LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING

(AUTONOMOUS)
Accredited by NAAC & NBA (Under Tier - I), ISO 9001:2015 Certified Institution
Approved by AICTE, New Delhi. and Affiliated to JNTUK, Kakinada
L.B. REDDY NAGAR, MYLAVARAM, KRISHNA DIST., A.P.-521 230.
Phone: 08659-222933, Fax: 08659-222931

DEPARTMENT OF AEROSPACE ENGINEERING

COURSE HANDOUT

PART-A

Name of Course Instructor: L. Prabhu
Course Name & Code **:** Aircraft Systems and Instruments – 20AE08
L-T-P Structure **:** 3-0-0 **Credits:** 3
Program/Sem/Sec : B.Tech, V-Sem **A.Y.:** 2022-23

PREREQUISITE: EOA

COURSE OUTCOMES (COs): At the end of the course, student will be able to

CO1	Identify the various types of controls in the airplane design (Understand-L2)
CO2	Understand the performance of hydraulic and pneumatic systems in the aircraft operation (Understand-L2)
CO3	Analyze the performance of various engine systems of an aircraft (Understand-L2)
CO4	Employ necessary auxiliary systems in the operation of an aircraft (Understand-L2)
CO5	Employ various instruments necessary of the aircraft operation (Understand-L2)

COURSE ARTICULATION MATRIX (Correlation between COs, POs & PSOs):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	1	-	-	-	-	-	-	-	3	2	3
CO2	3	1	1	1	-	-	-	-	-	-	-	3	2	3
CO3	3	1	1	1	-	-	-	-	-	-	-	3	2	3
CO4	3	1	1	1	-	-	-	-	-	-	-	3	2	3
CO5	3	1	1	1	-	-	-	-	-	-	-	3	2	3
1 - Low						**2 –**Medium						**3 –** High		

TEXTBOOKS:

T1	McKinley, J.L., Bent, R.D., "Aircraft Maintenance & Repair", McGraw-Hill, 1993.
T2	General Hand Books of Airframe and Power plant Mechanics", U.S. Dept. of Transportation, Federal Aviation Administration, The English Book Store, New Delhi1995.

REFERENCE BOOKS:

R1	Mekinley, J.L., Bent, R.D., "Aircraft Power Plants", McGraw-Hill, 1993
R2	Pallet, E.H.J., "Aircraft Instruments & Principles", Pitman & Co., 1993.
R3	Treager, S., "Gas Turbine Engine Technology", McGraw-Hill Education; 3rd Edition

PART-B

COURSE DELIVERY PLAN (LESSON PLAN):

UNIT-I: AIRPLANE CONTROL SYSTEMS

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to A/C Systems & Instrumentation	1	18-07-2022		TLM3	
2.	Introduction to Control surfaces	1	19-07-2022		TLM3	
3.	Conventional Control systems	1	21-07-2022		TLM3	
4.	Power assisted and actuated systems	1	23-07-2022		TLM3	
5.	Engine Control systems...(FADEC)	1	25-07-2022		TLM3	
6.	Introduction to Modern flight control systems	1	26-07-2022		TLM3	
7.	FBW systems	1	28-07-2022		TLM3	
8.	Digital FBW systems	1	30-07-2022		TLM3	
9.	Operation and working principle of autopilot system	1	01-08-2022		TLM3	
10.	Active control technology	1	02-08-2022		TLM3	
11.	Discussion board for Unit 1, Assignment I	1	04-08-2022		TLM3	
No. of classes required to complete UNIT-I		11				

UNIT-II : AIRCRAFT SYSTEMS

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
12.	Introduction to A/C systems, Study of workable systems & components	1	06-08-2022		TLM3	
13.	Introduction to Pneumatic Systems	1	08-08-2022		TLM3	
14.	Operation and working principle of pneumatic system	1	11-08-2022		TLM3	
15.	Components of Air pressure Systems	1	13-08-2022		TLM3	
16.	Working principle of air pressure system	1	16-08-2022		TLM3	
17.	Brake system	1	18-08-2022		TLM3	
18.	Power systems based on pneumatic	1	20-08-2022		TLM3	
19.	Introduction to landing gear systems	1	22-08-2022		TLM3	
20.	Working and classification of landing gear systems	1	23-08-2022		TLM3	
21.	Discussion on Unit II	1	25-08-2022		TLM3	
22.	Assignment	1	27-08-2022		TLM3	
No. of classes required to complete UNIT-II		11				

UNIT-III: ENGINE SYSTEMS

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
23.	Introduction to Engine systems	1	29-08-2022		TLM3	
24.	Piston engine fuel systems	1	30-08-2022		TLM3	
25.	Jet engine fuel systems	1	01-09-2022		TLM3	
26.	Components of multi engines	1	03-09-2022		TLM3	
27.	Lubrication systems for piston engines	1	05-09-2022		TLM3	
28.	Lubrication systems for jet engines,	1	06-09-2022		TLM3	
29.	Introduction about starting and Ignition systems	1	08-09-2022		TLM3	
30.	Types of ignition system	1	10-09-2022		TLM3	
31.	Operations of ignition systems	1	06-10-2022		TLM3	
32.	Typical examples for piston, & jet engines	1	10-10-2022		TLM3	
33.	Discussions on Unit III, Assignment III	1	11-10-2022		TLM3	
No. of classes required to complete UNIT-III		11				

UNIT-IV: AUXILIARY SYSTEMS

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
34.	Introduction to Auxiliary systems	1	13-10-2022		TLM3	
35.	Types of air cycle systems, Basic Air Cycle systems	1	15-10-2022		TLM3	
36.	Working principles of air cycle system	1	17-10-2022		TLM3	
37.	Vapour Cycle Systems	1	18-10-2022		TLM3	
38.	Boot-strap air cycle system	1	20-10-2022		TLM3	
39.	Evaporative vapour cycle systems	1	22-10-2022		TLM3	
40.	Evaporation air cycle systems	1	25-10-2022		TLM3	
41.	Oxygen systems,	1	27-10-2022		TLM3	
42.	Fire protection systems	1	29-10-2022		TLM3	
43.	De-icing and anti-icing system	1	31-10-2022		TLM3	
44.	Discussions on Unit IV, Assignment IV	1	01-11-2022		TLM3	
No. of classes required to complete UNIT-IV		11				

UNIT-V : AIRCRAFT INSTRUMENTS

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
45.	Introduction to Flight Instruments and Navigation Instruments	1	03-11-2022		TLM3	
46.	Accelerometers	1	05-11-2022		TLM3	
47.	Air speed Indicators	1	07-11-2022		TLM3	
48.	Mach Meters, Altimeters	1	08-11-2022		TLM3	
49.	Gyroscopic Instruments	1	10-11-2022		TLM3	
50.	Principles and operation	1	12-11-2022		TLM3	
51.	Study of various types of engine instruments	1	14-11-2022		TLM3	
52.	Operation and principles of Tachometers	1	15-11-2022		TLM3	
53.	Operation and principles of Temperature and Pressure gauges	1	17-11-2022		TLM3	
54.	Operation and principles of Pressure gauges	1	19-11-2022		TLM3	
55.	Discussion on Unit V, Assignments V	1	21-11-2022		TLM3	
No. of classes required to complete UNIT-V		11				

