LAKKIREDDY BALI REDDY COLLEGE OF ENGINEERING
DEPARTMENT OF AEROSPACE ENGINEERING
(Autonomous & Affiliated to JNTUK, Kakinada & Approved by AICTE, New Delhi,
NAAC Accredited, Certified by ISO 9001:2015
L B Reddy Nagar, Mylavaram-521 230, Krishna District, Andhra Pradesh.

COURSE HANDOUT
PART-A

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

ACADEMIC YEAR : 2022-23

COURSE NAME & CODE : **FLIGHT DYNAMICS-20AE15**

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 performance estimation on steady level flight at various altitudes and velocities, performance of maneuvering flight at unaccelerated and accelerated conditions, the concepts of static stability requirements during flight, the basic concepts of dynamic stability and control of an aircraft.

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

CO1	To determine thrust and power requirement conditions for steady level flight (Apply-L3)
CO2	To estimate performance parameters of flight during manoeuvring (Apply-L3)
CO3	To apply the conditions of static stability and control in the aircraft design (Apply-L3)
CO4	To understand various concepts and conditions of dynamic stability and control (Understand-L2)

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

Course Code	**Cos**	**Program Outcomes**												**PSOs**	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
20AE09	CO1	**3**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**3**
	CO2	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**3**
	CO3	**3**	**3**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**3**
	CO4	**3**	**2**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**3**
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 & 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	26-12-2022		TLM1	
2.	Introduction to Aircraft Performance, Equations of motion of Steady level flight	1	27-12-2022		TLM1	
3.	Drag Polar	1	28-12-2022		TLM1	
4.	Thrust Required for Level Flight	1	30-12-2022		TLM1	
5.	Thrust Available and Maximum Velocity	1	2-1-2023		TLM1	
6.	Power required for level flight, Power available and maximum velocity	1	3-01-2023		TLM1	
7.	Altitude effects	1	4-1-2023			
8.	Effect of Drag Divergence	1	6-1-2023		TLM1	
9.	Tutorial	1	9-1-2023		TLM3	
10.	Assignment-1/Quiz-1				---	
No. of classes required to complete UNIT-I		**9**		**No. of classes taken:**		

UNIT-II: MANOEUVERING 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
11.	Rate of climb and climb performance parameter	2	10-1-2023 11-1-2023		TLM1, TLM2	
12.	Hodograph Diagram ,Absolute and service ceiling, Time to climb	1	18-1-2023		TLM1	
13.	Gliding Flight	1	20-1-2023		TLM1	
14.	Tutorial	1	23-1-2023		TLM3	
15.	Range for propeller driven and jet propelled	2	24-1-2023 25-1-2023		TLM1,TLM2	
16.	Endurance, Endurance for propeller driven and jet propelled	2	27-1-2023 30-1-2023		TLM1,TLM2	
17.	Pull-Up and Pull-Down Manoeuvres	1	31-1-2023		TLM1, TLM2	
18.	Turning Flight, Constraints on load factor	1	1-2-2023		TLM1	
19.	V-n diagram	1	3-2-2023		TLM1, TLM2	
20.	Take-off performance	1	6-2-2023		TLM1	
21.	Landing performance	1	7-2-2023		TLM1	
22.	Tutorial	1	8-2-2023		TLM3	
23.	Assignment/Quiz-2				----	
No. of classes required to complete UNIT-II		**15**		**No. of classes taken:**		

I Mid Examination (20-02-2023 to 25-02-2023)

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
24.	Introduction, Moments on the airplane, Absolute angle of attack	1	10-2-2023		TLM1,TLM4	
25.	Criteria for longitudinal Stability	1	13-2-2023		TLM1	

26.	Wing contribution for longitudinal static stability	2	14-2-2023 15-2-2023		TLM1	
27.	Tail contribution for longitudinal static stability	2	17-2-2023 27-2-2023		TLM1, TLM2	
28.	Tutorial	1	28-2-2023		TLM3	
29.	Total pitching moment, Neutral point , Static margin	1	1-3-2023		TLM1	
30.	Stick fixed stability, Stick free stability, Longitudinal control	1	3-3-2023		TLM1	
31.	Elevator angle to trim, Elevator hinge moment	2	6-3-2023 7-3-2023		TLM1	
32.	Power effects	1	9-3-2023		TLM1	
33.	Tutorial	1	10-3-2023		TLM3	
34.	Assignment/Quiz-3					
No. of classes required to complete UNIT-III		13		**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
35.	Lateral stability-Dihedral effect, criterion for lateral stability	2	13-3-2023 14-3-2023		TLM1	
36.	Dihedral effect, Adverse yaw effects	1	15-3-2023		TLM1,TLM5	
37.	Contribution of wing, fuselage, tail, Lateral control - Coupling between rolling and yawing moments	1	17-3-2023		TLM1	
38.	Lateral control-strip theory estimation of aileron effectiveness, aileron reversal.	1	20-3-2023		TLM1	
39.	Directional stability-yaw and sideslip, Criterion of directional stability, Contribution wing, fuselage, tail	1	21-3-2023		TLM1	
40.	Tutorial	1	24-3-2023		TLM3	

41.	Directional control-rudder control effectiveness	1	27-3-2023		TLM1	
42.	Rudder requirements-adverse yaw, asymmetric power condition, spin recovery	1	28-3-2023		TLM1	
43.	Rudder lock and Dorsal fin	1	29-3-2023		TLM1	
44.	Tutorial	1	31-3-2023		TLM3	
45.	Assignment/Quiz-4					
No. of classes required to complete UNIT-IV		11		**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
46.	Introduction to dynamic longitudinal stability, Modes of stability	1	3-4-2023		TLM1,TLM5	
47.	Aircraft Equations of motion	2	4-4-2023 10-4-2023		TLM1	
48.	Small disturbance theory	2	11-4-2023 12-4-2023		TLM1,TLM5	
49.	Solving the stability quartic, Routh's Discriminant	2	17-4-2023 18-4-2023		TLM1	
50.	Phugoid motion, Short period of oscillation	1	19-4-2023		TLM1	
51.	Brief description of lateral and directional dynamic stability	2	21-4-2023 24-4-2023		TLM1	
52.	Spiral divergence, Dutch roll, auto rotation and spin	1	25-4-2023		TLM1	
53.	Tutorial	1	26-4-2023		TLM3	
54.	Assignment/Quiz-5					
55.	Revision	1	28-04-2023		TLM2	
No. of classes required to complete UNIT-V		**13**		**No. of classes taken:**		

