LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING
(AUTONOMOUS)
L.B.Reddy Nagar, Mylavaram – 521 230, N.T.R. District, Andhra Pradesh, India
Affiliated to JNTUK, Kakinada & Approved by AICTE New Delhi
Accredited by NBA under Tier - I, Accredited by NAAC
An ISO 21001:2018, 500001:2018, 14001:2015 Certified Institution
DEPARTMENT OF AEROSPACE ENGINEERING
Estd.: 1998 Website: https://www.lbrce.ac.in/ase/index.php Email: hodaero@lbrce.ac.in Phone:08659-222933 Ext:624/623

COURSE HANDOUT

PART-A

Name of Course Instructor: Mr. G V SURYA NARAYANA
Course Name & Code : **20AE08-Aircraft Systems and Instruments**
L-T-P Structure : 3-0-0 **Credits:** 3
Program/Sem/Sec : B.Tech-V SEM **A.Y.:** 2023-24

PREREQUISITE: Elements of Aerospace Engineering

COURSE EDUCATIONAL OBJECTIVES (CEOs): To learn the conventional and modern control systems and working principle of different types of hydraulic and pneumatic systems, engine systems, auxiliary systems, and flight and navigation instruments used in an aircraft.

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

CO1 To identify the various types of controls in the airplane design (Understand-L2)

CO2 To understand the performance of hydraulic and pneumatic systems in the aircraft operation (Understand-L2)

CO3 To analyze the performance of various engine systems of an aircraft (Analyze-L4)

CO4 To employ necessary auxiliary systems in the operation of an aircraft (Apply-L3)

CO5 To 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 and Repair, McGraw-Hill, 1993.
T2 General Handbooks 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, Third Edition, McGraw-Hill Education.

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 airplane control systems	01	03-07-2023		TLM1, TLM2	
2.	Conventional Control Surfaces	01	04-07-2023		TLM1, TLM2	
3.	Power Assisted and	01	06-07-2023		TLM1, TLM2	
4.	Fully Powered Flight Controls	01	07-07-2023		TLM1, TLM2	
5.	Power Actuated Systems,	01	10-07-2023		TLM1, TLM2	
6.	Engine Control Systems (FADEC)	01	11-07-2023		TLM1, TLM2	
7.	Push Pull Rod System	01	13-07-2023		TLM1, TLM2	
8.	Operating Principles	01	14-07-2023		TLM1	
9.	Modern Control Systems	01	17-07-2023		TLM1	
10.	Digital Fly by Wire Systems	01	18-07-2023		TLM1, TLM2	
11.	Auto Pilot System	01	20-07-2023		TLM1,	
12.	Active Control Technology.Assignment-1	01	21-07-2023		TLM1, TLM2	
No. of classes required to complete UNIT-I: 12				**No. of classes taken:**		

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
13.	Introduction to aircraft systems	01	24-07-2023		TLM1	
14.	Hydraulic Systems	01	25-07-2023		TLM1	
15.	Pneumatic Systems	01	27-07-2023		TLM1	
16.	Study of Typical Workable System Components	01	28-07-2023		TLM1, TLM2	
17.	System Components Advantages	01	31-07-2023		TLM1	
18.	System Components Working Principles	01	01-08-2023		TLM1	
19.	Typical Air Pressure System	01	03-08-2023		TLM1, TLM2	

20.	Brake System	01	04-08-2023		TLM1	
21.	Typical Pneumatic Power System Components,	01	07-08-2023		TLM1, TLM2	
22.	Types of Landing Gear Systems	01	08-08-2023		TLM1	
23.	Landing Gear Systems	01	10-08-2023		TLM1, TLM2	
24.	Classifications (Air Oleo). Assignment-I	01	11-08-2023		TLM1, TLM2	
No. of classes required to complete UNIT-II: 12				**No. of classes taken:**		

