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 **:** Aircraft Structures and Vibrations-23AE14
L-T-P Structure **:** 3-0-0 **Credits:** 3
Program/Sem/Sec : B. Tech, VI-Sem **A.Y.:** 2025-26

Pre-requisites: Solid Mechanics, Aerospace Vehicle structures

Course Educational Objectives: To comprehend shear flow and shear centers in thin-walled sections, bending and buckling behavior of thin plates and stiffened panels located in fuselage, wing and landing gear, free and forced vibration of systems

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

COs	Statements	Blooms Level
CO1	Determine shear flow and locate shear centres in open and closed thin-walled sections	Apply
CO2	Analyze the bending and buckling behavior of thin plates under various loading conditions	Analyze
CO3	Analyse the shear flow distribution in aircraft structural members	Analyze
CO4	Formulate behaviour of systems with single degree of freedom under free vibrations	Apply
CO5	Analyse the forced vibration response of single degree of freedom systems	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	3	2	2	2	–	–	1	1	1	–	2	3	3
CO2	3	3	3	2	2	–	–	1	1	1	–	3	3	3
CO3	3	3	2	2	2	–	–	1	1	1	–	2	3	3
CO4	3	2	2	2	2	–	–	1	1	1	–	2	2	3
CO5	3	3	2	2	2	–	–	1	1	1	–	2	2	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 – 7th Edition (2021), Elsevier
T2	Singh, V. P., and Pratap, R. Mechanical Vibrations-5th edition. Dhanpat Rai and Co. 2015.

REFERENCE BOOKS:

R1	Peery, D. J., and Azar, J. J. Aircraft structures, 2nd edition. McGraw-Hill. Dover Publications, 2007.
R2	Bruhn, E. F. Analysis and design of flight vehicle structures. Jacobs Publishing 1973.
R3	Rivello, R. M. Theory and analysis of flight structures. McGraw-Hill-1993.
R4	Grover, G. K. Mechanical vibrations: M.K.S. systems, 8th edition. Nem Chand and Bros-2009.

PART-B

COURSE DELIVERY PLAN (LESSON PLAN):

UNIT-I: SHEAR FLOW AND SHEAR CENTRE IN THIN-WALLED 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
1.	Introduction to Course and Cos	1	01-12-2025			
2.	Introduction to Unit-I	1	03-12-2025		TLM1	
3.	Introduction to Thin-Walled Beam Theory Open vs Closed Thin-Walled Members	1	05-12-2025		TLM1	
4.	Basic Shear Flow Concepts	1	08-12-2025		TLM1&2	
5.	Shear Flow in Symmetrical Cross-Sections	1	10-12-2025		TLM1&2	
6.	**TUTORIAL**	1	12-12-2025		TLM3	
7.	Shear Flow in Unsymmetrical Cross-Sections	1	12-12-2025		TLM1	
8.	Shear Centre: Definition and Physical Interpretation	1	15-12-2025		TLM1	
9.	Determination and Location of Shear Centre	1	17-12-2025		TLM1&2	
10.	Bredt–Batho Theory: Fundamentals	1	19-12-2025		TLM1&2	
11.	Multi-Cell Structures and Torsion in Aircraft Components	1	22-12-2025		TLM1	
12.	Comparison of Bending and Torsion in Thin-Walled Beams; Effective and Ineffective Areas	1	24-12-2025		TLM1&2	
13.	Problems	1	26-12-2025		TLM1	
No. of classes required to complete UNIT-I: 12				**No. of classes taken:**		

UNIT-II: BENDING AND 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
14.	Introduction to Unit-II	1	29-12-2025		TLM1&2	
15.	Overview of Thin Plate Theory	1	31-12-2025		TLM1&2	
16.	Pure Bending of Plates & Twisting of Plates	1	02-01-2026		TLM1&2	
17.	Transverse Loading of Isotropic Rectangular Plates	1	05-01-2026		TLM1	
18.	Problems	1	07-01-2026		TLM3	
19.	In-Plane Loading of Plates	1	09-01-2026		TLM1	
20.	Introduction to Elastic and Inelastic Buckling	1	12-01-2026		TLM1	
21.	Local Instability in Thin Plates	1	16-01-2026		TLM1	
22.	**TUTORIAL**	1	16-01-2026		TLM1	
23.	Panel Buckling and Critical Stress Estimation	1	19-01-2026		TLM3	
24.	Buckling of Stiffened Panels	1	21-01-2026		TLM1&2	
25.	**TUTORIAL**	1	23-01-2026		TLM1&2	
26.	Problems	1	23-01-2026		TLM1	
No. of classes required to complete UNIT-II: 11				**No. of classes taken:**		

UNIT-III: STRESS ANALYSIS IN WING AND FUSELAGE 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
27.	Introduction to Aircraft Primary Structural Members	1	02-02-2026		TLM1	
28.	Wing Box Construction and Load Paths	1	04-02-2026		TLM1	
29.	**TUTORIAL**	1	06-02-2026		TLM1&2	
30.	Fuselage Structural Layout	1	06-02-2026		TLM1&2	
31.	Stress Analysis in Wing Box Beams	1	09-02-2026		TLM1&2	
32.	Stress Analysis in Fuselage Frames & Shear-Resistant Web Beams	1	11-02-2026		TLM3	
33.	Shear Flow Analysis in Multi-Cell Thin-Walled Structures	1	13-02-2026		TLM1	
34.	Wagner's Tension Field Theory	1	16-02-2026		TLM1&2	
35.	Step-Wise Procedure for Shear Flow Computation	1	18-02-2026		TLM1&2	
36.	Determining Combined Shear Flow and Bending Stresses	1	20-02-2026		TLM1	
No. of classes required to complete UNIT-III: 09				**No. of classes taken:**		

UNIT-IV: FREE VIBRATIONS OF SINGLE DEGREE OF FREEDOM (SDOF) 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
37.	Introduction to Unit-IV Basic Concepts of Vibration and SDOF Modeling	1	20-02-2026		TLM1	
38.	Free Vibrations of Undamped Translational Systems	1	23-02-2026		TLM1&2	
39.	Free Vibrations of Undamped Torsional Systems	1	25-02-2026		TLM1	
40.	Equivalent Stiffness of Springs in Series and Parallel	1	27-02-2026		TLM1&2	
41.	Energy Methods for Determining Natural Frequency	1	27-02-2026		TLM1&2	
42.	Introduction to Damping in Mechanical Systems	1	02-03-2026		TLM3	
43.	**TUTORIAL**	1	06-03-2026		TLM1	
44.	Types of Damping: Viscous, Coulomb, and Structural	1	06-03-2026		TLM1&2	
45.	Solutions of Damped Free Vibrations	1	09-03-2026		TLM1&2	
46.	Logarithmic Decrement and Damping Estimation Techniques	1	11-03-2026		TLM1&2	
47.	**Problems**	1	13-03-2026		TLM1&2	
48.	Problems	1	13-03-2026		TLM1&2	
No. of classes required to complete UNIT-IV: 10				**No. of classes taken:**		