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

PART-C

EVALUATION PROCESS (R20 Regulation):

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

PART-D

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

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

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

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

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

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

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

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

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

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

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

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

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

PROGRAM SPECIFIC OUTCOMES (PSOs)

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

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

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

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DEPARTMENT OF AEROSPACE ENGINEERING

COURSE HANDOUT

PART-A

Name of Course Instructor : George Phlip
Course Name & Code : **Air Breathing Propulsion- 20AE16**
L-T-P Structure : 3-0-0 Credits : 3
Program/Sem/Sec : B.Tech., VI-Sem. A.Y: 2022-23

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 course, students are able to

CO 1	**Analyze** the performance characteristics of various jet engines
CO 2	**Design** subsonic and supersonic inlets for jet engines
CO 3	**Analyze** the performance characteristics of aircraft compressor
CO 4	**Identify** the parameters governing the design of combustion chambers.
CO 5	**Analyze** the performance of turbines of jet engines.

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	1	2	1	-	-	-	-	-	2	3	2	3
CO2	3	3	1	2	2	-	-	-	-	-	2	3	3	3
CO3	3	3	2	2	2	-	-	-	-	-	2	3	3	3
CO4	3	3	1	1	1	-	-	-	-	-	2	3	3	3
CO5	3	3	2	2	2	-	-	-	-	-	2	3	3	3

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

TEXT BOOKS:

T1 Ganesan. V, Gas Turbines, Third Edition, Tata McGraw-Hill, New Delhi, 2018
T2 Saravanamuttoo. H.I.H, Rogers. G. F. C, Cohen. H, Straznicky. P. V, Nix. A. C, Gas Turbine Theory, Seventh Edition Pearson Education, 2018.

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 GAS TURBINE ENGINE

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 and Unit-I	1	27/12/22		**TLM1**	
2.	Working of Gas Turbine Engine	1	28/12/22		**TLM1&2**	
3.	**Characteristics of Turboprop**	1	29/12/22		**TLM1**	
4.	Turbofan, And Turbojet Cycle Analysis	2	30/12/22, 3/1/23		**TLM1**	
5.	Performance Characteristics	2	4/1/23, 5/1/23		**TLM1**	
6.	**Thrust Equation - Factors Affecting Thrust**	1	6/1/23		**TLM1**	
7.	Methods of Thrust Augmentation	1	10/1/23		**TLM1**	
8.	Problems	3	11/1/23,12/1/23,18/1/23		**TLM1**	
No. of classes required to complete UNIT-I: 12				No. of classes taken:		

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
1.	Introduction to Unit-II	1	19/1/23		**TLM1**	
2.	Subsonic Inlets	1	20/1/23		**TLM1&2**	
3.	**Internal Flows and External Flow**	1	24/1/23		**TLM1**	
4.	Supersonic Inlets	1	25/1/23		**TLM1&2**	
5.	Starting Problem On Supersonic Inlets	1	27/1/23		**TLM1**	
6.	**Shock-Swallowing**	1	31/1/23		**TLM1**	
7.	Flow Stability Problem	1	1/2/23		**TLM1**	
8.	Problems	1	2/2/23		**TLM1**	
No. of classes required to complete UNIT-II:08				No. of classes taken:		

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
1.	Introduction to Unit-III	1	3/2/23		**TLM1&2**	
2.	Principle of Operation of Centrifugal Compressor	1	7/2/23		**TLM1&2**	
3.	**Work Done and Pressure Rise – Velocity Diagrams**	1	8/2/23		**TLM1**	

4.	Diffuser Vane Design Considerations	1	9/2/23		**TLM1**	
5.	Concept of Prewhirl, Stall and Surge	1	10/2/23		**TLM1**	
6.	**Elementary Theory of Axial Flow Compressor**	1	14/2/23		**TLM1&2**	
7.	Velocity Triangles – Degree of Reaction, Compressor Blade Design	1	15/2/23		**TLM1&2**	
8.	Centrifugal Compressor Performance Characteristics	1	16/2/23		**TLM1**	
9.	Axial Compressor Performance Characteristics and Problems	3	17/2/23, 28/2/23, 1/3/23		**TLM1&2**	
No. of classes required to complete UNIT-III:11				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
1.	Introduction to Unit-IV and Classification of Combustion Chambers	1	2/3/23		**TLM1&2**	
2.	**Combustion Process**	1	3/3/23		**TLM1&2**	
3.	**Important Factors Affecting Combustion Chamber Design**	1	7/3/23		**TLM1&2**	
4.	Combustion Chamber Performance	1	9/3/23		**TLM1&2**	
5.	Effect of Operating Variables on Performance	1	10/3/23		**TLM1&2**	
6.	**Flame Tube Cooling**	1	14/3/23		**TLM1&2**	
7.	Flame Stabilization, Use of Flame Holders	1	15/3/23		**TLM1&2**	
8.	Fuel Injection System and Problems	1	16/3/23		**TLM1&2**	
No. of classes required to complete UNIT-IV:08				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
1.	Introduction to Unit-V and Elementary Theory of Turbines	1	17/3/23		**TLM1&2**	
2.	**Impulse and Reaction Turbines**	1	21/3/23		**TLM1&2**	
3.	Axial Flow Turbine, Radial Flow Turbine	1	23/3/23		**TLM1**	
4.	Velocity Triangles and Power Output	3	24/3/23, 28/3/23, 29/3/23		**TLM1&2**	
5.	**Estimation of Stage Performance**	2	31/3/23, 4/4/23		**TLM1**	

