LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING
(AUTONOMOUS)
Accredited by NAAC & NBA (Under Tier - I), ISO 9001:2015 Certified Institution
Approved by AICTE, New Delhi. and Affiliated to JNTUK, Kakinada
L.B. REDDY NAGAR, MYLAVARAM, KRISHNA DIST., A.P.-521 230.
Phone: 08659-222933, Fax: 08659-222931
FRESHMAN ENGINEERING DEPARTMENT

COURSE HANDOUT

PART-A

Name of Course Instructor **:** Dr. K.R. Kavitha
Course Name & Code **:** Numerical Methods & Integral Calculus & 20FE10
L-T-P Structure **:** 3-1 -0 **Credits:3**
Program/Sem/Sec : II B.Tech/III sem/ASE **A.Y.:** 2022 - 23

PREREQUISITE: Nil

COURSE EDUCATIONAL OBJECTIVES (CEOs): The main objective of this course is to enable the students learn Numerical Techniques for solving the equations and apply interpolation techniques. They will also learn about the Fourier analysis of single valued functions, Multiple Integrals in different coordinate systems and Vector differentiation.

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

CO1	Estimate the best fit polynomial for the given tabulated data using Interpolation.(Understand – L2)
CO2	Apply numerical techniques in solving of equations and evaluation of integrals. (Apply – L3)
CO3	Discriminate among Cartesian, Polar and Spherical coordinates in multiple integrals and their respective applications to areas and volumes. (Apply – L3)
CO4	Generate the single valued functions in the form of Fourier series and obtain Fourier series representation of periodic function. (Apply – L3)
CO5	Evaluate the directional derivative, divergence and angular velocity of a vector function. (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	PSO3
CO1	**3**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**			
CO2	**3**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**			
CO3	**3**	**2**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**			
CO4	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**			
CO5	**3**	**1**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**			
1 - Low					**2** –Medium							**3** - High			

TEXTBOOKS:

T1 Dr. B.S. Grewal, "Higher Engineering Mathematics", 42nd Edition, Khanna Publishers, New Delhi, 2012.
T2 Dr. B. V. Ramana, "Higher Engineering Mathematics", 1st Edition, TMH, New Delhi, 2010.
T3 S. S. Sastry, "Introductory Methods of Numerical Analysis" 5th Edition, PHI Learning Private Limited, New Delhi, 2012.

REFERENCE BOOKS:

R1 M. D. Greenberg, "Advanced Engineering Mathematics", 2nd Edition, TMH Publications, New Delhi, 2011.
R2 Erwin Kreyszig, "Advanced Engineering Mathematics", 8th Edition, John Wiley & sons, New Delhi, 2011.

PART-B

COURSE DELIVERY PLAN (LESSON PLAN):

UNIT-I: Interpolation and Finite Differences

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to the course, Course Outcomes	1	12/09/22		TLM1	
2.	Introduction to UNIT I	1	14/09/22		TLM2	
3.	Forward Differences	1	16/09/22		TLM1	
4.	Backward differences	1	17/09/22		TLM1	
5.	Central Differences	1	19/09/22		TLM1	
6.	Symbolic relations and separation of symbols	1	21/09/22		TLM1	
7.	Symbolic relations and separation of symbols	1	23/09/22		TLM1	
8.	Newton's forward formulae for interpolation	1	24/09/22		TLM1	
9.	Newton's backward formulae for interpolation	1	26/09/22		TLM1	
10.	Lagrange's Interpolation	1	28/09/22		TLM1	
11.	Lagrange's Interpolation	1	30/09/22		TLM1	
12.	Tutorial I	1	01/10/22		TLM3	
No. of classes required to complete UNIT-I: 12				**No. of classes taken:**		

UNIT-II: Numerical solutions of Equations and Numerical Integration

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
13.	Introduction to UNIT II	1	10/10/22		TLM2	
14.	Algebraic and Transcendental Equations	1	12/10/22		TLM1	
15.	False Position method	1	14/10/22		TLM1	
16.	False Position method	1	15/10/22		TLM1	
17.	Newton- Raphson Method in one variable	1	17/10/22		TLM1	
18.	Newton- Raphson Method applications	1	19/10/22		TLM1	
19.	Trapezoidal rule	1	21/10/22		TLM1	
20.	Simpson's 1/3 Rule	1	22/10/22		TLM1	
21.	Simpson's 3/8 Rule	1	26/10/22		TLM1	
22.	Tutorial II	1	29/10/22		TLM3	
No. of classes required to complete UNIT-II: 10				**No. of classes taken:**		

UNIT-III: Multiple Integrals

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
23.	Introduction to Unit-III	1	28/10/22		TLM1	
24.	Double Integrals -Cartesian coordinates	1	31/10/22		TLM1	
25.	Double Integrals- Polar co ordinates	1	02/11/22		TLM1	
26.	Problems	1	04/11/22		TLM1	
27.	Applications to Double integrals (Content Beyond the syllabus)	1	05/11/22		TLM2	
I MID EXAMINATIONS (13-12-2021 TO 18-12-2021)						
28.	Triple Integrals - Cartesian	1	14/11/22		TLM1	

	coordinates					
29.	Triple Integrals - Spherical coordinates	1	16/11/22		TLM1	
30.	Change of order of Integration	1	18/11/22		TLM1	
31.	Tutorial III	1	19/11/22		TLM3	
32.	Change of order of Integration	1	21/11/22		TLM1	
No. of classes required to complete UNIT-III: 10				**No. of classes taken:**		

