LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING
(AUTONOMOUS)
Accredited by NAAC & NBA (CSE, IT, ECE, EEE & ME)
Approved by AICTE, New Delhi and Affiliated to JNTUK, Kakinada
L.B.Reddy Nagar, Mylavaram-521230, Krishna Dist, Andhra Pradesh, India

DEPARTMENT OF AEROSPACE ENGINEERING

COURSE HANDOUT

PART-A

Name of Course Instructor : S.Indrasena Reddy
Course Name & Code : MOC & 17AE24
L-T-P Structure : 2-2-0 Credits : 3
Program/Sem/Sec : B.Tech., ASE., VII-Sem. A.Y : 2021-22

PRE-REQUISITE: Strength of materials

COURSE EDUCATIONAL OBJECTIVES (CEOs): To Learn the basic knowledge about composite materials at micro and macro level, lamina and laminates, basic design concepts of sandwich panels, functionally graded materials and the manufacturing process of composite materials.

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

CO 1	Understand the stress-strain relations applicable for composite materials (Understanding-L2)
CO 2	Study the macro and micro mechanical behaviour of composite Lamina (Apply-L3)
CO 3	Analyze the structural behaviour of multi directional composites (Analyze-L4)
CO 4	Understand the basic design concept of sandwich panels used in aerospace industries (Understanding-L2)
CO 5	Apply techniques of fabrication processes to manufacture composites (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 Calcote, LR., "The Analysis of laminated Composite Structures", Von – Noastrand Reinhold Company, New York 1998.
T2 Jones, R.M., "Mechanics of Composite Materials", 2nd Edition McGraw-Hill, KogakushaLtd.,Tokyo, 1998.
T3 Carlsson, L.A., Kardomateas, G.A., "Structural and Failure Mechanics of Sandwich", Solid Mechanics and its Applications, Vol 121, Springer Heidlberg, New York, 2011.

REFERENCE BOOKS:

R1 Agarwal, B.D., Broutman, L.J., "Analysis and Performance of Fibre Composites", John Wiley and sons. Inc., New York, 1995
R2 Lubin, G., "Handbook on Advanced Plastics and Fibre Glass", Von Nostrand Reinhold Co.,New York, 1989.Publishers,3rd edition 2010.

PART-B

COURSE DELIVERY PLAN (LESSON PLAN):

UNIT-I: STRESS STRAIN RELATION

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 composite materials	1	27-09-21		TLM1	
2.	Classification of Reinforcements	1	28-09-21		TLM1	
3.	Classification based on matrices	1	29-09-21		TLM1	
4.	Advantages and applications	1	01-10-21		TLM2	
5.	Types of Fibers and their applications	1	04-10-21		TLM1	
6.	Types of matrix and their applications	1	05-10-21		TLM1	
7.	Generalized Hooke's Law	1	06-10-21		TLM1	
8.	Compliance and stiffness matrix	1	08-10-21		TLM1	
9.	Stress strain relations for non-isotropic materials	1	11-10-21		TLM1	
10.	Stress strain relations for orthotropic materials	1	12-10-21		TLM1	
No. of classes required to complete UNIT-I: 10				No. of classes taken:		

UNIT-II: METHODS OF 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
1.	Introduction to macro mechanics	1	18-10-21		TLM1	
2.	Stress-strain relations	1	19-10-21		TLM1	
3.	Determination of material properties	1	22-10-21		TLM1	
4.	Experimental characterization	1	25-10-21		TLM1	
5.	Problems on lamina properties	1	26-10-21		TLM1	
6.	Introduction to micro mechanics	1	27-10-21		TLM1	
7.	Mechanics of materials approach	1	29-10-21		TLM1	
8.	Determine elastic constants	1	01-11-21		TLM1	
9.	Elasticity approach to materials	1	02-11-21		TLM1	
10.	Properties of lamina	1	03-11-21		TLM1	
11.	Stiffness method	1	05-11-21		TLM1	
No. of classes required to complete UNIT-II:11				No. of classes taken:		

