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 with 'A' grade,

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. Nazumuddin Shaik
Course Name & Code : Aerospace Vehicle Structures-23AE07
L-T-P Structure : 3-0-0 **Credits:** 3
Program/Sem/Sec : B. Tech, V-Sem **A.Y.:** 2025-26

PREREQUISITE: Engineering Mechanics and Strength of Materials

COURSE EDUCATIONAL OBJECTIVE (CEO): To comprehend fundamentals of elasticity and failure theories, analysis of various Aerospace structural components under various loading conditions and application of energy methods to structural components.

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

COs	Statements	Blooms Level
CO1	Apply the stress and strain relations in elastic members and relevant failure theories to aerospace components.	Apply
CO2	Evaluate statically indeterminate beam structures subjected to various loading conditions.	Apply
CO3	Apply strain energy methods and theorems to beams and trusses under different loading conditions	Apply
CO4	Analyze the stability and critical buckling loads of columns under axial and eccentric loadings	Analyze
CO5	Estimate bending stresses in beams subjected to unsymmetrical bending	Apply

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		

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

TEXTBOOKS:

T1	T.H.G. Megson – Aircraft Structures for Engineering Students, 6th Edition, Butterworth Heinemann, 2016.
T2	Ramamrutham, S., and Narayanan, R. (2022). Theory of Structures, 11th Edition, Dhanpat Rai Publishing Company.

REFERENCE BOOKS:

R1	Bruce K. Donaldson – Analysis of Aircraft Structures: An Introduction, 2nd Edition, Cambridge University Press, 2008.
R2	R.C. Hibbeler – Mechanics of Materials, 10th Edition, Pearson Education, 2016.
R3	S. Timoshenko and D.H. Young – Elements of Strength of Materials, 5th Edition, CBS Publishers, 2017.

PART-B

COURSE DELIVERY PLAN (LESSON PLAN):

UNIT-I: BASIC ELASTICITY

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	30-06-2025			
2.	Introduction to Unit-I Basic Elasticity	1	01-07-2025		TLM1	
3.	Stresses and Strains	1	03-07-2025		TLM1	
4.	Equations of Equilibrium	1	05-07-2025		TLM1	
5.	Plane Stress and Plane Strain Problems	1	07-07-2025		TLM1&2	
6.	Compatibility Equations	1	08-07-2025		TLM1&2	
7.	Stress - Strain Relations	1	10-07-2025		TLM1&2	
8.	Airy's Stress Function	1	14-07-2025		TLM1	
9.	Failure Theories: Maximum Stress Theory	1	15-07-2025		TLM1	
10.	Maximum Strain Theory	1	17-07-2025		TLM1&2	
11.	**TUTORIAL**	1	19-07-2025		TLM3	
12.	Maximum Shear Stress Theory	1	21-07-2025		TLM1	
13.	Distortion Energy Theory	1	22-07-2025		TLM1	
14.	Maximum Strain Energy Theory	1	24-07-2025		TLM1&2	
15.	Problems	1	26-07-2025		TLM1	
16.	Problems	1	28-07-2025		TLM1	
No. of classes required to complete UNIT-I: 16				**No. of classes taken:**		

UNIT-II: STATICALLY INDETERMINATE STRUCTURES

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
17.	Introduction to Unit-II Statically indeterminate structures	1	29-07-2025		TLM1&2	
18.	Methods for Indeterminate Beams	1	31-07-2025		TLM1&2	

19.	Methods for Indeterminate Beams	1	02-08-2025		TLM1&2	
20.	Indeterminate structure, order of redundancy	1	04-08-2025		TLM1	
21.	Propped Cantilever	1	05-08-2025		TLM1	
22.	Fixed-Fixed Beams	1	07-08-2025		TLM1	
23.	Continuous Beams Carrying Point Load	1	11-08-2025		TLM1	
24.	Continuous Beams Carrying Uniformly Distributed Load	1	12-08-2025		TLM1	
25.	Shear Force and Bending Moment Diagrams	1	14-08-2025		TLM1	
26.	Shear Force and Bending Moment Diagrams	1	18-08-2025		TLM1	
27.	Clapeyron's Three Moment Equation.	1	19-08-2025		TLM1	
28.	Problems	1	21-08-2025		TLM1	
29.	**TUTORIAL**	1	23-08-2025		TLM3	
No. of classes required to complete UNIT-II: 13				**No. of classes taken:**		

UNIT-III: AIRCRAFT STRUCTURAL COMPONENTS AND ENERGY METHODS

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
30.	Introduction to Unit-III	1	01-09-2025		TLM1	
31.	Functions of structural components	1	02-09-2025		TLM1	
32.	Airframe loads	1	04-09-2025		TLM1&2	
33.	Types of structural joints	1	06-09-2025		TLM1&2	
34.	Type of loads on structural joints	1	08-09-2025		TLM1&2	
35.	**Strain Energy**: Strain Energy Stored in a Beam due to Axial Load	1	09-09-2025		TLM1	
36.	Strain Energy due to Bending Moment	1	11-09-2025		TLM1	
37.	Castigliano’s First and Second Theorems	1	15-09-2025		TLM1	
38.	Maxwell's Reciprocal Theorem	1	16-09-2025		TLM1&2	
39.	Unit Load Method - Application to Beams and Trusses	1	18-09-2025		TLM1&2	
40.	**TUTORIAL**	1	20-09-2025		TLM3	
41.	Problems	1	22-09-2025		TLM1	
No. of classes required to complete UNIT-III: 12				**No. of classes taken:**		