UNIT-IV: Fourier Series

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
33.	Introduction to UNIT IV	1	23/11/22		TLM1	
34.	Determination of Fourier coefficients, Even and Odd Functions	1	25/11/22		TLM1	
35.	Fourier Series expansion in the interval $[0,2\pi]$	1	26/11/22		TLM1	
36.	Fourier Series expansion in the interval $[-\pi,\pi]$	1	28/11/22		TLM1	
37.	Fourier Series in an arbitrary interval [0, 2l]	1	30/11/22		TLM1	
38.	Fourier Series in an arbitrary interval [-l, l]	1	02/12/22		TLM1	
39.	Fourier series in an arbitrary interval odd and even functions	1	03/12/22		TLM1	
40.	Half-range Sine and Cosine series	1	05/12/22		TLM1	
41.	Half-range Sine and Cosine series		07/12/22		TLM1	
42.	Tutorial IV	1	09/12/22		TLM3	
43.	Introduction to Fourier transforms (Content Beyond the Syllabus)	1	12/12/22		TLM2	
No. of classes required to complete UNIT-IV: 11				**No. of classes taken:**		

UNIT-V: Vector Differentiation

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
44.	Introduction to UNIT V	1	14/12/22		TLM1	
45.	Vector Differentiation	1	16/12/22		TLM1	
46.	Gradient	1	17/12/22		TLM1	
47.	Directional Derivative	1	19/12/22		TLM1	
48.	Divergence	1	21/12/22		TLM1	
49.	Curl	1	23/12/22		TLM1	
50.	Solenoidal and Irrotational functions, potential surfaces	1	24/12/22		TLM1	
51.	Laplacian and second order operators	1	26/12/22		TLM1	
52.	TUTORIAL - V	1	28/12/22		TLM3	
53.	Properties	1	30/12/22		TLM1	
54.	Introduction to Vector Integrals (Content Beyond the Syllabus)	1	31/12/22		TLM1	
No. of classes required to complete UNIT-V: 11				**No. of classes taken:**		

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

PART-C

EVALUATION PROCESS (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

PROGRAMME OUTCOMES (POs):

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

Title	Course Instructor	Course Coordinator	Module Coordinator	Head of the Department
Name of the Faculty	**Dr. K. R. Kavitha**	**Dr. K. R. Kavitha**	**Dr. A. Rami Reddy**	**Dr. A. Rami Reddy**
Signature				

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L B Reddy Nagar, Mylavaram-521 230, Krishna District, Andhra Pradesh.

COURSE HANDOUT
PART-A

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

ACADEMIC YEAR : 2022-23

COURSE NAME & CODE : **Engineering Fluid Mechanics**-**20AE02**

L-T-P STRUCTURE : 2-1-0

COURSE CREDITS : 3

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

PRE-REQUISITE: Nil

Course Educational Objectives: To demonstrate the properties of fluids and behavior of fluids under static conditions, differential relations for fluid flows, features of flow though pipes and to understand the working of Hydraulic turbines and Hydraulic pumps.

Course Outcomes: At the end of the course, the student will be able to
CO1: Analyze the forces acting on objects submerged in fluids under static conditions (Analyze-L4)
CO2: Apply differential relations to characterize the behavior of fluid flow (Apply-L3)
CO3: Apply the conservation laws to solve elementary fluid flow problems (Apply-L3)
CO4: Analyze the simple pipe network for fluid transportation (Azalyze-L4)
CO5: Analyze the performance of various hydraulic turbines and pumps (Analyze-L4)

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
20AE02	CO1	3	2	2	2	-	-	-	-	-	-	-	2	2	2
	CO2	3	3	3	2	-	-	-	-	-	-	-	2	3	3
	CO3	3	3	3	3	-	-	-	-	-	-	-	2	3	3
	CO4	3	2	3	2	-	-	-	-	-	-	-	2	2	2
	CO5	3	2	2	2	-	-	-	-	-	-	-	2	2	2
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 White. F.M, Fluid Mechanics, Seventh Edition, McGraw-Hill Education 2011.

T2 Rathakrishnan. E, Fluid Mechanics an Introduction, Fourth Edition, Prentice Hall of India, 2022

REFERENCE BOOKS:

R1 Balachandran P, Engineering Fluid Mechanics, Prentice Hall of India, 2012

R2 Fox. R.W, Mcdonald, A.J, Introduction of Fluid Mechanics, Fifth Edition, John Wiely, 1999

R3 Douglas. J.F, Gesiorek. J.M., Swaffield. J, A., Fluid Mechanics, Fourth Edition, Pearson Education, 2002.

R4 Shames. I.H, Mechanics of Fluids, Third Edition, McGraw-Hill, 1992

PART-B

COURSE DELIVERY PLAN (LESSON PLAN):

UNIT-I: Introduction and Fluid Statics

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction and Overview of the course, Dissemination of course outcomes, General description of Fluid Mechanics, Applications of Fluid Mechanics, Classification of Fluids, Fluids and Continuum	2	13-09-2022 14-09-2022		TLM1	
2.	Properties of Fluid –Pressure, Temperature, Density, Specific Weight, Specific Gravity, Viscosity-Newton's Law of Viscosity	2	16-09-2022 17-09-2022		TLM1	
3.	Compressibility, Surface Tension, Capillarity, Vapor Pressure	1	20-09-2022		TLM1	
4.	Fluid Statics: Pressure Acting at a Point in a Static Fluid-Pascal's Law	1	21-09-2022		TLM1	
5.	Basic Equation of Fluid Statics,	1	23-09-2022		TLM1	

