Faculty of

Engineering and Technology

SRM UNIVERSITY
(Under section 3 of UGC Act 1956)

Curriculum, Pre-Requisites / Co-Requisites Chart and Syllabus for B.Tech

UNDER CHOICE BASED FLEXIBLE CREDIT SYSTEM

REGULATIONS 2015

(For students admitted from 2015-16 onwards)

Specialization	: Aerospace Engineering
Offering Department	: Aerospace Engineering

Placed in the 32nd Academic Council Meeting held on 23rd July 2016

CONTENTS

FACULTY OF ENGINEERING AND TECHNOLOGY, SRM UNIVERSITY

DEPARTMENT OF AEROSPACE ENGINEERING

B.TECH AEROSPACE ENGINEERING CHOICE BASED FLEXIBLE CREDIT SYSTEM (CBFCS) Curriculum Under Regulations 2015 (For students admitted from 2015-16 onwards)

L Lecture Hours / Week | **T** Tutorial Hours / Week | **C** Credits | **P** Practical Hours / Week | **L** Laboratory Course | **E** Elective Courses | **J** Theory jointly with Lab | **M** Course with Multidisciplinary content

Category	Category - wise % of Credits	Year 1												Year 2											
		1st Semester						2nd Semester						1st Semester						2nd Semester					
		Course Code	Course Title	L	T	P	C	Course Code	Course Title	L	T	P	C	Course Code	Course Title	L	T	P	C	Course Code	Course Title	L	T	P	C
Arts & Humanities-G	8.33%	15LE101	English	2	0	0	2	15LE102	Value Education	2	0	0	2	15LE201E	German Language I	2	0	0	2	15LE207E	German Language II	2	0	0	2
		15PD101	Soft Skills I	1	1	0	1	15PD102	Soft Skills II	1	1	0	1	15LE202E	French Language I					15LE208E	French Language II				
								15NC101	NCC- National Cadet Corps	0	0	1	1	15LE203E	Japanese Language I					15LE209E	Japanese Language II				
								15NS101	NSS- National Service Scheme					15LE204E	Korean Language I					15LE210E	Korean Language II				
								15SP101	NSO- National Sports Organization					15LE205E	Chinese Language I					15LE211E	Chinese Language II				
								15YG101	Yoga					15PD201	Quantitative Aptitude & Logical Reasoning –I	1	1	0	1	15PD202	Verbal Aptitude	1	1	0	1
	15		Total	3	1	0	3		Total	3	1	1	4		Total	3	1	0	3		Total	3	1	0	3
Basic Sciences - B	19.44%	15MA101	Calculus And Solid Geometry	3	1	0	4	15MA102	Advanced Calculus And Complex Analysis	3	1	0	4	15MA202	Fourier Series, Partial Differential Equations And Their Applications	4	0	0	4	15MA206	Numerical Methods	4	0	0	4
		15PY101	Physics	3	0	0	3	15PY102L	Material Science	2	0	2	3												
		15PY101L	Physics Laboratory	0	0	2	1	15CY102	Principles of Environmental Science	2	0	0	2												
		15CY101	Chemistry	3	0	0	3																		
		15CY101L	Chemistry Laboratory	0	0	2	1																		
		15BT101	Biology For Engineers	2	0	0	2																		
	35		Total	11	1	4	14		Total	7	1	2	9		Total	4	0	0	4		Total	4	0	0	4
Engineering Sciences -E	10.56%	15CE101	Basic Civil Engineering	2	0	0	2	15ME101	Basic Mechanical Engineering	2	0	0	2	15AS102	Applied Engineering Mechanics	3	2	0	4						
		15EE101	Basic Electrical Engineering	2	0	0	2	15EC101	Basic Electronics Engineering	2	0	0	2												
		15ME105L	Engineering Graphics	1	0	4	3	15ME104L	Workshop Practice	0	0	3	2												
		15CS101L	Programming Laboratory	1	0	2	2																		
	19		Total	6	0	6	9		Total	4	0	3	6		Total	3	2	0	4		Total	0	0	0	0
Professional - Core -P	38.33%							15AS101	Elements of Aeronautics	2	0	0	2	15AS201J	Applied Fluid Mechanics	2	2	2	4	15AS204J	Aerodynamics – I	3	0	2	4
														15AS202	Aero Engineering Thermodynamics	3	0	0	3	15AS205J	Applied Solid Mechanics	3	0	2	4
														15AS203J	Aircraft Production Techniques	3	0	2	4	15AS206	Aerospace Materials	3	0	0	3
														15MH204	Solid State Devices and Circuits	3	0	0	3	15AS207	Aircraft Systems And Instruments	3	0	0	3
	69		Total	0	0	0	0		Total	2	0	0	2		Total	11	2	4	14		Total	12	0	4	14
Prof - Electives -P	10.00%																				**Department Elective-I**	**3**	**0**	**0**	**3**
	18		Total	0	0	0	0		Total	0	0	0	0		Total	0	0	0	0		Total	3	0	0	3
Project / Seminar / Internship-P	10.00%																								
	18		Total	0	0	0	0		Total	0	0	0	0		Total	0	0	0	0		Total	0	0	0	0
Open Electives	3.33%																								
	6		Total	0	0	0	0		Total	0	0	0	0		Total	0	0	0	0		Total	0	0	0	0
Total	**180**			**20**	**2**	**10**	**26**			**16**	**2**	**6**	**21**			**21**	**5**	**4**	**25**			**22**	**1**	**4**	**24**
			Total Contact Hours	**32**					**Total Contact Hours**	**24**					**Total Contact Hours**	**30**					**Total Contact Hours**	**27**			

FACULTY OF ENGINEERING AND TECHNOLOGY, SRM UNIVERSITY

DEPARTMENT OF AEROSPACE ENGINEERING

B.TECH AEROSPACE ENGINEERING CHOICE BASED FLEXIBLE CREDIT SYSTEM (CBFCS) Curriculum Under Regulations 2015 (For students admitted from 2015-16 onwards)

L	Lecture Hours / Week	T	Tutorial Hours / Week	C Credits P Practical Hours / Week	L	Laboratory Course	E Elective Courses	J	Theory jointly with Lab	M Course with Multidisciplinary content

	Year 3											Year 4										
	1st Semester						2nd Semester						1st Semester						2nd Semester				
Course Code	Course Title	L	T	P	C	Course Code	Course Title	L	T	P	C	Course Code	Course Title	L	T	P	C	Course Code	Course Title	L	T	P	C
15PD301	Communication & Reasoning Skills	1	1	0	1	15PD302	Quantitative Aptitude & Logical Reasoning –II	1	1	0	1												
	Total	1	1	0	1		Total	1	1	0	1		Total	0	0	0	0		Total	0	0	0	0
15MA301	Probability and Statistics	4	0	0	4																		
	Total	4	0	0	4		Total	0	0	0	0		Total	0	0	0	0		Total	0	0	0	0
	Total	0	0	0	0		Total	0	0	0	0		Total	0	0	0	0		Total	0	0	0	0
15AS301J	Aerodynamics –II	3	0	2	4	15AS305	Introduction to Space Technology	3	0	0	3	15AS401	Vibrations and Elements of Aeroelasticity	3	0	0	3						
15AS302	Flight Dynamics –I	3	0	0	3	15AS306	Flight Dynamics –II	3	0	0	3	15AS402J	Digital Avionics	3	0	2	4						
15AS303J	Aircraft Structures	3	0	2	4	15AS307	Rocket Propulsion	3	0	0	3	15AS403L	Aerospace Computational Analysis Laboratory	0	0	3	2						
15AS304	Air Breathing Propulsion	3	0	0	3	15AS307L	Aerospace Propulsion Laboratory	0	0	3	2	15AS304M	Multi-Disciplinary Design	2	2	0	3						
						15AS308L	Aircraft Component Drawing	0	0	3	2												
	Total	12	0	4	14		Total	9	0	6	13		Total	8	2	5	12		Total	0	0	0	0
	Department Elective-II	**3**	**0**	**0**	**3**		**Department Elective-III**	**3**	**0**	**0**	**3**		**Department Elective-V**	**3**	**0**	**0**	**3**						
							Department Elective-IV	**3**	**0**	**0**	**3**		**Department Elective-VI**	**3**	**0**	**0**	**3**						
	Total	3	0	0	3		Total	6	0	0	6		Total	6	0	0	6		Total	0	0	0	0
15AS390L	Internship / Industrial Training (To be done after Year II)	0	0	3	2	15AS375L / 15AS380L / 15AS385L / 15AS490L	Minor Project - I / Seminar - I / MOOC - I / Industry Module - I	0	0	3	2	15AS376L / 15AS381L / 15AS386L / 15AS491L	Minor Project - II / Seminar - II / MOOC - II / Industry Module - II	0	0	3	2	15AS496L	Major Project	0	0	24	12
	Total	0	0	3	2		Total	0	0	3	2		Total	0	0	3	2		Total	0	0	24	12
							Open Elective - I	3	0	0	3		Open Elective - II	3	0	0	3						
							As per list / as taken by the student						As per list / as taken by the student										
	Total	0	0	0	0		Total	3	0	0	3		Total	3	0	0	3		Total	0	0	0	0
		20	**1**	**7**	**24**			**19**	**1**	**9**	**25**			**17**	**2**	**8**	**23**			**0**	**0**	**24**	**12**
	Total Contact Hours	**28**					**Total Contact Hours**	**29**					**Total Contact Hours**	**27**					**Total Contact Hours**	**24**			

B.Tech (Full Time) – Aerospace Engineering
Faculty of Engineering and Technology, SRM University

Choice Based Flexible Credit System (CBFCS)
Semester – Wise List of Courses (2015 – 16 onwards)

Year – I / Semester – I

Course Code	Course Title	Category	L	T	P	C	Page No.
15LE101	English	G	2	0	0	2	---
15PD101	Soft Skills - I	G	1	1	0	1	---
15MA101	Calculus And Solid Geometry	B	3	1	0	4	---
15PY101	Physics	B	3	0	0	3	---
15PY101L	Physics Laboratory	B	0	0	2	1	---
15CY101	Chemistry	B	3	0	0	3	---
15CY101L	Chemistry Laboratory	B	0	0	2	1	---
15BT101	Biology For Engineers	B	2	0	0	2	---
15CE101	Basic Civil Engineering	E	2	0	0	2	---
15EE101	Basic Electrical Engineering	E	2	0	0	2	---
15ME105L	Engineering Graphics	E	1	0	4	3	---
15CS101L	Programming Laboratory	E	1	0	2	2	---
	Total		**20**	**2**	**10**	**26**	---

Year – I / Semester – II

Course Code	Course Title	Category	L	T	P	C	Page No.
15LE102	Value Education	G	2	0	0	2	---
15PD102	Soft Skills - II	G	1	1	0	1	---
15NC101 / 15NS101 / 15SP101 / 15YG101	NCC - National Cadet Corps / NSS - National Service Scheme / NSO – National Sports Organization / Yoga	G	0	0	1	1	---
15MA102	Advanced Calculus And Complex Analysis	B	3	1	0	4	---
15PY102L	Material Science	B	2	0	2	3	---
15CY102	Principles of Environmental Science	B	2	0	0	2	---
15ME101	Basic Mechanical Engineering	E	2	0	0	2	---
15EC101	Basic Electronics Engineering	E	2	0	0	2	---
15ME104L	Workshop Practice	E	0	0	3	2	---
15AS101	Elements of Aeronautics	P	2	0	0	2	2
	Total		**16**	**2**	**6**	**21**	---

B.Tech (Full Time) – Aerospace Engineering
Faculty of Engineering and Technology, SRM University

SRM UNIVERSITY
(Under section 3 of UGC Act 1956)

Choice Based Flexible Credit System (CBFCS)
Semester – Wise List of Courses (2015 – 16 onwards)

Year – II / Semester – I

Course Code	Course Title	Category	L	T	P	C	Page No.
15LE201E / 15LE202E / 15LE203E / 15LE204E / 15LE205E	German Language I / French Language I / Japanese Language I / Korean Language I / Chinese Language I	G	2	0	0	2	---
15PD201	Quantitative Aptitude & Logical Reasoning –I	G	1	1	0	1	---
15MA202	Fourier Series, Partial Differential Equations And Their Applications	B	4	0	0	4	---
15AS102	Applied Engineering Mechanics	E	3	2	0	4	6
15AS201J	Applied Fluid Mechanics	P	2	2	2	4	9
15AS202	Aero Engineering Thermodynamics	P	3	0	0	3	12
15AS203J	Aircraft Production Techniques	P	3	0	2	4	15
15MH204	Solid State Devices and Circuits	P	3	0	0	3	---
	Total		**21**	**5**	**4**	**25**	---

Year – II / Semester – II

Course Code	Course Title	Category	L	T	P	C	Page No.
15LE207E / 15LE208E / 15LE209E / 15LE210E / 15LE211E	German Language II / French Language II / Japanese Language II / Korean Language II / Chinese Language II	G	2	0	0	2	---
15PD202	Verbal Aptitude	G	1	1	0	1	---
15MA206	Numerical Methods	B	4	0	0	4	---
15AS204J	Aerodynamics – I	E	3	0	2	4	19
15AS205J	Applied Solid Mechanics	P	3	0	2	4	22
15AS206	Aerospace Materials	P	3	0	0	3	25
15AS207	Aircraft Systems And Instruments	P	3	0	0	3	28
	Department Elective - I	P	3	0	0	3	90 - 99
	Total		**22**	**1**	**4**	**24**	---

B.Tech (Full Time) – Aerospace Engineering
Faculty of Engineering and Technology, SRM University

Choice Based Flexible Credit System (CBFCS)
Semester – Wise List of Courses (2015 – 16 onwards)

Year – III / Semester – I

Course Code	Course Title	Category	L	T	P	C	Page No.
15PD301	Communication & Reasoning Skills	G	1	1	0	1	---
15MA301	Probability and Statistics	B	4	0	0	4	---
15AS301J	Aerodynamics –II	P	3	0	2	4	32
15AS302	Flight Dynamics –I	P	3	0	0	3	35
15AS303J	Aircraft Structures	P	3	0	2	4	38
15AS304	Air Breathing Propulsion	P	3	0	0	3	42
	Department Elective - II	P	3	0	0	3	100 - 134
15AS390L	Internship / Industrial Training*	P	0	0	3	2	44
	Total		**20**	**1**	**7**	**24**	---

*: To be done after Year II

Year – III / Semester – II

Course Code	Course Title	Category	L	T	P	C	Page No.
15PD302	Quantitative Aptitude & Logical Reasoning –II	G	1	1	0	1	---
15AS305	Introduction to Space Technology	P	3	0	0	3	47
15AS306	Flight Dynamics –II	P	3	0	0	3	50
15AS307	Rocket Propulsion	P	3	0	0	3	53
15AS307L	Aerospace Propulsion Laboratory	P	0	0	3	2	55
15AS308L	Aircraft Component Drawing	P	0	0	3	2	57
	Department Elective - III	P	3	0	0	3	100 - 134
	Department Elective - IV	P	3	0	0	3	100 - 134
15AS375L / 15AS380L / 15AS385L / 15AS490L	Minor Project - I / Seminar - I / MOOC - I / Industry Module - I	P	0	0	3	2	59 - 66
	Open Elective - I	P	3	0	0	3	---
	Total		**19**	**1**	**9**	**25**	---

B.Tech (Full Time) – Aerospace Engineering
Faculty of Engineering and Technology, SRM University

Choice Based Flexible Credit System (CBFCS)
Semester – Wise List of Courses (2015 – 16 onwards)

Year – IV / Semester – I

Course Code	Course Title	Category	L	T	P	C	Page No.
15AS401	Vibrations and Elements of Aeroelasticity	P	3	0	0	3	68
15AS402J	Digital Avionics	P	3	0	2	4	71
15AS403L	Aerospace Computational Analysis Laboratory	P	0	0	3	2	74
15AS304M	Multi-Disciplinary Design	P	2	2	0	3	76
	Department Elective - V	P	3	0	0	3	135 - 164
	Department Elective - VI	P	3	0	0	3	135 - 164
15AS376L / 15AS381L / 15AS386L / 15AS491L	Minor Project - II / Seminar - II / MOOC - II / Industry Module - II	P	0	0	3	2	78 - 85
	Open Elective - II	P	3	0	0	3	---
	Total		**17**	**2**	**8**	**23**	---

Year – IV / Semester – II

Course Code	Course Title	Category	L	T	P	C	Page No.
15AS496L	Major Project	P	0	0	24	12	87
	Total		**0**	**0**	**24**	**12**	---
						Grand Total of Credits	**180**	---

SRM UNIVERSITY
(Under section 3 of UGC Act 1956)

Choice Based Flexible Credit System (2015 – 16 onwards)
Department Electives

SRM UNIVERSITY
(Under section 3 of UGC Act 1956)

Choice Based Flexible Credit System (2015 – 16 onwards)
Department Electives

Course Code	Course Title	L	T	P	C	Page No.
Department Elective – V and VI						
15AS324E	Aircraft Control Systems	3	0	0	3	136
15AS411E	Helicopter Aerodynamics	3	0	0	3	138
15AS413E	Rocket Aerodynamics	3	0	0	3	141
15AS414E	Space Mission Design and Analysis	3	0	0	3	144
15AS415E	Computational Heat Transfer and Fluid Dynamics	3	0	0	3	146
15AS416E	Rockets and Missiles	3	0	0	3	148
15AS417E	Fatigue and Fracture Mechanics	3	0	0	3	151
15AS418E	Cryogenic Engineering	3	0	0	3	154
15AS419E	Aircraft Engine and Instrument Systems	3	0	0	3	157
15AS420E	Helicopter Maintenance	3	0	0	3	160
15AS421E	Aerial Robotics	3	0	0	3	163
15ME353E	TQM and Reliability Engineering	3	0	0	3	---
15ME356E	Finite Element Methods	3	0	0	3	---
15MH313E	Fundamentals of Microprocessors and Microcontrollers	3	0	0	3	---

All core / elective courses will be listed / delisted every semester, under open electives, based on the availability of resources and demand.

B.Tech (Full Time) – Aerospace Engineering
Faculty of Engineering and Technology, SRM University

SRM UNIVERSITY
(Under section 3 of UGC Act 1956)

Choice Based Flexible Credit System (CBFCS)
Cumulative Credits and Categorization of Courses

Year / Semester	L / T / P / C				Category				No. of Credits	Cumulative Credits
	L	T	P	C	G	B	E	P		
Year – I / Semester - I	20	2	10	26	3	14	9	0	26	26
Year – I / Semester - II	16	2	6	21	4	9	6	2	21	47
Year – II / Semester - I	21	5	4	25	3	4	4	14	25	72
Year – II / Semester - II	22	1	4	24	3	4	0	17	24	96
Year – III / Semester - I	20	1	7	24	1	4	0	19	24	120
Year – III / Semester - II	19	1	9	25	1	0	0	24	25	145
Year – IV / Semester - I	17	2	8	23	0	0	0	23	23	168
Year – IV / Semester - II	0	0	24	12	0	0	0	12	12	**180**
Total	**135**	**14**	**72**	**180**	**15**	**35**	**19**	**111**	**180**	

STUDENT OUTCOMES

The curriculum and syllabus for B.Tech programs (2015) conform to outcome based teaching learning process. In general, ELEVEN STUDENT OUTCOMES (a-k) have been identified and the curriculum and syllabus have been structured in such a way that each of the courses meets one or more of these outcomes. Student outcomes describe what students are expected to know and be able to do by the time of graduation. These relate to the skills, knowledge, and behaviors that students acquire as they progress through the program. Further each course in the program spells out clear instructional objectives which are mapped to the student outcomes.

The student outcomes are:

(a) an ability to apply knowledge of mathematics, science, and engineering

(b) an ability to design and conduct experiments, as well as to analyze and interpret data

(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

(d) an ability to function on multidisciplinary teams

(e) an ability to identify, formulate, and solve engineering problems

(f) an understanding of professional and ethical responsibility

(g) an ability to communicate effectively

(h) the broad education necessary to understand the impact of engineering solutions in global, economic, environmental, and societal context

(i) a recognition of the need for, and an ability to engage in life-long learning

(j) a knowledge of contemporary issues

(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

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C-D-I-O FRAMEWORK

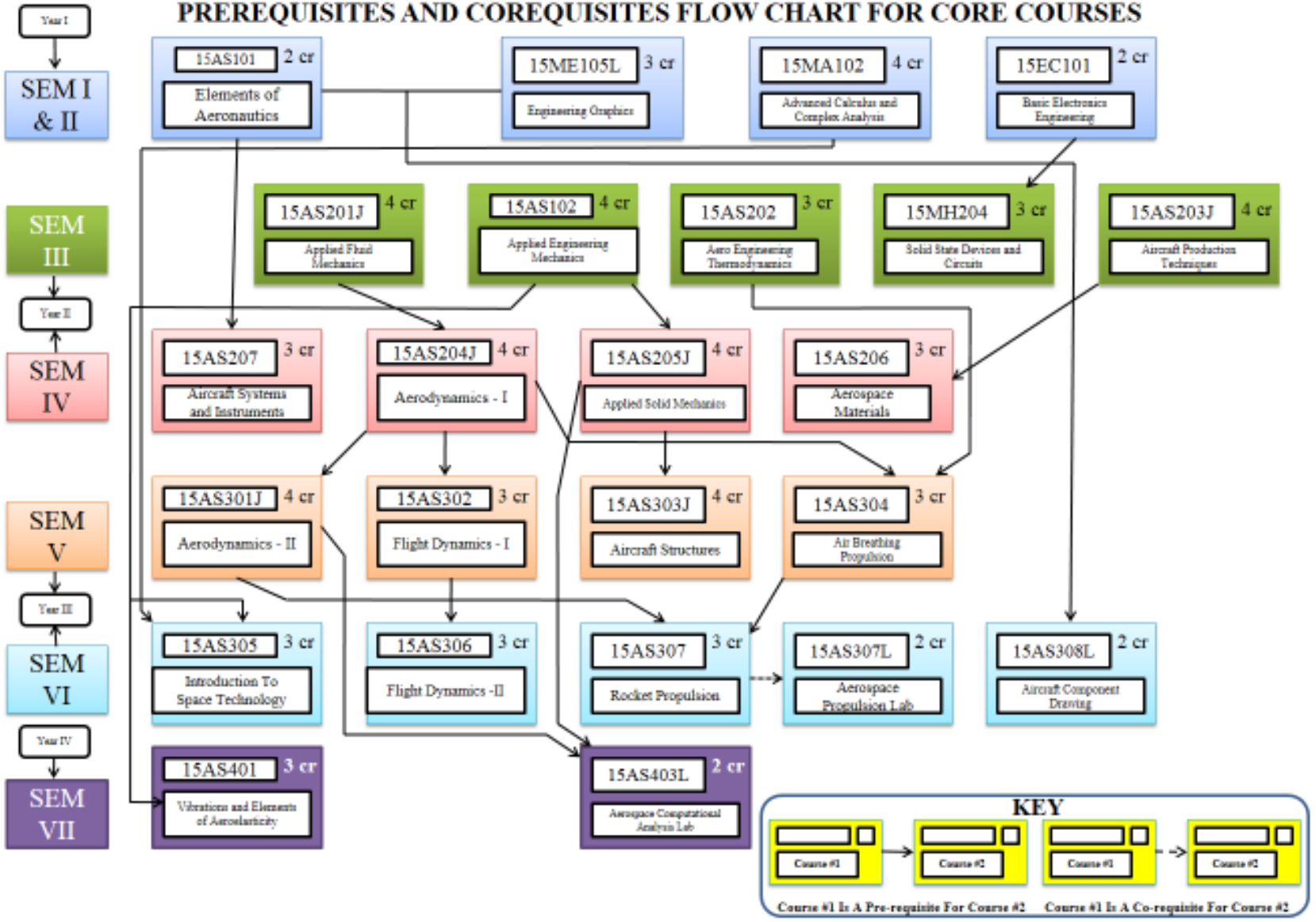
The CDIO Initiative (CDIO is a trademarked initialism for **Conceive — Design — Implement — Operate**) is an innovative educational framework for producing the next generation of engineers. The framework provides students with an education stressing engineering fundamentals set in the context of Conceiving — Designing — Implementing — Operating real-world systems and products. Throughout the world, CDIO Initiative collaborators have adopted CDIO as the framework of their curricular planning and outcome based assessment.

In the syllabus, every topic has been classified under one or more of C-D-I-O so that students and faculty alike are clear about the scope of learning to take place under each one of the topics.

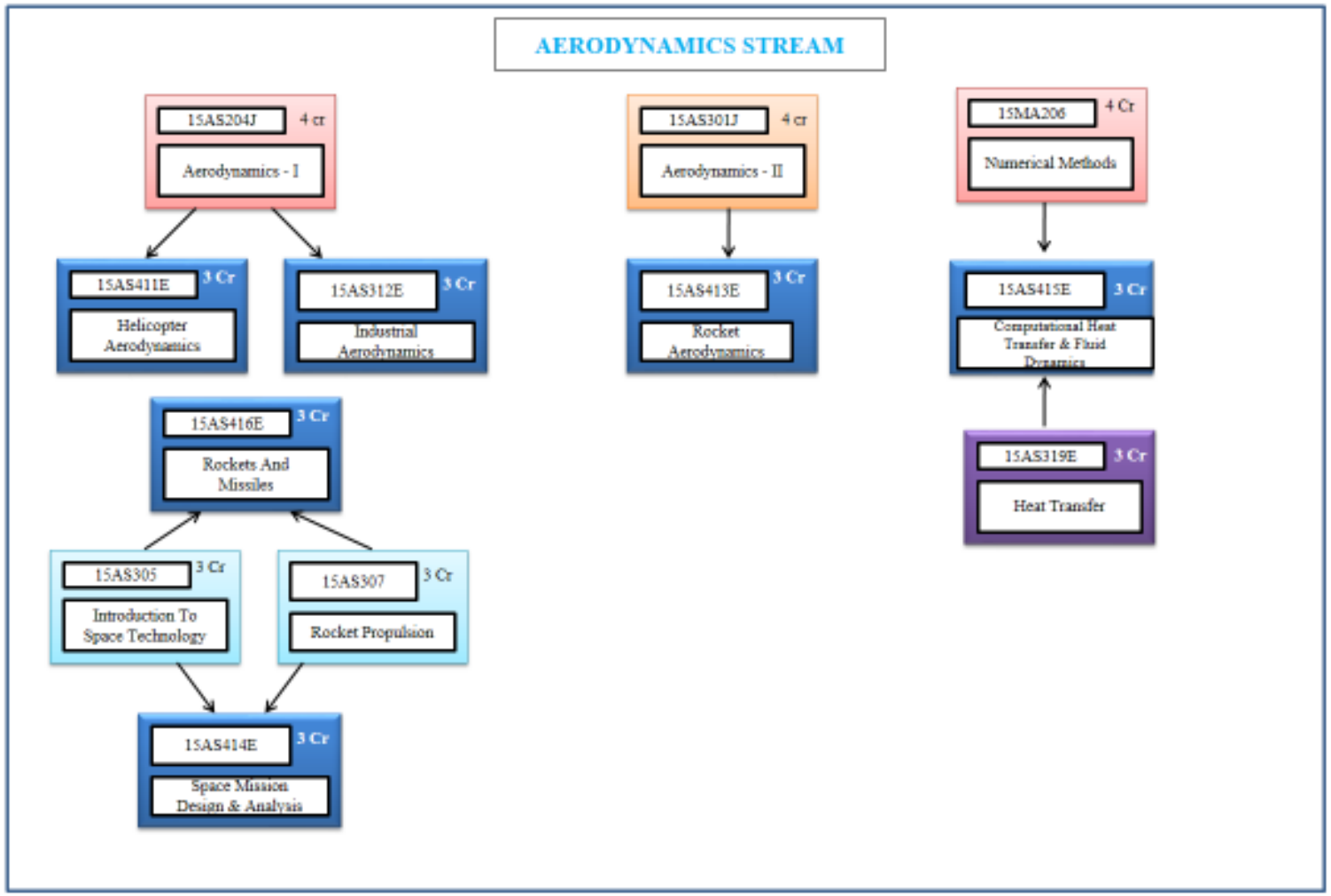
LEGENDS, SYMBOLS AND ABBREVIATIONS

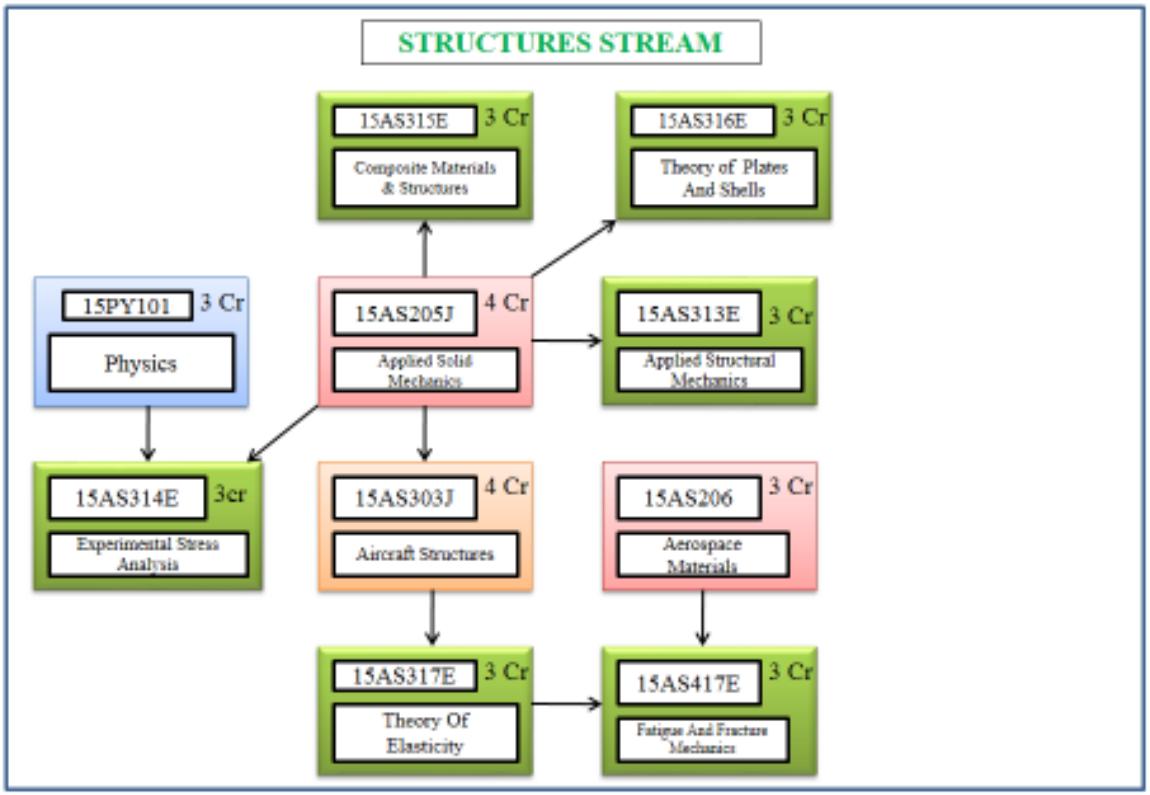
AR	**Architecture Courses**
AS	**Aerospace Engineering Courses**
B	**Courses under Basic Science and Mathematics**
BT	**Biotechnology Courses**
C-D-I-O	**Conceive-Design-Implement-Operate**
CE	**Civil Engineering Courses**
CS	**Computer Science and Engineering Courses**
CY	**Chemistry Courses**
'E' as a suffix in the course code	**Elective Courses**
'E' in the course category	**Courses under Engineering Sciences**
EC	**Electronics and Communication Engineering Courses**
EE	**Electrical and Electronics Engineering Courses**
G	**Courses under Arts and Humanities**
IOs	**Instructional Objectives**
'J' as a suffix in the course code	**Theory Courses jointly with Lab**
L	**Laboratory / Project / Industrial Training Courses**
LE	**Foreign Language Courses**
L-T-P-C	**L- Lecture Hours Per Week** **T- Tutorial Hours Per Week** **P- Practical Hours Per Week** **C- Credits for a Course**
M	**Courses with Multidisciplinary Content**
MA	**Mathematics Courses**
ME	**Mechanical Engineering Courses**
MH	**Mechatronics Engineering Courses**
MOOC	**Massive Open Online Courses**
NC	**NCC- National Cadet Corps**
NS	**NSS – National Service Scheme**
P	**Professional Core Courses**
PD	**Personality Development Courses**
PY	**Physics Courses**
SO/SOs	**Student Outcomes (a-k)**
SP	**NSO- National Sports Organization**
YG	**Yoga Course**