UNIT-IV: COLUMNS

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- Axially Loaded Compression Members	1	23-09-2025		TLM1	
43.	Crushing Load-Buckling Load	1	25-09-2025		TLM1&2	
44.	Euler's Theory-Effective Length of Column	1	27-09-2025		TLM3	
45.	Expressions for Buckling Load With Different Column End Conditions	1	29-09-2025		TLM1&2	
46.	**TUTORIAL**	1	04-10-2025		TLM3	
47.	Expressions for Buckling Load With Different Column End Conditions	1	06-10-2025		TLM1&2	
48.	Limitations-Euler's Formula Rankine's Formula	1	07-10-2025		TLM1	
49.	Columns Subjected to Eccentric Loading	1	09-10-2025		TLM1&2	
50.	Problems	1	13-10-2025		TLM1&2	
No. of classes required to complete UNIT-IV: 09				**No. of classes taken:**		

UNIT-V: UNSYMMETRICAL BENDING

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
51.	Introduction to Unit-V	1	14-10-2025		TLM1	
52.	Principal Axis Method	1	16-10-2025		TLM1	
53.	Neutral Axis Method	1	18-10-2025		TLM1	
54.	Bending Stresses	1	21-10-2025		TLM1&2	
55.	Beams of Symmetric Sections with Symmetric Loads	1	23-10-2025		TLM1&2	
56.	**TUTORIAL**	1	25-10-2025		TLM3	
57.	Beams of Symmetric Sections with Skew Loads	1	27-10-2025		TLM1	
58.	Beams of Unsymmetrical Sections with Symmetric Loads	1	28-10-2025		TLM1&2	
59.	Beams of Unsymmetrical	1	30-10-2025		TLM1&2	

	Sections with Skew Loads.					
60.	Problems	1	01-11-2025		TLM1	
No. of classes required to complete UNIT-V: 10				**No. of classes taken:**		

Advanced Topics/ beyond Syllabus in AVS

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.	Shear Flow				TLM1	
2.	Shear Centre				TLM1	

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 (R23 Regulation):

Evaluation Task	Marks
Assignment-I (Units-I, II)	A1=5
I-Descriptive Examination (Units-I, II)	M1=15
I-Quiz Examination (Units-I, II)	Q1=10
Assignment-II (Unit-III, IV & V)	A2=5
II- Descriptive Examination (UNIT-III, IV & V)	M2=15
II-Quiz Examination (UNIT-III, 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

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

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COURSE HANDOUT

PART-A

Name of Course Instructor : **Dr.P. Lovaraju**
Course Name & Code : Gas Dynamics and 23AE08
L-T-P Structure : 3-0-0 Credits : 3
Program/Sem/Sec : B.Tech., V-Sem. A.Y : 2025-2026

Pre-requisites: Engineering Fluid Mechanics, Engineering Thermodynamics, Aerodynamics

Course Educational Objectives: To learn the basic concepts of compressible fluid flows, properties of steady one-dimensional flow and supersonic flows, compressible flow with friction and heat transfer and compressible flow over wings

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

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

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 BOOK

1. Rathakrishnan. E, Gas Dynamics, 7th Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2021
2. John D Anderson, Jr. Fundamentals of Aerodynamics, 7th Edition, McGraw-Hill, 2024

REFERENCES

1. Ascher H. Shapiro, The dynamics and thermodynamics of compressible fluid flow Vol 1, The Ronald press Co. New York
2. Lipmann. H. W, Roshko. A, Elements of Gas Dynamics, Dover Special Priced Titles, 2007

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	30-06-2025 01-07-2025		TLM1	
2.	Revision of Thermodynamics related to this course	2	02-07-2025 04-07-2025		TLM2	
3.	Compressibility and its limiting conditions	1	07-07-2025		TLM1	
4.	Speed of Sound and its thermodynamics formulation	1	08-07-2025		TLM1	
5.	Introduction to Entropy, Entropy formulations	1	11-07-2025		TLM2	
6.	Basic form of Isentropic relations	1	14-07-2025		TLM1	
7.	Isentropic relations suitable for Compressible flows (in terms of Mach number), Stagnation Properties	1	16-07-2025		TLM1	
8.	Mach Angle, Mach cone, Mach wave, Shock Wave	1	18-07-2025		TLM2	
9.	Wave Propagation	1	21-07-2025		TLM2	
10.	Tutorial-I	1	22-07-2025		TLM3	
11.	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
12.	Introduction, Fundamental Equations	1	23-07-2025		TLM1	
13.	Discharge from a reservoir formulation	2	25-07-2025 28-07-2025		TLM1	
14.	Mass flow per Unit Area	1	30-07-2025		TLM1	
15.	Critical Values	1	01-08-2025		TLM1	
16.	Stream tube Area velocity relation	1	04-08-2025		TLM1	
17.	Nozzle and its types, Applications of Nozzle, De Laval Nozzle, Area Mach number relation	2	06-08-2025 08-08-2023		TLM1& TLM2	
18.	Isentropic flow through nozzle, Nozzle flow physics	2	11-08-2025 12-8-2025		TLM1	
19.	Diffusers, Compressibility correction to dynamic pressure	1	20-08-2025		TLM1	
20.	Tutorial-2	1	22-08-2025		TLM3	

21.	Assignment/Quiz 2					
No. of classes required to complete UNIT-II: 12				No. of classes taken:		

I MID EXAMINATION	**25-08-2025 to 30-08-2025**

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
22.	Introduction and Types of Waves	1	01-09-2025		TLM2	
23.	Normal Shock-Equations of Motion, Normal Shock relation for perfect gas	2	05-09-2025 08-09-2025		TLM1	
24.	Hugoniot Equation	1	10-09-2025		TLM1	
25.	Oblique Shock introduction, Oblique Shock relations	2	12-09-2025 15-09-2025		TLM1	
26.	Relation Between β-θ-M	2	17-9-2025 19-9-2025		TLM1	
27.	Shock polar,Detached shocks, Expansion waves, Prandtl Meyer Flow	1	22-9-2025		TLM1& TLM2	
28.	Flow with shocks and expansion waves at the exit of a convergent- divergent nozzle, simple and non-simple regions	1	24-9-2025		TLM 1	
29.	Tutorial-3	1	26-9-2025		TLM 3	
30.	Assignment/Quiz 3					
No. of classes required to complete UNIT-III: 11				**No. of classes taken:**		

