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

COURSE HANDOUT

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

ACADEMIC YEAR : 2018-19

COURSE NAME & CODE : FINITE ELEMENT METHOD - S 250

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

COURSE CREDITS : 3

COURSE INSTRUCTOR : B.SUDHEER KUMAR

COURSE COORDINATOR : B.SUDHEER KUMAR

PRE-REQUISITE: Mechanics of Materials, Machine Design, Numerical Methods & Heat Transfer

COURSE OBJECTIVE:

The main objective of this course is to introduce the mathematical concepts of the Finite Element Method for obtaining an approximate solution of ordinary and partial differential equations and to understand the use of the basic finite elements for structural applications using beam, plane elements and use of the FE method for heat transfer problems.

COURSE OUTCOMES (CO)

CO1: Identify mathematical model for solution of common engineering problems.
CO2: Solve the flexure elements subjected to loading and plane stress problems.
CO3: Solve the 2-D structures with isoparametric elements and axi-symmetric problem
CO4: Analyze complex cases involving heat transfer with the applications of fem
CO5: Formulate the finite element model for stepped bar & beam and perform the simulation

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	PSO 3
CO1	3	3	2	3		3					3	2			3
CO2	2	2	2	3	3	3					3	2			3
CO3	2	3	2	2	3	3					3	2			3
CO4	3	2	2	3		3					3	2			3
CO5	2	2	2	3	3	3					3	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 Chandraputla, Ashok and Belegundu, Introduction to Finite Elements in Engineering, 3rd edition,Prentice-Hall,2008

T2 S.S Rao, The Finite Element Methods in Engineering4th edition,B.H.Pergamon.2010

BOS APPROVED REFERENCE BOOKS:

R1 JN.Reddy, An introduction to Finite Element Method, 3rd edition, Mc Graw Hill, 2011.

R2 George R. Buchanan and R.RudraMoorthy, Finite Element Analysis, Tata Mc Graw Hill, 2006

COURSE DELIVERY PLAN (LESSON PLAN): Section-A

UNIT-I: ONE DIMENSIONAL PROBLEM

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 Finite Element Method	1	11-06-18		**TLM1, TLM2**	CO1	**T1**	
2.	Equilibrium equations in elasticity, Stresses in typical element	1	13-06-18		**TLM1,**	CO1	**T1**	
3.	Stresses and equilibrium	1	16-06-18		**TLM1**	CO1	**T1**	
4.	Strain displacement relations, Stress strain relations	1	18-06-18		**TLM1**	CO1	**T1**	
5.	Plane stress and plane strain problems	1	20-06-18		**TLM1**	CO1	**T1**	
6.	Potential energy and equilibrium method	1	22-06-18		**TLM1**	CO1	**T1**	
7.	FE Formulation from governing differential equations	1	23-06-18		**TLM1**	CO1	**T1**	
8.	Weighted residual methods	1	25-06-18		**TLM1**	CO1	**T1**	
9.	One dimensional problems, FE Modeling	1	27-06-18		**TLM1**	CO1	**T1**	
10.	**TUTORIAL-1**	1	29-06-18		**TLM1**	CO1	**T1**	
11.	Shape functions & coordinates of shape functions		30-06-18		**TLM1**	CO1	**T1**	
12.	Assembly of GSM & Load vector	1	02-07-18		**TLM1**	CO1	**T1**	
13.	Finite element equations and treatment of boundary conditions	1	04-07-18		**TLM1**	CO1	**T1**	
14.	Problems	1	06-07-18		**TLM1**	CO1	**T1, T2**	
15.	**TUTORIAL-2**	1	07-07-18		**TLM3**	CO1	**T1**	
16.	Assignment/Quiz-1	1	09-07-18		**TLM6**	CO1	**T1**	
No. of classes required to complete UNIT-I		16			No. of classes taken:			

UNIT-II: ANALYSIS OF BEAMS

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
17.	Analysis of Beams: Beam elements	1	11-07-18		**TLM1**	CO2	**T2**	
18.	Types loading ,DOF, Boundary conditions	1	13-07-18		**TLM1**	CO2	**T2**	
19.	Hermite shape functions	1	14-07-18		**TLM1**	CO2	**T2**	
20.	Stiffness matrix for two node DOF per node	1	16-07-18		**TLM1**	CO2	**T2**	
21.	**TUTORIAL-3**	1	18-07-18		**TLM3**	CO2	**T2**	
22.	Problems	1	20-07-18		**TLM4**	CO2	**T1, T2**	
23.	Two dimensional elements (CST),	1	21-07-18		**TLM1**	CO2	**T1, T2**	

	Boundary conditions							
24.	Jacobian, Shape functions, Area of triangles	1	23-07-18		**TLM1**	CO2	**T2**	
25.	Problems	1	25-07-18		**TLM4**	CO2	**T2**	
26.	**TUTORIAL-4**	1	27-07-18		**TLM4**	CO2	**T2**	
27.	Assignment/Quiz-2	1	28-07-18		**TLM6**	CO2	**T2**	
CRT CLASSES:30-07-2018 to 11-08-2018								
No. of classes required to complete UNIT-II		11			No. of classes taken:			

UNIT-III: AXISYMMETRIC LOADING AND NUMERICAL INTEGRATION

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
28.	Axisymmetric solids , Axisymmetric loading	1	20-08-18		**TLM1, TLM2**	CO3	**T2,R1**	
29.	Finite element modeling	1	24-08-18		**TLM1**	CO3	**T2,R1**	
30.	Axisymmetric loading with triangular elements	1	25-08-18		**TLM1**	CO3	**T2,R1**	
31.	Problems	1	27-08-18		**TLM4**	CO3	**T2,R1**	
32.	2-D four nodded isoparametric elements, Jacobian, shape functions,	1	29-08-18		**TLM1**	CO3	**T2,R1**	
33.	Problems	1	31-08-18		**TLM4**	CO3	**T2,R1**	
34.	**TUTORIAL-5**	1	1-09-18		**TLM3**	CO3	**T2,R1**	
35.	Isoparametric formulation of 4- node quadrilateral element	1	5-09-18		**TLM1**	CO3	**T2**	
36.	Numerical integration, Gauss Quadrature	1	7-09-18		**TLM1**	CO3	**T1, T2**	
37.	Problems	1	8-09-18		**TLM4**	CO3	**T2**	
38.	**TUTORIAL-6**	1	10-09-18		**TLM3**	CO3	**T2**	
39.	Assignment/Quiz-3	1	12-09-18		**TLM6**	CO3	**T1, T2**	
No. of classes required to complete UNIT-III		12			No. of classes taken:			

UNIT-IV: HEAT TRANSFER ANALYSIS

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
40.	One dimensional analysis of HT problems		15-09-18		**TLM1, TLM2**	CO4	**T1, T2**	
41.	Conductivity matrix, boundary conditions		17-09-18		**TLM1**	CO4		
42.	1-D analysis of a fin, Conductivity matrix boundary conditions, Problems	1	19-09-18		**TLM1**	CO4		
43.	**TUTORIAL-7**	1	21-09-18		**TLM3**	CO4	**T1, T2**	
44.	Problems	1	22-09-18		**TLM4**	CO4	**T1, T2**	

45.	Problems	1	24-09-18		**TLM4**	CO4	**T1, T2**	
46.	Two dimensional analysis of thin plate	1	26-09-18		**TLM1**	CO4	**T1, T2**	
47.	Conductivity matrix, boundary conditions	1	28-02-18		**TLM1**	CO4	**T1, T2**	
48.	Convection matrix, Heat rate vector	1	29-02-18		**TLM1**	CO4	**T1, T2**	
49.	**TUTORIAL-8**	1	01-10-18		**TLM3**	CO4	**T1, T2**	
50.	Assignment/Quiz-4	1	03-10-18		**TLM6**	CO4	**T1, T2**	
No. of classes required to complete UNIT-IV		11			No. of classes taken:			

UNIT-V: DYNAMIC ANALYSIS

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
51.	Dynamic analysis introduction, Formulation	1	05-10-18		**TLM1**	CO5	**T1, T2,R2**	
52.	Mass matrices, consistent Mass Matrices, Lumped Mass Matrices	1	06-10-18		**TLM1**	CO5		
53.	Evaluation of Eigen values &Eigenvectors	1	08-10-18		**TLM1**	CO5		
54.	**TUTORIAL-9**	1	10-10-18		**TLM3**	CO5	**T1, T2,R2**	
55.	Problems	1	11-10-18		**TLM4**	CO5	**T1, T2,R2**	
56.	**problems**	1	12-10-18		**TLM4**	CO5	**T1, T2,R2**	
57.	**TUTORIAL-10**	1	13-10-18		**TLM3**	CO5	**T1, T2**	
58.	Assignment/Quiz-5	1	15-10-18		**TLM6**	CO5	**T1, T2**	
59.	**CRT CLASSES:22-10-2018 to 27-10-2018**							
No. of classes required to complete UNIT-V		10			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
60.	Analysis of beams for Uniformly variable loads	1	16-10-18		**TLM1**	CO2	**T2,R2**	
61.	Evaluation of Eigen values &Eigenvectors for beams	1	16-10-18		**TLM1**	CO5	**T2, R2**	

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

ACADEMIC CALENDAR:

Description	From	To	Weeks
I Phase of Instructions-1	11-06-2018	11-08-2018	7W+2W(CRT)
I Mid Examinations	13-08-2018	18-08-2018	1W
II Phase of Instructions	20-08-2018	27-10-2018	9W+(1WCRT)
II Mid Examinations	29-10-2018	03-11-2018	1W
Preparation and Practicals	05-11-2018	17-11-2018	2W
Semester End Examinations	19-11-2018	01-12-2018	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
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**

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

PEO1: To build a professional career and pursue higher studies with sound knowledge in Mathematics, Science and Mechanical Engineering.
PEO2: To inculcate strong ethical values and leadership qualities for graduates to become successful in multidisciplinary activities.
PEO3: To develop inquisitiveness towards good communication and lifelong learning.

PROGRAMME OUTCOMES (POs):

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.

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

PSOs:

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

B.Sudheer Kumar	**B.Sudheer Kumar**	**Dr.Y.Appala Naidu**	**Dr.S.Pichi Reddy**
Course Instructor	**Course Coordinator**	**Module Coordinator**	**HOD**

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

COURSE HANDOUT

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

ACADEMIC YEAR : 2018-19

COURSE NAME & CODE : FINITE ELEMENT METHOD - S 250

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

COURSE CREDITS : 3

COURSE INSTRUCTOR : B.SUDHEER KUMAR

COURSE COORDINATOR : B.SUDHEER KUMAR

PRE-REQUISITE: Mechanics of Materials, Machine Design, Numerical Methods & Heat Transfer

COURSE OBJECTIVE:

The main objective of this course is to introduce the mathematical concepts of the Finite Element Method for obtaining an approximate solution of ordinary and partial differential equations and to understand the use of the basic finite elements for structural applications using beam, plane elements and use of the FE method for heat transfer problems.

COURSE OUTCOMES (CO)

CO1: Identify mathematical model for solution of common engineering problems.
CO2: Solve the flexure elements subjected to loading and plane stress problems.
CO3: Solve the 2-D structures with isoparametric elements and axi-symmetric problem
CO4: Analyze complex cases involving heat transfer with the applications of fem
CO5: Formulate the finite element model for stepped bar & beam and perform the simulation

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	PSO 3
CO1	3	3	2	3		3					3	2			3
CO2	2	2	2	3	3	3					3	2			3
CO3	2	3	2	2	3	3					3	2			3
CO4	3	2	2	3		3					3	2			3
CO5	2	2	2	3	3	3					3	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 Chandraputla, Ashok and Belegundu, Introduction to Finite Elements in Engineering, 3rd edition,Prentice-Hall,2008

T2 S.S Rao, The Finite Element Methods in Engineering4th edition,B.H.Pergamon.2010

BOS APPROVED REFERENCE BOOKS:

R1 JN.Reddy, An introduction to Finite Element Method, 3rd edition, Mc Graw Hill, 2011.