UNIT-V: FORCED VIBRATIONS AND ISOLATION IN SDOF 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
49.	Fundamentals of Forced Vibrations in SDOF Systems	1	16-03-2026		TLM1	
50.	Steady-State Response Under Harmonic Excitation	1	18-03-2026		TLM1	
51.	**TUTORIAL**	1	20-03-2026		TLM1&2	
52.	Rotating Unbalance Excitation	1	20-03-2026		TLM1&2	
53.	Reciprocating Unbalance Excitation		23-03-2026		TLM1	
54.	Base Excitation Theory	1	25-03-2026		TLM3	
55.	**TUTORIAL**	1	27-03-2026		TLM1&2	

56.	Vibration Isolation Principles & Transmissibility and Isolation Curves	1	27-03-2026		TLM1&2	
57.	Typical Isolators and Mountings in Aerospace Structures	1	30-03-2026		TLM1	
58.	Vibration Measuring Instruments – Vibrometers & Accelerometers	1	01-04-2026		TLM1	
No. of classes required to complete UNIT-V: 08				**No. of classes taken:**		

Content Beyond the Syllabus:

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. A. Revanth Reddy
Course Name & Code : Airbreathing Propulsion-23AE15
L-T-P Structure : 3-0-0 Credits : 3
Program/Sem/Sec : B.Tech., ASE., VI-Sem. A.Y : 2025-26

PRE-REQUISITE: Engineering Thermodynamics, Elements of Aerospace Engineering

COURSE EDUCATIONAL OBJECTIVES (CEOs): To learn engineering concepts of jet engines, flow through subsonic and supersonic inlets of a jet engine, principle of operation of aircraft jet engines, fundamentals of combustion process.

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

CO 1	To determine the performance parameters of various jet engines (Apply - L3)
CO 2	Understand flow thorough subsonic and supersonic inlets (Understand – L2)
CO 3	Estimate the performance parameters of aircraft compressor (Apply-L3)
CO 4	Understand and identify the parameters governing the combustion process (Understand-L2)
CO 5	Determine the performance parameters of turbines of jet engines (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	3	2	-	-	-	-	-	-	-	2	3	2
CO2	3	3	3	2	-	-	-	-	-	-	-	2	3	2
CO3	3	3	3	2	-	-	-	-	-	-	-	2	3	2
CO4	3	3	3	2	-	-	-	-	-	-	-	2	3	2
CO5	2	2	2	2	-	-	-	-	-	-	-	2	2	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 Ganesan. V, Gas Turbines, Third Edition, Tata McGraw-Hill, New Delhi, 2017

T2 Saravanamuttoo. H.I.H, Rogers. G. F. C, Cohen. H, Straznicky. P. V, Nix. A. C, Gas Turbine Theory, Seventh Edition, Pearson Education, 2019.

REFERENCE BOOKS:

R1 Hill, P.G., Peterson, C.R. Mechanics & Thermodynamics of Propulsion, Addison – Wesley. Longman INC, 1999

R2 Mattingly. J. D, Elements of propulsion: Gas Turbines and Rockets, AIAA Educational Series

R3 Rolls Royce Jet Engine, Third Edition, 1983

PART-B

COURSE DELIVERY PLAN (LESSON PLAN):

UNIT-I: FUNDAMENTALS OF AIRBREATHING PROPULSION

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.	Working of Gas Turbine Engine	1	3/12/25		TLM1	
2.	Characteristics of Turboprop	1	5/12/25		TLM1	
3.	Characteristics of Turbofan	1	6/12/25		TLM1	
4.	Characteristics of Turbojet	1	10/12/25		TLM1	
5.	Cycle Analysis	1	12/12/25		TLM1	
6.	Performance Characteristics	1	13/12/25		TLM1	
7.	Performance Characteristics (Cont)	1	17/12/25		TLM1	
8.	Performance Characteristics (Cont)	1	19/12/25		TLM1	
9.	Thrust Equation.	1	20/12/25		TLM1	
10.	Thrust Equation (cont)	1	24/12/25		TLM1	
11.	Factors Affecting Thrust	1	26/12/25		TLM1	
12.	Methods of Thrust Augmentation	1	27/12/25		TLM1	
13.	Introduction to Ramjets and Working Principle.	1	31/12/25		TLM1	
14.	Introduction to SCRAMJETS and Working Principle.	1	2/1/26		TLM1	
No. of classes required to complete UNIT-I: 14				No. of classes taken: 14		

UNIT-II: SUBSONIC AND SUPERSONIC INLETS

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 to Subsonic and Supersonic inlets	1	7/1/26		TLM1	
16.	Subsonic Inlets	1	9/1/26		TLM1	
17.	Internal Flows	1	10/1/26		TLM1	
18.	External Flows	0.5	21/1/26		TLM1	
19.	Supersonic Inlets	0.5	21/1/26		TLM1	
20.	Starting problem on Supersonic Inlets	0.5	23/1/26		TLM1	
21.	Shock Swallowing	0.5	23/1/26		TLM1	
22.	Flow Stability Problem	0.5	24/1/26		TLM3	
23.	Revision of the Unit II	0.5	24/1/26		TLM1	
No. of classes required to complete UNIT-II: 6				No. of classes taken:		

MID 1 – 26/1/2026 to 31/1/2026

UNIT-III: COMPRESSORS

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
24.	Introduction to compressors	1	04/02/26		TLM1	
25.	Principle of Operation of Centrifugal Compressor	1	06/02/26		TLM1	
26.	Work Done and Pressure Rise	1	07/02/26		TLM1	
27.	Velocity diagrams	1	11/02/26		TLM1	
28.	Diffuser vane considerations	0.5	13/02/26		TLM2	
29.	Prewhirl, Stall and Surge	0.5	13/02/26		TLM1	
30.	Elementary theory of Axial Flow Compressor	0.5	14/02/26		TLM2	
31.	Velocity Triangles	0.5	14/02/26		TLM1	
32.	Degree of reactions	1	18/02/26		TLM1	
33.	Centrifugal compressor Performance Characteristics	1	20/02/26		TLM2	
34.	Axial compressor Performance Characteristics	1	21/02/26		TLM1	
No. of classes required to complete UNIT-III: 9				No. of classes taken:		

