORIAL: 15 PRACTICAL: 0 TOTAL HOURS:60

Table 1: Mapping of COs with POs:

CO Vs PO	CO1	CO2	CO3	CO4	CO5	CO6	Total	Scaled to 0,1,2 and 3
PO_1	3	2	1	1	3	2	12	2
PO_2	2	1	3	3	2	2	13	2
PO_3	1	2	2	2	2	2	11	2

PO_4	0	1	2	2	2	2	9	2
PO_5	0	1	2	2	3	1	9	2
PO_6	0	0	1	1	1	1	4	1
PO_7	0	0	0	0	0	0	0	0
PO_8	0	0	0	0	0	0	0	0
PO_9	0	0	0	0	0	1	1	0
PO_{10}	0	0	0	0	0	0	0	0
PO_{11}	0	0	0	0	1	1	2	1
PO_{12}	0	0	0	0	0	1	1	0
PSO_1	0	0	0	0	0	0	0	0
PSO_2	0	0	0	0	0	2	2	1

1-6 → 1, 7-12 → 2, 13-18 → 3

0 – No Relation, 1 – Low Relation, 2 – Medium Relation, 3 – High Relation

XAS304 FLUID MECHANICS AND MACHINERY

L	T	P	C	H
2	1	0	3	3

COURSE OUTCOMES		DOMAIN	LEVEL
CO_1	***Describe*** the basic definitions and fluid properties	Cognitive	Remember
CO_2	***Express*** the ideas of fluid statics and kinematics.	Cognitive	Understand
CO_3	***Illustrate*** various fluid dynamics equations.	Cognitive	Analyze
CO_4	***Describe*** flow in venturi-meter and orifice meter.	Cognitive	Analyze
CO_5	***Assess*** flow through pipes and ***measure*** the losses in pipes.	Cognitive	Evaluate
CO_6	***Compare*** *and* ***describe*** the performance of centrifugal and reciprocating pump.	Cognitive	Evaluate Remember

UNIT I DEFINITIONS AND FLUID PROPERTIES 6+3

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 6+3

Pascal's law - centre of pressure - forces on curved surfaces - buoyancy 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 6+3

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 6+3

Laminar boundary layer - turbulent boundary layer - boundary layer separation - development of

laminar and turbulent flows in circular pipes - losses in pipes.

UNIT V HYDRAULIC MACHINES 6+3

Centrifugal pumps and reciprocating pump- components; - single and double acting – slip mechanism – discharge – types of water turbines.

LECTURE : 30 TUTORIAL:15 TOTAL: 45 Hours

TEXT BOOKS

1. Bansal, R.K., "Fluid Mechanics and Hydraulics Machines", Laxmi Publications (P) Ltd., New Delhi, 2013.
2. Frank.M. White., "Fluid mechanics", McGraw Hill series, Seventh Edition, 2011.

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.

E – References

1. https://nptel.ac.in/courses/112105171/

Mapping of CO with PO

CO Vs PO	CO1	CO2	CO3	CO4	CO5	CO6	Total	Total /6
PO_1	3	3	3	3	3	3	18	3
PO_2	3	3	3	3	2	2	16	3
PO_3	2	2	2	2	2	2	12	2

PO_4	2	2	2	2	2	2	12	2
PO_5	0	0	1	2	2	2	7	1
PO_6	2	2	2	2	2	2	12	2
PO_7	2	2	2	2	2	2	12	2
PO_8	0	0	0	0	0	0	0	0
PO_9	2	2	2	2	2	2	12	2
PO_{10}	0	0	0	0	0	0	0	0
PO_{11}	0	0	0	0	0	0	0	0
PO_{12}	1	1	1	1	1	1	6	1
PSO_1	2	2	2	2	2	2	12	2
PSO_2	2	1	1	1	1	1	7	1