R2 George R. Buchanan and R.RudraMoorthy, Finite Element Analysis, Tata Mc Graw Hill, 2006

COURSE DELIVERY PLAN (LESSON PLAN): Section-B

UNIT-I: ONE DIMENSIONAL PROBLEM

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 Finite Element Method	1	11-06-18		**TLM1, TLM2**	CO1	**T1**	
2.	Equilibrium equations in elasticity, Stresses in typical element	1	12-06-18		**TLM1,**	CO1	**T1**	
3.	Stresses and equilibrium	1	14-06-18		**TLM1**	CO1	**T1**	
4.	Strain displacement relations, Stress strain relations	1	18-06-18		**TLM1**	CO1	**T1**	
5.	Plane stress and plane strain problems	1	19-06-18		**TLM1**	CO1	**T1**	
6.	Potential energy and equilibrium method	1	21-06-18		**TLM1**	CO1	**T1**	
7.	FE Formulation from governing differential equations	1	22-06-18		**TLM1**	CO1	**T1**	
8.	Weighted residual methods	1	25-06-18		**TLM1**	CO1	**T1**	
9.	One dimensional problems, FE Modeling	1	26-06-18		**TLM1**	CO1	**T1**	
10.	**TUTORIAL-1**	1	28-06-18		**TLM1**	CO1	**T1**	
11.	Shape functions & coordinates of shape functions	1	29-06-18		**TLM1**	CO1	**T1**	
12.	Assembly of GSM & Load vector	1	02-07-18		**TLM1**	CO1	**T1**	
13.	Finite element equations and treatment of boundary conditions	1	03-07-18		**TLM1**	CO1	**T1**	
14.	Problems	1	05-07-18		**TLM1**	CO1	**T1, T2**	
15.	**TUTORIAL-2**	1	06-07-18		**TLM3**	CO1	**T1**	
16.	Assignment/Quiz-1	1	09-07-18		**TLM6**	CO1	**T1**	
No. of classes required to complete UNIT-I		16			No. of classes taken:			

UNIT-II: ANALYSIS OF BEAMS

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
17.	Analysis of Beams: Beam elements	1	10-07-18		**TLM1**	CO2	**T2**	
18.	Types loading ,DOF, Boundary conditions	1	12-07-18		**TLM1**	CO2	**T2**	
19.	Hermite shape functions	1	13-07-18		**TLM1**	CO2	**T2**	
20.	Stiffness matrix for two node DOF per node	1	16-07-18		**TLM1**	CO2	**T2**	
21.	**TUTORIAL-3**	1	17-07-18		**TLM3**	CO2	**T2**	
22.	Problems	1	19-07-18		**TLM4**	CO2	**T1, T2**	
23.	Two dimensional elements (CST),	1	20-07-18		**TLM1**	CO2	**T1, T2**	

	Boundary conditions							
24.	Jacobian, Shape functions, Area of triangles	1	24-07-18		**TLM1**	CO2	**T2**	
25.	Problems	1	25-07-18		**TLM4**	CO2	**T2**	
26.	**TUTORIAL-4**	1	26-07-18		**TLM4**	CO2	**T2**	
27.	Assignment/Quiz-2	1	27-07-18		**TLM6**	CO2	**T2**	
CRT CLASSES:30-07-2018 to 11-08-2018								
No. of classes required to complete UNIT-II		11			No. of classes taken:			

UNIT-III: AXISYMMETRIC LOADING AND NUMERICAL INTEGRATION

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
28.	Axisymmetric solids , Axisymmetric loading	1	20-08-18		**TLM1, TLM2**	CO3	**T2,R1**	
29.	Finite element modeling	1	21-08-18		**TLM1**	CO3	**T2,R1**	
30.	Axisymmetric loading with triangular elements	1	23-08-18		**TLM1**	CO3	**T2,R1**	
31.	Problems	1	24-08-18		**TLM4**	CO3	**T2,R1**	
32.	2-D four nodded isoparametric elements, Jacobian, shape functions,	1	27-08-18		**TLM1**	CO3	**T2,R1**	
33.	Problems	1	28-08-18		**TLM4**	CO3	**T2,R1**	
34.	**TUTORIAL-5**	1	30-08-18		**TLM3**	CO3	**T2,R1**	
35.	Isoparametric formulation of 4- node quadrilateral element	1	31-08-18		**TLM1**	CO3	**T2**	
36.	Numerical integration, Gauss Quadrature	1	03-09-18		**TLM1**	CO3	**T1, T2**	
37.	Problems	1	04-09-18		**TLM4**	CO3	**T2**	
38.	**TUTORIAL-6**	1	06-09-18		**TLM3**	CO3	**T2**	
39.	Assignment/Quiz-3	1	07-09-18		**TLM6**	CO3	**T1, T2**	
No. of classes required to complete UNIT-III		12			No. of classes taken:			

UNIT-IV: HEAT TRANSFER ANALYSIS

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
40.	One dimensional analysis of HT problems	1	10-09-18		**TLM1, TLM2**	CO4	**T1, T2**	
41.	Conductivity matrix, boundary conditions	1	11-09-18		**TLM1**	CO4	**T1, T2**	
42.	1-D analysis of a fin, Conductivity matrix boundary conditions, Problems	1	14-09-18		**TLM1**	CO4	**T1, T2**	
43.	**TUTORIAL-7**	1	17-09-18		**TLM3**	CO4	**T1, T2**	
44.	Problems	1	18-09-18		**TLM4**	CO4	**T1, T2**	

45.	Problems	1	20-09-18		**TLM4**	CO4	**T1, T2**	
46.	Two dimensional analysis of thin plate	1	24-09-18		**TLM1**	CO4	**T1, T2**	
47.	Conductivity matrix, boundary conditions	1	25-09-18		**TLM1**	CO4	**T1, T2**	
48.	Convection matrix, Heat rate vector	1	27-09-18		**TLM1**	CO4	**T1, T2**	
49.	**TUTORIAL-8**	1	28-09-18		**TLM3**	CO4	**T1, T2**	
50.	Assignment/Quiz-4	1	01-10-18		**TLM6**	CO4	**T1, T2**	
No. of classes required to complete UNIT-IV		11			No. of classes taken:			

UNIT-V: DYNAMIC ANALYSIS

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
51.	Dynamic analysis introduction, Formulation	1	04-10-18		**TLM1**	CO5	**T1, T2,R2**	
52.	Mass matrices, consistent Mass Matrices, Lumped Mass Matrices	1	05-10-18		**TLM1**	CO5	**T1, T2,R2**	
53.	Evaluation of Eigen values &Eigenvectors	1	08-10-18		**TLM1**	CO5	**T1, T2,R2**	
54.	**TUTORIAL-9**	1	09-10-18		**TLM3**	CO5	**T1, T2,R2**	
55.	Problems	1	11-10-18		**TLM4**	CO5	**T1, T2,R2**	
56.	**problems**	1	12-10-18		**TLM4**	CO5	**T1, T2,R2**	
57.	**TUTORIAL-10**	1	15-10-18		**TLM3**	CO5	**T1, T2**	
58.	Assignment/Quiz-5	1	16-10-18		**TLM6**	CO5	**T1, T2**	
	CRT CLASSES:22-10-2018 to 27-10-2018							
No. of classes required to complete UNIT-V		10			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
59.	Analysis of beams for Uniformly variable loads	1	16-10-18		**TLM1**	CO2	**T2,R2**	
60.	Evaluation of Eigen values &Eigenvectors for beams	1	16-10-18		**TLM1**	CO5	**T2, R2**	

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

ACADEMIC CALENDAR:

Description	From	To	Weeks
I Phase of Instructions-1	11-06-2018	11-08-2018	7W+2W(CRT)
I Mid Examinations	13-08-2018	18-08-2018	1W
II Phase of Instructions	20-08-2018	27-10-2018	9W+(1WCRT)
II Mid Examinations	29-10-2018	03-11-2018	1W
Preparation and Practical's	05-11-2018	17-11-2018	2W
Semester End Examinations	19-11-2018	01-12-2018	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
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**

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

PEO1: To build a professional career and pursue higher studies with sound knowledge in Mathematics, Science and Mechanical Engineering.
PEO2: To inculcate strong ethical values and leadership qualities for graduates to become successful in multidisciplinary activities.
PEO3: To develop inquisitiveness towards good communication and lifelong learning.

PROGRAMME OUTCOMES (POs):

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.

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

PSOs:

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

B.Sudheer Kumar	**B.Sudheer Kumar**	**Dr.Y.Appala Naidu**	**Dr.S.Pichi Reddy**
Course Instructor	**Course Coordinator**	**Module Coordinator**	**HOD**

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

COURSE HANDOUT

PROGRAM : B.Tech, VII-Sem., MECHANICAL ENGINEERING

ACADEMIC YEAR : 2018-19

COURSE NAME & CODE : **CAD/CAM- S154 (SECTION-A)**

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

COURSE CREDITS : 3

COURSE INSTRUCTOR : **A NAGESWARA RAO**

COURSE COORDINATOR : **A NAGESWARA RAO**

PRE-REQUISITE: Machine Tools

COURSE OBJECTIVE: The objective of the course is to introduce the concepts of computers in design and manufacturing .Principles of Numerical control and part programming along with concepts of advanced manufacturing technologies will be discussed.

COURSE OUTCOMES (CO)

CO1: Apply CAD/CAM principles for geometric modelling, design and manufacturing

CO2: Generate codes for part profiles and can accomplish machining.

CO3: Codify the part using GT codes and can apply GT system in automated manufacturing firm

CO4: Be cognizant of CAQC techniques that are to be applied in manufacturing.

CO5: Comprehend the applications of Computer Integrated Manufacturing.

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

Course Code	COs	Programme Outcomes												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
T170	CO1	1			2									2		
	CO2	1	1	2	2	1							1	3		
	CO3	1	1	1		1							1	3		
	CO4		2		1									2		
	CO5	1				1								3		
1 = Slight (Low) 2 = Moderate (Medium) 3-Substantial(High)																

BOS APPROVED TEXT BOOKS:

T1 MikelP.Groover and Emory W.Zimmers, CAD/CAM-prentice Hall of India private
Ltd.New Delhi, 20thedition, May 2010.

T2 Ibrahim Zeid, Mastering CAD/CAM, TATA McGraw-Hill publishing Co.Ltd, New

T3 Delhi2011.
P N Rao, CAD/CAM Principle and applications, Tata McGraw Hill Education Private
Ltd,New Delhi,8th edition 2013.

BOS APPROVED REFERENCE BOOKS:

R1 P.Radhakrishnan, S.Subramanyam &V.Raju, CAD/CAM/CIM, New Age International
Publishers,3rd edition 2010.

R2 MikelP.Groover, Automaiton, Production Systems and Computer Integrated Manufacturing, Prentice Hall of India private Ltd.New Delhi, 3rd edition,

R3 May 2008.
Ibrahim Zeid and R. Sivasubramanian, CAD/CAM theory and practice, Tata McGraw
Hill publishing Co. Ltd,New Delhi 2009.