6.	Turbine Performance Characteristics	1	6/4/23		**TLM1&2**	
7.	Methods of Blade Cooling	1	11/4/23		**TLM1&2**	
8.	Matching of Turbine and Compressor and Problems	4	12/4/23, 13/4/23, 18/4/23, 19/4/23		**TLM1&2**	
No. of classes required to complete UNIT-V:14				No. of classes taken:		

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

PART-C

EVALUATION PROCESS (R17 Regulation):

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

PART-D

PROGRAMME OUTCOMES (POs):

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

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

PROGRAMME SPECIFIC OUTCOMES (PSOs):

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

Course Instructor	Module Coordinator	HOD
Mr. George Phlip	Dr. P Lovaraju	Dr.P. Lovaraju

DEPARTMENT OF AEROSPACE ENGINEERING
COURSE HANDOUT

Part-A

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

ACADEMIC YEAR : 2022-23

COURSE NAME & CODE : ELEMENTS OF HEAT TRANSFER-20AE14

L-T-P STRUCTURE : 4-0-0

COURSE CREDITS : 3

COURSE INSTRUCTOR : K. Lakshmi Prasad

COURSE COORDINATOR : K. Lakshmi Prasad

PRE-REQUISITES: Engineering Fluid Mechanics, Engineering Thermodynamics.

COURSE EDUCATIONAL OBJECTIVES (CEOs): To learn the basic differential equations of heat transfer in conduction, convection, radiation, and to understand the LMTD concepts used in heat exchangers.

COURSE OUTCOMES (COs)

After completion of the course, the student will be able to

CO1: To formulate heat conduction phenomenon through plane, cylindrical surfaces (Apply L3)

CO2: To analyze steady state heat conduction in planes walls and cylindrical shells (Analyze-L4)

CO3: To analyze the convective heat transfer phenomenon in both external and internal flows (Analyze-L4)

CO4: To understand the thermal radiation concepts (Understand-L2)

CO5: To apply the heat transfer principles on the working of heat exchangers and electronic equipment (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	2	2	2	-	-	-	-	-	-	-	2	3	3
CO2	3	2	3	2	-	-	-	-	-	-	-	2	3	3
CO3	3	3	2	3	-	-	-	-	-	-	-	2	3	3
CO4	3	1	2	2	-	-	-	-	-	-	-	2	3	3
CO5	3	3	3	3	-	-	-	-	-	-	-	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).

BOS APPROVED TEXT BOOKS:

T1 Sachdeva. R.C, Fundamentals of Engineering Heat and Mass Transfer, Fifth Edition, New Age Intl. Publishers, 2015.

BOS APPROVED REFERENCE BOOKS:

R1 Rathakrishnan. E, Elements of Heat transfer CRC press, New York, 2012.

R2 Yunus A. Cengel, Afshin J. Ghajar, Heat and Mass Transfer: Fundamentals and Applications McGraw-Hill, 2020.

R3 Holman. J.P, Heat transfer, McGraw-Hill Higher Education, 2010.

R4 Ghoshdastidar. P.S, Heat Transfer, Oxford University Press, 2012.

Part-B

COURSE DELIVERY PLAN (LESSON PLAN): Section-A

UNIT-I: CONDUCTIVE HEAT TRANSFER:

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	Learning Outcome COs	Text Book followed	HOD Sign Weekly
1.	Course Outcomes & Blooms Taxonomy Levels	2	26.12.22 27.12.22		**TLM1/ TLM2**			
2.	Introduction	2	28.12.22 29.12.22		**TLM1/ TLM2**	CO1	T1	
3.	Heat Conduction-Fourier Law of Heat Conduction, Thermal Conductivity.	2	30.12.22 02.01.23		**TLM1/ TLM2**	CO1	T1	
4.	General Heat Conduction Equation in Cartesian Co-ordinates.	1	03.01.23		**TLM1/ TLM2**	CO1	T1	
5.	General Heat Conduction Equation in Cylindrical Co-ordinates.	1	04.01.23		**TLM1/ TLM2**	CO1	T1	
6.	Problems	5	**05.01.23** **06.01.23** **09.01.23** **10.01.23** **11.01.23**		**TLM1**	CO1	T1	
7.	**Quiz/Assignment**							
No. of classes required to complete UNIT-I		13			No. of classes taken:			

UNIT-II: ONE-DIMENSIONAL STAEDY STATE CONDUCTION:

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	Learning Outcome COs	Text Book followed	HOD Sign Weekly
8.	Heat Conduction in Plane Wall with Constant Thermal Conductivity	1	12.01.23		**TLM1/ TLM2**	CO2	T1	
9.	Heat Flow Through Composite Wall	1	18.01.23		**TLM1/ TLM2**	CO2	T1	
10.	Electrical Analogy	1	19.01.23		**TLM1/ TLM2**	CO2	T1	

11.	Thermal Resistance				**TLM1/ TLM2**	CO2	T1	
12.	Heat Conduction in Cylindrical shell with Constant Thermal Conductivity	1	20.01.23		**TLM1/ TLM2**	CO2	T1	
13.	Heat Flow Through Cylinder.	1	23.01.23		**TLM1/ TLM2**	CO2	T1	
14.	Critical thickness of Insulation	1	24.01.23		**TLM1/ TLM2**	CO2	T1	
15.	Uniform Internal Heat Generation in Slab	1	25.01.23		**TLM1/ TLM2**	CO2	T1	
16.	Extended Surfaces	3	**26.01.23 27.01.23 30.01.23**		**TLM1/ TLM2**	CO2	T1	
17.	Problems	4	**31.01.23 01.02.23 02.02.23 03.02.23**		**TLM1**	CO2	T1	
18.	**Quiz/Assignment**					CO2		
No. of classes required to complete UNIT-II		14			No. of classes taken:			

UNIT-III: CONVECTIVE HEAT TRANSFER:

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	Learning Outcome COs	Text Book followed	HOD Sign Weekly
19.	Introduction-Types of Convection	1	06.02.23		**TLM1/ TLM2**	CO3	T1, R8	
20.	Convective Heat Transfer Coefficient	1	07.02.23		**TLM1/ TLM2**	CO3	T1	
21.	Significance of Non-Dimensional Numbers	2	08.02.23 09.02.23		**TLM1/ TLM2**	CO3	T1	
22.	Convective Boundary Layers,	1	10.02.23		**TLM1/ TLM2**	CO3	T1	
23.	The Convection Heat Transfer Equations	1	13.02.23		**TLM1/ TLM2**	CO3	T1	
24.	Velocity Boundary Layer	1	14.02.23		**TLM1/ TLM2**	CO3	T1	
25.	Thermal Boundary Layer	1	15.02.23		**TLM1/ TLM2**	CO3	T1	
26.	Thermal Boundary Layer for Flow Past Heated Plate	1	16.02.23		**TLM1/ TLM2**	CO3	T1	

27.	Free Convection	2	17.02.23 27.02.23		**TLM1/ TLM2**	CO3	T1	
28.	Problems	5	**28.02.23 01.03.23 02.03.23 03.03.23 06.03.23**		**TLM1**	CO3	T1	
29.	**Quiz/Assignment**					CO3		
No. of classes required to complete UNIT-III		16			No. of classes taken:			

UNIT-IV: THERMAL RADIATION:

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	Learning Outcome COs	Text Book followed	HOD Sign Weekly
30.	Introduction-Nature of Thermal Radiation	1	07.03.23		**TLM1/ TLM2**	CO4	T1	
31.	Concept of Black Body –Laws of Black Body Radiation-	2	09.03.23 10.03.23		**TLM1/ TLM2**	CO4	T1	
32.	Radiation Heat Exchange Between Two Black Isothermal Surfaces	1	13.03.23		**TLM1/ TLM2**	CO4	T1	
33.	View Factor	1	14.03.23		**TLM1/ TLM2**	CO4	T1	
34.	Heat Exchange Between Non-Black Infinite Parallel Plates	1	15.03.23		**TLM1/ TLM2**	CO4	T1	
35.	Radiation Shields	2	16.03.23 17.03.23		**TLM1/ TLM2**	CO4	T1	
36.	Simple Problems	2	20.03.23 21.03.23		**TLM1**	CO4	T1	
37.	**Quiz/Assignment**					CO4		
No. of classes required to complete UNIT-IV		10			No. of classes taken:			

UNIT-V: APPLICATIONS: HEAT EXCHANGERS & COOLING OF ELECTRONIC EQUIPMENT

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	Learning Outcome COs	Text Book followed	HOD Sign Weekly
38.	**HEAT EXCHANGERS:** Introduction-Classification of Heat Exchangers	1	23.03.23		**TLM1/ TLM2**	CO5	T1	
39.	Overall Heat Transfer Coefficient-	1	24.03.23		**TLM1/ TLM2**	CO5	T1	
40.	- Fouling Factor	1	27.03.23		**TLM1/ TLM2**	CO5	T1	

41.	LMTD Method of Heat Exchanger Analysis	2	28.03.23 29.03.23		**TLM1/ TLM2**	CO5	T1	
42.	Manufacturing of Electronic Equipment,	1	31.03.23		**TLM1/ TLM2**	CO5	R2	
43.	Cooling Load of Electronic Equipment	1	03.04.23		**TLM1/ TLM2**	CO5	R2	
44.	Thermal Environment	1	04.04.23		**TLM1/ TLM2**	CO5	R2	
45.	Electronics Cooling in Different Applications,	1	06.04.23		**TLM1/ TLM2**	CO5	R2	
46.	Conduction Cooling, Air Cooling:	2	10.04.23 11.04.23		**TLM1/ TLM2**	CO5	R2	
47.	Forced Convection, Fan Selection,	1	12.04.23		**TLM1/ TLM2**	CO5	R2	
48.	Cooling Personal Computers, Liquid Cooling, Immersion Cooling	2	13.04.23 17.04.23		**TLM1/ TLM2**	CO5	R2	
49.	Problems	4	**18.04.23 19.04.23 20.04.23 21.04.23**		**TLM1**	CO5	R2	
50.	**Quiz/Assignment**					CO5		
No. of classes required to complete UNIT-V		18			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

Academic Calender-A.Y-2022-23

Description	From	To	Weeks
B Tech V Semester			
Commencement of class work	26.12.2022		
I phase of Instructions	26.12.2022	18.02.2023	8
I Mid Examination	20.02.2023	25.02.2023	1
II phase of Instructions	**27.02.2023**	**22.04.2023**	**8**
II Mid Examination	24.04.2023	29.04.2023	1
Preparation and Practical	**01.05.2023**	**06.05.2023**	**1**
Semester End Examination	08.05.2023	20.05.2023	2
Internship	**22.05.2023**	**01.07.2023**	**6**

Part - C

EVALUATION PROCESS:

Evaluation Task	COs	Marks
Assignment 1	1	A1=5
Assignment 2	2	A2=5
I-Mid Examination	1,2,3	B1=15
Quiz – 1	1,2,3	Q1=10
Assignment 3	3	A3=5
Assignment 4	4	A4=5
Assignment 5	5	A5=5
II-Mid Examination	3,4,5	B2=15
Quiz – 2	3,4,5	Q2=10
Evaluation of Assignment: A=(A1+A2+A3+A4+A5)/5	1,2,3,4,5	A=5
Evaluation of Mid Marks: B=75% of Max(B1,B2)+25% of Min(B1,B2)	1,2,3,4,5	B=15
Evaluation of Quiz Marks: Q=75% of Max(Q1,Q2)+25% of Min(Q1,Q2)	1,2,3,4,5	Q=10
Cumulative Internal Examination: A+B+Q	**1,2,3,4,5**	**CIE=30**
Semester End Examinations	**1,2,3,4,5**	**SEE=70**
Total Marks: CIE+SEE	**1,2,3,4,5**	**100**

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO1: To build a professional career and pursue higher studies with sound knowledge in Mathematics, Science and Mechanical Engineering.