XAS401 ENGINEERING THERMODYNAMICS **L T P C H**

2 1 0 3 3

COURSE OUTCOMES		**DOMAIN**	**LEVEL**
CO_1	***Describe*** the laws of thermodynamics and their application to a wide range of systems.	Cognitive	Remember
CO_2	***Analyze*** the work and heat interactions associated with a prescribed process path and to perform thermodynamic analysis of a flow system. An ability to evaluate entropy changes and familiarity with calculations of the efficiencies of heat engines and other related engineering devices.	Cognitive	Analyze
CO_3	***Assess*** the efficiency and mean effective pressure of different thermodynamic air standard cycles.	Cognitive	Evaluate
CO_4	***Describe*** the pure substance (an ideal gas) and its applications in various flow and non flow process, and ability to evaluate the efficiencies.	Cognitive	Remember
CO_5	***Describe*** the construction and working principle of different types of compressors.	Cognitive	Remember
CO_6	***Compare*** the different refrigeration and air-conditioning systems and able to calculate the COP /cooling load for various applications.	Cognitive	Evaluate

Unit I BASIC THERMODYNAMICS 6+3=9

Systems, Zeroth, First and Second laws - concept of entropy change in non-flow processes - SFEE equations [steady flow energy equation] – Heat engines – Refrigerators and heat pumps - Basic thermodynamic relations.

Unit II AIR STANDARD CYCLES AND IC ENGINES 6+3=9

Otto, Diesel, Dual and Brayton cycles – Air standard efficiency -Mean effective pressure –Two and four stroke IC Engines – P-V & T-S diagrams.

Unit III GAS TURBINES 6+3=9

Open and closed cycle gas turbines – Ideal and actual cycles – Brayton cycle – Cycle with reheat, inter-cooling and regeneration – Application of gas turbines in aviation – Velocity diagrams.

Unit IV AIR COMPRESSORS 6+3=9

Positive displacement compressors – Construction and working principle of centrifugal, diagonal (mixed flow) and axial compressors.

Unit V REFRIGERATION AND AIR CONDITIONING 6+3=9

Principles of refrigeration, Air conditioning - Heat pumps - Vapour compression – Vapour absorption types - Coefficient of performance, Properties of refrigerants - Basic functional difference between refrigeration and air conditioning – Various methods of producing refrigerating effects (RE).

LECTURE:30 TUTORIAL: 15 TOTAL: 45 Hours

TEXT BOOKS

1. Nag P K, "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. Sankaar B K, „Thermal Engineering", Tata McGraw Hill, New Delhi, 1998.

E – References

1. https://nptel.ac.in/courses/112105123/

Mapping of CO with PO

CO Vs PO	CO1	CO2	CO3	CO4	CO5	CO6	Total	Total /6
PO_1	3	3	3	3	3	3	18	3
PO_2	3	3	3	3	3	3	18	3
PO_3	0	2	0	0	2	2	6	1
PO_4	1	1	1	1	1	1	6	1
PO_5	0	0	0	0	0	0	0	0
PO_6	1	1	1	1	1	1	6	1
PO_7	2	2	2	2	2	2	12	2
PO_8	0	0	0	0	0	0	0	0
PO_9	2	2	2	2	2	2	12	2
PO_{10}	0	0	0	0	0	0	0	0
PO_{11}	0	0	0	0	0	0	0	0
PO_{12}	1	1	1	1	1	1	6	1
PSO_1	1	1	1	1	1	1	6	1
PSO_2	0	0	0	0	0	0	0	0
Total	14	16	14	14	16	16	**90**	**15**

XAS402 INTRODUCTION TO AIRCRAFT AND AEROSPACE VEHICLES

L	T	P	C	H
3	0	0	3	3

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Generalize*** the historical background of Aviations and ***List out*** the Aircraft/ Spacecraft components.	Cognitive	Remember, Understand
CO2	***Recall*** the important physical properties of atmosphere and ***Indicate*** the effects of atmosphere on aircraft and space flight systems.	Cognitive	Remember, Understand
CO3	***Explain*** the construction of aircraft structures and materials used in aircraft components.	Cognitive	Understand
CO4	***Recall*** materials used in spacecrafts and ***explain*** the power plants used in aircrafts.	Cognitive	Remember, Understand
CO5	***Write*** a case study report on power plants and ***Discuss*** about the power plants used in rockets and satellites**.**	Affective, Cognitive	Respond, Understand
CO6	***Use*** basic principles of mechanics and ***apply*** in flight performance.	Affective, Cognitive	Respond, Understand, Apply

Unit I INTRODUCTION 9

History of aircraft and spacecrafts - classifications of aircrafts - Components of an airplane – Forces and Moments acting in aircraft and spacecraft - Space vehicles and their functions- Basic flight instruments.