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
31.	Introduction, Flow in constant Area Duct with friction	1	29-9-2025		TLM1	
32.	Adiabatic Constant area flow of a perfect gas (basic Formulation)	2	30-9-2025 1-10-2025		TLM1	
33.	Definition of Friction Coefficient, Effect of Wall Friction on Fluid Properties	1	03-10-2025		TLM1	
34.	Working Relations, Fanno line flow	1	03-10-2025		TLM1	
35.	Flow with heating and cooling in ducts, Rayleigh line relation	1	06-10-2025		TLM1	
36.	Basic Formulation	1	8-10-2025		TLM1	
37.	Working Relations	1	10-10-2025		TLM1	
38.	Tutorial - 4	1	13-10-2025		TLM3	
39.	**Assignment/Quiz 4**					
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	Tentative	Actual	Teaching	HOD

		Classes Required	Date of Completion	Date of Completion	Learning Methods	Sign Weekly
1.	Introduction, Potential Equation for Compressible flow	2	15-10-2025 17-10-2025		TLM1&2	
2.	Linearization of Potential Equation	1	20-10-2025		TLM1& 2	
3.	Prandtl-Glauert Rule	1	22-10-2025		TLM1&2	
4.	Critical Mach Number	1	24-10-2025		TLM1	
5.	Drag-Divergence Mach Number	1	27-10-2025		TLM1&2	
6.	Area-Rule, Supercritical Aerofoil, Forward Swept and Swept Back Wings, Delta Wings	1	28-10-2025		TLM1&2	
7.	Tutorial -5	1	29-10-2025		TLM3	
8.	**Assignment/Quiz 5**					
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**	31-10-2025	TLM2
2.	Hypersonic Flows Introduction & Basic Aspects, Applications		TLM2

Mid-2	**3-11-2025 to 8-11-2025**

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
Dr. P. Lovaraju	Dr. P. Lovaraju	Dr. P. Lovaraju

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COURSE HANDOUT

PART-A

Name of Course Instructor:	**Mr. G V SURYA NARAYANA**	**Regulation:**	R23
Course Name & Code:	**23AE09-Aircraft Systems and Instruments**	**Credits:**	3
L-T-P Structure:	3-0-0	**A.Y.:**	2025-26
Program/Sem/Sec:	B.Tech-V SEM		

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

COs	Statements	Blooms Level
CO1	Identify the various types of controls in the airplane design	Understand
CO2	Understand the performance of hydraulic and pneumatic systems in the aircraft operation	Understand
CO3	Understand the working of various engine systems of an aircraft	Understand
CO4	Understand the functioning of auxiliary systems in the operation of an aircraft	Understand
CO5	Understand the working of various instruments necessary for the aircraft operation	Understand-

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 Aircraft Systems and Instruments	01	30-06-2025		TLM1, TLM2	
2.	Introduction to Airplane Control Systems	01	03-07-2025		TLM1, TLM2	
3.	Conventional Control Surfaces	01	04-07-2025		TLM1, TLM2	
4.	Power Assisted Flight Controls	01	05-07-2025		TLM1, TLM2	
5.	Fully Powered Flight Controls	01	07-07-2025		TLM1, TLM2	
6.	Power Actuated Systems	01	10-07-2025		TLM1, TLM2	
7.	Engine Control Systems (FADEC)	01	11-07-2025		TLM1, TLM2	
8.	Push Pull Rod System	01	12-07-2025		TLM1, TLM2	
9.	Operating Principles	01	14-07-2025		TLM1, TLM2	
10.	Modern Control Systems	01	17-07-2025		TLM1, TLM2	
11.	Digital Fly by Wire Systems	01	18-07-2025		TLM1	
12.	Auto Pilot System	01	19-07-2025		TLM1	
13.	Active Control Technology	01	21-07-2025		TLM1, TLM2	
14.	Basic Aircraft Wiring Practices,	01	24-07-2025		TLM1,	
15.	Aircraft systems Assignment-I	01	25-07-2025		TLM1, TLM2	
No. of classes required to complete UNIT-I: 15				**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
16.	Introduction to Aircraft Systems	01	28-07-2025		TLM1, TLM2	
17.	Hydraulic and Pneumatic Systems	01	31-07-2025		TLM1	
18.	Study of Typical Workable System	01	01-08-2025		TLM1	
19.	Components, Advantages	01	02-08-2025		TLM1	
20.	Working Principles, Typical Air Pressure System	01	04-08-2025		TLM1, TLM2	