UNIT-III: MULTI DIRCTIONAL COMPOSITES

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 laminate	1	15-1121		TLM1	
2.	Equilibrium equations for laminate	1	16-11-21		TLM1	
3.	CLT	1	17-11-21		TLM2	
4.	A,B, D matrices	1	19-11-21		TLM1	
5.	angle ply laminates	1	22-11-21		TLM2	
6.	A,B, D matrices angle ply laminates	1	23-11-21		TLM1	
7.	Cross ply laminates	1	24-11-21		TLM2	
8.	A,B, D matrices Cross ply laminates	1	26-11-21		TLM1	
9.	Failure criteria and strength of laminates	1	29-11-21		TLM2	
10.	Failure theories (T-Sai. T-sai-Wu etc)	1	30-11-21		TLM1	
No. of classes required to complete UNIT-III:10				No. of classes taken:		

UNIT-IV : SANDWICH CONSTRUCTIONS

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 sandwich construction	1	01-12-21		TLM1	
2.	Design concepts of sandwich panels	1	03-12-21		TLM1	
3.	Facing and core Materials	1	06-12-21		TLM1	
4.	Flexural rigidity of sandwich	1	07-12-21		TLM1	
5.	deflection of sandwich beams	1	08-12-21		TLM1	
6.	Problems on sandwich panels	1	10-12-21		TLM1	
7.	Applications of Sandwich panels	1	13-12-21		TLM2	
8.	Failure modes of sandwich panels	1	14-12-21		TLM2	
9.	Failure modes of sandwich panels	1	15-12-21		TLM2	
No. of classes required to complete UNIT-IV:09				No. of classes taken:		

UNIT-V : FABRICATION PROCESSES & FUNCTIONALLY GRADED MATERIALS:

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 fabrication process	1	17-12-21		TLM1	
2.	Various Open mould processes	1	20-12-21		TLM2	
3.	Various closed mould processes	1	21-12-21		TLM2	
4.	Vacuum bagging, infusion	1	22-12-21		TLM2	
5.	Pultrusion, RTM	1	24-12-21		TLM2	
6.	Auto Clave, Filament Winding	1	27-12-21		TLM2	
7.	Introduction to FGM's	1	28-12-21		TLM1	
8.	lengthwise and thickness wise	1	29-12-21		TLM1	
9.	power law.	1	31-12-21		TLM1	
No. of classes required to complete UNIT-V:09				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
(S.Indrasena Reddy)	(Dr.Prabhu.L)	(Dr.P.Lovaraju)

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DEPARTMENT OF AEROSPACE ENGINEERING

COURSE HANDOUT

PART-A

Name of Course Instructor : Dr. L. Prabhu
Course Name & Code : Theory of Vibrations / 17AE33
L-T-P Structure : 3-0-0 Credits : 3
Program/Sem/Sec : B.Tech., Aerospace, VII-Sem A.Y : 2021-22

PRE-REQUISITE: Engineering Mechanics, Strength of Materials

COURSE EDUCATIONAL OBJECTIVES (CEOs):

1. To construct a free body diagram and write the differential equations of motion of vibratory system to find natural frequency.
2. To learn the effects of damped free vibrations of single degree of freedom systems.
3. To understand the forced vibrations of unbalanced system and knowing about isolators, vibration measuring instruments.
4. To learn about the two degree of freedom systems of forced vibrations with harmonic excitation.
5. To learn about multi degree of freedom systems by applying exact analysis, influence coefficients and numerical methods.

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

CO 1	To formulate mathematical models for mechanical systems using mass, spring and dampers
CO 2	To analyze the systems with damped free vibrations single degree of freedom
CO 3	To develop a single degree of freedom forced vibrating mechanical system under various types of excitation conditions
CO 4	To analyze and modify two degree of freedom mechanical systems
CO 5	To analyze and design mechanical systems of multi degrees of freedom

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			1					1	2	2
CO2	3	2	2	2			1					1	2	2
CO3	3	2	2	2			1					1	2	2
CO4	3	2	2	2			1					1	2	2
CO5	3	2	2	2			1					1	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).

