LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING
(AUTONOMOUS)
L.B.Reddy Nagar, Mylavaram – 521 230.Andhra Pradesh, INDIA
Affiliated to JNTUK, Kakinada & Approved by AICTE New Delhi
NAAC Accredited with 'A' Grade , An ISO 9001:2015 Certified Institution
DEPARTMENT OF AEROSPACE ENGINEERING
Website: http://lbrce.ac.in Email: hodaero@lbrce.ac.in Phone:08659-222933 Ext:513/515

COURSE HANDOUT

PART-A

Name of Course Instructor : Nazumuddin Shaik
Course Name & Code : **Aero Engine Repair & Maintenance- 17AE42**
L-T-P Structure : 3-0-0 Credits : 3
Program/Sem/Sec : B.Tech., VIII-Sem. A.Y: 2021-22

PRE-REQUISITE: Thermodynamics, Propulsion

COURSE EDUCATIONAL OBJECTIVES (CEOs): To learn the function of various components of piston engine and inspection, maintenance, troubleshooting of piston engine and overhauling procedures of piston engines, the function of jet engine components and overhauling procedures of Gas turbine components.

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

CO 1	Classify the piston engine components (Underastand-L2)
CO 2	Inspect and troubleshoot the piston engines components (Underastand-L2)
CO 3	Illustrate the piston engine testing procedures (Underastand-L2)
CO 4	Describe the inspection procedure of jet engine components (Underastand-L2)
CO 5	Prepare overhaul procedures for jet engine components (Understand-L2)

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

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

REFERENCE BOOKS:

R1 Kroes & Wild, Aircraft Power plants, 7th Edition – McGraw Hill, New York, 1994.
R2 Gas Turbine Engines, TURBOMECA, The English Book Store, New Delhi, 1993.
R3 Pratt & Whitney, The Aircraft Gas Turbine Engine and its Operation, (latest edition), The English Book Store, New Delhi, 1974.

PART-B

COURSE DELIVERY PLAN (LESSON PLAN):

UNIT-I: CLASSIFICATION OF PISTON ENGINE COMPONENTS

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to Course and COs and Unit-I	1	31-01-2022		**TLM1&2**	
2.	Types of Piston Engines	1	01-02-2022		**TLM1&2**	
3.	Piston Engines Principles of Operation	1	03-02-2022		**TLM1&2**	
4.	Piston Engines Function of Components	1	04-02-2022		**TLM1&2**	
5.	Piston Engines Materials Used	1	07-02-2022		**TLM1&2**	
6.	Details of Starting the Engines	1	08-02-2022		**TLM1&2**	
7.	Details of Carburetion and Injection Systems for	1	09-02-2022		**TLM1&2**	
8.	Details of Injection Systems	1	10-02-2022		**TLM1&2**	
9.	Details of Small and Large Engines	1	11-02-2022		**TLM1&2**	
10.	Ignition System Components	1	14-02-2022		**TLM1&2**	
11.	Spark Plug Details	1	15-02-2022		**TLM1&2**	
12.	Engine Operating Conditions at Various Altitudes	1	16-02-2022		**TLM1&2**	
13.	Maintenance and Inspection Check to be Carried Out.	1	17-02-2022		**TLM1&2**	
No. of classes required to complete UNIT-I: 14				No. of classes taken:		