Unit II EFFECTS OF ATMOSPHERE 9

Physical properties and structure of the atmosphere – Temperature, Density, pressure with altitude relationships - Effect of atmosphere on Aircraft and Space Vehicles - Mach number- Aerofoil terminologies -Evolution of lift, drag and moment.

Unit III STRUCTURES AND MATERIALS 9

Wing and fuselage construction – aluminium and steel alloys - composite materials - materials used for space vehicles – futuristic materials.

Unit IV POWER PLANTS 9

Basic ideas about piston and gas turbine engines – Operating principle of rocket - Types of rocket propulsion – Power generation in Satellites.

Unit V PERFORMANCE 9

Various maneuvers of aircraft – Turning performance – Types of drag - Various ceilings.

LECTURE: 45 TUTORIAL: 0 TOTAL: 45 Hours

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..

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

E – References

1. https://nptel.ac.in/courses/101105059/

Mapping of COs with POs:

CO Vs PO	CO1	CO2	CO3	CO4	CO5	CO6	Total	Scaled to 0,1,2 and 3
PO_1	1	3	3	3	3	3	16	3
PO_2	0	1	1	2	2	2	8	2
PO_3	0	0	0	0	1	1	2	1
PO_4	0	0	0	0	0	0	0	0
PO_5	0	0	0	0	0	0	0	0
PO_6	0	1	2	2	2	2	9	2
PO_7	0	1	1	1	1	1	5	1
PO_8	0	0	0	0	0	0	0	0
PO_9	0	0	1	1	1	1	4	1
PO_{10}	0	0	0	0	0	0	0	0
PO_{11}	0	0	0	0	0	0	0	0
PO_{12}	0	0	0	0	0	0	6	1
PSO_1	0	0	0	0	2	2	4	1
PSO_2	0	0	1	2	2	2	7	2

1-6=**1**, 7-12=**2**, 13-18=**3**

0 – No Relation, 1 – Low Relation, 2 – Medium Relation, 3 – High Relation

XAS403 AERODYNAMICS I

L	T	P	C	H
3	0	2	4	5

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Recall*** the Bernoulli's , Euler Theorem and ***Study*** of Basic Equations of Fluid flow	Cognitive	Remember Understand
CO2	***Explain*** various flows and ***Calibrate*** the wind tunnel	Cognitive Psychomotor	Understand Analyze Mechanism
CO3	***Express*** combinational stream functions for various flows and ***Calibrate*** pressure distribution over Cylinder.	Cognitive Psychomotor	Understand Analyze Mechanism
CO4	***Explain*** Kutta Transformations and ***Calibrate*** pressure distribution over various models	Cognitive Psychomotor	Understand Analyze Mechanism
CO5	***Sketch*** the flow visualization over the models, ***Explain*** Lifting line theory and ***Present*** solution to real time problems.	Cognitive Psychomotor Affective	Understand Analyze Mechanism Respond
CO6	***Display*** the Boundary Layer Flow over models and ***Discuss*** Navier stokes's Equation.	Cognitive Psychomotor	Remember Understand

UNIT I REVIEW OF BASIC FLUID MECHANICS 7

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

UNIT II TWO DIMENSIONAL INCOMPRESSIBLE FLOWS 10

Elementary flows – uniform flow, source, sink, vortex and their combinations, Pressure and velocity distributions on bodies with and without circulation in ideal and real fluid flows.

UNIT III CONFORMAL MAPPING 8

Classification of aerofoil - Transformation from circle to various shapes - Karman – Trefftz profiles – ideal and real flow – Magnus effect – D' Alembert paradox.