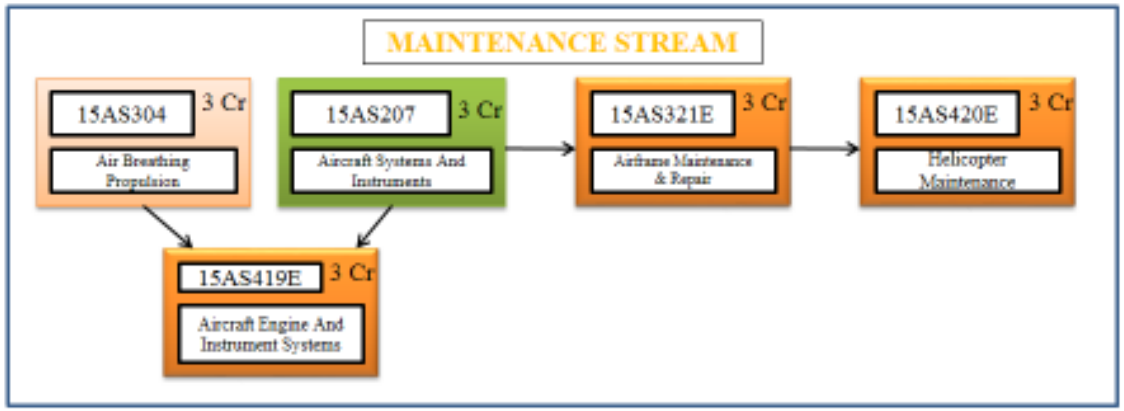
B.TECH AEROSPACE ENGINEERING
CHOICE BASED FLEXIBLE CREDIT SYSTEM (CBFCS) - REGULATIONS 2015
PREREQUISITES AND COREQUISITES FLOW CHART FOR CORE COURSES

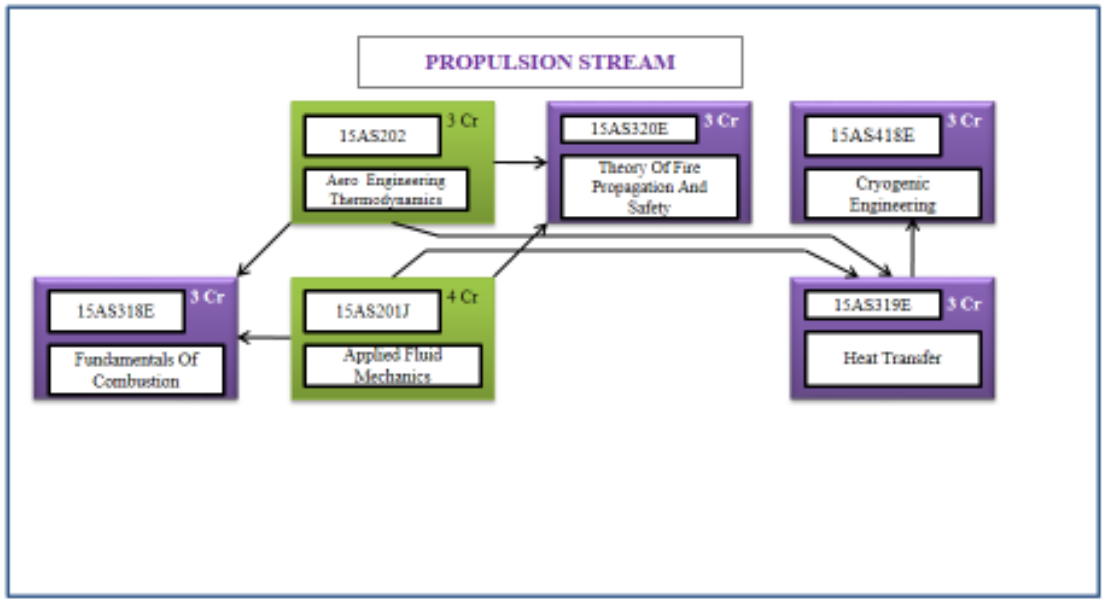


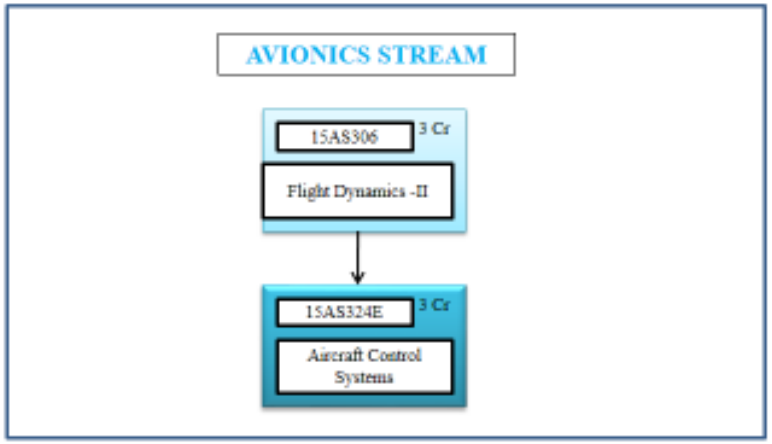
B.TECH AEROSPACE ENGINEERING
CHOICE BASED FLEXIBLE CREDIT SYSTEM (CBFCS) - REGULATIONS 2015
PREREQUISITES AND COREQUISITES FLOW CHART FOR ELECTIVE COURSES




STRUCTURES STREAM
15AS315E
3 Cr
Composite Materials & Structures
15AS316E
3 Cr
Theory of Plates And Shells
15PY101
3 Cr
Physics
15AS205J
4 Cr
Applied Solid Mechanics
15AS313E
3 Cr
Applied Structural Mechanics
15AS314E
3cr
Experimental Stress Analysis
15AS303J
4 Cr
Aircraft Structures
15AS206
3 Cr
Aerospace Materials
15AS317E
3 Cr
Theory Of Elasticity
15AS417E
3 Cr
Fatigue And Fracture Mechanics


MAINTENANCE STREAM
15AS304
3 Cr
Air Breathing Propulsion
15AS207
3 Cr
Aircraft Systems And Instruments
15AS321E
3 Cr
Airframe Maintenance & Repair
15AS420E
3 Cr
Helicopter Maintenance
15AS419E
3 Cr
Aircraft Engine And Instrument Systems


PROPULSION STREAM
15AS202
3 Cr
Aero Engineering Thermodynamics
15AS320E
3 Cr
Theory Of Fire Propagation And Safety
15AS418E
3 Cr
Cryogenic Engineering
15AS318E
3 Cr
Fundamentals Of Combustion
15AS201J
4 Cr
Applied Fluid Mechanics
15AS319E
3 Cr
Heat Transfer


AVIONICS STREAM
15AS306
3 Cr
Flight Dynamics -II
15AS324E
3 Cr
Aircraft Control Systems

Year – I Courses

15AS101	ELEMENTS OF AERONAUTICS	L	T	P	C
		2	0	0	2
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P PROFESSIONAL CORE				
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting, 23rd July 2016				

PURPOSE	To introduce the students to the basics of Aerospace Engineering.							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, learner will be able to								
1.	Get a birds eye view of Aerospace Engineering.	a						
2.	To describe about the atmosphere, aircraft flight and different speed regimes.	a						
3.	To explain the basics of aircraft structures, power plants, controls and instruments.	a						
4.	To describe the basic Space Technology concepts.	a						

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: History of Aviation and Aircraft Configurations	**9**			
1.	History of Aviation – Imitation of birds, Ornithopters,	1	C	1	1,2
2.	Lighter than air vehicles Hot air balloons	1	C	1	1,2
3.	George Cayley's contribution	1	C	1	2
4.	Gliders	1	C	1	1,2
5.	Wright Brothers contribution	1	C	1	2
6.	Effects of 1st and 2nd world wars	2	C	1	2
7.	Classification of airplanes.	1	C	1	1,4
8.	Components of a simple conventional aircraft and their functions.	1	C	1	1,2,4
	UNIT II: Basics of Aeronautics	**9**			
9.	International Standard Atmosphere	1	C	2	1,2,4,5
10.	Temperature, pressure and altitude relationships	1	C, D	2	2,5
11.	Bernoulli's equation for incompressible flow	1	C	2	2,5

12.	Lift, Drag and Moments	1	C	2	1,2,3,4,5
13.	How does an aircraft wing generate lift?	1	C	2	1,2,5
14.	Basic characteristics of airfoils, NACA nomenclature	1	C	2	2,3,4,5
15.	Introduction to high speed flight - propagation of sound, Mach number	2	C	2	1,2,5
16.	Subsonic, transonic, supersonic and hypersonic flows	1	C	2	1,2,5
	UNIT III: Aircraft Structures and Power Plants	**9**			
17.	Types of construction	1	C	3	2,4
18.	Truss, Monocoque and Semimonocoque construction.	1	C	3	2,4
19.	Typical wing and fuselage Structures	1	C	3	2,4
20.	Materials used in Aircraft	1	C	3	2,3,4
21.	Types of power plants	1	C	3	1,2
22.	An insight into air-breathing engines	1	C	3	1,2
23.	Piston prop, turboprop and jet engines	1	C	3	1,2
24.	Relative merits of piston prop, turboprop, and jet engines	2	C	3	1,2
	UNIT IV: Control Systems and Instruments	**9**			
25.	Functions of aileron, elevator and rudder.	1	C	3	1,2,4,5
26.	Secondary flight controls	1	C	3	1,2,5
27.	Types of control systems	1	C	3	1,2,5
28.	Mechanical, Powered and fly by wire control systems	1	C	3	1,2,5
29.	Basic instruments for flying	1	C	3	1,2,4
30.	Altimeter, ASI	2	C	3	1,2,4
31.	Turn and slip indicator	1	C	3	1,2,4
32.	Artificial horizon.	1	C	3	1,2,4
	UNIT V: Introduction to Space Technology	**9**			

33.	Basic principle of rocket propulsion	1	C	4	1,2,4
34.	Solid propulsion rockets	1	C	4	2,4,5
35.	Liquid propulsion rockets	1	C	4	1,2,4,5
36.	Hybrid and cryogenic rockets	1	C	4	1,2,4,5
37.	Launch vehicles designed and developed by ISRO	2	C	4	1,2,4,5
38.	Satellites – principle of operation	1	C	4	1,2
39.	Satellite types	1	C	4	1,2
40.	Satellite applications	1	C	4	1,2
	Total contact hours*	45			

*Excluding Assessment hours

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	Kermode,A.C., *'Flight Without Formulae'*, 5th Edition, Pearson Education,1970.
2.	Anderson, J.D., *'Introduction to Flight'*, 8th Edition, Tata McGraw Hill, 1996.
	REFERENCE BOOKS/OTHER READING MATERIAL
3.	Shevell,R.S., *'Fundamentals of flights'*, 2nd Edition, Pearson education 2004.
4.	Kermode.A.C., *'Mechanics of Flight'*, 12th Edition, Pearson Education 1972.
5.	Clancy L.J.., *'Aerodynamics'*, 2nd Edition, Sterling book house 1975.
6.	McKinley, J.L. and R.D. Bent, *Aircraft Power Plants*, McGraw Hill 1993.

Course Nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**

Year – II / Semester –I Courses

15AS102	APPLIED ENGINEERING MECHANICS	L	T	P	C
		3	2	0	4
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	E ENGINEERING SCIENCES				
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting 23rd July 2016				

PURPOSE	To make the students to understand the basic physical principles involved in the field of engineering.							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student should be able								
1.	To familiarize the concept of equilibrium of particles and rigid bodies.	a	e					
2.	To familiarize the concept of finding centroid of planar figures and moment of inertia about different axes.	a	e					
3.	To familiarize with the dynamics of particles.	a	e					
4.	To familiarize with the dynamics of rigid bodies.	a	e					
5.	To apply the concepts of mechanics to solve problems related to space mechanics.	a	e					

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: STATICS OF PARTICLES	**12**			
1.	Fundamentals of mechanics, Forces on particles, Resolution and Resultant of forces, Principle of Transmissibility.	3	C,D	1	1,2,4
2.	Forces in space, Moment of force, Varignon's theorem.	3	C,D	1	1,2,4
3.	Equivalent system of forces, Equipollent system of forces, Free body diagram, Types of supports and	3	C,D	1	1,2,4
4.	Equilibrium of rigid bodies in two dimensions, Statically determinate and indeterminate structures.	3	C,D	1	1,2,4

	UNIT II: PROPERTIES OF SURFACES AND VOLUMES	**12**			
5	Determination of centroids by integration, centroids of lines, areas and volumes.	3	C,D	2	1,2,3
6	Theorem of Pappus and Guldinus.	3	C,D	2	1,2,3
7	Determination of moment of inertia by integration, Parallel and Perpendicular axis theorems.	3	C,D	2	1,2,3
8	Polar moment of inertia, Mass moment of inertia.	3	C,D	2	1,2,3
	UNIT III: DYNAMICS OF PARTICLES	**12**			
9	Rectilinear motion-Uniform motion and Uniformly accelerated motion, Rectangular components of velocity	3	C,D	3	1,2,3,4
10	Curvilinear motion-Normal and tangential components, Radial and transverse components.	3	C,D	3	1,2,3,4
11	Cylindrical coordinates- Newtons second law, D'Alembert's principle.	2	C,D	3	1,2,3,4
12	Principle of work and energy, principle of impulse and momentum.	2	C,D	3	1,2,3,4
13	Impact of Elastic bodies-Direct central and Oblique central impact.	2	C,D	3	1,2,3,4
	UNIT IV: DYNAMICS OF RIGID BODIES	**12**			
14	Kinematics of rigid bodies: Relative motion- Translation and rotation of rigid bodies. Fixed axis rotation	3	C,D	4	1,2,4
15	General plane motion-Absolute and Relative velocity in plane motion	3	C,D	4	4
16	Instantaneous center of rotation in plane motion	2	C,D	4	1,2,4
17	Principle of work and energy for a rigid body	2	C,D	4	1,2,4
18	Principle of impulse and momentum for the plane motion of a rigid body.	2	C,D	4	1,2,3,4
	UNIT V: APPLICATIONS IN SPACE MECHANICS	**12**			
19	Central Force Motion-Gravitational Central Force Motion, Application to Space Mechanics.	3	C,D	5	4
20	Collision of a particle with a massive rigid body.	3	C,D	5	4
21	Moment of momentum equation to the problems of space mechanics.	3	C,D	5	4
22	Euler's equations of motion.	3	C,D	5	4
	Total contact hours*	60			

*Excluding Assessment hours

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1	Ferdinand P. Beer, E. Russell Johnston Jr., David Mazurek, Philip J Cornwell, "*Vector Mechanics for Engineers: Statics and Dynamics"* , McGraw - Hill, New Delhi, Tenth Edition, 2013.
2	Shames, I.H., and Krishna Mohana Rao, G., "*Engineering Mechanics (Statics and Dynamics)"*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), 2006.
	REFERENCE BOOKS/OTHER READING MATERIAL
3	Timoshenko, and Young, "*Engineering Mechanics"*, Tata Mc-Graw Hill Book Company, Edition 4, New Delhi, 1988.
4	Shames, I.H., "*Engineering Mechanics (Statics and Dynamics)"*, Prentice-Hall of India Pvt. Ltd. , 1993.

Course nature		**Theory**					
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
					End semester examination Weightage :		**50%**

15AS201J	APPLIED FLUID MECHANICS	L	T	P	C
		2	2	2	4
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P PROFESSIONAL CORE AERODYNAMICS				
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting –23rd July, 2016				

PURPOSE	To be familiar with all the basic concepts of fluids and fluid flow phenomenon, conservation equations and their applications to simple problems.							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Understand the properties of the fluid and solve the fluid flow problems	a	b	e				
2.	Understand the mathematical techniques of practical flow problems.	a	b	e				
3.	Understand the Boundary layer problems	a	b	e				

Session	Description of Topic (Theory)	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: PROPERTIES OF FLUIDS AND FLUID STATICS	**9**			
1.	Brief history of fluid mechanics - Fluids and their properties	1	C,D	1	1,2,3
2.	Continuum, density, viscosity, surface tension - Numerical problems	2	C,D	1	1,2,3
3.	Compressibility and bulk modulus, concept of pressure.	1	C,D	1	1,2,3
4.	Fluid statics - Pascal's law, Hydrostatic law - Piezometric head, and Numerical problems	2	C,D	1	1,2,3
5.	Manometry- simple manometer and differential manometer- Numerical problems	3	C,D	1	1,2,3
	UNIT II: FLUID KINEMATICS AND DYNAMICS	**9**			
6.	Lagrangian and Eulerian description of fluid flow, types of fluid flow, streamlines, path lines, and streak lines.	1	C,D	1,2	1,2,4
7.	System and Control volume concept – Reynolds transport theorem and its applications in finite control volume analysis - Numerical problems	3	C,D	1,2	1,2,4
8.	Euler's equation of motion along a streamline - Bernoulli's equation - Numerical problems	2	C,D	1,2	1,2,4
9.	Bernoulli's equation – Application through various examples including flow measuring devices –Orifice meter, venturimeter, pitot – tube - Numerical problems	3	C,D	1,2	1,2,4
	UNIT III: POTENTIAL FLOW	**9**			
10.	Equation of streamline – stream function - velocity potential functionNumerical problems.	2	C,D	1,2	1,3,4
11.	Basic elementary flows – Uniform parallel flow, Source, sink, free and forced vortex.	3	C,D	1,2	1,3,4

12.	Combination of elementary flows, pressure and velocity distributions on bodies with and without circulation in ideal	4	C,D	1,2	1,3,4
	UNIT IV: DIMENSIONAL ANALYSIS AND FLUID FLOW IN CLOSED CONDUICTS	**9**			
13.	Dimensional Analysis – Rayleigh's method, Buckingham Pi - theorem, Derivations and applicationsof important dimensionless numbers, basic modeling and similitude.	3	C,D	1,2	1,2,4
14.	Viscous fluid flow - Laminar and turbulent flow, Hagen - Poiseuille flow in circular pipes and Numerical problems.	2	C,D	1,2	1,2,4
15.	Development of flow in pipes, Pipe friction, Darcy-Weisbach equation and Chezy's formula.	2	C,D	1,2	1,2,4
16.	Pipe losses - Major and Minor losses - Numerical Problems in parallel, series and branched pipes.	2	C,D	1,2	1,2,4
	UNIT V: FLUID FLOW OVER BODIES	**9**			
17.	Boundary layer theory - boundary layer development on a flat plate, displacement thickness, momentum thickness, Energy thickness and numerical problems.	3	C,D	1,2,3	1,2,3
18.	Drag on a flat plate –Vonkarman Momentum integral	2	C,D	1,2,3	1,2,3
19.	Nature of turbulence, Separation of flow over bodies - streamlined and bluff bodies, Lift and Drag on cylinder and Aerofoil – Numerical problems.	4	C,D	1,2,3	1,2,3
	Total contact hours *	**45**			

*Excluding Assessment hours

Sl. No.	Description of experiments	Contact hours	C-D-I-O	IOs	Reference
1.	Determination of coefficient of discharge of orifice meter.	2	I-O	1,2	6
2.	Determination of coefficient of discharge of venturimeter.	2	I-O	1,2	6
3.	Verification of Bernoulli's theorem.	2	I-O	1,2	6
4.	Major loss due to friction in pipe flow.	2	I-O	1,2	6
5.	Minor losses due to pipe fittings in pipes.	2	I-O	1,2	6
6.	Determination of Impact force of water jet on vane.	2	I-O	1,2	6
7.	Determination of type of flow by Reynolds apparatus.	2	I-O	1,2	6
8.	Determination of viscosity using Red wood viscometer.	2	I-O	1,2	6
9.	Performance test on centrifugal blower with different	2	I-O	1,2	6
10.	Performance test on reciprocating air compressor.	2	I-O	1,2	6
11.	Flow visualization using smoke, dye and Hele - Shaw	2	I-O	1,2	6
12.	Study of flow over bluff bodies and streamlined bodies by flow visualization technique.	2	C	1,2	6
13.	Aerodynamic studies on isolated airfoil in wind tunnel.	2	C	1,2	6
14.	Calibration of subsonic wind tunnel.	2	I-O	1,2	6
15.	Estimation of drag over a cylinder.	2	I-O	1,2	6
	Total contact hours *	20			

*Any ten experiments will be offered

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	Munson, Bruce R., Young, Donald F., Okiishi, Theodore H., Huebsch, Wade W. "*Fundamentals of Fluid Mechanics"*, Seventh Edition, John Wiley & Sons, Inc. 2016.
2.	Kumar, K.L.,"*EngineeringFluid Mechanics"*, 8th Edition, S. Chand, New Delhi, 2008.
	REFERENCE BOOKS/OTHER READING MATERIAL
3.	Irving H. Shames, "*Mechanics of Fluids"*, 4rd Edition, McGraw-Hill, 2003.
4.	Streeter, Victor, Bedford, K.W. and Wylie, E. Benjamin, "*Fluid Mechanics"*, 2nd Edition, Tata McGraw Hill, New Delhi, 1997.
5.	Douglas.J. F., Gasiorek and Swaffield, "*Fluid Mechanics*", 3rd Edition, ELBS/ Pitman.U. K., 1995.
6.	Laboratory Manual

Course nature				**Theory + Practical**			
Assessment Method – Theory Component (Weightage 50%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**
Assessment Method – Practical Component (Weightage 50%)							
In-semester	**Assessment tool**	Experiments	Record	MCQ/Quiz/Viva Voce	Model examination		**Total**
	Weightage	**40%**	**5%**	**5%**	**10%**		**60%**
						End semester examination Weightage :	**40%**

15AS202	AERO ENGINEERING THERMODYNAMICS	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P PROFESSIONAL CORE	PROPULSION			
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting –23rd July, 2016				

PURPOSE	This course provides the basic knowledge about thermodynamic laws and relations, and their application to practical and engineering processes.

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Understand laws of thermodynamics and its applications to Aerospace Engineering.	a	e					
2.	Comprehend the concept and applications of energy, entropy and exergy.	a	e					
3.	Understand various gas and vapor power cycles with applications.	a	e					
4.	Understand the gas mixture behavior and chemical reactions.	a	e					
5.	Apply the Thermodynamic Principles to Aerospace Engineering Applications.	a	e					

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: INTRODUCTION TO AERO-THERMODYNAMICS	**9**			
1.	Basic Concepts: Microscopic & macroscopic point of view, Path and point functions. Intensive and extensive, total and specific quantities. System and their types. Zeroth law of thermodynamics, Thermodynamic equilibrium. Quasi-static, reversible and irreversible processes. Heat and work transfer, sign convention - Numericals.	3	C	1	1,2,6

2.	First law of Thermodynamics: First law for a closed system undergoing a cycle, concept of Internal energy, change of state, Energy and Work Transfer in closed systems, P-V diagram, PMM1-Numericals.	3	C	1	1,2,6
3.	First law for an Open system: Conservation of mass, energy, steady flow energy equation. Aerospace applications of SFEE to Nozzles, Diffuser, turbine, compressor, boiler, pump, heat exchanger and throttling process –Numericals, Tutorial- Chapter Doubt clarification.	3	C,D	1,5	1-6
	UNIT II: SECOND LAW OF THERMODYNAMICS AND AEROSPACE APPLICATIONS	**9**			
4.	Limitations of first law of Thermodynamics. Introduction to Heat Reservoirs, Sources and Sinks. Heat Engine, Refrigerator, and Heat pump. Thermal efficiency of heat engines, C.O.P, Kelvin-Planck and Clausius statements and their equivalence, PMM 2-Numericals.	3	C	1,5	1-6
5.	Reversible and irreversible processes- causes of irreversibility, Carnot Theorem and corollary, Absolute Thermodynamic Temperature scale, Carnot cycle and Performance–	3	C,D	1,5	1,2,6
6.	Aerospace Engineering Applications of Second Law. Tutorial- Chapter Doubt clarification.	3	C,D	1,5	1-6
	UNIT III: ENTROPY LAW IN THERMODYNAMICS	**9**			
7.	Limitations of Second Law of Thermodynamics, Concept of Entropy, Clausius inequality, T-s diagram, entropy change for different processes.	3	C	1,2, 5	1-6
8.	Principle of increase of Entropy, Maxwell relations, T-ds Equations, Difference and ratio of heat capacities, Energy equation, Joule-Thomson Coefficient, Clausius-Clapeyron equation, Entropy change of Ideal and Real gases - Isentropic efficiencies of Aerospace steady flow devices–Numericals.	3	C	1,2, 5	1,2,6
9.	Exergy in Aerospace Engineering: High and low grade energy, Available and non-available energy of a source and finite body. Tutorial- Chapter Doubt clarification.	3	C	1,2, 5	1-6

	UNIT IV: AERO-THERMODYNAMIC GAS POWER CYCLES	**9**			
10.	Roe of Carnot cycle in Aerospace engineering, Otto cycle, Diesel cycle, Dual cycle, Comparison of Otto, Diesel and Dual cycles, Air standard efficiency, Mean effective pressure -	3	C,D	1,3,5	1-6
11.	Introduction to Aerospace Propulsion - Brayton cycle, Effect of Reheat, Regeneration and Intercooling, Turbine and Compressor efficiency, Humphrey cycle -Numericals.	3	C,D	1,3,5	1,2,6

12.	Equivalent Carnot cycles: Stirling and Ericsson cycle and efficiencies, variables affecting efficiency, Numericals. Interactive session with practical working of Gas Power based Engines. Tutorial- Chapter Doubt clarification.	3	C,D	1,3,5	1-6
	UNIT V: INTRODUCTION TO COMBUSTION	**9**			
13.	Mass fraction and mole fraction, p-v-t behavior and properties of ideal gas mixtures, Avogadro's law, Gibbs-Dalton law, enthalpy and specific heat of a gas mixtures.	3	C,D	4,5	1-6
14.	Aerospace Chemical Propulsion: Fuels in combustion, Enthalpy of reaction, formation and combustion. Stoichiometric Air-fuel ratio, equivalence ratio, gravimetric and volumetric analysis, Introduction to adiabatic flame temperature -Numericals.	3	C,D	4,5	1,2,6
15.	Chapter -Course Doubt clarification.	3	C,D	4,5	1-6
	Total contact hours*	**45**			

*Excluding Assessment hours

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	Nag, P. K, "*Engineering Thermodynamics*", 5th Edition, Tata McGraw Hill, New Delhi, 2013.
2.	Yunus A. Cengel and Michael A. Boles, "*Thermodynamics an engineering approach*", seventh edition, Mc Graw Hill Higher education, 2011.
	REFERENCE BOOKS/OTHER READING MATERIAL
3.	Michael Moran, J., and Howard Shapiro, N**.,** "*Fundamentals of Engineering Thermodynamics*", 4th Edition, John Wiley & Sons, New York, 2010.
4.	Rayner Joel, "*Basic Engineering Thermodynamics*", 5th Edition, Addison Wesley, New York, 2016.
5.	Holman, J. P., "*Thermodynamics*", 4th Edition Tata McGraw Hill, New Delhi, 2015.
6.	Rathakrishnan. E**,** "*Fundamentals of Engineering Thermodynamics*", Prentice – Hall, India, 2005.

Course nature			**Theory**				
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
					End semester examination Weightage:		**50%**

15AS203J	AIRCRAFT PRODUCTION TECHNIQUES	L	T	P	C
		3	0	2	4
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P PROFESSIONAL CORE	Maintenance			
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting –23rd July , 2016				

PURPOSE	To make the student aware of various production technologies generally involved in air craft manufacturing.

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Understand the Concepts of welding and casting Technology.	a	c					
2.	Understand the machining operations.	a	c	k				
3.	Understand the unconventional machining processes.	a	c					
4.	Understand the Forming of metals and Sheet metal.	a	c					
5.	Understand the operations aircraft metals heat treatment and surface finishing.	a	c					

Session	Description of Topic (Theory)	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: CASTING AND WELDING	**9**			
1.	General principles of various Casting Processes.	1	C	1	1,2
2.	Sand casting, die-casting, centrifugal casting, investment casting and shell molding types.	3	C	1	1,2
3.	Principles and equipment used in arc welding, gas welding, resistance welding.	2	C	1	1,2
4.	Laser welding, Electron Beam welding.	2	C	1	1,2
5.	Soldering and brazing techniques.	1	C	1	1,2
	UNIT II: MACHINING OPERATIONS	**9**			
6.	General Principles of working of lathe, types of lathe and commonly performed operation in lathe.	2	C	2	1,2
7.	General Principles of working, types and operation of grinding and drilling machines.	2	C	2	1,2
8.	General Principles of working, types and operation of Shaper and milling machines.	2	C	2	1,2
9.	General Principles of working, types and operation of CNC Machining.	3	C	2	1,2
	UNIT III: UNCONVENTIONAL MACHININGPROCESSES	**9**			
10.	Principles of working and Application of Abrasive Jet Machining, Ultrasonic Machining.	3	C	3	1,3,4

11.	Principles of working and Application of Electric Discharge Machining, Electrochemical Machining, Chemical Machining.	3	C	3	1,3,4
12.	Principles of working and Application of LASER Beam Machining, Electron Beam Machining, Plasma Arc Machining.	3	C	3	1,3,4
	UNIT IV: FORMING OPERATIONS	**9**			
13.	Forming of metals – Forging of metals, Rolling, Extrusion, and Drawing.	3	C	4	1,2
14.	Sheet metal operations-shearing, punching, super plastic forming, diffusion bonding, and different operations in bending.	4	C	4	1,2
15.	Riveting types and techniques used in aerospace industry.	2	C	4	1,2
	UNIT V: HEAT TREATMENT AND SURFACE FINISHING	**9**			
16.	Heat treatment process of Aluminum alloys, titanium alloys, steels.	3	C	5	1,5
17.	Case hardening, internal stresses and the stress relieving procedures.	3	C	5	1,5
18.	Surface Finishing operations - protective treatment for aluminum alloys, steels, anodizing of titanium alloys, organic coating, and thermal spray coatings.	3	C	5	1,5
	Total contact hours*	**45**			

*Excluding Assessment hours

Sl. No.	Description of experiments	Contact hours	C-D-I-O	IOs	Reference
	LATHE				
1.	Introduction- lathe machine, plain turning, Step turning & grooving (Including lathe mechanisms, simple problems).	2	I-O	2	6
2.	Taper turning-compound rest/offset method &Drilling using lathe (Including Drilling feed mechanism, Twist drill nomenclature, and Different types of taper turning	3	I-O	2	6
3.	External threading-Single start (Including Thread cutting mechanism-simple problems).	2	I-O	2	6
	SHAPER				
4.	Shaping-V-Block (Including Shaper quick return	2	I-O	2	6
5.	Slotting-Keyways (Including Broaching tool nomenclature and slotter	2	I-O	2	6
	DRILLING				
6.	Drilling operations (drilling, reaming, tapping and counter	2	I-O	2	6
	MILLING				
7.	Milling-Polygon /Spur gear (Including Milling mechanism, simple problems).	2	I-O	2	6

	SHEET METAL FORMING				
8.	Lap joint by riveting.	2	I-O	2,5	6
9.	Butt joint by riveting.	2	I-O	2,5	6
10.	Surface patch repair Riveting (Using Pneumatic Gun).	2	I-O	2,5	6
11.	Surface Patch repair on Perspex.	2	I-O	2,5	6
12.	Tube bending and flaring using aluminum tube.	2	I-O	2,5	6
13.	Control cable inspection and repair.	2	I-O	2,5	6
	Total contact hours *	20			

*Any ten experiments will be offered

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	Keshu S.C, Ganapathy K.K, "*Aircraft production technique'* Interline Publishing House, Bangalore 1993.
2.	Dr. P C Sharma, "*A Text book of Production Technology*" S. CHAND and company Pvt. Ltd. New Delhi, Eighth edition 2014.
3.	**REFERENCE BOOKS/OTHER READING MATERIAL**
4.	R.K. Jain "*Production technology*" - Khanna Publishers New Delhi 2002.
5.	O.P.Khanna and lal "*Production technology*" M.Dhanpat rai publications, New Delhi 1997.
6.	Airframe and Power plant Mechanics, *"Aircraft hand Book*" Federal Aviation Administration, Shroff publishers and distributors Pvt. Ltd. New Delhi 2010.
7.	Laboratory Manual

Course nature			**Theory + Practical**				
Assessment Method – Theory Component (Weightage 50%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**
Assessment Method – Practical Component (Weightage 50%)							
In-semester	**Assessment tool**	Experiments	Record	MCQ/Quiz/Viva Voce	Model examination		**Total**
	Weightage	**40%**	**5%**	**5%**	**10%**		**60%**
						End semester examination Weightage :	**40%**

Year – II / Semester –II Courses

15AS204J	AERODYNAMICS – I	L	T	P	C
		3	0	2	4
Co-requisite:	Nil				
Prerequisite:	15AS201J				
Data Book / Codes/Standards	Nil				
Course Category	P PROFESSIONAL CORE	AERODYNAMICS			
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting –23rd July , 2016				