UNIT-IV: COMBUSTION CHAMBERS

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
35.	Classification of Combustion Chambers	0.5	25/02/26		TLM1	
36.	Combustion Process	0.5	25/02/26		TLM1	
37.	Factors affecting CC design	0.5	27/02/26		TLM1	
38.	CC Performance	0.5	27/02/26		TLM1	
39.	Effect of Operating variables on Performance	0.5	28/02/26		TLM1	
40.	Flame tube cooling	0.5	28/02/26		TLM1	
41.	Flame Stabilization	0.5	04/03/26		TLM1	
42.	Use of Flame Holders	0.5	04/03/26		TLM1	
43.	Fuel Injection Systems	0.5	06/03/26		TLM1	
44.	Revision of Unit IV	0.5	06/03/26		TLM1	
No. of classes required to complete UNIT-IV: 05				No. of classes taken:		

UNIT-V: TURBINES

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
45.	Elementary theory of Turbines	1	07/03/26		TLM1	
46.	Impulse Turbines	1	11/03/26		TLM1	

47.	Reaction Turbines	1	13/03/26		TLM1	
48.	Axial flow Turbines	1	14/03/26		TLM1	
49.	Radial flow Turbines	1	18/03/26		TLM1	
50.	Velocity triangles and Power output	1	20/03/26		TLM1	
51.	Velocity triangles and Power output (Cont..)	1	21/03/26		TLM1	
52.	Estimation of Stage Performance	1	25/03/26		TLM1	
53.	Estimation of Stage Performance (Cont..)	1	27/03/26		TLM1	
54.	Turbine Performance Characteristics	1	28/03/26		TLM1	
55.	Turbine Performance Characteristics	1	01/04/26		TLM1	
56.	Methods of Blade Cooling	1	04/04/26		TLM1	
No. of classes required to complete UNIT-V:12				No. of classes taken:		

MID 2 – 06/04/2026 to 11/04/2026

Advanced Topics/ beyond Syllabus in MOC

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.						
2.						

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)	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):

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	Module Coordinator	HoD
Dr. A Revanth Reddy	Dr. A Revanth Reddy	Dr. P. Lovaraju

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Phone: 08659-222933, Fax: 08659-222931

DEPARTMENT OF AEROSPACE ENGINEERING

COURSE HANDOUT
PART-A

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

ACADEMIC YEAR : 2025-26

COURSE NAME & CODE : **FLIGHT DYNAMICS-23AE16**

L-T-P STRUCTURE : 3-0-0

COURSE CREDITS : 3

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

PRE-REQUISITES: Engineering Mechanics, Aerodynamics

Course Educational Objectives: To learn the concepts of steady level and maneuvering flight performances at various operating conditions, static-dynamic stability and control of an aircraft.

Course Outcomes:

COs	Statements	Blooms Level
CO1	Determine thrust and power requirement conditions for steady level flight	Apply
CO2	Estimate performance parameters of flight during manoeuvring	Apply
CO3	Apply the conditions of static stability and control in the aircraft design	Apply
CO4	Analyze the stability of aircraft under dynamic modes	Analyze

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

Course Code	Cos	Program Outcomes												PSOs	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
23AE16	CO1	3	2	2	2	2	-	-	1	1	1	-	2	3	3
	CO2	3	3	2	2	2	-	-	1	1	1	-	2	3	3
	CO3	3	3	2	3	2	-	-	1	1	1	-	3	3	3
	CO4	3	2	2	3	2	-	-	1	1	1	-	3	3	3
1 = Slight (Low)		**2 = Moderate (Medium)**								**3-Substantial(High)**					

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

TEXT BOOKS

T1 Aircraft Performance and Design, J.D Anderson, McGrawhill Education, 2017
T2 Nelson, R.C. "Flight Stability and Automatic Control", McGraw-Hill Book Co., 2017.

REFERENCE BOOKS

R1 Perkins, C.D., and Hage, R.E., "Airplane Performance stability and Control", John Wiley and Son:, Inc, NY, 1988.
R2 Etkin, B., "Dynamics of Flight Stability and Control", Edn. 2, John Wiley, NY, 1982.
R3 Babister, A.W., "Aircraft Dynamic Stability and Response", Pergamon Press, Oxford, 1980.
R4 Michael V. Cook, "Flight Dynamics Principles", Second Edition, Elsevier Aerospace Engineering Series, 2007.
R5 Mc Cornick B. W, "Aerodynamics, Aeronautics and Flight Mechanics", John Wiley, NY, 1995.

PART-B

COURSE DELIVERY PLAN (LESSON PLAN):

UNIT-I: STEADY FLIGHT PERFORMANCE

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 discussion of course outcomes (Cos)	1	1-12-2025		TLM1	
2.	Introduction to Aircraft Performance, Equations of motion of Steady level flight	1	2-12-2025		TLM1	
3.	Drag Polar	1	3-12-2025		TLM1	
4.	Thrust Required for Level Flight	1	8-12-2025		TLM1	
5.	Thrust Available and Maximum Velocity	1	9-12-2025		TLM1	
6.	Power required for level flight, Power available and maximum velocity	1	10-12-2025		TLM1	
7.	Altitude effects	1	15-12-2025		TLM1	
8.	Effect of Drag Divergence	1	16-12-2025		TLM1	
9.	Tutorial	1	17-12-2025		TLM3	
No. of classes required to complete UNIT-I		**9**		**No. of classes taken:**		

UNIT-II: MANOEUVRING FLIGHT:

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
10.	Rate of climb and climb performance parameter	2	22-12-2025 23-12-2025		TLM1, TLM2	
11.	Hodograph Diagram ,Absolute and service ceiling, Time to climb	1	24-12-2025		TLM1	
12.	Gliding Flight	1	29-12-2025		TLM1	
13.	Range for propeller driven and jet propelled	1	30-12-2025		TLM1	
14.	Endurance, Endurance for propeller driven and jet propelled	1	31-12-2025		TLM1,TLM2	
15.	Turning Flight, Pull-Up and Pull-Down Manoeuvres	1	5-01-2026		TLM1,TLM2	
16.	Constraints on load factor, V-n diagram	1	6-01-2026		TLM1, TLM2	
17.	Take-off performance Landing performance	1	7-01-2026		TLM1	
18.	Tutorial	1	19-01-2026		TLM3	
No. of classes required to complete UNIT-II		**10**		**No. of classes taken:**		