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 VISCOUS FLOWS 8

Concepts of boundary Layer- Blasius theorem- displacement, Momentum thickness - Flow over a flat plate.

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.

E – References

1. https://nptel.ac.in/courses/101105059/

List of Experiments

1. Flow visualization in water flow channel.

2. Flow visualization in smoke tunnel

3. Study of Low speed subsonic wind tunnel

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

5. Find the Pressure distribution over circular cylinder and plot it.

6. Enumerate and plot Pressure distribution over Symmetrical airfoil and estimation of C_L and C_D.

7. Enumerate and plot Pressure distribution over Un Symmetrical airfoil and estimation of C_L and C_D.

8. Enumerate and plot Pressure distribution over Cambered airfoil and estimation of C_L and C_D.

9. Study of Schlieren system to visualize shock.

10. Study of Shadow graph system to visualize shock.

Lecture:45 Tutorial:0 Practical:45 Total : 90 Hours

CO –PO Mapping;

CO Vs PO	CO1	CO2	CO3	CO4	CO5	CO6	Total	Scaled to 0,1,2 and 3
PO_1	3	3	3	3	3	3	15	2
PO_2	2	3	3	3	3	3	16	3
PO_3	1	2	2	3	3	3	11	2
PO_4	3	3	3	3	3	3	15	2
PO_5	0	2	2	2	3	3	9	1
PO_6	0	3	3	3	2	2	13	2
PO_7	1	2	2	2	2	2	9	1
PO_8	0	2	2	0	0	0	4	1
PO_9	0	3	3	0	0	0	6	1
PO_{10}	0	0	0	0	0	0	0	0
PO_{11}	0	0	0	0	0	0	0	0
PO_{12}	3	3	3	3	2	2	16	3
PSO_1	0	0	0	0	0	0	0	0
PSO_2	2	2	2	2	1	1	10	2

XAS404 AIRCRAFT STRUCTURES I

L	T	P	C	H
3	1	0	4	4

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Recall*** engineering mechanics and ***solve*** member forces in statically determinate structures.	Cognitive	Remember, Apply
CO2	***Draw*** and ***explain*** shear force and bending moment diagrams for statically indeterminate beams.	Cognitive	Remember, Understand
CO3	***Discuss*** and ***analyze*** the behavior of elastic structures subjected to combined loads, including bending, torsion and axial loads.	Cognitive	Understand, Analyze
CO4	***Explain*** and ***Use*** Euler's formula for various columns to find out critical load. ***Distinguish*** Euler's formula and Rankine's formula.	Cognitive	Understand, Apply
CO5	***Explain*** the real time application of columns.	Cognitive	Understand
CO6	***List*** the theories of failure and ***explain*** them and then ***utilize*** the failure theories to investigate the engineering structures. ***Uses*** of failure theories in Aircraft structures.	Cognitive, Psychomotor, Affective	Understand, Set, Receive

UNIT I STATICALLY DETERMINATE STRUCTURES 8+2

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

UNIT II STATICALLY INDETERMINATE STRUCTURES 10+4

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

UNIT III ENERGY METHODS 8+3

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

UNIT IV COULMNS 11+3

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

UNIT V FAILURE THEORIES 8+3

Types of failure theories – Principal stress theory – Principal strain theory – Shear stress theory – Shear strain energy theory – Strain energy theory –Fatigue and Creep Failure analysis.

LECTURE: 45 TUTORIAL: 15 TOTAL: 60

TEXT BOOKS

1. Rajput R K., 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.

E – References

1. https://nptel.ac.in/courses/101104069/21

Mapping of COs with POs:

CO Vs PO	CO1	CO2	CO3	CO4	CO5	CO6	Total	Scaled to 0,1,2 and 3
PO_1	3	3	2	3	3	2	16	3
PO_2	2	1	1	2	2	3	11	2
PO_3	2	1	1	2	2	3	11	2
PO_4	2	1	1	3	3	3	13	3
PO_5	3	0	0	3	3	3	12	2