Contents beyond the Syllabus

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
56.	Introduction to Aircraft Maintenance Engineering	3	22-11-2022 24-11-2011 26-11-2022		**TLM1 & TLM2**	

Teaching Learning Methods			
TLM1	Chalk and Talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C

EVALUATION PROCESS (R17 Regulation):

Evaluation Task	**Marks**
Assignment-I (Units-I, II & UNIT-III (Half of the Syllabus))	A1=5
I-Descriptive Examination (Units-I, II & UNIT-III (Half of the Syllabus))	M1=15
I-Quiz Examination (Units-I, II & UNIT-III (Half of the Syllabus))	Q1=10
Assignment-II (Unit-III (Remaining Half of the Syllabus), IV & V)	A2=5
II- Descriptive Examination (UNIT-III (Remaining Half of the Syllabus), IV & V)	M2=15
II-Quiz Examination (UNIT-III (Remaining Half of the Syllabus), IV & V)	Q2=10
Mid Marks =80% of Max ((M1+Q1+A1), (M2+Q2+A2)) + 20% of Min ((M1+Q1+A1), (M2+Q2+A2))	M=30
Cumulative Internal Examination (CIE): M	30
Semester End Examination (SEE)	70
Total Marks = CIE + SEE	100

PART-D

PROGRAMME OUTCOMES (POs): Engineering Graduates will be able to:

PO 1	**Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem Analysis:** Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	**Conduct Investigation of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including predictions and modeling to complex engineering activities with an understanding of the limitations.
PO 6	**The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and Teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-long Learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1	To apply the knowledge of Aerodynamics, Propulsion, Aircraft structures and Flight Dynamics in the Aerospace vehicle design
PSO 2	To prepare the students to work effectively in Aerospace and Allied Engineering organizations

Title	**Course Instructor**	**Module Coordinator**	**Head of the Department**
Name of the Faculty	Dr.L. Prabhu	Dr.L. Prabhu	Dr.P.Lovaraju
Signature			

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DEPARTMENT OF AEROSPACE ENGINEERING

COURSE HANDOUT

PART-A

Name of Course Instructor: Mr.Nazumuddin Shaik
Course Name & Code **:** Aircrft Structures-II-20AE10
L-T-P Structure **:** 2-1-0 **Credits:** 3
Program/Sem/Sec : B.Tech, V-Sem **A.Y.:** 2022-23

PREREQUISITE: Strength of Materials and Aircraft Structures-I

COURSE EDUCATIONAL OBJECTIVES (CEOs):

The objective of the course is to enable the students apply standard methods calculate the stress and displacement of thin walled symmetrical and unsymmetrical components located in fuselage, wing and landing gear are subjected static loads.

COURSE OUTCOMES (COs): At the end of the course, student will be able to

CO1	Assess the behaviour of beam structures subjected to different loading conditions (Apply-L3)
CO2	Estimate the shear flow distribution and location of shear centre for open sections (Apply-L3)
CO3	Determine the shear flow distribution and location of shear centre in closed section beams (Apply-L3)
CO4	Formulate the relations for thin plates subjected to bending and buckling loads (Apply-L3)
CO5	Analyze the behaviour of bending and shear flow over aircraft wing and fuselage cross-sections (Analyze-L4)

COURSE ARTICULATION MATRIX (Correlation between COs, POs & PSOs):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	-	-	-	-	-	-	-	2	2	3
CO2	3	3	2	2	-	-	-	-	-	-	-	2	2	3
CO3	3	3	2	2	-	-	-	-	-	-	-	3	3	3
CO4	3	3	3	2	-	-	-	-	-	-	-	3	3	3
CO5	3	3	3	2	-	-	-	-	-	-	-	3	3	3
1 - Low						**2 –**Medium					**3 –** High			

TEXTBOOKS:

T1	Peery. D. J, Azar. J. J, Aircraft Structures, Second Edition, McGraw–Hill, New York, 2007.
T2	Megson, T. H. G, Aircraft Structures for Engineering Students, Sixth Edition, Elsevier 2017.

REFERENCE BOOKS:

R1	Bruhn. E. F. Analysis and Design of Flight Vehicles Structures, S. r. Jacobs, 1973.
R2	Rivello. R. M, Theory and Analysis of Flight Structures, McGraw-Hill, 1993.

PART-B

COURSE DELIVERY PLAN (LESSON PLAN):

UNIT-I: BENDING STRESS

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to Course and COs	1	18-07-2022			
2.	Introduction to Unit-I	1	20-07-2022		TLM1&2	
3.	Introduction - Principal Axis	1	22-07-2022		TLM1&2	
4.	Neutral Axis Methods	1	23-07-2022		TLM1&2	
5.	Bending Stresses- Beams of Symmetric Sections Symmetric Loads	1	25-07-2022		TLM1&2	
6.	Beams of Symmetric Sections with Skew Loads	1	27-07-2022		TLM1&2	
7.	**TUTORIAL**	1	29-07-2022		TLM3	
8.	Unsymmetrical Sections with Symmetric Loads.	1	30-07-2022		TLM1&2	
9.	Unsymmetrical Sections with Symmetric Loads.	1	01-08-2022		TLM1&2	
10.	Unsymmetrical Sections with Skew Loads.	1	03-08-2022		TLM1&2	
11.	Unsymmetrical Sections with Skew Loads	1	05-08-2022		TLM1&2	
12.	Problems	1	06-08-2022		TLM1	
13.	Problems	1	08-08-2022		TLM1	
No. of classes required to complete UNIT-I: 13				**No. of classes taken:**		

UNIT-II: SHEAR FLOW IN OPEN SECTIONS

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
14.	Introduction to Unit-II	1	10-08-2022		TLM1&2	
15.	Thin Walled Beams Shear Flow	1	12-08-2022		TLM1&2	
16.	Concept of Shear Flow	1	17-08-2022		TLM1&2	
17.	Shear Centre	1	20-08-2022		TLM1&2	
18.	Shear Flow in Open-Section	1	22-08-2022		TLM1&2	
19.	**TUTORIAL**	1	24-08-2022		TLM3	
20.	Shear Flow in Open-Section Symmetrical	1	26-08-2022		TLM1&2	
21.	Shear Flow in Open-Section Symmetrical	1	27-08-2022		TLM1&2	
22.	Shear Flow in Open-Section Unsymmetrical	1	29-08-2022		TLM1&2	
23.	Shear Flow in Open-Section Unsymmetrical	1	31-08-2022		TLM1&2	
24.	Problems	1	02-09-2022		TLM1	

25.	**TUTORIAL**	1	03-09-2022		TLM3	
No. of classes required to complete UNIT-II: 12				**No. of classes taken:**		