UNIT-II: INSPECTIONS OF PISTON ENGINES

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to Unit-II	1	21-02-2022		**TLM1&2**	
2.	**Piston engines** inspection	1	22-02-2022		**TLM1&2**	
3.	**Piston engines** Maintenance	1	23-02-2022		**TLM1&2**	
4.	Trouble Shooting	1	24-02-2022		**TLM1&2**	
5.	Inspection of All Engine Components	1	25-02-2022		**TLM1&2**	
6.	Inspection of All Engine Components	1	28-02-2022		**TLM1&2**	
7.	Daily and Routine Checks	1	02-03-2022		**TLM1&2**	
8.	Overhaul Procedures	1	03-03-2022		**TLM1&2**	
9.	Compression Testing of Cylinders	1	04-03-2022		**TLM1&2**	
10.	Special Inspection Schedules	1	07-03-2022		**TLM1&2**	
11.	Engine Fuel, Control and Exhaust Systems	1	08-03-2022		**TLM1&2**	
12.	Control and Exhaust Systems	1	09-03-2022		**TLM1&2**	
13.	Engine Mount and Super Charger	1	10-03-2022		**TLM1&2**	
14.	Checks and Inspection Procedures.	1	11-03-2022		**TLM1&2**	
No. of classes required to complete UNIT-II:14				No. of classes taken:		

UNIT-III: OVERHAULING OF PISTON ENGINES

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to Unit-III	1	17-03-2022		**TLM1&2**	
2.	Symptoms of Failure	1	21-03-2022		**TLM1&2**	
3.	Fault Diagnostics	1	22-03-2022		**TLM1&2**	
4.	Case Studies of Different Engine Systems	1	23-03-2022		**TLM1&2**	
5.	Tools and Equipment Requirements for Various Checks and Alignment During Overhauling	1	24-03-2022		**TLM1&2**	
6.	Tools for Inspection	1	25-03-2022		**TLM1&2**	
7.	Tools for Safety and for Visual Inspection –	1	28-03-2022		**TLM1&2**	
8.	Methods and Instruments for Non-Destructive Testing Techniques	1	29-03-2022		**TLM1&2**	
9.	Non-Destructive Testing Techniques	1	30-03-2022		**TLM1&2**	
10.	Equipment for Replacement of Part and Their Repair. Engine Testing	1	31-03-2022		**TLM1&2**	
11.	Engine Testing Procedures and Schedule Preparation	1	04-04-2022		**TLM1&2**	
12.	Online Maintenance	1	05-04-2022		**TLM1&2**	
No. of classes required to complete UNIT-III:12				No. of classes taken:		

UNIT-IV : CLASSIFICATION OF JET ENGINE COMPONENTS

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to Unit-IV	1	06-04-2022		**TLM1&2**	
2.	Types of Jet Engines – Principles of Operation – Functions of Components – Materials Used	1	07-04-2022		**TLM1&2**	
3.	Details of Starting and Operating Procedures	1	08-04-2022		**TLM1&2**	
4.	Gas Turbine Engine Inspection & Checks – Use of Instruments for Online Maintenance –	1	11-04-2022		**TLM1&2**	
5.	Special Inspection Procedures: Foreign Object Damage – Blade Damage – Etc.	1	12-04-2022		**TLM1&2**	
6.	Maintenance Procedures of Gas Turbine Engines	1	13-04-2022		**TLM1&2**	
7.	Trouble Shooting and Rectification Procedures	1	18-04-2022		**TLM1&2**	
8.	Component Maintenance Procedures	1	19-04-2022		**TLM1&2**	
9.	Systems Maintenance Procedures. Gas Turbine Testing Procedures –Test Schedule Preparation	1	20-04-2022		**TLM1&2**	

10.	Storage of Engines – Preservation and De-Preservation Procedures	1	21-04-2022		**TLM1&2**	
No. of classes required to complete UNIT-IV:10				No. of classes taken:		

UNIT-V : OVERHAUL PROCEDURES

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to Unit-V	1	22-04-2022		**TLM1&2**	
2.	Engine Overhaul Procedures	1	25-04-2022		**TLM1&2**	
3.	Inspections and Cleaning of Components	1	26-04-2022		**TLM1&2**	
4.	Repairs Schedules for Overhaul	1	27-04-2022		**TLM1&2**	
5.	Balancing of Gas Turbine Components	1	28-04-2022		**TLM1&2**	
6.	Gas Turbine Trouble Shooting	1	29-04-2022		**TLM1&2**	
7.	Procedures for Rectification	1	02-05-2022		**TLM1&2**	
8.	Condition Monitoring of the Engine On Ground	1	04-05-2022		**TLM1&2**	
9.	Condition Monitoring of the Engine On at Altitude	1	05-05-2022		**TLM1&2**	
10.	Engine Health Monitoring and Corrective Methods.	1	06-05-2022		**TLM1&2**	
No. of classes required to complete UNIT-V:10				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
Mr. Nazumuddin Shaik	Dr. P. Lovaraju	Dr. P. Lovaraju