PURPOSE	To study incompressible flow over airfoils, wings, and bodies – and to be able to estimate the interaction effects when such bodies are combined.							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Calculate forces and moments acting on aero foils and wings under ideal flow conditions.	a	b	e				
2.	Determine the aerofoil and wing characteristics.	a	b	e				
3.	Design a propeller and determine aerodynamic interaction effects between different components of aircraft.	a	b	e				

Session	Description of Topic (Theory)	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: INTRODUCTORY TOPICS FOR AERODYNAMICS	**9**			
1.	Introduction to aerodynamics	2	C,D	1,2	1,2,3,4
2.	Airfoil geometry and nomenclature	1	C	1,2	1,2,3,4
3.	Wing geometry parameters and its application	2	C	1,2	1,2,3,4
4.	Vortex motions and types- Starting vortex, kutta's and kelvins theorem, and Kutta – Joukowski theorem.	3	C,D	1,2	1,2,3,4
5.	Lift generation, bound and horseshoe vortex	1	C	1,2	1,2,3,4
	UNIT II: AEROFOIL THEORY	**9**			
6.	Aerodynamic forces and moments ,and Numerical problems	2	C,D	1,2	1,2,3,4
7.	Center of pressure and Aerodynamic center, and Numerical	2	C,D	1,2	1,2,3,4
8.	Thin airfoil theory- symmetrical airfoil	1	C,D	1,2	1,2,3,4
9.	Thin airfoil theory- unsymmetrical airfoil	2	C,D	1,2	1,2,3,4
10.	Thin airfoil theory-Flapped airfoil	1	C,D	1,2	1,2,3,4
11.	Numerical problems on thin airfoil theory	1	D	1,2	1,2,3,4
	UNIT III: THEORY OF PROPELLERS	**9**			
12.	Introduction to propellers, and Types of propellers	2	C	1,2,3	1,3,4
13.	Axial momentum theory ,and Numerical problems	2	C,D	1,2,3	1,3,4
14.	blade-element theory, and Numerical problems	3	C,D	1,2,3	1,3,4

15.	Combined blade element and momentum theories, and performance of propellers.	2	C,D	1,2,3	1,3,4
	UNIT IV: WING THEORY	**9**			
16.	Biot – savart law and application	1	C,D	1,2	1,2,3,4
17.	Prandtl theory- Elliptical lift Distribution	2	C,D	1,2	1,2,3,4
18.	Prandtl theory- General lift Distribution	2	C,D	1,2	1,2,3,4
19.	Lift slope relation , and Numerical problems	2	C,D	1,2	1,2,3,4
20.	Influence of taper and twist applied to wings, effect of sweep back, and delta wings	2	C	1,2	1,2,3,4
	UNIT V: FLOW PAST NON-LIFTING BODIES AND INTERFERENCE EFFECTS	**9**			
21.	Flow past non lifting bodies	1	C	1,2,3	1,2,3,4
22.	Source panel method and its application	2	C,D	1,2	1,2,3,4
23.	Vortex panel method and its application	3	C,D	1,2	1,2,3,4
24.	Wing- fuselage interference, Wing-engine interference and flow over airplane as a whole	3	C,D	1,2,3	1,3
	Total contact hours *	**45**			

*Excluding Assessment hours

Sl. No.	Description of experiments (any 10 exercises)	Contact hours	C-D-I-O	IOs	Reference
1.	Study of subsonic wind tunnels and its measurement techniques.	2	C	1,2	5
2.	Study of flow over bluff and streamlined bodies by laser beam assisted smoke visualization technique.	2	C	1,2	5
3.	Study of Magnus effect using rotating cylinder by laser beam assisted smoke visualization technique.	2	C	1,2	5
4.	Study of flow over a tapered finite wing with and without wingtip by laser beam assisted flow visualization technique.	2	C	1,2	5
5.	Calibration of subsonic wind tunnel	2	I,O	1,2	5
6.	Pressure distribution and Estimation of forces acting over a smooth and rough cylinder	2	I,O	1,2	5
7.	Pressure distribution and Estimation of forces acting over a sphere model	2	I,O	1,2	5
8.	Estimation of forces acting over a bluff/streamlined body using six component force balance	2	I,O	1,2	5
9.	Estimation of forces acting over a symmetrical airfoil for different angle of attack	2	I,O	1,2	5
10.	Estimation of forces acting over an unsymmetrical airfoil for different angle of attack	2	I,O	1,2	5
11.	Estimation of forces acting on the finite wing with washin and washout angle of 10^0	2	I,O	1,2	5

12.	Estimation of forces acting on the finite wing with movable flap.	2	I,O	1,2	5
13.	Investigation of effect of wing aspect ratio using six component force balance	2	I,O	1,2	5
	Total contact hours *	25			

*Any ten experiments will be offered

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	Houghton, E, L., and Carruthers, N, B., "*Aerodynamics for Engineering Students"*, Edward Arnold Publishers Ltd., London, 6th edition, 2012.
2.	Anderson, J,D., "Fundamentals of Aerodynamics", McGraw Hill Book Co., New York, 6th edition, 2016
	REFERENCE BOOKS/OTHER READING MATERIAL
3.	Clancy, L, J., *Aerodynamics*, Pitman, 1986.
4.	Milne, L.H., Thomson, *Theoretical Aerodynamics*, Dover, 1985.
5.	Laboratory Manual

Course nature		**Theory + Practical**					
Assessment Method – Theory Component (Weightage 50%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**
Assessment Method – Practical Component (Weightage 50%)							
In-semester	**Assessment tool**	Experiments	Record	MCQ/Quiz/Viva Voce	Model examination		**Total**
	Weightage	**40%**	**5%**	**5%**	**10%**		**60%**
						End semester examination Weightage :	**40%**

15AS205J	APPLIED SOLID MECHANICS	L	T	P	C
		3	0	2	4
Co-requisite:	Nil				
Prerequisite:	15AS102				
Data Book / Codes/Standards	Nil				
Course Category	P PROFESSIONAL CORE	STRUCTURES			
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting, 23rd July 2016				

PURPOSE	To acquire the knowledge on fundamentals of deformation, stresses, strains and other behavior on structural elements.

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Understand the concept of stresses and strains in structural elements.	a	b	e				
2.	Analyze the beam of different cross sections for shear force, bending moment, slope and deflection.	a	b	e				
3.	Analyze the states of stress (shear, bending, torsion)	a	b	e				
4.	Be familiar with biaxial stresses.	a	b	e				
5.	Familiarize with the applications of pressure vessels.	a	b	e				
6.	Expose to the practical concepts of various testing methods.	a	b	e				

Session	Description of Topic (Theory)	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: CONCEPT OF STRESSES AND STRAINS	**9**			
1.	Concept of stress and strain, Hooke's law Tension, compression and shear.	1	C	1	1&2
2.	Poisson's ratio, elastic constants like young's modulus, bulk modulus and shear modulus, and their relations.	1	C	1	1&2
3.	Numerical problems on stress, strain and volumetric strain.	2	C,D	1	1&2
4.	Analysis of bar of uniform and varying sections subjected to single and varying loads.	2	C,D	1	1&2
5.	Analysis of composite bars and solving numerical problems.	1	C,D	1	1&2
6.	Thermal stresses-concepts, support yield, composite bars and solving numerical problems.	2	C,D	1	1&2
	UNIT II: ANALYSIS OF BEAMS	**9**			
7.	Types of beams, supports and loads. Static equilibrium	1	C	2	1&2
8.	Concept of Shear force and bending moment diagram and their sign conventions. Plot of SF & BMD for cantilever beam for loads like point load, UDL, UVL and a couple.	2	C,D	2	1&2
9.	Plot of SF&BMD for simply supported beam for loads like point load, UDL, UVL and a couple	1	C,D	2	1&2
10.	Plot of SF&BMD for overhanging beam subjected to point load, UDL. Concept of point of contra flexure.	1	C,D	2	1&2
11.	Introduction to bending stress, pure bending stress derivation. Concepts of section modulus and Moment of resistance.	2	C,D	2	1&2

12.	Concept of shear stress and its distribution for different symmetric and unsymmetrical beam sections	2	C,D	2	1&2
	UNIT III: TORSION OF CIRCULAR SHAFTS AND SPRINGS	**9**			
13.	Theory of pure torsion, derivation of shear stress produced in a circular (solid & hollow) shaft subjected to torsion.	2	C	3	1&2
14.	Expression for torque in terms of polar moment of inertia Strength, stiffness of shaft and Torsional rigidity & power	2	C,D	3	1&2
15.	Problems on solid and hollow shaft. Discussion on torque link in landing gear.	2	C,D	3	1&2
16.	Strain energy due to torsion - concepts , Shaft subjected to combined bending and torsion	1	C	3	1&2
17.	Introduction to helical springs. Derivation of expression to find parameters for close-coiled helical springs and solving the associated problems.	2	C,D	3	1&2
	UNIT IV: DEFLECTION OF BEAMS	**9**			
18.	Relationship between deflection, slope, radius of curvature, shear force and bending moment.	1	C	2	1&2
19.	By Double integration method, finding slope and deflection of a cantilever beam with a point load and UDL.	2	C,D	2	1&2
20.	By Double integration method and Macaulay's method, finding slope and deflection of a simply supported beam with a point	3	C,D	2	1&2
21.	By moment area method, finding slope and deflection of a cantilever beam and simply supported beam with a point load and UDL. Discussion on SF & BMD on aircraft wing.	3	C,D	2	1&2
	UNIT V: BIAXIAL STRESSES AND THIN & THICK PRESSURE VESSELS	**9**			
22.	Principal plane, principal stress - Analytical method, direct stress in one plane - Simple problems.	1	C,D	4,5	1&2
23.	Analytical method - Direct stress in two mutually perpendicular directions accompanied by a simple shear stress.	1	C,D	4,5	1&2
24.	Mohr's circle – direct stress in two mutually perpendicular directions.	1	C	4,5	1&2
25.	Mohr's circle - Direct stress in two mutually perpendicular directions accompanied by a simple shear stress.	1	C	4,5	1&2
26.	Thin cylindrical vessel subjected to internal pressure and torque. Application to fuselage.	1	C,D	4,5	1&2
27.	Change in dimensions due to internal pressure- problems.	1	C,D	4,5	1&2
28.	Stresses in Thick cylinders –Lame's theory.	1	C	4,5	1&2
29.	Stresses in compound thick cylinder.	1	C	4,5	1&2
30.	Concept of shrink fit and problems on compound cylinders.	1	C,D	4,5	1&2
	Total contact hours*	45			

*Excluding Assessment hours

Sl. No.	Description of experiments	Contact hours	C-D-I-O	IOs	Reference
1.	Test a specimen using digital torsion testing machine	2	I,O	3	3
2.	Test a specimen using optical Brinell hardness testing	2	I,O	6	3
3.	Test a specimen using digital Rockwell hardness testing	2	I,O	6	3
4.	Perform a tensile test on a mild steel rod using computerized tensile testing machine.	2	I,O	1	3
5.	To Perform a compression test on a specimen.	2	I,O	1	3
6.	Perform fatigue strength of a specimen using fatigue-testing	2	I,O	3	3
7.	Perform impact test using Izod impact testing machine	2	I,O	6	3
8.	Perform impact test using Charpy impact testing machine	2	I,O	6	3
9.	To perform Vickers hardness test on a specimen using Computerized semi-automatic micro hardness testing	2	I,O	6	3
10.	Study of magnified images obtained using Inverted Metallurgical Microscope on a specimen.	2	I,O	6	3
	Total contact hours	20			

LEARNING RESOURCES	
Sl. No	**TEXT BOOKS**
1.	Ferdinand P.Beer, and Rusell Johnston, John T.Dewolf*"Mechanics of Materials"*, SI Metric third Edition, Tata McGraw-Hill Education, 2011.
2.	R.K.Rajput., *"Strength of materials",* Fourth Edition ,S. Chand Limited, 2007.
3.	Laboratory Manual.
	REFERENCE BOOKS/OTHER READING MATERIAL
4.	William A. Nash*,"Theory and Problems of Strength of Materials",* Schaum's Outline Series, McGraw Hill International Edition, 3rd Edition, 2007.
5.	Egor P. Popov., "*Engineering Mechanics of Solids*", 2nd edition, Prentice Hall of India Private Limited, New Delhi, 2009.
6.	James M. Gere, *"Mechanics of Materials",* Eighth Edition, Brooks/Cole, USA, 2013.
7.	Shigley, J. E., *"Applied Mechanics of Materials",* International Student Edition, McGraw Hill Koyakusha Limited, 2000.

Course nature		**Theory + Practical**					
Assessment Method – Theory Component (Weightage 50%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**
Assessment Method – Practical Component (Weightage 50%)							
In-semester	**Assessment tool**	Experiments	Record	MCQ/Quiz/Viva Voce	Model examination		**Total**
	Weightage	**40%**	**5%**	**5%**	**10%**		**60%**
						End semester examination Weightage :	**40%**

15AS206	AEROSPACE MATERIALS	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	15AS203J				
Data Book / Codes/Standards	Nil				
Course Category	P PROFESSIONAL CORE	STRUCTURES			
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting, 23rd July 2016				

PURPOSE	To study Mechanical behavior of different aircraft materials, Selection of Aerospace Materials and their applications.

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
This course will enable the students to know more about								
1.	Different materials with their properties	a	e					
2.	Different materials with their mechanical behavior	a	e					
3.	Various Heat Treatment processes of aircraft metals and alloys	a	e					
4.	Applications of Aluminum alloys and Composites	a	e					
5.	Selection of Aerospace Materials	a	e					

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: MATERIAL REQUIREMENTS FOR AEROSPACE STRUCTURES AND ENGINES	**9**			
1.	Introduction , Fixed-wing aircraft structures	2	C	1	1,3
2.	Helicopter structures	2	C	1	1,3
3.	Space shuttle structures	2	C	1	1,3
4.	Materials used in jet engines	3	C	1	1,3
	UNIT II: MECHANICAL BEHAVIOR OF ENGINEERING MATERIALS	**9**			

5.	Linear and non-linear elastic properties, Mechanism of elastic and inelastic action.	3	C	2	1,7
6.	Yielding, strain hardening, true stress, true strain, Failure of materials – fracture, Fatigue, creep.	3	C,D	2	1,7
7.	Bauchinger's Effect, Notch Effect, Testing and flaw detection of materials and components.	3	C	2	1,7
	UNIT III: HEAT TREATMENT OF ALLOYS AND CORROSION	**9**			
8.	Introduction to heat treatment process, Heat treatment of carbon steel.	2	C	1,3	1,2,4
9.	Heat treatment of - aluminum alloys, magnesium alloys.	3	C	1,3	1,2,4
10.	Heat treatment of titanium alloys.	2	C	1,3	1,2,4
11.	Classification and Effect of corrosion Aircraft, Corrosion-Protection, Resistant materials.	2	C	1,3	1,2,4
	UNIT IV: ALUMINUM ALLOYS AND COMPOSITES	**9**			
12.	Introduction - Physical Metallurgy - Cast Aluminum Alloys and Wrought Aluminum Alloys.	3	C	3,4	1,2,3
13.	Aerospace Applications – Plastics and Rubber.	2	C	4	1,5
14.	Introduction to FRP, Glass and Carbon Composites - Fibers and Resins Characteristics and applications.	3	C	4	1,5
15.	Failure theories for isotropic and anisotropic materials.	1	C	4	1,5
	UNIT V: SELECTION OF MATERIALS FOR AIRCRAFT AND ROCKETS	**9**			
16.	Classification of aircraft materials - Materials used for aircraft components.	2	C	1,5	1,5
17.	Application of Composite materials.	2	C	4,5	1,5
18.	Super alloys.	2	C	1,5	1,5
19.	Emerging trends in Aerospace materials, Introduction to smart materials, light weight material for MAV/UAV.	2	C	5	1,5
	Total contact hours*	45			

*Excluding Assessment hours

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	Adrian P. Mouritz, *"Introduction to aerospace materials"* Woodhead Publishing Limited, 2012.
2.	Titterton, G., *"Aircraft Materials and Processes ",* Fifth Edition, Pitman Publishing Co., 1995.
3.	Krishnadas Nair, C.G., *"Handbook of Aircraft Materials ",* Interline Publishing, 1993.

4.	Balram Gupta, "*Aerospace Materials* ", Vol. I, Vol. II and Vol. III, S.Chand & Company Ltd., New Delhi -1996.
	REFERENCE BOOKS/OTHER READING MATERIAL
5.	Brian Cantor, Hazel Assender and Patrick Grant "*Series in Materials Science and Engineering Aerospace Materials*", Institute of Physics Publishing Bristol and Philadelphia (IOP) Publishing Ltd 2001.
6.	Martin, J.W., *"Engineering Materials, Their Properties, and Applications "*, Wykedham Publications (London) Ltd., 1987.

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**

15AS207	AIRCRAFT SYSTEMS AND INSTRUMENTS	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	15AS101				
Data Book / Codes/Standards	Nil				
Course Category	P PROFESSIONAL CORE				
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting 23rd July 2016				

PURPOSE	To impart knowledge on various systems and instruments used in an aircraft.							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, learner will be able to								
1.	Understand the operation of control system in an airplane	a	c	g				
2.	Acquire knowledge on major and sub systems of an airplane	a	c	g				
3.	Learn the working of various module of engine systems	a	c	g				
4.	Appreciate the need and functions of Cabin Environmental Systems	a	c	g				
5.	Gain knowledge on various aircraft instruments and their principle of operation	a	c	g				

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: AIRPLANE CONTROL SYSTEMS	**9**			
1.	Need for Control Systems, Conventional Flight Controls	1	C	1	1
2.	Flight Control Linkage Systems	2	C	1	1
3.	Power Assisted and Fully Powered Flight Controls	2	C	1	1
4.	Fly by Wire and Digital Fly by wire systems.	2	C	1	1,4
5.	Automatic Flight Control System	2	C	1	1,2,4
	UNIT II: AIRCRAFT SYSTEMS	**11**			
6.	Hydraulic Systems, Study of typical Hydraulic Systems	2	C	2	1,2,5
7.	Components and its function	2	C	2	1,2,5
8.	Aircraft Brake System ,Applications of Hydraulic System	2	C	2	1,2,5
9.	Pneumatic Systems, Advantages, Typical Air Pressure System	2	C	2	1,2,5
10.	Applications of Pneumatic System	1	C	2	1,2,5

11.	Landing Gear System, Classifications, Retractive Mechanisms	2	C	2	1,2,5
	UNIT III: AIRCRAFT ENGINE SYSTEMS	**8**			
12.	Fuel Systems for Piston and Jet Engines, Components of Multiengine	2	C	3	1,2,3,5,6
13.	Lubrication System for Reciprocating and Jet Engines	2	C	3	3,6
14.	Ignition Systems for Reciprocating Engines	2	C	3	3,6
15.	Starting Systems for Reciprocating and Jet Engines	2	C	3	3,6
	UNIT IV: CABIN ENVIRONMENTAL CONTROL SYSTEMS	**8**			
16.	Air Cycle and Vapour Cycle Cooling System	2	C	4	1,2,5
17.	Aircraft Pressurization System	2	C	4	1,2,5
18.	Cabin Heating Systems	2	C	4	1,2,5
19.	Aircraft Oxygen System	2	C	4	1,2,5
	UNIT V: AIRCRAFT INSTRUMENTS	**9**			
20.	Air Data Instruments, Types	1	C	5	1,2,4,5
21.	Principle and Operation of Air Data Instruments	2	C	5	1,2,4,5
22.	Gyroscopic Instruments, Types	1	C	5	1,2,4,5
23.	Principle and Operation of Gyroscopic Instruments	2	C	5	1,2,4,5
24.	Instrument Landing System	1	C	5	1,2,3,4
25.	Glass Cockpits of Modern Aircrafts	2	C	5	1,2,4,5
	Total contact hours*	45			

*Excluding Assessment hours

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	Ian Moir and Allan Seabridge, *"Aircraft Systems – Mechanical, Electrical and Avionics subsystems integration"*, Third Edition, Professional Engineering Publishing Limited, 2008.
2.	*"Aviation Maintenance Technician Handbook - Airframe",* Vol.2, ", U.S.Dept. of Transportation, Federal Aviation Administration, Flight Standards Service, 2012.
3.	*"Aviation Maintenance Technician Handbook - Powerplant",* Vol.1,2, ", U.S.Dept. of Transportation, Federal Aviation Administration, Flight Standards Service, 2012.

	REFERENCE BOOKS/OTHER READING MATERIAL
4.	Nagabhushana.Sand Sudha.L.K , *"Aircraft Instrumentation and Systems",* I.K..International Publishing House Pvt. Ltd, New Delhi,2010.
5.	Michael J.Kroes, William A.Watkins ad Frank Delp, *"Aircraft Maintenance and Repair",* Seventh Edition, Tata McGraw Hill Education Private Limited, New Delhi, 2013.
6.	Irwin Treager*, "Aircraft Gas Turbine Engine Technology",* Third Edition, McGraw-Hill, 1997.

Course Nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**

Year – III / Semester –I Courses

15AS301J	AERODYNAMICS – II	L	T	P	C
		3	0	2	4
Co-requisite:					
Prerequisite:	15AS204J				
Data Book / Codes/Standards	Gas Table				
Course Category	P PROFESSIONAL CORE	AERODYNAMICS			
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting 23rd July 2016				

PURPOSE	To study the principles of compressible flow, that has wide application in aerospace engineering.							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1	To have exposure in recent advances made in transonic, supersonic and hypersonic flows.	a	b	e	k			
2	To familiarize with numerical method of characteristics.	a	b	e	k			

Session	Description of Topic (Theory)	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: CONCEPTS OF COMPRESSIBLE FLOW	**9**			
1.	Introduction to compressible flow, Review of continuity, momentum and steady flow energy equations and entropy considerations	2	C, D	1	1,2,3,4,5
2.	Energy and momentum equations for compressible fluid flow	1	C, D	1	1,2,3,4,5
3.	velocity of sound-critical state	1	C,	1	1,2,3,4,5
4.	Isentropic relations from entropy relations, and Numerical problems	3	C, D	1	1,2,3,4,5
5.	Reference velocities-stagnation states and types of waves-Mach cones	2	C, D	1	1,2,3,4,5
	UNIT II: SHOCKS AND ITS APPLICATIONS	**9**			
6.	Normal shocks-governing equations , and Numerical problems	3	C,	1	1,2,3,4,5
7.	Oblique shock properties	2	C,	1	1,2,3,4,5
8.	Shock interactions, and pitot formula	2	C,	1	1,2,3,4,5
9.	Numerical problems on oblique shocks	2	C,	1	1,2,3,4,5
	UNIT III: EXPANSION WAVES AND FLOW OVER NOZZLES	**9**			
10.	Prantl-Meyer expansion flow and related problems.	4	C,	1	1,2,3,4,5
11.	Nozzle flow relations	2	C,	1	1,2,3,4,5
12.	Under and over expanded nozzles	1	C,	1	1,2,3,4,5
13.	Numerical problems on nozzle flow	2	C,	1	1,2,3,4,5
	UNIT IV : FLOW IN CONSTANT AREA DUCT WITH FRICTION AND HEAT TRANSFER	**9**			

14.	Fanno flow- equations, variation of flow properties with duct length and charts for Fanno flow.	2	C, D	1	1,2,3,4,5
15.	Numerical problems on Fanno flow	2	C,	1	1,2,3,4,5
16.	Rayleigh flow equations, variation of flow properties of duct to heat addition, and tables and charts for Rayleigh flow	3	C, D	1	1,2,3,4,5
17.	Numerical problems on Rayleigh flow	2	C,	1	1,2,3,4,5
	UNIT V: BRIEF INTRODUCTION TO THE METHODS OF CHARACTERISTICS	**9**			
18.	Method of characteristics and its application	3	C,	2	1,2,3,4
19.	Prandtl-Glauert and Goethert rules.	1	C,	2	1,2,3,4
20.	Ackeret's supersonic airfoil theory	2	C, D	2	1,2,3,4
21.	Small perturbation theory and Numerical problems	3	C,	2	1,2,3,4
	Total contact hours*	45			

*Excluding Assessment hours

Sl. No.	Description of experiments	Contact hours	C-D-I-O	IOs	Reference
1.	Study of various types of Supersonic wind tunnel.	2	C	1	6
2.	Study of various Supersonic flow visualization techniques and its applications.	2	C	1	6
3.	Calibration of supersonic wind tunnel	2	I,O	1	6
4.	Comparison of shock wave pattern on Diamond Airfoil between analytical and experimental method (Flow visualization	2	I,O	1	6
5.	Experiment on supersonic flow breakdown inside test section due to the influence of second throat area.	2	I,O	1	6
6.	Investigation of starting normal shock wave movement inside Convergent Divergent Nozzle.	2	I,O	1	6
7.	Experimental verification of "Three dimensional relieving effect" .	2	I,O	1	6
8.	Investigation of supersonic flow over different aircraft and missile models using Schlieren flow visualization technique.	2	I,O	1	6
9.	Investigation of detached shock wave pattern using Schlieren flow visualization technique.	2	I,O	1	6
10.	Investigation of intersection of right and left running shock waves for various deflection angles using Schlieren flow	2	I,O	1	6
	Total contact hours	20			

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	Radhakrishnan, E., "*Gas Dynamics"*, Prentice Hall India Learning Private Limited, 5th edition (2014)
2.	Yahya, S. M., "*Fundamentals of compressible flow with aircraft and rocket propulsion"*, Wiley Eastern,4th edition(2010)
	REFERENCE BOOKS/OTHER READING MATERIAL
3.	Shapiro, A.H., "*The Dynamics and Thermodynamics of Compressible Fluid Flow* (*Vol I and VolII)*", Ronald Press,1953.
4.	Anderson J. D., Jr., "*Modern Compressible Flow with Historical Perspective*," McGraw Hill Publishing Co., 2004
5.	Miles, E.R.C., "*Supersonic Aerodynamics*", Dover, New York, 1950.
6.	Laboratory Manual

Course nature				**Theory + Practical**			
Assessment Method – Theory Component (Weightage 50%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**
Assessment Method – Practical Component (Weightage 50%)							
In-semester	**Assessment tool**	Experiments	Record	MCQ/Quiz/Viva Voce	Model examination		**Total**
	Weightage	**40%**	**5%**	**5%**	**10%**		**60%**
						End semester examination Weightage :	**40%**

15AS302	FLIGHT DYNAMICS- I	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	15AS204J				
Data Book / Codes/Standards	Nil				
Course Category	P PROFESSIONAL CORE				
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting 23rd July 2016				

PURPOSE	To expose the students to the different forces acting on the flight vehicle and its effect on its performance.

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will familiarize with								
1.	the different forces acting on a vehicle in flight	a	e					
2.	properties of drag	a	e					
3.	variation of thrust	a	e					
4.	performance during different flight conditions	a	e					
5.	Flight testing.	a	e	k				

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: FORCE AND DRAG	**8**			
1.	Forces and moments acting on a vehicle in flight	2	C	1	2.3
2.	Equations of motion of a rigid flight vehicle	2	C,D	1	2
3.	Various types of drags.	2	C,D	2	1,2,3
4.	Drag polar of vehicles from low speeds to hypersonic speeds.	2	C,D	2	2,3

	UNIT II: AIR BREATHING ENGINES AND ROCKETS	**9**			
5.	Thrust and propulsive efficiency of air breathing engine and rocket	2	C.D	3	1,2
6.	Review of the variation of thrust/power and SFC with altitude and velocity, for various air breathing engines	4	C,D	2	1,2
7.	Propellers	1	C,D	2	2,3
8.	Variation of thrust/power and SFC with altitude and velocity of rockets	2	C,D		1
	UNIT III: UNACCELERATED FLIGHT	**10**			
9.	Variation of Thrust required and power required with velocity	2	C,D	2,3	1,2
10.	steady, level flight	2	C,D	2,3,4	1,2
11.	Glide and climb performance	2	C,D	2,3,4	2
12.	Range and endurance of jet driven and propeller driven aircraft.	3	C,D	2,3,4	2
13.	Excess power, rate and angle of climb	1	C		
	UNIT IV: ACCELERATED FLIGHT	**9**			
14.	Accelerated level flight	2	C,D	4	2
15.	Turning performance	2	C,D	4	2
16.	Pull up and pull down performance	1	C,D	4	2
17.	V-n diagram	1	C		1,2,3
18.	Takeoff and landing performance	3	C,D	4	2
	UNIT V: FLIGHT TESTING	**9**			
19.	Altitude definitions, Speed definitions	2	C,D	5	4
20.	Air speed, altitude and temperature measurements.	1	C	5	4
21.	Errors and calibration	2	C,D	5	4
22.	Measurement of engine power, charts and corrections	2	C	5	1,4
23.	Flight determination of drag polar	2	C,D	5	3,4
	Total contact hours*	45			

*Excluding Assessment hours

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	Perkins, C. D., and Hage, R, E., "*Airplane Performance, Stability and Control*," Wiley Toppan, 1974.
2.	John D. Anderson, *"Aircraft Performance and Design",* McGraw-Hill, 1999
	REFERENCE BOOKS/OTHER READING MATERIAL
3.	McCormik, B. W., "*Aerodynamics, Aeronautics and Flight Mechanics"*, John Wiley, 1995.
4.	Nelson, R.C., "*Flight Stability and Automatic Control"*, McGraw Hill, 1989.

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
					End semester examination Weightage :		**50%**

15AS303J	AIRCRAFT STRUCTURES	L	T	P	C
		3	0	2	4
Co-requisite:	Nil				
Prerequisite:	15AS205J				
Data Book / Codes/Standards	Nil				
Course Category	P PROFESSIONAL CORE	STRUCTURES			
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting, 23rd July 2016				

PURPOSE	To acquire the knowledge on unsymmetrical bending, shear flow, shear centre, buckling of thin plates, wing and fuselage stress analysis.							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Apply advanced methods to analyze the structure with skew loads in Engineering problems.	a	b	e				
2.	Improve their ability in solving geometrical applications of a structure.	a	b	e				
3.	Equip them to be familiar with shear flow and shear centre concepts.	a	b	e				
4.	Familiarize with the applications of fourth order differential equations in buckling of thin plates.	a	b	e				
5.	Expose to the concept of wing and fuselage stress analysis.	a	b	e				
6.	Enhance the application of concepts in an experimental manner.	a	b	e				

Session	Description of Topic (Theory)	Contact hours	C-D-I-O	IOs	Reference
	UNIT I-UNSYMMETRICAL BENDING	**9**			
1.	Concept of bending stresses in beams of symmetrical and unsymmetrical sections.	1	C	1,2	1&2
2.	Derivation for bending stress expression for generalized ‘k’ method, neutral axis method and principal axis method.	2	C	1,2	1&2
3.	Bending of symmetric sections with skew loads - Problems	2	C,D	1,2	1&2
4.	Bending stress determination for symmetrical section with stringers.	2	C,D	1,2	1&2
5.	Bending stress determination for unsymmetrical section with stringers.	2	C,D	1,2	1&2
	UNIT II-SHEAR FLOW IN OPEN SECTIONS	**9**			
6.	Introduction to thin walled beams, concept of shear flow and the shear centre. Shear flow expression for open sections.	1	C,D	3	1&2
7.	Shear flow and shear centre determination, and shear flow distribution for thin-walled symmetrical open sections.	2	C,D	3	1&2
8.	Shear flow and shear centre determination, and shear flow distribution for symmetrical open sections with stringers.	3	C,D	3	1&2
9.	Shear flow and shear centre determination, and shear flow distribution for a unsymmetrical open sections with stringers.	2	C,D	3	1&2
10.	Concept of structural idealization.	1	C,D	3	1&2

	UNIT III-SHEAR FLOW IN CLOSED SECTIONS	**9**			
11.	Concept of Bredt - Batho theory and assumptions for Engineers Theory of bending. Shear flow expression for closed sections.	1	C	3	1&2
12.	Shear flow and shear centre determination, and shear flow distribution for a thin-walled symmetrical (single cell) closed sections subjected to shear force.	1	C,D	3	1&2
13.	Shear flow and shear centre determination, and shear flow distribution for a thin-walled symmetrical (two cell) closed sections subjected to torque.	1	C,D	3	1&2
14.	Shear flow and shear centre determination, and shear flow distribution for a thin-walled symmetrical (three cell) closed sections subjected to torque.	1	C,D	3	1&2
15.	Shear flow and shear centre determination, and shear flow distribution for symmetrical and unsymmetrical (single cell) closed sections with stringers (walls effective and ineffective in bending).	1	C,D	3	1&2
16.	Shear flow and shear centre determination, and shear flow distribution for symmetrical and unsymmetrical (two cells) closed sections with stringers (walls effective and ineffective in bending).	2	C,D	3	1&2
17.	Shear flow and shear centre determination, and shear flow distribution for symmetrical and unsymmetrical (three cells) closed sections with stringers (walls effective and ineffective in bending).	2	C,D	3	1&2
	UNIT IV-BUCKLING OF PLATES	**9**			
18.	Derivation - Plates subjected to bending, twisting and a distributed transverse load	2	C,D	4	1&2
19.	Local instability and Instability of stiffened panels.	1	C,D	4	1&2
20.	Estimation of crippling stress using Needham's and Gerard's method.	3	C,D	4	1&2
21.	Sheet effective width concepts, inter rivet and sheet wrinkling failures, inelastic buckling of plates.	2	C,D	4	1&2
22.	Thin walled column strength, Torsional instability of thin-walled columns.	1	C,D	4	1&2
	UNIT V-STRESS ANALYSIS IN WING AND FUSELAGE	**9**			
23.	Shear and bending moment distribution for wings	1	C,D	5	1&2
24.	Shear and bending moment distribution for fuselage	1	C,D	5	1&2
25.	Shear resistant web beams.	1	C	5	1&2
26.	Tension (Wagner's) and semi-tension field beams.	1	C,D	5	1&2
27.	Typical wing structural arrangement, wing strength requirements, Beam theory assumptions, wing stress analysis methods, Application to practical wing section, shear lag	3	C,D	5	1&2
28.	Basic fuselage structure, fuselage stress analysis methods, shears flow analysis for fuselage structures.	2	C,D	5	1&2
	Total contact hours*	45			

*Excluding Assessment hours

Sl. No.	Description of experiments	Contact hours	C-D-I-O	IOs	Reference
1.	Unsymmetrical Bending of a Beam	2	I,O	1,2	3
2.	Shear Centre of an open Section beam	2	I,O	3	3
3.	Shear Centre of a closed Section beam	2	I,O	3	3
4.	Experiments on constant strength beams	2	I,O	6	3
5.	Wagner beam – Tension field beam	2	I,O	5	3
6.	Experiments on thin walled pressure vessels.	2	I,O	6	3
7.	Combined bending and Torsion of a Hollow Circular Tube.	2	I,O	6	3
8.	Verification of Maxwell's reciprocal theorem.	2	I,O	6	3
9.	To determine the buckling load of a column.	2	I,O	4,6	3
10.	To determine the Material Fringe Pattern of a Photo-elastic Model.	2	I,O	6	3
11.	Fabrication and testing of a Composite Laminate.	2	I,O	6	3
12.	Free Vibration of a Cantilever Beam.	2	I,O	6	3
13.	Forced Vibration of Beams.	2	I,O	6	3
	Total contact hours*	20			

*Any ten experiments will be offered

LEARNING RESOURCES	
Sl No.	**TEXT BOOKS**
1.	Megson T H G, *'Aircraft Structures for Engineering Students'*, Elsevier, Fifth edition, 2013.
2.	Bruhn. E.F., *'Analysis and Design of Flight Vehicles Structures'*, Tri-state offset company, USA, 1985.
3.	Laboratory Manual.
	REFERENCE BOOKS/OTHER READING MATERIAL
4.	Rivello, R.M., *Theory and Analysis of Flight Structures*, McGraw Hill, 1993.
5.	Peery, D.J., and Azar, J.J., *Aircraft Structures*, 2nd edition, McGraw – Hill, N.Y., 1999.