UNIT-III: SHEAR FLOW IN CLOSED SECTIONS

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
26.	Introduction to Unit-III	1	05-09-2022		TLM1&2	
27.	Bredt–Batho Theory	1	07-09-2022		TLM1&2	
28.	Shear Flow in Closed-Section	1	09-09-2022		TLM1&2	
29.	Single Cell –Shear Flow	1	19-09-2022		TLM1&2	
30.	Multi-Cell –Shear Flow	1	21-09-2022		TLM1&2	
31.	Shear Centre	1	23-09-2022		TLM1&2	
32.	**TUTORIAL**	1	24-09-2022		TLM3	
33.	Shear Centre & Torsion	1	10-10-2022		TLM1&2	
34.	Thin Wall Bending with skin Effective	1	12-10-2022		TLM1&2	
35.	Thin Wall Bending with skin Ineffective	1	14-10-2022		TLM1&2	
36.	**TUTORIAL**	1	15-10-2022		TLM3	
37.	Problems	1	17-10-2022		TLM1&2	
No. of classes required to complete UNIT-III: 12				**No. of classes taken:**		

UNIT-IV: BENDING & BUCKLING OF THIN PLATES

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
38.	Plates Subjected to Pure Bending and Twisting	1	19-10-2022		TLM1&2	
39.	Plates Subjected to Distributed and Transverse Load	1	21-10-2022		TLM1&2	
40.	In-Plane Loading	1	22-10-2022		TLM1&2	
41.	Thin Rectangular Plate with Small Initial Curvature.	1	31-10-2022		TLM1&2	
42.	**TUTORIAL**	1	02-11-2022		TLM3	
43.	Introduction to Inelastic buckling of plates	1	04-11-2022		TLM1&2	
44.	Determination of critical load for a flat plate	1	05-11-2022		TLM1&2	
45.	Local instability, Instability of stiffened panels	1	07-11-2022		TLM1&2	
46.	Failure stress in plates and stiffened panels	1	09-11-2022		TLM1&2	
No. of classes required to complete UNIT-IV: 09				**No. of classes taken:**		

UNIT-V: STRESS ANALYSIS IN WING AND FUSELAGE

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
47.	Introduction to Unit-V	1	11-11-2022		TLM1&2	
48.	Study of Wing Spars and Box Beams	1	12-11-2022		TLM1&2	

49.	Shear Resistant Web Beams	1	14-11-2022		TLM1&2	
50.	Tension Field Web Beams (Wagner's)	1	16-11-2022		TLM1&2	
51.	**TUTORIAL**	1	18-11-2022		TLM3	
52.	Procedures to Find Shear stress Distribution for Cantilever Beam.	1	19-11-2022		TLM1&2	
53.	Procedures to Bending Moment Distribution for Cantilever Beam.	1	21-11-2022		TLM1&2	
54.	**TUTORIAL**	1	23-11-2022		TLM3	
55.	Problems	1	25-11-2022		TLM1&2	
56.	Problems	1	26-11-2022		TLM1&2	
No. of classes required to complete UNIT-V: 10				**No. of classes taken:**		

Teaching Learning Methods			
TLM1	Chalk and Talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C

EVALUATION PROCESS (R17 Regulation):

Evaluation Task	**Marks**
Assignment-I (Units-I, II & UNIT-III (Half of the Syllabus))	A1=5
I-Descriptive Examination (Units-I, II & UNIT-III (Half of the Syllabus))	M1=15
I-Quiz Examination (Units-I, II & UNIT-III (Half of the Syllabus))	Q1=10
Assignment-II (Unit-III (Remaining Half of the Syllabus), IV & V)	A2=5
II- Descriptive Examination (UNIT-III (Remaining Half of the Syllabus), IV & V)	M2=15
II-Quiz Examination (UNIT-III (Remaining Half of the Syllabus), IV & V)	Q2=10
Mid Marks =80% of Max ((M1+Q1+A1), (M2+Q2+A2)) + 20% of Min ((M1+Q1+A1), (M2+Q2+A2))	M=30
Cumulative Internal Examination (CIE): M	30
Semester End Examination (SEE)	70
Total Marks = CIE + SEE	100

PART-D

PROGRAMME OUTCOMES (POs):

Engineering Graduates will be able to:

PO 1	**Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

PO 2	**Problem Analysis:** Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	**Conduct Investigation of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.
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PO 6	**The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and Teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-long Learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1	To apply the knowledge of Aerodynamics, Propulsion, Aircraft structures and Flight Dynamics in the Aerospace vehicle design
PSO 2	To prepare the students to work effectively in Aerospace and Allied Engineering organizations

Title	**Course Instructor**	**Module Coordinator**	**Head of the Department**
Name of the Faculty	Mr. Nazumuddin Shaik	Dr.L. Prabhu	Dr.P.Lovaraju
Signature			

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L B Reddy Nagar, Mylavaram-521 230, Krishna District, Andhra Pradesh.

COURSE HANDOUT
PART-A

PROGRAM : B.Tech., V-Sem., ASE

ACADEMIC YEAR : 2022-23

COURSE NAME & CODE : **GAS DYNAMICS-20AE09**

L-T-P STRUCTURE : 2-1-0

COURSE CREDITS : 3

COURSE INSTRUCTOR : **Dr. P. Lovaraju**

PRE-REQUISITES: Engineering Fluid Mechanics, Engineering Thermodynamics, Aerodynamics

Course Educational Objectives: To learn the basic concepts of compressible fluid flows, steady one-dimensional flow properties discharging from a reservoir, the supersonic flow properties, the basic formulation for flow with friction and heat transfer and the theoretical aspects of compressible flow over wings

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

CO1	Apply the of compressible fluid flow equations solve flow problems (Apply-L3)
CO2	Apply the steady one-dimensional flow principles in designing the nozzles and diffusers (Apply-L3)
CO3	Analyze the supersonic flow behaviour over objects (Analyze-L4)
CO4	Analyze fluid flow through ducts by considering friction and heat transfer affects (Analyze-L4)
CO5	Apply compressible flow theory to analyze flow over wings (Apply-L3)

COURSE ARTICULATION MATRIX (Correlation between COs&POs,PSOs):

Course Code	Cos	Program Outcomes												PSOs	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
20AE09	CO1	3	2	2	2	-	-	-	-	-	-	-	3	3	3
	CO2	3	3	2	2	-	-	-	-	-	-	-	3	3	3
	CO3	3	3	2	3	-	-	-	-	-	-	-	3	3	3
	CO4	3	2	2	3	-	-	-	-	-	-	-	3	3	3
	CO5	3	2	2	3	-	-	-	-	-	-	-	3	3	3
1 = Slight (Low)		**2 = Moderate (Medium)**											**3-Substantial(High)**		

Note: Enter Correlation Levels **1** or **2** or **3.** If there is no correlation, **put '-' 1-** Slight(Low), **2 -** Moderate(Medium), **3 -** Substantial (High).