I Mid Examination (26-01-2026 to 31-01-2026)

UNIT-III: STATIC LONGITUDINAL STABILITY AND 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
19.	Introduction, Moments on the airplane, Absolute angle of attack	1	20-01-2026		TLM1,TLM4	
20.	Criteria for longitudinal Stability	1	21-01-2026		TLM1	
21.	Wing contribution for longitudinal static stability	2	2-02-2026 3-02-2026		TLM1	
22.	Tail contribution for longitudinal static stability	2	4-02-2026 9-02-2026		TLM1, TLM2	
23.	Total pitching moment, Neutral point, Static margin	1	10-02-2026		TLM1	
24.	Stick fixed stability, Stick free stability, Longitudinal control	1	11-02-2026		TLM1	
25.	Elevator angle to trim, Elevator hinge moment, Power effects	1	16-02-2026		TLM1	

26.	Tutorial	1	17-02-2026		TLM3	
No. of classes required to complete UNIT-III		10		**No. of classes taken:**		

UNIT-IV: STATIC LATERAL-DIRECTIONAL STABILITY AND 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
27.	Lateral stability-Dihedral effect, criterion for lateral stability	1	23-02-2026		TLM1	
28.	Dihedral effect, Adverse yaw effects	1	24-02-2026		TLM1,TLM5	
29.	Contribution of wing, fuselage, tail, Lateral control - Coupling between rolling and yawing moments	1	25-02-2026		TLM1	
30.	Lateral control-strip theory estimation of aileron effectiveness, aileron reversal.	1	2-03-2026		TLM1	
31.	Directional stability-yaw and sideslip, Criterion of directional stability, Contribution wing, fuselage, tail	1	3-03-2026		TLM1	
32.	Directional control-rudder control effectiveness	1	9-03-2026		TLM1	
33.	Rudder requirements-adverse yaw, asymmetric power condition, spin recovery, Rudder lock and Dorsal fin	1	10-03-2026		TLM1	
34.	Tutorial	1	11-03-2026		TLM3	
No. of classes required to complete UNIT-IV		8		**No. of classes taken:**		

UNIT-V: DYNAMIC STABILITY AND 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
35.	Introduction to dynamic longitudinal stability, Modes of stability	1	16-03-2026		TLM1,TLM5	
36.	Aircraft Equations of motion	2	17-03-2026 18-03-2026		TLM1	
37.	Small disturbance theory	1	23-03-2026		TLM1,TLM5	
38.	Solving the stability quartic, Routh's Discriminant	1	24-03-2026		TLM1	

39.	Phugoid motion, Short period of oscillation	1	25-03-2026		TLM1	
40.	Brief description of lateral and directional dynamic stability	1	30-03-2026		TLM1	
41.	Spiral divergence, Dutch roll, auto rotation and spin	1	31-03-2026		TLM1	
42.	Tutorial	1	1-04-2026		TLM3	
43.	Revision				TLM2	
No. of classes required to complete UNIT-V		**9**		**No. of classes taken:**		

Content Beyond the Syllabus:

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

PART-C

EVALUATION PROCESS (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

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

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

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

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

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

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

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

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

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

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

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

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

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

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: To apply the knowledge of Aerodynamics, Propulsion, Aircraft structures and Flight Dynamics in the Aerospace vehicle design
PSO2: To prepare the students to work effectively in Aerospace and Allied Engineering organizations

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

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 NAAC with 'A' grade, An ISO 9001:2015 Certified Institution
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

PROGRAM : B. Tech, VI Sem, Aerospace Engineering

ACADEMIC YEAR : 2025-2026

COURSE NAME AND CODE : 23AE17 Computational Fluid Dynamics and Heat Transfer

L-T-P STRUCUTRE : 3-0-0

COURSE CREDITS : 3

COURSE INSTRUCTOR : Dr. Sreenadh Chevula

PRE-REQISITE : Numerical Methods, Engineering Fluid Mechanics, Aerodynamics

Course educational objectives

To learn the basic governing equations of fluid dynamics, mathematical behaviour of partial differential equations, phenomena of various discretization techniques, techniques to solve the simple incompressible and heat transfer problems

COURSE OUTCOMES(Co's) At the end of the course students are able to

CO	Statements	Blooms Level
CO1:	Formulate the governing equations of fluid dynamics	Apply
CO2:	Apply the discretization techniques to governing equations of fluid dynamics	Apply
CO3:	Understand various CFD techniques	Understand
CO4:	Solve elementary incompressible fluid problems using the CFD techniques	Apply
CO5:	Solve the elementary heat transfer problems using the CFD techniques	Apply

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

REFERENCES

T1. Anderson, Computational Fluid Dynamics-Basics with Applications, Mc Graw Hill, 2017.

T2. Anderson, D. A, Tannehill. J. C, Pletcher. R. H, Computational Fluid Mechanics and Heat Transfer, CRC Press, 2012.

T3. Patankar. S. V, Numerical Heat Transfer and Fluid Flow, CRC Press, 1980.

T4. Sengupta. T. K, Fundamentals of Computational Fluid Dynamics, University Press, 2004.

T5. Ghoshdastidar P.S. Heat Transfer, Oxford University Press, 2012

PART-B
COURSE DELIVERY PLAN (LESSON PLAN)

UNIT - I INTRODUCTION

		No of classes	Tentative date	Actual Date of	Teaching	Learning	Text Book	HoD Sign
S.No	**Topics to be Covered**	**required**	**of completion**	**completion**	**Learning method**	**Outcomes**	**Followed**	**Weekly**
1	**Computational Fluid Dynamics as a Research and Design Tool, Applications of Computational Fluid Dynamics.**	1	03-12-2025		TLM 1& 2	CO1	T1	
	Governing Equations of Fluid Dynamics:							
2	Introduction, Control Volume,	1	04-12-2025		TLM 1& 2	CO1	T1	
3	Substantial Derivative, Divergence of Velocity	1	06-12-2025		TLM 1& 2	CO1	T1	
4	Continuity Equation	1	10-Dec-25		TLM 1& 2	CO1	T1	
5	Momentum Equation	1	11-Dec-25		TLM 1& 2	CO1	T1	
6	Energy Equation	1	13-12-2025		TLM 1& 2	CO1	T1	
7	Conservation and non-conservation forms of governing flow equations	2	17, 18-12-2025		TLM 1& 2	CO1	T1	
Total No of classes required to complete Unit-1		**8**	No of Classes Taken:					