Course nature				**Theory + Practical**			
Assessment Method – Theory Component (Weightage 50%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**
Assessment Method – Practical Component (Weightage 50%)							
In-semester	**Assessment tool**	Experiments	Record	MCQ/Quiz/Viva Voce		Model examination	**Total**
	Weightage	**40%**	**5%**	**5%**		**10%**	**60%**
						End semester examination Weightage :	**40%**

15AS304	AIR BREATHING PROPULSION	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	15AS202, 15AS204J				
Data Book / Codes/Standards	Gas Tables				
Course Category	P PROFESSIONAL CORE	PROPULSION			
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting, 23rd July 2016				

PURPOSE	To improve the student's ability to analyze Engineering concepts of air breathing propulsion systems.							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Understand the working principles of gas turbine propulsion systems.	a	e					
2.	Design and analyze inlets, combustion chambers, nozzles used in Air breathing engines.	a	e					
3.	Design and analyze the compressors and turbines in gas turbine propulsion systems.	a	e					
4.	Understand the principle of operation and performance of RAMJET and SCRAMJET engines.	a	e					

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I-THERMODYNAMICS OF AIRBREATHING PROPULSION SYSTEMS	**9**			
1.	Introduction- Turbojet engines-Turbofan engines.	4	C,D	1	1-2
2.	Turboprop and Turbo shaft engines	2	C,D	1	1-2
3.	Typical engine performance- Methods of thrust augmentation - Numerical problems	3	C,D	1	1-2-5-6
	UNIT II-INLETS, COMBUSTION CHAMBER AND NOZZELS	**10**			
4.	Introduction-Subsonic inlets-Supersonic inlets-Modes of Inlet operation	3	C	2	1-2-3-4
5.	Gas turbine combustors-Types of combustion chamber-Fuel injector- Flame Tube cooling-Flame Stabilization-Flame holders	4	C,D	2	1-2-3-4
6.	Exhaust Nozzle-Numerical problems	3	C,D	2	1-2-3-4
	UNIT III- COMPRESSORS	**10**			
7.	Compressor and its classification- Centrifugal compressor - Work and compression ratio -Performance characteristics- Centrifugal compressor staging-Numerical problems.	3	C	3	2-3-6

8.	Axial compressor-Work and compression ratio- Degree of reaction- Characteristic performance of a single stage axial compressor	3	C,D	3	2-3-6
9.	Characteristic performance of a multistage axial compressor-Cascading of axial compressor-Compressor efficiency	4	C,D	3	2-3-6
	UNIT IV-AXIAL TURBINES	**10**			
10.	Axial turbine stage -Velocity triangles and Power output - Elementary theory - Vortex theory	4	C,D	3	2-3-6
11.	Limiting Factors of gas turbine design-Turbine performance-Turbine Blade cooling	4	C,D	3	2-3-6
12.	Axial flow Turbine and compressor matching -Numerical problems.	2	C,D	3	2-3-6
	UNIT-V RAMJET AND SCRAMJET	**6**			
13.	Operating principle of RAMJET engine- RAMJET with afterburner- RAMJET performance	2	C,D	4	1-3-6
14.	SCRAMJET working principle-Problems faced in supersonic combustion	2	C	4	1-3-6
15.	Numerical Problems	2	C,D	4	1-3-6
	Total contact hours*	45			

*Excluding Assessment hours

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	Philip Hill and Carl Peterson, "*Mechanics and thermodynamics of propulsion",* Pearson India, second edition 2010.
2.	Cohen.H, Rogers.G.F.C. and Saravanamuttoo.H.I.H, "*Gas turbine theory*". Pearson education, fifth edition,2001
	REFERENCE BOOKS/OTHER READING MATERIAL
3.	V.Ganesan., "*Gas Turbines*", Tata McGraw-Hill Education, third edition, 2010.
4.	Rolls-Royce, Jet Engine Manual, 3rd edition, 1983.
5.	Oats, G.C., "*Aerothermodynamics of Aircraft Engine Components*", AIAA Education Series, New York, 1985.
6.	Mattingly, J.D., Heiser, W.H., and Pratt,D.T., "*Aircraft Engine Design*", AIAA Education Series, New York, second edition, 2002

Course nature			**Theory**				
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
					End semester examination Weightage :		**50%**

15AS390L	INTERNSHIP / INDUSTRIAL TRAINING	L	T	P	C
		0	0	3	2
Co-requisite:	NIL				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	P PROFESSIONAL CORE				
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting, 23rd July 2016				

PURPOSE	To provide short-term work experience in an Industry/ Company/ Organisation

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able								
1.	To get an inside view of an industry and organization/company				j			
2.	To gain valuable skills and knowledge				j			
3.	To make professional connections and enhance networking	f	g					
4.	To get experience in a field to allow the student to make a career transition			i				

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	1. It is mandatory for every student to undergo this course. 2. Every student is expected to spend a minimum of 15-days in an Industry/ Company/ Organization, during the summer vacation. 3. The type of industry must be NOT below the Medium Scale category in his / her domain of the degree programme. 4. The student must submit the "Training Completion Certificate" issued by the industry / company / Organisation as well as a technical report not exceeding 15 pages, within the stipulated time to be eligible for making a presentation before the committee constituted by the department. 5. The committee will then assess the student based on the report submitted and the presentation made. 6. Marks will be awarded out of maximum 100. 7. Appropriate grades will be assigned as per the regulations. 8. Only if a student gets a minimum of pass grade, appropriate credit will be transferred towards the degree requirements, as per the regulations. 9. It is solely the responsibility of the individual student to fulfill the above conditions to earn the credits. 10. The attendance for this course, for the purpose of awarding attendance grade, will be considered 100%, if the credits are transferred, after satisfying the above (1) to (8) norms; else if the credits are not transferred or transferable, the attendance will be considered as ZERO. 11. The committee must recommend redoing the course, if it collectively concludes, based on the assessment made from the report and presentations submitted by the student, that either the level of training received or the skill and / or knowledge gained is NOT satisfactory.		D, I,O	1,2, 3,4	

Course nature				Training – 100% internal continuous assessment
Assessment Method (Weightage 100%)				
In-semester	Assessment tool	Presentation	Report	Total
	Weightage	80%	20%	100%
End semester examination Weightage :				0%

Year – III / Semester –II Courses

15AS305	INTRODUCTION TO SPACE TECHNOLOGY	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	15AS102, 15MA102				
Data Book / Codes/Standards	Nil				
Course Category	P PROFESSIONAL CORE				
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting, 23rd July 2016				

PURPOSE	To impart the basic knowledge on satellites, orbits, fundamentals of orbital dynamics and rocket flight dynamics							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Learn about fundamental laws that govern the orbital dynamics, equations for satellite dynamics, basics of different orbits	a	b	e				
2.	Learn about the description of Keplerian orbital elements, satellite position and motion within the orbit, factors that cause orbit perturbation	a	b	e				
3.	Learn the different types of satellite orbit transfer from one orbit to an another, basics of inter-planetary trajectory	a	b	e				
4.	Learn the governing equations of rocket flight dynamics, different flight phases, injection of satellite, injection errors on orbit	a	b	e				
5.	Learn about equations of ballistic missile trajectory, impact point error analysis	a	b	e				

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
1.	**UNIT I: ORBITAL MECHANICS FUNDAMENTALS**	**9**			1,2,6,7
2.	Laws of orbital dynamics, Solar system, Earth geometry and structure of upper atmosphere.	2	C	1	1,2,6,7
3.	Multi-body problem, Two body problem	2	C	1	1,2,6,7
4.	Equation of motion, Orbit equation	2	C	1	1,2,6,7
5.	Motion in circular, elliptical orbits, parabolic, hyperbolic orbits, Interplanetary trajectories	2	C	1	1,2,6,7
6.	Tutorial	1			
	UNIT II: ORBITS IN THREE DIMENSIONS	**9**			
7.	Coordinate systems, Time systems	1	C	2	1,2,6,7
8.	Keplerian Orbital elements	2	C	2	1,2,6,7
9.	Relations between position and time, Keplers equation	2	C	2	1,2,6,7
10.	Effects of the earth's oblateness, Types of satellite orbits, their characteristics and applications	2	C	2	1,2,6,7

11.	Orbit perturbation due to third body, Orbit decay and life time	1	C	2	1,2,6,7
12.	Tutorials	1			
	UNIT III: ORBITAL TRANSFER AND POWERED FLIGHT	**9**			
13.	Rocket equation, application to orbit transfer, velocity requirement, different propulsion systems, Propellant	2	C	3	1,2,4,5
14.	Single and two Impulse transfer, Hohmann transfer	2	C	3	1,2,3,6,7,
15.	One tangent manoeuver, Plane change manoeuver, Bi-Elliptical manoeuver, Phasing manoeuver	2	C	3	1,6,7
16.	Inter planetary missions	2	C	3	1,6,7
17.	Tutorial				
	UNIT IV: ROCKET FLIGHT DYNAMICS	**9**			
18.	One dimensional and two dimensional rocket motions in free space and homogeneous gravitational fields, fundamentals of three dimensional six degrees of freedom trajectory simulation, Description of vertical, inclined and gravity turn trajectories.	3	C	4	1,2,5
19.	Launching of a satellite, orbital elements from injection state vector, injection error analysis	3	C	4	2
20.	Multistage rocket systems, restricted staging	2	C	4	1,2,4,5
21.	Tutorial	1			
	UNIT V: BALLISTIC MISSION TRAJECTORIES	**9**			
22.	Free-flight range equation, flight-path angle equation, maximum range trajectory	3	C	5	2,3
23.	Time of free-Flight, effect of earth rotation, relative velocity, inertial velocity	3	C	5	2,3
24.	Effect of launching errors of state vector on impact point	2	C	5	2,3
25.	Tutorial	1			
	Total contact hours *	45			

*Excluding Assessment hours

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	Howard D. Curtis., “Orbital Mechanics for Engineering Students” Elsevier Butterworth-Heinemann, 2005
2.	Cornelisse, J.W, Schoyer H F R, and Wakker K F, "Rocket Propulsion and Space Dynamic", Pitman Publishing Co., 1979

	REFERENCE BOOKS/OTHER READING MATERIAL
3.	Bate R R, Mueller D D and White J E " Fundamentals of Astrodynamics" Dover Publications, New York, 1972
4.	Ashish Tewari, "Atmospheric and Space Flight Dynamics", Birkhauser Boston, 2007
5.	Martin J L Turner, "Rocket and Spacecraft Propulsion", Springer Praxis Publishing Co, Chichster, UK, 2001
6.	David A Vallado, " Fundamentals Astrodynamics and applications", Space technology Series, McGraw Hill, 1997
7.	Vladimir A Chobotov, " Orbital Mechanics", AIAA Education Series, 2002

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**

15AS306	FLIGHT DYNAMICS - II	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	15AS302				
Data Book / Codes/Standards	Nil				
Course Category	P PROFESSIONAL CORE	AERODYNAMICS			
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting, 23rd July 2016				

PURPOSE	To impart the students on the basic concepts of stability control, maneuverability and flight tests.							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, learner will be able to								
1.	Understand about the basics of stability of aircraft	a	b					
2.	Understand the need of horizontal tail, trim tabs, effect of change in C.G, static margin	a	b	e				
3.	Familiarize the need of controls in aircraft	a	b	e				
4.	Familiarize about different modes of frequency of aircraft	a	b	e				
5.	Familiarize about how to find stability points using real flight data	a	b					

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: BASIC CONCEPTS	**9**			
1.	Basic concepts of stability and control	1	C	1	1,2,3,4,5
2.	static longitudinal, directional and lateral stability control	1	C	1	1,2,3,4,5
3.	Equations of equilibrium and stability- contribution of Wing	3	C,D	1	1,2
4.	Equations of equilibrium and stability- contribution of Wing + Tail	4	C,D	1,2	1,2
	UNIT II: LONGITUDINAL DYNAMIC STABILITY AND CONTROL	**12**			
5.	Stick - fixed stability, control effectiveness,	1	C	2	1,2
6.	Elevator hinge moment	1	C	2	1,2
7.	Trim Tabs, aerodynamic and weight balancing,	2	C	2	1,2,5
8.	Effects of freeing the stick.	2	C	2	1,2
9.	Stick free Neutral Point	2	C	2,3	1,2
10.	Stick Fixed vs Stick free neutral point	2	C	2,3	1,2
11.	Control forces and force gradients	1	C	2,3	1,2

12.	Critical conditions for stability and control.	1	C	2	1,2
	UNIT III: MANEUVERABILITY	**10**			
13.	Effect of maneuvers. Longitudinal dynamic stability,	2	C	3	1,2, 4
14.	Equations of motion of a disturbed aircraft	2	C,D	3	1,2, 4
15.	Stability derivatives, characteristic equation for stick fixed case	3	C,D	3	1,2, 4
16.	Modes and stability criterion, effect of freeing the stick	3	C	3,4	1,2, 4
	UNIT IV: DYNAMIC STABILITY	**8**			
17.	Brief description of lateral dynamic stability	2	C	4	1,2
18.	Brief description of directional dynamic stability.	2	C	4	1,2
19.	Spiral, divergence and Dutch roll.	2	C	4	1,2
20.	Response, automatic control, auto pilot	2	C	4	1,2
	UNIT V: FLIGHT TESTS	**6**			
21.	Autorotation	1	C	4	5
22.	Spin – character and recovery	1	C	4	1,2
23.	Determination of stick fixed and stick free neutral points using flight tests.	2	C,D	5	1,5
24.	Determination of stick fixed and stick free maneuvering points using flight tests.	2	C,D	5	1,5
	Total contact hours*	45			

*Excluding Assessment hours

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	Nelson, R,C.*,"Flight Stability and Automatic Control",* McGraw Hill, 1989
2.	Bernard Etkin "*Dynamics of atmospheric flight"* Wiley, 1972
	REFERENCE BOOKS/OTHER READING MATERIAL
3.	Perkins, C, D., and Hage, R,E., *"Airplane Performance, Stability and Control,"* Wiley Toppan, 1974.
4.	Babister, A, W.,*"Aircraft Stability and Response"*, Pergamon Press,1980.
5.	L J Clancy "*Aerodynamics"* John Wiley & Sons (1975)

Course nature				Theory			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**

15AS307	ROCKET PROPULSION	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	15AS301J, 15AS304				
Data Book / Codes/Standards	Gas Tables				
Course Category	P PROFESSIONAL CORE	PROPULSION			
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting 23rd July, 2016				

PURPOSE	To familiarize the students on the fundamental concepts of rocket propulsion and some advanced rocket propulsion techniques.							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Understand the basic principles of rocket propulsion.	a	e					
2.	Analyze the choice of propellants and basic performance parameters of chemical propellants.	a	e					
3.	Design and Analyze the various chemical propulsion systems.	a	e					
4.	Understand the working of advanced rocket propulsion techniques.	a	e					

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I-FUNDAMENTALS OF ROCKET PROPULSION	**9**			
1.	History and evolution of rockets - Rocket principle and Rocket equation - Classification of rockets - Mass ratio of rocket	3	C,D	1	1,2,3
2.	Rocket Nozzles - Classifications - Nozzle Performance - Nozzle area ratio - Mass flow rate-Characteristic velocity - Thrust coefficient	3	C,D	1	1,2,3
3.	Performance parameters and Efficiencies of rocket - Staging and Clustering - Numerical problems.	3	C,D	1	1,2,3
	UNIT II-CHEMICAL PROPELLANTS	**9**			
4.	Molecular mass - Specific Heat-specific heat ratio - Stoichiometric ratio and mixture ratio	3	C	2	1,2,4
5.	Energy release during combustion - Heat of formation - Heat of combustion - Criterion for choice of propellant	3	C,D	2	1,2,4
6.	Solid propellants - Composition and processing - Liquid propellants – Classifications – Storability - Numerical problems.	3	C,D	2	1,2,4
	UNIT III-SOLID PROPELLANT ROCKET	**9**			
7.	Hardware components and its functions - Mechanism of burning - Ignition system and igniter types	3	C	3	1,2
8.	Propellant grain configuration and its applications - Burn rate - Factors influencing burn rates	3	C,D	3	1,2
9.	Burn rate index for stable operation - Action time and burn time - Design of Solid Propellant rocket - Numerical problems.	3	C,D	3	1,2

	UNIT IV-LIQUID PROPELLANT ROCKET	**9**			
10.	Classifications - Hardware components and its functions	2	C	3	1,2
11.	Propellant feed systems and Turbo pump feed system - Injectors and types - Thrust chamber and its cooling	4	C	3	1,2
12.	Cryogenic propulsion system, Special features of cryogenic systems - Numerical problems.	3	C,D	3	1,2
	UNIT V-ADVANCE PROPULSION TECHNIQUES	**9**			
13.	Hybrid propellant rocket - Electrical rockets - Electro-thermal, Electro-static and Electro-magnetic propulsion system	4	C	4	1,2,3
14.	Arc-jet thruster - Ion thruster - Hall Effect Thruster - Magneto plasma dynamic thruster	3	C	4	1,2,3
15.	Nuclear rockets - Solar Propulsion system - Numerical problems.	2	C,D	4	1,2,3
	Total contact hours*	45			

*Excluding Assessment hours

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	Ramamurthi.K, "*Rocket propulsion"*, Laxmi Publications, India, Second edition 2016.
2.	George P. Sutton, Oscar Biblarz, "*Rocket propulsion elements"*, Wiley India Pvt Ltd. eighth Edition 2010.
	REFERENCE BOOKS/OTHER READING MATERIAL
3.	Philip Hill and Carl Peterson, "*Mechanics and thermodynamics of propulsion", Pearson* India, second edition 2010.
4.	Stephen R. Turns, "*An Introduction to Combustion: Concepts and Applications",* McGraw-Hill Education, third Edition , 2011.

Course nature			**Theory**				
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**

15AS307L	AEROSPACE PROPULSION LABORATORY			L	T	P	C
				0	0	3	2
Co-requisite:	15AS307						
Prerequisite:	Nil						
Data Book / Codes/Standards	Nil						
Course Category	P	PROFESSIONAL CORE	PROPULSION				
Course designed by	Department of Aerospace Engineering						
Approval	Academic Council Meeting – 23rd July, 2016						

PURPOSE	To acquire depth knowledge about the working of the aircraft engines, preparation and testing of a solid propellant.

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, learner will be able to								
1.	Analyze the different aircraft engines.	b	e					
2.	Explain the concepts of free and forced convection heat transfer.	b	e					
3.	Explain the concepts of free jet and wall jet.	b	e					
4.	Familiarize with hybrid propulsion system and ramjet engine	b	e					
5.	Have a detailed knowledge on chemical ingredients of a solid propellant and its preparation.	b	e					
6.	Perform testing on a solid propellant.	b	e					

Sl. No.	**Description of experiments**	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
1.	Study of piston and jet engines.	3	C	1	1
2.	Determination of convective heat transfer coefficient over a flat plate by natural convection.	3	I,O	2	1
3.	Determination of convective heat transfer coefficient over a flat plate by forced convection.	3	I,O	2	1
4.	Characteristic plots of a free jet through a non-circular orifice.	3	I,O	3	1
5.	Characteristic plots of a wall jet through a non-circular orifice.	3	I,O	3	1
6.	Performance test on a propeller.	3	I,O	3	1
7.	Study of hybrid propulsion system.	3	I,O	4	1,2,3
8.	Thrust measurement of a Ramjet engine	3	I,O	4	1,3
9.	Burning rate measurement of solid propellant by varying oxidizer and binder ratio.	3	I,O	5,6	1,2
10.	Thrust measurement on a prepared solid propellant.	3	I,O	5,6	1,2
	Total contact hours	30			

LEARNING RESOURCES	
Sl. No.	**REFERENCES**
1.	Laboratory Manual
2.	Ramamurthi.K: *Rocket propulsion*. Macmillan Publishing Co, India. First edition. 2010.
3.	Hill.P.G. and Peterson.C.R: *Mechanics and thermodynamics of propulsion*. 2nd edition, Addison-Wesley, 2009.

Course nature				**Practical**		
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	Experiments	Record	MCQ/Quiz/Viva Voce	Model examination	**Total**
	Weightage	**40%**	**5%**	**5%**	**10%**	**60%**
					End semester examination Weightage :	**40%**

15AS308L	AIRCRAFT COMPONENT DRAWING	L	T	P	C
		0	0	3	2
Co-requisite:	Nil				
Prerequisite:	15ME105L, 15AS101				
Data Book / Codes/Standards	Nil				
Course Category	P PROFESSIONAL CORE				
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting – 23rd July, 2016				

PURPOSE	To introduce the concept of design of basic structural components using drafting & modeling package.							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1	To familiarize with basic aircraft and its components	a	c	k				
2	To familiarize 3-Dimensional Design of typical aircraft & its components.	a	c	k				
3	To familiarize assembly and drafting of aircraft components	a	c	k				

Sl. No.	Description of experiments	Contact hours	C-D-I-O	IOs	Reference
1.	2D layout of aircraft wing rib section.	3	I,O	1,2	1
2.	2D layout of bulkhead section	3	I,O	1,2	1
3.	3D model of aircraft Wing Structure.	3	I,O	1,2	1
4.	3D model of aircraft tail wing Structure.	3	I,O	1,2	1
5.	3D model of fuselage Structure.	3	I,O	1,2	1
6.	3D model of Landing Gear Components	3	I,O	1,2	1
7.	Landing Gear Assembly	3	I,O	1,2,3	1
8.	Aircraft Assembly	3	I,O	1,2,3	1
9.	Drafting of landing gear assembly.	3	I,O	1,2,3	1
10.	Drafting of Typical Aircraft.	3	I,O	1,2,3	1
	Total contact hours	30			

LEARNING RESOURCES	
Sl. No.	**REFERENCES**
1	Laboratory Manual

Course nature				**Practical**		
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	Experiments	Record	MCQ/Quiz/Viva Voce	Model examination	**Total**
	Weightage	**40%**	**5%**	**5%**	**10%**	**60%**
					End semester examination Weightage :	**40%**

15AS375L	MINOR PROJECT - I	L	T	P	C
		0	0	3	2
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P PROFESSIONAL CORE				
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting – 23rd July, 2016				

PURPOSE	To obtain a hands-on experience in converting a small novel idea / technique into a working model / prototype involving multi-disciplinary skills and / or knowledge and working in at team.

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able								
1	To conceptualise a novel idea / technique into a product	c						
2	To think in terms of multi-disciplinary environment		d					
3	To understand the management techniques of implementing a project				k			
4	To take on the challenges of teamwork, prepare a presentation in a professional manner, and document all aspects of design work.			g				

Session	Description of Topic	Contact Hours	C-D-I-O	IOs	Reference
	A Multidisciplinary project to be taken up by a team of maximum of ten students. Development of prototype product, a 3D model, simulation, blueprint for a larger project and any other development work are permitted. The contribution of the individuals in the project should be clearly brought out. A combined report is to be submitted. A presentation is to be made for the reviewers on the work done by the candidate.	**30**	C,D,I	1,2,3,4	
	Total contact hours	**30**			

Course nature		**Project – 100% internal continuous assessment**	
Assessment Method (Weightage 100%)			
In-semester	**Assessment tool**	Refer the table	**Total**
	Weightage	Refer the table below	**100%**
End semester examination Weightage :			**0%**

Assessment Components:

Assessment component	Expected outcome	Evaluators	Criteria or basis	Marks
Project proposal (Review - I)	A short presentation to be delivered on: • A brief, descriptive project title (2-4 words). This is critical! • The 3 nearest competitors (existing solutions) and price. • Team members name, phone number, email, department/degree program, and year. • A description of the product opportunity that has been identified. To include: Documentation of the market need, shortcomings of existing competitive products, and definition of the target market and its size. • Proposed supervisor / guide	Panel of reviewers	Viability / feasibility of the project Extent of preliminary work done.	**0**
Review - II	• Mission Statement / Techniques • Concept Sketches, Design Specifications / Modules & Techniques along with System architecture • Coding	Panel of reviewers	Originality, Multi-disciplinary component, clarity of idea and presentation, team work, handling Q&A.	**20**
Review – III	• Final Concept and Model / Algorithm/ Technique • Drawings, Plans / programme output • Financial Model / costing • Prototype / Coding • Final Presentation and Demonstration	Panel of reviewers	Originality, Multi-disciplinary component, clarity of idea and presentation, team work, handling Q&A.	**50**
Final Technical Report	A good technical report	Supervisor / Guide	Regularity, systematic progress, extent of work and quality of work	**30**
			Total	**100**

15AS380L	SEMINAR - I	L	T	P	C
		0	0	3	2
Co-requisite:	NIL				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	P PROFESSIONAL CORE				
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting – 23rd July, 2016				

PURPOSE	To enhance the disseminating skills of the student about the current and contemporary research work that are being carried out across the world.

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able								
1.	To understand the research methodology adopted by various researchers	h	i	j				
2.	To mathematically model a problem, critically analyse it and adopt strategies to solve	b	c	e				
3.	To understand and present a well documented research	e	g					

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	Guidelines for conducting 15AS380L Seminar for B.Tech 1. Upon registering for the course the student must identify a sub-domain of the degree specialization that is of interest to the student and start collecting research papers as many as possible. 2. After collecting sufficient number of research papers the student must peruse all the papers, meet the course faculty and discuss on the salient aspects of each and every paper. 3. The course faculty, after discussion with the student will approve TWO research papers that is appropriate for presentation. 4. The student must collect additional relevant reference materials to supplement and compliment the two research papers and start preparing the presentation. 5. Each student must present a 15-minute presentation on each of the approved research paper to the panel of evaluators. 6. The presenter must present one research paper within the first half of the semester (6 weeks) and another research paper in the next half of the semester (6 weeks) as per the schedule. 7. All other students registered for the course will form the audience. 8. The audience as well as the evaluators will probe the student with appropriate questions and solicit response from the presenter. 9. The presentation will be evaluated against 7 to 8 assessment criteria by 4 to 5 evaluators.	**30**	C,D	1,2,3,4	
	Total contact hours	**30**			

Department of Aerospace Engineering
EVALUATION OF SEMINAR PRESENTATIONS

Name of the Student: Date:

Register Number: Degree and Branch:

Topic:

Sl. No.	Criteria for Assessment	Evaluator 1	Evaluator 2	Evaluator 3	Evaluator 4	Evaluator 5
1	Understanding of the subject					
2	Clarity of presentation					
3	Appropriate use of Audio visual aids					
4	Whether cross references have been consulted					
5	Ability to respond to questions on the subject					
6	Time scheduling					
7	Completeness of preparation					

Poor	1	Below Average	2	Average	3	Good	4	Very Good	5

Overall Grades:

Remarks:

Signature of Course Coordinator:

Course nature				100% internal continuous assessment.
Assessment Method (Weightage 100%)				
In-semester	Assessment tool	Presentation 1	Presentation 2	Total
	Weightage	50%	50%	100%
End semester examination Weightage :				0%

15AS385L	MOOC - I	L	T	P	C
		0	0	3	2
Co-requisite:	NIL				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	P PROFESSIONAL CORE				
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting – 23rd July, 2016				

PURPOSE	To offer students the opportunity to study with the world's best universities by integrating select MOOCs in a regular degree programme and providing students full credit transfer, as per university regulations, if they earn a "Verified / Completion Certificate" and take a proctored examination through a secure, physical testing center.

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able								
1.	To apply the concepts, theories, laws, technologies learnt herein to provide engineering solutions.	f	h	i	j			

Course nature		**Online - 100% internal continuous assessment.**				
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	Quiz	Assignment	Non-proctored / Unsupervised Tests	Proctored / Supervised Test	**Total**
	Weightage	**25%**	**25%**	**10%**	**40%**	**100%**
End semester examination Weightage :						**0%**

Registration process, Assessment and Credit Transfer:

1. Students can register for courses offered by approved global MOOCs platforms like edX, Coursera or Universities with which SRM partners specifically for MOOCs.
2. Annually, each department must officially announce, to the students as well as to the Controller of Examinations, the list of courses that will be recognised and accepted for credit transfer.
3. The department must also officially announce / appoint one or more faculty coordinator(s) for advising the students attached to them, monitoring their progress and assist the department in proctoring the tests, uploading the marks / grades, and collecting and submitting the graded certificate(s) to the CoE, within the stipulated timeframe.
4. Student who desires to pursue a course, from the above department-approved list, through MOOCs must register for that course during the course registration process of the Faculty of Engineering and Technology, SRM University.
5. The maximum credit limits for course registration at SRM will include the MOOCs course registered.
6. The student must periodically submit the marks / grades obtained in various quizzes, assignments, tests etc immediately to the Faculty Advisor or the Course Coordinator for uploading in the university's academic module.
7. The student must take the final test as a Proctored / Supervised test in the university campus.
8. The student must submit the "Certificate of Completion" as well as the final overall Marks and / or Grade within the stipulated time for effecting the grade conversion and credit transfer, as per the regulations. It is solely the responsibility of the individual student to fulfil the above conditions to earn the credits.
9. The attendance for this course, for the purpose of awarding attendance grade, will be considered 100% , if the credits are transferred, after satisfying the above (1) to (7) norms; else if the credits are not transferred or transferable, the attendance will be considered as ZERO.