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

COURSE HANDOUT

Part-A

PROGRAM : B.Tech., VIII-Sem., Aerospace Engineering

ACADEMIC YEAR : 2021-22

COURSE NAME & CODE : Helicopter Engineering-17AE35

L-T-P STRUCTURE : 3-1-0

COURSE CREDITS : 3

COURSE INSTRUCTOR : **Ashutosh shukla**

COURSE COORDINATOR : **Ashutosh shukla**

PRE-REQUISITES : **Aerodynamics-I and Aerodynamics-II**

COURSE EDUCATIONAL OBJECTIVES (CEOs): The main objectives of this course are to learn about wind tunnels, different flow visualization methods, instrumentation for measuring fluid velocity, temperature and pressure. Also to learn about data acquisition and uncertainty analysis.

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

CO1 : To analyze the performance various components of helicopter

CO2 : To apply momentum theory in the design of propeller

CO3 : To analyze the performance of helicopter in various operating conditions

CO4 : To analyze the stability modes of helicopter

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

BOS APPROVED REFERENCE BOOKS:

1. E. Rathakrishnan., Helicopter Aerodynamics, PHI, 2018.
2. Gessow, A., Myers, Aerodynamics of Helicopter, G.C MacMillan & Co., N.Y. 1987.
3. B. W. McCormick, Aerodynamics of V/STOL Flight, Academic Press, 1987.
4. W. Johnson, Helicopter Theory, Princeton university Press, 1980.
5. B. W. McCormick, Aerodynamics, Aeronautics & Flight Mechanics, John Wiley, 1995.

Part-B

COURSE DELIVERY PLAN (LESSON PLAN): Section-A

UNIT-I: BASICS OF HELICOPTER CONFIGURATION

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	1-02-2022		**TLM1**	CO1	T1	
2.	Configurations of Helicopter	1	2-02-2022		**TLM1**	CO1	T1	
3.	Specifics of Helicopters	1	4-02-2022		**TLM1**	CO1	T1	
4.	Articulated Rotor Systems	1	7-02-2022		**TLM2**	CO1	T1	
5.	Effect of Cyclic Pitch Change	1	8-02-2022		**TLM1**	CO1	T1	
6.	Swash Plate	1	9-02-2022		**TLM1**	CO1	T1	
7.	Fully Articulated Rotor	1	11-02-2022		**TLM1**	CO1	R1 to R5	
8.	TUTORIAL-I	1	17-02-2022		**TLM3**	CO1	T1	
9.	Semi-Rigid rotor	1	18-02-2022		**TLM1**	CO1	T1	
10.	Rigid Rotor, Coriolis effect	1	22-02-2022		**TLM1**	CO1	R1 to R5	
11.	Objective-1 ,assignment1	1	23-02-2022		**TLM3**	CO1	T1	
No. of classes required to complete UNIT-I: 11					No. of classes taken:			

UNIT-II: MOMENTUM THEORY

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.	Thrust Generation	1	25-02-2022		**TLM1**	CO2	T1,R1 to R5	
2.	Hovering	1	28-02-2022		**TLM1**	CO2	T1	
3.	Figure of Merit	2	2-03-2022 3-03-2022		**TLM2**	CO2	T1	
4.	**Blade element**	1	04-03-2022		**TLM1**	CO2	R1 to R5	