TEXT BOOKS:

T1 Rathakrishnan. E, Gas Dynamics, 7th Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2021

REFERENCE BOOKS:

R1 Ascher H. Shapiro, The dynamics and thermodynamics of compressible fluid flow Vol 1, The Ronald press Co. New York, 1953

R2 Lipmann. H. W, Roshko. A, Elements of Gas Dynamics, John Wiley & Sons, New York

R3 Thomson P.A., Compressible Fluid Dynamics, McGraw-Hill, New York, 1972

R4 Anderson, J.D., "Fundamentals of Aerodynamics", McGraw-Hill Book Co., New York, 1998

PART-B

COURSE DELIVERY PLAN (LESSON PLAN):

UNIT-I: BASICS OF COMPRESSIBLE FLOW:

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Overview of the Course, Course outcome, Introduction	2	18-07-2022 20-07-2022		TLM1	
2.	Revision of Thermodynamics related to this course	2	21-07-2022 22-07-2022		TLM1	
3.	Compressibility and its limiting conditions	1	25-07-2022		TLM1	
4.	Speed of Sound and its thermodynamics formulation	1	27-07-2022		TLM1	
5.	Introduction to Entropy, Entropy formulations	1	28-07-2022		TLM1	
6.	Basic form of Isentropic relations	1	29-07-2022		TLM1	
7.	Isentropic relations suitable for Compressible flows (in terms of Mach number), Stagnation Properties	2	1-08-2022 3-08-2022		TLM1	

8.	Mach Angle, Mach cone, Mach wave, Shock Wave, Wave Propagation	1	4-08-2022		TLM1	
9.	Tutorial-I	1	5-08-2022		TLM3	
10.	Assignment/Quiz-1				---	
No. of classes required to complete UNIT-I		**12**		**No. of classes taken:**		

UNIT-II: STEADY ONE-DIMENSIONAL FLOW:

S.No.	**Topics to be covered**	**No. of Classes Required**	**Tentative Date of Completion**	**Actual Date of Completion**	**Teaching Learning Methods**	**HOD Sign Weekly**
11.	Introduction, Fundamental Equations	1	8-08-2022		TLM1, TLM2	
12.	Discharge from a reservoir formulations	1	10-08-2022		TLM1	
13.	Mass flow per Unit Area	1	11-08-2022		TLM1	
14.	Critical Values	1	12-08-2022		TLM1	
15.	Streamtube Area velocity relation	1	17-08-2022		TLM1,TLM2	
16.	Nozzle and its types, Applications of Nozzle	1	18-08-2022		TLM1,TLM2	
17.	De Laval Nozzle, Area Mach number relation	1	22-08-2022		TLM1	
18.	Isentropic flow through nozzle	1	24-08-2022		TLM1, TLM2	
19.	Nozzle flow physics	1	25-08-2022		TLM1	
20.	Diffusers	1	26-08-2022		TLM1	
21.	Compressibility correction to dynamic pressure	1	29-08-2022		TLM1	
22.	Tutorial-II	1	1-09-2022		TLM3	
23.	Assignment/Quiz-2				----	
No. of classes required to complete UNIT-II		**12**		**No. of classes taken:**		

(CRT 12-09-2022 to 17-09-2022)

I Mid Examination (26-09-2022 to 1-10-2022)

UNIT-III: SHOCK AND EXPANSION WAVES:

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
24.	Introduction and Types of Waves	1	2-09-2022		TLM1,TLM4	
25.	Normal Shock-Equations of Motion, Normal Shock relation for perfect gas	1	19-09-2022		TLM1, TLM2	
26.	Hugoniot Equation	1	21-09-2022		TLM1	
27.	Oblique Shock introduction, Oblique Shock relations	1	22-09-2022		TLM1, TLM2	
28.	Relation Between β-θ-M	1	23-09-2022		TLM1	
29.	Detached shocks, Expansion waves, Prandtl Meyer Flow	1	10-10-2022		TLM1	
30.	Flow with shocks and expansion waves at the exit of a convergent-divergent nozzle	2	12-10-2022 13-10-2022		TLM1	
31.	Tutorial-3	1	14-10-2022		TLM3	
32.	Assignment/Quiz-3					
No. of classes required to complete UNIT-III		9		**No. of classes taken:**		

(CRT- 26-10-2022 to 29-10-2022)

UNIT-IV: FLOW WITH FRICTION AND HEAT TRANSFER

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
33.	Introduction, Flow in constant Area Duct with friction	1	17-10-2022		TLM1	
34.	Adiabatic Constant area flow of a perfect gas (basic Formulation)	2	19-10-2022 20-10-2022		TLM1,TLM5	
35.	Definition of Friction	1	21-10-2022		TLM1	

	Coefficient, Effect of Wall Friction on Fluid Properties					
36.	Working Relations	1	2-11-2022		TLM1	
37.	Flow with heating and cooling in ducts, Rayleigh line relation	1	3-11-2022		TLM1	
38.	Basic Formulation	1	4-11-2022		TLM1	
39.	Working Relations	2	7-11-2022 9-11-2022		TLM1	
40.	Tutorial-4	1	10-11-2022		TLM3	
41.	Assignment/Quiz-4					
No. of classes required to complete UNIT-IV		10		**No. of classes taken:**		

UNIT-V: COMPRESSIBLE FLOW OVER WINGS

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
42.	Introduction, Potential Equation for Compressible flow	1	11-11-2022		TLM1,TLM5	
43.	Linearization of Potential Equation	2	14-11-2022 16-11-2022		TLM1	
44.	Prandtl-Glauert Rule	1	17-11-2022		TLM1,TLM5	
45.	Critical Mach Number	1	18-11-2022		TLM1	
46.	Drag-Divergence Mach Number	1	21-11-2022		TLM1	
47.	Area-Rule, Supercritical Aerofoil, Forward Swept and Swept Back Wings, Delta Wings	1	23-11-2022		TLM1	
48.	Crocco's Theorem	1	24-11-2022		TLM1	
49.	Tutorial -5	1	25-11-2022		TLM3	
50.	Assignment/Quiz-5					
51.	Revision				TLM2	
No. of classes required to complete UNIT-V		**9**		**No. of classes taken:**		

Teaching Learning Methods			
TLM1	Chalk and Talk	**TLM4**	Demonstration (lab or field visit)
TLM2	PPT	**TLM5**	ICT (NPTEL, Swayam Prabha, MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/project

PART-C

EVALUATION PROCESS (R20 Regulation):

Evaluation Task	**Marks**
Assignment-I (Units-I, II & UNIT-III (Half of the Syllabus))	A1=5
I-Descriptive Examination (Units-I, II & UNIT-III (Half of the Syllabus))	M1=15
I-Quiz Examination (Units-I, II & UNIT-III (Half of the Syllabus))	Q1=10
Assignment-II (Unit-III (Remaining Half of the Syllabus), IV & V)	A2=5
II- Descriptive Examination (UNIT-III (Remaining Half of the Syllabus), IV & V)	M2=15
II-Quiz Examination (UNIT-III (Remaining Half of the Syllabus), IV & V)	Q2=10
Mid Marks =80% of Max ((M1+Q1+A1), (M2+Q2+A2)) + 20% of Min ((M1+Q1+A1), (M2+Q2+A2))	M=30
Cumulative Internal Examination (CIE): M	30
Semester End Examination (SEE)	70
Total Marks = CIE + SEE	100

PART-D

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

PO1: Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

PO3: Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct Investigation of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.