REFERENCE BOOKS:

R1 Thomson. W. T., Theory of Vibrations with Applications, CBS Publishers & Distributors, 2002.
R2 Grover. G. K., Mechanical Vibrations: M.K.S. Systems, Nemchand & Bros., 1972.
R3 Singh. V. P., Mechanical Vibrations, Dhanpati Rai & Sons, 2016.
R4 Rao. V. D., Srinivas. J., Textbook of Vibrations, PHI Learning Pvt. Ltd., 2004.
R5 Rao. S. S., Mechanical Vibrations, Prentice Hall, 2011.

PART-B

COURSE DELIVERY PLAN (LESSON PLAN):

UNIT-I: Basic Elasticity

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to vibration	1	29-09-2021		TLM1	
2.	Basic terminology	1	30-09-2021		TLM1	
3.	Formation of differential equation	1	01-10-2021		TLM1	
4.	Solution of differential equation	1	06-10-2021		TLM1	
5.	Torsional vibration	1	07-10-2021		TLM1	
6.	Springs in series & parallel	1	08-10-2021		TLM1	
7.	Natural frequency of a vibration system by energy method	2	09-10-2021 20-10-2021		TLM1 TLM3	
8.	Discussion, Quiz and Assignment - 1	1	21-10-2021		TLM1	
No. of classes required to complete UNIT-I: 09				No. of classes taken:09		

UNIT-II: Statically Determinant 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
9.	Introduction to damped free vibration	1	22-10-2021		TLM1	
10.	Classification of dampers	1	23-10-2021		TLM1	
11.	Free vibration with viscous dampers	1	27-10-2021		TLM1	
12.	Overdamped system	1	28-10-2021		TLM1	
13.	Critically damped system	1	29-10-2021		TLM1	
14.	Overdamped system	1	30-10-2021		TLM1	
15.	Logarithmic decrement	1	03-11-2021		TLM1	
16.	Viscous dampers	1	05-11-2021		TLM1	
17.	Assignment/Quiz-2	1	06-11-2021		TLM1/TLM3	
No. of classes required to complete UNIT-II:09				No. of classes taken:		

UNIT-III: Statically Indeterminate Structures

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
18.	Introduction to forced vibration	1	17-11-2021		TLM1	
19.	Types of forced excitation	1	18-11-2021		TLM1	
20.	Forced vibrations with constant harmonic excitation	1	19-11-2021		TLM1	
21.	Steady state vibrations	1	20-11-2021		TLM1	
22.	Forced vibration with rotating and reciprocating unbalance	1	24-11-2021		TLM1	
23.	Forced vibrations due to excitation of the	1	25-11-2021		TLM1	
24.	Vibration isolation and transmissibility	1	26-11-2021		TLM1	
25.	vibration measuring instruments	1	27-11-2021		TLM1	
26.	Assignment/Quiz 3	1	01-12-2021		TLM3	
No. of classes required to complete UNIT-III:09				No. of classes taken:		

UNIT-IV: Energy Methods

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
27.	Introduction to two degree of freedom	1	02-12-2021		TLM1	
28.	Two masses fixed on a tightly stretched string	1	03-12-2021		TLM1	
29.	Double pendulum	1	04-12-2021		TLM1	
30.	Torsional system	1			TLM1	
31.	Undamped forced vibrations with harmonic excitation	2	08-12-2021 09-12-2021		TLM1	
32.	Undamped dynamic vibration absorber	2	10-12-2021 15-12-2021		TLM1 TLM3	
33.	Assignment/Quiz 4	1	16-12-2021		TLM1	
No. of classes required to complete UNIT-IV:09				No. of classes taken:		