5.	TUTORIAL-II	1	7-03-2022		**TLM3**	CO2	T1	
6.	Local Solidity, Top Loss	1	8-03-2022		**TLM1**	CO2	R1 to R5	
7.	Performance of ideally twisted Constant Chord B	1	9-03-2022		**TLM1**	CO2	T1	
8.	Rapid performance in Hover	1	10-03-2022		**TLM1**	CO2	R1 to R5	
9.	Equivalent Chord	1	11-3-2022		**TLM1**	CO2	T1	
10.	Assignment2,objective 2	1	11-03-2022		**TLM3**	CO2	R1 to R5	
No. of classes required to complete UNIT-II: 11					No. of classes taken:			

UNIT-III: PERFORMANCE IN HOVERING AND CLIMBING

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	21-03-2022		**TLM1**	CO3	T1,R1 to R5	
2.	Optimum Hovering	1	21-03-2022		**TLM1**	CO3	T1	
3.	Induced Torque	1	22-03-2022		**TLM3**	CO3	R1 to R5	
4.	Profile Drag Torque	1	23-03-2022		**TLM2**	CO3	T1	
5.	TUTORIAL-III	1	28-03-2022		**TLM3**	CO3	T1	
6.	Performance Equation	2	30-03-2022 31-03-2022		**TLM1**	CO3	T1	
7.	Optimum Rotor Design	1	1-04-2022,		**TLM1**	CO3	T1	
8.	Ground effect	1	4-04-2022		**TLM1**	CO3	T1	
9.	Objective-3 Assignment3	1	5-04-2022		**TLM3**	CO3	T1	
No. of classes required to complete UNIT-III: 12					No. of classes taken: 11			

UNIT-IV: PERFORMANCE IN HORIZONTAL FLIGHT

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	06-04-2022		**TLM1**	CO3	T1, R1 to R5	
2.	Flapping and lag Hinge	1	7-04-2022		**TLM2**	CO3	T1	
3.	Steady Hover, Equilibrium in Horizontal Blade	1	9-04-2022		**TLM3**	CO3	R1 to R5	
4.	Blade Hinge Motion	1	12-04-2022		**TLM1**	CO3	T1	
5.	TUTORIAL-IV	1	13-04-2022		**TLM3**	CO3	T1	
6.	Blade Element Angle of Attack - Flapping Coefficient	1	15-04-2022		**TLM1**	CO3	R1 to R5	
7.	Performance equation, Drag-Lift Ratio	1	19-04-2022		**TLM1**	CO3	T1	
8.	Profile Drag-Lift Ratio Charts	1	20-04-2022		**TLM1**	CO3	R1 to R5	
9.	Profile Power, Parasite Power	1	21-04-2022		**TLM1**	CO3	T1, T2	
10.	Blade Stall	1	26-04-2022		**TLM1**	CO3	T1	
11.	Objective-IV Assignment-IV	1	27-04-2022		**TLM3**	CO3	R1 to R5	
No. of classes required to complete UNIT-IV: 11					No. of classes taken:			

UNIT-V: STABILITY AND CONTROL

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	28-04-2022		**TLM1**	CO4	T1, R1 to R5	
2.	Trim - Static Stability	1	29-04-2022		**TLM1**	CO4	T1	
3.	Dynamic Stability	1	30-04-2022		**TLM3**	CO4	R1 to R5	

4.	Rotor Static Stability	1	02-5-2022		**TLM1**	CO4	T1	
5.	Stability in hover	1	03-05-2022		**TLM1**	CO4	T1	
6.	TUTORIAL-IV	1	04-05-2022		**TLM3**	CO4	R1 to R5	
7.	Dynamic Stability Reduction	1	05-5-2022		**TLM1**	CO4	T1	
8.	Stability in Forward Flight	1	06-5-2022		**TLM1**	CO4	R1 to R5	
9.	Objective-V Assignment-V	1	06-5-2022		**TLM2**	CO4	T1	
10.	**II Mid Examinations**	**3 days**						
No. of classes required to complete			UNIT-V: 12		No. of classes taken:			
Total number of classes			63					