PO_6	0	0	0	0	0	3	3	1
PO_7	0	0	0	0	0	0	0	0
PO_8	0	0	0	0	0	0	0	0
PO_9	0	0	0	0	0	2	2	1
PO_{10}	0	0	0	0	0	0	0	0
PO_{11}	0	0	0	1	1	2	4	1
PO_{12}	0	0	0	0	0	1	1	0
PSO_1	0	0	0	0	0	0	0	0
PSO_2	0	0	0	0	0	1	1	0

1-5 → 1, 6-10 → 2, 11-15 → 3

0 – No Relation, 1 – Low Relation, 2 – Medium Relation, 3 – High Relation

XASE01 AIRCRAFT SYSTEMS AND INSTRUMENTS

L	T	P	C	H
3	0	0	3	3

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Explain*** the components and concepts of various aircraft systems.	Cognitive	Understand
CO2	***Compare*** the basic and modern control systems.	Cognitive	Understand
CO3	Study the ***functions*** of fuel system and ***Examine*** the auxiliary Aircraft power plant systems.	Cognitive	Understand, Analyze
CO4	***Outline*** the needs of Air-conditioning systems and cabin pressurization system.	Cognitive	Understand
CO5	***Differentiate*** the use of flight instruments and Navigation Instruments.	Cognitive	Analyze
CO6	***Inspect*** the needs of engine instruments and their operations.	Cognitive	Analyze

UNIT I AIRCRAFT SYSTEMS 9

Hydraulic systems –basic principle – components – hydraulic systems controllers – modes of operation – pneumatic systems – working principles – typical pneumatic power system – brake system – components, landing gear systems – classification – shock absorbers – Extension, retractable mechanism.

UNIT II AIRPLANE CONTROL SYSTEMS 8

Conventional Systems – power assisted and fully powered flight controls – power actuated systems – engine control systems – push pull rod system – operating principles – digital fly by wire systems – auto pilot system, active control technology.

UNIT III ENGINE SYSTEMS 8

Fuel, lubricating, starting and ignition systems in piston and jet engines- multi-engine fuel systems -types of valves used in gas turbine engines.

UNIT IV AIRCONDITIONING AND PRESSURIZING SYSTEM 9

Basic air cycle systems – vapour cycle systems, 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 11

Flight instruments and navigation instruments – accelerometers, air speed indicators – mach meters – altimeters - gyroscopic instruments– principles and operation – study of various types of engine instruments – digital tachometers – temperature gauges – pressure gauge – operation and principles.

LECTURE: 45 TUTORIAL: 0 PRACTICAL: 0 TOTAL: 45

TEXT BOOKS

1. Nagabhushana S, L.K.Sudha. “Aircraft Instrumentation and systems” ISBN-13: 978-9380578354- I.K. International Publishing House Pvt.Ltd.

2. Mekinley, J.L. and R.D. Bent, "Aircraft Power Plants", McGraw Hill 1993.

3. Pallet, E.H.J, "Aircraft Instruments & Principles", Pitman & Co 1993.

REFERENCE BOOKS

1. Roy Lanagton, Chuck Clark etc., “Aircraft Fuel Systems” Publication Wiley.

2. Mckinley, J.L. and Bent R.D. "Aircraft Maintenance & Repair", McGraw Hill, 1993.

3. Handbooks of “Airframe and Power plant Mechanics” US dept. of Transportation, Federal, Aviation Administration, The English Book Store, New Delhi, 1995.

E – References

1. “Instrument Landing Systems (ILS)” Author: Michael Feramez.

2. Nolan, Chap-2, Navigation Systems- Enroute

3. Jan Rohac “Aircraft and Spacecraft Instrumentation” Lecture Notes- EFIS, EICAS, ECAM.

4. nptel.ac.in/

Mapping of COs with POs:

CO Vs PO	CO1	CO2	CO3	CO4	CO5	CO6	Total	Scaled to 0,1,2 and 3
PO_1	3	2	2	2	2	1	12	3
PO_2	2	2	3	2	2	2	13	3
PO_3	1	2	3	3	1	1	11	3
PO_4	0	1	2	3	1	1	8	2
PO_5	0	1	2	1	0	1	5	1
PO_6	1	2	3	2	2	2	12	3
PO_7	0	1	3	2	2	1	9	2
PO_8	1	2	1	1	1	1	7	2
PO_9	1	2	2	1	1	1	8	2
PO_{10}	0	0	1	1	1	0	3	1
PO_{11}	1	0	0	0	0	0	1	1
PO_{12}	2	2	3	2	2	2	13	3
PSO_1	0	1	2	1	2	1	7	2
PSO_2	1	0	3	0	0	1	5	1