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
25.	Introduction to Engine Systems	01	14-08-2023		TLM1	
26.	Engine Systems	01	17-08-2023		TLM1	
27.	Fuel Systems	01	18-08-2023		TLM1, TLM2	
28.	Fuel Systems for Piston Engines and	01	21-08-2023		TLM1, TLM2	
29.	Fuel Systems for Jet Engines,	01	22-08-2023		TLM1	
30.	Types of Fuel Systems	01	24-08-2023		TLM1, TLM2	
31.	Components of Multi Engines. Assignment-I	01	25-08-2023		TLM1	
MID EXAM						
32.	Lubricating Systems for Piston	01	04-09-2023		TLM1	
33.	and Jet Engines, Starting	01	05-09-2023		TLM1, TLM2	
34.	Ignition Systems,	01	07-09-2023		TLM1, TLM2	
35.	Typical Examples for Piston	01	08-09-2023		TLM1	
36.	and Jet Engines. Assignment-II	01	11-09-2023		TLM1	
No. of classes required to complete UNIT-III: 12				**No. of classes taken:**		

UNIT-IV: AUXILIARY SYSTEM:

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
37.	Introduction to Auxiliary System	01	12-09-2023		TLM1, TLM2	
38.	Basic Air Cycle Systems	01	14-09-2023		TLM1	
39.	Vapor Cycle Systems	01	15-09-2023		TLM1	
40.	Boot-Strap Air Cycle System	01	19-09-2023		TLM1	
41.	Evaporative Vapor Cycle Systems	01	21-09-2023		TLM1, TLM2	
42.	Evaporation Air Cycle Systems	01	22-09-2023		TLM1, TLM2	
43.	Oxygen Systems	01	25-09-2023		TLM1, TLM2	
44.	Fire Protection Systems	01	26-09-2023		TLM1	
45.	De-icing and Anti-Icing System. Assignment-II	01	29-09-2023		TLM1	
No. of classes required to complete UNIT-IV: 09				**No. of classes taken:**		

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
46.	Introduction to Aircraft Instruments	01	03-10-2023		TLM1	
47.	Flight Instruments	01	05-10-2023		TLM1, TLM2	
48.	Navigation Instruments	01	06-10-2023		TLM1, TLM2	
49.	Principles and Operation	01	09-10-2023		TLM1	
50.	Accelerometers , Air Speed Indicators	01	10-10-2023		TLM1	
51.	Mach Meters, Altimeters	01	12-10-2023		TLM1, TLM2	
52.	Gyroscopic Instruments	01	13-10-2023		TLM1, TLM2	
53.	Study of Various Types of Engine Instruments	01	16-10-2023		TLM1	
54.	Operation and Principles	01	17-10-2023		TLM1, TLM2	
55.	Tachometers, Temperature Gauges	01	19-10-2023		TLM1	
56.	Pressure Gauge Assignment-II	01	20-10-2023		TLM1, TLM2	
No. of classes required to complete UNIT-V: 11				**No. of classes taken:**		

Advance Topics:

S. No.	Advance Topic	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
57.	Advance controlls and Syatems	01	24-10-2023		TLM1, TLM5	
58.	Engine parameters	01	26-10-2023		TLM1, TLM5	
59.	Advance Instruments	01	27-10-2023		TLM1, TLM5	
No. of Advance classes required to complete: 03				**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:** To 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 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 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**
Signature			
Name of the Faculty	MR. G V SURYA NARAYANA		DR. P. LOVARAJU

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DEPARTMENT OF AEROSPACE ENGINEERING

COURSE HANDOUT

PART-A

Name of Course Instructor : I.Dakshina Murthy
Course Name & Code : Gas Dynamics20AE09
L-T-P Structure : 2-1-0 Credits : 3
Program/Sem/Sec : B.Tech., V-Sem. A.Y : 2023-2024

PRE-REQUISITE: 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 (COs): At the end of the semester, students are able to

20AE09: 1	Apply the of compressible fluid flow equations solve flow problems (Apply-L3)
20AE09:2	Apply the steady one-dimensional flow principles in designing the nozzles and diffusers(Apply-L3)
20AE09: 3	Analyze the supersonic flow behavior over objects (Analyze-L4)
20AE09: 4	Analyze fluid flow through ducts by considering friction and heat transfer affects (Analyze-L4)
20AE09: 5	Apply compressible flow theory to analyze flow over wings (Apply-L3)

CourseCode	COs	Program Outcomes												PSOs	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
20AE09	CO1	3	3	2	2	-	-	-	-	-	-	-	3	3	3
	CO2	3	2	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