15AS490L	INDUSTRY MODULE - I	L	T	P	C
		0	0	3	2
Co-requisite:	NIL				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	P PROFESSIONAL CORE				
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting – 23rd July, 2016				

PURPOSE	To impart an insight into the current industrial trends and practices

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able								
1.	To obtain an insight into the current industrial trends and practices			j				
2.	To obtain an insight into the technologies adopted by industries			j				
3.	To obtain an insight into the technical problems encountered by the industries and the scope for providing solutions.		h					
4.	To network with industry	g						

Description of Topic	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
1. The department will identify and shortlist few emerging topics that are trending in industry. 2. The department will identify experts from industry who are willing to deliver modules on the shortlisted topics. 3. The identified expert will assist the department in formulating the course content to be delivered as a 30-hour module, prepare lectures notes, ppt, handouts and other learning materials. 4. The department will arrange to get the necessary approvals for offering the course, from the university's statutory academic bodies well before the actual offering. 5. The department must officially announce, to the students as well as to the Controller of Examinations, the list of courses that will be offered as industry module. 6. The department must also officially announce / appoint one or more faculty coordinator(s) for advising the students attached to them, monitoring their progress and assist the department in proctoring/supervising/assessment the quizzes, assignments, tests etc, uploading the marks, attendance etc, within the stipulated timeframe. 7. The Student who desires to pursue a course, from the above department-approved list, must register for that course during the course registration process of the Faculty of Engineering and Technology, SRM University. 8. The maximum credit limits for course registration at SRM will include the Industry Module also. 9. All academic requirements of a professional course like minimum attendance, assessment methods, discipline etc will be applicable for this Industry Module. 10. The course will be conducted on weekends or beyond the college regular working hours.		C,D,I,O	1,2,3,4	
Total contact hours	**30**			

Course nature					**100% internal continuous assessment.**		
Assessment Method – Theory Component (Weightage 50%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage							**50%**

Year – IV / Semester –I Courses

15AS401	VIBRATIONS AND ELEMENTS OF AEROELASTICITY	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	15AS102				
Data Book / Codes/Standards	Nil				
Course Category	P PROFESSIONAL CORE	STRUCTURES			
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting – 23rd July, 2016				

PURPOSE	To make the students to understand the methods to study the dynamic behavior of different aircraft components and the interaction of aerodynamic, elastic and inertia forces.

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student should be able								
1.	To familiarize concept of basic motions of a structure.	a	e					
2.	To familiarize concept of the single degree of freedom systems.	a	e					
3.	To familiarize the concept of multi degree of freedom systems.	a	e					
4.	To familiarize the concept of approximate methods to find the natural frequencies of a system.	a	e					
5.	To familiarize with the interaction of aerodynamic, elastic and inertia forces.	a	e					

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: BASIC MOTIONS	**9**			
1.	Simple harmonic motion-Terminologies.	2	C	1	1,4,6
2.	Newton's law-D'Alembert's principle.	2	C	1	1,4,6
3.	Energy Methods	5	C	1	1,4,6

	UNIT II: SINGLE DEGREE OF FREEDOM SYSTEMS	**9**			
4.	Free vibrations-Damped vibrations	3	C	2	1,4,6
5.	Forced vibrations-with and without damping.	2	C	2	1,4,6
6.	Support excitation.	2	C	2	1,4,6
7.	Vibration measuring instruments.	2	C	2	1,4,6
	UNIT III: MULTI DEGREE OF FREEDOM SYSTEMS	**9**			
8.	Two degree of freedom systems-Static and Dynamic couplings, vibration absorber	3	C	3	1,4,6
9.	Principal coordinates, Principal modes, Orthogonal condition, Eigen value problem.	2	C	3	1,4,6
10.	Hamilton's principle, Lagrangean equation and application, vibration of elastic bodies.	2	C	3	1,4,6
11.	Vibration of strings, Longitudinal, lateral and torsional vibrations.	2	C	3	1,4,6
	UNIT IV: APPROXIMATE METHODS	**9**			
12.	Rayleigh's method to find natural frequencies.	5	C	4	1,4,6
13.	Holzer's method to find natural frequencies.	4	C	4	1,4,6
	UNIT V: ELEMENTS OF AEROELASTICITY	**9**			
14.	Aeroelastic problems-Collar's triangle of forces	3	C	5	2,3,5
15.	Wing divergence problem	3	C	5	2,3,5
16.	Aileron control reversal, Flutter problems	3	C	5	2,3,5
	Total contact hours*	45			

*Excluding Assessment hours

LEARNING RESOURCES	
Sl.No.	**TEXT BOOKS**
1.	Timoshenko S., *"Vibration Problems in Engineering"*– John Wiley and Sons,New York, 1993.
2.	Fung Y.C., *"An Introduction to the Theory of Aero elasticity"* – John Wiley &Sons, New York, 1995.
	REFERENCE BOOKS/OTHER READING MATERIAL
3.	Bisplinghoff R.L., Ashley H and Hoffman R.L., *"Aero elasticity"* – Addision Wesley Publication, New York, 1983.
4.	Tse. F.S., Morse, I.F., Hinkle, R.T., *"Mechanical Vibrations",* – Prentice Hall,New York, 1984.
5.	Scanlan R.H. & Rosenbaum R., *"Introduction to the study of Aircraft Vibration & Flutter"*, John Wiley and Sons. New York, 1982.
6.	Tongue. B. H., *"Principles of Vibration",* Oxford University Press, 2000.

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**

15AS402J	DIGITAL AVIONICS	L	T	P	C
		3	0	2	4
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Core				
Course designed by	Department of Aerospace engineering				
Approval	Academic Council Meeting – 23rd July, 2016				

PURPOSE	To introduce the basic components of avionics systems, digital data bus, Cockpit essentials, Power requirements and packaging of Avionics and programming of Microprocessors and microcontrollers

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	understand the basic concepts of Avionics systems and design	a	b		e			
2.	knowledge of working of avionics systems in an aircraft	a	b	d	e			
3.	expose to avionics architecture and test avionics bus systems, integration and display systems	a	b		e			
4.	Deploy these skills effectively in understanding and analysis of avionics systems.	a	b		e			
5.	Program microprocessors and microcontrollers to interface various output devices	a	b		e			

Session	Description of Topic (Theory)	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: INTRODUCTION TO AVIONICS AND ITS DESIGN	**9**			
1.	Introduction, Need for avionics, Role of avionics in civil and military aircrafts	3	C	1	1-2
2.	Top-Down Design procedure of avionics systems, Software assessment and validation	2	C,D	1	4
3.	Fault tree analysis, Failure mode and effect analysis	2	C,D	1	1-2
4.	Importance of illities	2	C	1	1-2
	UNIT II: DIGITAL AVIONICS ARCHITECTURE AND DATA BUSES	**10**			
5.	Evolution of Avionics Architecture and examples	3	C	2,3	5
6.	Elements and Protocols of MIL-STD 1553B Bus	3	C,D	2,3	5
7.	Elements and Protocol of ARINC 429	2	C,D	2,3	5
8.	Elements and Protocol of AFDX Network	2	C,D	2,3	5

	UNIT III: AVIONICS SYSTEM ESSENTIALS: DISPLAYS, I/O DEVICES AND POWER	**10**			
9.	Trends in display technology, Alpha numeric displays, character displays.	1	C	2,3	5
10.	MFDs, MFK, HUD, HDD, HMD, DVI, HOTAS	4	C,D	2,3	5
11.	Synthetic and enhanced vision, situational awareness	2	C,D	2,3	5
12.	Panaromic/big picture display, Electrical power requirements for Civil and military cockpit	2	C,D	2,3	5
13.	Civil and military requirement comparison and Tips for power system design	1	D	2,3	5
	UNIT IV: AVIONICS PACKAGING	**8**			
14.	Modular Avionics Packaging, Trade-off studies	3	C	1,2	1,2
15.	ARINC and DOD types, System cooling	3	C,D	1,2	1-2
16.	EMI/EMC requirements and standard	2	C,D	1,2	1-2
	UNIT V: MAINTENANCE AND COST OF AVIONICS	**8**			
17.	Built in Test equipments, speed maintenance ATLAS	2	D	4	4,5
18.	Remote diagnostics, Maintenance support-life cycle cost for Military and civil avionics systems	4	C	4	4
19.	Cash flow analysis and software cost- Establishing spare levels	2	C	4	4
	Total contact hours*	45			

*Excluding Assessment hours

Sl. No.	Description of experiments	Contact hours	C-D-I-O	IOs	Reference
1.	Study of Microprocessor 8085 and its instruction set	2	C	5	6
2.	Study of Microcontroller PIC 16 and its instruction set	2	C	5	6
3.	Testing and evaluation of MIL-STD 1553B bus	2	I,O	3	5
4.	Testing and evaluation of ARINC 429 bus	2	I,O	3	5
5.	Testing and Evaluation of AFDX network	2	I,O	3	5
6.	Arithmetic sum and subtraction of two numbers using Microprocessor 8085	2	I,O	5	6

7.	Multiplication and division of two numbers using Microprocessor 8085	2	I,O	5	6
8.	Interfacing stepper with Microcontroller (PIC 16)	2	I,O	5	6
9.	Interfacing stepservo-motor with Microcontroller (PIC 16)	2	I,O	5	6
10.	Interfacing LCD with microcontroller (PIC 16)	2	I,O	5	6
	Total contact hours	20			

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	Carry R Spitzer, "*The Avionics Handbook*" CRC press, 2000
2.	Spitzer, C R, "*Digital Avionics Systems*" Prentice Hall, Eaglewood cliffs, N.J., USA, 1987
	REFERENCE BOOKS/OTHER READING MATERIAL
3.	Collinson R.P.G., "*Introduction to Avionics*", Chapman and Hall, 1996
4.	Jim curren, "*Trends In Advanced Avionics*", IOWA state university, 1992
5.	Lan Moir, ' *Civil avionics systems*' Second edition, Wiley publications, 1996
6.	Gaonkar, R.S., *Microprocessors Architecture - Programming and Applications*, Wiley and Sons Ltd, New Delhi, 1990

Course nature		**Theory + Practical**					
Assessment Method – Theory Component (Weightage 50%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**
Assessment Method – Practical Component (Weightage 50%)							
In-semester	**Assessment tool**	Experiments	Record	MCQ/Quiz/Viva Voce	Model examination		**Total**
	Weightage	**40%**	**5%**	**5%**	**10%**		**60%**
						End semester examination Weightage :	**40%**

15AS403L	AEROSPACE COMPUTATIONAL ANALYSIS LABORATORY	L	T	P	C
		0	0	3	2
Co-requisite:	Nil				
Prerequisite:	15AS205J, 15AS301J				
Data Book / Codes/Standards	Nil				
Course Category	P PROFESSIONAL CORE				
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting – 23rd July, 2016				

PURPOSE	To introduce the concept of design of basic structural components using drafting & modeling package.							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be familiarize with								
1	Structural analysis of beams and aircraft structural components	a	c	k				
2	Subsonic and supersonic flow analysis over the objects	a	c	k				
3	Heat transfer analysis over the objects	a	c	k				

Sl. No.	Description of experiments	Contact hours	C-D-I-O	IOs	Reference
1.	Static & Dynamic analysis of beams.	3	I,O	1	1
2.	Structural analysis of wing structure	3	I,O	1	1
3.	2D analysis of subsonic flow through duct	3	I,O	2	1
4.	2D analysis of supersonic flow through C-D Nozzle.	3	I,O	2	1
5.	2D analysis of subsonic flow over bluff /streamlined body.	3	I,O	2	1
6.	2D analysis of supersonic flow over bluff /streamlined body.	3	I,O	2	1
7.	3D flow analysis of subsonic wind tunnel	3	I,O	2	1
8.	Simulation of Premixed / Non-Premixed Combustion analysis	3	I,O	3	1
9.	Heat transfer analysis over a flat plate with natural / forced convection	3	I,O	3	1
10.	Panel method for evaluating pressure distribution over a cylinder/symmetric NACA airfoil using MATLAB.	3	I,O	2	1
11.	Structural Analysis of a 2-D continuous beam using MATLAB code	3	I,O	1	1
12.	Heat Transfer analysis in a Thin Plate using MATLAB code	3	I,O	3	1
	Total contact hours*	30			

*Any ten experiments will be offered

LEARNING RESOURCES	
Sl. No.	**REFERENCES**
1	Laboratory Manual

Course nature				**Practical**		
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	Experiments	Record	MCQ/Quiz/Viva Voce	Model examination	**Total**
	Weightage	**40%**	**5%**	**5%**	**10%**	**60%**
					End semester examination Weightage :	**40%**

15AS304M	MULTI-DISCIPLINARY DESIGN	L	T	P	C
		2	2	0	3
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P PROFESSIONAL CORE				
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting – 23rd July, 2016				

PURPOSE	Students of any specialization at an undergraduate level learn courses related to various sub-domains (Multi-disciplinary) of their specialization individually. They are not exposed to understanding how the various multi-disciplinary fields interact and integrate in real life situations. It is very common that an expert in a particular domain models and designs systems or products oblivious of the impact of other subsystems. This lack of multi-disciplinary thinking is very blatantly visible when the students take up their major project during their final year. This course aims to develop appropriate skills on systemic thinking on how to identify and formulate a problem, decompose the problem into smaller elements, conceptualise the design, evaluate the conceptual design by using scientific, engineering and managerial tools, select, analyze and interpret the data, consideration of safety, socio-politico-cultural, risks and hazards, disposal, regional and national laws, costing and financial model and undertake documentation and finally presentation.

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able								
1.	To subdivide a complex system into smaller disciplinary models, manage their interfaces and reintegrate them into an overall system model	a	c	e	f	i	l	
2.	To rationalize a system architecture or product design problem by selecting appropriate design variables, parameters and constraints	a	c	e	f	i	l	
3.	To design for value and quantitatively assess the expected lifecycle cost of a new system or product	a	c	e	f	i	l	
4.	To take on the challenges of teamwork, prepare a presentation in a professional manner, and document all aspects of design work.	a	c	e	f	i	l	

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
1	Introduction: Facilitating Multidisciplinary Projects	4	C,D,I,O	1,2,3,4	
2	Identifying and formulating a problem	4			
3	System Modelling	4			
4	Thinking perspectives: Decomposition–Composition Thinking Hierarchical Thinking, Organizational Thinking, Life-Cycle Thinking, Safety Thinking, Risk Thinking, Socio-politico-cultural thinking, Environment thinking	4			
5	Decomposing a system – Identifying the major sub-systems	4			
6	Mathematical Modeling and Governing equations for each sub systems	4			
7	Objectives, Constraints and Design Variables	4			

8	Conceptual Design	4			
9	Collaborative Design – Disciplinary teams satisfy the local constraints while trying to match the global constraints set by	4			
10	Tools for modeling, designing, analysis, data interpretation, decision making etc	4			
11	Design Analysis, evaluation and selection	4			
12	Costing and Financial model	2			
13	Documentation, reviewing and presentation	4			
	Total contact hours	**60**			

LEARNING RESOURCES	
Sl. No.	**REFERENCES**
1.	*Systems Design and Engineering: Facilitating Multidisciplinary Development Projects* G. Maarten Bonnema, Karel T. Veenvliet, Jan F. Broenink December 15, 2015, CRC Press ISBN 9781498751261
2.	*Exploring Digital Design-Multi-Disciplinary Design Practices***,** Ina Wagner , Tone Bratteteig , Dagny Stuedahl, Springer-Verlag London, 2010, ISSN:1431-1496

Course nature						**Predominantly Practice complimented by theory**
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	Review 1	Review 2	Review 3	Review 4	**Total**
	Weightage	**10%**	**25%**	**25%**	**40%**	**100%**
End semester examination Weightage :						**0%**

Pedagogy:

Theme or major/broad domains will be announced by the department every semester. Multi-disciplinary designs will be made by the students in groups (group size may be decided by the course coordinator), with the topic of interest falling within the theme or major/broad domains as announced by the department, applying any combinations of the disciplines in engineering. 3D modelling and / or simulation must be used to validate the design.

In a combination of lecture and hands-on experiences, students must be exposed to understand and analyse engineering designs (or products) and systems, their realization process and project management. Analysis of the design criteria for safety, ergonomics, environment, life cycle cost and sociological impact is to be covered. Periodic oral and written status reports are required. The course culminates in a comprehensive written report and oral presentation. If required guest lecturers from industry experts from the sub-domains may be arranged to provide an outside perspective and show how the system design is being handled by the industry. The Conceive Design Implement Operate (CDIO) principles must be taught to the students.

A full-scale fabrication is not within the purview /scope of this course. Of course this design, if scalable and approved by the department, can be extended as the major project work

This course is 100% internal continuous assessment.

15AS376L	MINOR PROJECT - II	L	T	P	C
		0	0	3	2
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P PROFESSIONAL CORE				
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting – 23rd July, 2016				

PURPOSE	To obtain an hands-on experience in converting a small novel idea / technique into a working model / prototype involving multi-disciplinary skills and / or knowledge and working in at team.

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able								
1.	To conceptualise a novel idea / technique into a product	c						
2.	To think in terms of multi-disciplinary environment		d					
3.	To understand the management techniques of implementing a project				k			
4.	To take on the challenges of teamwork, prepare a presentation in a professional manner, and document all aspects of design work.			g				

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	An Multidisciplinary project to be taken up by a team of maximum of ten students. Development of prototype product, a 3D model, simulation, blueprint for a larger project and any other development work are permitted. The contribution of the individuals in the project should be clearly brought out. A combined report is to be submitted. A presentation is to be made for the reviewers on the work done by the candidate.	**30**	C,D,I	1,2,3,4	
	Total contact hours	**30**			

Course nature		**Project – 100% internal continuous assessment**	
Assessment Method (Weightage 100%)			
In-semester	**Assessment tool**	Refer the table	**Total**
	Weightage	Refer the table below	**100%**
End semester examination Weightage :			**0%**

Assessment components

Assessment component	Expected outcome	Evaluators	Criteria or basis	Marks
Project proposal (Review – I)	A short presentation to be delivered on: • A brief, descriptive project title (2-4 words). This is critical! • The 3 nearest competitors (existing solutions) and price. • Team members name, phone number, email, department/degree program, and year. • A description of the product opportunity that has been identified. To include: Documentation of the market need, shortcomings of existing competitive products, and definition of the target market and its size. • Proposed supervisor / guide	Panel of reviewers	Viability / feasibility of the project Extent of preliminary work done.	**0**
Review II	• Mission Statement / Techniques • Concept Sketches, Design Specifications / Modules & Techniques along with System architecture • Coding	Panel of reviewers	Originality, Multi-disciplinary component, clarity of idea and presentation, team work, handling Q&A.	**20**
Review III	• Final Concept and Model / Algorithm/ Technique • Drawings, Plans / programme output • Financial Model / costing • Prototype / Coding • Final Presentation and Demonstration	Panel of reviewers	Originality, Multi-disciplinary component, clarity of idea and presentation, team work, handling Q&A.	**50**
Final technical Report	A good technical report	Supervisor / Guide	Regularity, systematic progress, extent of work and quality of work	**30**
			Total	**100**

15AS381L	SEMINAR - II	L	T	P	C
		0	0	3	2
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P PROFESSIONAL CORE				
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting – 23rd July, 2016				

PURPOSE	To enhance the disseminating skills of the student about the current and contemporary research work that are being carried out across the world.

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able								
1.	To understand the research methodology adopted by various researchers	h	i	j				
2.	To mathematically model a problem, critically analyse it and adopt strategies to solve	b	c	e				
3.	To understand and present a well documented research	e	g					

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	Guidelines for conducting 15AS381L Seminar for B.Tech 1. Upon registering for the course the student must identify a sub-domain of the degree specialization that is of interest to the student and start collecting research papers as many as possible. 2. After collecting sufficient number of research papers the student must peruse all the papers, meet the course faculty and discuss on the salient aspects of each and every paper. 3. The course faculty, after discussion with the student will approve TWO research papers that is appropriate for presentation. 4. The student must collect additional relevant reference materials to supplement and compliment the two research papers and start preparing the presentation. 5. Each student must present a 15-minute presentation on each of the approved research paper to the panel of evaluators. 6. The presenter must present one research paper within the first half of the semester (6 weeks) and another research paper in the next half of the semester (6 weeks) as per the schedule. 7. All other students registered for the course will form the audience. 8. The audience as well as the evaluators will probe the student with appropriate questions and solicit response from the presenter. 9. The presentation will be evaluated against 7 to 8 assessment criteria by 4 to 5 evaluators. 10. The score obtained through the presentations of TWO research papers will be converted to appropriate percentage of marks. This course is 100% internal continuous assessment.	**30**	C,D	1,2,3,4	
	Total contact hours	**30**			

Course nature				**100% internal continuous assessment.**
Assessment Method (Weightage 100%)				
In-semester	**Assessment tool**	Presentation 1	Presentation 2	**Total**
	Weightage	**50%**	**50%**	**100%**
End semester examination Weightage :				**0%**

Department of Aerospace Engineering

EVALUATION OF SEMINAR PRESENTATIONS

Name of the Student: Date:

Register Number: Degree and Branch:

Topic:

Sl. No.	Criteria for Assessment	Evaluator 1	Evaluator 2	Evaluator 3	Evaluator 4	Evaluator 5
1	Understanding of the subject					
2	Clarity of presentation					
3	Appropriate use of Audio visual aids					
4	Whether cross references have been consulted					
5	Ability to respond to questions on the subject					
6	Time scheduling					
7	Completeness of preparation					

Poor	1	Below Average	2	Average	3	Good	4	Very Good	5

Overall Grades:

Remarks:

Signature of Course Coordinator :

15AS386L	MOOC - II	L	T	P	C
		0	0	3	2
Co-requisite:	NIL				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	P PROFESSIONAL CORE				
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting – 23rd July, 2016				

PURPOSE	To offer students the opportunity to study with the world's best universities by integrating select MOOCs in a regular degree programme and providing students full credit transfer, as per university regulations, if they earn a "Verified / Completion Certificate" and take a proctored examination through a secure, physical testing center.

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able								
1.	To apply the concepts, theories, laws, technologies learnt herein to provide engineering solutions.	f	h	i	j			

Course nature			**Online - 100% internal continuous assessment.**			
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	Quiz	Assignment	Non-proctored / Unsupervised Tests	Proctored / Supervised Test	**Total**
	Weightage	**25%**	**25%**	**10%**	**40%**	**100%**
End semester examination Weightage :						**0%**

Registration process, Assessment and Credit Transfer:

1. Students can register for courses offered by approved global MOOCs platforms like edX, Coursera or Universities with which SRM partners specifically for MOOCs.
2. Annually, each department must officially announce, to the students as well as to the Controller of Examinations, the list of courses that will be recognised and accepted for credit transfer.
3. The department must also officially announce / appoint one or more faculty coordinator(s) for advising the students attached to them, monitoring their progress and assist the department in proctoring the tests, uploading the marks / grades, and collecting and submitting the graded certificate(s) to the CoE, within the stipulated timeframe.
4. Student who desires to pursue a course, from the above department-approved list, through MOOCs must register for that course during the course registration process of the Faculty of Engineering and Technology, SRM University.
5. The maximum credit limits for course registration at SRM will include the MOOCs course registered.
6. The student must periodically submit the marks / grades obtained in various quizzes, assignments, tests etc immediately to the Faculty Advisor or the Course Coordinator for uploading in the university's academic module.
7. The student must take the final test as a Proctored / Supervised test in the university campus.
8. The student must submit the "Certificate of Completion" as well as the final overall Marks and / or Grade within the stipulated time for effecting the grade conversion and credit transfer, as per the regulations. It is solely the responsibility of the individual student to fulfil the above conditions to earn the credits.
9. The attendance for this course, for the purpose of awarding attendance grade, will be considered 100% , if the credits are transferred, after satisfying the above (1) to (7) norms; else if the credits are not transferred or transferable, the attendance will be considered as ZERO.

15AS491L	INDUSTRY MODULE - II	L	T	P	C
		0	0	3	2
Co-requisite:	NIL				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	P PROFESSIONAL CORE				
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting – 23rd July, 2016				

PURPOSE	To impart an insight into the current industrial trends and practices

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able								
1.	To obtain an insight into the current industrial trends and practices			j				
2.	To obtain an insight into the technologies adopted by industries			j				
3.	To obtain an insight into the technical problems encountered by the industries and the scope for providing solutions.		h					
4.	To network with industry	g						

Description of Topic	Contact hours	C-D-I-O	IOs	Reference
1.The department will identify and shortlist few emerging topics that are trending in industry. 2.The department will identify experts from industry who are willing to deliver modules on the shortlisted topics. 3.The identified expert will assist the department in formulating the course content to be delivered as a 30-hour module, prepare lectures notes, ppt, handouts and other learning materials. 4.The department will arrange to get the necessary approvals for offering the course, from the university's statutory academic bodies well before the actual offering. 5.The department must officially announce, to the students as well as to the Controller of Examinations, the list of courses that will be offered as industry module. 6.The department must also officially announce / appoint one or more faculty coordinator(s) for advising the students attached to them, monitoring their progress and assist the department in proctoring/supervising/assessment the quizzes, assignments, tests etc, uploading the marks, attendance etc, within the stipulated timeframe. 7.The Student who desires to pursue a course, from the above department-approved list, must register for that course during the course registration process of the Faculty of Engineering and Technology, SRM University. 8.The maximum credit limits for course registration at SRM will include the Industry Module also. 9.All academic requirements of a professional course like minimum attendance, assessment methods, discipline etc will be applicable for this Industry Module. 10The course will be conducted on week ends or beyond the college		C,D,I,O	1,2,3,4	
Total contact hours	**30**			

Course nature		**100% internal continuous assessment.**					
Assessment Method – Theory Component (Weightage 50%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage							**50%**

Year – IV / Semester –II Courses

15AS496L	MAJOR PROJECT	L	T	P	C
		0	0	24	12
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P	PROFESSIONAL CORE			
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting – 23rd July, 2016				

PURPOSE	The Major Project experience is the culminating academic endeavor of students who earn a degree in their Undergraduate Programs. The project provides students with the opportunity to explore a problem or issue of particular personal or professional interest and to address that problem or issue through focused study and applied research under the direction of a faculty member. The project demonstrates the student's ability to synthesize and apply the knowledge and skills acquired in his/her academic program to real-world issues and problems. This final project affirms students' ability to think critically and creatively, to solve practical problems, to make reasoned and ethical decisions, and to communicate effectively.

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able								
1.	To provide students with the opportunity to apply the knowledge and skills acquired in their courses to a specific problem or issue.	a	c		e	f		i
2.	To allow students to extend their academic experience into areas of personal interest, working with new ideas, issues, organizations, and individuals.	a	c		e	f		i
3.	To encourage students to think critically and creatively about academic, professional, or social issues and to further develop their analytical and ethical leadership skills necessary to address and help solve these issues.	a	c		e	f	h	i
4.	To provide students with the opportunity to refine research skills and demonstrate their proficiency in written and/or oral communication skills.	a	c		e	f	g	i
5.	To take on the challenges of teamwork, prepare a presentation in a professional manner, and document all aspects of design work.			d			g	

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	1. The Major project is a major component of our engineering curriculum: it is the culmination of the program of study enabling the students to showcase the knowledge and the skills they have acquired during the previous four years, design a product/service of significance, and solve an open-ended problem in engineering. 2. Each student must register to the project course related to his or her program 3. Major Project course consists of one semester and would be allowed to register only during the final year of study. 4. The Major Project may be initiated during the pre-final semester but will be assessed and credits transferred only during the last semester of study, upon completion of all other degree requirements. Generally the undergraduate major project is a team based one. 5. Each team in the major project course will consist of maximum of 5 students. 6. Each project will be assigned a faculty, who will act as the supervisor. 7. The project shall be driven by realistic constraints like that related to economic, environmental, social, political, ethical, health & safety, manufacturability and sustainability. 8. Each group must document and implement a management structure. Group leadership roles must be clearly identified including who has responsibility for monitoring project		C,D,I,O	1,2,3,4,5	
	9. A group project may be interdisciplinary, with students enrolled in different engineering degrees, or in Engineering plus other faculties such as Management, Medical and Health Sciences, Science and Humanities. 10. Each student team is expected to maintain a log book that would normally be used to serve as a record of the way in which the project progressed during the course of the session. 11. Salient points discussed at meetings with the supervisor (i.e., suggestions for further meetings, changes to experimental procedures) should be recorded by the student in order to provide a basis for subsequent work. 12. The logbook may be formally assessed; 13. The contribution of each individual team member will be clearly identified and the weightage of this component will be explicitly considered while assessing the work done. 14. A project report is to be submitted on the topic which will be evaluated during the final review. 15. Assessment components will be as spelt out in the regulations. 16. The department will announce a marking scheme for awarding marks for the different sections of the report. 17. The project report must possess substantial technical depth and require the students to exercise analytical, evaluation and				
	Total contact hours				

Course nature		Project – 100 % Internal continuous Assessment			
Assessment Method (Weightage 100%)					
In-semester	**Assessment tool**	Review 1	Review 2	**Review 3**	**Total**
	Weightage	**10%**	**15%**	**20%**	**45%**
End semester examination	**Assessment Tool**	**Project Report**	**Viva Voce**		
	Weightage :	**25%**	**30%**		**55%**

Year – II / Elective Courses

15AS211E	CREATIVITY, INNOVATION AND NEW PRODUCT DEVELOPMENT	L	T	P	C
		3	0	0	3
Co-requisite:	NIL				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	P Professional Elective				
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting 23rd July , 2016				

PURPOSE	To develop leadership qualities and creative thinking capability in Engineering Product Development.							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	To improve creativity and problem solving methods	a	d	e	f	g		
2.	To improve the knowledge in finding innovative approach to issues.	a	d	e	f	g		
3.	To equip themselves in skills of project selection	a	d	e	f	g		
4.	To understand Patent Laws and international practices.	a	d	e	f	g		
5.	To have expose to design, testing & quality standards in developing an aerospace prototype.	a	d	e	f	g		

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: INTRODUCTION	**9**			
1.	Introduction – The process of technological innovation; factors contributing to successful technological innovation.	2	C	1	1-8
2.	Technological milestones, their evolution	1	C	1	2,3
3.	The need for creativity and innovation for individual & nation.	1	C	1	1,2,3
4.	Creativity and problem solving – Obstacles, Keys & Questions.	2	C,D	1,2	1,2,8
5.	Brain storming – Different techniques for creative intelligence.	2	C,D	1,2	1,2,6,8
6.	Tutorial	1	C,D	1,2	8
	UNIT II: PROJECT SELECTION	**9**			
7.	Collection of ideas & categories / different routes	1	C	2	2,5,6,8
8.	Challenge the assumptions, Asking searching questions, Taking different views, Combining the unusual, Adapt, adopt & improve, Breaking the rules.	2	C,D	2	1,3,8
9.	Increasing the yield & Implementation methods	1	C,D	2	2
10.	Purpose and types, Indian National Technology Missions	2	C	2	1,3,6,8
11.	Selection criteria – Analysis methods.	2	C,D	2,3	2,8
12.	Tutorials	1	C,D	2,3	8,9

	UNIT III: PROJECT EVALUATION	**9**			
13.	Introduction to project evaluation & screening methods	1	C	2,3	2,3,8
14.	Product Lifecycle and different organizations	1	C,D,	2,3	2,3,6,8
15.	Product Evaluation Profile; Stability Factors.	2	C,D	2,3	2,3,5,8
16.	Growth factors & Marketability factors	1	C,D	3	2,3,5,8
17.	Research & Development factors	1	C,D	3	2,3,5,8
18.	Position factors & Production factors	1	C,D	3	2,3,5,8
19.	Value Engineering &Tutorials	2	C,D	I,3,3	1,2,3,8
	UNIT IV: NEW PRODUCT DEVELOPMENTS (IPR)	**9**			
20.	Evolution of IPR – 4 traditional forms	1	C	4	4,5
21.	Definition and development of 7 types of IPR.	1	C,D,	4	4,5
22.	Need for IPR in India; patentable innovation.	1	C,D	4	4,5
23.	Obligations and Enforcement measures.	1	C,D	4	4,5
24.	Patent search & its advantages IP council	1	C,D	4	4,5
25.	International treaties and conventions.	1	C,D	4	4,5
26.	WIPO , TRIPS,WTO & PCT.	2	C,D	4	4,5
27.	Tutorials	1	C,D	4	4,5
	UNIT V: NEW PRODUCT PLANNING	**9**			
28.	Design of aerospace prototype –requirement, design & process.	2	C,D	2,5	2,4,6,8
29.	Functional design and margins	1	C,D	2,5	2,4,6,8
30.	Test & Qualification - Types of tests. and their significance	1	C,D	2,5	2,4,6,8
31.	Test Plan and issues in concluding a test	1	C,D	2,5	2,4,6,8
32.	Quality standards and product strategy, six sigma practice	1	C,D	2,5	2,4,6,8
33.	Marketing - methods and research.	1	C,D	2,5	2,4,6,8
34.	Tutorials on product development	2	C,D,I	2,5	2,4,6,8
	Total contact hours*	45			

*Excluding Assessment hours

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	Osho: "*Creativity – Unleashing the Forces Within"*St Martin's Griffin, New York, March, 2007..
2.	Paul Sloane: "*The Leader's Guide to Lateral Thinking Skills"*, Second Edition,Kogan Page India, New Delhi, 2008.
3	Kelemen.A.L.: " *New Product Planning and Development"* International Correspondence Schools Division, Scraton, Pennsyvania, 1969.
4	Department of Space*: IPR Manual*, Bangalore, 2007

	REFERENCE BOOKS/OTHER READING MATERIAL
5.	Khandwalla, R.N.:"*Fourth Eye (Excellence through creativity)"* Wheeler Publishing, Allahabad, 1992.
6.	Abdul Kalam.A.P.J. Arun Tiwari: "*Wings of Fire*", Universities Press, Hyderabad, -500029. 1999.
7.	Edward de Bono: *"How to have a beautiful mind*",Vermilon, London, 2004.
8.	Annamalai.N. : "www.creativitysphere"
9	Rajiv.V.Dharaskar: "Innovation – Growth Engine for Nation. Nice Buzzword but often Misunderstood" www.dharaskar.com.