	Hydrostatic Pressure Distributions					
6.	Manometers	2	24-09-2022 27-09-2022		TLM1	
7.	Hydrostatic Pressure Distributions in gases (earth's atmosphere)	1	28-09-2022		TLM1	
8.	Hydrostastic forces on submerged plane surface (derivation)	2	30-09-2022 1-10-2022		TLM1	
9.	Buoyancy and Stability	1	11-10-2022		TLM1	
10.	Tutorial	1	12-10-2022		TLM3	
11.	Assignment/Quiz-1				---	
No. of classes required to complete UNIT-I		**14**		**No. of classes taken:**		

UNIT-II: Analysis of Fluid Flow and Differential Relations for Fluid Flow

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
	Lagrangian and Eulerian approaches, Flow Patterns- Pathline, Streamline, Streakline, Timeline, Stream Tube	2	14-10-2022 15-10-2022		TLM1, TLM2	
12.	Differential Relations of Fluid Flow: Velocity Field, Acceleration Field of a Fluid	1	18-10-2022		TLM1,TLM2	
13.	Differential Equation of Mass Conservation	1	19-10-2022		TLM1,TLM2	
14.	Stream Function, Velocity Potential Vorticity, Rotationality, Irrotationality	2	21-10-2022 22-10-2022		TLM1	
15.	Differential Equation of Linear Momentum, Euler's Equations	2	25-10-2022 26-10-2022		TLM1, TLM2	

16.	Potential Flow, Bernoulli's Equation	2	28-10-2022 29-10-2022		TLM1	
17.	Bernoulli's Equation and its Applications, Orifice Tank	1	1-11-2022		TLM1	
18.	Venturi meter, Pitot-static Tube and various other applications	2	2-11-2022 4-11-2022			
19.	Tutorial	1	5-11-2022		TLM3	
20.	Assignment/Quiz-2				----	
No. of classes required to complete UNIT-II		**14**		**No. of classes taken:**		

I Mid Examination (7/11/2022 to 12/11/2022)

UNIT-III: Flow through Pipes, Dimensional Analysis & Similarity

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
21.	Flow Through Pipes: Reynolds Experiment, Reynolds number	1	8-11-2022		TLM1,TLM4	
22.	Head loss, Darcy-Wiesbach equation, Hydraulic Gradient &Total Energy Lines	2	9-11-2022 11-11-2022		TLM1, TLM2	
23.	Laminar Fully Developed Pipe Flow- Hagen Poiseuille Law	2	15-11-2022 16-11-2022		TLM1	
24.	Pipes in Series, Pipes in Parallel	2	18-11-2022 19-11-2022		TLM1, TLM2	
25.	Equivalent Pipe, Hydraulic Diameter, Minor Losses, Moody Chart and its usage	1	22-11-2022		TLM1	
26.	Introduction, Principle of Dimensional Homogeneity,	1	23-11-2022		TLM1	
27.	Buckingham's Pi Theorem	1	25-11-2022		TLM1	
28.	Dimensionless Groups, Similarity	1	26-11-2022		TLM1	
29.	Tutorial	1	2-12-2022		TLM3	

30.	Assignment/Quiz-3					
No. of classes required to complete UNIT-III		12		**No. of classes taken:**		

UNIT-IV: Hydraulic Turbines & Performance of Hydraulic 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
31.	Introduction, Classification of turbines- Hydro-electric power plants impulse and reaction turbines,	2	3-12-2022 6-12-2022		TLM1	
32.	Pelton Turbine working principle	1	7-12-2022		TLM1,TLM5	
33.	Velocity triangles, Work done, Efficiency, Condition for maximum efficiency	2	9-12-2022 10-12-2022		TLM1	
34.	Francis Turbine, working principle	1	13-12-2022		TLM1	
35.	Velocity triangles, Work done and Efficiency	2	14-12-2022 16-12-2022		TLM1	
36.	Kaplan Turbine, working principle, Velocity triangles, Work done and Efficiency	1	17-12-2022		TLM1	
37.	Draft Tube and its theory	1	20-12-2022		TLM1	
38.	Geometric similarity, Unit and specific quantities	1	21-12-2022		TLM1	
39.	Tutorial	1	23-12-2022		TLM3	
40.	Assignment/Quiz-4					
No. of classes required to complete UNIT-IV		12		**No. of classes taken:**		

UNIT-V: Reciprocating and Centrifugal Pumps

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
41.	Reciprocating Pumps: Classification, Working Principle,	1	24-12-2022		TLM1,TLM5	
42.	Co-efficient of Discharge and Slip, Indicator Diagram	1	27-12-2022		TLM1	
43.	Centrifugal Pumps: Classification, Working Principle, Constructional Details	2	28-12-2022 23-12-2022		TLM1,TLM5	
44.	Velocity Triangles, Work done, Head and Efficiencies	1	24-12-2022		TLM1	
45.	Losses, Specific Speed, Pumps in Series and Parallel	1	27-12-2022		TLM1	
46.	Performance Characteristics	1	28-12-2022 30-12-2022		TLM1	
47.	Tutorial -5	1	31-12-2022		TLM3	
48.	Assignment/Quiz-5	1				
49.	Revision				TLM2	
No. of classes required to complete UNIT-V		**9**		**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: Mr.I.Dakshina Murthy

Course Name & Code : Engineering Thermodynamics (20AE03) **Regulation**: R20
L-T-P Structure : **2-1-0** **Credits:** 3
Program/Sem/Sec : B.Tech/III/-- **A.Y.:** 2022-2023

PREREQUISITE: NIL

COURSE EDUCATIONAL OBJECTIVES (CEOs): To learn the basic concepts of energy conversions, laws of thermodynamics, concept of entropy, the properties of different gas mixtures and pure substances and basic aspects of ideal thermal cycles.