UNIT-V: Columns

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
34.	Introduction to Multi degree of freedom	1	17-12-2021		TLM1	
35.	Influence coefficients	1	18-12-2021		TLM1	
36.	Flexibility coefficients and Maxwell reciprocal theorem	1	22-12-2021		TLM1	
37.	Torsional vibrations of Multi rotor systems	1	23-12-2021		TLM1	
38.	Vibrations of geared systems	1	24-12-2021		TLM1	
39.	Determination of natural frequency of vibration by Rayleigh's method.	2	29-12-2021 30-12-2021		TLM1 TLM3	
40.	Assignment/Quiz 5	1	31-12-2021		TLM1	
No. of classes required to complete UNIT-V:08				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 the defense and space research programs.

Dr. L. Prabhu			Dr. P. Lovaraju
Course Instructor	Course Coordinator	Module Coordinator	HOD

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DEPARTMENT OF AEROSPACE ENGINEERING

COURSE HANDOUT

PROGRAM : **B.Tech., VII-Sem., ASE**

ACADEMIC YEAR : **2021-22**

COURSE NAME & CODE : **Computational Fluid Dynamics and 17AE25**

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

COURSE CREDITS : **3**

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

COURSE COORDINATOR : **Dr. P. Lovaraju**

PRE-REQUISITE:

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 flow problems, and basic techniques to solve simple heat transfer problems .

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

CO 1	Formulate the basic fluid dynamics problem mathematically (Apply-L3)
CO 2	Analyze the mathematical behaviour of partial differential equations (Analyze-L4)
CO 3	Apply the grid generation principles for different problems (Apply-L3)
CO 4	Solve elementary incompressible fluid problems using the CFD techniques (Apply-L3)
CO5	Solve the elementary heat transfer problems using the CFD techniques (Apply-L3)

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

Course Code	COs	Programme Outcomes												PSOs	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
17AE25	CO1	3	2	2	2	1	-	-	-	-	-	-	2	3	3
	CO2	3	3	2	2	1	-	-	-	-	-	-	2	3	3
	CO3	3	2	3	2	3	-	-	-	-	-	-	2	3	3
	CO4	3	2	2	2	3	-	-	-	-	-	-	2	3	3
	CO5	3	2	2	2	3	-	-	-	-	-	-	2	3	3
1 = Slight (Low) 2 = Moderate (Medium) 3-Substantial (High)															

BOS APPROVED TEXT BOOKS:

T1 Anderson.J.D, Computational Fluid Dynamics-Basics with Applications, Mc Graw Hill, 1995.

T2 Thanigaiarasu. S, Computational Fluid Dynamics and Heat Transfer.

BOS APPROVED REFERENCE BOOKS:

R1 Anderson, D. A, Tannehill. J. C, Pletcher. R. H, Computational Fluid Mechanics and Heat Transfer, CRC Press, 2012.

R2 Patankar. S. V, Numerical Heat Transfer and Fluid Flow, CRC Press, 1980.

R3 Sengupta. T. K, Fundamentals of Computational Fluid Dynamics, University Press, 2004.

COURSE DELIVERY PLAN (LESSON PLAN):

UNIT-I: Introduction, Governing Equations of Fluid Dynamics

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.	Introduction to Course and discussion of course outcomes (Cos)	1	27-09-2021		**TLM2**	CO1	T1	
2.	Computational Fluid Dynamics as a Research and Design Tool, Applications of Computational Fluid Dynamics.	1	28-09-2021		**TLM2**	CO1	T1	
3.	Introduction, Control Volume, Substantial Derivative, Divergence of Velocity,	1	29-09-2021		**TLM2**	CO1	T1	
4.	Continuity Equation	1	4-10-2021		**TLM2**	CO1	T1	
5.	Momentum Equation	2	5-10-2021, 6-10-2021		**TLM2**	CO1	T1	
6.	Energy Equation	2	9-10-2021 11-10-2021		**TLM2**	CO1	T1	
7.	Conservation and Non-conservation forms of governing flow equations	1	18-10-2021		**TLM2**	CO1	T1	
8.	Tutorial	1	19-10-2021		**TLM3**			
9.	Assignment-1/Quiz-1	1	**23-10-2021**					
No. of classes required to complete UNIT-I:		11	No. of classes taken:					