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	04-07-2023 05-07-2023		TLM1	
2.	Revision of Thermodynamics related to this course	2	06-07-2023 11-07-2023		TLM2	
3.	Compressibility and its limiting conditions	1	12-07-2023		TLM1	
4.	Speed of Sound and its thermodynamics formulation	1	13-07-2023		TLM1	
5.	Introduction to Entropy, Entropy formulations	1	15-07-2023		TLM2	
6.	Basic form of Isentropic relations	1	18-07-2023		TLM1	
7.	Isentropic relations suitable for Compressible flows (in terms of Mach number), Stagnation Properties	1	19-07-2023		TLM1	
8.	Mach Angle, Mach cone, Mach wave, Shock Wave	1	20-07-2023		TLM2	
9.	Wave Propagation	1	22-07-2023		TLM2	
10.	Tutorial-I	1	25-07-2023		TLM3	
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
1.	Introduction, Fundamental Equations	1	26-07-2023		TLM1	
2.	Discharge from a reservoir formulation	1	27-07-2023		TLM1	
3.	Mass flow per Unit Area	1	01-08-2023		TLM1	
4.	Critical Values	1	02-08-2023		TLM1	
5.	Stream tube Area velocity relation	1	03-08-2023		TLM1	
6.	Nozzle and its types, Applications of Nozzle, De Laval Nozzle, Area Mach number relation	1	05-08-2023		TLM1& TLM2	
7.	Isentropic flow through nozzle, Nozzle flow physics	2	08-08-2023 09-08-2023		TLM1	
8.	Diffusers, Compressibility correction to dynamic pressure	1	10-08-2023		TLM1	
9.	Tutorial-2	1	16-08-2023		TLM3	
No. of classes required to complete UNIT-II: 10				No. of classes taken:		

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
1.	Introduction and Types of Waves	1	17-08-2023		TLM2	
2.	Normal Shock-Equations of Motion, Normal Shock relation for perfect gas	2	19-08-2023 22-08-2023		TLM1	

3.	Hugoniot Equation	1	23-08-2023		TLM1	
4.	Oblique Shock introduction, Oblique Shock relations	2	24-08-2023 26-08-2023		TLM1	
5.	Relation Between β-θ-M	2	05-09-2023 07-09-2023		TLM1	
6.	Detached shocks, Expansion waves, Prandtl Meyer Flow	1	09-09-2023		TLM1& TLM2	
7.	Flow with shocks and expansion waves at the exit of a convergent-divergent nozzle	1	12-09-2023		TLM 1	
8.	Tutorial-3	1	13-09-2023		TLM 3	
No. of classes required to complete UNIT-III: 11				No. of classes taken:		

Mid-1	28-08-2023 to 02-09-2023

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
1.	Introduction, Flow in constant Area Duct with friction	1	14-09-2023		TLM1	
2.	Adiabatic Constant area flow of a perfect gas (basic Formulation)	2	16-09-2023 19-09-2023		TLM1	
3.	Definition of Friction Coefficient, Effect of Wall Friction on Fluid Properties	1	20-09-2023		TLM1	
4.	Working Relations	1	21-09-2023		TLM1	
5.	Flow with heating and cooling in ducts, Rayleigh line relation	1	23-09-2023		TLM1	
6.	Basic Formulation	1	26-09-2023		TLM1	
7.	Working Relations	1	27-09-2023		TLM1	
8.	Tutorial - 4	1	30-09-2023		TLM3	
No. of classes required to complete UNIT-IV:09				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
1.	Introduction, Potential Equation for Compressible flow	2	03-10-2023 04-10-2023		TLM1&2	
2.	Linearization of Potential Equation	1	05-10-2023		TLM1& 2	
3.	Prandtl-Glauert Rule	1	07-10-2023		TLM1&2	
4.	Critical Mach Number	1	10-10-2023		TLM1	
5.	Drag-Divergence Mach Number	1	11-10-2023		TLM1&2	
6.	Area-Rule, Supercritical Aerofoil, Forward Swept and Swept Back Wings, Delta Wings	2	12-10-2023 17-10-2023		TLM1&2	

7.	Crocco's Theorem	1	18-10-2023		TLM1	
8.	Tutorial -5	1	19-10-2023		TLM3	
No. of classes required to complete UNIT-V:10				No. of classes taken:		

Revision/Advanced Topics/Content Covered beyond Syllabus:

S.No.	Topics to be covered	Dates	TLM
1.	Revision Cycle -1	21-10-2023 24-10-2023	TLM
2.	Revision Cycle -2	25-10-2023 26-10-2023	TLM1
3.	Hypersonic Flows Introduction & Basic Aspects, Applications	28-10-2023	TLM1