PO5: Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including predictions and modeling to complex engineering activities with an understanding of the limitations.

PO6: The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: To apply the knowledge of Aerodynamics, Propulsion, Aircraft structures and Flight Dynamics in the Aerospace vehicle design

PSO2: To prepare the students to work effectively in Aerospace and Allied Engineering organizations

Course Instructor	**Module Coordinator**	**HOD**

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L.B. REDDY NAGAR, MYLAVARAM, KRISHNA DIST., A.P.-521 230.
Phone: 08659-222933, Fax: 08659-222931

DEPARTMENT OF AEROSPACE ENGINERRING

COURSE HANDOUT

PART-A

Name of Course Instructor: S.Indrasena Reddy
Course Name & Code **:** FEME & 20AE12
L-T-P Structure **:3-1-0** **Credits:** 3
Program/Sem/Sec : B.Tech/V Sem **A.Y.:** 2022-23

PREREQUISITE: **Engineering Mechanics**

COURSE EDUCATIONAL OBJECTIVES (CEOs):

COURSE OUTCOMES (COs): At the end of the course, student will be able to

CO1	Identify mathematical model for solution of common engineering problems (Understand-L2)
CO2	Analyze structural behavior of Plane Truss Elements (Analyze-L4)
CO3	Determine the design quantities (deformation, strain, stress) for engineering structures under different loading conditions (Apply-L3)
CO4	Formulate new solutions for the existing problems using FEM approaches (Apply-L3)
CO5	Estimate natural frequencies of bar and beam structures (Apply-L3)

COURSE ARTICULATION MATRIX (Correlation between COs, POs & PSOs):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1	-	-	-	-	-	-	-	2	3	3
CO2	3	3	3	3	-	-	-	-	-	-	-	3	3	3
CO3	3	3	3	3	-	-	-	-	-	-	-	3	3	3
CO4	3	3	2	3	-	-	-	-	-	-	-	3	3	3
CO5	3	3	3	2	-	-	-	-	-	-	-	3	3	3

1 - Low **2 –**Medium **3 -** High

REFERENCES

1. Chandraputla, Ashok, Belegundu., Introduction to Finite Elements in Engineering, 4th edition, Pearson Education India, 2015
2. Rao.S.S, The Finite Element Methods in Engineering, 4th edition, 6th reprint, B.H. Pergamon, 2010.
3. Reddy.J.N, An introduction to Finite Element Method, 3rd edition, 13th reprint, McGraw Hill, 2011.
4. Kenneth H. Huebner, Donald L. Dewhirst, Douglas E Smith, Ted G. Byrom., The Finite Element Method for Engineers, 4th edition, John Wiley & sons (ASIA) Pvt Ltd, 2001.
5. David Hutton., Fundamentals of Finite Element Analysis, Tata McGraw Hill, 2005
6. George R Buchanan, R.Rudra Moorthy., Finite Element Analysis, Tata McGraw Hill, 2006

PART-B

COURSE DELIVERY PLAN (LESSON PLAN):

UNIT-I: INTRODUCTION TO FEM & 1-D PROBLEMS

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to FEM	1	18-07-22		**TLM1**	
2.	Equilibrium equations	1	20-07-22		**TLM1**	
3.	Stresses and equilibrium	1	21-07-22		**TLM1**	
4.	Strain displacement relations	1	22-07-22		**TLM1**	
5.	Stress strain relations	1	25-07-22		**TLM1**	
6.	Plane stress and plane strain problems	1	27-07-22		**TLM1**	
7.	Potential energy and equilibrium method	1	28-07-22		**TLM1**	
8.	FE Formulation from governing diff. equations	1	29-07-22		**TLM1**	
9.	Weighted residual methods	1	01-08-22		**TLM1**	
10.	FE Modeling, 1-D bar problems	1	03-08-22		**TLM1**	
11.	coordinates of shape functions	1	04-08-22		**TLM1**	
12.	Assembly of GSM & Load vector	1	05-08-22		**TLM1**	
13.	Finite element equations	1	08-08-22		**TLM3**	
14.	FE-treatment of boundary conditions	1	10-08-22		**TLM1**	
No. of classes required to complete UNIT-I: 14				**No. of classes taken:**		

UNIT-II: ANALYSIS OF TRUSSES:

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
15.	Introduction- Plane Trusses	1	11-08-22		**TLM1**	
16.	Local and Global Coordinate Systems	1	12-08-22		**TLM1**	
17.	Transformation Matrix	1	17-08-22		**TLM1**	
18.	Derivation of Element Stiffness Matrix	1	18-08-22		**TLM1**	
19.	Stress Calculations.	1	22-08-22		**TLM1**	
20.	Element Stiffness Matrix	1	24-08-22		**TLM1**	
21.	Plane truss Problems – Vertical deformation	1	25-08-22		**TLM1**	
22.	Plane truss Problems	1	26-08-22		**TLM3**	
23.	Plane truss Problems -Stresses	1	29-08-22		**TLM1**	
No. of classes required to complete UNIT-II: 09			**No. of classes taken:**			

UNIT-III: ANALYSIS OF BEAMS:

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
24.	Analysis of Beams: Beam elements	1	01-09-22		**TLM1**	
25.	Types loading ,DOF, BC's	1	02-09-22		**TLM1**	
26.	Hermite shape functions	1	05-09-22		**TLM1**	
27.	Hermite shape functions-Derivation	1	07-09-22		**TLM1**	
28.	Element Stiffness matrix	1	08-09-22		**TLM1**	
29.	Load vector, Boundary conditions	1	09-09-22		**TLM1**	
30.	Beam problems	1	10-10-22		**TLM3**	
31.	Two dimensional elements (CST)	1	12-10-22		**TLM1**	
32.	CST problems	1	13-10-22		**TLM1**	
33.	Shape functions, Stiffness matrix,	1	14-10-22		**TLM1**	
34.	Strain-Displacement matrix	1	17-10-22		**TLM1**	
35.	Force terms	1	19-10-22		**TLM1**	
No. of classes required to complete UNIT-III: 12			**No. of classes taken:**			