COURSE DELIVERY PLAN (LESSON PLAN): Section-A

UNIT-I

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
62.	Introduction to CAD/CAM	1	12-06-18		TLM2	CO1	T1	
63.	Computers in manufacturing	1	13-06-18		TLM2	CO1	T1	
64.	Product Cycle Revised with CAD/CAM	1	14-06-18		TLM1	CO1	T1	
65.	Application of computers to Design	1	16-06-18		TLM1	CO1	T1	
66.	Reasons for implementing CAD	1	19-06-18		TLM1	CO1	T1	
67.	Creating Manufacturing database	1	20-06-18		TLM1	CO1	T1	
68.	Benefits of CAD, **Tutorial-1**	1	21-06-18		TLM3	CO1	T1	
69.	Computer Graphics- Introduction , Database structure	1	23-06-18		TLM1	CO1	T1	
70.	Functions of a graphics package	1	26-06-18		TLM2	CO1	T1	
71.	Raster scan graphics	1	27-06-18		TLM1	CO1	T1	
72.	Concatenated transformations.	1	28-06-18		TLM1	CO1	T1	
73.	Translation, scaling, reflection,	1	30-06-18		TLM2	CO1	T1	

	rotation							
74.	Problems on Transformations	1	03-07-18		TLM1	CO1	T1	
75.	**Tutorial-2** /Assignment/Quiz	1	04-07-18		TLM3	CO1	T1	
No. of classes required to complete UNIT-I		14			No. of classes taken:			

UNIT-II

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	Learning Outcome COs	Text Book followed	HOD Sign Weekly
76.	Geometric Modelling: Introduction	1	05-07-18		TLM2	CO2	T2	
77.	Wireframe Modelling: Entities wireframe models	1	07-07-18		TLM1	CO2	T2	
78.	Parametric representation of analytical curves	1	10-07-18		TLM1	CO2	T2	
79.	**Tutorial-3**	1	11-07-18		TLM3	CO2	T2	
80.	Hermite cubic spline curve	1	12-07-18		TLM1	CO2	T2	
81.	Bezier and B-spline curves		14-07-18		TLM1	CO2	T2	
82.	Characteristics of Curves	1	17-07-18		TLM1	CO2	T2	
83.	Problems		18-07-18		TLM1	CO2	T2	
84.	Surface representation: Entities, models	1	19-07-18		TLM1	CO2	T2	
85.	Parametric representation of Bezier, B-Spline	1	21-07-18		TLM1	CO2	T2	
86.	Characteristics Bezier, B-Spline surfaces	1	24-07-18		TLM1	CO2	T2	
87.	Solid modelling	1	25-07-18		TLM1	CO2	T2	
88.	B-Rep	1	26-07-18		TLM1	CO2	T2	
89.	CSG	1	28-07-18		TLM1	CO2	T2	
90.	**Tutorial-4/** Assignment/Quiz	1	31-07-18		TLM3	CO2	T2	
No. of classes required to complete UNIT-II		15			No. of classes taken:			

UNIT-III

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	Learning Outcome COs	Text Book followed	HOD Sign Weekly
91.	Numerical control: Introduction, NC Modes	1	21-08-18		TLM1	CO3	T3	
92.	NC elements, N C Coordinate systems	1	22-08-18		TLM1	CO3	T3	

93.	Structure of CNC machine tools	1	23-08-18		TLM1	CO3	T3	
94.	Spindle design and spindle drives,	1	25-08-18		TLM1	CO3	T3	
95.	**Tutorial-5**	1	28-08-18		TLM3	CO3	T3	
96.	Feed drives, actuation systems	1	29-08-18		TLM1	CO3	T3	
97.	CNC Part programming: fundamentals	1	30-08-18		TLM1	CO3	T3	
98.	Manual part programming	1	01-09-18		TLM1	CO3	T3	
99.	Computer Aided part programming	1	04-09-18		TLM2	CO3	T3	
100.	Part programming examples	1	05-09-18		TLM1	CO3	T3	
101.	examples	1	06-09-18		TLM1	CO3	T3	
102.	examples	1	08-09-18		TLM1	CO3	T3	
103.	**Tutorial-6/** Assignment/Quiz-3	1	11-09-18		TLM3	CO3	T3	
No. of classes required to complete UNIT-III		13			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 Outcome COs	Text Book followed	HOD Sign Weekly
104.	Group Technology	1	12-09-18		TLM1	CO4	T3	
105.	Coding and classification schemes-OPITZ	1	13-09-18		TLM1	CO4	T3	
106.	MICLASS, example for coding	1	15-09-18		TLM1	CO4	T3	
107.	CODE Systems, examples for coding	1	18-09-18		TLM1	CO4	T3	
108.	Production Flow Analysis, Advantages and limitations, GT Machine cells, Benefits of GT	1	19-09-18		TLM1	CO4	T3	
109.	**Tutorial-7**	1	20-09-18		TLM3	CO4	T3	
110.	CAPP- Retrieval and Generative	1	22-09-18		TLM1	CO4	T3	
111.	Flexible Manufacturing System: Introduction,	1	25-09-18		TLM1	CO4	T3	
112.	FMS equipment, FMS layouts, benefits	1	26-09-18		TLM1	CO4	T3	
113.	FMS Planning and implementation,	1	27-09-18		TLM1	CO4	T3	
114.	**Tutorial-8,**Assignment/Quiz-4	1	29-09-18		TLM3	CO4	T3	
No. of classes required to complete UNIT-IV		11			No. of classes taken:			

UNIT-V:

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
115.	CAQC: Introduction, The computers in QC	1	02-10-18		TLM1	CO5	T3	
116.	Contact inspection methods	1	03-10-18		TLM1	CO5	T3	

117.	Non-Contact inspection methods: Optical	1	04-10-18		TLM1	CO5	T3	
118.	Non-Contact inspection methods: non optical	2	06-10-18		TLM1	CO5	T3	
119.	Computer aided testing, CAQC with CAD/CAM	1	09-10-18		TLM1	CO5	T3	
120.	**Tutorial-9**	1	10-10-18		TLM3	CO5	T3	
121.	CIM Introduction	1	11-10-18		TLM1	CO5	T3	
122.	CIM integration, Implementation	1	13-10-18		TLM1	CO5	T3	
123.	Benefits of CIM	1	16-10-18		TLM1	CO5	T3	
124.	Lean manufacturing	1	17-10-18		TLM1	CO5	T3	
125.	**Tutorial-10** Assignment/Quiz-5	1	18-10-18		TLM3	CO5	T3	
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
126.	CAD/CAM latest advancements	1	20-10-18		TLM1		R1	
127.	Mechanical softwares	1	23-10-18		TLM1		R1	
128.	Simulation advantage	1	24-10-18		TLM1		R1	

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

ACADEMIC CALENDAR:

Description	From	To	Weeks
I Phase of Instructions +CRT	11-06-2018	27-01-2017	7+2
I Mid Examinations	13-08-2018	18-08-2018	1
II Phase of Instructions +CRT	20-08-2018	27-10-2018	9+1
II Mid Examinations	29-10-2018	03-11-2018	1
Preparation and Practical's	05-11-2018	17-11-2018	2
Semester End Examinations	19-11-2018	01-12-2018	2

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**

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

PEO1: To build a professional career and pursue higher studies with sound knowledge in
Mathematics, Sciences and Mechanical Engineering
PEO2: To inculcate strong ethical values and leadership qualities for graduates to become
Successful in multidisciplinary activities
PEO3: To develop inquisitiveness towards good communication and lifelong learning

PROGRAM OUTCOMES (POs):

a. An ability to apply knowledge of Mathematics, Sciences and Engineering fundamentals to find the solution to real time Mechanical Engineering problems.
b. An ability to identify and formulate mathematical models to analyze complex engineering problems.
c. An ability to design a mechanical systems/ processes to meet the desired needs within realistic constraints such as economic, environmental, societal, health & safety .
d. An ability to design and conduct experiments, perform analysis, interpretation of data and synthesis of information to provide valid conclusions.
e. An ability to develop the model and analyze the Mechanical systems using modern software tools.
f. An ability to understand societal, health, safety, legal, cultural issues and the consequent responsibilities relevant to engineering practice.
g. An ability to understand the impact of engineering solutions in societal, environmental context and demonstrate the knowledge for sustainable development.
h. An ability to understand the professional ethics to follow the norms of engineering practice.
i. An ability to function effectively as an individual and as a member / leader in diverse technical teams.
j. An ability to communicate effectively with the engineering community and society through reports & presentations.
k. An ability to apply management principles to organise the multidisciplinary projects.
l. An ability to understand the need of independent and lifelong learning so as to address day to day technological changes.

Programme Specific Outcomes (PSOs):

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

Course Instructor	Course Coordinator	Module Coordinator	HOD
A NAGESWARA RAO	A NAGESWARA RAO	J SUBBAREDDY	Dr S PICHI REDDY

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

COURSE HANDOUT

PROGRAM : B.Tech, VII-Sem., MECHANICAL ENGINEERING

ACADEMIC YEAR : 2018-19

COURSE NAME & CODE : **CAD/CAM- S154 (SECTION-B)**

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

COURSE CREDITS : 3

COURSE INSTRUCTOR : **A NAGESWARA RAO**

COURSE COORDINATOR : **A NAGESWARA RAO**

PRE-REQUISITE: Machine Tools

COURSE OBJECTIVE: The objective of the course is to introduce the concepts of computers in design and manufacturing .Principles of Numerical control and part programming along with concepts of advanced manufacturing technologies will be discussed.

COURSE OUTCOMES (CO)

CO1: Apply CAD/CAM principles for geometric modelling, design and manufacturing

CO2: Generate codes for part profiles and can accomplish machining.

CO3: Codify the part using GT codes and can apply GT system in automated manufacturing firm

CO4: Be cognizant of CAQC techniques that are to be applied in manufacturing.

CO5: Comprehend the applications of Computer Integrated Manufacturing.

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

Course Code	COs	Programme Outcomes												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
T170	CO1	1			2									2		
	CO2	1	1	2	2	1							1	3		
	CO3	1	1	1		1							1	3		
	CO4		2		1									2		
	CO5	1				1								3		
1 = Slight (Low) 2 = Moderate (Medium) 3-Substantial(High)																

BOS APPROVED TEXT BOOKS:

T1 MikelP.Groover and Emory W.Zimmers, CAD/CAM-prentice Hall of India private Ltd.New Delhi, 20thedition, May 2010.

T2 Ibrahim Zeid, Mastering CAD/CAM, TATA McGraw-Hill publishing Co.Ltd, New

T3 Delhi2011.

P N Rao, CAD/CAM Principle and applications, Tata McGraw Hill Education Private Ltd,New Delhi,8th edition 2013.

BOS APPROVED REFERENCE BOOKS:

R1 P.Radhakrishnan, S.Subramanyam &V.Raju, CAD/CAM/CIM, New Age International Publishers,3rd edition 2010.

R2 MikelP.Groover, Automaiton, Production Systems and Computer Integrated Manufacturing, Prentice Hall of India private Ltd.New Delhi, 3rd edition,

R3 May 2008.

Ibrahim Zeid and R. Sivasubramanian, CAD/CAM theory and practice, Tata McGraw Hill publishing Co. Ltd,New Delhi 2009.