Mid-2	**10-07-2023 to 15-07-2023**

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 Regulations):

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 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	**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`	Module Coordinator	HOD
I.Dakshina Murthy	Dr. P. Lovaraju	Dr. P. Lovaraju

LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING

(AUTONOMOUS)

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Accredited by NBA under Tier – I, Accredited by NAAC with 'A' grade,
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DEPARTMENT OF AEROSPACE ENGINEERING

Estd.: 1998 Website: https://www.lbrce.ac.in/ase/index.php Email: hodaero@lbrce.ac.in Phone:08659-222933 Ext:624/623

COURSE HANDOUT

PART-A

Name of Course Instructor: Mr. Nazumuddin Shaik
Course Name & Code **:** Aircraft Structures-II-20AE10
L-T-P Structure **:** 2-1-0 **Credits:** 3
Program/Sem/Sec : B.Tech, V-Sem **A.Y.:** 2023-24

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	03-07-2023			
2.	Introduction to Unit-I	1	04-07-2023		TLM1	
3.	Introduction - Principal Axis	1	05-07-2023		TLM1	
4.	Neutral Axis Methods	1	10-07-2023		TLM1	
5.	Bending Stresses- Beams of Symmetric Sections Symmetric Loads	1	11-07-2023		TLM1&2	
6.	Beams of Symmetric Sections with Skew Loads	1	12-07-2023		TLM1&2	
7.	**TUTORIAL**	1	15-07-2023		TLM3	
8.	Unsymmetrical Sections with Symmetric Loads.	1	17-07-2023		TLM1	
9.	Unsymmetrical Sections with Symmetric Loads.	1	18-07-2023		TLM1	
10.	Unsymmetrical Sections with Skew Loads.	1	19-07-2023		TLM1&2	
11.	Unsymmetrical Sections with Skew Loads	1	22-07-2023		TLM1&2	
12.	Problems	1	24-07-2023		TLM1	
13.	Problems	1	25-07-2023		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	26-07-2023		TLM1&2	
15.	Thin Walled Beams Shear Flow	1	31-07-2023		TLM1&2	
16.	Concept of Shear Flow	1	01-08-2023		TLM1&2	
17.	Shear Centre	1	02-08-2023		TLM1	
18.	Shear Flow in Open-Section	1	05-08-2023		TLM1	
19.	**TUTORIAL**	1	07-08-2023		TLM3	
20.	Shear Flow in Open-Section Symmetrical	1	08-08-2023		TLM1	
21.	Shear Flow in Open-Section Symmetrical	1	09-08-2023		TLM1	
22.	Shear Flow in Open-Section Unsymmetrical	1	14-08-2023		TLM1	
23.	Shear Flow in Open-Section Unsymmetrical	1	16-08-2023		TLM1	
24.	Problems	1	19-08-2023		TLM1	
25.	**TUTORIAL**	1	19-08-2023		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	21-08-2023		TLM1	
27.	Bredt–Batho Theory	1	22-08-2023		TLM1	
28.	Shear Flow in Closed-Section	1	23-08-2023		TLM1&2	
29.	Single Cell –Shear Flow	1	26-08-2023		TLM1&2	
30.	Multi-Cell –Shear Flow	1	04-09-2023		TLM1&2	
31.	Shear Centre	1	05-09-2023		TLM1	
32.	**TUTORIAL**	1	06-09-2023		TLM3	
33.	Shear Centre & Torsion	1	11-09-2023		TLM1	
34.	Thin Wall Bending with skin Effective	1	12-09-2023		TLM1&2	
35.	Thin Wall Bending with skin Ineffective	1	13-09-2023		TLM1&2	
36.	**TUTORIAL**	1	16-09-2023		TLM3	
37.	Problems	1	18-09-2023		TLM1	
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	20-09-2023		TLM1	
39.	Plates Subjected to Distributed and Transverse Load	1	23-09-2023		TLM1&2	
40.	In-Plane Loading	1	25-09-2023		TLM1&2	
41.	Thin Rectangular Plate with Small Initial Curvature.	1	26-09-2023		TLM1&2	
42.	**TUTORIAL**	1	27-09-2023		TLM3	
43.	Introduction to Inelastic buckling of plates	1	30-09-2023		TLM1&2	
44.	Determination of critical load for a flat plate	1	02-10-2023		TLM1&2	
45.	Local instability, Instability of stiffened panels	1	03-10-2023		TLM1&2	
46.	Failure stress in plates and stiffened panels	1	04-10-2023		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	07-10-2023		TLM1	
48.	Study of Wing Spars and Box Beams	1	09-10-2023		TLM1	
49.	Shear Resistant Web Beams	1	10-10-2023		TLM1&2	
50.	Tension Field Web Beams (Wagner's)	1	11-10-2023		TLM1&2	