CONTENTS BEYOND THE SYLLABUS:

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	Learning Outcome COs	Text Book followed	HOD Sign
1.	Advanced Topics in Unit I	1	16-07-2018		**TLM1**	CO1	T1, R1 to R5	
2.	Advanced Topics in Unit II	1	10-08-2018		**TLM1**	CO2		
3.	Advanced Topics in Unit III	1	07-09-2018		**TLM1**	CO3		
4.	Advanced Topics in Unit IV	1	28-09-2018		**TLM1**	CO4		
5.	Advanced Topics in Unit V	1	26-10-2018		**TLM1**	CO5		

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

ACADEMIC CALENDAR:

Description	From	To	Weeks
Commencement of Class Work: 11-06-2018			
I Phase of Instructions	**11-06-2018**	**11-08-2018**	9
I Mid Examinations	**13-08-2018**	**18-08-2018**	1
II Phase of Instructions	**20-08-2018**	**27-10-2018**	10
II Mid Examinations	**29-10-2018**	**03-11-2018**	1
Preparation and Practicals	**05-11-2018**	**17-11-2018**	2
Semester End Examinations	**19-11-2018**	**01-12-2018**	2

Part - C

EVALUATION PROCESS:

Evaluation Task	COs	Marks
Assignment/Quiz – 1	1	A1=05
Assignment/Quiz – 2	2	A2=05
I-Mid Examination	1,2	B1=20
I-Online Mid Examination	1,2	C1=10
Assignment/Quiz – 3	3	A3=05
Assignment/Quiz – 4	4	A4=05
Assignment/Quiz – 5	5	A5=05
II-Mid Examination	3,4,5	B2=20
II-Online Mid Examination	3,4,5	C2=10
Evaluation of Assignment/Quiz Marks: A=(A1+A2+A3+A4+A5)/5	1,2,3,4,5	**A=05**
Evaluation of Mid Marks: B=75% of Max(B1,B2)+25% of Min(B1,B2)	1,2,3,4,5	**B=20**
Evaluation of Online Mid Marks: C=75% of Max(C1,C2)+25% of Min(C1,	1,2,3,4,5	**C=10**
Attendance: D (≥95% =**5M**; 90%≤A<95%=**4M;** 85%≤A<90%=**3M;** 80%≤A<85%=**2M;** 75%≤A<80%=**1M; <75%=0M)**	-	**D=05**
Cumulative Internal Examination: A+B+C+D	**1,2,3,4,5**	**A+B+C+D=40**

Semester End Examinations: E	**1,2,3,4,5**	**E=60**
Total Marks: A+B+C+D+E	**1,2,3,4,5**	**100**

PROGRAMME OUTCOMES (POs):

Engineering Graduates will be able to:

PO1: To apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

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

PO3: To 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: To 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: To 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 limitations.

PO6: To 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: To understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

PO8: To apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice

PO9: To function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

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

PO11: To 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: To recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

PROGRAMME SPECIFIC OUTCOMES (PSOs):

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

PSO2: To prepare the students to work effectively in the defense and space researchprograms

Position	***Course Instructor***	***Course Coordinator***	***Module Coordinator***	***HOD***
Name				
Signature				

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

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

COURSE HANDOUT
PART-A

Name of Course Instructor : Mrs.K.S.L.LAVANYA
Course Name & Code : Renewable Energy Sources & 17EE83
L-T-P Structure : 3-0-0 Credits: 3
Program/Sem/Sec : B.Tech., Aerospace Engineering VII-Sem. A.Y: 2021-22

Pre-requisites : --NIL

Course Educational Objective: This course enables the student to

- Knowe the challenges and problems associated with the use of various energy sources,including fossil fuels,with regard to future supply and the environment.
- Familiarize renewable energy technologies.

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

CO 1	Compare the conventional and sustainable energy resources
CO 2	Illustrate the planning and operation of renewable energy systems.
CO 3	Analyze various factors for the erection of the wind power plant.