COURSE DELIVERY PLAN (LESSON PLAN): Section-B

UNIT-I

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
129.	Introduction to CAD/CAM	1	11-06-18		TLM2	CO1	T1	
130.	Computers in manufacturing	1	13-06-18		TLM2	CO1	T1	
131.	Product Cycle Revised with CAD/CAM	1	15-06-18		TLM1	CO1	T1	
132.	Application of computers to Design	1	16-06-18		TLM1	CO1	T1	
133.	Reasons for implementing CAD	1	18-06-18		TLM1	CO1	T1	
134.	Creating Manufacturing database	1	20-06-18		TLM1	CO1	T1	
135.	Benefits of CAD, **Tutorial-1**	1	22-06-18		TLM3	CO1	T1	
136.	Computer Graphics- Introduction , Database structure	1	23-06-18		TLM1	CO1	T1	
137.	Functions of a graphics package	1	25-06-18		TLM2	CO1	T1	
138.	Raster scan graphics	1	27-06-18		TLM1	CO1	T1	
139.	Concatenated transformations.	1	29-06-18		TLM1	CO1	T1	
140.	Translation, scaling, reflection, rotation	1	30-06-18		TLM2	CO1	T1	
141.	Problems on Transformations	1	02-07-18		TLM1	CO1	T1	
142.	**Tutorial-2** /Assignment/Quiz	1	04-07-18		TLM3	CO1	T1	
No. of classes required to complete UNIT-I		14			No. of classes taken:			

UNIT-II

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	Learning Outcome COs	Text Book followed	HOD Sign Weekly
143.	Geometric Modelling: Introduction	1	06-07-18		TLM2	CO2	T2	
144.	Wireframe Modelling: Entities wireframe models	1	07-07-18		TLM1	CO2	T2	
145.	Parametric representation of analytical curves	1	09-07-18		TLM1	CO2	T2	
146.	**Tutorial-3**	1	11-07-18		TLM3	CO2	T2	
147.	Hermite cubic spline curve	1	13-07-18		TLM1	CO2	T2	
148.	Bezier and B-spline curves		14-07-18		TLM1	CO2	T2	
149.	Characteristics of Curves	1	16-07-18		TLM1	CO2	T2	
150.	Problems		18-07-18		TLM1	CO2	T2	

151.	Surface representation: Entities, models	1	20-07-18		TLM1	CO2	T2	
152.	Parametric representation of Bezier, B-Spline	1	21-07-18		TLM1	CO2	T2	
153.	Characteristics Bezier, B-Spline surfaces	1	23-07-18		TLM1	CO2	T2	
154.	Solid modelling	1	25-07-18		TLM1	CO2	T2	
155.	B-Rep	1	27-07-18		TLM1	CO2	T2	
156.	CSG	1	28-07-18		TLM1	CO2	T2	
157.	**Tutorial-4/** Assignment/Quiz	1	30-07-18		TLM3	CO2	T2	
No. of classes required to complete UNIT-II		15			No. of classes taken:			

UNIT-III

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	Learning Outcome COs	Text Book followed	HOD Sign Weekly
158.	Numerical control: Introduction, NC Modes	1	20-08-18		TLM1	CO3	T3	
159.	NC elements, N C Coordinate systems	1	22-08-18		TLM1	CO3	T3	
160.	Structure of CNC machine tools	1	24-08-18		TLM1	CO3	T3	
161.	Spindle design and spindle drives,	1	25-08-18		TLM1	CO3	T3	
162.	**Tutorial-5**	1	27-08-18		TLM3	CO3	T3	
163.	Feed drives, actuation systems	1	29-08-18		TLM1	CO3	T3	
164.	CNC Part programming: fundamentals	1	31-08-18		TLM1	CO3	T3	
165.	Manual part programming	1	01-09-18		TLM1	CO3	T3	
166.	Computer Aided part programming	1	03-09-18		TLM2	CO3	T3	
167.	Part programming examples	1	05-09-18		TLM1	CO3	T3	
168.	examples	1	07-09-18		TLM1	CO3	T3	
169.	examples	1	08-09-18		TLM1	CO3	T3	
170.	**Tutorial-6/** Assignment/Quiz-3	1	10-09-18		TLM3	CO3	T3	
No. of classes required to complete UNIT-III		13			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 Outcome COs	Text Book followed	HOD Sign Weekly
171.	Group Technology	1	12-09-18		TLM1	CO4	T3	
172.	Coding and classification schemes-OPITZ	1	14-09-18		TLM1	CO4	T3	
173.	MICLASS, example for coding	1	15-09-18		TLM1	CO4	T3	
174.	CODE Systems, examples for coding	1	17-09-18		TLM1	CO4	T3	
175.	Production Flow Analysis, Advantages	1	19-09-18		TLM1	CO4	T3	

	and limitations, GT Machine cells, Benefits of GT							
176.	**Tutorial-7**	1	21-09-18		TLM3	CO4	T3	
177.	CAPP- Retrieval and Generative	1	22-09-18		TLM1	CO4	T3	
178.	Flexible Manufacturing System: Introduction,	1	24-09-18		TLM1	CO4	T3	
179.	FMS equipment, FMS layouts, benefits	1	26-09-18		TLM1	CO4	T3	
180.	FMS Planning and implementation,	1	28-09-18		TLM1	CO4	T3	
181.	**Tutorial-8,**Assignment/Quiz-4	1	29-09-18		TLM3	CO4	T3	
No. of classes required to complete UNIT-IV		11			No. of classes taken:			

UNIT-V:

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
182.	CAQC: Introduction, The computers in QC	1	01-10-18		TLM1	CO5	T3	
183.	Contact inspection methods	1	03-10-18		TLM1	CO5	T3	
184.	Non-Contact inspection methods: Optical	1	05-10-18		TLM1	CO5	T3	
185.	Non-Contact inspection methods: non optical	2	06-10-18		TLM1	CO5	T3	
186.	Computer aided testing, CAQC with CAD/CAM	1	08-10-18		TLM1	CO5	T3	
187.	**Tutorial-9**	1	10-10-18		TLM3	CO5	T3	
188.	CIM Introduction	1	12-10-18		TLM1	CO5	T3	
189.	CIM integration, Implementation	1	13-10-18		TLM1	CO5	T3	
190.	Benefits of CIM	1	15-10-18		TLM1	CO5	T3	
191.	Lean manufacturing	1	17-10-18		TLM1	CO5	T3	
192.	**Tutorial-10** Assignment/Quiz-5	1	19-10-18		TLM3	CO5	T3	
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
193.	CAD/CAM latest advancements	1	20-10-18		TLM1		R1	
194.	Mechanical softwares	1	22-10-18		TLM1		R1	
195.	Simulation advantage	1	24-10-18		TLM1		R1	

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

ACADEMIC CALENDAR:

Description	From	To	Weeks
I Phase of Instructions +CRT	11-06-2018	27-01-2017	7+2
I Mid Examinations	13-08-2018	18-08-2018	1
II Phase of Instructions +CRT	20-08-2018	27-10-2018	9+1
II Mid Examinations	29-10-2018	03-11-2018	1
Preparation and Practical's	05-11-2018	17-11-2018	2
Semester End Examinations	19-11-2018	01-12-2018	2

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**

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

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

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

PEO3: To develop inquisitiveness towards good communication and lifelong learning

PROGRAM OUTCOMES (POs):

a. An ability to apply knowledge of Mathematics, Sciences and Engineering fundamentals to find the solution to real time Mechanical Engineering problems.

b. An ability to identify and formulate mathematical models to analyze complex engineering problems.

c. An ability to design a mechanical systems/ processes to meet the desired needs within realistic constraints such as economic, environmental, societal, health & safety .

d. An ability to design and conduct experiments, perform analysis, interpretation of data and synthesis of information to provide valid conclusions.

e. An ability to develop the model and analyze the Mechanical systems using modern software tools.

f. An ability to understand societal, health, safety, legal, cultural issues and the consequent responsibilities relevant to engineering practice.
g. An ability to understand the impact of engineering solutions in societal, environmental context and demonstrate the knowledge for sustainable development.
h. An ability to understand the professional ethics to follow the norms of engineering practice.
i. An ability to function effectively as an individual and as a member / leader in diverse technical teams.
j. An ability to communicate effectively with the engineering community and society through reports & presentations.
k. An ability to apply management principles to organise the multidisciplinary projects.
l. An ability to understand the need of independent and lifelong learning so as to address day to day technological changes.

Programme Specific Outcomes (PSOs):

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

Course Instructor	Course Coordinator	Module Coordinator	HOD
A NAGESWARA RAO	A NAGESWARA RAO	J SUBBAREDDY	Dr S PICHI REDDY

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

COURSE HANDOUT

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

ACADEMIC YEAR : 2018-19

COURSE NAME & CODE : Refrigeration and Air-Conditioning - S 367

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

COURSE CREDITS : 3

COURSE INSTRUCTOR : **Mr. V. DHANA RAJU**

COURSE COORDINATOR : **Mr. V. DHANA RAJU**

PRE-REQUISITE: Thermodynamics

COURSE OBJECTIVE: In a broader way, this course provides the simple understanding of refrigeration and air conditioning fundamentals. First, it covers the different refrigeration cycles and its analysis. Then the concepts of psychrometry and psychrometry processes used for air conditioning are imparted. Finally, the concepts of comfort air conditioning, cooling load design and its estimation are addressed.

COURSE OUTCOMES (CO)

CO1: Describe the basic concepts of refrigeration and its applications.
CO2: Evaluate the performance parameters of refrigeration systems.
CO3: Identify the desirable refrigerants and its use in various refrigeration systems.
CO4: Analyze the psychrometric properties and processes used in Air Conditioning systems.
CO5: Design of Air Conditioning systems for thermal comfort conditions.

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	PSO 3
CO1	2	2	2	1		2	2					1	3		
CO2	3	3	3	1		2	2					1	3		
CO3	2	2	2	2		3	3					2	2		
CO4	3	3	2	2		2	2					2	2		
CO5	3	3	3	2		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:

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T2 R. Dossat, Principles of Refrigeration - - Pearson 4th Edition 2001.

BOS APPROVED REFERENCE BOOKS:

R1 S. C. Arora, Domkundwar, A course in refrigeration and air conditioning-Dhanapat Rai& sons 5th Edition 1997.

R2 Wilbert F.Stoecker, Jerold W. J.Jones, MGH, 1986.

R3 Manohar Prasad, Refrigeration and Air conditioning, New Age international, 2003

COURSE DELIVERY PLAN (LESSON PLAN): Section-A

UNIT-I FUNDAMENTALS OF REFRIGERATION

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
196.	**Introduction:** Refrigeration, Applications of refrigeration	1	11-06-2018		**TLM1**	CO1	**T1**	
197.	Unit of refrigeration and COP	1	13-06-2018		**TLM1**	CO1	**T1**	
198.	Heat Engine, Refrigerator and Heat pump	1	14-06-2018		**TLM1**	CO1	**T1**	
199.	Types of Refrigeration systems, Problems on refrigeration basics	1	15-06-2018		**TLM1, TLM4**	CO2	**T1**	
200.	**CRT Training-18-06-2018 to 30-06-2018**							
201.	**TUTORIAL-01**	1	02-07-2018		**TLM3**	CO1	**T1**	
202.	**Refrigerant:**	1	04-07-2018		**TLM2**	CO3	**T1/ R1**	

	Desirable characteristics of ideal refrigerant							
203.	Classification of refrigerants- Desirable Properties-Nomenclature, Refrigerant Designation	1	05-07-2018		**TLM 1, TLM 4**	CO3	**T1**	
204.	Commonly used refrigerants, Alternate refrigerants,	1	06-07-2018		**TLM 1**	CO3	**T1**	
205.	Green House effect& Global	1	09-07-2018		**TLM 7**	CO3	**T1**	
206.	**Air refrigeration system**: working on Reversed Carnot cycle	1	10-07-2018		**TLM 1**	CO1	**T1**	
207.	Air refrigeration system working on Bell Coleman cycle	1	11-07-2018		**TLM 1**	CO1	**T1**	
208.	COP- Open and Dense air systems Problems	1	12-07-2018		**TLM 1 TLM 4**	CO2	**T1**	
209.	Solving Problems	1	13-07-2018		**TLM 4**	CO2	**T1**	
210.	**TUTORIAL-02** Assignment-I/Quiz-I	1	16-07-2018		**TLM 3, TLM 6**	CO2	**T1**	
No. of classes required to complete UNIT-I = 14			No. of classes taken:					

UNIT-II VAPOUR COMPRESSION REFRIGERATION SYSTEM & COMPONENTS -11

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
211.	**Introduction to VCR system:** Essential components of the VCR plant	1	18-07-2018		**TLM 1**	CO1	**T2**	
212.	Simple vapour compression refrigeration cycle, COP	1	19-07-2018		**TLM 1**	CO1	**T2**	
213.	Representation of cycle on T-S and p-h Charts	1	20-07-2018		**TLM 1, TLM 2**	CO1	**T2**	
214.	Effect of sub cooling and superheating	1	23-07-2018		**TLM 1**	CO1	**R1**	
215.	Solving Problems	1	25-07-2018		**TLM 4**	CO2	**R1**	
216.	**TUTORIAL-03**	1	26-07-2018		**TLM 3**	CO2	**T2**	
217.	**VCR-System Components**: Compressors -Classification-Working Principles	1	27-07-2018		**TLM 2, TLM8**	CO1	**T2**	
218.	Condensers – Classification-working principle	1	30-07-2018		**TLM 2, TLM8**	CO1	**T2**	
219.	Evaporators-Classification-working principle	1	01-08-2018		**TLM 2, TLM8**	CO1	**T2**	
220.	Expansion valve – Classification-working principle-	1	02-08-2018		**TLM 2, TLM8**	CO1	**T2**	
221.	Advantages and disadvantages Assignment-2/Quiz-2	1	03-08-2018		**TLM 1, TLM 6**	CO1	**T2**	
No. of classes required to complete UNIT-II = 11			No. of classes taken:					