UNIT-II: 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 Methods	Learning Outcome COs	Text Book followed	HOD Sign Weekly
1.	Introduction	1	25-10-2021		**TLM2**	**CO2**	**T1**	
2.	Classification of Quasi-Linear Partial Differential Equations	2	26-10-2021, 27-10-2021		**TLM2**	**CO2**	**T1**	
3.	Eigen Value Method	1	30-10-2021		**TLM2**	**CO2**	**T1**	
4.	Hyperbolic Equations	1	1-11-2021		**TLM2**	**CO2**	**T1**	
5.	Parabolic Equations	1	2-11-2021		**TLM2**	**CO2**	**T1**	
6.	Elliptic Equations	1	3-11-2021		**TLM2**	**CO2**	**T1**	
7.	Tutorial	1	5-11-2021		TLM3		T1	
8.	Assignment-2/Quiz-2	1	6-11-2021					
No. of classes required to complete UNIT-II:		9	No. of classes taken:					

I MID EXAMINATIONS (8-11-2021 TO 13-11-2021)

UNIT-III: Basics Aspects of Discretization

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.	Introduction of Finite Differences	1	15-11-2021		TLM2	CO3	T1	
2.	Difference Equations Forward Difference and Rearward Difference	1	16-11-2021		TLM2	CO3	T1	
3.	Central Difference	1	17-11-2021		TLM2	CO3	T1	
4.	Explicit and Implicit Approaches	2	20-11-2021, 22-11-2021		TLM2	CO3	T1	
5.	Errors	1	23-11-2021		TLM2	CO3	T1	
6.	Stability Analysis	1	24-11-2021		TLM2	CO3	T1	
7.	Grid Generation. General transformation of equations, Matrics and Jacobians	2	27-11-2021 29-11-2021		TLM2	CO3	T1	
8.	Tutorial	1	30-11-2021		TLM3			
9.	Assignment-3/Quiz 3	1	1-12-2021					
No. of classes required to complete UNIT-III:		11	No. of classes taken:					

UNIT-IV : Incompressible Fluid Flow

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.	Introduction	1	4-12-2021		TLM2	CO4	T1	
2.	Maccromack's Technique	2	6-12-2021, 7-12-2021		TLM2	CO4	T1	
3.	Predictor step and Corrector Step	1	, 8-12-2021,		TLM2	CO4	T1	
4.	Incompressible Couette Flow, Implicit Crank-Nicholson Technique	2	11-12-2021, 13-12-2021		TLM2	CO4	T1	
5.	Pressure Correction Method	1	14-12-2021		TLM2	CO4	T1	
6.	Computation of Boundary Layer Flows	1	15-12-2021		TLM2	CO4	T1	
7.	Tutorial				TLM3			
8.	Assignment-4/Quiz 4							
No. of classes required to complete UNIT-IV:		8	No. of classes taken:					

UNIT-V : 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.	Finite Difference Applications in Heat conduction and Convention,	2	18-12-2021 20-12-2021		TLM2	CO5	T2, R1	
2.	Heat conduction - steady heat conduction in a rectangular geometry	1	21-12-2021		TLM2	CO5	T2, R1	
3.	Transient heat conduction in a plane wall	1	22-12-2021		TLM2	CO5	T2, R1	
4.	Two-Dimensional transient heat conduction,	1	27-12-2021		TLM2	CO5	T2, R1	
5.	Finite difference application in convective heat transfer.	1	28-12-2021		TLM2	CO5	T2, R1	
6.	Tutorial	1	29-12-2021		TLM3			
7.	Assignment-5/Quiz 5	1	1-01-2022					
8.	Revision				TLM2			
No. of classes required to complete UNIT-V:12		8	No. of classes taken:					

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

ACADEMIC CALENDAR:

Description	From	To	Weeks
I Phase of Instructions-1	27-09-2021	6-11-2021	6W
I Mid Examinations	8-11-2021	13-11-2021	1W
II Phase of Instructions	15-11-2021	1-01-2022	7W
II Mid Examinations	03-01-2022	08-01-2022	1W
Preparation and Practical	10-01-2022	15-01-2022	1W
Semester End Examinations	17-01-2022	29-01-2022	2W

EVALUATION PROCESS:

Evaluation Task	COs	Marks
Assignment/Quiz – 1	1	A1=5
Assignment/Quiz – 2	2	A2=5
I-Mid Examination	1,2	B1=20
I-Mid Examination(Objective)	1,2	C1=10
Assignment/Quiz – 3	3	A3=5
Assignment/Quiz – 4	4	A4=5
Assignment/Quiz – 5	5	A5=5
II-Mid Examination	3,4,5	B2=20
II-Mid Examination(Objective)	3,4,5	C2=10
Evaluation of Assignment/Quiz Marks: 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=20
Evaluation of Quiz Marks: C=75% of Max(C1,C2)+25% of Min(C1,C2)	1,2,3,4,5	C=10
Attendance Marks: D(>95%=5, 90-95%=4,85-90%=3,80-85%=2,75-80%=1)		D=5
Cumulative Internal Examination : A+B+C+D	**1,2,3,4,5**	**40**
Semester End Examinations	**1,2,3,4,5**	**E=60**
Total Marks: A+B+C+D+E	**1,2,3,4,5**	**100**

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

COURSE HANDOUT

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

ACADEMIC YEAR : 2021-22

COURSE NAME & CODE : INTRODUCTION TO SPACE TECHNOLOGY - 17AE28

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

COURSE CREDITS 3

COURSE INSTRUCTOR : **M.BHUVANESHWARI**

MODULE COORDINATOR: Dr.P.LOVARAJU

PRE-REQUISITE: NONE

COURSE OBJECTIVE: In this course student will be able to learn the space mission strategies and fundamental orbital mechanics. She/he can be able to calculate flight trajectories of rockets and missiles. He will be able to understand the fundamentals of atmospheric re-entry issues and satellite attitude control techniques.

COURSE OUTCOMES (CO)

CO1	Understand the concepts of launching satellites in space (Understand-L2)
CO2	Apply the principles of orbital mechanics on motion of bodies in orbits (Apply-L3)
CO3	Comprehend the trajectories of rockets and missiles (Understand-L2)
CO4	Describe the dynamics of spacecraft attitude (Understand-L2)

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

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

BOS APPROVED TEXT BOOKS:

T1 W.E.Wiesel, Spaceflight Dynamics, McGraw-Hill,1997

T2 Cornelisse, Schoyer HFR, Wakker KF, Rocket Propulsion and Space Flight Dynamics, pitman publications, 1984

BOS APPROVED REFERENCE BOOKS:

R1 J.Sellers., "Understanding Space: An Introduction to Astronautics", McGraw- Hill, 2000.

R2 Francis J Hale., "Introduction to Space Flight", Prentice-Hall, 1994.

COURSE DELIVERY PLAN (LESSON PLAN)

UNIT-I: INTRODUCTION

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 origin of space and Space Missions- Types	1	28/09/2021		**TLM2**	
2.	Space Environment-Introduction	1	29/09/2021		**TLM2**	
3.	Launch vehicle selection	1	30/09/2021		**TLM2**	
4.	Introduction to Rocket Propulsion	1	05/10/2021		**TLM2**	
5.	Fundamentals of solid Rocket Propellants	1	06/10/2021		**TLM2**	
6.	Solid Rocket Propellants- Burn rate & properties	1	07/10/2021		**TLM2**	
7.	Fundamentals of Liquid Rocket Propellants	1	09/10/2021		**TLM2**	
8.	Liquid Rocket Propellants-Pump & Pressure Feed Systems	1	20/10/2021		**TLM2**	
9.	Rocket Equation	1	21/10/2021		**TLM2**	
No. of classes required to complete UNIT-I		09	No. of classes taken:			