21.	Cabin pressurization	01	07-08-2025		TLM1	
22.	heating systems	01	08-08-2025		TLM1	
23.	cooling systems	01	09-08-2025		TLM1, TLM2	
24.	Brake System	01	11-08-2025		TLM1, TLM2	
25.	Typical Pneumatic Power System	01	14-08-2025		TLM1	
26.	Components	01	18-08-2025		TLM1, TLM2	
27.	Landing Gear Systems	01	21-08-2025		TLM1, TLM2	
28.	Classifications	01	22-08-2025		TLM1	
29.	Air Oleo Assignment-I	01	23-08-2025		TLM1, TLM2	
No. of classes required to complete UNIT-II: 14				**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
30.	Fuel Systems for Piston	01	01-09-2025		TLM1	
31.	Fuel Systems for Jet Engines	01	04-09-2025		TLM1	
32.	Components of Multi Engines	01	05-09-2025		TLM1, TLM2	
33.	Modern Fuel system Components	01	06-09-2025		TLM1, TLM2	
34.	Boot pumps	01	08-09-2025		TLM1	
35.	selector valves	01	11-09-2025		TLM1, TLM2	
36.	ejector pumps	01	12-09-2025		TLM1	
37.	Lubricating Systems for Piston	01	13-09-2025		TLM1	
38.	Lubricating Systems for Jet Engines	01	15-09-2025		TLM1, TLM2	
39.	Electrical Starting and Ignition Systems	01	18-09-2025		TLM1, TLM2	
40.	Ignition Systems Assignment-II	01	19-09-2025		TLM1	
No. of classes required to complete UNIT-III: 11				**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
41.	Introduction to Auxiliary System	01	20-09-2025		TLM1, TLM2	
42.	Auxiliary power unit (APU)	01	22-09-2025		TLM1	
43.	Basic Air Cycle Systems	01	25-09-2025		TLM1	
44.	Vapour Cycle Systems	01	26-09-2025		TLM1	
45.	Boot-Strap Air Cycle System	01	27-09-2025		TLM1, TLM2	
46.	Evaporative Vapour Cycle Systems	01	29-09-2025		TLM1, TLM2	
47.	Evaporation Air Cycle Systems	01	03-10-2025		TLM1, TLM2	
48.	Oxygen Systems	01	04-10-2025		TLM1, TLM2	
49.	Ice and Rain protection systems	01	06-10-2025		TLM1, TLM2	
50.	De-icing and Anti-Icing System	01	09-10-2025		TLM1, TLM2	
51.	Fire Protection Systems	01	10-10-2025		TLM1, TLM2	
52.	Aircraft Warning System	01	11-10-2025		TLM1, TLM2	
53.	Caution, Advisory and Fault Alerts. Assignment-II	01	13-10-2025		TLM1	
No. of classes required to complete UNIT-IV: 13				**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
54.	Flight and Navigation Instruments	01	16-10-2025		TLM1	
55.	Principles and Operation Accelerometers	01	17-10-2025		TLM1, TLM2	
56.	Air Speed Indicators	01	18-10-2025		TLM1, TLM2	
57.	Mach Meters, Altimeters	01	20-10-2025		TLM1	
58.	Gyroscopic Instruments	01	23-10-2025		TLM1	
59.	VOR, DME	01	24-10-2025		TLM1, TLM2	
60.	GPS, INS	01	25-10-2025		TLM1, TLM2	
61.	Study of Various Types of Engine Instruments Operation and Principles – Tachometers	01	27-10-2025		TLM1	

62.	Temperature Gauges, Pressure Gauge. Assignment-II	01	30-10-2025			
No. of classes required to complete UNIT-V: 09				**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
63.	Advance controlls and Syatems	01	30-10-2025		TLM1, TLM5	
64.	Advanced Engine contrll parameters	01	31-10-2025		TLM1, TLM5	
65.	Advance Instruments	01	01-11-2025		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):

PO1	**Engineering knowledge:** To 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 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.
PO5	**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
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	**Ethic**s: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and teamwork**: 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.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO1	To apply the knowledge of Aerodynamics, Propulsion, Aircraft structures, and Flight Dynamics in Aerospace vehicle design.
PSO2	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

LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING
(AUTONOMOUS)
L. B. Reddy Nagar, Mylavaram – 521 230, N.T.R. District, Andhra Pradesh, India
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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 : FEA & 23AE11
L-T-P Structure :3-1-0 **Credits:** 3
Program/Sem/Sec : B.Tech/V Sem **A.Y.:** 2025-26

PREREQUISITE: Engineering Mechanics

COURSE EDUCATIONAL OBJECTIVES (CEOs):

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

COs	Statements	Blooms Level
CO1	Apply mathematical model for solution of common engineering problems	Apply
CO2	Solve 2-Dimensional Structural Problems using CST Element	Apply
CO3	Apply Axi-symmetric modelling concepts to solids of revolution for stress approximation	Apply
CO4	Analyze the structural behavior of Trusses and Beams Elements	Analyze
CO5	Estimate the natural frequencies and mode shapes of the bar elements	Apply

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	1-7-2025		**TLM1**	
2.	Equilibrium equations	1	3-7-2025		**TLM1**	
3.	Stresses and equilibrium	1	4-7-2025		**TLM1**	
4.	Strain displacement relations	1	5-7-2025		**TLM1**	
5.	Stress strain relations	1	8-7-2025		**TLM1**	
6.	Plane stress and plane strain problems	1	10-7-2025		**TLM1**	
7.	Problems on stress strain relations	1	11-7-2025		**TLM1**	
8.	Potential energy and equilibrium method	1	15-7-2025		**TLM1**	
9.	FE Formulation from governing diff. equations	1	17-7-2025		**TLM1**	
10.	Weighted residual methods	1	18-7-2025		**TLM1**	
11.	FE Modeling, 1-D bar problems	1	22-7-2025		**TLM1**	
12.	coordinates of shape functions	1	24-7-2025		**TLM1**	
13.	Assembly of GSM & Load vector	1	25-7-2025		**TLM3**	
14.	Finite element equations	1	26-7-2025		**TLM1**	
15.	FE-treatment of boundary conditions	1	27-7-2024		**TLM1**	
16.	Numerical	1	29-7-2024		**TLM1**	
17.	Numerical	1	31-7-2024		**TLM1**	
18.	Assignment,Quiz-I		1-8-2024			
No. of classes required to complete UNIT-I: 17				**No. of classes taken:**		