PEO2: To inculcate strong ethical values and leadership qualities for graduates to become successful in multidisciplinary activities.

PEO3: To develop inquisitiveness towards good communication and lifelong learning.

PROGRAMME OUTCOMES (POs)

Engineering Graduates will be able to:

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

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.

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.

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.

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.
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.
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.
8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
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.
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.
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.

PSOs

1. To apply the principles of thermal sciences to design and develop various thermal systems.
2. To apply the principles of manufacturing technology, scientific management towards improvement of quality and optimization of engineering systems in the design, analysis and manufacturability of products.
3. To apply the basic principles of mechanical engineering design or evaluation of performance of various systems relating to transmission of motion and power, conservation of energy and other process equipment.

Course Instructor	Course Coordinator	Module Coordinator	HOD
Mr. K Lakshmi Prasad	Mr. K Lakshmi Prasad	Dr. P. Vijay Kumar	Dr. S. Pichi Reddy

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L.B.Reddy Nagar, Mylavaram-521230, Krishna Dist, Andhra Pradesh, India

DEPARTMENT OF AEROSPACE ENGINEERING

COURSE HANDOUT

PART-A

Name of Course Instructor : Dr. L. Prabhu
Course Name & Code : Airport Design / 20AE19
L-T-P Structure : 3-0-0 Credits : 3
Program/Sem/Sec : B.Tech., Aerospace, VI-Sem A.Y : 2022-23

COURSE EDUCATIONAL OBJECTIVES:

To study the procedure of the formation of aerodrome and its design, various maintenance activities for airport maintenance, air traffic control, procedure and air traffic service.

COURSE OUTCOMES:

After completion of the course students are able to:

CO1:	Acquire the concept of air traffic rules and clearance procedures for airline operation.
CO2:	Analyze the various air traffic data for air traffic services.
CO3:	Analyze the influence of aerodrome design factors for service establishments.

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
CO2	3	3	2	-	-	-	-	-	-	-	-	3	3	3
CO3	3	3	2	-	-	-	-	-	-	-	-	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).

REFERENCE

1. Virendra kumar and Sathish Chandra, Airport Planning and Design, Galgotia publications Pvt Ltd, New Delhi, 2012.
2. Aeronautical Information Publication (India) Vol. I & II, the English book store, 17-1, Connaught Circus, New Delhi, 2006.
3. M.S Nolan, "Fundamentals Air Traffic Control", Latest Edition, YESDEE Publishers, 2010.
4. Seth B. Young, Alexander T. Wells, "Airport Planning and Management" McGraw-Hill Education, New Delhi, 2011.

PART-B

COURSE DELIVERY PLAN (LESSON PLAN):

UNIT-I: BASIC CONCEPTS

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.	**Basic Concepts:** Objectives of ATS	1	26-12-2022		**TLM2**	
2.	parts of ATC service	1	28-12-2022		**TLM2**	
3.	scope and provision of ATCS	1	29-12-2022		**TLM2**	
4.	VFR & IFR operations	1	30-12-2022		**TLM2**	
5.	classification of ATS air spaces	1	31-12-2022		**TLM2**	
6.	varies kinds of separation	1	02-01-2023		**TLM2**	
7.	altimeter setting procedures, establishment	1	04-01-2023		**TLM2**	
8.	designation and identification of units providing ATS	1	05-01-2023		**TLM2**	
9.	ATS -division of responsibility	1	06-01-2023		**TLM2**	
10.	ATS control	1	07-01-2023		**TLM2**	
11.	Revision, Assignment	4	09,11-13, Jan 2023		**TLM2**	
No. of classes required to complete UNIT-I: 1				No. of classes taken:		

UNIT-II: AIR TRAFFIC SERVICES:

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.	Area control service,	1	18-01-2023		**TLM2**	
2.	assignment of cruising levels minimum flight altitude	1	19-01-2023		**TLM2**	
3.	ATS routes and significant Points -	1	20-01-2023		**TLM2**	
4.	RNAV And RNP	1	21-01-2023		**TLM2**	
5.	Vertical, lateral and longitudinal separations based on time / distance	1	23-01-2023		**TLM2**	
6.	ATC Clearances	1	25-01-2023		**TLM2**	
7.	ATC flight plans	1	27-01-2023		**TLM2**	
8.	ATC position report	1	28-01-2023		**TLM2**	
9.	Comparison of various ATC services.	1	30-01-2023		**TLM2**	
10.	Comparison of various ATC services.	1	01-02-2023		**TLM2**	
11.	Revision, Assignment	3	2nd - 4th Feb 2023		**TLM2**	
No. of classes required to complete UNIT-II:13				No. of classes taken:		

UNIT-III: FLIGHT INFORMATION

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.	Flight Information,	1	06-02-2023		**TLM2**	
2.	Alerting Services, Coordination,	1	08-02-2023		**TLM2**	

3.	Emergency Procedures	1	09-02-2023		**TLM2**	
4.	Rules of the Air Radar service	1	10-02-2023		**TLM2**	
5.	Identification procedures using primary radar	1	13-02-2023		**TLM2**	
6.	Mid Exam I Revision	3	15th to 17th Feb 2023		**TLM2**	
7.	Identification procedures using secondary radar	1	27-02-2023		**TLM2**	
8.	performance checks - use of radar in area	1	01-03-2023		**TLM2**	
9.	performance checks - approach control services	1	02-03-2023		**TLM2**	
10.	assurance control and coordination between radar non radar control	1	03-03-2023		**TLM2**	
11.	basic radar terminology	1	04-03-2023		**TLM2**	
12.	Revision, Assignment	2	6th, 9th Mar 2023		**TLM2**	
No. of classes required to complete UNIT-III:15				No. of classes taken:		