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

CO1	Describe the thermodynamic properties of various systems (Understand-L2)
CO2	Apply the laws of thermodynamics to analyze various thermal systems. (Apply-L3)
CO3	Analyze the entropy change of various processes (Apply-L3)
CO4	Analyze the properties of different gas mixtures and pure substances. (Analyze-L4)
CO5	Analyze ideal gas power cycles and refrigeration cycle to estimate various performance parameters (Analyze-L4)

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

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	3	-	-	-	-	-	-	-	3	3	3
CO2	3	3	3	3	-	-	-	-	-	-	-	3	3	3
CO3	3	3	3	2	-	-	-	-	-	-	-	3	3	3
CO4	3	3	3	3	-	-	-	-	-	-	-	3	3	3
CO5	2	3	3	3	-	-	-	-	-	-	-	3	3	3
1 - Low **2 –**Medium **3 -** High														

TEXTBOOKS:

T1 Rathakrishnan. E, Fundamentals of Engineering Thermodynamics, Second Edition, Prentice Hall of India, 2010

REFERENCE BOOKS:

R1 Nag. P.K, Engineering Thermodynamics- Fifth Edition, McGraw-Hill, 2013.

R2 Cengel. Y.A and Boles, M.A, Thermodynamics: An Engineering Approach, Seventh Edition, McGraw-Hill, 2011.

R3 Sonntag. R. E, Borgnakke. C, Van Wylen. G. J, Fundamentals of Thermodynamics, Fifth Edition John Wiley & sons, publications Inc, 1998.

PART-B

COURSE DELIVERY PLAN (LESSON PLAN):

UNIT-I: BASIC CONCEPTS AND DEFINITIONS

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 and Definitions:** Introduction	1	12-09-2022		TLM 1	
2.	Macroscopic and Microscopic View Point, Continuum, System, Control Volume, Properties of System	1	13-09-2022		TLM 1	
3.	State and Equilibrium, Thermodynamic Equilibrium	1	14-09-2022		TLM 1	
4.	**Tutorial – I**	1	15-09-2022		TLM 3	
5.	Process- Quasi static process-Cycle	1	19-09-2022		TLM 1	
6.	Temperature -Temperature scales, Problems	1	20-09-2022		TLM 1	
7.	Zeroth law of Thermodynamics, energy-forms of energy, heat, work, Mechanical forms of work	1	21-09-2022		TLM 1	
8.	**Tutorial – II**	1	22-09-2022		TLM 3	
9.	Moving boundary of system, Thermodynamic definition of work, Moving Boundary work	1	26-09-2022		TLM 1 &2	
10.	Work done in various non-flow process, Problems on Pdv Work	1	27-09-2022		TLM 1 &2	
11.	Problems on Pdv Work, Path and point function	1	28-09-2022		TLM 1 &2	
12.	**Tutorial - III**	1	29-09-2022		TLM 3	
13.	Assignment/Quiz	1	10-10-2022			
No. of classes required to complete UNIT-I: 13				**No. of classes Taken:**		

UNIT-II: FIRST LAW OF THERMODYNAMICS & ITS ANALYSIS OF CONTROL VOLUME

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
14.	**First Law of Thermodynamics**: Introduction	1	11-10-2022		TLM 1	
15.	Joule's Experiment	1	12-10-2022		TLM 1 &2	
16.	First Law Analysis of closed system, Different Forms of Stored Energy	1	13-10-2022		TLM 1 &2	
17.	**Tutorial – IV**	1	17-10-2022		TLM 3	
18.	Energy balance, Internal energy, specific heat, Enthalpy, PMM-I	1	18-10-2022		TLM 1 &2	
19.	Conservation of Energy, Flow Work, Problems on First law applied to closed system	1	19-10-2022		TLM 1 &2	
20.	**First law analysis of control volume-** The Steady Flow Process, Steady Flow Energy Equation	1	20-10-2022		TLM 1 &2	

21.	**Tutorial – V**	1	25-10-2022		TLM 3	
22.	Steady flow engineering devices- Nozzle, Turbine, compressor, Heat Exchanger	1	26-10-2022		TLM 1 &2	
23.	Problems on Steady Flow Devices	1	27-10-2022		TLM 1 &2	
24.	Assignment/Quiz	1	31-10-2022			
No. of classes required to complete UNIT-II: 11				**No. of classes Taken:**		

UNIT-III: SECOND LAW OF THERMODYNAMICS & ENTROPY

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
25.	**Second law of thermodynamics** :Introduction, Thermal energy reservoirs, heat engines	1	01-11-2022		TLM 1	
26.	Kelvin-Planks, clausius statement of second law of thermodynamics, Refrigerator, heat pumps,	1	02-11-2022		TLM 1	
27.	Equivalence of kelvin-plank and clausius statements, Perpetual motion machines, reversible and irreversible process	1	03-11-2022		TLM 2	
28.	**Tutorial – VI**	1	04-11-2022		TLM 3	
29.	Carnot cycle, Carnot principles, Corollary of Carnot Theorem, Absolute Thermodynamic Temperature Scale	2	14-11-2022 15-11-2022		TLM 1	
30.	Problems	2	16-11-2022 17-11-2022		TLM 1 &2	
31.	**Entropy**: Introduction, Clausius inequality, property diagrams	2	21-11-2022 22-11-2022		TLM 1 &2	
32.	**Tutorial - VII**	1	23-11-2022		TLM 3	
33.	Max well Relation, entropy change for ideal gases, Isentropic relations for ideal gases, Principle of increase of entropy	2	24-11-2022 28-11-2022		TLM 1 &2	
No. of classes required to complete UNIT-III: 13			**No. of classes Taken:**			