UNIT-II: TWO DIMENSIONAL 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
19.	Finite element modeling_CST	1	3-8-2024		**TLM1**	
20.	Isoparametric Representation-Shape functions	1	5-8-2024		**TLM1**	
21.	Derivation of stiffness matrix	1	8-8-2024		**TLM1**	
22.	Strain Displacement matrix	1	10-8-2024		**TLM1**	
23.	CST-force terms	1	12-8-2025		**TLM1**	
24.	Stress Calculations	1	14-8-2025		**TLM1**	
25.	Numericals	1	19-8-2025		**TLM1**	
26.	Numericals	1	21-8-2025		**TLM3**	
27.	Assignment,Quiz-II	1	22-8-2025			
No. of classes required to complete UNIT-II: 09			**No. of classes taken:**			

I MID EXAMINATION	**25-08-2025 to 30-08-2025**

UNIT-III: 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
28.	Axisymmetric solids	1	2-9-2025		**TLM1**	
29.	Finite element modeling-Jacobian Matrix	1	4-9-2025		**TLM1**	
30.	Element Stiffness matrix	1	5-9-2025		**TLM1**	
31.	Axisymmetric loading with triangular elements	1	6-9-2025		**TLM1**	
32.	Axisymmetric Problems	1	9-9-2025		**TLM1**	

33.	Problems on Axisymmetric Loading	1	11-9-2025		**TLM1**	
34.	Four nodded isoparametric elements	1	12-9-2025		**TLM3**	
35.	Jacobian, shape functions	1	16-9-2025		**TLM1**	
36.	4- node quadrilateral element	1	18-9-2025		**TLM1**	
37.	Numerical integration	1	19-9-2025		**TLM1**	
38.	Gauss Quadrature	1	20-9-2025		**TLM1**	
39.	Assignment,Quiz-III	1	23-9-2025			
No. of classes required to complete UNIT-III: 12			**No. of classes taken:**			

UNIT-IV: ANALYSIS OF TRUSSES AND 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
40.	Introduction- Plane Trusses	1	25-9-2025		**TLM1**	
41.	Local and Global Coordinate system- Transformation matrix	1	26-9-2025		**TLM1**	
42.	Element Stiffness Matrix, stress Calculations	1	27-9-2025		**TLM1**	
43.	Numericals on trusses	1	3-10-2025		**TLM1**	
44.	Numericals on trusses	1	4-10-2025		**TLM1**	
45.	Introduction- Beams,Hermite shape functions	1	7-10-2025		**TLM3**	
46.	Element stiffness matrix	1	9-10-2025		**TLM1**	
47.	Load vector,Boundary conditions	1	10-10-2025		**TLM1**	
48.	Numericals on beams	1	11-10-2025		**TLM1**	
49.	Numericals on beams	1	14-10-2025		**TLM1**	
50.	Assignment,Quiz-IV	1	16-10-2025			
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
51.	Dynamic Analysis formulation	1	17-10-2025		**TLM1**	
52.	Lumped mass matrices	1	18-10-2025		**TLM1**	
53.	Consistent mass matrices	1	23-10-2025		**TLM1**	
54.	Problems	1	24-10-2025		**TLM1**	
55.	Evaluation of Eigen values, Eigen vectors	1	25-10-2025		**TLM1**	
56.	Evaluation of stepped bars	1	28-10-2025		**TLM1**	
57.	Eigen values, Eigen vectors	1	30-10-2025		**TLM3**	
58.	Stepped bars Problems	1	21-10-24		**TLM1**	
59.	Stepped bars Problems- Eigen values	1	23-10-24		**TLM1**	
60.	Evaluation of Eigen Values-Problems	1	24-10-24		**TLM1**	
61.	Problems	1	25-10-2025		**TLM1**	
62.	Assignment,Quiz-V	1	28-10-2025			
63.	Revision class		30-10-2025			
64.	Revision class		31-10-2025			
No. of classes required to complete UNIT-V: 12				**No. of classes taken:**		

Mid-2	**3-11-2025 to 8-11-2025**

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	**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

Course Instructor	Module Coordinator	HOD
B. Udaya Lakshmi	S. Indrasena Reddy	Dr. P. Lova Raju

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
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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.V.V.Rama Krishna
Course Name & Code : **Fundamentals of Satellite Communications-23EC85**
L-T-P Structure : 3-0-0 Credits : 3
Program/Sem/Sec : B.Tech, ASE, V-Sem A.Y : 2025-26
PRE-REQUISITE : Dynamics, Kinematics, Thermodynamics.

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

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

CO 1	**Describe** the operational frequency bands, Space craft control mechanisms**,** sensors and navigational aids used in satellite systems **Understand-L2)**
CO 2	**Summarize** the functions of satellite space segment, earth segment, Multiple access techniques and satellite services. **(Understand-L2)**
CO 3	I **Illustrate** the operational principles of satellite power system and space craft Control mechanism. **(Understand-L2)**
CO 4	**Apply** the fundamental concepts of orbital mechanics & satellite communication and its application **(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	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.

T2 Dennis Roddy, "Satellite communications", Tata McGraw Hills, 4th Edition, 2009.

REFERENCE BOOKS:

R1 M. Richharia, "Satellite Communications Systems: Design principles", BS Publications,2'[d] Edition, 2005.