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
CO1	3		2	1	1		1		1	1		
CO2	2		3	1	1		1		1	1		
CO3			3		1							

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: Non- conventional Energy Sources / G.D. Rai ,Khanna Publishers,6th edition,2014

T2: Renewable Energy Resources-Twidell &Wier,CRC Press (Taylor & Francis),2015

REFERENCE BOOKS:

1.Renewable Energy Resources /Tiwari and Ghosal /. Narosa.2004.
2.Renewable Energy Technologies/Ramesh & Kumar/Narosa 1997
3.Non-Conventional Energy Systems/K Mittal /Wheeler,2003
4. Renewable Energy sources and emerging technologies by D.P.Kothari,K.C.Singhal,P.H.I

Part - B
COURSE DELIVERY PLAN (LESSON PLAN):

UNIT-I: PRINCIPLES OF SOLAR RADIATION

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	Learning outcome cos	Text book followed	HOD Sign Weekly
1.	Role and potential of new and renewable source,	1	14/2/22		TLM1	CO1	T1,T2	
2.	the solar energy option	1	15/2/22		TLM1	CO1	T1	
3.	Environmental impact of solar power	1	16/2/22		TLM1	CO1	T1	
4.	Physics of the sun, the solar constant	1	17/2/22		TLM1	CO1	T1	
5.	extraterrestrial and terrestrial solar radiation	1	18/2/22		TLM1 &TLM2	CO2	T1	
6.	Solar radiation on titled surface	1	21/2/22		TLM1 &TLM2	CO2	T2	
7.	Instruments for measuring solar radiation	1	22/2/22		TLM1& TLM2	CO2	T2	
8.	Instruments for measuring solar radiation	1	23/2/22		TLM1	CO2	T2	
9.	Sun shine,solar radiation data	1	24/2/22		TLM1	CO2	T2	
10.	Revision		25/2/22		TLM1			
No. of classes required to complete UNIT-I : 10							No. of classes taken:	

UNIT-II : SOLAR ENERGY COLLECTION, STORAGE AND APPLICATIONS

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
11.	Flat plate and concentrating collectors,	1	28-02-2022		TLM1	CO2	T1/R1	

12.	classification of concentrating collectors,	1	01-03-2022		TLM1	CO2	T1/T2	
13.	orientation and thermal analysis	1	02-03-2022		TLM2	CO2	R1	
14.	advanced collectors.	1	03-03-2022		TLM1/TLM2	CO2	T1/R1	
15.	Solar Energy Storage and Applications	1	04-03-2022		TLM1/TLM2	CO2	T1/R1	
16.	Different methods	1	07-03-2022		TLM1/TLM2	CO2	T1/R1	
17.	sensible, latent heat and stratified storage,	1	08-03-2022		TLM1/TLM2	CO2	T1/R1	
18.	solar ponds. Solar applications	1	09-03-2022		TLM1/TLM2	CO2	T1	
19.	solar heating, cooling techniques	1	10-03-2022		TLM1/TLM2	CO2	T1	
20.	solar distillation and drying,	1	11-03-2022		TLM1	CO2	T2	
21.	Photovoltaic energy conversion	1	17-03-2022		TLM2	CO2	T2	
No. of classes required to complete UNIT-II : 11							No. of classes taken: 10	

UNIT-III : WIND ENERGY

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
18	Sources and potentials	1	21-03-2022		TLM1/TLM2	CO3	T1	
19	horizontal windmills	1	22-03-2022		TLM1/TLM2	CO3	T2	
20	horizontal windmills	1	23-03-2022		TLM1/TLM2	CO3	T2	
21	vertical axis windmills	1	24-03-2022		TLM1/TLM2	CO3	T2	
22	vertical axis windmills	1	25-03-2022		TLM1/TLM2	CO3	T2	
23	performance characteristics	1	28-03-2022		TLM1/TLM2	CO3	T2	