UNIT-IV: NON REACTIVE GAS MIXTURES & PROPERTIES OF PURE SUBSTANCES

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.	**Non reactive gas mixtures**- Introduction, Mass fraction, mole fraction, Daltons law of additive pressures, Amagat's law of additive volumes	1	29-11-2022		TLM 1 &2	
35.	Ideal gas mixture, problems on Gas Mixtures	2	30-11-2022 01-12-2022		TLM 1 &2	
36.	**Pure substance**: Introduction, phase of pure substance, Phase change processes, property diagrams	2	05-12-2022 06-12-2022		TLM 1 &2	
37.	**Tutorial – VIII**	1	07-12-2022		TLM 3	

38.	P-V-T surface, property tables, h-s Diagram or Mollier Diagram for pure Substance	1	08-12-2022		TLM 1 &2	
39.	Problems on Pure Substances	2	01-12-2022 05-12-2022		TLM 1 &2	
No. of classes required to complete UNIT-IV: 9			**No. of classes Taken:**			

UNIT-V: GAS POWER CYCLES AND REFRIGERATION CYCLES

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
40.	**Gas power cycles**-Introduction, Analysis of power cycles- Carnot, Otto	2	06-12-2022 07-12-2022		TLM 1 &2	
41.	Analysis of Diesel, Dual	2	08-12-2022 12-12-2022		TLM 1 &2	
42.	Analysis of Brayton Cycle, Problems on gas power cycles	2	13-12-2022 14-12-2022		TLM 1 &2	
43.	**Tutorial – IX**	1	15-12-2022		TLM 3	
44.	**Refrigeration Cycles**: Reversed Carnot cycle, Bell-Coleman cycle,	2	19-12-2022 20-12-2022		TLM 1 &2	
45.	Simple vapor compression cycle, Problems	2	21-12-2022 22-12-2022 26-12-2022		TLM 1 &2	
46.	Revision of Important Concepts	3	27-12-2022 28-12-2022 29-12-2022		TLM 1 &2	
No. of classes required to complete UNIT-V: 11			**No. of classes Taken:**			

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

PART-C

EVALUATION PROCESS (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

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

PROGRAMME SPECIFIC OUTCOMES (PSOs):

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

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

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DEPARTMENT OF AEROSPACE ENGINERRING

COURSE HANDOUT

PART-A

Name of Course Instructor: S.Indrasena Reddy
Course Name & Code **:** Strength of Materials & 20AE04
L-T-P Structure **:3-1-0** **Credits:** 3
Program/Sem/Sec : B.Tech/III Sem **A.Y.:** 2022-23

PREREQUISITE: Engineering Mechanics

COURSE EDUCATIONAL OBJECTIVES (CEOs):

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

CO1	Analyze the stress and strain behavior in different types of members under various load conditions
CO2	Evaluate stress, shear force, bending moment, deflection for beams and torsion for circular shafts under different loading conditions
CO3	Evaluate shear stress distributions over different cross sections
CO4	Apply the failure theories on structural members principle stresses.
CO5	Analyze internal stresses due to internal pressures in thin and thick cylindrical shells.

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								3	3	2
CO2	3	3	3	2								3	3	2
CO3	3	3	3	2								3	3	2
CO4	3	3	3	3								3	3	1
CO5	3	3	3	3								3	3	2
1 - Low						**2 –**Medium						**3 -** High		

TEXTBOOKS:

T1 Ramamrutham. S, Narayanan R, Strength of Materials, Dhanpat Rai & Sons, 2017.

REFERENCE BOOKS:

R1 Popov. E. P, Mechanics of Materials, Prentice Hall Inc, 1976

R2 Andrew. P, Singer F.L., Strength of Materials, Harper and Row Publishers, New York, 1987.

R3 Gambhir. M. L, Fundamentals of Solid Mechanics, PHI Learning, 2009. Subramanian. R, Strength of Materials, Second Edition, Oxford University Press, 2010.

PART-B

COURSE DELIVERY PLAN (LESSON PLAN):

UNIT-I: SIMPLE STRESSES AND STRAINS

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 strength of material	1	12-09-22		TLM1	
2.	Properties of material, Stress	1	14-09-22		TLM1	
3.	Types of stresses strains	1	15-09-22		TLM1	
4.	Stress strain diagrams for ductile, brittle	1	17-09-22		TLM1	
5.	stepped bars, Bars of varying c/s	1	19-09-22		TLM1	
6.	Composite bar problems	1	21-09-22		TLM3	
7.	Volumetric Strain	1	22-09-22		TLM1	
8.	Thermal stresses	1	24-09-22		TLM1	
9.	strain energy due to axial force	1	26-09-22		TLM1	
10.	Strain energy problems	1	28-09-22		TLM3	
11.	stresses due to sudden loads and impact	1	29-09-22		TLM1	
12.	Relation between elastic Constants	1	01-10-22		TLM1	
No. of classes required to complete UNIT-I: 12				**No. of classes taken:**		