UNIT-IV : AERODROME DATA

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.	Aerodrome data - basic terminology	1	10-03-2023		**TLM2**	
2.	aerodrome reference code	1	13-03-2023		**TLM2**	
3.	aerodrome reference point - aerodrome elevation -	1	15-03-2023		**TLM2**	
4.	Instrument runway, physical characteristics; length of primary runway	1	16-03-2023		**TLM2**	
5.	Instrument runway, physical characteristics; length of secondary runway	1	17-03-2023		**TLM2**	
6.	Width of runways - minimum distance between parallel runways etc	1	18-03-2023		**TLM2**	
7.	Aerodrome reference temperature	1	20-03-2023		**TLM2**	
8.	Runway obstacles restriction	1	23-03-2023		**TLM2**	
9.	Comparison between domestic and international airports	1	24-03-2023		**TLM2**	
10.	Revision, Assignment	3	25, 27, 29 Mar 2023		**TLM2**	
No. of classes required to complete UNIT-IV:12				No. of classes taken:		

UNIT-V : VISUAL AIDS FOR NAVIGATION

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.	Visual aids for navigation, wind direction indicator,	1	31-03-2023		**TLM2**	

2.	landing direction indicator	1	01-04-2023		**TLM2**	
3.	location and characteristics of signal area	1	03-04-2023		**TLM2**	
4.	location and characteristics of markings, lights, aerodrome beacon,	1	06-04-2023		**TLM2**	
5.	Identification beacon, simple approach lighting system and	1	10-04-2023		**TLM2**	
6.	various lighting systems - VASI	1	12-04-2023		**TLM2**	
7.	various lighting systems - PAPI,	1	13-04-2023		**TLM2**	
8.	visual aids for denoting obstacles	1	15-04-2023		**TLM2**	
9.	object to be marked and lighter-emergency and other services.	1	17-04-2023		**TLM2**	
10.	Revision, Assignment	3	19 – 21 Apr 2023		**TLM2**	
No. of classes required to complete UNIT-V: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 (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	Module Coordinator	HOD
Dr. L. Prabhu	Dr.P.Lovaraju	Dr.P.Lovaraju

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(AUTONOMOUS)
L.B.Reddy Nagar, Mylavaram – 521 230, N.T.R. District, Andhra Pradesh, India
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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

PROGRAM : B.Tech, VI Sem, Aerospace Engineering
ACADEMIC YEAR : 2022-2023
COURSE NAME AND CODE : 20AE17- INTRODUCTION TO COMPUTATIONAL
L-T-P STRUCUTRE : 3-0-0
COURSE CREDITS : 3
COURSE INSTRUCTOR : Dr.Sreenadh Chevula
COURSE COORDINAOTR : Dr.Sreenadh Chevula

PRE-REQISITE

Course educational objectives : To learn the basic governing equations of fluid dynamics, mathematical behaviour of partial differential equations, phenomena of various discretization techniques, techniques

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

CO1	Formulate the governing equations of fluid dynamics (Apply-L3)
CO2	Apply the discretization techniques to governing equations of fluid dynamics (Apply-L3)
CO3	Understand various CFD techniques (Understand-L2)
CO4	Apply various CFD techniques to solve fluid dynamic problems (Apply-L3)

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

CO4	3	2	2	2	3	-	-	-	-	-	-	2	**3**	**3**

BOS APPROVED TEXT BOOKS

T1 Anderson.J.D, 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

R1 Patankar. S. V, Numerical Heat Transfer and Fluid Flow, CRC Press, 1980.

R2 Sengupta. T. K, Fundamentals of Computational Fluid Dynamics, University Press, 2004.

COURSE DELIVERY PLAN(LESSON PLAN)

UNIT - I Introduction, Governing Equations of Fluid Dynamics, Mathematical Behavior of Partial Differential Equations

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	**Computational Fluid Dynamics as a Research and Design Tool,**	2	26,27 Dec,2022		**TLM2**	CO1	T1	
	Applications of Computational Fluid Dynamics.							
	Governing Equations of Fluid Dynamics:							
2	Introduction, Control Volume,	1	29 Dec,2022		**TLM2**	CO1	T1	
3	Substantial Derivative, Divergence of Velocity	1	30-Dec-22		**TLM2**	CO1	T1	
4	Continuity Equation	1	31-Dec-22		**TLM2**	CO1	T1	
5	Momentum Equation	2	4,5 Jan 2023		**TLM2**	CO1	T1	
6	Energy Equation	2	6,7 Jan 2023		**TLM2**	CO1	T1	
7	Conservation and Non-conservation forms of governing flow equations	2	9,11 Jan 2023		**TLM2**	CO1	T1	
	Mathematical Behavior of Partial Differential Equations:							
8	Introduction	2	18, 19, Jan 2023		**TLM2**	CO1	T1	
9	Classification of Quasi-Linear Partial Differential Equations	2	20,21 Jan 2023		**TLM2**	CO1	T1	
10	Eigen Value Method,	2	23, 25 Jan 2023		**TLM2**	CO1	T1	
11	Hyperbolic Equations	2	27,28 Jan 2023		**TLM2**	CO1	T1	
12	Parabolic Equations	1	30-Jan-23		**TLM2**	CO1	T1	
14	Elliptic Equations	1	01-Feb-23		**TLM2**	CO1	T1	
Total No of classes required to complete Unit-1		19	No of Clasess Taken :					

UNIT - 2 Basics Aspects of Discretization

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,	1	2 Feb,2323		**TLM2**	CO2	T1	
2	Introduction of Finite Differences,	2	3,4 Feb 2023		**TLM2**	CO2	T1	
3	Difference Equations,	2	6,8 Feb 2023		**TLM2**	CO2	T1	
4	Explicit Approaches	2	9, 10, Feb 2023		**TLM2**	CO2	T1	
5	Implicit Approaches	2	11,13 Feb 2023		**TLM2**	CO2	T1	

6	Errors and Stability Analysis	3	14,15,16 Feb 2023		**TLM2**	CO2	T1	
7	Grid Generation	1	17-Feb-23					
Total No of classes required to complete Unit-2		13	No of Clasess Taken :					