24	performance characteristics	1	29-03-2022		TLM1/TLM2	CO3	T2	
25	Betz criteria	1	30-03-2022		TLM1/TLM2	CO3	T2	
	Revision	1	31-03-2022		TLM1	CO3	T2	
No. of classes required to complete UNIT-III : 09							No. of classes taken:	

UNIT-IV:

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	Learning Outcomecos	Text book followed	HOD Sign Weekly
26	Principles of Bio-Conversion,	1	01-04-2022		TLM1/TLM2	CO2	T1	
27	Anaerobic /aerobic digestion	1	04-04-2022		TLM1/TLM2	CO2	T1	
28	types of Bio-gas digesters	2	05-04-2022		TLM1/TLM2	CO2	T1/T2	
29	gas yield	1	06-04-2022		TLM1/TLM2	CO2	T1/T2	
30	combustion characteristics of bio-gas	1	07-04-2022		TLM1/TLM2	CO2	T1/T2	
31	utilization for cooking	2	08-04-2022		TLM1/TLM2	CO2	T1/T2	
32	l.C. Engine operation	1	11-04-2022		TLM1/TLM2	CO2	T1/T2	
33	economic aspects	1	12-04-2022		TLM1/TLM2	CO2	T1/T2	
	revision	1	13/04/2022			CO2	T2	
No. of classes required to complete UNIT-IV : 09							No. of classes taken:	

UNIT-V: REFRIGERATION AND AIR CONDITIONING

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

34	OTEC: Principles	1	18/4/2022		TLM1/TLM2	CO2	T1/R1	
35	utilization		19/4/2022		TLM1/TLM2	CO2	T2	
36	setting of OTEC plants,	1	20/4/2022		TLM1/TLM2	CO2	R1	
37	thermodynamic cycles	1	21/4/2022 & 22/04/2022		TLM1/TLM2	CO2	R1	
38	Tidal and Wave Energy	1	25/04/2022 & 26/04/2022		TLM1/TLM2	CO2	R1	
39	Potential and conversion techniques	1	27/04/2022 & 28/04/2022		TLM1/TLM2	CO2	T1	
40	mini-hydel power plants		29/4/2022		TLM1/TLM2	CO2	T1	
	Economics		2/05/2022		TLM1	CO2	T1	
No. of classes required to complete UNIT-V : 11							No. of classes taken:	

Contents beyond the Syllabus

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	Learning Outcome COs	Text Book followed	HOD Sign Weekly
1	Economic aspects in utilization of electrical energy	1	04/05/2022		TLM1/ TLM2	CO2	T2,R1,R2	

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	31-01-2022	12-03-2022	6W
I Mid Examinations	14-03-2022	16-03-2022	½ W
II Phase of Instructions	17-03-2022	04-05-2022	8W
II Mid Examinations	05-05-2022	07-05-2022	1W
Preparation and Practical	09-05-2022	11-05-2022	½ W
Semester End Examinations	12-05-2022	18-05-2022	1 W

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

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

PEO1: To provide students with a solid foundation in mathematical, scientific and engineering fundamentals required to solve engineering problems.

PEO2: To train students with good scientific and engineering breadth so as to analyze, design, and create novel products and solutions for the real life problems

PEO3: To prepare students to excel in competitive examinations, postgraduate programs, advanced education or to succeed in industry/technical profession

PEO4: To inculcate in students professional and ethical attitude, effective communication skills, teamwork skills, multidisciplinary approach, and an ability to relate engineering issues to broader social context

PEO5: To provide student with an academic environment with awareness of excellence, leadership, and the life-long learning needed for a successful professional career

Engineering Graduates will be able to:

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

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

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

4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
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PSO2: To prepare the students to work effectively in the defense and space research programs.

K.S.L.LAVANYA	K.S.L.LAVANYA	Dr.M.S.Giridhar	Dr.J.Siva vara prasad
Course Instructor	Course Coordinator	Module Coordinator	HOD