1-5 → 1, 6-10 → 2, 11-15 → 3

0 – No Relation, 1 – Low Relation, 2 – Medium Relation, 3 – High Relation

XASE02 SENSORS AND MEASUREMENTS

L	T	P	C	H
3	0	0	3	3

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Classify*** the types of measurement system and its classifications.	Cognitive	Understand
CO2	***Explain*** the concepts of Strain gauges	Cognitive	Understand
CO3	***Explain*** the physical principles and characteristics of different types of displacement, pressure and temperature sensors and transducer.	Cognitive	Understand
CO4	***Classify*** the photo and piezo electric sensors applications.	Cognitive	Understand
CO5	***Express*** the working principle and its characteristics of different bridge circuits used in signal conditioning and to know about the signal analyzer.	Cognitive	Understand
CO6	***Discuss*** the working principle of display and recording devices.	Cognitive	Understand

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.

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

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

E – References

1. https://nptel.ac.in/courses/112103174/3

Mapping of COs with POs:

CO Vs PO	CO1	CO2	CO3	CO4	CO5	CO6	Total	Scaled to 0,1,2 and 3
PO_1	3	3	3	3	3	3	18	3
PO_2	1	1	1	1	1	1	6	1

PO_3	1	1	1	1	1	1	6	1
PO_4	2	2	2	2	2	2	12	2
PO_5	0	0	0	0	0	0	0	0
PO_6	1	1	1	1	1	1	6	1
PO_7	0	0	0	0	0	0	0	0
PO_8	1	1	1	1	1	1	6	1
PO_9	2	2	2	2	2	2	12	2
PO_{10}	0	0	0	0	0	0	0	0
PO_{11}	1	1	1	1	1	1	6	1
PO_{12}	1	1	1	1	1	1	6	1
PSO_1	3	3	3	3	3	3	18	3
PSO_2	0	0	0	0	0	0	0	0

1-6 → 1, 7-12 → 2, 13-18 → 3

0 – No Relation, 1 – Low Relation, 2 – Medium Relation, 3 – High Relation

XASE03 CONTROL SYSTEMS

L	T	P	C	H
3	0	0	3	3

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Identify*** the basic elements, derive the transfer function and ***Construct*** the transfer function of Simple pneumatic, hydraulic and thermal systems.	Cognitive	Remember
CO2	***Explain*** the performance of open and closed loop system.	Cognitive	Understand
CO3	***Describe*** the Time domain and ***show*** the response of time.	Cognitive	Remember Understand
CO4	***Explain*** Frequency domain.	Cognitive	Understand
CO5	***Construc***t *and* ***verify*** the frequency response.	Cognitive	Apply
CO6	***Describe*** the digital control systems.	Cognitive	Remember

UNIT I INTRODUCTION 9

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 9

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 9

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 9

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

UNIT V SAMPLED DATA SYSTEMS 9

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

Lecture: 45 Tutorial: 0 Total: 45 Hours

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, “Feedback 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.

E- References

1. https://onlinecourses.nptel.ac.in/noc18_ee41/preview

2. https://nptel.ac.in/courses/108101037/

COs versus POs mapping:

CO/ PO	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
CO1	2	1	1	1	0	0	1	1	0	1	0	1	2	0
CO2	2	2	1	1	1	1	1	1	1	1	0	2	2	1
CO3	2	3	3	3	2	2	1	1	1	1	1	2	2	1
CO4	2	3	3	3	2	2	1	1	1	1	1	2	2	1
CO5	2	3	3	3	2	2	1	1	1	1	1	2	2	1
CO6	2	1	1	1	1	1	1	1	1	1	0	1	2	1
Total	12	13	12	12	8	8	6	6	5	6	3	10	12	5
Scaling	2	2	2	2	1	1	1	1	1	1	1	2	2	1