20-02-2023 to 24-2-2023 MID-1 Examination

UNIT - 3 Simple CFD Techniques

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	1	25-Feb-23		**TLM2**	CO3	T1	
2	The Lax–Wendroff method	2	27 Feb, 1 March 2023		**TLM2**	CO3	T1	
3	Maccormack technique	2	2,3 March 2023		**TLM2**	CO3	T1	
4	Space Marching	1	04-Mar-23		**TLM2**	CO3	T1	
5	Relaxation Technique and its use with low-speed inviscid Flow	2	6,9 March 2023		**TLM2**	CO3	T1	
6	Artificial Viscosity	2	10,11 March 2023		**TLM2**	CO3	T1	
Total No of classes required to complete Unit-3		10	No of Clasess Taken :					

UNIT - 4 Numerical Solutions of Quasi 1-D Nozzle Flows:

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	1	13-Mar-23		**TLM2**	CO4	T1	
2	Supersonic Isentropic Nozzle	2	15, 16 March 2023		**TLM2**	CO4	T1	
3	Maccormack technique	1	17-Mar-23		**TLM2**	CO4	T1	
4	Governing Equations	2	18, 20 March 2023		**TLM2**	CO4	T1	
5	Finite Difference Equations	2	23,24 March 2023		**TLM2**	CO4	T1	
6	CFD Solution of Purely Subsonic Isentropic Nozzle Flow	2	25,27 March 2023		**TLM2**	CO4	T1	
7	Shock Capturing	2	29,31 March 2023		**TLM2**	CO4	T1	

Total No of classes required to complete Unit-4	12	No of Clasess Taken :			

UNIT - 5 Incompressible Couette Flow:

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,	1	01-Apr-23		**TLM2**	CO5	T1, T2	
2	The Physical Problem and its exact Analytical Solution	3	3,4,5 Apr, 2023		**TLM2**	CO5	T1, T2	
3	Implicit Crank-Nicholson Technique	2	6,8 Apr 2023		**TLM2**	CO5	T1, T2	
4	Pressure Correction Method	3	10,11,12 Apr 2023		**TLM2**	CO5	T1, T2	

Total No of classes required to complete Unit-5	9	No of Clasess Taken :				

24-04-2023 to 28-2-2023 MID-2 Examination

Teaching Learning Method	
TLM2	PPT and Chalk and Talk

8-05-2023 to 20-05-2023 Semester End Examination

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L.B.Reddy Nagar, Mylavaram-521230, Krishna Dist, Andhra Pradesh, India

DEPARTMENT OF ELECTRONICS AND COMMUNICATION

COURSE HANDOUT

PART-A

Name of Course Instructor : P. James Vijay
Course Name & Code : ELEMENTS OF COMMUNICATION SYSTEMS - 20EC82
L-T-P Structure : 3-0-0 Credits : 3
Program/Sem/Sec : B.Tech., ASE., VI-Sem., A.Y : 2022-23
PRE-REQUISITE: Concept of signals and modulation theory.

COURSE EDUCATIONAL OBJECTIVES (CEOs): This course provides the knowledge on fundamental properties of systems, radio transmitters, receivers, and noise present in the communication channel and transmission lines and antennas used in communication systems.

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

CO 1	**Summarize** the properties of systems and concepts of noise in communication systems. (Understand-L2).
CO 2	**Outline** the concepts of communication system, transmission lines, antennas, and response of linear systems (Understand-L2).
CO 3	**Apply** the knowledge of systems, transmission and reception concepts for communication systems in the presence of noise. (Apply-L3).
CO 4	**Interpret** the response of linear systems and performance of RF transmitters, receivers, transmission lines and antennas (Understand L2).

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

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

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

TEXT BOOKS:

1. Simon Haykin, Communication Systems, Second Edition, John Wiley & Sons Publications, Singapore, 1983.
2. Kennedy, Davis, Electronic Communication Systems, 4th edition, Tata McGraw-Hill Publications, 2009.

REFERENCE BOOKS:

1. Herbert Taub , Donald L. Schilling, "Principles of Communication Systems", Second Edition, Tata McGraw-Hill, New Delhi, 1991.
2. B.P.Lathi, "Modern Digital and Analog Communication Systems", Third Edition, Oxford University.

PART-B

COURSE DELIVERY PLAN (LESSON PLAN):

UNIT-I: Introduction to 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	26-12-2022		TLM1	
2.	Brief introduction about the course and its importance.	1	27-12-2022		TLM1	
3.	Introduction to Systems - Definition	1	29-12-2022		TLM1	
4.	Classification of systems	1	31-12-2022		TLM1	
5.	Properties of systems – Linear and Non - linear	1	02-01-2023		TLM1	
6.	Time invariant and time variant	1	03-01-2023		TLM1	
7.	Causal and Non-causal	1	05-01-2023		TLM1	
8.	Stable and Unstable	1	07-01-2023		TLM1	
9.	Signal and system bandwidth, Revision	1	09-01-2023		TLM1	
10.	Problems based on properties	1	10-01-2023		TLM1	
No. of classes required to complete UNIT-I: 10				No. of classes taken:		

UNIT-II: Response of linear 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	1	12-01-2023		TLM1	
2.	Transfer function	1	19-01-2023		TLM1	
3.	Impulse response	1	21-01-2023		TLM1	
4.	Distortion less transmission through a system	1	23-01-2023		TLM1	
5.	Transmission of a signal through LTI system	1	24-01-2023		TLM1	
6.	Elements of communication system and its description	1	28-01-2023		TLM1	
7.	Revision	1	30-01-2023		TLM1	
No. of classes required to complete UNIT-II: 7				No. of classes taken:		

UNIT-III: Noise in Communication 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.	Concepts	1	31-01-2023		TLM1	
2.	External Noise	1	02-02-2023		TLM1	
3.	Internal noise	1	04-02-2023		TLM1	
4.	White Noise, Band limited white noise	1	06-02-2023		TLM1	
5.	Colored noise	1	07-02-2023		TLM1	
6.	Noise Calculations, noise figure	1	09-02-2023		TLM1	