UNIT-II: SHEAR FORCE AND BENDING MOMENT

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
13.	Introduction to SF and BM	1	10-10-22		TLM1	
14.	Relationship B/W SF and B.M	1	12-10-22		TLM1	
15.	SFD & BMD for cantilever beam	1	13-10-22		TLM1	
16.	Cantilever beam problems	1	15-10-22		TLM1	
17.	UDL on cantilever beam problems	1	17-10-22		TLM1	
18.	SFD & BMD for S.S.B	1	19-10-22		TLM3	
19.	Combination of loads for cantilever	1	20-10-22		TLM1	
20.	Combination of loads for S.S.B	1	22-10-22		TLM1	
21.	Point of contra flexure	1	26-10-22		TLM1	
22.	Maximum Bending Moment	1	27-10-22		TLM1	
23.	SFD and BMD for Overhang beams	1	29-10-22		TLM1	
No. of classes required to complete UNIT-II: 11				**No. of classes taken:**		

UNIT-III: STRESSES IN BEAMS, TORSION

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.	Theory of simple bending	1	31-10-22		TLM1	
25.	Derivation of Flexural equation	1	02-11-22		TLM1	
26.	Section modulus of various cross section	1	03-11-22		TLM1	
27.	Flexural stresses	1	05-11-22		TLM1	
28.	Normal stresses due to flexure	1	14-11-22		TLM1	
29.	Bending stress problems	1	16-11-22		TLM3	
30.	Theory of pure torsion & Assumptions	1	17-11-22		TLM1	
31.	Derivation of Torsion equations	1	19-11-22		TLM1	
32.	Torsion problems	1	21-11-22		TLM1	
33.	Torsion problems-Solid and hollow	1	23-11-22		TLM3	
34.	Power transmitted by shaft	1	24-11-22		TLM1	
No. of classes required to complete UNIT-III: 12				**No. of classes taken:**		

UNIT-IV: SHEAR STRESSES, PRINCIPAL STRESSES

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
35.	Introduction to shear stress	1	26-11-22		TLM1	
36.	Shear stress distribution	1	28-11-22		TLM1	
37.	Shear stress distribution across I,T sections	1	30-11-22		TLM1	
38.	Shear stress distribution problems	1	01-12-22		TLM3	
39.	Principal Stresses	1	03-12-22		TLM1	
40.	Member Subjected to Direct Stresses	1	05-12-22		TLM1	
41.	Normal & Tangential stresses on inclined	1	07-12-22		TLM1	
42.	Stresses on inclined planes	1	08-12-22		TLM3	
43.	Failure Theories	1	12-12-22		TLM1	
No. of classes required to complete UNIT-IV: 11				**No. of classes taken:**		

UNIT-V: DEFLECTION OF BEAMS, CYLINDERS

S. No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
44.	Introduction to deflection of beams	1	14-12-22		TLM1	
45.	Differential equation of Elastic line	1	15-12-22		TLM1	
46.	Deflection in statically determinate beams	1	17-12-22		TLM1	
47.	Deflection of SSB beams	1	19-12-22		TLM1	
48.	Deflection of Cantilever beams	1	21-12-22		TLM1	
49.	Macaulay's Method for prismatic members	1	22-12-22		TLM1	
50.	Deflection of overhang beams	1	24-12-22		TLM1	
51.	Introduction- Thin, Thick cylindrical shell	1	26-12-22		TLM3	
52.	Hoop and longitudinal stresses thin cylin.	1	28-12-22		TLM1	
53.	Thick cylindrical shells	1	29-12-22		TLM1	
54.	Spherical shells changes in dimensions	1	31-12-22		TLM1	
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 Aerospace and Allied Engineering organizations

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

LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING

(AUTONOMOUS)

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L.B. REDDY NAGAR, MYLAVARAM, KRISHNA DIST., A.P.-521 230.

Phone: 08659-222933, Fax: 08659-222931

DEPARTMENT OF AEROSPACE ENGINEERING

TIME TABLE

Name of Course Instructor: Mr.I.Dakshina Murthy/Ms.M.Bhuvaneshwari

Course Name & Code : Engineering Fluid Mechanics Lab – 20AE51 **Regulation**: R20

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

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

DAY	1	2	3	4		5	6	7
	9.00 to 09.50	09.50 to 10.40	11.00 to 11.40	11.40 to 12.30		01.30 to 02.20	02.20 to 03.10	03.10 to 04.00
MON					LUNCH			
TUE						-------- EFM Lab (Batch A)-------		
WED								
THU		------- EFM Lab (Batch B)------						
FRI								
SAT								

LAB IN-CHARGE **HOD**

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Phone: 08659-222933, Fax: 08659-222931
DEPARTMENT OF AEROSPACE ENGINEERING

Experiment Schedule

Name of Course Instructor: Mr.I.Dakshina Murthy/Ms.M.Bhuvaneshwari
Course Name & Code : Engineering Fluid Mechanics Lab – 20AE51 **Regulation**: R20
L-T-P Structure : 0-0-3 **Credits:** 1.5
Program/Sem/Sec : B.Tech/III-SEM **A.Y.:** 2022-23