UNIT - 2 MATHEMATICAL BEHAVIOR OF PARTIAL DIFFERENTIAL EQUATIONS AND BASICS ASPECTS OF DISCRETIZATION

		No of classes	Tentative date	Actual Date of	Teaching	Learning	Text Book	HoD Sign
S.No	**Topics to be Covered**	**required**	**of completion**	**completion**	**Learning method**	**Outcomes**	**Followed**	**Weekly**
	Mathematical Behaviour of Partial Differential Equations:							
1	Introduction	1	20-12-2025		TLM 1& 2	CO1	T1	
2	Classification of Quasi-Linear Partial Differential Equations	1	24-12-2025		TLM 1& 2	CO1	T1	
3	Eigen Value Method,	1	27-12-2025		TLM 1& 2	CO1	T1	
4	Hyperbolic Equations, Parabolic Equations, Elliptic Equations	1	31-12-2025		TLM 1& 2	CO1	T1	

BASICS ASPECTS OF DISCRETIZATION								
5	Introduction of Finite Differences,	1	01-01-2026		TLM 1& 2	CO2	T1	
6	Difference Equations,	1	07-01-2026		TLM 1& 2	CO2	T1	
7	Explicit Approaches, Implicit Approaches	1	08-01-2026		TLM 1& 2	CO2	T1	
8	Errors and Stability Analysis	1	21-01-2026		TLM 1& 2	CO2	T1	
9	Grid Generation	1	22-01-2026		TLM 1& 2	CO2	T1	
	Total No of classes required to complete Unit-2	**9**	No of Classes Taken:					

UNIT - 3 SIMPLE CFD TECHNIQUES

		No of classes	Tentative date	Actual Date of	Teaching	Learning	Text Book	HoD Sign
S.No	**Topics to be Covered**	**required**	**of completion**	**completion**	**Learning method**	**Outcomes**	**Followed**	**Weekly**
1	**Introduction**	**1**	**24-01-2026**		TLM 1& 2	**CO3**	**T1**	
26-01-2026 to 31-01-2026 MID-I Examination								

		No of classes	Tentative date	Actual Date of	Teaching	Learning	Text Book	HoD Sign
S.No	**Topics to be Covered**	**required**	**of completion**	**completion**	**Learning method**	**Outcomes**	**Followed**	**Weekly**
2	The Lax–Wendroff method	1	03-02-2026		TLM 1& 2	CO3	T1	
3	MacCormack technique	1	04-02-2026		TLM 1& 2	CO3	T1	
4	Space Marching	1	07-02-2026		TLM 1& 2	CO3	T1	
5	Relaxation Technique and its use with low-speed inviscid Flow	2	10, 11-02-2026		TLM 1& 2	CO3	T1	
6	Artificial Viscosity	1	14-02-2026		TLM 1& 2	CO3	T1	
	Total No of classes required to complete Unit-3	**7**	No of Classes Taken:					

UNIT - 4 INCOMPRESSIBLE COUETTE FLOW

		No of classes	Tentative date	Actual Date of	Teaching	Learning	Text Book	HoD Sign
S.No	**Topics to be Covered**	**required**	**of completion**	**completion**	**Learning method**	**Outcomes**	**Followed**	**Weekly**
1	Introduction	1	18-02-2026		TLM 1& 2	CO4	T1	
2	The Physical Problem and its exact	1	19-02-2026		TLM 1& 2	CO4	T1	
	Analytical Solution	2	21, 25-02-2026					
3	Implicit Crank-Nicholson Technique	2	26, 28-02-2026		TLM 1& 2	CO4	T1	

4	Pressure Correction Method	2	04, 05-03-2026		TLM 1& 2	CO4	T1	
	Total No of classes required to complete Unit-4	**8**						

UNIT - 5 HEAT TRANSFER

S.No	Topics to be Covered	No of classes required	Tentative date of completion	Actual Date of completion	Teaching Learning method	Learning Outcomes	Text Book Followed	HoD Sign Weekly
1	Introduction	2	07,11-03-2026		TLM 1& 2	CO5	T1, T2	
2	Finite Difference Applications in Heat conduction	2	12,14-03-2026		TLM 1& 2	CO5	T1, T2	
3	1D and 2D-steady state heat conduction in a rectangular geometry	2	18,19-03-2026		TLM 1& 2	CO5	T1, T2	
4	1D and 2D transient heat conduction	2	21,25-03-2026		TLM 1& 2	CO5	T1, T2	
5	Finite difference application in convective heat transfer.	2	26,28-03-2026					
	Total No of classes required to complete Unit-5	10						

06 -04-2025 to 11-04-2026 MID-II Examination
20-04-2026 to 2-05-2026 Semester end examination

Teaching Learning Method

Teaching Learning Methods			
TLM1	Chalk and Talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM 2	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

Title	**Course Instructor**	**Head of the Department**
Name of the Faculty	**Dr. Sreenadh Chevula**	**Dr. P. Lovaraju**
Signature		

LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING

(AUTONOMOUS)

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DEPARTMENT OF AEROSPACE ENGINEERING

COURSE HANDOUT

PART-A

Name of Course Instructor: Mr. I. Dakshina Murthy

Course Name & Code	**: Instrumentation Measurement and Experiments in Fluids(23AE23)**	
L-T-P Structure	**:** 3-0-0	**Credits:** 3
Program/Sem	: R23, B. Tech / VI-Sem	**A.Y. :** 2025-26

PREREQUISITE: Engineering Physics, Mathematics

COURSE EDUCATIONAL OBJECTIVES (CEOs): To learn the need for experimentation and wind tunnel techniques, theory of flow visualization techniques and analogue methods, working principle of various velocity measurement instruments, working of various pressure and temperature measurement instruments, and principle data acquisition and uncertainty estimation of measured data

COURSE OUTCOMES (COs): On Completion of the course, student should be able to

CO1	Employ the wind tunnels for aerodynamic testing of bodies **(Apply L3)**
CO2	Adopt and use a visualization technique to understand the flow field **(Apply L3)**
CO3	Employ the suitable instrument to measure the velocity, temperature and pressure of fluid flow **(Apply L3)**
CO4	Acquire experimental data and to estimate the uncertainty in measured values during experimentation **(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	2	3	3	2	2				1	2	1	2	3	2
CO2	2	3	2	2	2				1	2	1	2	3	2
CO3	3	3	3	2	2				1	2	1	2	2	3
CO4	2	3	3	3	2				1	3	1	3	2	3
	1 - Low						**2 –**Medium						**3 -** High	

REFERENCE BOOKS:

R1. E. Rathakrishnan, Instrumentation, Measurements and Experiments in Fluids, CRC press, CRC Press; 2nd edition, 2020

R2. Jack Philip Holman, Experimental methods for Engineers, McGraw Hill Education; 7th edition, 2017.