7.	Noise temperature, Noise equivalent bandwidth	2	11-02-2023 13-02-2023		TLM1	
8.	Narrow band noise and its mathematical representation	2	14-02-2023 16-02-2023		TLM1	
9.	Power spectral density of in phase and quadrature components of noise	2	27-02-2023 28-02-2023		TLM1	
10.	Revision	1	02-03-2023		TLM1	
No. of classes required to complete UNIT-III: 13				No. of classes taken:		

UNIT-IV : Radio Transmitters and Receivers

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.	Radio Transmitters : AM Transmitter	2	04-03-2023 06-03-2023		TLM1	
2.	FM Transmitter – Direct method of FM Transmission	1	07-03-2023		TLM2	
3.	Indirect method of FM transmission	1	09-03-2023		TLM1	
4.	Radio Receivers : Types of Radio receivers	2	11-03-2023 13-03-2023		TLM1	
5.	TRF Receiver and its limitations	1	14-03-2023		TLM1	
6.	Super heterodyne receiver	2	16-03-2023 18-03-2023		TLM2	
7.	Revision	1	20-03-2023		TLM1	
No. of classes required to complete UNIT-IV: 10				No. of classes taken:		

UNIT-V : Transmission lines and Antennas

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.	Transmission lines : Fundamentals	1	21-03-2023		TLM1	
2.	Characteristic Impedance	1	23-03-2023		TLM1	
3.	Losses in transmission lines, Standing waves	2	25-03-2023 27-03-2023		TLM2	
4.	Quarter and half wavelength lines	2	28-03-2023 01-04-2023		TLM1	
5.	Reactance properties	2	03-04-2023 04-04-2023		TLM1	
6.	Antennas : Basics	1	06-04-2023		TLM1	
7.	Directional high frequency Antennas : Dipole Arrays	2	08-04-2023 10-04-2023		TLM1	
8.	Folded Dipole and applications	2	11-04-2023 13-04-2023		TLM2	

9.	UHF and Microwave Antennas : Antennas with Parabolic reflectors	1	15-04-2023		TLM2	
10.	Horn Antennas, Lens Antennas	2	17-04-2023 18-04-2023		TLM1	
11.	Revision	1	20-04-2023		TLM1	
No. of classes required to complete UNIT-V: 17				No. of classes taken:		

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

PART-C

EVALUATION PROCESS (R17 Regulations):

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

PART-D

PROGRAMME OUTCOMES (POs):

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

PROGRAMME SPECIFIC OUTCOMES (PSOs):

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

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

LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING

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DEPARTMENT OF AEROSPACE ENGINEERING

COURSE HANDOUT

PART-A

Name of Course Instructor: Dr.P.Lovaraju/Mr.I.Dakshina Murthy/Mr.George Phlip
Course Name & Code : Propulsion Lab-20AE59 Regulation: R20
L-T-P Structure : 0-0-3 Credits: 1.5
Program/Sem/Sec : B.Tech/VI-SEM A.Y.: 2022-23

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	27-12-22		26-12-22		TLM4	
2.	Exp No1.	03	03-01-23		02-01-23		TLM4	
3.	Exp No 2	03	10-01-23		09-01-23		TLM4	
4.	Exp No 3	03	17-01-23		23-01-23		TLM4	
5.	Exp No 4	03	24-01-23		30-01-23		TLM4	

6.	Exp No 5	03	31-01-23		06-02-23		TLM4	
7.	Exp No 6	03	07-02-23		13-02-23		TLM4	
8.	Exp No 7	03	14-02-23		27-02-23		TLM4	
9.	Exp No 8	03	28-02-23		06-03-23		TLM4	
10.	Exp No 9	03	07-03-23		13-03-23		TLM4	
11.	Exp No 10	03	14-03-23		20-03-23		TLM4	
12.	Repetition	03	21-03-23		27-03-23		TLM4	
13.	Repetition	03	28-03-23		03-04-23			
14.	Lab internal Exam	03	04-03-23		10-04-23		TLM4	
No. of classes required to complete: 13						**No. of classes taken:**		

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

PART-C

EVALUATION PROCESS (R20 Regulation):

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

PART-D

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

PEO 1	To provide students with 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.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-long learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

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

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

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DEPARTMENT OF AEROSPACE ENGINEERING

COURSE HANDOUT

PART-A

Name of Course Instructor: Mr. Nazumuddin Shaik/
Mr. S. Indrasena Reddy/Mr. G.V. Surya Narayana

Course Name & Code: Aircraft Component Modeling and Analysis Lab - 20AE60 **Regulation**: R20

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

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

PRE-REQUISITES: Engineering workshop

COURSE EDUCATIONAL OBJECTIVES (CEOs):

To learn modeling package (CATIA) to draw 3D parts and Assembly of various aircraft components, and finite element package (ANSYS) to analyze the behavior of simple structural elements under static loading system.

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

CO1	Draw aircraft components 3D geometric modeling. (Apply-L2)
CO2	Solve and analyze the structural components of aircraft for deformations and stresses using a numerical tool. (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	2	3	2	3	-	-	-	-	-	-	2	3	3
CO2	3	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)	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	ACMA Introduction-CATIA Introduction	30-12-2022		TLM4	
2.	Aircraft Component Modeling-I	6-1-2023		TLM4	
3.	Aircraft Component Modeling -II	20-1-2023		TLM4	
4.	Assembly of Components	27-1-2023		TLM4	
5.	Aircraft Component Modeling -III	3-2-2023		TLM4	
6.	Assembly of Components	10-2-2023		TLM4	
7.	Static analysis on beam	17-2-2023		TLM4	
8.	Eigenvalue Buckling analysis	3-3-2023		TLM4	
9.	Model analysis on Wing	10-3-2023		TLM4	
10.	Thermal analysis	17-3-2023		TLM4	
11.	Static analysis of composite laminate	24-3-2023		TLM4	
12.	Repetition			TLM4	
13.	Lab internal Exam	31-03-2023		TLM4	

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

PART-C

EVALUATION PROCESS (R20 Regulation):

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

PART-D

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

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

PROGRAMME OUTCOMES (POs):

Engineering Graduates will be able to:

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

PO 11	**Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-long Learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

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

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