I Cycle Schedule (AD LAB): BATCH- A & B

S. No.	Batch 'A' Dates	Batch 'B' Dates	Exp. No.	Experiment Name
1	13/09/2022	15/09/2022	--	Introduction to the Lab
2	20/09/2022	22/09/2022	E1	Verification of Bernoulli's theorem
3	27/09/2022	29/09/2022	E2	Calibration of Venturi meter
4	11/10/2022	13/10/2022	E3	Calibration of orifice meter
5	18/10/2022	20/10/2022	E4	Determination of friction factor for a given pipeline
6	25/10/2022	27/10/2022	E5	Determination of co-efficient of discharge of rectangular notch
7	01/11/2022	03/11/2022	-	Repeat & Viva-voce

II Cycle Schedule (AD LAB): BATCH- A & B

S. No.	Batch 'A' Dates	Batch 'B' Dates	Exp. No.	Experiment Name
7	22/11/2022	17/11/2022	E6	Turbine flow meter
8	29/11/2022	24/11/2022	E7	Impact of jet on vanes
9	06/12/2022	01/12/2022	E8	Performance test on single stage centrifugal pump
10	13/12/2022	08/12/2022	E9	Performance test on Kaplan turbine
11	20/12/2022	15/12/2022	E10	Determination of co-efficient of discharge of given mouthpiece
12	27/12/2022	22/12/2022	---	Internal Exam

LAB IN-CHARGE **HOD**

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(AUTONOMOUS)
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L.B. REDDY NAGAR, MYLAVARAM, KRISHNA DIST., A.P.-521 230.
Phone: 08659-222933, Fax: 08659-222931
DEPARTMENT OF AEROSPACE ENGINEERING

Batch Division

Name of Course Instructor: Mr.I.Dakshina Murthy/Ms.M.Bhuvaneshwari
Course Name & Code : Engineering Fluid Mechanics Lab – 20AE51 **Regulation**: R20
L-T-P Structure : 0-0-3 **Credits:** 1.5
Program/Sem/Sec : B.Tech/III-SEM **A.Y.:** 2022-23

SECTION	ROLL NUMBERS	TOTAL NO OF STUDENTS
BATCH -A	20761A5628, 21761A5601 to 21761A5624	24
BATCH -B	21761A5625 to 21761A5648 & 21765A5604	25

BATCH:A	BATCH:B
A_1 ----20765A5628, 21761A5601, 02, 03, 04	B_1 ---- 21761A5625, 26, 27, 28, 29
A_2 -----21761A5605, 06, 07, 08, 09	B_2 ---- 21761A5630, 31, 32, 33, 34
A_3 -----21761A5611, 12, 13, 14, 15	B_3 ---- 21761A5635, 36, 37, 38, 39
A_4 ----- 21761A5616, 17, 18, 19, 20	B_4 ----21761A5640, 41, 42, 43, 44
A_5 ----- 21761A5621, 22, 23, 24	B_5 – 21761A5645, 46, 47, 48 & 21765A5604

LAB IN-CHARGE **HOD**

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DEPARTMENT OF AEROSPACE ENGINEERING

CYCLE SCHEDULE - BATCH -A

Name of Course Instructor: Mr.I.Dakshina Murthy/Ms.M.Bhuvaneshwari
Course Name & Code : Engineering Fluid Mechanics Lab – 20AE51 **Regulation**: R20
L-T-P Structure : 0-0-3 **Credits:** 1.5
Program/Sem/Sec : B.Tech/III-SEM **A.Y.:** 2022-23

I CYCLE SCHEDULE - BATCH -A

Scheduled Date	Actual Date/Exp. No	B-I	B-II	B-III	B-IV	B-V
13/09/2022		Introduction				
20/09/2022		E1	E2	E3	E4	E5
27/09/2022		E2	E3	E4	E5	E1
11/10/2022		E3	E4	E5	E1	E2
18/10/2022		E4	E5	E1	E2	E3
25/10/2022		E5	E1	E2	E3	E4

II CYCLE SCHEDULE- BATCH -A

Scheduled Date	Actual Date/Exp. No	B-I	B-II	B-III	B-IV	B-V
22/11/2022		E6	E7	E8	E9	E10
29/11/2022		E7	E8	E9	E10	E6
06/12/2022		E8	E9	E10	E6	E7
13/12/2022		E9	E10	E6	E7	E8
20/12/2022		E10	E6	E7	E8	E9

LAB IN-CHARGE **HOD**

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DEPARTMENT OF AEROSPACE ENGINEERING

CYCLE SCHEDULE - BATCH -B

Name of Course Instructor: Dr.P.Lovaraju/Mr.I.Dakshina Murthy

Course Name & Code : Aerodynamics Lab-20AE56 **Regulation**: R20

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

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

I CYCLE SCHEDULE - BATCH -B

Scheduled Date	Actual Date/Exp. No	B-I	B-II	B-III	B-IV	B-V
15/09/2022		Introduction				
22/09/2022		E1	E2	E3	E4	E5
29/09/2022		E2	E3	E4	E5	E1
13/10/2022		E3	E4	E5	E1	E2
20/10/2022		E4	E5	E1	E2	E3
27/10/2022		E5	E1	E2	E3	E4

II CYCLE SCHEDULE- BATCH -B

Scheduled Date	Actual Date/Exp. No	B-I	B-II	B-III	B-IV	B-V
17/11/2022		E6	E7	E8	E9	E10
24/11/2022		E7	E8	E9	E10	E6
01/12/2022		E8	E9	E10	E6	E7
08/12/2022		E9	E10	E6	E7	E8
15/12/2022		E10	E6	E7	E8	E9