XASE04 AIRFRAME MAINTENANCE AND REPAIR

L	T	P	C	H
3	0	0	3	3

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Recall*** different equipments used in welding shop, ***Explain*** various repair techniques used in sheet metal.	Cognitive	Remember Understand
CO2	***List out*** types of plastics used in airframes and its maintenance.	Cognitive	Remember
CO3	***Describe*** the cleaning process of fiber reinforced plastic (FRP) materials.	Cognitive	Understand
CO4	***Discuss*** the various leveling procedure of jacking, weighing and assembly.	Cognitive	Remember
CO5	***Review*** of hydraulic, pneumatic system their trouble shooting and maintenance practice.	Cognitive	Remember
CO6	***Discuss*** the safety practices of material storage and handling.	Cognitive	Understand

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 Fiber 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.

E – References

1. https://nptel.ac.in/courses/101106035/lec55.pdf

Mapping of COs with POs:

CO Vs PO	CO1	CO2	CO3	CO4	CO5	CO6	Total	Scaled to 0,1,2 and 3
PO_1	3	3	3	3	3	3	18	3
PO_2	2	2	2	1	2	1	10	2
PO_3	1	2	2	0	1	1	7	2

PO_4	0	1	1	2	1	1	6	1
PO_5	0	0	0	0	0	0	0	0
PO_6	2	1	1	0	1	0	5	1
PO_7	1	2	2	1	1	0	7	2
PO_8	1	1	1	2	1	2	8	2
PO_9	1	2	2	1	1	0	7	2
PO_{10}	0	0	0	0	0	0	0	0
PO_{11}	0	0	0	0	0	0	0	0
PO_{12}	0	0	0	0	0	2	2	1
PSO_1	0	0	0	0	0	0	0	0
PSO_2	1	2	2	0	1	1	7	2

1-6 → 1, 7-12 → 2, 13-18 → 3

0 – No Relation, 1 – Low Relation, 2 – Medium Relation, 3 – High Relation

XASE05 THEORY OF ELASTICITY

L	T	P	C	H
3	0	0	3	3

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Recall*** strength of material and use stress-strain relationship to ***calculate*** the displacements.	Cognitive	Remember, Apply
CO2	***Distinguish*** plane stress and plane strain problems.	Cognitive	Understand
CO3	***Use*** of Airy's stress function in elastic structures.	Cognitive	Apply
CO4	***Apply*** and ***Analyze*** Navier's theory, St. Venant's theory and Prandtl's theory on torsion.	Cognitive	Apply, Analyze
CO5	***State*** classical plate theory.	Cognitive	Remember
CO6	***Apply*** Navier's theory for plates.	Cognitive	Apply

UNIT I BASIC EQUATIONS OF ELASTICITY 9

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 9

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 9

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

UNIT IV TORSION 9

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 9

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: 45 TUTORIAL: 0 TOTAL: 45

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.

E –References

1. https://onlinecourses.nptel.ac.in/noc18_ce18/preview
2. https://nptel.ac.in/courses/105108070/

Mapping of CO with PO

CO Vs PO	CO1	CO2	CO3	CO4	CO5	CO6	Total	Scaled to 0,1,2 and 3
PO_1	3	3	3	2	2	2	15	3
PO_2	2	3	2	2	2	2	13	2
PO_3	1	3	1	1	1	1	8	1
PO_4	1	2	1	1	1	1	7	1
PO_5	3	3	3	0	3	3	15	2
PO_6	1	2	0	0	0	0	3	1
PO_7	0	2	0	0	2	2	6	1
PO_8	0	2	0	0	0	0	2	0
PO_9	0	1	0	0	0	0	1	0
PO_{10}	0	0	0	0	0	0	0	0
PO_{11}	0	0	0	0	0	0	0	0
PO_{12}	0	2	0	0	0	0	2	0
PSO_1	0	0	0	0	0	0	0	0
PSO_2	0	0	0	0	0	0	0	0