UNIT-II: ORBITAL MECHANICS & ORBITAL MANEUVERS

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.	Two body motion-Inertial Frame	1	23/10/2021		**TLM1**	
11.	Two body motion-Angular Momentum & Orbit Eq.	1	26/10/2021		**TLM1**	
12.	Conic Sections- Circular Orbits and Elliptical Orbits	1	27/10/2021		**TLM1**	
13.	Conic Sections- Parabolic Orbits and - Hyperbolic Orbits	1	28/10/2021		**TLM1**	
14.	Classic Orbital Elements & Ground Tracks	1	30/10/2021		**TLM1**	
15.	Orbital Maneuvers-Hohmann transfer	1	02/11/2021		**TLM1**	
16.	Bi-elliptical	1	03/11/2021		**TLM1**	
17.	Plane changes and Combined maneuvers & Propulsion for maneuvers	1	06/11/2021		**TLM1**	
No. of classes required to complete UNIT-II		08	No. of classes taken:			

Unit III- ASCENT FLIGHT MECHANICS OF ROCKETS & MISSILES

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
18.	Two-Dimensional trajectories of rockets and missiles	1	16/11/2021		**TLM1**	
19.	Multi-Stage Rockets	1	17/11/2021		**TLM1**	
20.	Vehicle Sizing	1	18/11/2021		**TLM1**	
21.	Two-Stage Rockets	1	20/11/2021		**TLM1**	
22.	Trade-off Ratios	1	23/11/2021		**TLM1**	

23.	Single Stage to Orbit	1	24/11/2021		**TLM1**	
24.	Sounding Rockets	1	25/11/2021		**TLM1**	
25.	Gravity turn trajectories	1	27/11/2021		**TLM1**	
No. of classes required to complete UNIT-III		08	No. of classes taken:			

Unit IV- ATMOSPHERIC REENTRY

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
26.	Introduction to Reentry	1	30/11/2021		**TLM1**	
27.	Steep Ballistic Reentry	1	01/12/2021		**TLM1**	
28.	Ballistic Orbital Reentry	1	02/12/2021		**TLM1**	
29.	Skip Reentry	1	04/12/2021		**TLM1**	
30.	Double Dip Reentry	1	07/12/2021		**TLM1**	
31.	Aero Braking	1	08/12/2021		**TLM1**	
32.	Lifting Body Reentry	1	09/12/2021		**TLM1**	
33.	REVISION	1	11/12/2021		**TLM1**	
No. of classes required to complete UNIT-IV		08	No. of classes taken:			

Unit V- SATELLITE ATTITUDE DYNAMICS

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
34.	Introduction	1	14/12/2021		**TLM1**	
35.	Torque Free Axi-symmetric Body	1	15/12/2021		**TLM1**	
36.	Attitude Control for spinning Spacecraft	2	16/12/2021& 18/12/2021		**TLM1**	
37.	Attitude Control for non-spinning Spacecraft	2	21/12/2021& 22/12/2021		**TLM1**	
38.	The Yo-Yo Mechanism	1	23/12/2021		**TLM1**	
39.	Gravity Gradient Satellite	1	28/12/2021		**TLM1**	
40.	Dual Spin Spacecraft- Attitude Determination	2	29/12/2021& 30/12/2021		**TLM1**	
No. of classes required to complete UNIT-V		10	No. of classes taken:			

Teaching Learning Methods					
TLM1	Chalk and Talk	**TLM4**	Problem Solving	**TLM7**	Seminars or GD
TLM2	PPT	**TLM5**	Programming	**TLM8**	Lab Demo
TLM3	Tutorial	**TLM6**	Assignment or Quiz	**TLM9**	Case Study

EVALUATION PROCESS:

Evaluation Task	COs	Marks
Assignment/Quiz – 1	1	A1=5
Assignment/Quiz – 2	2	A2=5
I-Mid Examination	1,2	B1=20
Assignment/Quiz – 3	3	A3=5
Assignment/Quiz – 4	4	A4=5
Assignment/Quiz – 5	5	A5=5
II-Mid Examination	3,4,5	B2=20
Evaluation of Assignment/Quiz Marks: 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=20
Cumulative Internal Examination : A+B	**1,2,3,4,5**	**A+B=25**
Semester End Examinations	**1,2,3,4,5**	**C=75**
Total Marks: A+B+C	**1,2,3,4,5**	**100**

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

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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
(Ms.M.Bhuvaneshwari)	(Dr.P.Lovaraju)	(Dr.P.Lovaraju)

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COURSE HANDOUT
Part-A

COURSE INSTRUCTORS : Mr. S.Indrasena Reddy /Mr. Nazumuddin Shaik

COURSE NAME & CODE : Aircraft Component Modeling and Analysis-17AE66

L-T-P STRUCTURE : 0-0-2 **COURSE CREDITS : 1**

PROGRAM : B.Tech. VII-Sem. **ACADEMIC YEAR :** 2021-22

COURSE COORDINATOR: Mr.S. Indrasena Reddy

PRE-REQUISITE: Engineering Graphics, Computer Aided Machine Drawing

COURSE EDUCATIONAL OBJECTIVES (CEOs):

The main objective of this course is to learn surface modeling package (CATIA) to draw 2D sketches, 3D parts, various aircraft components and assembly drawing and finite element package (ANSYS) to analyze the behavior of simple structural elements under static loading system.

COURSE OUTCOMES (COs)

At the end of the semester, the student will be able

CO1: Draw aircraft components in 2D and 3D geometric modeling (Apply-L3)

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	Tentative Date of Completion	Actual Date of Completion	17AE66 - AIRCRAFT COMPONENT MODELING AND ANALYSIS(ACMA) LAB		Learning Outcome COs	HOD Sign Weekly
			List of Experiments			
1	03-11-2020		ACMA Introduction-CATIA Introduction		CO1	
2	10-11-2020		Exp-1	Aircraft Component Design-I	CO1	
3	17-11-2020		Exp-2	Aircraft Component Design-II	CO1	
4	24-11-2020		Exp-3	Aircraft Component Design-III	CO1	
5	01-12-2020		Exp-4	Aircraft Component Design-IV	CO1	
6	08-12-2020		Exp-5	Assembly of Components	CO1	
7	15-12-2020		Exp-6	Static analysis on beam	CO2	
8	29-12-2020		Exp-7	Eigenvalue Buckling analysis	CO2	
9	05-01-2021		Exp-8	Model analysis on Wing	CO2	
10	19-01-2021		Exp-9	Thermal analysis	CO2	
11	02-02-2021 & 09-02-2021		Exp-10	Static analysis of composite laminate	CO2	

Contents beyond the Syllabus:

12			Exp-11	Aircraft components assembly and analysis	CO1 & CO2

Part - C

EVALUATION PROCESS (R17 Regulations) :

Parameter		Marks
Day – to – Day Work	Observation	A1 = 10 Marks
	Record	A2 = 10 Marks
Internal Test		B =10 Marks
Attendance		C = 05 Marks
Viva – Voce During Regular Lab Sessions		D = 05 Marks
Cumulative Internal Examination		**A1+ A2 + B+C+D = 40 Marks**
Semester End Examinations		**E = 60 Marks**
Total Marks: A1+ A2 + B + C + D + E		**100 Marks**

Part - D

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

Program Educational Objectives (PEO)

PEO1: To provide students with sound mathematical, engineering and multidisciplinary knowledge to solve Aerospace and Allied Engineering problems.

PEO2: To prepare students to excel in higher education programs and to succeed in industry/academia profession.

PEO3: To inculcate ethical attitude, leadership qualities, problem solving abilities and life-long learning for a successful professional career.

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

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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

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