LAB IN-CHARGE **HOD**

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DEPARTMENT OF AEROSPACE ENGINEERING

LIST OF EXPERIMENTS

Name of Course Instructor: Dr.P.Lovaraju/Mr.I.Dakshina Murthy

Course Name & Code : Aerodynamics Lab-20AE56 **Regulation**: R20

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

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

CYCLE I

1. Verification of Bernoulli's theorem
2. Calibration of Venturi meter
3. Calibration of orifice meter
4. Determination of friction factor for a given pipeline
5. Determination of co-efficient of discharge of rectangular notch

CYCLE II

1. Turbine flow meter
2. Impact of jet on vanes
3. Performance test on single stage centrifugal pump
4. Performance test on Kaplan turbine
5. Determination of co-efficient of discharge of given mouthpiece

LAB IN-CHARGE **HOD**

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DEPARTMENT OF AEROSPACE ENGINEERING

COURSE HANDOUT
PART - A

PROGRAM : **R20-**B.Tech., III-Sem., AE
ACADEMIC YEAR : 2021-22
COURSE NAME & CODE : Engineering Fluid Mechanics Laboratory – 20AE51
L-T-P STRUCTURE : 0-0-3
COURSE CREDITS : 1.5
COURSE INSTRUCTOR(S) : Mr.I Dakshina Murthy/Ms.M.Bhuvaneshwari

Course Educational Objectives:

Students will learn about the insights of calculating the discharge in various flow measuring devices, performance parameters of hydraulic machines.

Course Outcomes:

After completion of the course students will be able to:

CO1	Apply the principles Fluid mechanics in discharge measuring devices used in pipes channels and tanks (Apply-L3)
CO2	Analyse the performance of various hydraulic machines (Analyze-L4)

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

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	1	-	-	-	-	-	-	-	2	2	2
CO2	3	3	2	1	-	-	-	-	-	-	-	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).

PART - B
Detailed Schedule of Experiments
I CYCLE SCHEDULE - BATCH -A

Scheduled Date	A-I	A-II	A-III	A-IV	A-V
13/09/2022	Introduction				
20/09/2022	E1	E2	E3	E4	E5
27/09/2022	E2	E3	E4	E5	E1
11/10/2022	E3	E4	E5	E1	E2
18/10/2022	E4	E5	E1	E2	E3
25/10/2022	E5	E1	E2	E3	E4

II CYCLE SCHEDULE- BATCH -A

Scheduled Date	A-I	A-II	A-III	A-IV	A-V
22/11/2022	E6	E7	E8	E9	E10
29/11/2022	E7	E8	E9	E10	E6
06/12/2022	E8	E9	E10	E6	E7
13/12/2022	E9	E10	E6	E7	E8
20/12/2022	E10	E6	E7	E8	E9

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I CYCLE SCHEDULE - BATCH -B

Scheduled Date	B-I	B-II	B-III	B-IV	B-V
15/09/2022	Introduction				
22/09/2022	E1	E2	E3	E4	E5
29/09/2022	E2	E3	E4	E5	E1
13/10/2022	E3	E4	E5	E1	E2
20/10/2022	E4	E5	E1	E2	E3
27/10/2022	E5	E1	E2	E3	E4

II CYCLE SCHEDULE- BATCH -B

Scheduled Date	B-I	B-II	B-III	B-IV	B-V
17/11/2022	E6	E7	E8	E9	E10
24/11/2022	E7	E8	E9	E10	E6
01/12/2022	E8	E9	E10	E6	E7
08/12/2022	E9	E10	E6	E7	E8
15/12/2022	E10	E6	E7	E8	E9

BATCH:A	BATCH:B
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A_3 -----21761A5611, 12, 13, 14, 15	B_3 ---- 21761A5635, 36, 37, 38, 39
A_4 ----- 21761A5616, 17, 18, 19, 20	B_4 ----21761A5640, 41, 42, 43, 44
A_5 ----- 21761A5621, 22, 23, 24	B_5 – 21761A5645, 46, 47, 48 & 21765A5604

LIST OF EXPERIMENTS

CYCLE I

6. Verification of Bernoulli's theorem
7. Calibration of Venturi meter
8. Calibration of orifice meter
9. Determination of friction factor for a given pipeline
10. Determination of co-efficient of discharge of rectangular notch

CYCLE II

6. Turbine flow meter
7. Impact of jet on vanes
8. Performance test on single stage centrifugal pump
9. Performance test on Kaplan turbine
10. Determination of co-efficient of discharge of given mouthpiece

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DEPARTMENT OF AEROSPACE ENGINEERING

ACADEMIC CALENDAR:

Description	From	To	No. of Weeks
I Phase of Instructions-1	12-09-2022	05-11-2022	8
I Mid Examinations	07-11-2022	12-11-2022	1
II Phase of Instructions	14-11-2022	07-01-2022	8
II Mid Examinations	02-01-2022	07-01-2022	1
Preparation and Practical's	09-01-2022	14-01-2022	1
Semester End Examinations	16-01-2023	28-01-2023	2

PART – C

EVALUATION PROCESS:

Parameter	Marks
Day – to – Day Work	A1 = 5 Marks
Record	A2 = 5 Marks
Internal Test	B =5 Marks
Cumulative Internal Examination	**A1+ A2 + B = 15 Marks**
Semester End Examinations	**C = 35 Marks**
Total Marks: A1+ A2 + B + C	**50 Marks**

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

PROGRAMME SPECIFIC OUTCOMES (PSOs):

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

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