UNIT-IV: FINITE ELEMENT MODELING OF AXISYMMETRIC SOLIDS

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
36.	Axisymmetric solids	1	20-10-22		**TLM1**	
37.	Finite element modeling-Jacobian Matrix	1	21-10-22		**TLM1**	
38.	Element Stiffness matrix	1	26-10-22		**TLM1**	
39.	Axisymmetric loading with triangular elements	1	27-10-22		**TLM1**	
40.	Axisymmetric Problems	1	28-10-22		**TLM1**	
41.	Problems on Axisymmetric Loading	1	31-10-22		**TLM3**	
42.	Four nodded isoparametric elements	1	02-11-22		**TLM1**	
43.	Jacobian, shape functions	1	03-11-22		**TLM1**	
44.	4- node quadrilateral element	1	04-11-22		**TLM1**	
45.	Numerical integration	1	07-11-22		**TLM1**	
46.	Gauss Quadrature	1	09-11-22		**TLM1**	
No. of classes required to complete UNIT-IV: 11				**No. of classes taken:**		

UNIT-V: DYNAMIC ANALYSIS

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
47.	Dynamic Analysis intro	1	10-11-22		**TLM1**	
48.	Lumped mass matrices	1	11-11-22		**TLM1**	
49.	Consistent mass matrices	1	14-11-22		**TLM1**	
50.	Problems	1	16-11-22		**TLM1**	
51.	Evaluation of Eigen values, Eigen vectors	1	17-11-22		**TLM1**	
52.	Evaluation of stepped bars	1	18-11-22		**TLM1**	
53.	Eigen values, Eigen vectors	1	21-11-22		**TLM3**	
54.	Stepped bars Problems	1	23-11-22		**TLM1**	
55.	Stepped bars Problems- Eigen values	1	24-11-22		**TLM1**	
56.	Evaluation of Eigen values-Problems	1	25-11-22		**TLM1**	
No. of classes required to complete UNIT-V: 11				**No. of classes taken:**		

Teaching Learning Methods			
TLM1	Chalk and Talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha /MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C

EVALUATION PROCESS (R17 Regulation):

Evaluation Task	Marks
Assignment-I (Units-I, II & UNIT-III (Half of the Syllabus))	A1=5
I-Descriptive Examination (Units-I, II & UNIT-III (Half of the Syllabus))	M1=15
I-Quiz Examination (Units-I, II & UNIT-III (Half of the Syllabus))	Q1=10
Assignment-II (Unit-III (Remaining Half of the Syllabus), IV & V)	A2=5
II- Descriptive Examination (UNIT-III (Remaining Half of the Syllabus), IV & V)	M2=15
II-Quiz Examination (UNIT-III (Remaining Half of the Syllabus), IV & V)	Q2=10
Mid Marks =80% of Max ((M1+Q1+A1), (M2+Q2+A2)) + 20% of Min ((M1+Q1+A1), (M2+Q2+A2))	M=30
Cumulative Internal Examination (CIE): M	30
Semester End Examination (SEE)	70
Total Marks = CIE + SEE	100

PART-D

PROGRAMME OUTCOMES (POs):

PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations
PO 6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO 7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethic**s: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1	To apply the knowledge of Aerodynamics, Propulsion, Aircraft structures and Flight Dynamics in the Aerospace vehicle design
PSO 2	To prepare the students to work effectively in Aerospace and Allied Engineering organizations

Course Instructor	Course Coordinator	Module Coordinator	HOD
(S.Indrasena Reddy)	(S.Indrasena Reddy)	(Dr.Prabhu.L)	(Dr.P.Lovaraju)

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Approved by AICTE, New Delhi and Affiliated to JNTUK, Kakinada
L.B.Reddy Nagar, Mylavaram-521230, Krishna Dist, Andhra Pradesh, India

DEPARTMENT OF ELECTRONICS AND COMMUNICATION

COURSE HANDOUT

PART-A

Name of Course Instructor : P. James Vijay
Course Name & Code : SATELLITE TECHNOLOGY - 20EC81
L-T-P Structure : 3-0-0 Credits : 3
Program/Sem/Sec : B.Tech., ASE., V-Sem., A.Y : 2022-23

PRE-REQUISITE: Basics related to Dynamics, Kinematics, Thermodynamics and Properties of an Ellipse.

COURSE EDUCATIONAL OBJECTIVES (CEOs): This course provides the knowledge on different laws associated with the motion of a satellite. The course gives the knowledge on launching a satellite into orbit with launch vehicles. The course also provides the knowledge on various subsystems, structures, thermal control, and applications of a satellite.

COURSE OUTCOMES (COs): At the end of the course, students are able to

CO 1	**List** out the operational bands, Space craft control mechanisms**,** sensors and navigational aids for satellite applications **(Remember-L1)**
CO 2	**Summarize** the functions of satellite space segment, earth segment, Multiple access techniques and satellite services. **(Understand-L2)**
CO 3	**Illustrate** the operational principles of satellite power system and space craft Control mechanism. **(Understand-L2)**
CO 4	**Outline** the concepts of orbital mechanics & satellite communication and its application**(Understand-L2)**

COURSE ARTICULATION MATRIX (Correlation between COs, POs & PSOs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	1	-	-	-	-	3	2	-	-	-	-	1	1	-	-
CO2	1	1	1	-	-	2	1	-	-	-	-	1	2	-	-
CO3	1	1	1	-	-	2	1	-	-	-	-	1	2	-	-
CO4	1	1	1	-	-	2	1	-	-	-	-	1	2	-	-

Note: Enter Correlation Levels **1** or **2** or **3.** If there is no correlation, **put '-'**
1- Slight (Low), **2 –** Moderate (Medium), **3 -** Substantial (High).

TEXT BOOKS:

T1 Timothy Pratt, Charles Bostian, Jeremy Allnutt , "Satellite communications", John Wiley & Sons,2"^{d} edition, 2003.

REFERENCE BOOKS:

R1 M. Richharia, "Satellite Communications Systems: Design principles", BS Publications, 2nd Edition, 2005.

R2 D.C Agarwal , "Satellite communications", Khanna Publications, 5th Edition,2006.

R3 Richard, Filipowsky Eugen 1 Muehllorf, 'Space Communication Systems', Prentice Hall 1995.

PART-B

COURSE DELIVERY PLAN (LESSON PLAN):

UNIT-I: Introduction to Satellite Systems:

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Course Objectives	1	19/07/2022		TLM2	
2.	Brief introduction about the course and its importance.	1	21/07/2022		TLM2	
3.	Need for Space Communications, Definition of a satellite and Orbit.	1	22/07/2022		TLM2	
4.	General Structure of satellite Communication	1	23/07/2022		TLM2	
5.	Types of Spacecraft Orbits	1	26/07/2022		TLM2	
6.	Common satellite applications and missions	1	28/07/2022		TLM2	
7.	Launch Vehicles and Launching of a satellite	1	29/07/2022		TLM2	
8.	Satellite system and their functions-(Structural, thermal, power mechanisms, propulsion, etc)	1	30/07/2022		TLM2	
9.	Revision	1	02/08/2022			
No. of classes required to complete UNIT-I: 9				No. of classes taken:		

UNIT-II: Orbital Mechanics:

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction and overview of Orbital Mechanics	1	04/08/2022		TLM1	
2.	Newton's laws of Force, Fundamentals of Orbital Dynamics-Kepler's laws	1	05/08/2022		TLM2	
3.	Orbital parameters and determination	2	06/08/2022 11/08/2022		TLM2	
4.	Orbital Perturbations-Need for station keeping	1	12/08/2022		TLM1	
5.	GPS systems-Architecture of GPS, Working Principle of GPS	2	13/08/2022 16/08/2022		TLM2	
6.	Ground station or Earth station Requirements	1	18/08/2022		TLM1	
7.	Problems and Revision	1	20/08/2022		TLM1	
No. of classes required to complete UNIT-II: 9				No. of classes taken:		

UNIT-III: Power System and Bus Electronics:

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to Power system and Bus electronics	1	23/08/2022		TLM2	

2.	Solar Panels: Silicon and Ga-As Cells	2	25/08/2022 26/08/2022		TLM2	
3.	Power generation capacity, efficiency	2	27/08/2022 30/08/2022		TLM1, TLM2	
4.	Space Battery Systems	1	01/09/2022		TLM2	
5.	Battery Types, Characteristics , Battery efficiency Parameters	1	02/09/2022		TLM2	
6.	Telemetry, Tracking and Command Control (TT&C) functions	2	03/09/2022 06/09/2022		TLM2	
7.	Telemetry, Tracking and Command Control (TT&C) functions	2	08/09/2022 09/09/2022		TLM2	
8.	Generally Employed Communication Bands	1	10/09/2022		TLM2	
9.	Revision	1	04/10/2022			
No. of classes required to complete UNIT-III: 13				No. of classes taken:		

UNIT-IV : Spacecraft Control:

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to Spacecraft Control	1	06/10/2022		TLM2	
2.	Control Requirements: Attitude Control and station keeping functions, type of control maneuvers	2	07/10/2022 08/10/2022		TLM2	
3.	Stabilization Schemes: Spin stabilization	1	11/10/2022		TLM2	
4.	gravity gradient method, 3 axis stabilization	2	13/10/2022 14/10/2022		TLM2	
5.	Commonly Used Control Systems: Mass expulsion systems, Momentum exchange systems.	2	18/10/2022 20/10/2022		TLM2	
6.	Gyro and Magnetic Torque -sensors, Star and sun sensor, Earth sensor.	1	21/10/2022		TLM2	
7.	Magnetometers and Inertial Sensors.	1	22/10/2022		TLM2	
No. of classes required to complete UNIT-IV: 10				No. of classes taken:		

UNIT-V : Satellite Services and Applications:

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction, GPS architecture	1	25/10/2022		TLM2	
2.	Location principle	1	27/10/2022		TLM2	
3.	Direct to home, home receiver	1	28/10/2022		TLM2	
4.	Satellite mobile services, VSAT	1	29/10/2022		TLM2	
5.	MSAT, RADARSAT	1	01/11/2022		TLM2	

6.	IRNSS Constellation	1	03/11/2022		TLM2	
7.	Satellite structures and materials	1	04/11/2022		TLM2	
8.	Revision	1	05/11/2022			
No. of classes required to complete UNIT-V: 8				No. of classes taken:		

Teaching Learning Methods			
TLM1	Chalk and Talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C

EVALUATION PROCESS (R17 Regulations):

Evaluation Task	**Marks**
Assignment-I (Unit-I)	A1=5
Assignment-II (Unit-II)	A2=5
I-Mid Examination (Units-I & II)	M1=20
I-Quiz Examination (Units-I & II)	Q1=10
Assignment-III (Unit-III)	A3=5
Assignment-IV (Unit-IV)	A4=5
Assignment-V (Unit-V)	A5=5
II-Mid Examination (Units-III, IV & V)	M2=20
II-Quiz Examination (Units-III, IV & V)	Q2=10
Attendance	B=5
Assignment Marks = Best Four Average of A1, A2, A3, A4, A5	A=5
Mid Marks =75% of Max(M1,M2)+25% of Min(M1,M2)	M=20
Quiz Marks =75% of Max(Q1,Q2)+25% of Min(Q1,Q2)	B=10
Cumulative Internal Examination (CIE) : A+B+M+Q	40
Semester End Examination (SEE)	60
Total Marks = CIE + SEE	100

PART-D

PROGRAMME OUTCOMES (POs):

PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations
PO 6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO 7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethic**s: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1	**Communication:** Design and develop modern communication technologies for building the inter disciplinary skills to meet current and future needs of industry.
PSO 2	**VLSI and Embedded Systems:** Design and Analyze Analog and Digital Electronic Circuits or systems and Implement real time applications in the field of VLSI and Embedded Systems using relevant tools
PSO 3	**Signal Processing:** Apply the Signal processing techniques to synthesize and realize the issues related to real time applications

Course Instructor	Course Coordinator	Module Coordinator	HOD
Mr. P. James Vijay	Mr. P. James Vijay	Dr. M. V. Sudhakar	Dr. Y. Amar Babu

LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING

(AUTONOMOUS)

Accredited by NAAC with 'A' grade& NBA (Under Tier - I), ISO 9001:2015 Certified Institution
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DEPARTMENT OF AEROSPACE ENGINEERING

COURSE HANDOUT

PART-A

Name of Course Instructor: Mr. Nazumuddin Shaik/ Dr. Prabhu L

Course Name & Code : Aircraft Structures Lab - 20AE57 **Regulation**: R20

L-T-P Structure : 0-0-3 **Credits:** 1.5

Program/Sem/Sec : B.Tech/V-SEM **A.Y.:** 2022-23

PRE-REQUISITES: Engineering workshop

COURSE EDUCATIONAL OBJECTIVES (CEOs):

To understand the various principles and theorems involved in the theory of aircraft structure, vibrations and experimental analysis by doing simple and advanced experiments and analysing the results.

COURSE OUTCOMES (COs): After completion of the course students are able to:

CO1	Analyze beam structures subjected to different loading conditions (Analyze-L4)
CO2	Analyze deflection based on different theories (Analyze-L4)
CO3	Analyze the performance of cams, governors and gyroscope (Analyze-L4)

COURSE ARTICULATION MATRIX (Correlation between COs, POs & PSOs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	3	-	-	-	-	-	-	-	3	3	3
CO2	2	3	2	3	-	-	-	-	-	-	-	3	3	3
CO3	2	3	2	3	-	-	-	-	-	-	-	3	3	3

Note: Enter Correlation Levels **1** or **2** or **3.** If there is no correlation, **put '-'1-** Slight (Low), **2 –** Moderate (Medium), **3 -** Substantial (High).