UNIT-III VAPOUR ABSORPTION, STEAM JET & NON-CONVENTIONAL REFRIGERATION SYSTEM -12

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
222.	**Vapour Absorption Refrigeration system**: working principle	1	06-08-2018		**TLM 1**	CO1	**T1**	
223.	Max. COP derivation for the VAR system and problems	1	08-08-2018		**TLM 1, TLM 4**	CO2	**T1**	
224.	Description and working of NH_3-Water system	1	09-08-2018		**TLM 2**	CO1	**T1**	
225.	LiBr-Water (Two shell & Four shell) System	1	10-08-2018		**TLM 2**	CO1	**T1**	
226.	**TUTORIAL-04**	1	20-08-2018		**TLM 3**	CO3	**T1**	
227.	Principle of operation of Three fluid absorption systems, Salient features.	1	23-08-2018		**TLM 2, TLM 1**	CO1	**T1**	
228.	**Steam Jet Refrigeration System:** Working Principle	1	24-08-2018		**TLM 1, TLM 2**	CO1	**T1**	
229.	Basic Analysis- Applications	1	27-08-2018		**TLM 1**	CO1	**T1**	
230.	Solving Problems	1	29-08-2018		**TLM 4**	CO2	**T1**	
231.	**Non-Conventional Refrigeration Systems:** Thermo electric refrigeration, Vortex tube refrigeration	1	30-08-2018		**TLM 2**	CO1	**R1**	
232.	Adiabatic Demagnetization refrigeration	1	31-08-2018		**TLM 2**	CO1	**R1**	
233.	**TUTORIAL-05** Assignment-3/Quiz-3	1	3-09-2018		**TLM 3, TLM 6**	CO1	**T1**	
No. of classes required to complete UNIT-III = 12			No. of classes taken:					

UNIT-IV PSYCHROMETRY & HUMAN COMFORT- 12

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
234.	**Psychrometry**: Introduction	1	5-09-2018		**TLM 1**	CO4	**T2**	
235.	Psychometric properties and relations	1	6-09-2018		**TLM 1**	CO4	**T2**	
236.	Psychometric problems	1	7-09-2018		**TLM 4**	CO4	**T2**	
237.	**TUTORIAL-06**	1	10-09-2018		**TLM 3**	CO4	**T2**	
238.	Psychometric chart and its analysis, Psychometric processes and its analysis	1	12-09-2018		**TLM 1**	CO4	**T2**	
239.	Sensible, Latent and Total heat	1	14-09-2018		**TLM 1**	CO4	**T2**	
240.	Sensible Heat Factor and Bypass Factor	1	17-09-2018		**TLM 1**	CO4	**T2**	
241.	Solving Problems	1	19-09-2018		**TLM 4**	CO4	**T2**	
242.	**TUTORIAL-07**	1	20-09-2018		**TLM 3**	CO4	**T2**	

243.	**Human Comfort:** Thermodynamics	1	24-09-2018		**TLM 1**	CO4	**T2**	
244.	Effective temperature – Comfort chart	1	26-09-2018		**TLM 2**	CO4	**T2**	
245.	Factors affecting the human comfort and its analysis Assignment-4/Quiz-4	1	27-09-2018		**TLM 1, TLM 6**	CO4	**T2**	
No. of classes required to complete UNIT-IV = 12			No. of classes taken:					

UNIT-V AIR CONDITIONING SYSTEMS AND DESIGN -11

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
246.	**Introduction**: Air Conditioning Systems, Components of Air conditioning	1	28-09-2018		**TLM 2, TLM8**	CO5	**R1/T2**	
247.	Central and Unitary systems, Winter and Year-round systems	1	01-10-2018		**TLM 2, TLM8**	CO5	**R1/T1**	
248.	Cooling load estimation	1	03-10-2018		**TLM 1**	CO5	**R1/T1**	
249.	Solving Problems	1	04-10-2018		**TLM 4**	CO5	**R1/ T1**	
250.	**TUTORIAL-08**	1	05-10-2018		**TLM 3**	CO5	**T1**	
251.	Design of Air Condition Systems	1	08-10-2018		**TLM 1**	CO5	**T1**	
252.	bypass factor-circulated air with ADP	1	10-10-2018		**TLM 1**	CO5	**T1**	
253.	System with Ventilated and re-circulation	1	11-10-2018		**TLM 1, TLM8**	CO5	**T1**	
254.	RSHF, GSHF and ESHF	1	12-10-2018		**TLM 1**	CO5	**T1**	
255.	Solving Problems	1	15-10-2018		**TLM 4**	CO5	**T1**	
256.	**TUTORIAL-09** Assignment-5/Quiz-5	1	19-10-2018		**TLM 3, TLM 6**	CO5	**T1**	
No. of classes required to complete UNIT-V = 11			No. of classes taken:					
CRT Training-22-10-2018 to 26-10-2018								

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.	**Air craft Refrigeration System**	**1**	**22-10-2018**		**TLM2**	**CO1,CO4**	**R3**	
2.	**Cryogenics**	**1**	**24-10-2018**		**TLM2**	**CO1,CO3,CO5**	**R1& R2**	

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

ACADEMIC CALENDAR:

Description	From	To	Weeks
I Phase of Instructions-1	11-06-2018	13-08-2018	7W+2W

I Mid Examinations	13-08-2018	18-08-2018	1W
II Phase of Instructions	20-08-2018	26-10-2018	9W+1W
II Mid Examinations	29-10-2018	03-11-2017	1W
Preparation and Practical	05-11-2018	17-11-2018	2W
Semester End Examinations	19-11-2018	01-12-2018	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
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**

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

LAKKIREDDY BALI REDDY COLLEGE OF ENGINEERING
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L B Reddy Nagar, Mylavaram-521 230, Krishna District, Andhra Pradesh.

COURSE HANDOUT

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

ACADEMIC YEAR **:** 2018-19

COURSE NAME & CODE **:** Refrigeration and Air-Conditioning - S 367

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

COURSE CREDITS **:** 3

COURSE INSTRUCTOR **: Mr. Mallikarjuna Rao Dandu**

COURSE COORDINATOR : Mr. V. DHANA RAJU

PRE-REQUISITE: Thermodynamics.

COURSE OBJECTIVE: In a broader way, this course provides the simple understanding of refrigeration and air conditioning fundamentals. First, it covers the different refrigeration cycles and its analysis. Then the concepts of psychrometry and psychrometry processes used for air conditioning are imparted. Finally, the concepts of comfort air conditioning, cooling load design and its estimation are addressed.

COURSE OUTCOMES(CO)

CO1: Describe the basic concepts of refrigeration and its applications.
CO2: Evaluate the performance parameters of refrigeration systems.
CO3: Identify the desirable refrigerants and its use in various refrigeration systems.
CO4: Analyze the psychrometric properties and processes used in Air Conditioning systems.
CO5: Design of Air Conditioning systems for thermal comfort conditions.

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	PSO 3
CO1	2	2	2	1		2	2					1	3		
CO2	3	3	3	1		2	2					1	3		
CO3	2	2	2	2		3	3					2	2		
CO4	3	3	2	2		2	2					2	2		
CO5	3	3	3	2		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).

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R2 Wilbert F.Stoecker, Jerold W. J.Jones, MGH, 1986.

R3 Manohar Prasad, Refrigeration and Air conditioning, New Age international, 2003

COURSE DELIVERY PLAN (LESSON PLAN): Section-B

UNIT-I FUNDAMENTALS OF REFRIGERATION, REFRIGERANT & AIR- REFRIGERATION SYSTEM -14

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
257.	**Introduction:** Refrigeration, Applications of refrigeration	1	11-06-2018		**TLM1**	CO1	**T1**	
258.	Unit of refrigeration and COP	1	13-06-2018		**TLM1**	CO1	**T1**	
259.	Heat Engine, Refrigerator and Heat pump	1	14-06-2018		**TLM1**	CO1	**T1**	
260.	Types of Refrigeration systems, Problems on refrigeration basics	1	15-06-2018		**TLM1, TLM4**	CO2	**T1**	
261.	**CRT Training-18-06-2018 to 30-06-2018**							
262.	**TUTORIAL-01**	1	02-07-2018		**TLM3**	CO1	**T1**	

263.	**Refrigerant:** Desirable characteristics of ideal refrigerant	1	04-07-2018		**TLM2**	CO3	**T1/R1**	
264.	Classification of refrigerants- Desirable Properties-Nomenclature, Refrigerant Designation	1	05-07-2018		**TLM 1, TLM 4**	CO3	**T1**	
265.	Commonly used refrigerants, Alternate refrigerants,	1	06-07-2018		**TLM 1**	CO3	**T1**	
266.	Green House effect& Global	1	09-07-2018		**TLM 7**	CO3	**T1**	
267.	**Air refrigeration system**: working on Reversed Carnot cycle	1	10-07-2018		**TLM 1**	CO1	**T1**	
268.	Air refrigeration system working on Bell Coleman cycle	1	11-07-2018		**TLM 1**	CO1	**T1**	
269.	COP- Open and Dense air systems Problems	1	12-07-2018		**TLM 1 TLM 4**	CO2	**T1**	
270.	Solving Problems	1	13-07-2018		**TLM 4**	CO2	**T1**	
271.	**TUTORIAL-02** Assignment-I/Quiz-I	1	16-07-2018		**TLM 3, TLM 6**	CO2	**T1**	
No. of classes required to complete UNIT-I = 14			No. of classes taken:					

UNIT-II VAPOUR COMPRESSION REFRIGERATION SYSTEM & COMPONENTS -11

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
272.	**Introduction to VCR system:** Essential components of the VCR plant	1	18-07-2018		**TLM 1**	CO1	**T2**	
273.	Simple vapour compression refrigeration cycle, COP	1	19-07-2018		**TLM 1**	CO1	**T2**	
274.	Representation of cycle on T-S and p-h Charts	1	20-07-2018		**TLM 1, TLM 2**	CO1	**T2**	
275.	Effect of sub cooling and superheating	1	23-07-2018		**TLM 1**	CO1	**R1**	
276.	Solving Problems	1	25-07-2018		**TLM 4**	CO2	**R1**	
277.	**TUTORIAL-03**	1	26-07-2018		**TLM 3**	CO2	**T2**	
278.	**VCR-System Components**: Compressors -Classification-Working Principles	1	27-07-2018		**TLM 2, TLM8**	CO1	**T2**	
279.	Condensers – Classification-working principle	1	30-07-2018		**TLM 2, TLM8**	CO1	**T2**	
280.	Evaporators-Classification-working principle	1	01-08-2018		**TLM 2, TLM8**	CO1	**T2**	
281.	Expansion valve – Classification-working principle-	1	02-08-2018		**TLM 2, TLM8**	CO1	**T2**	
282.	Advantages and disadvantages Assignment-2/Quiz-2	1	03-08-2018		**TLM 1, TLM 6**	CO1	**T2**	
No. of classes required to complete UNIT-II = 11			No. of classes taken:					