R3. Jewel B. Barlow, William H. Rae, Alan Pope., Low Speed Wind Tunnel Testing, Wiley India Pvt Ltd; Third edition, 2010.

R4. Pope, A., Goin, L., High Speed Wind Tunnel Testing, John Wiley, 1985.

R5. Ernest Doebelin, Measurement Systems, McGraw Hill Education; 6th edition, 2017

R6. John H. Lienhard V Thomas G. Beckwith, Roy D. Marangoni, Mechanical Measurements, Pearson Education; Revised 6e edition, 2020

PART-B

COURSE DELIVERY PLAN (LESSON PLAN):

UNIT-I: Need and Objective of Experimental Study and Wind Tunnels

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 the course	1	01-12-2025		TLM 1	
2.	Measurement systems and Performance Terms	1	04-12-2025		TLM 1	
3.	Introduction to wind tunnels, classification, low-speed wind tunnel	1	06-12-2025		TLM 1, 2	
4.	Power losses in wind tunnels & energy ratio	3	08-12-2025 11-12-2025 15-12-2025		TLM 1	
5.	High-speed wind tunnels	1	18-12-2025		TLM2	
6.	Instrumentation and Calibration of Wind tunnels	2	20-12-2025 22-12-2025		TLM 1, 2	
7.	Wind tunnel balance, types of balances	3	25-12-2025 27-12-2025 29-12-2025		TLM 1, 2	
8.	Strain gauge balance and balance calibration	1	01-01-2026		TLM 1, 2	
No. of classes required to complete UNIT-I: 13				**No. of classes taken:**		

UNIT-II: Flow Visualization and Analog 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
9.	Introduction and need for flow visualization & Classification of flow visualization	1	03-01-2026		TLM1	
10.	Construction and working of a smoke tunnel	1	05-01-2026		TLM 1, 2	
11.	Optical visualization techniques, Interferometer	1	83-01-2026		TLM 1, 2	
12.	Schlieren technique	2	10-01-2026 12-01-2026		TLM 1, 2	
13.	Shadowgraph technique	1	15-01-2026		TLM 1, 4	
14.	Hele-Shaw apparatus, necessary equations, construction, working.	2	17-01-2026 19-01-2026		TLM1, 4	
15.	Electrolytic tank	1	22-01-2026		TLM 1, 2	
16.	Hydraulic analogy & Jumps	1	24-01-2026		TLM 1, 2	
No. of classes required to complete UNIT-II: 10				**No. of classes taken:**		

UNIT-III: Velocity Measurement

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 and Velocity & Mach number from pressure measurements	1	02-02-2026		TLM 1, 2	
18.	Laser droplet anemometer- LDA Principle, Doppler shift equation, Reference beam system	1	05-02-2026		TLM1,2	
19.	Hot-Wire Anemometer and principle, (CCA), (CTA)	1	07-02-2026		TLM 1, 2	
20.	Hot-Wire Anemometer and principle, (CCA), (CTA)	1	09-02-2026		TLM 1, 2	
21.	Hot-Wire Probes, Limitations of Hot-Wire Anemometer	1	12-02-2026		TLM 1, 2	
22.	Measurement of velocity using vortex shedding Technique	1	16-02-2026		TLM 1, 2	
23.	Fluid Jet Anemometer	1	19-02-2026		TLM 1, 2	
No. of classes required to complete UNIT-III: 07				**No. of classes taken:**		

UNIT-IV: Pressure Measurement Techniques and Temperature Measurement

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.	Barometers, Manometers, Dial type pressure gauge,	1	21-02-2026		TLM1,2 &4	
25.	Pressure Transducers, Static, and Pitot-Static Tube, Characteristics probes	1	23-02-2026		TLM1,2 &4	
26.	Flow direction measurement probes and Low-Pressure, Measurement Gauges	1	26-02-2026		TLM1,2	
27.	Temperature measurement: Types of thermometers, Thermocouples principle and operation	2	28-02-2026 02-03-2026		TLM1,2	
28.	RTD, Thermistors, Pyrometers,	1	05-03-2026		TLM 1, 2	
29.	Temperature measurement in fluid flows	1	07-03-2026		TLM 1, 2	
No. of classes required to complete UNIT-IV: 07				**No. of classes taken:**		

UNIT-V: Data Acquisition and Uncertainty 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
30.	Introduction to data acquisition, Data Acquisition Principle, Generation of Signal	1	09-03-2026		TLM 1, 2	
31.	Signal Conditioning, Multiplexing, Data Conversion, Data Storage and Display, Data Processing,	2	12-03-2026 16-03-2026		TLM 1, 2	
32.	Digital Interfacing, Data Acquisition using Personal Computers,	1	21-03-2026		TLM 1, 2	
33.	Introduction to uncertainty	1	23-03-2026		TLM 1, 2	
34.	Estimation of measurement errors	1	28-03-2026		TLM 1, 2	
35.	Uncertainty Analysis- Uses of uncertainty analysis, Uncertainty in flow Mach number	1	30-03-2026		TLM 1, 2	
No. of classes required to complete UNIT-V: 8				**No. of classes taken:**		

SYLLABUS BEYOND 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	Ludwieg Tube	1	02-04-2026		TLM 2	
2	Supersonic and Hypersonic Tunnels	1	04-04-2026		TLM 2	
No. of classes required to complete : 02				**No. of classes taken:**		

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

PART-C

EVALUATION PROCESS (R17 Regulation):

Evaluation Task	Marks
Assignment-I (Unit-I, and Unit II)	A1=5
I-Descriptive Examination (Unit-I, and Unit II)	M1=15
I-Quiz Examination (Unit-I, and Unit 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):	30
Semester End Examination (SEE)	70
Total Marks = CIE + SEE	100

PART-D

PROGRAM 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

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

LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING

(Autonomous Status Since the Academic Year 2010-11 & Extended up to 2031-32)
NAAC Accredited with CGPA of 3.20 on 4-point scale at 'A' Grade
NIRF-2022 (Positioned in the Band of 251-300 in the Engineering Category)
NIRF-2023 (Positioned in the Band of 101-150 in the Innovation Category)
NBA Accredited under Tier-I (ECE, EEE, CSE, IT, ME, CIV, ASE) Recognized as Scientific Industrial Research Organization(SIRO) by DSIRApproved by AICTE, New Delhi and Affiliated to JNTUK, Kakinada L.B.Reddy Nagar, Mylavaram-521230, N.T.R Dist., Andhra Pradesh, India.