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

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	02-07-2025		TLM1	
2.	Brief introduction about the course and its importance.	1	03-07-2025		TLM1	
3.	Need of space communication,	1	05-07-2025		TLM1	
4.	General Structure of satellite Communication system- (Flipped Classroom)	1	09-07-2025		TLM2	
5.	Types of Spacecraft Orbits, Launch vehicles.	1	10-07-2025		TLM1	
6.	Satellite subsystems and their functions – structure.	1	12-07-2025		TLM2	
7.	Satellite subsystems and their functions – thermal mechanisms.	1	16-07-2025		TLM2	
8.	Satellite subsystems and their functions – power, propulsion.	1	17-07-2025		TLM2	
9.	Satellite subsystems and their functions – Guidance and control.	1	19-07-2025		TLM1	
10.	Satellite subsystems and their functions – bus electronics.	1	23-07-2025		TLM1	
11.	Communication bands-characteristics and applications.	1	24-07-2025		TLM2	
12.	Revision of I Unit		26-07-2025		TLM1	
No. of classes required to complete UNIT-I:12				No. of classes taken:		

UNIT-II: Orbital Mechanics and satellite launching

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.	Fundamentals of Orbital Dynamics – Kepler ’s laws.	1	30-07-2025		TLM1	
2.	Fundamentals of Orbital Dynamics – Kepler’s laws	1	31-07-2025		TLM1	
3.	Orbital parameters	1	02-08-2025		TLM2	
4.	Orbital parameters		06-08-2025		TLM2	
5.	Problems	1	07-08-2025		TLM1	
6.	Orbital Perturbations	1	09-08-2025		TLM2	
7.	Orbital Perturbations(Blended Learning)		13-08-2025		TLM2	
8.	Need for station keeping.	1	14-08-2025		TLM2	
9.	Orbital effect	1	16-08-2025		TLM1	
10.	Launch Vehicles		20-08-2025		TLM2	

11.	Reusable Launch Vehicles.	1	21-08-2025		TLM2	
12.	Revision of II Unit		23-08-2025		TLM1	
No. of classes required to complete UNIT-II: 15				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.	Solar Panels: Silicon and Ga-As Cells.	1	03-09-2025		TLM2	
2.	Power generation capacity, efficiency.	1	04-09-2025		TLM2	
3.	Space Battery System Battery Types	1	06-09-2025		TLM2	
4.	Characteristics efficiency Parameters	1	10-09-2025		TLM1	
5.	Power electronics.	1	11-09-2025		TLM2	
6.	Telemetry of satellite	1	13-09-2025		TLM2	
7.	Command Control	1	17-09-2025		TLM2	
8.	monitoring functions(Interactive Quizzes & Polls)	1	18-09-2025		TLM2	
9.	Control Functions	1	20-09-2025		TLM1	
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.	Control Requirements: Attitude Control	1	24-09-2025		TLM1	
2.	Station keeping functions,	1	25-09-2025		TLM1	
3.	Type of control maneuvers.	1	27-09-2025		TLM1	
4.	Stabilization Schemes: Spin stabilization.	1	01-10-2025		TLM2	
5.	Stabilization Schemes: gravity gradient method, 3 axis stabilization.	1	02-10-2025		TLM2	
6.	Control Systems: Mass expulsion systems.	1	04-10-2025		TLM2	
7.	Control Systems: Momentum exchange systems.	1	08-10-2025		TLM1	
8.	Gyro and Magnetic Torque - sensors, Star and sun sensor, Earth sensor.	1	09-10-2025		TLM2	
9.	Magnetometers and Inertial Sensors.	1	11-10-2025		TLM2	
No. of classes required to complete UNIT-IV: 11				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 to Satellite services and applications	1	15-10-2025		TLM2	
2.	GPS location and principle.	1	16-10-2025		TLM2	

3.	Direct to Home, Home receiver	1	28-10-2025		TLM2	
4.	Satellite Mobile Services: VSAT.	1	22-10-2025		TLM2	
5.	RADARSAT.	1	23-10-2025		TLM2	
6.	IRNSS constellation.	1	25-10-2025		TLM2	
7.	Satellite structures and materials.	1	29-10-2025		TLM2	
No. of classes required to complete UNIT-V: 10				No. of classes taken:		

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
1.	Information about NaviC & some recently launched satellites information.	1	30-10-2025		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 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	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
V V Ramakrishna	V V Ramakrishna	Dr.M.V. Sudhakara Reddy	Dr. G. Srinivasulu

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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-23AE55** **Regulation: R23**
L-T-P Structure : **0-0-3** **Credits: 1.5**
Program/Sem/Sec : **B.Tech/V-SEM** **A.Y.: 2025-2026**

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	30-06-2025		02-07-2025		TLM4	
2.	Exp No 1	03	07-07-2025		09-07-2025		TLM4	
3.	Exp No 2	03	14-07-2025		16-07-2025		TLM4	
4.	Exp No 3	03	21-07-2025		23-07-2025		TLM4	
5.	Exp No 4	03	28-07-2025		30-07-2025		TLM4	
6.	Exp No 5	03	04-08-2025		06-08-2025		TLM4	
7.	Repeat	03	11-08-2025	-------	13-08-2025		TLM4	

8.	Repeat & Viva-voce	03	18-08-2025		20-08-2025		TLM4	
9.	Exp No 6	03	01-09-2025		03-09-2025		TLM4	
10.	Exp No 7	03	08-09-2025		10-09-2025		TLM4	
11.	Exp No 8	03	15-09-2025		17-09-2025		TLM4	
12.	Exp No 9	03	22-09-2025		24-09-2025		TLM4	
13.	Exp No 10	03	29-09-2025		01-10-2025		TLM4	
14.	Repeat	03	06-10-2025		08-10-2025		TLM4	
15.	Repeat	03	13-10-2025		15-10-2025		TLM4	
16.	Repeat	03	20-10-2025		22-10-2025		TLM4	
17.	Internal Exam	03	27-10-2025		29-10-2025		TLM4	
No. of classes required to complete: 17 & 16						**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.....	A=05
Record = **B**	1,2,3,4,5,6,7.....	B=05
Internal Test = **C**	1,2,3,4,5,6,7.....	C = 05
Cumulative Internal Examination: A + B + C = 15	1,2,3,4,5,6,7.....	**15**
Semester End Examinations = D	1,2,3,4,5,6,7.....	**D = 35**
Total Marks: A + B + C + D = 50	1,2,3,4,5,6,7.....	**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.
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.
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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: S.Indrasena Reddy/ Nazumuddin Shaik
Course Name & Code **:** Aircraft Component Modelling Using CATIA & 23AE56 **Regulation**: R23
L-T-P Structure **: 0-0-3** **Credits:** 1.5
Program/Sem/Sec : B.Tech/V **A.Y.:** 2025-26

Course Educational Objective: To provide hands-on training in CATIA software for modelling of aircraft components.