UNIT-III VAPOUR ABSORPTION, STEAM JET & NON-CONVENTIONAL REFRIGERATION SYSTEM -12

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
283.	**Vapour Absorption Refrigeration system**: working principle	1	06-08-2018		**TLM 1**	CO1	**T1**	
284.	Max. COP derivation for the VAR system and problems	1	08-08-2018		**TLM 1, TLM 4**	CO2	**T1**	
285.	Description and working of NH_3-Water system	1	09-08-2018		**TLM 2**	CO1	**T1**	
286.	LiBr-Water (Two shell & Four shell) System	1	10-08-2018		**TLM 2**	CO1	**T1**	
287.	**TUTORIAL-04**	1	20-08-2018		**TLM 3**	CO3	**T1**	
288.	Principle of operation of Three fluid absorption systems, Salient features.	1	23-08-2018		**TLM 2, TLM 1**	CO1	**T1**	
289.	**Steam Jet Refrigeration System:** Working Principle	1	24-08-2018		**TLM 1, TLM 2**	CO1	**T1**	
290.	Basic Analysis- Applications	1	27-08-2018		**TLM 1**	CO1	**T1**	
291.	Solving Problems	1	29-08-2018		**TLM 4**	CO2	**T1**	
292.	**Non-Conventional Refrigeration Systems:** Thermo electric refrigeration, Vortex tube refrigeration	1	30-08-2018		**TLM 2**	CO1	**R1**	
293.	Adiabatic Demagnetization refrigeration	1	31-08-2018		**TLM 2**	CO1	**R1**	
294.	**TUTORIAL-05** Assignment-3/Quiz-3	1	3-09-2018		**TLM 3, TLM 6**	CO1	**T1**	
No. of classes required to complete UNIT-III = 12			No. of classes taken:					

UNIT-IV PSYCHROMETRY & HUMAN COMFORT- 12

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
295.	**Psychrometry**: Introduction	1	5-09-2018		**TLM 1**	CO4	**T2**	
296.	Psychometric properties and relations	1	6-09-2018		**TLM 1**	CO4	**T2**	
297.	Psychometric problems	1	7-09-2018		**TLM 4**	CO4	**T2**	
298.	**TUTORIAL-06**	1	10-09-2018		**TLM 3**	CO4	**T2**	
299.	Psychometric chart and its analysis, Psychometric processes and its analysis	1	12-09-2018		**TLM 1**	CO4	**T2**	
300.	Sensible, Latent and Total heat	1	14-09-2018		**TLM 1**	CO4	**T2**	
301.	Sensible Heat Factor and Bypass Factor	1	17-09-2018		**TLM 1**	CO4	**T2**	
302.	Solving Problems	1	19-09-2018		**TLM 4**	CO4	**T2**	
303.	**TUTORIAL-07**	1	20-09-2018		**TLM 3**	CO4	**T2**	

304.	**Human Comfort:** Thermodynamics	1	24-09-2018		**TLM 1**	CO4	**T2**	
305.	Effective temperature – Comfort chart	1	26-09-2018		**TLM 2**	CO4	**T2**	
306.	Factors affecting the human comfort and its analysis Assignment-4/Quiz-4	1	27-09-2018		**TLM 1, TLM 6**	CO4	**T2**	
No. of classes required to complete UNIT-IV = 12			No. of classes taken:					

UNIT-V AIR CONDITIONING SYSTEMS AND DESIGN -11

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
307.	**Introduction**: Air Conditioning Systems, Components of Air conditioning	1	28-09-2018		**TLM 2, TLM8**	CO5	**R1/T2**	
308.	Central and Unitary systems, Winter and Year-round systems	1	01-10-2018		**TLM 2, TLM8**	CO5	**R1/T1**	
309.	Cooling load estimation	1	03-10-2018		**TLM 1**	CO5	**R1/T1**	
310.	Solving Problems	1	04-10-2018		**TLM 4**	CO5	**R1/T1**	
311.	**TUTORIAL-08**	1	05-10-2018		**TLM 3**	CO5	**T1**	
312.	Design of Air Condition Systems	1	08-10-2018		**TLM 1**	CO5	**T1**	
313.	bypass factor-circulated air with ADP	1	10-10-2018		**TLM 1**	CO5	**T1**	
314.	System with Ventilated and re-circulation	1	11-10-2018		**TLM 1, TLM8**	CO5	**T1**	
315.	RSHF, GSHF and ESHF	1	12-10-2018		**TLM 1**	CO5	**T1**	
316.	Solving Problems	1	15-10-2018		**TLM 4**	CO5	**T1**	
317.	**TUTORIAL-09** Assignment-5/Quiz-5	1	19-10-2018		**TLM 3, TLM 6**	CO5	**T1**	
No. of classes required to complete UNIT-V = 11			No. of classes taken:					
CRT Training-22-10-2018 to 26-10-2018								

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
3.	Air craft Air-Refrigeration System	**1**	**22-10-2018**		**TLM2**	**CO1, CO4**	**R3**	
4.	Cryogenics	**1**	**24-10-2018**		**TLM2**	**CO1, CO3, CO5**	**R1& R2**	

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

ACADEMIC CALENDAR:

Description	From	To	Weeks
I Phase of Instructions-1	11-06-2018	13-08-2018	7W+2W

I Mid Examinations	13-08-2018	18-08-2018	1W
II Phase of Instructions	20-08-2018	26-10-2018	9W+1W
II Mid Examinations	29-10-2018	03-11-2017	1W
Preparation and Practical	05-11-2018	17-11-2018	2W
Semester End Examinations	19-11-2018	01-12-2018	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
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**

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

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

COURSE HANDOUT

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

ACADEMIC YEAR **:** 2018-19

COURSE NAME & CODE **:** Refrigeration and Air-Conditioning - S 367

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

COURSE CREDITS **:** 3

COURSE INSTRUCTOR **: Mr. Mallikarjuna Rao Dandu**

COURSE COORDINATOR : Mr. V. DHANA RAJU

PRE-REQUISITE: Thermodynamics.

COURSE OBJECTIVE: In a broader way, this course provides the simple understanding of refrigeration and air conditioning fundamentals. First, it covers the different refrigeration cycles and its analysis. Then the concepts of psychrometry and psychrometry processes used for air conditioning are imparted. Finally, the concepts of comfort air conditioning, cooling load design and its estimation are addressed.

COURSE OUTCOMES(CO)

CO1: Describe the basic concepts of refrigeration and its applications.
CO2: Evaluate the performance parameters of refrigeration systems.
CO3: Identify the desirable refrigerants and its use in various refrigeration systems.
CO4: Analyze the psychrometric properties and processes used in Air Conditioning systems.
CO5: Design of Air Conditioning systems for thermal comfort conditions.

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	PSO 3
CO1	2	2	2	1		2	2					1	3		
CO2	3	3	3	1		2	2					1	3		
CO3	2	2	2	2		3	3					2	2		
CO4	3	3	2	2		2	2					2	2		
CO5	3	3	3	2		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 C. P. Arora. , Refrigeration and air conditioning - TMH, 2nd Edition, 2000.

T2 R. Dossat, Principles of Refrigeration - - Pearson 4th Edition 2001.

BOS APPROVED REFERENCE BOOKS:

R1 S. C. Arora, Domkundwar, A course in refrigeration and air conditioning-Dhanapat Rai& sons 5th Edition 1997.

R2 Wilbert F.Stoecker, Jerold W. J.Jones, MGH, 1986.

R3 Manohar Prasad, Refrigeration and Air conditioning, New Age international, 2003

COURSE DELIVERY PLAN (LESSON PLAN): Section-B

UNIT-I FUNDAMENTALS OF REFRIGERATION, REFRIGERANT & AIR- REFRIGERATION SYSTEM -14

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
318.	**Introduction:** Refrigeration, Applications of refrigeration	1	11-06-2018		**TLM1**	CO1	**T1**	
319.	Unit of refrigeration and COP	1	13-06-2018		**TLM1**	CO1	**T1**	
320.	Heat Engine, Refrigerator and Heat pump	1	14-06-2018		**TLM1**	CO1	**T1**	
321.	Types of Refrigeration systems, Problems on refrigeration basics	1	15-06-2018		**TLM1, TLM4**	CO2	**T1**	
322.	**CRT Training-18-06-2018 to 30-06-2018**							
323.	**TUTORIAL-01**	1	02-07-2018		**TLM3**	CO1	**T1**	

324.	**Refrigerant:** Desirable characteristics of ideal refrigerant	1	04-07-2018		**TLM2**	CO3	**T1/R1**	
325.	Classification of refrigerants- Desirable Properties-Nomenclature, Refrigerant Designation	1	05-07-2018		**TLM 1, TLM 4**	CO3	**T1**	
326.	Commonly used refrigerants, Alternate refrigerants,	1	06-07-2018		**TLM 1**	CO3	**T1**	
327.	Green House effect& Global	1	09-07-2018		**TLM 7**	CO3	**T1**	
328.	**Air refrigeration system**: working on Reversed Carnot cycle	1	10-07-2018		**TLM 1**	CO1	**T1**	
329.	Air refrigeration system working on Bell Coleman cycle	1	11-07-2018		**TLM 1**	CO1	**T1**	
330.	COP- Open and Dense air systems Problems	1	12-07-2018		**TLM 1 TLM 4**	CO2	**T1**	
331.	Solving Problems	1	13-07-2018		**TLM 4**	CO2	**T1**	
332.	**TUTORIAL-02** Assignment-I/Quiz-I	1	16-07-2018		**TLM 3, TLM 6**	CO2	**T1**	
No. of classes required to complete UNIT-I = 14			No. of classes taken:					

UNIT-II VAPOUR COMPRESSION REFRIGERATION SYSTEM & COMPONENTS -11

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
333.	**Introduction to VCR system:** Essential components of the VCR plant	1	18-07-2018		**TLM 1**	CO1	**T2**	
334.	Simple vapour compression refrigeration cycle, COP	1	19-07-2018		**TLM 1**	CO1	**T2**	
335.	Representation of cycle on T-S and p-h Charts	1	20-07-2018		**TLM 1, TLM 2**	CO1	**T2**	
336.	Effect of sub cooling and superheating	1	23-07-2018		**TLM 1**	CO1	**R1**	
337.	Solving Problems	1	25-07-2018		**TLM 4**	CO2	**R1**	
338.	**TUTORIAL-03**	1	26-07-2018		**TLM 3**	CO2	**T2**	
339.	**VCR-System Components**: Compressors -Classification-Working Principles	1	27-07-2018		**TLM 2, TLM8**	CO1	**T2**	
340.	Condensers – Classification-working principle	1	30-07-2018		**TLM 2, TLM8**	CO1	**T2**	
341.	Evaporators-Classification-working principle	1	01-08-2018		**TLM 2, TLM8**	CO1	**T2**	
342.	Expansion valve – Classification-working principle-	1	02-08-2018		**TLM 2, TLM8**	CO1	**T2**	
343.	Advantages and disadvantages Assignment-2/Quiz-2	1	03-08-2018		**TLM 1, TLM 6**	CO1	**T2**	
No. of classes required to complete UNIT-II = 11			No. of classes taken:					

UNIT-III VAPOUR ABSORPTION, STEAM JET & NON-CONVENTIONAL REFRIGERATION SYSTEM -12

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
344.	**Vapour Absorption Refrigeration system**: working principle	1	06-08-2018		**TLM 1**	CO1	**T1**	
345.	Max. COP derivation for the VAR system and problems	1	08-08-2018		**TLM 1, TLM 4**	CO2	**T1**	
346.	Description and working of NH_3-Water system	1	09-08-2018		**TLM 2**	CO1	**T1**	
347.	LiBr-Water (Two shell & Four shell) System	1	10-08-2018		**TLM 2**	CO1	**T1**	
348.	**TUTORIAL-04**	1	20-08-2018		**TLM 3**	CO3	**T1**	
349.	Principle of operation of Three fluid absorption systems, Salient features.	1	23-08-2018		**TLM 2, TLM 1**	CO1	**T1**	
350.	**Steam Jet Refrigeration System:** Working Principle	1	24-08-2018		**TLM 1, TLM 2**	CO1	**T1**	
351.	Basic Analysis- Applications	1	27-08-2018		**TLM 1**	CO1	**T1**	
352.	Solving Problems	1	29-08-2018		**TLM 4**	CO2	**T1**	
353.	**Non-Conventional Refrigeration Systems:** Thermo electric refrigeration, Vortex tube refrigeration	1	30-08-2018		**TLM 2**	CO1	**R1**	
354.	Adiabatic Demagnetization refrigeration	1	31-08-2018		**TLM 2**	CO1	**R1**	
355.	**TUTORIAL-05** Assignment-3/Quiz-3	1	3-09-2018		**TLM 3, TLM 6**	CO1	**T1**	
No. of classes required to complete UNIT-III = 12			No. of classes taken:					