Department of Aerospace Engineering

COURSE HANDOUT

PART: A

Program/Sem/Sec : B.Tech., ASE., VI-Sem.
Academic Year : 2025-26
Course Name & Code : Principles of Communications & 23EC82
L-T-P-Cr Structure : 3-0-0-3
Course Instructor : Mr. Ch Siva Rama Krishna

Course Objectives:

1	To provides the Knowledge on various analog modulation techniques in both time and frequency domains.
2	To understand the generation and demodulation methods of various analog modulation techniques.
3	To give the information regarding functions of AM and FM transmitters and receivers.
4	To understand the effect of noise on the performance of AM and FM receivers and the principles of PAM, PWM, and PPM, TDM and FDM techniques.

Course Outcomes (COs): At the end of the course, students will be able to

CO 1	Describe the principles of amplitude and angle modulation techniques including AM, DSB-SC, SSB, VSB, FM, and PM, along with their spectral properties and generation/detection methods	L2
CO 2	Summarize the role of Fourier analysis, autocorrelation, energy spectral density, and signal processing tools in the analysis of modulated signals	L3
CO 3	Analyze sampling, quantization, pulse modulation, and digital baseband modulation schemes such as PAM, DM, and DPCM, including reconstruction and noise effects	L3
CO 4	Analyze sampling, quantization, pulse modulation, and digital baseband modulation schemes such as PAM, DM, and DPCM, including reconstruction and noise effects	L4

Course Articulation Matrix - Correlation between COs, POs & PSOs

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	2	1	-	-	-	-	-	-	-	-	2	1	-	-
CO 2	2	2	1	-	-	-	-	-	-	-	-	2	2	-	-
CO 3	2	3	1	1	-	-	-	-	-	-	-	3	3	-	-
CO 4	3	2	1	-	-	-	-	-	-	-	-	1	1	-	-

Correlation Levels: **1**-Slight (Low), **2**-Moderate (Medium), **3**-Substantial (High) and No correlation: '-'

TEXT BOOKS:

1. Simon Haykin, Communications Systems, John Wiley and Sons, Inc, 4th Edition, 2006.
2. David Tse, Pramod Viswanath, "Fundamentals of Wireless Communication," Cambridge university press, 2005.

References:

1. Simon Haykin, "Principles of Communication Systems", John Wiley, 2nd Edition.
2. George Kennedy and Bernard Davis "Electronics & Communication System", TMH 2004.

PART-B:
COURSE DELIVERY PLAN (LESSON PLAN)

UNIT-I:

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 the Course	1	01-12-2025		TLM1	
2.	Course Objectives and Course Outcomes	1	02-12-2025		TLM1	
3.	Introduction to communication system	1	03-12-2025		TLM1	
4.	Basic tools for communication: Fourier Series/Transform	1	05-12-2025		TLM1	
5.	Properties of Fourier Transform	1	08-12-2025		TLM1	
6.	Autocorrelation, Energy Spectral Density	1	09-12-2025		TLM1	
7.	Tutorial	1	10-12-2025		TLM3	
8.	Parseval's Relation	1	12-12-2025		TLM1	
9.	Amplitude Modulation	1	15-12-2025		TLM1	
10.	Spectrum of AM	1	16-12-2025		TLM1	
11.	Tutorial	1	17-12-2025		TLM3	
12.	Envelope Detection	1	19-12-2025		TLM1	
13.	Power Efficiency, Modulation Index	1	22-12-2025		TLM1	
No. of classes required to complete UNIT-I: 13			**No. of classes taken:**			

UNIT-II:

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.	Double Sideband Suppressed Carrier Modulation	1	23-12-2025		TLM1	
2.	Tutorial	1	24-12-2025		TLM3	
3.	Demodulation: Costas Receiver	1	26-12-2025		TLM1	
4.	Single Sideband Modulation	1	29-12-2025		TLM1	
5.	Hilbert Transform	1	30-12-2025		TLM1	
6.	Tutorial	2	31-12-2025		TLM3	
7.	Complex Pre-envelope	1	02-01-2026		TLM1	
8.	Demodulation of SSB	1	05-01-2026		TLM1	
9.	Vestigial Sideband Modulation	1	06-01-2026		TLM1	
10.	Tutorial	1	07-01-2026		TLM3	
11.	Problems	1	09-01-2026		TLM1	
No. of classes required to complete UNIT-II : 11			**No. of classes taken :**			

UNIT-III:

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.	Angle Modulation, Frequency Modulation	1	12-01-2026		TLM1	
2.	Phase Modulation	1	13-01-2026		TLM1	
3.	Modulation Index	1	16-01-2026		TLM1	
4.	Instantaneous Frequency	1	19-01-2026		TLM1	
5.	Spectrum of FM Signals, Carsons Rule for FM Bandwidth	1	20-01-2026		TLM1	
6.	Tutorial	1	21-01-2026		TLM3	
7.	Narrowband FM Generation	1	23-01-2026		TLM1	
8.	Wideband FM Generation via Indirect Method	1	02-02-2026		TLM1	
9.	FM Demodulation	1	03-02-2026		TLM2	
10.	Tutorial	1	04-02-2026		TLM3	
No. of classes required to complete UNIT-III: 10			**No. of classes taken:**			

UNIT-IV :

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 Sampling, Spectrum of Sampled Signal.	1	06-02-2026		TLM1	
2.	Aliasing, Nyquist Criterion	1	09-02-2026		TLM1	
3.	Signal Reconstruction from Sampled Signal	1	10-02-2026		TLM1	
4.	Tutorial	1	11-02-2026		TLM3	
5.	Pulse Amplitude Modulation	1	13-02-2026		TLM1	
6.	Quantization	1	16-02-2026		TLM1	
7.	Uniform Quantizers – Midrise and Midtread	1	17-02-2026		TLM1	
8.	Tutorial	1	18-02-2026		TLM3	
9.	Quantization noise	1	20-02-2026		TLM2	
10.	Non uniform Quantizers	1	23-02-2026		TLM1	
11.	Delta Modulation	1	24-02-2026		TLM1	
12.	Tutorial	1	26-02-2026		TLM3	
13.	Differential Pulse Code Modulation	1	27-02-2026		TLM1	
No. of classes required to complete UNIT-IV : 13			**No. of classes taken :**			