PART-B

COURSE DELIVERY PLAN (LESSON PLAN):

S. No.	Topics to be covered (Experiment Name)	Tentative Date of Completion	Actual Date of Completion	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
		BATCH-II		BATCH-I			
1.	Demo	18-07-2022		22-07-2022		TLM4	
2.	Compression Test of Columns.	25-07-2022		29-07-2022		TLM4	
3.	Verification of Maxwell's Reciprocal Theorem.	01-08-2022		05-08-2022		TLM4	
4.	Verification of Castigliano's Theorem.	08-08-2022		12-08-2022		TLM4	
5.	Shear Failure of Bolted and Riveted Joints.	22-08-2022		26-08-2022		TLM4	
6.	Non Destructive Test- Dye Penetration Test and Magnetic Particle Detection.	29-08-2022		02-09-2022		TLM4	
7.	Unsymmetrical Bending of a Cantilever Beam (C, Z, L and T-Sections)	10-10-2022		07-10-2022		TLM4	
8.	Wagner Beam-Tension Field Beam.	17-10-2022		14-10-2022		TLM4	
9.	Determine gyroscopic couple using Gyroscope.	31-10-2022		21-10-2022		TLM4	
10.	Evaluate the performance of Governors	07-11-2022		28-10-2022		TLM4	
11.	Composite Laminate preparation and testing.	14-11-2022		04-11-2022		TLM4	
12.	Repetition					TLM4	
13.	Lab internal Exam					TLM4	

Teaching Learning Methods			
TLM1	Chalk and Talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C

EVALUATION PROCESS (R20 Regulation):

Evaluation Task	**Expt. no's**	**Marks**
Day to Day work = **A**	1,2,3,4,5,6,7,8.	A=05
Record = **B**	1,2,3,4,5,6,7,8	B=05
Internal Test = **C**	1,2,3,4,5,6,7,8	C = 05
Cumulative Internal Examination : A + B + C = 15	1,2,3,4,5,6,7,8	**15**
Semester End Examinations = D	1,2,3,4,5,6,7,8	**D = 35**
Total Marks: A + B + C + D = 50	1,2,3,4,5,6,7,8	**50**

PART-D

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

PEO 1	To provide students with sound mathematical, engineering and multidisciplinary knowledge to solve Aerospace and Allied Engineering problems
PEO 2	To prepare students to excel in higher education programs and to succeed in industry/academia profession.
PEO 3	To inculcate ethical attitude, leadership qualities, problem solving abilities and life-long learning for a successful professional career

PROGRAMME OUTCOMES (POs):

Engineering Graduates will be able to:

PO 1	**Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem Analysis:** Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	**Conduct Investigation of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including predictions and modeling to complex engineering activities with an understanding of the limitations.
PO 6	**The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental

	contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and Teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-long Learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1	To apply the knowledge of Aerodynamics, Propulsion, Aircraft structures and Flight Dynamics in the Aerospace vehicle design
PSO 2	To prepare the students to work effectively in Aerospace and Allied Engineering organizations

Title	**Course Instructor**	**Module Coordinator**	**Head of the Department**
Name of the Faculty	Mr. Nazumuddin Shaik	Dr.L. Prabhu	Dr.P.Lovaraju
Signature			

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DEPARTMENT OF AEROSPACE ENGINEERING

COURSE HANDOUT

PART-A

Name of Course Instructor: Dr.P.Lovaraju/Mr.I.Dakshina Murthy
Course Name & Code : Aerodynamics Lab-20AE56 Regulation: R20
L-T-P Structure : 0-0-3 Credits: 1.5
Program/Sem/Sec : B.Tech/V-SEM A.Y.: 2022-23

Course Educational Objectives:
1. To learn the basic experiments in wind tunnel
2. To learn the basic experiments in open jet facility
3. To learn the basic flow visualization techniques

Course Outcomes: At the end of the semester, the student will be able to
CO1: To analyze the flow characteristics over aerodynamic bodies (Analyze-L4)
CO2: To analyze nozzle flow characteristics (Analyze-L4)

COURSE ARTICULATION MATRIX (Correlation between COs&POs,PSOs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	**3**	**3**	**3**	**3**								**3**	**3**	**3**
CO2	**3**	**3**	**3**	**3**								**3**	**3**	**3**

Note: Enter Correlation Levels **1** or **2** or **3.** If there is no correlation, **put '-'1-** Slight (Low), **2 –** Moderate (Medium), **3 -** Substantial (High).

PART-B

COURSE DELIVERY PLAN (LESSON PLAN):

S. No.	Topics to be covered (Experiment Name)	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
			BATCH-A		**BATCH-B**			
1.	Introduction	03	18-07-2022		22-07-2022		TLM4	
2.	Exp No1.	03	25-07-2022		29-07-2022		TLM4	
3.	Exp No 2	03	01-08-2022		05-08-2022		TLM4	
4.	Exp No 3	03	08-08-2022		12-08-2022		TLM4	
5.	Exp No 4	03	22-08-2022		26-08-2022		TLM4	
6.	Exp No 5	03	29-08-2022		02-09-2022		TLM4	
7.	Exp No 6	03	10-10-2022		07-10-2022		TLM4	

8.	Exp No 7	03	17-10-2022		14-10-2022		TLM4	
9.	Exp No 8	03	31-10-2022		21-10-2022		TLM4	
10.	Exp No 9	03	07-11-2022		28-10-2022		TLM4	
11.	Exp No 10	03	14-11-2022		04-11-2022		TLM4	
12.	Repetition	03	----		11-11-2022		TLM4	
13.	Lab internal Exam	03	14-11-2022		18-11-2022		TLM4	
No. of classes required to complete: 13						**No. of classes taken:**		

Teaching Learning Methods			
TLM1	Chalk and Talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C

EVALUATION PROCESS (R20 Regulation):

Evaluation Task	**Expt. no's**	**Marks**
Day to Day work = **A**	1,2,3,4,5,6,7,8…	A=05
Record = **B**	1,2,3,4,5,6,7,8	B=05
Internal Test = **C**	1,2,3,4,5,6,7,8	C = 05
Cumulative Internal Examination : A + B + C = 15	1,2,3,4,5,6,7,8	**15**
Semester End Examinations = D	1,2,3,4,5,6,7,8	**D = 35**
Total Marks: A + B + C + D = 50	1,2,3,4,5,6,7,8	**50**

PART-D

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

PEO 1	To provide students with a solid foundation in mathematical, scientific and engineering fundamentals required to solve engineering problems.
PEO 2	To train students with good scientific and engineering breadth so as to analyze, design, and create novel products and solutions for the real-life problems
PEO 3	To prepare students to excel in competitive examinations, postgraduate programs, advanced education or to succeed in industry/technical profession
PEO4	To inculcate in students professional and ethical attitude, effective communication skills, teamwork skills, multidisciplinary approach, and an ability to relate engineering issues to broader social context
PEO5	To provide student with an academic environment with awareness of excellence, leadership, and the life-long learning needed for a successful professional career

PROGRAMME OUTCOMES (POs):

PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
PO 3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
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PO 12	**Life-long learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1	To apply the knowledge of Aerodynamics, Propulsion, Aircraft structures and Flight Dynamics in the Aerospace vehicle design.
PSO 2	To prepare the students to work effectively in the defense and space research programs.

Title	**Course Instructor**	**Module Coordinator**	**Head of the Department**
Signature			
Name of the Faculty	Mr. I Dakshina Murthy	Dr. P. Lovaraju	Dr. P. Lovaraju