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

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

COs	Statements	Blooms Level
CO1	Create, modify, and constrain 2D sketches for component design	Apply
CO2	Develop 3D models and assemble various aircraft components using CATIA	Apply

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			3				2			2	3	3
CO2	3	2			3				2			2	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)

23AE56- COMPONENT MODELLING USING CATIA

Batch-B (Monday)

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	HOD Sign Weekly
1.	CATIA Introduction	3	30-06-25		
2.	Design of basic 2D sketches	3	07-07-25		
3.	Modelling of basic 3D parts	3	14-07-25		
4.	Design of aircraft wing structural elements	3	21-07-25		
5.	Design of aircraft fuselage structural elements	3	28-07-25		
6.	Modelling of landing gear components	3	04-08-25		
7.	Modelling of jet engine components	3	11-08-25		
8.	Drafting of conventional aircraft components	3	18-08-25		
9.	Assembly of a knuckle joint	3	01-09-25		
10.	Assembly of a radial engine	3	08-09-05		
11.	Assembly of wing elements	3	15-09-05		
12.	Assembly of fuselage components	3	22-09-25		
13.	Assembly of landing gear system	3	06-10-25		
14.	Assembly of jet engine components	3	13-10-25		
15.	Repetition Lab	3	20-10-25		
16.	Internal Test	3	27-10-25		
No. of classes required to complete: 16					

Batch-A (Wednesday)

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	HOD Sign Weekly
1.	CATIA Introduction	3	02-07-25		
2.	Design of basic 2D sketches	3	09-07-25		
3.	Modelling of basic 3D parts	3	16-07-25		
4.	Design of aircraft wing structural elements	3	23-07-25		
5.	Design of aircraft fuselage structural elements	3	30-07-25		
6.	Modelling of landing gear components	3	06-08-25		
7.	Modelling of jet engine components	3	13-08-25		
8.	Drafting of conventional aircraft components	3	20-08-25		
9.	Assembly of a knuckle joint	3	03-09-25		
10.	Assembly of a radial engine	3	10-09-25		
11.	Assembly of wing elements	3	17-09-25		
12.	Assembly of fuselage components	3	24-09-25		
13.	Assembly of landing gear system	3	08-10-25		
14.	Assembly of jet engine components	3	15-10-25		
15.	Repetition Lab	3	22-10-25		
16.	Internal Test	3	29-10-25		
No. of classes required to complete: 16					

PART-C

EVALUATION PROCESS (R23 Regulations):

Evaluation Task	Marks
Day to Day work = **A**	A=10
Record = **B**	B=05
Internal Test = **C**	C = 15
Cumulative Internal Examination : A + B + C	**30**
Semester End Examinations = D	**D = 70**
Total Marks: A + B + C + D	**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.
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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	(S.Indrasena Reddy)	(S.Indrasena Reddy)	(Dr.P.Lovaraju)
Signature			

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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/ G. V. Surya Narayana
Course Name & Code : Computational Structural Analysis Lab-23AES3
L-T-P Structure : 0-1-2 **Credits:** 2
Program/Sem/Sec : B. Tech, V-Sem **A.Y.:** 2025-26

COURSE EDUCATIONAL OBJECTIVE (CEO): To provide hands-on training in using ANSYS for finite element analysis (FEA) on behavior of aerospace and mechanical structural components under various static and dynamic loading conditions.

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

COs	Statements	Blooms Level
CO1	Perform static structural analysis on beams, trusses, and other structural elements using FEA tools.	Apply
CO2	Analyze aircraft structural components for deformation, stress distribution, and failure criteria.	Analyze

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	3	-	-	-	-	-	-	3	3	3
CO2	3	3	3	3	3	-	-	-	-	-	-	3	3	3
1 - Low							**2 –**Medium					**3 –** 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).

PART-B

COURSE DELIVERY PLAN (LESSON PLAN):

S. No.	Topics to be covered	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Fundamentals of Finite Element Analysis (FEA)	01-07-2025		TLM4	
2.	ANSYS Workbench and APDL environment	08-07-2025		TLM4	
3.	Problem-solving strategy using FEA, Units, boundary conditions, Creating and modifying geometry using Design Modeler	15-07-2025		TLM4	
4.	Sketching tools and part modelling concepts, Solid modelling strategies for structural components	22-07-2025		TLM4	

5.	Geometry simplification and repair for FEA, Pre and post processing basics	29-07-2025		TLM4	
6.	Static structural analysis	05-08-2025		TLM4	
7.	Modal and buckling analysis	12-08-2025		TLM4	
8.	Introduction to dynamic analysis Brief overview of nonlinear analysis and its applications	19-08-2025		TLM4	
9.	STRUCTURAL ANALYSIS OF AIRCRAFT COMPONENTS: Wing sections, Fuselage panels,	02-09-2025		TLM4	
10.	Landing gear elements Analysis of composite structures.	09-09-2025		TLM4	
11.	ANSYS Parametric Design Language	16-09-2025		TLM4	
12.	Material modeling for metallic and composite structures.	23-09-2025		TLM4	
13.	Composite structures Solving and results Analysis	07-10-2025		TLM4	
14.	Project work Support	14-10-2025		TLM4	
15.	Project work Support	21-10-2025		TLM4	
16.	Project work Support	28-10-2025		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 (R23 Regulation):