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Tutorial	**Total**
	Weightage	**10%**	**10%**	**20%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**

15AS212E	AIR TRANSPORTATION AND AIRCRAFT MAINTENANCE MANAGEMENT	L	T	P	C
		3	0	0	3
Co-requisite:	NIL				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	P Professional Elective				
Course designed by	Department of Aerospace Engineering				
Approval	31st Academic Council Meeting -2016				

PURPOSE	To familiarize the students with the knowledge about air transportation, its economic principles and scheduling and monitoring of aircraft maintenance.							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	To understand the organization details in air-transportation	c	f	h				
2.	To study the principles of airline scheduling	c	f	h				
3.	To understand the airline maintenance schedule and monitoring	c	f	h				

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: INTRODUCTION	**9**			
1.	Development Of Air Transportation	1	C		1
2.	Comparison Of Air Transportation With Other Modes Of Transport	1	C		1
3.	International Aviation Associations ICAO, IATA	1	C		1
4.	Factors Affecting General Aviation Industry	1	C		1
5.	Airline Management-Levels-Functions-Principle Of Organisation Planning	1	C		1
6.	The Organisational Chart	1	C		1
7.	Line Management	1	C		1
8.	Staff Management	1	C		1
9.	Tutorial	1	C		1
	UNIT II : AIRLINE ECONOMICS	**9**			
10.	Forecasting	1	C		1
11.	Fleet Planning, Aircraft Selection Process	1	C		1

12.	Operating Cost, Passenger Capacity, Load Factor Etc. Passenger Fare And Tariffs	1	C		1
13.	Influence Of Geographical, Economic And Political Factors On Routes And Route Selection	1	C		1
14.	Fleet Planning, Fleet Commonality, Factors Affecting Choice Of Fleet.	1	C		1
15.	Valuation And Depreciation -	1	C		1
16.	Budgeting, Cost Planning	1	C		1
17.	Aircrew Evaluation - Route Analysis - Aircraft Evaluation	1	C		1
18.	Tutorial	1	C		1
	UNIT III : PRINCIPLES OF AIRLINE SCHEDULING	**9**			
19.	Equipment Maintenance	1	C		1
20.	Flight Operations And Crew Scheduling	1	C		1
21.	Ground Operations And Facility Limitations	1	C		1
22.	Equipments And Types Of Schedule	1	C		1
23.	Hub And Spoke Scheduling, Advantages And Disadvantages	1	C		1
24.	Preparing Flight Plans	1	C		1
25.	Aircraft Scheduling In Line With Aircraft Maintenance Practices.	1	C		1
26.	Future of Aircraft maintenance	1	C		1
27.	Tutorial	1	C		1
	UNIT IV: AIRCRAFT RELIABILITY	**9**			
28.	Aircraft Reliability	1	C		2,3,4,5
29.	The maintenance schedule and its determinations	1	C		2,3,4,5
30.	Condition monitoring maintenance	1	C		2,3,4,5
31.	EROPS	1	C		2,3,4,5
32.	ETOPS	1	C		2,3,4,5
33.	Aging Aircraft maintenance	1	C		2,3,4,5
34.	Helicopter maintenance	1	C		2,3,4,5
35.	Current capabilities of NDT	1	C		2,3,4,5
36.	TUTORIAL	1	C		2,3,4,5

	UNIT 5: TECHNOLOGY IN AIRCRAFT MAINTENANCE	**9**			
37.	Airlines scheduling (w.r.to Engineering)	1	C		2,3,4,5
38.	Product support and spares	1	C		2,3,4,5
39.	Maintenance spares	1	C		2,3,4,5
40.	Equipments and tools for aircraft maintenance	1	C		2,3,4,5
41.	Aircraft weight control	1	C		2,3,4,5
42.	Budgetary control - Onboard maintenance systems	1	C		2,3,4,5
43.	Engine monitoring Turbine engine oil maintenance	1	C		2,3,4,5
44.	Turbine engine vibration monitoring	1	C		2,3,4,5
45.	Life usage monitoring	1	C		2,3,4,5
	Total contact hours *	45			

* Excluding Assessment hours

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	John G Wensveen . "*Air Transportation – A Management Prespective"* Ashgate Publications. 8th edition, 2015
2.	Friend C.H. "*Aircraft Maintenance Management*" Longman aviation technology. 2nd edition 1992
	REFERENCE BOOKS/OTHER READING MATERIAL
3.	*"Indian Aircraft Manual"*, DGCA, sterling book House, Mumbai, reprint 2014
4.	PS Senguttuvan." *Fundamentals of air transport management*", excel books, reprint 2010

Course nature			**Theory**				
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Tutorial	**Total**
	Weightage	**10%**	**10%**	**20%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**

15AS213E	AIRCRAFT GENERAL ENGINEERING AND MAINTENANCE PRACTICES			L	T	P	C
				3	0	0	3
Co-requisite:	Nil						
Prerequisite:	Nil						
Data Book / Codes/Standards	Nil						
Course Category	P	Professional Elective	Maintenance				
Course designed by	Department of Aerospace Engineering						
Approval	Academic Council Meeting 23rd July, 2016						

PURPOSE	To make the students to understand the basic concepts of aircraft general engineering and maintenance practices.

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student should be able								
1.	To familiarize with ground handling of aircraft, Engine starting procedures and special procedures such as Mooring, jacking, levelling and towing operations.	a	e					
2.	To familiarize with ground servicing of Air conditioning and pressurization systems.	a		f				
3.	To familiarize with Shop safety and Environmental cleanliness.	a		f				
4.	To familiarize with FAA airworthiness regulations and check list involved in each inspection of aircraft.	a	e					
5.	To familiarize with terminology involved in aircraft hardware selection, identification of fluid line fittings.	a	e					

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: AIRCRAFT GROUND HANDLING AND SUPPORT EQUIPMENT	**9**			
1.	Mooring, jacking, levelling and towing operations – Preparation – Equipment – precautions.	3	C	1	1,2
2.	Engine starting procedures – Piston engine, turboprops and turbojets.	3	C	1	1,2
3.	Engine fire extinguishing.	1	C	1	1,2
4.	Ground power units.	2	C	1	1,2
	UNIT II: GROUND SERVICING OF VARIOUS SUB SYSTEMS	**8**			
5.	Air conditioning and pressurization.	3	C	2	1,2
6.	Oxygen and oil systems.	3	C	2	1,2
7.	Ground units and their maintenance.	2	C	2	1,2
	UNIT III: MAINTENANCE OF SAFETY	**6**			
8.	Shop safety.	2	C	3	1,2,3
9.	Environmental cleanliness.	2	C	3	1,2,3
10.	Precautions.	2	C	3	1,2,3
	UNIT IV: INSPECTION	**10**			
11.	Inspection Process, Purpose, Types.	2	C	4	1,2,3
12.	Inspection intervals – Techniques – Checklist	2	C	4	1,2,3
13.	Special inspection – Publications, bulletins, various manuals – FAR Air worthiness directives.	3	C	4	1,2,3
14.	Type certificate Data Sheets – ATA specifications.	3	C	4	1,2,3
	UNIT V: AIRCRAFT HARDWARE, MATERIALS, SYSTEMS PROCESSES	**12**			
15.	Hand tools – Precision instruments – Special tools and equipments in an airplane maintenance shop.	3	C	5	1,3
16.	Identification terminology – Specification and correct use of various aircraft hardware (i.e. nuts, bolts, rivets, screws etc.)	3	C	5	1,3

17.	American and British systems of specifications – Threads, gears, bearings, etc. – Drills, tapes & reamers – Identification of all types of fluid line fittings.	3	C	5	1,3
18.	Materials, metallic and non-metallic - Plumbing Connectors - Cables – Swaging procedures, tests, Advantages of swaging over splicing.	3	C	5	1,3
	Total contact hours *	45			

* Excluding Assessment hours

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	Michael J.Kroes, William A.Watkins ad Frank Delp, "*Aircraft Maintenance and Repair*", Tata McGraw Hill Education Private Limited, Seventh Edition, New Delhi, 2013.
	REFERENCE BOOKS/OTHER READING MATERIAL
2.	Airframe and Power plant Mechanics, *"Aircraft hand Book*" Federal Aviation Administration, Shroff publishers and distributors Pvt. Ltd. New Delhi 2010.
3.	Airframe and Power plant Mechanics, *"General hand Book*" Federal Aviation Administration, Shroff publishers and distributors Pvt. Ltd. New Delhi 2010.

Course nature			**Theory**				
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
					End semester examination Weightage :		**50%**

Year – III / Elective Courses

15AS311E	FLOW VISUALIZATION TECHNIQUES	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Elective	Aerodynamics			
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting 23rd July , 2016				

PURPOSE	To introduce the basic concepts of different flow visualization techniques on models during the low as well as high speed wind tunnel testing.

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, learner will be able to								
1.	Understand about the basics and types of flow visualization	a	b	c	e			
2.	Understand the features of high speed flow visualization and their complexity in operation	a	b		e			
3.	To familiarize about the various ways of fluid measurement using optical methods	a	b	c	e			
4.	To familiarize about the various ways of flow vizualization	a	b					
5.	To understand the idea of Digital Particle Image velocimetry	a	b		e			

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: Dye and smoke visualization	**11**			
1.	Introduction	2	C	1	1,2
2.	Flow visualization in water	2	C	1	1,2
3.	Flow visualization in Air	4	C	1,2	1,2
4.	Photographic equipments and techniques	1	C	1,2	1,2,3
5.	Safety	2	C	1,2	1,2
	UNIT II: Pressure and shear sensitivity coating	**9**			
6.	Introduction	4	C	2	1,2
7.	Pressure sensitive paints	2	C	2	1,2
8.	Shear sensitive liquid crystal coating method	2	C	2	1,2
9.	Fringe imaging skin friction interferometer	1	C	2	1,2

	UNIT III: compressible flow visualization	**7**			
10.	Basic optical concepts	2	C	3	3
11.	Shadowgraph -Schleiren	1	C	3	3
12.	Interferometer - Mach Zehnder interferometry	2	C	3	3
13.	Holographic interferometry - Recent developments	2	C	3	3
	UNIT IV: Digital Particle Image Velocimetry	**8**			
14.	Introduction - Experimental setup	2	C	4	1,3
15.	Image correlation - video imaging	2	C	4	1,3
16.	Post processing - sources of error – applications	4	C	4	1,3
	UNIT V: Other Visualization Techniques	**10**			
17.	Hydrogen Bubble	3	C	5	1,2
18.	Molecular tagging velocimetry and thermometry	4	C	5	1,2
19.	Surface temperature sensing - Three dimensional Imaging	3	C	5	1,2
	Total contact hours*	45			

*Excluding Assessment hours

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	Flow Visualization: Techniques and Examples "Alexander J Smits & T T Lim" Imperial college press, 2012
2.	Instrumentation, Measurements, and Experiments in Fluids "E.Rathakrishnan" CRC Press
	REFERENCE BOOKS/OTHER READING MATERIAL
1.	Schlieren and Shadowgraph Techniques: Visualizing Phenomena in Transparent Media "G.S. Settles" Springer

Course nature		**Theory**					
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
					End semester examination Weightage :		**50%**

15AS312E	INDUSTRIAL AERODYNAMICS	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	15AS204J				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Elective	Aerodynamics			
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting, 23rd July 2016				

PURPOSE	To familiarize the student with non-aeronautical uses of aerodynamics such as road vehicles and building aerodynamics and problems of flow induced vibrations.							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	To offers an introduction to industrial aerodynamics and wind engineering with the main characteristics of natural winds.	a	c	d	e			
2.	To impart knowledge of external and internal pressures and forces on buildings and vehicles with emphasis on design significance.	a	c	d	e			

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: ATMOSPHERE	**9**			
1.	Introduction to Atmospheric Circulations	1	C,D	1	1,2,3,4
2.	Local winds &Terrain types	1	C	1	1,2,3,4
3.	Mean velocity Profiles	2	C,D	1	1,2,3,4
4.	Power law logarithm law	2	C,D	1	1,2,3,4
5.	Roughness Parameters	1	C	1	1,2,3,4
6.	Simulation techniques in wind Tunnels	2	C	1	1,2,3,4
	UNIT II: WIND ENERGY COLLECTORS	**9**			
7.	Horizontal axis and vertical axis machines	2	C	1	1,2,3,4
8.	Energy density of different rotors	2	C,D	1	1,2,3,4
9.	Power coefficient	2	C,D	1	1,2,3,4
10.	Betz coefficient by momentum theory	3	C,D	1	1,2,3,4
	UNIT III: VEHICLE AERODYNAMICS	**9**			
11.	Boundary layers and separation	1	C	2	1,2,3,4
12.	Two dimensional wake and vertex formation	1	C	2	1,2,3,4

13.	Strouhal and Reynolds numbers	1	C,D	2	1,2,3,4
14.	Separation and reattachments	2	C	2	1,2,3,4
15.	Power requirements and drag coefficients of automobiles	2	C,D	2	1,2,3,4
16.	Effect of cut back angle, Aerodynamics of Trains	2	C,D	2	1,2,3,4
	UNIT IV: BUILDING AERODYNAMICS	**9**			
17.	Pressure distribution on low rise buildings	2	C	2	1,2,3,4
18.	wind forces on buildings	1	C	2	1,2,3,4
19.	Environmental winds in city blocks	1	C	2	1,2,3,4
20.	Special problems of tall buildings	2	C,D	2	1,2,3,4
21.	Building codes, ventilation and architectural aerodynamics	3	C	2	1,2,3,4
	UNIT V: FLOW INDUCED VIBRATIONS	**9**			
22.	Vortex shedding & Effects of Reynolds number on wake formation of bluff shapes	3	C	1,2	2,4,5
23.	Wake Galloping	2	C	2	2,4,5
24.	Oscillation of tall structure and launch vehicles under wind loads	2	C	2	2,4,5
25.	stall flutter	2	C	2	2,4,5
	Total contact hours*	45			

*Excluding Assessment hours

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	M.Sovran (Ed), *"Aerodynamics and drag mechanisms of bluff bodies and road vehicles",* Plenum press, New York, 1978.
2.	P. Sachs, *"Winds forces in engineering",* Pergamon Press, 1978.
	REFERENCE BOOKS/OTHER READING MATERIAL
3.	Scorer R.S *"Environmental Aerodynamics"*, Ellis Harwood Ltd, England, 1978
4.	R.D. Blevins, *"Flow induced vibrations"*, Van Nostrand, 2nd edition 2014.
5.	N.G. Calvent, *"Wind Power Principles"*, Charles Griffin & Co., London, 1979.

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**

15AS313E	APPLIED STRUCTURAL MECHANICS	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	15AS205J				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Elective	STRUCTURE			
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting, 23rd July 2016				

PURPOSE	To acquire analytical ability in solving structural related problems.

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, learner will be able to		a	b	e				
1.	Understand about the general loads on aircraft.	a	b	e				
2.	Improve their ability in solving statically indeterminate beams.	a	b	e				
3.	Equip themselves familiar with strain energy methods.	a	b	e				
4.	Familiarize with the buckling of columns.	a	b	e				
5.	Expose to the concept of applications of failure theories.	a	b	e				

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: GENERAL LOADS ON AIRCRAFT	**9**			
1.	Introduction to limit loads, design loads and factor of safety.	1	C	1	1&2
2.	Broad classification of external loads on a conventional aircraft and discussion on V-n diagram	1	C	1	1&2
3.	Problems involving accelerated motion of rigid airplane.	3	C,D	1	1&2
4.	Problems of calculating reactions and loads on member of landing gear units.	4	C,D	1	1&2
	UNIT II: ANALYSIS OF STATICALLY INDETERMINATE BEAMS	**9**			
5.	Continuous beam concept. Derivation of Clapeyron's equation of three moments.	1	C	2	1&2
6.	Application of Clapeyron's equation of three moments to continuous beam with simply supported ends.	1	C,D	2	1&2
7.	Application of Clapeyron's equation of three moments to continuous beam with fixed end supports.	2	C,D	2	1&2
8.	Application of Clapeyron's equation of three moments to continuous over-hanging beam.	1	C,D	2	1&2
9.	Derivation for Moment distribution method, stiffness factor, Distribution factor.	1	C	2	1&2
10.	Application of Moment distribution method to continuous beam with simply supported ends.	1	C,D	2	1&2
11.	Application of Moment distribution method to continuous beam with fixed end supports.	1	C,D	2	1&2

12.	Application of Moment distribution method to continuous over-hanging beam.	1	C,D	2	1&2
	UNIT III: ENERGY METHODS	**9**			
13.	Derivation of Strain Energy stored due to axial, bending and Torsional loads.	1	C	3	1&2
14.	Derivation of Castigliano's theorem I and II, Maxwell's Reciprocal theorem	2	C	3	1&2
15.	Application of Castigliano's theorem – I to find deflection of beams and rings.	3	C,D	3	1&2
16.	Application of Castigliano's theorem – II to find deflection of trusses, unit load method to find member forces in a single and double redundant trusses/frames.	3	C,D	3	1&2
	UNIT IV: COLUMNS	**9**			
17.	Introduction to columns and its classification. Buckling load, factor of safety. Euler's theory for long columns.	1	C	4	1&2
18.	Assumptions followed in Euler's theory for long columns. Different end conditions of a column, Limitations of Euler's formula, concept of buckling stress.	1	C	4	1&2
19.	Derivation of Euler's formula for different end conditions	2	C,D	4	1&2
20.	Problems to solve for crippling load using Euler's formula	2	C,D	4	1&2
21.	Derivation: Column with initial curvature and Eccentric loading and related problems	1	C,D	4	1&2
22.	Rankine's theory and related problems and beam columns.	2	C,D	4	1&2
	UNIT V: FAILURE THEORIES	**9**			
23.	Introduction to failure theories and discussion about different materials and its properties	2	C	5	1&2
24.	Maximum Principal stress theory : derivation and problems	1	C,D	5	1&2
25.	Maximum Principal strain theory : derivation and problems	1	C,D	5	1&2
26.	Maximum Shear stress theory : derivation and problems	1	C,D	5	1&2
27.	Maximum strain energy theory : derivation and problems	1	C,D	5	1&2
28.	Maximum shear strain energy theory or Energy of Distortion theory - derivation and problems	1	C,D	5	1&2
29.	Application of above theories to aircraft Structural problems	2	C,D	5	1&2
	Total contact hours *	45			

*Excluding Assessment hours

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	Bansal, R.K., *"Strength of Materials"*, Lakshmi Publications Pvt. Limited, New Delhi, 2010.
2.	Bhavikatti.S.S, "*Structural Analysis",Vol-2*, E-2, Vikas Publishing House Pvt Limited, 2009.
	REFERENCE BOOKS/OTHER READING MATERIAL
3.	Punmia.B.C, Ashok Kumar Jain, Arun Kumar Jain, "*Theory of Structures"*, Laxmi Publications, New Delhi, 12th Edition, 2004
4.	Bruhn. E.F., *'Analysis and Design of Flight Vehicles Structures'*, Tri-state offset company, USA, 1985.

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
					End semester examination Weightage :		**50%**

15AS314E	EXPERIMENTAL STRESS ANALYSIS			L	T	P	C
				3	0	0	3
Co-requisite:	Nil						
Prerequisite:	15PY101, 15AS205J						
Data Book / Codes/Standards	Nil						
Course Category	P	Professional Elective	STRUCTURES				
Course designed by	Department of Aerospace Engineering						
Approval	Academic Council Meeting, 23rd July 2016						

PURPOSE	To familiarize the students with various strain measurements and non- destructive testing techniques.							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
This course will enable the students to know more about								
1.	Principles of measurement	a	e					
2.	Different strain measuring instruments.	a	e	k				
3.	Electrical resistance strain gage and related materials for gage construction	a	e	k				
4.	Principle of photoelasticity and related techniques for stress measurements	a	e	k				
5.	Different non-destructive testing methods	a	k					

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: MEASUREMENTS	**9**			
1.	Principles of measurements	2	C	1	3
2.	Range and Accuracy of measurements	2	C	1	3
3.	Sensitivity of Measurements	2	C	1	3
4.	Error Analysis	2	C	1	3
	UNIT II: EXTENSOMETERS	**8**			

5.	Mechanical Strain Gauges	2	C	2	1,4
6.	Optical Strain Gauges	2	C	2	1,4
7.	Electrical Strain Gauge	2	C	2	1,4
8.	Acoustical Strain Gauge	1		2	1,4
	UNIT III: ELECTRICAL RESISTANCE STRAIN GAUGES	**10**			
9.	Principle of Operation and Requirements, Types and their uses, Materials for strain gage	2	C	3	1,4
10.	Calibration and Temperature Compensation, Cross-Sensitivity	1	C	3	1,4
11.	Circuits for Static and Dynamic Strain Measurements, Strain Indicators	3	C	3	1,2,4
12.	Rosette Analysis	3	C-D	3	1,2,4
	UNIT IV: PHOTOELASTICITY	**9**			
13.	Concepts of light, Photoelastic effects, stress optic law	2	C	4	1,2
14.	Interpretation of fringe pattern	3	C	4	1,2
15.	Compensation and Separation Techniques	2	C	4	1,2
16.	Photoelastic materials.	1	C	4	1,2
	UNIT V: NON-DESTRUCTIVE TESTING	**9**			
17.	Fundamentation of NDT, Radiography, Magnetic Particle Inspection	2	C	5	5
18.	Ultrasonic Testing, Fluorescent Penetrant Technique	2	C	5	5
19.	Eddy Current Testing, Acoustic Emission Technique, Thermography	2	C	5	5
20.	Fundamentals of brittle coating methods, Introduction to Moire Techniques, holography	2	C	5	5
	Total contact hours*	45			

*Excluding Assessment hours

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	Dally, J. W., and Riley, W. F., *Experimental Stress Analysis*, McGraw Hill Inc., New York, 1978
2.	Srinath, L. S., Raghava, M.R., Lingaiah, K.Gargesha, G.Pant B., and Ramachandra, K., *Experimental Stress Analysis*, Tata McGraw Hill, New Delhi, 1984
3.	Thomas G Beckwith, Roy D.Marangoni, John H.Lienhard V, *Mechanical measurements* ,Pearson, 2007.
	REFERENCE BOOKS/OTHER READING MATERIAL
4.	Hetyenyi, M., *Hand Book of Experimental Stress Analysis*, John Wiley and Sons Inc., New York, 1972
5.	Adrian P. Mouritz, *"Introduction to Aerospace Materials"* Woodhead Publishing Limited, 2012

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
					End semester examination Weightage :		**50%**

15AS315E	COMPOSITE MATERIALS & STRUCTURES			L	T	P	C
				3	0	0	3
Co-requisite:	Nil						
Prerequisite:	15AS205J						
Data Book / Codes/Standards	Nil						
Course Category	P	Professional Elective	STRUCTURES				
Course designed by	Department of Aerospace Engineering						
Approval	Academic Council Meeting, 23rd July 2016						

PURPOSE	This course is designed to provide a broad overview of analysis of stress, strain and fabrication of composite materials							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Work on various composite materials	a						
2.	Fabricate different composite materials	a						
3.	Analyze different composite materials	a						
4.	Derive the governing equation of composite materials	a						
5.	Design and analysis of sandwich composites	a						

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: STRESS STRAIN RELATION	**9**			
1.	Introduction	1	C	1-4	1-7
2.	Advantages and application of composites	2	C	1	1,3,4,6
3.	Reinforcements and Matrices,	1	C,D	1	1,3,4,6
4.	Generalized Hooks law- Elastic constants for anisotropic , orthotropic and isotropic materials	5	C,D	1	1,3,4,6
5.	**UNIT II: METHODS OF ANALYSIS**	**9**			
6.	Micromechanics- Mechanics of materials approach and Elasticity approach to determine material properties	3	C	2	1,3,4,6
7.	Macro mechanics, stress strain relationship with respect to neutral axis, arbitrary axis	4	C,D	2	1,3
8.	Determination of material properties	1	C,D	2	1,3,
9.	Experimental characterization of lamina	1	C,D		
	UNIT III: LAMINATED PLATES	**9**			
10.	Governing differential equation of general laminate	3	C,D	4	2,5,7
11.	Angle and cross ply laminates	3	C,D	4	2,5,7,1
12.	Failure Criteria of composites	3	C,D		1,2

	UNIT IV: SANDWICH CONSTRUCTION	**9**			3.6
13.	Basic design concept of sandwich construction	4	C	4	7
14.	Materials used for sandwich construction	3	C,D	4	1
15.	Failure modes of sandwich panels	2	C,D	4	4,5
	UNIT V: FABRICATION PROCESS	**9**			
16.	Various open and closed mould process, Manufacture of fibers	6	C,D	4	3,4
17.	Types of resins, Properties and application	2	C	4	4
18.	Netting analysis	1	C	4	2,3
	Total contact hours *	45			

*Excluding Assessment hours

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	Autar K Kaw, *"Mechanics of Composite Materials"* CRC Press, Taylor and Francis Group
2.	Jones.R.M, *"Mechanics of Composite Materials",* McGraw-Hill, Kogakusha Ltd., Tokyo, 1985.
	REFERENCE BOOKS/OTHER READING MATERIAL
3.	Calcote.L.R, *"The Analysis of laminated Composite Structures",* Von – Noastrand Reinhold Company, New York 1998.
4.	Agarwal.B.D, and Broutman.L.J, "*Analysis and Performance of Fibre Composites",* John Wiley and sons. Inc., New York, 1995.
5.	Lubin.G, *"Handbook on Advanced Plastics and Fibre Glass"*, Von Nostrand Reinhold Co., New York, 1989

Course nature		**Theory**					
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**

15AS316E	THEORY OF PLATES AND SHELLS			L	T	P	C
				3	0	0	3
Co-requisite:	Nil						
Prerequisite:	15AS205J						
Data Book / Codes/Standards	Nil						
Course Category	P	Professional Elective	STRUCTURES				
Course designed by	Department of Aerospace Engineering						
Approval	Academic Council Meeting, 23rd July 2016						

PURPOSE	To study the behavior of the plates and shells with different geometry under various types of loads.

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will familiarize with								
1.	Different types of plates based on bending properties	a	e					
2.	Application of governing equation to bending of plates of various shapes	a	e					
3.	Vibration analysis of plates	a	e					
4.	Numerical methods for plate analysis	a	e					
5.	Theory of shells	a	e	k				

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: CLASSICAL PLATE THEORY	**8**			
1.	Classical Plate Theory – Assumptions	2	C,D	1	1
2.	Classical Plate Theory –Differential Equation, Boundary Conditions.	3	C,D	1	1,2
3.	Navier's Method of Solution for Simply Supported Rectangular Plates	4	C,D	1	1,2
	UNIT II: PLATES OF VARIOUS SHAPES	**10**			
4.	Leavy's Method of Solution for Rectangular Plates under Different Boundary Conditions. Governing Equation	3	C,D	2	1,2

5.	Solution for Axi-symmetric loading	2	C,D	2	1,3
6.	Annular Plates	3	C,D	2	1,3
7.	Plates of other shapes	2	C,D	2	1,3
	UNIT III: EIGEN VALUE ANALYSIS	**8**			
8.	Stability of Rectangular Plates.	4	C,D	3	1,3,5
9.	Free Vibration Analysis of Rectangular Plates.	4	C,D	3	1,3,5
	UNIT IV: APPROXIMATE METHODS	**10**			
10.	Rayleigh – Ritz Method	2	C	4	1,3
11.	Galerkin Methods	2	C,D	4	1,3
12.	Finite Difference Method	2	C,D	4	1,3
13.	Application to Rectangular Plates for Static, Free Vibration and Stability Analysis.	4	C,D	4	1,3
	UNIT V: SHELLS	**9**			
14.	Basic Concepts of Shell Type of Structures	3	C,D	5	2
15.	Membrane and Bending Theories for Circular Cylindrical Shells.	6	C	5	2,4
	Total contact hours*	45			

*Excluding Assessment hours

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	Timoshenko, S.P. Winowsky. S., and Kreger, “Theory of Plates and Shells”, McGraw-Hill Book Co. 1990.
2.	T. K. Varadan and K. Bhaskar, “Theory of Plates and Shells”,1999, Narosa.
3.	Edvard Ventsel, Theodor Krauthammer, ‘Thin plates and shells-theory, analysis and applications”
	REFERENCE BOOKS/OTHER READING MATERIAL
4.	Flugge, W. “Stresses in Shells”, Springer – Verlag, 1985.
5.	Timoshenko, S.P. and Gere, J.M., “Theory of Elastic Stability”, McGraw-Hill Book Co. 1986

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**

15AS317E	THEORY OF ELASTICITY	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	15AS303J				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Elective	STRUCTURE			
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting, 23rd July 2016				

PURPOSE	To familiarize the students in the area of fatigue and fracture mechanics							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, learner will be able to		a	b	e				
1.	Understand the various assumptions in solving elasticity problems, Equations of equilibrium	a	b	e				
2.	Familiarize with stress-strain relations, strain-displacement relations, compatibility equations	a	b	e				
3.	Understand the solutions by polynomials, stresses , displacements for beams subjected to different loads	a	b	e				
4.	Familiarize with problems in polar coordinates for axisymmetric problems	a	b	e				
5.	Expose to various theories of torsion and applications of shafts of various cross-sections	a	b	e				

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: ASSUMPTIONS IN ELASTICITY	**9**			
1.	Introduction	1	C	1	1-2
2.	Definitions for stress and strain	1	C	1	1-2
3.	Sign conventions, notations for stress	1	C	1	1-2
4.	Sign conventions, notation for strain	1	C,D	1	1
5.	Component of strain	1	C	1	1-2
6.	Component of stress	1	C,D	1	1
7.	Hooke's law, problems	1	C,D	1	1-2
8.	Equations of equilibrium-2D	1	C	1	1-2
9.	Equations of equilibrium-3D	1	C,D	1	1-2
	UNIT II: EQUATIONS OF ELASTICITY	**9**			
10.	Introduction	1	C	2	1-2

11.	Strain-Displacement Relations	1	C	2	1-2
12.	Stress-Strain Relations	1	C,D	2	1-2
13.	Lame's constant-cubical dilatation	1	C	2	1-2
14.	Compressibility of material, Bulk modulus	1	C,D	2	1
15.	Compatibility equations for stresses	1	C	2	2
16.	Compatibility equations for strain	1	C	2	2
17.	Principal stresses and strain, Mohr's circle	1	C,D	2	2
18.	Saint Venant's principle, Theories of failure	1	C,D	2	1-2
	UNIT III: PLANE STRESS AND PLANE STRAIN PROBLEMS	**9**			
19.	Airy's stress function	1	C	3	1-2
20.	Inharmonic Equations	1	C	3	1
21.	Polynomial solutions of second degree	1	C	3	1
22.	Polynomial solutions of third degree	1	C,D	3	1
23.	Polynomial solutions of fourth degree	1	C	3	1
24.	Simple two dimensional problems in Cartesian coordinates like bending of cantilever beams determination of stresses	1	C	3	1
25.	Simple two dimensional problems in Cartesian coordinates like bending of cantilever beams determination of slope and deflections	1	C	3	1
26.	Simple two dimensional problems in Cartesian coordinates like bending of simply supported beams determination of stresses	1	C	3	1
27.	Simple two dimensional problems in Cartesian coordinates like bending of simply supported beams determination of slope and deflection	1	C	3	1
	UNIT IV: POLAR CORDINATES	**9**			
28.	Equations of equilibrium in polar coordinates	1	C	4	1
29.	Strain-displacement relations, Stress-strain relations	1	C	4	1
30.	Stress distribution symmetrical about an axis	1	C,D	4	1
31.	Stress distribution in pure bending of curved bars	1	C	4	1

32.	Displacement for symmetrical stress distribution	1	C,D	4	1
33.	Stress distribution in a rotating disc	1	C	4	1
34.	Bending of curved bar by a force at the end	1	C,D	4	1
35.	Kirch, Michell's and Boussinesque problems	1	C,D	4	1
36.	Kirch, Michell's and Boussinesque problems	1	C	4	1
	UNIT V: TORSION	**9**			
37.	Introduction	1	C	5	1
38.	Navier's theory of torsion	1	C	5	1-2
39.	St.Venant's theory of torsion	1	C	5	1-2
40.	Prandtl's theory of torsion	1	C	5	1-2
41.	Semi-inverse method	1	C	5	1-2
42.	Application of shafts to circular cross sections	1	C	5	1
43.	Application of shafts to elliptical cross sections	1	C	5	1
44.	Application of shafts to equilateral triangular cross sections	1	C	5	1
45.	Application of shafts to rectangular cross sections	1	C	5	1
	Total contact hours*	45			

*Excluding Assessment hours

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	Timoshenko,S and Goodier, T.N., *Theory of Elasticity*, McGraw-Hill Ltd., Tokyo,1990
2.	Enrico Voltorra and J.H.Caines, *Advanced Strength of Materials*, Prentice Hall, New Jersey,1991.
	REFERENCE BOOKS/OTHER READING MATERIAL
3.	Wang, C.T., *Applied Elasticity,* McGraw-Hill Co., New York, 1993
4.	Sokolnkoff, IS., *Mathematical Theory of Elasticity*, McGraw-Hill., New York, 1978

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**

15AS318E	FUNDAMENTALS OF COMBUSTION	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	15AS201J, 15AS202				
Data Book	Thermodynamic Properties Table of C-H-N-O system				
Course Category	P Professional Elective	PROPULSION			
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting, 23rd July 2016				

PURPOSE	To impart the knowledge on combustion phenomena and calculation of important combustion parameters.							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Understand the combustion phenomena	a						
2.	To calculate the fundamental combustion parameters	a	e					
3.	To solve diffusion mass transfer problems	a	e					
4.	Understand the chemical kinetics and chemical mechanisms	a						
5.	To understand flame speed and various methods of measuring flame speed	a						
6.	To understand premixed and diffusion flames.	a						

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: INTRODUCTION TO COMBUSTION	**14**			
1.	Introduction, fuel and oxidizer, various modes of combustion and Applications of combustion.	2	C	1	1,3
2.	**Combustion and thermo chemistry -** Review of property relations-Laws of thermodynamics-Reactant and product mixtures - Stoichiometry	6	C	2	1,2,3,4,5
3.	Heat of combustion -Adiabatic flame temperature-Chemical equilibrium	6	C	2	1,2,3
	UNIT II MASS TRANSFER IN COMBUSTION	**8**			
4.	Introduction to diffusion mass transfer	1	C	2	1,3
5.	Transport properties for gas mixtures	1	C	2	3
6.	Mass transfer laws	2	C	2	1,2,3
7.	Mass transfer problems	4	C,D	2	1,3
	UNIT III: CHEMICAL KINETICS	**6**			
8.	Introduction to rate of reaction	1	C	3	1,2,3,4,5
9.	Rate laws and approximations	3	C,D	3	1,3
10.	Reaction mechanisms	2	C,D	3	1
	UNIT IV: PREMIXED FLAMES	**9**			
11.	Introduction	1	C	6	1,2,3,4,5
12.	Physical description	2	C	6	1,3
13.	Simplified analysis	2	C	6	1,3

14.	Flame velocity- Factors affecting flame velocity-Methods of measuring flame velocity.	2	C,D	5,6	1,3,4
15.	Flammability limit-Flame stabilization	2	C	6	1,3
	UNIT V: DIFFUSION FLAMES	**8**			
16.	Introduction	1	C	6	1,2,3,4,5
17.	Conservation laws	1	C	6	1,2,3,4,5
18.	Jet flame physical description	1	C	6	1,3
19.	Theoretical description	1	C	6	1,2,3,5
20.	Counterflow flames	1	C	1,6	1
21.	Droplet evaporation and burning	1	C,D	1,6	1,2,3
22.	Spray combustion model	1	C,D	1,6	1
23.	Burning of solids	1	C,D	1,6	1
	Total contact hours*	45			

*Excluding Assessment hours

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	Stephen R. Turns, "*An Introduction to Combustion: Concepts and Applications",* McGraw-Hill Education, third Edition , 2011.
2.	Kenneth K Kuo " *Principles of Combustion*" second Edition, John Wiley and Sons, 2005.
	REFERENCE BOOKS/OTHER READING MATERIAL
3.	D.P.Mishra, " *Fundamentals of Combustion*", Prentice Hall of India, New Delhi, 2008
4.	H.S. Mukunda "*Understanding Combustion*" Universities Press, Second edition 2009.
5.	Anil W. Date, "*Analytic Combustion: With Thermodynamics, Chemical Kinetics and Mass Transfer*", Cambridge University Press, 2011.