UNIT-V : SEQUENTIAL CIRCUITS-II

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.	Basics of Probability	1	02-03-2026		TLM1	
2.	Conditional Probability	1	03-03-2026		TLM1	
3.	Tutorial	1	04-03-2026		TLM3	
4.	MAP Principle	1	06-03-2026		TLM1	
5.	Random Variables	1	09-03-2026		TLM1	
6.	Probability Density Functions		10-03-2026		TLM1	

7.	Tutorial		11-03-2026		TLM3
8.	Applications in Wireless Channels		13-03-2026		TLM1
9.	Basics of Random Processes,	1	16-03-2026		TLM1
10.	Gaussian Random Process	1	17-03-2026		TLM1
11.	Tutorial	1	18-03-2026		TLM3
12.	Noise.		20-03-2026		TLM1
13.	Problems		23-03-2026		TLM1
14.	Problems		31-03-2026		TLM1
No. of classes required to complete UNIT-V : 14			**No. of classes taken :**		

Content 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
2.	Introduction to HDL,Verilog HDL	1	01-04-2026		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:

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 (III, IV & V)	**A2=5**
II- Descriptive Examination (Unit-III, IV & V)	**M2=15**
II-Quiz Examination (Unit-III, IV & V)	**Q2=10**
Cumulative Internal Examination (CIE) = 80% of Max((M1+Q1+A1) , (M2+Q2+A2)) + 20% of Min((M1+Q1+A1) , (M2+Q2+A2))	**30**
Semester End Examination (SEE)(Unit-I, Unit – II, Unit –III, Unit-IV and Unit-V)	**70**
Total Marks = CIE + SEE	**100**

PART-D:

ROGRAMME OUTCOMES (POs) & PROGRAMME SPECIFIC OUTCOMES (PSOs):

Program 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.

Program 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
Mr. Ch. Sivaramakrishna	Mr. Ch. Sivaramakrishna	Dr. M V Sudhakar	Dr. G. Srinivasulu

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 Instructors: Mr. Nazumuddin Shaik/
Mr. S. Indrasena Reddy/
Mrs. B. Udaya Lakshmi

Course Name & Code : Aircraft Structures Lab - 23AE57 **Regulation**: R23
L-T-P Structure : 0-0-3 **Credits:** 1.5
Program/Sem/Sec : B. Tech/VI-SEM **A.Y.:** 2025-26

PRE-REQUISITES: Aerospace Vehicle Structures

COURSE EDUCATIONAL OBJECTIVES (CEOs):
To experimentally study fundamental structural concepts applied in aircraft structures and to validate classical structural theorems and principles using hands-on experiments. To introduce non destructive testing (NDT) techniques and composite material testing.

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

COs	Statements	Blooms Level
CO1	Analyze the structural behavior of beams under different loading conditions.	Analyze
CO2	Evaluate deflections and internal stresses of various members using theoretical and experimental methods.	Analyze
CO3	Examine and interpret results from Non-Destructive Testing (NDT) methods to assess surface and sub-surface defects in structural components.	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	3	2	3	2	–	–	1	1	1	–	3	3	3
CO2	2	3	2	3	2	–	–	1	1	1	–	3	3	3
CO3	2	3	2	3	2	–	–	1	1	1	–	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 (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-I		BATCH-II			
1.	Demo	02-12-2025		04-12-2025		TLM4	
2.	Verification of Maxwell's Reciprocal Theorem	09-12-2025		11-12-2025		TLM4	
3.	Non-Destructive Test- Dye Penetration Test	16-12-2025		18-12-2025		TLM4	
4.	Unsymmetrical bending- Direct stress of Cantilever Beam	23-12-2025		18-12-2025		TLM4	
5.	Compression Test on long Columns	30-12-2025		08-01-2026		TLM4	
6.	Shear Centre of Open section beam	06-01-2026		08-01-2026		TLM4	
7.	Composite Laminate Preparation and Bending Test	20-01-2026		22-01-2026		TLM4	
8.	Verification of Castigliano's Theorem	03-02-2026		05-02-2026		TLM4	
9.	Wagner Beam- Tension Field Beam.	10-02-2026		12-02-2026		TLM4	
10.	Non-Destructive Test-Magnetic Particle Detection.	17-02-2026		19-02-2026		TLM4	
11.	Shear Centre of Closed section beam	24-02-2026		26-02-2026		TLM4	
12.	Beam deflection of a Cantilever Beam	03-03-2026		05-03-2026		TLM4	
13.	Determination of Principles Stresses and Strains/Forced Vibrations Test	10-03-2026		12-03-2026		TLM4	
14.	Repetition	17-03-2026		24-03-2026		TLM4	
15.	Lab internal Exam	31-03-2026		02-04-2026		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	Experiment 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.
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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

(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. A. Revanth Reddy/Mr. I. Dakshina Murthy
Course Name & Code : Propulsion Lab-23AE58 **Regulation: R23**
L-T-P Structure : 0-0-3 **Credits: 1.5**
Program/Sem/Sec : B.Tech/VI-SEM **A.Y.: 2025-26**

Course Educational Objectives:
To learn the various basic experiments related to components of jet engines and piston engines.

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

CO1	Estimate the performance parameters of various jet engine components [Apply-L3]
CO2	Characterize the wall and free jet [Apply-L3]
CO3	Prepare various solid propellent grains [Apply-L3]

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	3	3	2	3	-	-	-	-	-	-	-	3	3	3
CO3	3	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)	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	04-12-25		02-12-25		TLM4	
2.	Exp No1.	03	11-12-25		09-12-25		TLM4	
3.	Exp No 2	03	18-12-25		16-12-25		TLM4	
4.	Exp No 3	03	08-01-26		23-12-25		TLM4	
5.	Exp No 4	03	15-01-26		30-12-25		TLM4	

6.	Exp No 5	03	22-01-26		06-12-26		TLM4	
7.	Exp No 6	03	05-02-26		03-02-26		TLM4	
8.	Exp No 7	03	12-02-26		10-02-26		TLM4	
9.	Exp No 8	03	19-02-26		17-02-26		TLM4	
10.	Exp No 9	03	26-02-26		24-02-26		TLM4	
11.	Exp No 10	03	05-03-26		03-03-26		TLM4	
12.	Lab internal Exam	03	12-03-25		10-03-25		TLM4	
No. of classes required to complete: 12						**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):

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