51.	**TUTORIAL**	1	14-10-2023		TLM3	
52.	Procedures to Find Shear stress Distribution for Cantilever Beam.	1	16-10-2023		TLM1&2	
53.	Procedures to Bending Moment Distribution for Cantilever Beam.	1	17-10-2023		TLM1&2	
54.	**TUTORIAL**	1	18-10-2023		TLM3	
55.	Problems	1	21-10-2023		TLM1	
56.	Problems	1	28-10-2023		TLM1	
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.
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	Mr. Nazumuddin Shaik	Dr. P. Lovaraju
Signature			

LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING
(AUTONOMOUS)
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Affiliated to JNTUK, Kakinada & Approved by AICTE New Delhi
Accredited by NBA (Tier – I) and NAAC with 'A' grade, An ISO 9001:2015 Certified
DEPARTMENT OF AEROSPACE ENGINEERING
Website: https://www.lbrce.ac.in/ase/index.php Email: hodaero@lbrce.ac.in Phone:08659-222933 Ext:624/623

COURSE HANDOUT

PART-A

Name of Course Instructor: B. Udaya Lakshmi
Course Name & Code **:** FEME & 20AE12
L-T-P Structure **:3-1-0** **Credits:** 3
Program/Sem/Sec : B.Tech/V Sem **A.Y.:** 2023-24

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	4-7-2023		**TLM1**	
2.	Equilibrium equations	1	5-7-2023		**TLM1**	
3.	Stresses and equilibrium	1	7-7-2023		**TLM1**	
4.	Strain displacement relations	1	11-7-2023		**TLM1**	
5.	Stress strain relations	1	12-7-2023		**TLM1**	
6.	Plane stress and plane strain problems	1	14-7-2023		**TLM1**	
7.	Potential energy and equilibrium method	1	15-7-2023		**TLM1**	
8.	FE Formulation from governing diff. equations	1	18-7-2023		**TLM1**	
9.	Weighted residual methods	1	19-7-2023		**TLM1**	
10.	FE Modeling, 1-D bar problems	1	21-7-2023		**TLM1**	
11.	coordinates of shape functions	1	22-7-2023		**TLM1**	
12.	Assembly of GSM & Load vector	1	25-7-2023		**TLM1**	
13.	Finite element equations	1	26-7-2023		**TLM3**	
14.	FE-treatment of boundary conditions	1	28-7-2023		**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	1-8-2023		**TLM1**	
16.	Local and Global Coordinate Systems	1	2-8-2023		**TLM1**	
17.	Transformation Matrix	1	4-8-2023		**TLM1**	
18.	Derivation of Element Stiffness Matrix	1	5-8-2023		**TLM1**	
19.	Stress Calculations.	1	8-8-2023		**TLM1**	
20.	Element Stiffness Matrix	1	9-8-2023		**TLM1**	
21.	Plane truss Problems – Vertical deformation	1	11-8-2023		**TLM1**	
22.	Plane truss Problems	1	12-8-2023		**TLM3**	
23.	Plane truss Problems -Stresses	1	16-8-2023		**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	18-8-2023		**TLM1**	
25.	Types loading ,DOF, BC's	1	19-8-2023		**TLM1**	
26.	Hermite shape functions	1	22-8-2023		**TLM1**	
27.	Hermite shape functions-Derivation	1	25-8-2023		**TLM1**	
28.	Element Stiffness matrix	1	26-8-2023		**TLM1**	
29.	Load vector, Boundary conditions	1	5-9-2023		**TLM1**	
30.	Beam problems	1	6-9-2023		**TLM3**	
31.	Two dimensional elements (CST)	1	12-9-2023		**TLM1**	
32.	CST problems	1	13-9-2023		**TLM1**	
33.	Shape functions, Stiffness matrix,	1	15-9-2023		**TLM1**	
34.	Strain-Displacement matrix	1	16-9-2023		**TLM1**	
35.	Force terms	1	20-9-2023		**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	22-9-2023		**TLM1**	
37.	Finite element modeling-Jacobian Matrix	1	23-9-2023		**TLM1**	
38.	Element Stiffness matrix	1	26-9-2023		**TLM1**	
39.	Axisymmetric loading with triangular elements	1	27-9-2023		**TLM1**	
40.	Axisymmetric Problems	1	29-9-2023		**TLM1**	
41.	Problems on Axisymmetric Loading	1	30-9-2023		**TLM3**	
42.	Four nodded isoparametric elements	1	3-10-2023		**TLM1**	
43.	Jacobian, shape functions	1	4-10-2023		**TLM1**	
44.	4- node quadrilateral element	1	6-10-2023		**TLM1**	
45.	Numerical integration	1	7-10-2023		**TLM1**	
46.	Gauss Quadrature	1	10-10-23		**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	11-10-23		**TLM1**	
48.	Lumped mass matrices	1	13-10-23		**TLM1**	
49.	Consistent mass matrices	1	17-10-23		**TLM1**	
50.	Problems	1	18-10-23		**TLM1**	
51.	Evaluation of Eigen values, Eigen vectors	1	20-10-23		**TLM1**	
52.	Evaluation of stepped bars	1	21-10-23		**TLM1**	
53.	Eigen values, Eigen vectors	1	21-10-23		**TLM3**	
54.	Stepped bars Problems	1	25-10-23		**TLM1**	
55.	Stepped bars Problems- Eigen values	1	27-10-23		**TLM1**	
56.	Evaluation of Eigen values-Problems	1	28-10-23		**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
(B.Udaya Lakshmi)	(S.Indrasena Reddy)	(S.Indrasena Reddy)	(Dr.P.Lovaraju)