UNIT-IV PSYCHROMETRY & HUMAN COMFORT- 12

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
356.	**Psychrometry**: Introduction	1	5-09-2018		**TLM 1**	CO4	**T2**	
357.	Psychometric properties and relations	1	6-09-2018		**TLM 1**	CO4	**T2**	
358.	Psychometric problems	1	7-09-2018		**TLM 4**	CO4	**T2**	
359.	**TUTORIAL-06**	1	10-09-2018		**TLM 3**	CO4	**T2**	
360.	Psychometric chart and its analysis, Psychometric processes and its analysis	1	12-09-2018		**TLM 1**	CO4	**T2**	
361.	Sensible, Latent and Total heat	1	14-09-2018		**TLM 1**	CO4	**T2**	
362.	Sensible Heat Factor and Bypass Factor	1	17-09-2018		**TLM 1**	CO4	**T2**	
363.	Solving Problems	1	19-09-2018		**TLM 4**	CO4	**T2**	
364.	**TUTORIAL-07**	1	20-09-2018		**TLM 3**	CO4	**T2**	

365.	**Human Comfort:** Thermodynamics	1	24-09-2018		**TLM 1**	CO4	**T2**	
366.	Effective temperature – Comfort chart	1	26-09-2018		**TLM 2**	CO4	**T2**	
367.	Factors affecting the human comfort and its analysis Assignment-4/Quiz-4	1	27-09-2018		**TLM 1, TLM 6**	CO4	**T2**	
No. of classes required to complete UNIT-IV = 12			No. of classes taken:					

UNIT-V AIR CONDITIONING SYSTEMS AND DESIGN -11

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
368.	**Introduction**: Air Conditioning Systems, Components of Air conditioning	1	28-09-2018		**TLM 2, TLM8**	CO5	**R1/T2**	
369.	Central and Unitary systems, Winter and Year-round systems	1	01-10-2018		**TLM 2, TLM8**	CO5	**R1/T1**	
370.	Cooling load estimation	1	03-10-2018		**TLM 1**	CO5	**R1/T1**	
371.	Solving Problems	1	04-10-2018		**TLM 4**	CO5	**R1/T1**	
372.	**TUTORIAL-08**	1	05-10-2018		**TLM 3**	CO5	**T1**	
373.	Design of Air Condition Systems	1	08-10-2018		**TLM 1**	CO5	**T1**	
374.	bypass factor-circulated air with ADP	1	10-10-2018		**TLM 1**	CO5	**T1**	
375.	System with Ventilated and re-circulation	1	11-10-2018		**TLM 1, TLM8**	CO5	**T1**	
376.	RSHF, GSHF and ESHF	1	12-10-2018		**TLM 1**	CO5	**T1**	
377.	Solving Problems	1	15-10-2018		**TLM 4**	CO5	**T1**	
378.	**TUTORIAL-09** Assignment-5/Quiz-5	1	19-10-2018		**TLM 3, TLM 6**	CO5	**T1**	
No. of classes required to complete UNIT-V = 11			No. of classes taken:					
CRT Training-22-10-2018 to 26-10-2018								

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
5.	Air craft Air-Refrigeration System	**1**	**22-10-2018**		**TLM2**	**CO1, CO4**	**R3**	
6.	Cryogenics	**1**	**24-10-2018**		**TLM2**	**CO1, CO3, CO5**	**R1& R2**	

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

ACADEMIC CALENDAR:

Description	From	To	Weeks
I Phase of Instructions-1	11-06-2018	13-08-2018	7W+2W

I Mid Examinations	13-08-2018	18-08-2018	1W
II Phase of Instructions	20-08-2018	26-10-2018	9W+1W
II Mid Examinations	29-10-2018	03-11-2017	1W
Preparation and Practical	05-11-2018	17-11-2018	2W
Semester End Examinations	19-11-2018	01-12-2018	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
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**

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

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

COURSE HANDOUT

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

ACADEMIC YEAR **:** 2018-19

COURSE NAME & CODE **:** Metrology and Instrumentation **(**S310)

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

COURSE CREDITS **:** 3

COURSE INSTRUCTOR **: P.Sandeep Kumar**

COURSE COORDINATOR : P.Sandeep Kumar

PRE-REQUISITE: Statistics and Engineering Physics

COURSE OBJECTIVE : The main objective of this course is to ascertain basic principles of measurements and calibrate the instruments.

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

CO:1	Apply different measuring techniques in quality control departments of industries and to ensure quality of products.
CO:2	Measure the dimensions using linear, angular and optical measuring instruments.
CO:3	Analyze measuring systems of surface roughness and perform alignment / acceptance test effectively.
CO:4	Design the instruments for the measurement of stress, strain, force, torque etc.
CO:5	Analyze measuring systems of Pressure, Fluid flow and Temperature.

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	PSO 3
CO1	3				1							2		2	
CO2	3	2	2		1							2		2	
CO3	3	3	2		1							2		2	2
CO4	3	2	2	2	1							2	2		
CO5	3	2	2	2	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).

BOS APPROVED TEXT BOOKS:

T1 D.S.Kumar, Mechanical Measurements and Controls, 4th Edition, Metropolitan Book Co-Private Ltd.

T2 R.K.Jain, Engineering Metrology, Khanna Publishers.3rd edition,2003

T3 BeckWith, Marangoni,Linehard, Mechanical Measurements, Person Education Asia.6th edition,2011.

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R1 A.K, Sawhneypuneet " A course in Mechanical Measurements and instrumentation control" DhanpatRai publications, 12thEdition, 2012

R2 J.P. Holman, Experimental Methods for Engineers, McGraw Hill.

R3 Ernest O. Doebelin, Measurement systems Application and Design, International Student Edition, 4thEdition, McGraw-Hill Book Company, 1998.

R4 M. Mahajan, A text book of Metrology, DhanpatRai& Co.

R5 I C Gupta, Engineering Metrology, DanpathRai

COURSE DELIVERY PLAN (LESSON PLAN): M&I

UNIT-I

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 SUBJECT	1	11-06-2018		**TLM2**	CO1		
2.	COURSE OUTCOMES	1	13-06-2018		**TLM2**	CO1		
3.	**BASIC CONCEPTS** INTRODUCTION				**TLM2**	CO1	**T2**	
4.	FUNDAMENTAL MEASURING PROCESSES AND METHODS	1	15-06-2018		**TLM1**	CO1	**R4, T3**	
5.	GENERALISED MEASUREMENT	1	18-06-2018		**TLM1**	CO1	**T3**	

	SYSTEM AND ITS FUNCTIONAL ELEMENTS							
6.	PERFORMANCE CHARACTERISTICS	1	20-06-2018		**TLM1**	CO1	**R4**	
7.	**Tutorial-I**	1	22-06-2018		**TLM3**			
8.	**ANALYSIS OF EXPERIMENTAL DATA:** CAUSES AND TYPES OF EXPERIMENTAL ERRORS	1	23-06-2018		**TLM1**	CO1	**T1**	
9.	TREATMENT OF EXPERIMENTAL DATA	1	25-06-2018		**TLM1**	CO1	**T1**	
10.	METHOD OF LEAST SQUARES	1	27-06-2018		**TLM1**	CO1	**T1**	
11.	GRAPHICAL ANALYSIS AND CURVE FITTING.	1	29-06-2018		**TLM1**	CO1	**T1**	
12.	**Tutorial-II**	1	30-06-2018		**TLM3**			
No. of classes required to complete UNIT-I		11			No. of classes taken:			

UNIT-II

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	Learning Outcome COs	Text Book followed	HOD Sign Weekly
13.	**LINEAR MEASUREMENT** STANDARDS OF MEASUREMENTS LINE AND END STANDARD.	1	02-07-2018		**TLM1**	CO2	**R5,T2**	
14.	BASIC PRINCIPLE AND APPLICATIONS OF SLIP GAUGES	1	04-07-2018		**TLM2**	CO2	**R5,T2**	
15.	DIAL INDICATOR AND MICROMETERS	1	06-07-2018		**TLM2**	CO2	**R5,T2**	
16.	**ANGULAR MEASUREMENTS** BEVEL PROTRACTOR – ANGLE SLIP GAUGES	1	07-07-2018		**TLM2**	CO2	**R5,T2**	
17.	SINE BAR, ROLLERS AND SPHERES USED TO DETERMINE THE TAPERS	1	09-07-2018		**TLM2**	CO2	**R5,T2**	
18.	APPLICATIONS OF ANGULAR MEASUREMENT	1	11-07-2018		**TLM2**	CO2	**R5,T2**	
19.	**Tutorial-III**	1	13-07-2018		**TLM3**			
20.	**OPTICAL MEASURING INSTRUMENTS** TOOL MAKER'S MICROSCOPE AND ITS USES	1	14-07-2018		**TLM2**	CO2	**R5,T2**	
21.	COLLIMATORS, OPTICAL PROJECTOR	1	16-07-2018		**TLM2**	CO2	**R5,T2**	
22.	OPTICAL FLATS AND THEIR USES	1	18-07-2018		**TLM2**	CO2	**R5,T2**	
23.	INTERFEROMETER, AND THOSE APPLICATIONS	1	20-07-2018				**R5,T2**	
24.	**Tutorial-IV**	1	21-07-2018					
No. of classes required to complete UNIT-II		12			No. of classes taken:			

UNIT-III

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	Learning Outcome COs	Text Book followed	HOD Sign Weekly
25.	**SURFACE TEXTURE** FACTORS EFFECTING SURFACE ROUGHNESS	1	23-07-2018		**TLM2**	CO3	**R5,T2**	

26.	REASONS FOR CONTROLLING SURFACE TEXTURE	1	25-07-2018		**TLM2**	CO3	**R5,T2**	
27.	DIFFERENCES BETWEEN SURFACE ROUGHNESS AND SURFACE WAVINESS				**TLM2**	CO3	**R5,T2**	
28.	ELEMENTS OF SURFACE TEXTURE NUMERICAL ASSESSMENT OF SURFACE FINISH – CLA, R, R.M.S VALUES – RA VALUES, AND RZ VALUES	1	27-07-2018		**TLM2**	CO3	**R5,T2**	
29.	BASIC PRINCIPLE OF PROFILE METER AND TOMLINSON SURFACE METER	1	28-07-2018		**TLM2**	CO3	**R5,T2**	
30.	ISI SYMBOLS FOR INDICATION OF SURFACE FINISH	1	30-07-2018		**TLM2**	CO3	**R5,T2**	
31.	APPLICATIONS SURFACE TEXTURE	1	01-08-2018		**TLM2**	CO3	**R5,T2**	
32.	**Tutorial-V**	1	03-08-2018		**TLM3**			
33.	**LIMITS AND FITS** INTRODUCTION, NORMAL SIZE, TOLERANCE LIMITS, DEVIATIONS, ALLOWANCE	1	04-08-2018		**TLM2**	CO3	**R5,T2**	
34.	FITS AND THEIR TYPES – UNILATERAL AND BILATERAL TOLERANCE SYSTEM	1	06-08-2018		**TLM2**	CO3	**R5,T2**	
35.	HOLE AND SHAFT BASIS SYSTEMS	1	08-08-2018		**TLM2**	CO3	**R5,T2**	
36.	INTERCHANGEABILITY AND SELECTIVE ASSEMBLY				**TLM2**	CO3	**R5,T2**	
37.	INDIAN STANDARD INSTITUTION SYSTEM	1	10-08-2018		**TLM2**	CO3	**R5,T2**	
38.	**Tutorial-VI**	1	11-08-2018		**TLM3**			
No. of classes required to complete UNIT-III		12			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 Outcome COs	Text Book followed	HOD Sign Weekly
39.	**MEASUREMENT OF DISPLACEMENT** INTRODUCTION, CLASSIFICATION	1	20-08-2018		**TLM2**	CO4	**T1,T3**	
40.	DIMENSIONAL MEASUREMENT, GAUGE BLOCKS	1			**TLM2**	CO4	**T1,T3**	
41.	OPTICAL METHODS, PNEUMATIC GAUGE	1	25-08-2018		**TLM2**	CO4	**T1,T3**	
42.	APPLICATIONS OF DISPLACEMENT MEASUREMENT	1	27-08-2018		**TLM2**	CO4	**T1,T3**	
43.	**Tutorial-VII**	1	29-08-2018		**TLM3**			
44.	**MEASUREMENT OF STRESS AND STRAIN** INTRODUCTION, STRAIN MEASUREMENTS ELECTRICAL RESISTANCE STRAIN GAUGE, GAUGE FACTOR	1	31-08-2018		**TLM2**	CO4	**T1,T3**	
45.	MEASUREMENT OF RESISTANCE STRAIN-GAGE OUTPUTS	1	01-09-2018		**TLM2**	CO4	**T1,T3**	
46.	TEMPERATURE COMPENSATION	1	05-09-2018		**TLM1**	CO4	**T1,T3**	