Evaluation Task	**Expt. no's**	**Marks**
Day to Day work = **A**	1,2,3,4,5,6,7,8,9,10.	A=10
Record = **B**	1,2,3,4,5,6,7,8,9,10.	B=05
Internal Test = **C**	1,2,3,4,5,6,7,8,9,10.	C =15
Cumulative Internal Examination: A + B + C = 30	1,2,3,4,5,6,7,8,9,10.	**30**
Semester End Examinations = D	1,2,3,4,5,6,7,8,9,10.	**D = 70**
Total Marks: A + B + C + D = 100	1,2,3,4,5,6,7,8,9,10.	**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

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

LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING

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Phone: 08659-222933, Fax: 08659-222931

DEPARTMENT OF AEROSPACE ENGINEERING

COURSE HANDOUT

PART-A

Name of Course Instructor:	Dr. Y. Raghu Vamsi/Mr. G V Surya Narayan	**Regulation**:	R23
Course Name & Code:	23EM01 – TINKERING LAB	**Credits:**	1
L-T-P Structure:	0-0-2	**A.Y.:**	2025-26
Program/Sem/Sec :	B.Tech/V-SEM		

Course Educational Objectives (CEO): The aim of tinkering lab for engineering students is to provide a hands-on learning environment where students can explore, experiment, and innovate by building and testing prototypes. These labs are designed to demonstrate practical skills that complement theoretical knowledge.

Course Outcomes (COs): At the end of the course - students will be able to:
CO1: Use Arduino boards for controlling various applications. **(Apply-L3)**
CO2: Control various applications using ESP32. **(Apply-L3)**
CO3: Design of different real time applications using breadboard, Mobile App and 3D printer. **(Apply-L3)**

CO-PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	2	3	3	2	2	1	1	-	1	-	-	1	-	2	2	-
CO2	2	3	3	2	2	1	1	-	1	-	-	1	-	2	2	-
CO3	2	3	3	2	2	1	1	-	1	-	-	1	-	2	2	-

List of Experiments:

1) Make your own parallel and series circuits using breadboard for any application of your choice.
2) Demonstrate a traffic light circuit using breadboard.
3) Build and demonstrate automatic Street Light using LDR.
4) Simulate the Arduino LED blinking activity in Tinkercad.
5) Build and demonstrate an Arduino LED blinking activity using Arduino IDE.
6) Interfacing IR Sensor and Servo Motor with Arduino.
7) Blink LED using ESP32.
8) LDR Interfacing with ESP32.
9) Control an LED using Mobile App.
10) Design and 3D print a Walking Robot
11) Design and 3D Print a Rocket.

12) Build a live soil moisture monitoring project, and monitor soil moisture levels of a remote plan in your computer dashboard.
13) Demonstrate all the steps in design thinking to redesign a motor bike.

Students need to refer to the following links:

1) https://aim.gov.in/pdf/equipment-manual-pdf.pdf
2) https://atl.aim.gov.in/ATL-Equipment-Manual/
3) https://aim.gov.in/pdf/Level-1.pdf
4) https://aim.gov.in/pdf/Level-2.pdf
5) https://aim.gov.in/pdf/Level-3.pdf

PART-B

COURSE DELIVERY PLAN (LESSON PLAN):

S. No.	Topics to be covered. (Experiment Name)	No. of Classes Required	Tentative Date of Completion	Actually Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Make your own parallel and series circuits using breadboard for any application of your choice.	02	05-07-2025		TLM4	
2.	Demonstrate a traffic light circuit using breadboard.	02	12-07-2025		TLM4	
3.	Build and demonstrate automatic Street Light using LDR.	02	19-07-2025		TLM4	
4.	Simulate the Arduino LED blinking activity in Tinkercad.	02	02-08-2025		TLM4	
5.	Build and demonstrate an Arduino LED blinking activity using Arduino IDE.	02	09-08-2025		TLM4	
6.	Interfacing IR Sensor and Servo Motor with Arduino.	02	23-08-2025		TLM4	
7.	Blink LED using ESP32.	02	06-09-2025		TLM4	
8.	LDR Interfacing with ESP32.	02	13-09-2025		TLM4	
9.	Control an LED using Mobile App	02	20-09-2025		TLM4	
10.	Design and 3D print a Walking Robot	02	27-09-2025		TLM4	
11.	Design and 3D Print a Rocket.	02	04-10-2025		TLM4	
12.	Build a live soil moisture monitoring project, and monitor soil moisture levels of a remote plan in your computer dashboard.	02	11-10-2025		TLM4	
13.	Demonstrate all the steps in design thinking to redesign a motor bike.	02	18-10-2025		TLM4	
14.	Repetition	02	25-10-2025		TLM4	

15.	Lab internal Exam	02	01-11-2025		TLM4	
No. of classes required to complete 14						

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

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Cumulative Internal Examination: A + B + C = 30	1,2,3,4,5,6,7,8,9,10.	**30**
Semester End Examinations = D	1,2,3,4,5,6,7,8,9,10.	**D = 70**
Total Marks: A + B + C + D = 100	1,2,3,4,5,6,7,8,9,10.	**100**

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
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Title	**Course Instructor**	**Module Coordinator**	**Head of the Department**
Signature			
Name of the Faculty	Dr. Y Raghu Vamsi Mr. G V Surya Narayana		Dr. P. Lovaraju