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(AUTONOMOUS)
Accredited by NAAC & NBA (CSE, IT, ECE, EEE & ME)
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 : 2023-24

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	10/07/2023		TLM2	
2.	Brief introduction about the course and its importance.	1	11/07/2023		TLM2	
3.	Need for Space Communications, Definition of a satellite and Orbit.	1	13/07/2023		TLM2	
4.	General Structure of satellite Communication	1	15/07/2023		TLM2	
5.	Types of Spacecraft Orbits	1	17/07/2023		TLM2	
6.	Common satellite applications and missions	1	18/07/2023		TLM2	
7.	Launch Vehicles and Launching of a satellite	1	20/07/2023		TLM2	
8.	Satellite system and their functions-(Structural, thermal, power mechanisms, propulsion, etc)	2	24/07/2023		TLM2	
9.	Revision	1	25/07/2023			
No. of classes required to complete UNIT-I: 10				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	27/07/2023		TLM1	
2.	Newton's laws of Force, Fundamentals of Orbital Dynamics-Kepler's laws	1	31/07/2023		TLM2	
3.	Orbital parameters and determination	2	03/08/2023		TLM2	
4.	Orbital Perturbations-Need for station keeping	2	08/08/2023		TLM1	
5.	GPS systems-Architecture of GPS, Working Principle of GPS	2	14/08/2023		TLM2	
6.	Ground station or Earth station Requirements	1	17/08/2023		TLM1	
7.	Problems and Revision	1	19/08/2023		TLM1	
No. of classes required to complete UNIT-II: 10				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	21/08/2023		TLM2	
2.	Solar Panels: Silicon and Ga-As Cells	2	24/08/2023		TLM2	
3.	Power generation capacity, efficiency	1	26/08/2023		TLM1, TLM2	
4.	Space Battery Systems	1	04/09/2023		TLM2	
5.	Battery Types, Characteristics , Battery efficiency Parameters	2	07/09/2023		TLM2	