Course nature			**Theory**				
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
					End semester examination Weightage :		**50%**

15AS319E	HEAT TRANSFER	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	15AS201J, 15AS202				
Data Book / Codes/Standards	C P Kothandaraman,.*Heat and mass transfer data book*, New Age International Publishers, Eighth Edition, 2014				
Course Category	P Professional Elective	Propulsion			
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting, 23rd July 2016				

PURPOSE	To familiarize the student in the area of conduction, convection and radiation.

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
This course will enable the students to know more about								
1.	To familiarize on the various modes of heat transfer.	a	e					
2.	To solve the heat transfer problem	a	e	k				

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: INTRODUCTION TO HEAT TRANSFER & STEADY STATE CONDUCTION.	**9**			
1.	Different modes of heat transfer and general principles	1	C	1	1,5
2.	Introduction to Conduction – Heat diffusion equation	2	C	1	1,5
3.	One-Dimensional, Steady-State Conduction – plane wall.	4	C,D	2	1,5
4.	One-Dimensional, Steady-State Conduction – Radial systems	2	C,D	2	1,5
	UNIT II: CONDUCTION : ENERGY GENERATION, EXTENDED SURFACE & TRANSIENT CONDUCTION	**10**			
5.	Conduction with Thermal Energy Generation – Plane wall & radial systems	3	C,D	1,2	1,5
6.	Heat Transfer from Extended Surfaces - Fins of Uniform Cross-Sectional Area, Fin Performance, Overall Surface Efficiency	3	C,D	1,2	1,5

7.	Transient Conduction - The Lumped Capacitance Method, Large walls & long cylinders.	3	C,D	1,2	
8.	Transient Conduction: Semi infinite solids	1	C,D	1,2	1,5
	UNIT III: CONVECTION : INTRODUCTION & FREE CONVECTION	**8**			
9.	physical mechanism on convection, classification of fluid flows,	2	C	1	1,2
10.	Governing equation, velocity and thermal boundary layer	3	C,D	1	1,2
11.	Empirical Correlations: External Free Convection Flows	3	C,D	1,2	1,2
	UNIT IV: FORCED CONVECTION	**9**			
12.	Laminar and turbulent convective heat transfer analysis in flows between parallel plates	3	C,D	1,2	1,2,
13.	Laminar and turbulent convective heat transfer analysis in flows over a flat plate	3	C,D	1,2	1,2
14.	Laminar and turbulent convective heat transfer analysis in flows in a circular pipe	3	C,D	1,2	1,2
	UNIT V: RADATIVE HEAT TRANSFER	**9**			
15.	Radiation: Processes and Properties	3	C	1	1,2
16.	Radiation shape Factors	2	C,D	1,2	1,2
17.	Heat exchange between non-black bodies	2	C,D	1,2	1,2
18.	Radiation shields.	2	C,D	1,2	1,2
	Total contact hours*	45			

*Excluding Assessment hours

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	Yunus A. Cengel & Afshin J. Ghajar, "*Heat & Mass Transfer*", fifth Edition,McGraw-Hill, 2014.
2.	Theodore L. Bergman , Adrienne S. Lavine , Frank P. Incropera , David P. DeWitt, "*Fundamentals of Heat and Mass Transfer"*, seventh Edition, John Wiley and Sons, New York, 2011
	REFERENCE BOOKS/OTHER READING MATERIAL
3.	John H Lienhard, "*A Heat Transfer Text Book*", Dover publications inc, New York, 2011.
4.	Sarma, P.K.,Rama Krishna, K. " *Heat Transfer : A Conceptual Approach*", New Age International publishers, eighth edition, 2006

Course nature			**Theory**				
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
					End semester examination Weightage :		**50%**

15AS320E	THEORY OF FIRE PROPAGATION AND SAFETY	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	15AS202, 15AS201J				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Elective				
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting, 23rd July 2016				

PURPOSE	This course provides the basic knowledge about fire in view of energy, the governing laws and relations, and their application to practical and engineering processes.

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**
At the end of the course, student will be able to		
1.	Understand fires its applications and safety.	a
2.	Comprehend the concept and applications of energy conservation in fires utilizations and apply the same for recent engineering advancement.	a
3.	Understand basic knowledge to the physical principles governing fire growth.	a
4.	Understand the behavior and chemical reactions related.	a
5.	Apply the latest engineering ability in fire detection, prevention systems and life safety	a

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: INTRODUCTION TO FIRE SCIENCE	**9**			
1.	Introduction, History of Fire phenomenon, Applications and Need of Fire Safety. Fundamentals and Classification of Fire	3	C	1	1,2,6
2.	science basics: Role of Thermodynamics, Fluid mechanics, Heat and Mass Transfer, Flammability principle-Numericals.	3	C	1	1,2,6

3.	Fires in space, Combustion–principle and calculations. Tutorial- Chapter Doubt clarification.	3	C, D	1,5	1-6
	UNIT II: FUNDAMENTALS OF FIRE PROPAGATION	**9**			
4.	Role of Fire dynamics. Fundamentals of Heat and Mass Transfer for Fire propagation, smoke production and transport -Numericals.	3	C	1,5	1-6
5.	Fire Initiation and Composition (Flame, heat, gases, smoke) - Heat transfer from Flames - Ignition temperature, Burning-rate, Flash point, Fire point, Flash over, Design Objectives of fire safety strategy. Tutorial- Chapter Doubt clarification.	3	C, D	1,5	1,2,6
6.	Scaled Fire Analysis: Ignition and flame spread, Material flammability. Parameters affecting Ignition, Flame spreading, heat release rate, flame extinction-Numericals. Tutorial- Chapter Doubt clarification.	3	C, D	1,5	1-6
	UNIT III: FIRE PLUMES	**9**			
7.	Classification: Buoyant Plumes, Combusting Plumes, Starting plume, Fireball, Transient Aspects of Fire Plumes.	3	C	1,2,5	1-6
8.	Fire spread over liquid and solid fuel surfaces, Enclosure fires, Incineration, Forest fires, Analysis of fire plumes, Fire safety aspects–Numericals.	3	C, D	1,2,5	1,2,6
9.	Standardized flammability testing and its relation to fundamental combustion.	3	C, D	1,2,5	1-6
	UNIT IV: FIRE SPREADING HAZARDS AND CONTROL	**9**			
10.	Identifying hazards and risks, Safety implications, developing safe work systems, Introduction to Fires causes, Explosion hazards in Chemical, Electrical units.	3	C, D	1,3,5	1-6
11.	Finite Real Fire Effects, Fire hazards (health–flammability-reactivity (stability)), Air contaminants in fires-toxic effects of fire gases.	3	C, D	1,3,5	1,2,6
12.	Introduction to Smoldering combustion, smoke formation, composition and movement, hazards. Essential conditions for explosion occurrence, characteristics and Prevention. Tutorial- Chapter Doubt clarification.	3	C, D	1,3,5	1-6
	UNIT V: FIRE PREVENTION AND PROTECTION	**9**			
13.	Active and Passive Fire Protection Features. Fire prevention-handling and storing flammable and combustible liquids/fuels/propellants. Elimination of ignition sources. Fire protection in plants and factories, Fire walls, fire doors. Aerospace fire control.	3	C, D	4,5	1-6

14.	Fire suppression. Fixed automatic sprinklers. Sprinkler system and design. Fire detection, smoke detection, Role of combustion detectors (light detectors, Heat detectors. Flame detectors -infra red detector - ultra violet flame detector).	3	C, D	4,5	1,2,6
15.	Fire Extinguishers-Types-extinguisher-location, Inspection–testing, principles and calculations. Interactive session for fire extinction (Learning Extinguisher usage).	3	C,D, I	4,5	1-6
	Total contact hours*	45			

*Excluding Assessment hours

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	James G. Quintiere**,** *"Fundamentals of Fire Phenomena",* 2006 Wiley.
2.	Dougal Drysdale**,** "*An Introduction to Fire Dynamics*", 2011 Wiley.
	REFERENCE BOOKS/OTHER READING MATERIAL
3.	R.S. Gupta**,** "*A Hand Book of Fire Technology"*.
4.	Kevin Cassidy**,** *"Fire Safety and loss Prevention"*.
5.	S. Rao, H.L. Saluja**,** *"Electrical and Fire Safety Engineering"*.
6.	A.C. Panchdhari**,** *"Management of Fire"*.

Course nature		**Theory**					
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage:	**50%**

15AS321E	AIRFRAME MAINTENANCE AND REPAIR	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	15AS207				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Elective				
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting, 23rd July 2016				

PURPOSE	To impart knowledge on various repair and maintenance procedures followed in an aviation industry.							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, learner will be able to								
1.	Acquire knowledge on welding and sheet metal repair operations and maintenance practices in aviation industry	a	k					
2.	Gain knowledge on maintenance and repair procedures on plastics and composite structures	a	k					
3.	Understand the Assembly & Rigging procedures and operation of Helicopter flight controls.	a	k					
4.	Learn the inspection and maintenance of major and auxiliary systems	a	k					
5.	Appreciate the procedure of Troubleshooting & safety practices	a	e	k				

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: WELDING IN AIRCRAFT STRUCTURAL COMPONENTS	12			
1.	Equipments used in Welding shop and their maintenance	4	C	1	1,2
2.	Ensuring Quality Weld, Soldering and Brazing	2	C	1	1,2
3.	Sheet Metal Repair and Maintenance : Inspection of Damage, NDT Methods	2	C	1	1,2
4.	Classification of Damage, Damage Investigation	2	C	1	1,2
5.	Riveted repair Operation	2	C	1	1,2
	UNIT II: PLASTICS AND COMPOSITES IN AIRCRAFT	**9**			
6.	Review of types of plastics used in aircraft	1	C	2	1
7.	Maintenance and Repair of plastic components	2	C	2	1
8.	Repair of Cracks and Holes, Various repair schemes, Scopes	2	C	2	1

9.	Advanced composites in aircraft	1	C	2	1,2
10.	Repair of composite components, Special precautions	2	C	2	1,2
11.	NDT Methods	1	C	2	1,2
	UNIT III: AIRCRAFT JACKING, ASSEMBLY AND RIGGING	**8**			
12.	Aircraft Jacking, Weighing and CG Location	3	C	3	1,2
13.	Balancing of Control Surfaces, Inspection and Maintenance	2	C	3	1,2
14.	Helicopter flight controls	2	C	3	1,2
15.	Tracking and Balancing of main rotor	1	C	3	1,2
	UNIT IV: REVIEW OF HYDRAULIC AND PNEUMATIC SYSTEM	**9**			
16.	Inspection and Maintenance of landing gear system	1	C	4	1,2
17.	Inspection and Maintenance of air-conditioning and pressurization system	2	C	4	1,2
18.	Installation and Maintenance of Instruments, handling, testing and Inspection	2	C	4	1,2
19.	Inspection and Maintenance of Fire protection systems, Ice protection system and Rain removal system.	2	C	4	1,2
20.	Inspection and Maintenance of Water and waste system, Position and warning system and Auxiliary Power Units.	2	C	4	1,2
	UNIT V: SAFETY PRACTICES	**7**			
21.	Hazardous materials storage and handling	2	C	5	1
22.	Aircraft furnishing practices, Equipments	2	C	5	1
23.	Trouble shooting Theory and practices	3	C	5	1
	Total contact hours*	45			

*Excluding Assessment hours

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	Michael J.Kroes, William A.Watkins ad Frank Delp, “Aircraft Maintenance and Repair”, Seventh Edition, Tata McGraw Hill Education Private Limited, New Delhi,
	REFERENCE BOOKS/OTHER READING MATERIAL
2.	“Aviation Maintenance Technician Handbook - Airframe”, Vol.1, 2”, U.S.Dept. of Transportation, Federal Aviation Administration, Flight Standards Service, 2012.
3.	Larry Reithmeir., “Aircraft Repair Manual”, Palamar Books, Marquette,1992.

Course Nature							
Theory							
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**

15AS322E	AIRBORNE SENSORS AND ACTUATORS	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Elective	Avionics			
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting 23rd July , 2016				

PURPOSE	To improve the students' ability to design, model and test the airborne actuators and sensors							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Understand the advanced concepts of Airborne actuators and sensors	a	b					
2.	Provide the necessary mathematical knowledge that are needed in modelling physical processes.	a	b					
3.	Understand aircraft actuation systems, servo-components, inertial sensors, modelling, design and testing of sensors	a	b					
4.	Deploy these skills effectively in the solution of problems in avionics engineering.	a	b					

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: AIRCRAFT ACTUATION SYSTEMS	**9**			
1.	Introduction	2	C	1	1,2
2.	Principles of actuation systems	3	C	1	1,2
3.	Types of actuation systems	4	C	1	1,2
	UNIT II: SERVO COMPONENTS	**9**			
4.	Actuators	3	C	1	1,3
5.	Valves	3	C	1	1,3
6.	Servo amplifiers pick off	3	C	1	2
	UNIT III: MODELING, DESIGN AND TESTING	**9**			
7.	Linear and non linear actuation systems	1	C,D	2	1
8.	Modeling of actuation systems	2	C,D	2	3
9.	Servo-loop analysis, actuator design	3	C,D	2,3	3
10.	Testing methodologies	1	C	3	2,3

11.	Performance testing test equipments for actuation systems	2	C	3	2,3
	UNIT IV: INERTIAL SENSORS	**9**			
12.	Gyroscope principles, Gyro equations, Rate gyro and integration	2	C	3	1
13.	Free gyro, vertical and directional gyro and laser gyroscope	1	C	3	2
14.	Inertial navigation- Basic principles, theory and apllications	2	C	3	2
15.	Accelerometer- Principle and theory, spring mass, force balance	2	C	3	2,3
16.	Piezo electric accelerometers and MEMS sensors	2	C	1	2,3
	UNIT V: SENSOR TESTING	**9**			
17.	Test philosophies and methodologies	3	C	3	2,3
18.	Test equipments	3	C	3	2,3
19.	Performance testing of sensors	3	C	3	2,3
	Total contact hours*	45			

*Excluding Assessment hours

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	James Ephraim Johnson, *Electro hydraulic Servo Systems*, Published by Editors of Hydraulics & pneumatics magazine, 1984.
2.	Pallett, E.H.J. '*Aircraft instruments, principles and applications'*, Pitman publishing Ltd., London, 1981.
	REFERENCE BOOKS/OTHER READING MATERIAL
3.	Neal E.Wood et al, '*Electro-mechanical actuation development AFFDL-TR-150*' DEC 1978.

Course nature		**Theory**					
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**

15AS323E	AIRPORT ENGINEERING	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Elective				
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting 23rd July, 2016				

PURPOSE	To provide an in depth knowledge and to understand the basic concepts in airport engineering							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student should be able								
1.	To familiarize about airports and surveys	a	e					
2.	To understand about airport planning and forecasting	a		f				
3.	To understand and design runway and taxiways	a		f				
4.	To understand about air traffic control tower and terminal areas	a	e					
5.	To understand about helipads and STOL ports	a	e					

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I : INTRODUCTION	**9**			
1.	International airport authority of India - Civil aviation department Airport Authority of India - Open sky policy – Airport terminology	3	C	1	1,2
2.	Aircraft characteristics - Characteristics of the jet aircraft- Classification of aerodromes - Classification of airports - Flying activities	3	C	1	1,2

3.	Airport surveys - Objects of surveys - Types of surveys- Drawings to be prepared	3	C	1	1,2
	UNIT II: AIRPORT PLANNING	**9**			
4.	Improvement of existing airport - Airport site selection	3	C	2	1,2
5.	Airport size - Forecasting in aviation - Airport obstructions	3	C	2	1,2
6.	Clear zone - Turning zone - Zoning laws	3	C	2	1,2
	UNIT III: RUNWAY AND TAXIWAY DESIGN	**9**			
7.	Runway orientation - Change in direction of runway - Basic runway length - Corrections to basic runway length - Runway patterns	3	C	3	1,2
8.	Layout of taxiways - Geometric standards for taxiway - Exit taxiways - Design of exit taxiways - Loading aprons - Holding aprons	3	C	3	1,2
9.	Fillets - Separation clearance - Bypass or turnaround taxiway	3	C	3	1,2
	UNIT IV: TERMINAL AREA AND ATC	**9**			
10.	Terminal building - Passenger flow - Size of apron – Hangars - Typical airport layouts	3	C	4	1,2
11.	Air traffic control- Importance of air traffic control - Flight rules - Air traffic control network	3	C	4	1,2
12.	Air traffic control aids - Automation in air traffic control aids - GPS Air Traffic Control - Free flight air traffic control	3	C	4	1,2
	UNIT V: HELIPORTS and STOLPORTS	**9**			
13.	Advantages of helicopters - Planning of heliports - Elevated heliports - Heliports at airports	5	C	5	1,2
14.	Characteristics of STOL aircraft - Advantages of STOL aircraft - Planning of STOL ports	4	C	5	1,2
	Total contact hours*	45			

*Excluding Assessment hours

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	Rangwala. *"Airport Engineering",* Charotar Publishing House Pvt., 15th edition 2015.
	REFERENCE BOOKS/OTHER READING MATERIAL
2.	Norman J. Ashford, Saleh A. Mumayiz, Paul H. Wright. *"Airport Engineering: Planning, Design and Development of 21St - Century Airports*", 4ed, CBS Publishers & Distributors.

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**

Year – IV / Elective Courses

15AS324E	AIRCRAFT CONTROL SYSTEMS	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	15AS306				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Elective	Avionics			
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting 23rd July, 2016				

PURPOSE	Provide students with a foundational understanding of classical methods of feedback control system analysis and design and an introduction to modern control methods.							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Analysis of Controlled Linear SISO Systems	a	e					
2.	Design of Controlled Linear SISO Systems	a	e					
3.	Analysis of Controlled Linear MIMO Systems	a	e					
4.	Design of Controlled Linear MIMO Systems	a	e					
5.	Design relevant Applications to Aerospace Systems	a	e					

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I- INTRODUCTION TO CONTROL SYSTEMS	**12**			
1.	Introduction to Control Systems, Open-Loop, Closed-Loop Control, Feedback Block Diagrams and their Simplification	2	C,D	1	1-2-3
2.	Mason's Gain Formula, Mathematical Modeling of Dynamical Systems	2	C,D	1	1-2-3
3.	Modeling in the State Space, Transfer Functions and Impulse Response Functions	2	C,D	1	1-2-3
4.	First- and Second-Order Systems, Higher-Order Systems, Transient Response Analysis, Time Domain Performance Specifications	2	C,D		
5.	Delay Time, Rise Time, Peak Time, Maximum Overshoot, and Settling Time, Stability Analysis and Routh's Stability Criterion.	2	C,D		
6.	Proportional, Derivative, and Integral Control Actions, Steady-State Error Analysis in Feedback Systems	2	C,D		
	UNIT II- ROOT LOCUS ANALYSIS	**7**			
7.	Root Locus Plots, General Rules for Constructing the Root Locus	3	C	2	1-2-4
8.	Positive feedback Systems	2	C,D	2	1-2-4
9.	Parameter Variation	2	C,D	2	1-2-4

	UNIT III- FREQUENCY-RESPONSE ANALYSIS	**9**			
10.	Bode Diagrams, Nyquist Plots, Stability and Relative Stability Analysis	3	C	3	1-2
11.	Systems with Transport Lags, Gain and Phase Margins, Closed-Loop Frequency Response	3	C,D	3	1-2
12.	Frequency Domain Performance Specifications, Peak Resonance, Resonant Frequency, and Bandwidth	3	C,D	3	1-2
	UNIT IV- TIME AND FREQUENCY DOMAIN DESIGN OF CONTROL SYSTEMS	**8**			
13.	PID Design, Lead-Lag Compensation	3	C	3	1-2
14.	Sensitivity and Complimentary Sensitivity Transfer Functions	2	C	3	1-2
15.	Disturbance Rejection and Loop Shaping	3	C,D	3	1-2
	UNIT-V ANALYSIS AND CONTROL DESIGN IN THE STATE SPACE	**9**			
16.	Lyapunov Stability, Asymptotic Stability, Input-Output Stability, State Transition Matrix, Controllability and Observability,	3	C	4	1-2-3
17.	The Lyapunov Equation, Full-State Feedback Control Design and Pole Placement, Optimal State Space Control System	3	C	4	1-2-3
18.	Linear Quadratic Regulator, Classical Control Theory, Modern Control Theory	3	C,D	4	1-2-3
	Total contact hours*	45			

* Excluding Assessment hours

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	Ogata, K., *Modern Control Engineering,* Prentice Hall, 2002
2.	Kuo, B.C., *Automatic Control Systems*, Prentice Hall, 1991
	REFERENCE BOOKS/OTHER READING MATERIAL
3.	Franklin, G.F., Powell, J.D., and Emami-Naeini, A., *Feedback Control of Dynamic Systems*, Addison Wesley, 1994.
4.	Dorf, R.C., and Bishop, R.H., *Modern Control Systems*, Prentice Hall, 2001.
5.	Nise, N.S., *Control Systems Engineering*, Benjamin-Cummings, 1995.

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**

15AS411E	HELICOPTER AERODYNAMICS			L	T	P	C
				3	0	0	3
Co-requisite:	Nil						
Prerequisite:	15AS204J						
Data Book / Codes/Standards	Nil						
Course Category	P	Professional Elective	Aerodynamics				
Course designed by	Department of Aerospace Engineering						
Approval	Academic Council Meeting, 23rd July 2016						

PURPOSE	**PURPOSE** To familiarize on the elements of helicopter aerodynamics and ground Effect machines.

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student should be able								
1.	To become familiarize on major helicopter components, characteristics and configurations.	a	e					
2.	To become familiar with major issues involved in forward flight rotor theory.	a	c	e				
3.	To become familiar with special power estimates.	a	c	e				
4.	To become familiar with ground effect machines.							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: ELEMENTS OF HELICOPTER AERODYNAMICS	**9**			
1.	Configurations based on torque reaction-Jet rotors and compound helicopters.	3	C	1	1,3
2.	Methods of control — Collective and cyclic pitch changes.	3	C	1	1,3
3.	Lead - Lag and flapping hinges.	3	C	1	1,3
	UNIT II: IDEAL ROTOR THEORY	**9**			
4.	Hovering performance.	2	C,D	2	1,2,3,4

5.	Momentum and simple blade element theories – Figure of merit.	3	C,D	2	1,2,3,4
6.	Profile and induced power estimation.	2	C,D	2	1,2,3,4
7.	Constant chord and ideal twist rotors.	2	C,D		1,2,3,4
	UNIT III: POWER ESTIMATES	**9**			
8.	Induced, profile and parasite power requirements in forward	3	C,D	3	1,2,4
9.	Performance curves with effects of altitude.	3	C,D	3	1,2,4
10.	Preliminary ideas on helicopter stability.	3	C,D	3	1,2,4
	UNIT IV: LIFT, PROPULSION AND CONTROL OF V/STOL AIRCRAFT	**9**			
11.	Various configurations - Propeller, rotor, ducted fan and jet lift.	3	C,D	3	1,2,4
12.	Tilt wing and vectored thrust.	3	C,D	3	1,2,4
13.	Performance of VTOL and STOL aircraft in hover, transition and forward motion.	3	C,D	3	1,2,4
	UNIT V: GROUND EFFECT MACHINES	**9**			
14.	Types - Hover height, lift augmentation and power calculations for plenum chamber and peripheral jet machine.	4	C,D	4	2,3,4
15.	Drag of hovercraft on land and water.	3	C,D	4	2,3,4
16.	Applications of hovercraft.	2	C,D	4	2,3,4
	Total contact hours*	45			

*Excluding Assessment hours

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	Gessow, A., and Myers, G,C., *"Aerodynamics of Helicopter",* Macmillan & Co., N.Y. 1987.
2.	McCormick, B,W., *Aerodynamics of V/STOL Flight*, Academic Press, 1987.
	REFERENCE BOOKS/OTHER READING MATERIAL
3.	Johnson, W., *Helicopter Theory,* Princeton University Press, 1980.
4.	Gupta, L., *Helicopter Engineering*, Himalayan Books, 1996.

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**

15AS413E	ROCKET AERODYNAMICS	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	15AS301J				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Elective	Maintenance			
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting, 23rd July 2016				

PURPOSE	Upon completion of the course, Students will learn the concept of high speed aerodynamics and configurations of rockets.