6.	Telemetry, Tracking and Command Control (TT&C) functions	2	11/09/2023		TLM2	
7.	Telemetry, Tracking and Command Control (TT&C) functions	2	16/09/2023		TLM2	
8.	Generally Employed Communication Bands	1	19/09/2023		TLM2	
9.	Revision	1	21/09/2023			
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	23/09/2023		TLM2	
2.	Control Requirements: Attitude Control and station keeping functions, type of control maneuvers	2	26/09/2023		TLM2	
3.	Stabilization Schemes: Spin stabilization	1	30/09/2023		TLM2	
4.	gravity gradient method, 3 axis stabilization	2	05/10/2023		TLM2	
5.	Commonly Used Control Systems: Mass expulsion systems, Momentum exchange systems.	2	09/10/2023		TLM2	
6.	Gyro and Magnetic Torque -sensors, Star and sun sensor, Earth sensor.	1	10/10/2023		TLM2	
7.	Magnetometers and Inertial Sensors.	1	12/10/2023		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, Location Principle	1	14/10/2023		TLM2	
2.	Direct to home, home receiver	1	16/10/2023		TLM2	
3.	Satellite mobile services, VSAT	1	17/10/2023		TLM2	
4.	MSAT, RADARSAT	1	19/11/2023		TLM2	
5.	IRNSS Constellation	1	21/11/2023		TLM2	
6.	Satellite structures and materials	1	24/11/2023		TLM2	
7.	Revision	1	26/11/2023			
No. of classes required to complete UNIT-V: 7				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=15
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=15
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. V. V. Ramakrishna	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
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: Dr.P.Lovaraju/Mr.I.Dakshina Murthy/Mr.A.Pratyush
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.: 2023-24

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	03-07-2023		07-07-2023		TLM4	
2.	Exp No 1	03	10-07-2023		14-07-2023		TLM4	
3.	Exp No 2	03	17-07-2023		21-07-2023		TLM4	
4.	Exp No 3	03	24-07-2023		28-07-2023		TLM4	
5.	Exp No 4	03	07-08-2023		04-08-2023		TLM4	
6.	Exp No 5	03	14-08-2023		11-08-2023		TLM4	
7.	Repeat	03	-------	-------	18-08-2023		TLM4	

8.	Repeat	03	-------	-------	25-08-2023		TLM4	
9.	Exp No 6	03	21-08-2023		08-09-2023		TLM4	
10.	Exp No 7	03	04-09-2023		15-09-2023		TLM4	
11.	Exp No 8	03	11-09-2023		22-09-2023		TLM4	
12.	Exp No 9	03	25-09-2023		29-09-2023		TLM4	
13.	Exp No 10	03	09-10-2023		22-09-2023		TLM4	
14.	Repeat	03	-------	-------	06-10-2023		TLM4	
15.	Repeat	03	-------	-------	13-10-2023		TLM4	
16.	Repeat	03	-------	-------	20-10-2023		TLM4	
17.	Internal Exam	03	16-10-2023		27-10-2023		TLM4	
No. of classes required to complete: 13 & 17						**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 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):

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.
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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 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.

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

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DEPARTMENT OF AEROSPACE ENGINEERING

COURSE HANDOUT

PART-A

Name of Course Instructor: Mr. Nazumuddin Shaik/ Mr. Ashutosh Shukla

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.:** 2023-24

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	03-07-2023		07-07-2023		TLM4	
2.	Compression Test of Columns.	10-07-2023		14-07-2023		TLM4	
3.	Verification of Maxwell's Reciprocal Theorem.	17-07-2023		21-07-2023		TLM4	
4.	Verification of Castigliano's Theorem.	24-07-2023		28-07-2023		TLM4	
5.	Shear Failure of Bolted and Riveted Joints.	31-07-2023		04-08-2023		TLM4	
6.	Non Destructive Test- Dye Penetration Test	07-08-2023		11-08-2023		TLM4	
7.	Unsymmetrical beam Direct stress of Cantilever Beam (C, Z, L and T-Sections)	14-08-2023		18-08-2023		TLM4	
8.	Wagner Beam-Tension Field Beam.	21-08-2023		25-08-2023		TLM4	
9.	Non Destructive Test-Magnetic Particle Detection.	04-09-2023		08-09-2023		TLM4	
10.	Shear Centre of Open section beam	11-09-2023		15-09-2023		TLM4	
11.	Unsymmetrical deflection of a Cantilever Beam	18-09-2023		22-09-2023		TLM4	
12.	Repetition	25-09-2023		29-09-2023		TLM4	
13.	Lab internal Exam	16-10-2023		27-10-2023		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.
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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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	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	Mr. Nazumuddin Shaik	Dr.P.Lovaraju
Signature			