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of this course the student will know								
1.	High speed aerodynamics of various flight regimes of rockets	a	c	k				
2.	Various configurations of rockets	a	e					
3.	Testing of a rocket model	a	e					

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: BOUNDARY LAYER THEORY	**9**			
1.	Basics of boundary layer theory	2	C,D	1	1,3
2.	Compressible boundary layer	2	C	1	1,3
3.	Shock shear layer interaction	2	C	1	1
4.	Aerodynamic heating-heat transfer effects	3	C,D	1	1
	UNIT II: BASICS OF HYPERSONIC AERODYNAMICS	**9**			

5.	Thin shock layers – entropy layers	2	C	1	1
6.	Low density and high density flows	2	C,D	1	1
7.	Hypersonic flight paths hypersonic flight similarity parameters	2	C	1	1
8.	Shock wave and expansion wave relations of inviscid hypersonic flows	3	C,D	1	1,3
	UNIT III: ROCKET CONFIGURATIONS AND DRAG ESTIMATION	**9**			
9.	Various configurations of rockets-components	2	C	1,2	2,4
10.	Forces on the vehicle during atmospheric flight	3	C,D	1,2	2,4
11.	Nose cone design	2	C	1,2	2,4
12.	Drag estimation	2	C,D	1,2	2,4
	UNIT IV: AERODYNAMICS OF SLENDER AND BLUNT BODIES	**9**			
13.	Aerodynamics of slender and blunt bodies	3	C,D	1,2,3	2,4
14.	Wing-body interference effects	3	C,D	1,2,3	2,4
15.	Asymmetric flow separation and vortex shedding-unsteady flow characteristics.	3	C	1,2,3	2,4
	UNIT V: AERODYNAMIC ASPECTS OF ROCKET LAUNCHING	**9**			
16.	Cross wind effects	1	C	1,3	2,4
17.	Specific considerations in launching	2	C	2,3	2
18.	Rocket integration and separation	2	C	2,3	2,4
19.	Methods of evaluation and determination- Wind tunnel tests	3	C	3	2
20.	Comparison with CFD Analysis.	1	C	3	2,4
	Total contact hours*	45			

*Excluding Assessment hours

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	Anderson, J.D., *"Hypersonic and High Temperature Gas Dynamics",* AIAA Education Series.
2.	Chin SS, *Missile Configuration Design*, Mc Graw Hill, New York, 1961.
	REFERENCE BOOKS/OTHER READING MATERIAL
3.	Anderson, J.D., "*Fundamentals of Aerodynamics*", McGraw-Hill Book Co., New York, 1985.
4.	Nielson, Jack N, Stever, Gutford, *"Missile Aerodynamics*", Mc Graw Hill, New York, 1960

Course nature			**Theory**				
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
					End semester examination Weightage :		**50%**

15AS414E	SPACE MISSION DESIGN & ANALYSIS	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	15AS305 , 15AS307				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Elective				
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting, 23rd July 2016				

PURPOSE	To impart the basic knowledge on satellite orbital mission design and analysis, advanced knowledge of orbital dynamics and about spacecraft systems							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Learn about different space missions, formulate the objectives and mission life cycle, identify the requirements, needs, and constraints, characterize and evaluate the, mission, design the orbit and constellation, understand the space environment, its peculiarities, selection of spacecraft material for survivability and selection of rocket launch system	a	b	e				
2.	Learn the concept on Spacecraft design and sizing, spacecraft payload design, all the spacecraft subsystems their functional requirement, and description	a	b	e				
3.	Orbit determination techniques, Keplers equation, Lamberts problem, restricted three body problem, Lagrangian points, stability analysis	a	b	e				
4.	Launching 0f a satellite, determination of the orbit from the injection state vector, injection error analysis, reentry flight dynamics, reentry heating and landing techniques.	a	b	e				
5.	Understand about the interplanetary trajectory design and analysis.	a	b	e				

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: SPACE MISSION DESIGN PROCESS	**9**			
1.	Classification of space missions – Low earth, Medium altitude, Geo-stationary, deep space, space mission life cycle, Mission objectives, identification of mission needs, requirements and constraints, mission characterization, mission evaluation, orbit and constellation design	5	C	1	3-6
2.	Space Environment – peculiarities, survivability, selection of spacecraft material	2	C,D	1	3-6
3.	Selection of launch system	2	C,D	1	3-6
	UNIT II: SPACECRAFT SYSTEM ENGINEERING	**9**			
4.	Spacecraft design and sizing, spacecraft payload design, spacecraft subsystems, functional requirement	2	C,D	2	3-6

5.	Propulsion, attitude determination and control, power systems, thermal control, navigation and guidance, telemetry, tracking and command systems, ground system design	7	C,D	2	3-6
	UNIT III: GENERAL N-BODY PROBLEM	**9**			
6.	Relative Motion in the N-body Problem, Two body problem, orbit determination techniques, Keplers equation, Lamberts problem	6	C,D	3	1,2
7.	Restricted Three Body Problem – Lagrange points - Jacobi Integral, orbital perturbation	3	C,D	3	1,2
	UNIT IV: SATELLITE INJECTION AND RENTRY FLIGHT DYNAMICS	**9**			
8.	Launching of a satellite - General aspects of satellite Injections, launch vehicle ascent trajectories, injection parameters and orbital elements, launch vehicle performance, orbit deviations due to injection errors	5	C	4	1,2
9.	Reentry flight dynamics – fundamentals of entry flight mechanics, fundamentals of entry heating, entry vehicle design, landing and recovery techniques	4	C,D	4	1,2,6
	UNIT V: INTERPLANETARY TRAJECTORIES	9			
10.	Patched Conic Approximation - Patched Conic Procedure - Sphere of Influence - Locating the Planets - Design of the Transfer Ellipse - Design of the Departure Trajectory - Design of the Arrival Trajectory - Gravity-Assist maneuver - Establishing Planetary Orbit – Motion of the Earth-Moon System - Time of Flight and Injection Velocity - Lunar Patched Conic	9	C,D	5	2
	Total contact hours*	45			

*Excluding Assessment hours

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1	Cornelisse, J.W, Schoyer H F R, and Wakker K F, "*Rocket Propulsion and Space Dynamic*", Pitman Publishing Co., 1979
2	Ashish Tewari, "*Atmospheric and Space Flight Dynamics*", Birkhauser, Boston, 2007
	REFERENCE BOOKS/OTHER READING MATERIAL
3	Peter Fortescue, John Stark, Graham Swinerd, "*Spacecraft systems engineering*" Wiley 2004
4	Vincent N Pisacane, "*Fundamentals of space system design*" Oxford University Press, 2005
5	W J Larson and J R Wertz, "*Space Mission Analysis and Design*", Kluwer Academic Publishers, 1999
6	Michael Griffin, "*Space Vehicle Design*", AIAA education series, 2004

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Tutorial	**Total**
	Weightage	**10%**	**10%**	**20%**	**5%**	**5%**	**50%**
					End semester examination Weightage :		**50%**

15AS415E	COMPUTATIONAL HEAT TRANSFER & FLUID DYNAMICS			L	T	P	C
				3	0	0	3
Co-requisite:	Nil						
Prerequisite:	15MA206, 15AS319E						
Data Book / Codes/Standards	Nil						
Course Category	P	Professional Elective	Aerodynamics				
Course designed by	Department of Aerospace Engineering						
Approval	Academic Council Meeting, 23rd July 2016						

PURPOSE	To impart knowledge about various computational fluid methods for fluid flow and heat transfer problems so as to enables the students to write computer programs for solving elementary fluid dynamics/heat transfer problems.							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Students will be exposed to governing equations required for CFD and their mathematical behavior.	a						
2.	Students will be exposed to modeling of Fluid flow and heat transfer problem.	a						

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: GOVERNING EQUATIONS OF FLUID FLOW	**9**			
1.	Conservation Principles	1	C	1	4
2.	Derivation of Navier- Stokes Equations	4	C-D	1	4
3.	The Three Fundamental Approaches to problem solving - Analytical, Experimental & Numerical	4	C	1	
	UNIT II: FUNDAMENTALS OF DISCRETISATION	**9**			
4.	Finite Difference Approximation of derivatives	1	C	1	1
5.	Truncation error; order of magnitude of error	1	C	1	1
6.	Basics of Finite volume Method	1	C	1	1
7.	Integration Over a Control Volume	2	C	1	1
8.	Discretisation of Computational Domain	1	C	1	1
9.	Example of Numerical Solution – Draining of a tank problem	3	C	1,2	1
	UNIT III: ONE – DIMENSIONAL UNSTEADY STATE HEAT CONDUCTION	**10**			
10.	Discretisation of 1 – D unsteady Heat conduction Equation	1	C	1,2	1
11.	Explicit Vs Implicit Approaches	1	C	1	1,4

12.	Tri – diagonal Matrix Algorithm	1	C	1	1,4
13.	Analysis of Numerical oscillations	3	C	1	1,4
14.	Computer Exercises	4	C	2	2
	UNIT IV: CONVECTION -DIFFUSION PROBLEMS	**8**			
15.	Need for Upwind Differencing Scheme	3	C	1	1,4
16.	Numerical Diffusion	3	C	1	1,3,4
17.	Scarborough Criterion	2	C	1	1,2
	UNIT-V : FLOW SOLVERS	**9**			
18.	SIMPLE- Collocated Grid versus Staggered Grid	5	C	1	1,3,4
19.	Applications of SIMPLE	4	C	1,2	1,2,3,4
	Total contact hours*	45			

*Excluding Assessment hours

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	Anil Date ; *Introduction to CFD* Cambridge University Press First Edition (2005)
	REFERENCE BOOKS/OTHER READING MATERIAL
2.	Versteeg. H.K and Malalasekera. W, *"An Introduction to Computational Fluid Dynamics, the Finite Volume Method"* Addison Wesley Longmen Limited, Second Edition (2007)
3.	Patankar. S.V. *"Numerical Heat Transfer and Fluid Flow",* Hemisphere Publishing corporation, First Edition (1980.)
4.	John.D.Anderson jr., *"Computational Fluid Dynamics – The basics with applications"* McGraw-Hill First Edition (1995)

Course nature		**Theory**					
Assessment Method (Weight age 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**

15AS416E	ROCKETS AND MISSILES	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	15AS305, 15AS307				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Elective				
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting, 23rd July 2016				

PURPOSE	1. To impart design basics of rockets and missiles systems, their construction and functions. 2. To focus on design principles, materials selection, testing and performance assessment. 3. To understand aerodynamics, flight dynamics, optimization of performance of multi-stage rockets and separation dynamics.

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	To learn about the different systems of rockets and missiles, formulation of the equation of motion and about the advanced rockets for future missions	a	b	e				
2.	To understand the function of the solid propellant propulsion and pyrotechnic systems and the design principles	a	b	e				
3.	To understand the function of the liquid propellant propulsion and control systems and the design principles	a	b	e				
4.	To formulate the equation of motions for a mission and spent stage separation dynamics, understanding the principles of navigation, guidance and control of rockets and missiles, and design of a multistage rocket	a	b	e				
5.	To understand the system design, construction, function, performance and testing aspects. and to familiarize with the selection of suitable materials for different rocket systems	a	b	e				

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: FUNDAMENTALS OF ROCKET FLIGHT DYNAMICS	**9**			
1.	Introduction – Classification of launch vehicles and missiles, different space missions, rocket flight systems	2	C	1	2,9,10
2.	Forces and moments acting on a rocket – Propulsion, aerodynamics, gravity, control systems, stability analysis	2	C	1	4,5
3.	Inertial and non-inertial frames, coordinate transformation, Coriolis theorem, equations of motion for three dimensional motion through vacuum and atmosphere	2	C	1	4,5
4.	Reentry flight dynamics, Rocket flight performance dispersion and computation methods	2	C	1	5,9,10
5.	Introduction to single stage to orbit concepts, reusable launch vehicles, advanced space propulsion systems	1	C	1	5,9,10

	UNIT II: SOLID PROPULSION AND PYROTECHNICS	**9**			
6.	Solid propellant rocket fundamentals	1	C,D	2	1,2,3,6,7
7.	Propellant ingredients, Propellant properties. Propellant grain processing	1	C,D	2	1,2,3,6,7
8.	Propellant Grain types, requirements, Grain design, properties	2	C,D	2	1,2,3,6,7
9.	Ballistics and Burn rate control design and evaluation	2	C,D	2	1,2,3,6,7
10.	Solid rocket components and motor design	2	C,D	2	1,2,3,6,7
11.	Separation systems, Pyrotechnic devices	1	C	2	1,2,3,6,7
	UNIT III: LIQUID PROPULSION & CONTROL SYSTEMS	**9**			
12.	Liquid propellant rocket fundamentals, applications, types	2	C,D	3	1,2,3,6,7
13.	Design of propellant feed system, Gas pressure feed system, tanks, turbo-pump, engine cycle, cooling systems	5	C,D	3	1,2,3,6,7
14.	Liquid Slosh, Pogo, Water hammer, Geyser effect	1	C,D	3	1,2,3,6,7
15.	Thrust vector control system Performance improvement.	1	C,D	3	1,2,3,6,7
	UNIT IV: MULTI-STAGING OF ROCKET PERFORMANCE, AUXILLIARY SYSTEMS	**9**			
16.	Multi-staging of rockets , performance estimation, vehicle optimization techniques	3	C,D	4	4,5,10
17.	Flight trajectory optimisation, constraints, rocket flight simulation techniques	2	C	4	4,5,10
18.	Stage separation system – dynamics, separation techniques, reentry vehicles landing techniques	2	C	4	4,5,10
19.	Navigation, guidance and control systems in launch vehicle, missiles guidance and aerodynamic control systems	2	C	4	4,5,10
	UNIT V: DESIGN, MATERIALS AND TESTING OF ROCKETS	9			
20.	Design of prototype rocket – requirement and design approach	2	D	5	2
21.	Product design and process planning aspects	2	C	5	2,3
22.	Material selection criteria, Super alloys, Composites	1	C	5	2,3
23.	Test and Qualification - Types of tests.	2	C	5	2,3
24.	Environmental tests. Planning details, concluding a normal and incomplete test	2	C	5	2,3
	Total contact hours*	45			

*Excluding Assessment hours

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	Ramamurthi.K: "*Rocket Propulsion*", Macmillan Publishers, New Delhi-110002, March, 2010
2.	George.P.Sutton, Oscar Biblarz: "*Rocket Propulsion Elements*" John Wiley India,New Delhi-110002, June,2010
3.	Taylor, Travis. S:"*Introduction to rocket science and engineering*" CRC Press, New York, 2009.
4.	Cornelisse, J.W, Schoyer H F R, and Wakker K F, "*Rocket Propulsion and Space Dynamic*", Pitman Publishing Co., 1979
5.	Ashish Tewari, "*Atmospheric and Space Flight Dynamics*", Birkhauser Boston, 2007
	REFERENCE BOOKS/OTHER READING MATERIAL
6.	Martin J L Turner, " Rocket and Spacecraft Propulsion", Springer Praxix Publising Co, 2004
7.	Ronald Humble, Henry and Larson, "*Space Propulsion Analysis and Design",* McGraw-Hill,1995
8.	George M Siouris, "*Missile guidance and control systems*", Springer , 2004
9.	W J Larson and J R Wertz, "*Space Mission Analysis and Design*", Kluwer Academic Publishers, 1999
10.	Michael Griffin, "*Space Vehicle Design*", AIAA education series, 2004

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Tutorial	**Total**
	Weightage	**10%**	**10%**	**20%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**

15AS417E	FATIGUE AND FRACTURE MECHANICS	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	15AS206, 15AS317E				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Elective	STRUCTURE			
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting, 23rd July 2016				

PURPOSE	To familiarize the students in the area of fatigue and fracture mechanics

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, learner will be able to		a	b	e				
1.	Understand the concept of plotting S-N curves, mean stress, stress concentration	a	b	e				
2.	Emphasis the study of low cycle fatigue, load histories, cumulative damage, statistical aspects of fatigue studies	a	b	e				
3.	Familiarize with physical aspects , surface effects, temperature effects of fatigue	a	b	e				
4.	Familiarize with fracture of brittle materials, strain energy release rate, theoretical strength of metals	a	b	e				
5.	Expose to the concept of various design philosophies, Case histories, fatigue resistance of fiber-metal laminates	a	b	e				

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: FATIGUE OF STRUCTURES	**9**			
1.	S-N curve, Endurance limit	1	C	1	1-2
2.	Effect of mean stress on fatigue, Goodman diagram	1	C	1	1-2
3.	Gerber and Soderberg relations and diagrams	1	C	1	1-2
4.	Problems on mean stress	1	C,D	1	1
5.	Notches and stress concentration	1	C	1	1-2
6.	Problems on stress concentration	1	C,D	1	1
7.	Neuber's stress concentration, Plastic stress concentration, problems	1	C,D	1	1-2
8.	Notched S-N curves	1	C	1	1-2
9.	Problems on Notched S-N curves	1	C,D	1	1-2
	UNIT II: STATISTICAL ASPECTS OF FATIGUE BEHAVIOR	**9**			
10.	Low cycle fatigue and high cycle fatigue	1	C	2	1-2
11.	Coffin-Manson's relation, transition life	1	C	2	1-2

12.	Problems on low cycle fatigue	1	C,D	2	1-2
13.	Cyclic hardening, cyclic softening, cyclic stress strain curve	1	C	2	1-2
14.	Strain-life equation, problems	1	C,D	2	1
15.	Analysis of load histories, Level crossing method	1	C	2	2
16.	Range counting method	1	C	2	2
17.	Rain flow method, problems	1	C,D	2	2
18.	Cumulative damage, Miner's theory, problems	1	C,D	2	1-2
	UNIT III: PHYSICAL ASPECTS OF FATIGUE	**9**			
19.	Structural features of fatigue, crack initiation, slip-band crack growth	1	C	3	1-2
20.	Crack growth on planes of high tensile stress, Ultimate fracture	1	C	3	1
21.	Fatigue crack propagation, Paris law	1	C	3	1
22.	Problems on crack propagation	1	C,D	3	1
23.	Size effects on fatigue	1	C	3	1
24.	Surface effects on fatigue, surface roughness, surface properties, surface residual stresses	1	C	3	1
25.	Fatigue under combined stresses, Effect of metallurgical variables on fatigue	1	C	3	1
26.	Corrosion fatigue, fretting	1	C	3	1
27.	Effect of low-temperature fatigue, High-temperature fatigue, Thermal fatigue	1	C	3	1
	UNIT IV: FRACTURE MECHANICS	**9**			
28.	Types of fracture in metals	1	C	4	1
29.	Theoretical cohesive strength of metals	1	C	4	1
30.	Problems on theoretical strength	1	C,D	4	1
31.	Griffith theory of brittle fracture, Irwin-Orwin theory	1	C	4	1
32.	Problems on brittle fracture	1	C,D	4	1

33.	Strain-energy release rate	1	C	4	1
34.	Stress intensity factor, crack deformation modes, problems	1	C,D	4	1
35.	Fracture toughness and design, Plane-strain toughness testing, Problems	1	C,D	4	1
36.	Plasticity correction, crack-opening displacement, J-integral, R-curve	1	C	4	1
	UNIT V: FATIGUE DESIGN AND TESTING	**9**			
37.	Safe life and fail safe design philosophies	1	C	5	1
38.	Infinite-life design and mage-tolerant design philosophies	1	C	5	1
39.	Designing against fatigue of structures, Different types of structural fatigue problems	1	C	5	2
40.	Uncertainties, scatter and safety margins	1	C	5	2
41.	Some case histories, Improved shoulder fillets, Secondary bending due to non-symmetric hole	1	C	5	2
42.	Cracked aircraft wing panel repaired with a poorly designed patch, Online structural monitoring of the Tsing Ma bridge	1	C	5	2
43.	Fatigue resistance of fiber-metal laminates, Laminated sheet material without fibers,	1	C	5	2
44.	Fiber-metal laminate Arall and Glare, Fiber-metal laminate concept	1	C	5	2
45.	Fiber-metal laminates as sheet material, crack growth in glare, Fatigue properties of Glare components	1	C	5	2
	Total contact hours*	45			

*Excluding Assessment hours

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	George E Dieter., *"Mechanical Metallurgy",* McGraw Hill Education (India) Private Limited, New Delhi, Third Edition 2013.
2.	Jaap Schijve, *"Fatigue of Structures and Materials", Springer*, Second Edition, 2009.
	REFERENCE BOOKS/OTHER READING MATERIAL
3.	Barrels, W., and Ripley, E.L., "*Fatigue of Aircraft structures"*,Pergamon Press,Oxford,1983
4.	Knott, J.F., '*Fundamentals of Fracture Mechanics'*,Butterworth & Co., (Publisher) Ltd., London, 1983

Course natures		**Theory**					
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**

15AS418E	CRYOGENIC ENGINEERING	L	T	P	C
		3	0	0	3
Co-requisite:	NIL				
Prerequisite:	15AS319E				
Data Book / Codes/Standards	Refrigeration Table				
Course Category	P Professional Elective	Propulsion			
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting 23rd July , 2016				

PURPOSE	To have a detailed study of the basics of cryogenic systems, its cycle and application in aerospace engineering.

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able								
1.	To analyze the Cryogenic systems	a						
2.	To know cryogenic applications in aerospace engineering	a						
3.	To have a detailed knowledge of cryo-coolers, Gas-Liquefaction, Refrigeration Systems, Cryogenic Insulations and Vacuum Technology.	a	e					
4.	To embark on a research career in Cryogenic Engineering	a	k					

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: INTRODUCTION TO CRYOGENIC SYSTEMS	**9**			
1.	Introduction , Cryogenic propellants and its applications	1	C	1,2	1,2
2.	Liquid hydrogen, liquid oxygen, liquid nitrogen, liquid helium	3	C	1,2	1,2

3.	Properties of cryogenic fluids at cryogenic temperature - Mechanical properties, Thermal properties, Electrical properties	2	C	1,2	1,2
4.	Ortho Hydrogen & Para Hydrogen	1	C	1,2	1,2
5.	Safety in Cryogenics, Applications in Space Technology	2	C	1,2,4	1-7
	UNIT II: GAS LIQUEFACTION SYSTEMS	**9**			
6.	Liquefaction systems- Introduction, Joule Thomson effect ,Joule Thomson Coefficient.	2	C,D	1,3	1-7
7.	Linde –Hampson System, Claude System	2	C,D	1,3	1-7
8.	Heylandt System, Claude Liquefaction cycle	2	C,D	1,3	1-7
9.	Numericals on Gas Liquefaction cycle	3	D	1,3	1-7
	UNIT III: GAS CYCLE CRYOGENIC REFRIGERATION SYSTEMS	**9**			
10.	Classification of Cryo coolers - Stirling Cryo – cooler, Gifford-McMahon Cry cooler, ,	2	C	1,3	3
11.	Pulse tube refrigerator, Solvay cycle refrigerator	3	C	1,3	3
12.	Vuilleumier refrigerator, Cryogenic regenerators	2	C	1,3	3
13.	Numericals on Cryogenic Refrigeration system	2	D	1,3	1-7
	UNIT IV: GAS SEPARATION AND GAS PURIFICATION SYSTEMS	**8**			
14.	Thermodynamic ideal separation system, Principles of gas separation	1	C	3	1-7
15.	Linde single column air separation. Linde double column air separation	2	C	3	1-7
16.	Argon and Neon separation systems	2	C	3	1-7
17.	Pre purification of Air	1	C	3	1-7
18.	Cryogenic Gas Adsorption ,Cryo-condensation Process	2	C	3	1-7
	UNIT V: VACUUM TECHNOLOGY , CRYOGENIC FLUID STORAGE AND TRANSFER SYSTEMS	**10**			
19.	Vacuum Technology- Production of high vacuum	1	C	3,4	1-7
20.	Mechanical vacuum pumps, Diffusion pumps	2	C	3	1-7

21.	Cryo-pumping	1	C	3	1-7
22.	Cryogenic fluid storage vessels-Insulation, Evacuated porous insulation	2	C	3,4	1-7
23.	Powder & Fibers Opacified powder insulation, Gas filled powders & Fibrous materials Multilayer super-insulation	2	C	3,4	1-7
24.	Propellant servicing ,Propellant management	1	C	3,4	1-7
25.	Cryogenic fluid transfer systems	1	C	3,4	1-7
	Total contact hours *	45			

* Excluding Assessment hours

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	Haseldom, G, "*Cryogenic Fundamentals"*, Academic Press, 2001
2.	Randall F. Barron., "*Cryogenic Systems"*, Oxford University, 1985
3.	Walker.G ,"*Cryocoolers*", Plenum Press, New York (1983)
4.	Mamata Mukhopadhyay ,"*Fundamentals of Cryogenic Engineering*",PHI Learning (P) Ltd, Delhi,2010
	REFERENCE BOOKS/OTHER READING MATERIAL
5.	J.H.Bell ,"*Cryogenic Engineering*" , Prentice Hall, Englewood Cliffs,1963
6.	Parner, S. F., "*Propellant Chemistry"*, Reinhold Publishing Corpn., New York,1985
7.	R.B.Scott , "*Cryogenic Engineering*" , Van Nostrand Co, New Jercy,1960

Course nature	**Theory**

Assessment Method (Weightage 100%)

In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
					End semester examination Weightage :		**50%**

15AS419E	AIRCRAFT ENGINE AND INSTRUMENT SYSTEMS	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	15AS207, 15AS304				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Elective	Maintenance			
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting, 23rd July 2016				

PURPOSE	**PURPOSE** To study about aircraft engines, instruments and electrical systems.

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
This course will enable the students to know more about								
1.	Reciprocating and Gas turbine engine systems.	a	c					
2.	Reciprocating and Gas turbine engine Induction and Exhaust systems.	a	c	k				
3.	Basic electrical systems in aircraft.	a	c					
4.	Reciprocating and Gas turbine engine instruments and its operating mechanism.	a	c	k				

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: RECIPROCATING ENGINES	**10**			
1.	Fuels and their characteristics for IC engines, contamination of fuels and prevention.	1	C	1	1,2
2.	Fuel system- Basic Fuel System, Fuel Metering Systems- Fuel Metering Devices for Reciprocating Engines.	3	C	1	1,2
3.	Carburetor Systems- Carburetor Types, Pressure Injection Carburetors.	3	C	1	1,2
4.	Automatic Mixture Control (AMC), Fuel-Injection Systems.	3	C	1	1,2
	UNIT II: GAS TURBINE ENGINES	**10**			

5.	Fuels and their characteristics for gas turbine engines, contamination of fuels and prevention.	1	C	1	1,2
6.	Fuel Systems- Turbine Fuel Controls, Hydromechanical /Electronic Fuel Control.	3	C	1	1,2
7.	FADEC Fuel Control Systems, FADEC for an Auxiliary Power Unit, FADEC Fuel Control Propulsion Engine.	3	C	1	1,2
8.	Engine Fuel System Components- Main Fuel Pumps, Fuel Heater, Fuel Filters, Fuel Spray Nozzles and Fuel Manifolds.	3	C	1	1,2
	UNIT III: INDUCTION AND EXHAUST SYSTEM	**9**			
9.	Reciprocating Engine Induction Systems - Basic Carburetor Induction System, Supercharged Induction Systems.	2	C	2	1,3
10.	Reciprocating Engine Exhaust Systems, Exhaust Systems With Turbocharger.	2	C	2	1,3
11.	Turbine engine inlet systems - Turboprop and Turboshaft compressor inlets, Turbofan engine inlet sections.	2	C	2	1,3
12.	Turbine engine exhaust nozzles - Thrust reversers, Afterburning / Thrust augmentation, Thrust vectoring, Engine noise supression, Turbine engine emissions.	3	C	2	1,3
	UNIT IV: BASIC AIRCRAFT ELECTRICAL SYSTMES	**7**			
13.	Source of power – DC and AC generator.	2	C	3	2,3
14.	Inverters, rectifiers, transformers, batteries.	3	C	3	2,3
15.	Airplane lighting– Power utilization in airplanes.	2	C	3	2,3
	UNIT V: ENGINE INSTRUMENTS	**9**			
16.	Reciprocating engine instruments - Oil pressure, Oil temperature, Cylinder head temperature (CHT).	2	C	4	2,3
17.	Manifold pressure, Fuel quantity, Fuel pressure, Tachometer, Carburetor temperature.	2	C	4	2,3
18.	Turbine engine instruments - Oil pressure, Exhaust gas temperature (EGT), Turbine inlet temperature (TIT) or turbine gas temperature (TGT), Engine pressure ratio (EPR).	2	C	4	2,3
19.	Fuel quantity, Fuel pressure, Fuel flow, Tachometer (percent calibrated) N1 and N2 compressor speeds, Torquemeter (on turboprop and turboshaft engines).	3	C	4	2,3
	Total contact hours*	45			

*Excluding Assessment hours

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	*Aviation Maintenance Technician Handbook–Powerplant Volume 1 & 2*, U.S. Department of Transportation FEDERAL AVIATION ADMINISTRATION Flight Standards Service 2012.
2.	*Aviation Maintenance Technician Handbook—Airframe Volume 1 & 2*, U.S. Department of Transportation FEDERAL AVIATION ADMINISTRATION Flight Standards Service 2012.
	REFERENCE BOOKS/OTHER READING MATERIAL
3.	Bent, R.D. Mickinely., *Aircraft Maintenance and Repair*, 2nd Edition – McGraw Hill Inc , NowYork, 1978.

Course nature			**Theory**				
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
					End semester examination Weightage :		**50%**

15AS420E	HELICOPTER MAINTENANCE	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	15AS321E				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Elective	Maintenance			
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting, 23rd July 2016				

PURPOSE	To make the students to understand the basic concepts of Helicopter maintenance and repair procedures followed by overhauling.

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student should be able								
1.	To familiarize with Fundamentals of Helicopter and ground handling	a	c					
2.	To familiarize with basic concepts of Head maintenance, Vibration tracking of helicopter blades, Flight control systems and mast adjustment concepts.	a	e					
3.	To familiarize with concept of main rotor transmission, sprag clutch importance of torque meter maintenance.	a	e					
4.	To familiarize with importance of power plants, tail rotor systems servicing, Fuselage maintenance and Special purpose equipment	c	e					

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: HELICOPTER FUNDAMENTAL	**6**			
1.	Helicopter fundamentals, Evolution of helicopter.	1	C	1,2	1,2
2.	Helicopter configurations-rotor arrangements.	2	C	1,2	1,2

3.	Compound Helicopter - jet rotor-no tail rotor concepts.	1	C	1,2	1,2
4.	Basic directions – Ground handling, bearing – Gears.	2	C	1,2	1,2
	UNIT II: MAIN ROTOR SYSTEM	**11**			
5.	Head maintenance – blade alignment – Static main rotor balance – Vibration – Tracking – Span wise dynamic balance – Blade sweeping –Electronic balancing.	3	C	2	1,2,3
6.	Dampener maintenance –Counter weight adjustment – Auto rotation adjustments – Mast & Flight Control Rotor - Mast – Stabilizer, dampeners.	3	C	2	1,2,3
7.	Swash plate flight control systems collective – Cyclic – Push pull tubes – Torque tubes – Bell cranks.	3	C	2	1,2,3
8.	Mixer box – Gradient unit control boosts – Maintenance & Inspection control rigging.	2	C		1,2,3
	UNIT III: MAIN ROTOR TRANSMISSIONS	**11**			
9.	Engine transmission coupling – Drive shaft.	3	C	2,3	1,2,3
10.	Maintenance clutch – Freewheeling units – Spray clutch.	3	C	2,3	1,2,3
11.	Roller unit – Torque meter – Rotor brake Maintenance of these components.	3	C	2,3	1,2,3
12.	Vibrations – Mounting systems – Transmissions.	2	C	2,3	1,2,3
	UNIT IV: POWER PLANTS & TAIL ROTORS	**10**			
13.	Fixed wing power plant modifications – Installation.	3	C	4	1,2,3,4
14.	Different type of power plant maintenance.	2	C	4	1,3,4
15.	Tail rotor system – Servicing tail rotor track.	3	C	4	1,2
16.	System rigging.	2	C	4	1,3,4
	UNIT V: AIRFRAMES AND RELATED SYSTEMS	**7**			
17.	Rotary wing Fuselage structural construction - Tubular, sheet metal, Bonded - Bell 206, Hughes 500, Eurocopter BO- 105 Fuselage- Fuselage maintenance.	3	C	4	1,2
18.	Airframe Systems - Stress and loads on Airframe, Wheel and skid Gear, visibility.	2	C	4	1,2,3
19.	Structural components and materials, Special purpose equipment.	2	C	4	1,2,3
	Total contact hours*	45			

*Excluding Assessment hours

LEARNING RESOURCES	
Sl.No.	**TEXT BOOKS**
1.	Jeppesen, "*Helicopter Maintenance Hand Book*", Jeppesons and Sons Inc., 2000.
2.	Gupta. L "*Helicopter Engineering*", Himalayan Books, 1996.
	REFERENCE BOOKS/OTHER READING MATERIAL
3.	"*Civil Aircraft Inspection Procedures*", Part I and II, CAA, English Book House, New Delhi, 1986.
4.	LARRY REITHMIER, "*Aircraft Repair Manual*", Palamar Books Marquette, 1992.

Course nature		**Theory**					
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**

15AS421E	AERIAL ROBOTICS	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Elective	Avionics			
Course designed by	Department of Aerospace Engineering				
Approval	Academic Council Meeting, 23rd July 2016				

PURPOSE	To improve the student's ability to understand the concepts of unmanned aircraft modeling, state estimation, control and basics of motion planning.							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Understand the kinematics and dynamics of fixed wing unmanned aerial vehicle	a	e					
2.	Understand the kinematics and dynamics of multirotor micro aerial vehicle.	a	e					
3.	State estimation of aerospace vehicle	a	e					
4.	Design flight controls of aerospace vehicle	a	e					
5.	Motion planning of aerospace vehicle	a	e					

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I-KINEMATICS AND DYNAMICS OF Fixed Wing Unmanned Aerial Vehicle	**9**			
1.	Introduction- Aerial Robot- Modeling and Dynamics Formulation	3	C,D	1	1-2
2.	Frame Rotations and Representations-Euler angles-Quaternion	3	C,D	1	1-2
3.	Dynamics of a Fixed-Wing Unmanned Aerial Vehicle	3	C,D	1	1-2
	UNIT II- KINEMATICS AND DYNAMICS OF Multirotor Micro Aerial Vehicle(MMAV)	**9**			
4.	Propeller Theory-Thrust and Drag moment	3	C	2	1-2-4
5.	Dynamics of a Multirotor Micro Aerial Vehicle(MMAV)	4	C,D	2	1-2-4
6.	Mathematical modeling of Multirotor Micro Aerial Vehicle(MMAV)	2	C,D	2	1-2-4
	UNIT III- STATE ESTIMATION	**9**			
7.	Navigational Sensors-Inertial Sensors-Magnetometer-Pressure Sensor	3	C	3	1-2
8.	GPS-Camera based Navigation-Kalman Filter-Position and velocity analysis	3	C,D	3	1-2
9.	Inertial Navigation Systems-Attitude estimation.	3	C,D	3	1-2
	UNIT IV- FLIGHT CONTROLS	**9**			

10.	PID Control–Lateral control of MMAV using PID	3	C	3	1-2
11.	LQR Control–Design of LQR servo control in MATLAB	3	C	3	1-2
12.	Linear Model Predictive Control-Design and Implementation of a Linear MPC for MMAV	3	C,D	3	1-2
	UNIT-V MOTION PLANNING	**9**			
13.	Holonomic Vehicle Boundary Value Solver	3	C	4	1-2-3
14.	Dubins Airplane model Boundary Value Solver- Collision-free Navigation	3	C	4	1-2-3
15.	Structural Inspection Path Planning	3	C,D	4	1-2-3
	Total contact hours*	45			

*Excluding Assessment hours

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	R. Beard, and T. W. McLain, *'Small Unmanned Aircraft: Theory and Practice'* Princeton University Press, 2012.
2.	R.C. Nelson., *Flight Stability and Automatic Control,* McGraw Hill, New York 1998.
	REFERENCE BOOKS/OTHER READING MATERIAL
3.	L.R. Newcome., *Unmanned Aviation, a Brief History of Unmanned Aerial Vehicles*, American Institute of Aeronautics and Astronautics, Reston 2004.
4.	Kuo, B.C., *Automatic Control Systems*, Prentice Hall, 1991.

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
						End semester examination Weightage :	**50%**