47.	STRAIN GAGE ROSETTES, APPLICATIONS OF STRAIN MEASUREMENT	1	07-09-2018		**TLM2**	CO4	**T1,T3**	
48.	**Tutorial-VIII**	1	08-09-2018		**TLM3**			
49.	**MEASUREMENT OF FORCE AND TORQUE** INTRODUCTION, ELASTIC TRANSDUCER	1	10-09-2018		**TLM2**	CO4	**T1,T3**	
50.	STRAIN GAGE LOAD CELLS	1	12-09-2018		**TLM2**	CO4	**T1,T3**	
51.	DYNAMOMETERS-MECHANICAL, HYDRAULIC, ELECTRICAL	1	14-09-2018		**TLM2**	CO4	**T1,T3**	
52.	APPLICATIONS OF FORCE AND TORQUE MEASUREMENT	1	15-09-2018		**TLM2**	CO4	**T1,T3**	
53.	**Tutorial-IX**	1	17-09-2018		**TLM3**			
No. of classes required to complete UNIT-IV		15			No. of classes taken:			

UNIT-V

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
54.	**MEASUREMENT OF PRESSURE** INTRODUCTION, MANOMETERS	1	19-09-2018		**TLM2**	CO5	**T1,T3**	**T1,T3**
55.	DIAL TYPE PRESSURE GAUGE, PRESSURE TRANSDUCERS	1	22-09-2018		**TLM2**	CO5	**T1,T3**	
56.	PITOT, STATIC, AND PITOT-STATIC TUBE AND ITS CHARACTERISTICS	1	24-09-2018		**TLM2**	CO5	**T1,T3**	
57.	LOW PRESSURE MEASUREMENT GAUGES APPLICATIONS OF PRESSURE MEASUREMENT	1	26-09-2018		**TLM2**	CO5	**T1,T3**	
58.	**Tutorial-X**	1	28-09-2018		**TLM3**			
59.	**MEASUREMENT OF FLUID FLOW** INTRODUCTION, ROTAMETER	1	29-09-2018		**TLM2**	CO5	**T1,T3**	
60.	TURBINE FLOW METER, LASER DOPPLER	1	01-10-2018		**TLM2**	CO5	**T1,T3**	
61.	ANEMOMETER, HOT-WIRE ANEMOMETER, APPLICATIONS OF FLUID FLOW MEASUREMENT	1	03-10-2018		**TLM2**	CO5	**T1,T3**	
62.	**Tutorial-XI**	1	05-10-2018		**TLM3**			
63.	**MEASUREMENT OF TEMPERATURE** INTRODUCTION, TYPES OF THERMOMETERS	1	06-10-2018		**TLM2**	CO5	**T1,T3**	
64.	THERMOCOUPLES, RTD	1	08-10-2018		**TLM2**	CO5	**T1,T3**	
65.	THERMISTERS, PYROMETERS, APPLICATIONS OF TEMPERATURE MEASUREMENT	1	10-10-2018		**TLM2**	CO5	**T1,T3**	
66.	**Tutorial-XII**	1	12-10-2018		**TLM3**			
No. of classes required to complete UNIT-V		13			No. of classes taken:			

CONTENTS BEYOND THE SYLLABUS

S.No.	Topics to be covered	No. of Classes	Tentative Date of	Actual Date of	Teaching Learning	Learning Outcome	Text Book	HOD Sign

		Required	Completion	Completion	Methods	COs	followed	Weekly
67.	INTRODUCTION TO GEAR MEASUREMENTS	1	13-10-2018		**TLM2**	CO2	**T1,T3**	
68.	INTRODUCTION TO COMPARATORS	1	15-10-2018		**TLM2**	CO2	**T1,T3**	
69.	MEASUREMENT OF SPEED	1	19-10-2018		**TLM2**	CO4	**T1,T3**	

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/Assignment/Quiz

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**

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

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

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

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

PROGRAMME OUTCOMES (POs):

Engineering Graduates will be able to:

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

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

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

4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and

interpretation of data, and synthesis of the information to provide valid conclusions.

5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

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

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

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

9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

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

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

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

Programme Specific Outcomes (PSOs):

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

P.Sandeep Kumar	P.Sandeep Kumar	Prof. S Pichi Reddy	Prof. S Pichi Reddy
Course Instructor	**Course Coordinator**	**Module Coordinator**	**HOD**

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COURSE HANDOUT

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

ACADEMIC YEAR : 2018-19

COURSE NAME & CODE : Metrology and Instrumentation (S310)

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

COURSE CREDITS : 3

COURSE INSTRUCTOR : P.Sandeep Kumar

COURSE COORDINATOR : P.Sandeep Kumar

PRE-REQUISITE: Statistics and Engineering Physics

COURSE OBJECTIVE : The main objective of this course is to ascertain basic principles of measurements and calibrate the instruments.

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

CO:1	Apply different measuring techniques in quality control departments of industries and to ensure quality of products.
CO:2	Measure the dimensions using linear, angular and optical measuring instruments.
CO:3	Analyze measuring systems of surface roughness and perform alignment / acceptance test effectively.
CO:4	Design the instruments for the measurement of stress, strain, force, torque etc.
CO:5	Analyze measuring systems of Pressure, Fluid flow and Temperature.

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CO1	3				1							2		2	
CO2	3	2	2		1							2		2	
CO3	3	3	2		1							2		2	2
CO4	3	2	2	2	1							2	2		
CO5	3	2	2	2	1							2	2		

Note: Enter Correlation Levels **1** or **2** or **3.** If there is no correlation, **put '-'**
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R4 M. Mahajan, A text book of Metrology, DhanpatRai& Co.

R5 I C Gupta, Engineering Metrology, DanpathRai

COURSE DELIVERY PLAN (LESSON PLAN): M&I

UNIT-I

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 SUBJECT	1	11-06-2018		**TLM2**	CO1		

2.	COURSE OUTCOMES	1	13-06-2018		**TLM2**	CO1		
3.	**BASIC CONCEPTS** INTRODUCTION				**TLM2**	CO1	**T2**	
4.	FUNDAMENTAL MEASURING PROCESSES AND METHODS	1	14-06-2018		**TLM1**	CO1	**R4, T3**	
5.	GENERALISED MEASUREMENT SYSTEM AND ITS FUNCTIONAL ELEMENTS	1	18-06-2018		**TLM1**	CO1	**T3**	
6.	PERFORMANCE CHARACTERISTICS	1	20-06-2018		**TLM1**	CO1	**R4**	
7.	**Tutorial-I**	1	21-06-2018		**TLM3**			
8.	**ANALYSIS OF EXPERIMENTAL DATA:** CAUSES AND TYPES OF EXPERIMENTAL ERRORS	1	23-06-2018		**TLM1**	CO1	**T1**	
9.	TREATMENT OF EXPERIMENTAL DATA	1	25-06-2018		**TLM1**	CO1	**T1**	
10.	METHOD OF LEAST SQUARES	1	27-06-2018		**TLM1**	CO1	**T1**	
11.	GRAPHICAL ANALYSIS AND CURVE FITTING.	1	28-06-2018		**TLM1**	CO1	**T1**	
12.	**Tutorial-II**	1	30-06-2018		**TLM3**			
No. of classes required to complete UNIT-I		11			No. of classes taken:			

UNIT-II

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	Learning Outcome COs	Text Book followed	HOD Sign Weekly
13.	**LINEAR MEASUREMENT** STANDARDS OF MEASUREMENTS LINE AND END STANDARD.	1	02-07-2018		**TLM1**	CO2	**R5,T2**	
14.	BASIC PRINCIPLE AND APPLICATIONS OF SLIP GAUGES	1	04-07-2018		**TLM2**	CO2	**R5,T2**	
15.	DIAL INDICATOR AND MICROMETERS	1	05-07-2018		**TLM2**	CO2	**R5,T2**	
16.	**ANGULAR MEASUREMENTS** BEVEL PROTRACTOR – ANGLE SLIP GAUGES	1	07-07-2018		**TLM2**	CO2	**R5,T2**	
17.	SINE BAR, ROLLERS AND SPHERES USED TO DETERMINE THE TAPERS	1	09-07-2018		**TLM2**	CO2	**R5,T2**	
18.	APPLICATIONS OF ANGULAR MEASUREMENT	1	11-07-2018		**TLM2**	CO2	**R5,T2**	
19.	**Tutorial-III**	1	12-07-2018		**TLM3**			
20.	**OPTICAL MEASURING INSTRUMENTS** TOOL MAKER'S MICROSCOPE AND ITS USES	1	14-07-2018		**TLM2**	CO2	**R5,T2**	
21.	COLLIMATORS, OPTICAL PROJECTOR	1	16-07-2018		**TLM2**	CO2	**R5,T2**	
22.	OPTICAL FLATS AND THEIR USES	1	18-07-2018		**TLM2**	CO2	**R5,T2**	
23.	INTERFEROMETER, AND THOSE APPLICATIONS	1	19-07-2018				**R5,T2**	
24.	**Tutorial-IV**	1	21-07-2018					
No. of classes required to complete UNIT-II		12			No. of classes taken:			

UNIT-III

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	Learning Outcome COs	Text Book followed	HOD Sign Weekly
25.	**SURFACE TEXTURE** FACTORS EFFECTING SURFACE ROUGHNESS	1	23-07-2018		**TLM2**	CO3	**R5,T2**	
26.	REASONS FOR CONTROLLING SURFACE TEXTURE	1	25-07-2018		**TLM2**	CO3	**R5,T2**	
27.	DIFFERENCES BETWEEN SURFACE ROUGHNESS AND SURFACE WAVINESS				**TLM2**	CO3	**R5,T2**	
28.	ELEMENTS OF SURFACE TEXTURE NUMERICAL ASSESSMENT OF SURFACE FINISH – CLA, R, R.M.S VALUES – RA VALUES, AND RZ VALUES	1	26-07-2018		**TLM2**	CO3	**R5,T2**	
29.	BASIC PRINCIPLE OF PROFILE METER AND TOMLINSON SURFACE METER	1	28-07-2018		**TLM2**	CO3	**R5,T2**	
30.	ISI SYMBOLS FOR INDICATION OF SURFACE FINISH	1	30-07-2018		**TLM2**	CO3	**R5,T2**	
31.	APPLICATIONS SURFACE TEXTURE	1	01-08-2018		**TLM2**	CO3	**R5,T2**	
32.	**Tutorial-V**	1	04-08-2018		**TLM3**			
33.	**LIMITS AND FITS** INTRODUCTION, NORMAL SIZE, TOLERANCE LIMITS, DEVIATIONS, ALLOWANCE	1	06-08-2018		**TLM2**	CO3	**R5,T2**	
34.	FITS AND THEIR TYPES – UNILATERAL AND BILATERAL TOLERANCE SYSTEM	1	08-08-2018		**TLM2**	CO3	**R5,T2**	
35.	HOLE AND SHAFT BASIS SYSTEMS	1	09-08-2018		**TLM2**	CO3	**R5,T2**	
36.	INTERCHANGEABILITY AND SELECTIVE ASSEMBLY				**TLM2**	CO3	**R5,T2**	
37.	INDIAN STANDARD INSTITUTION SYSTEM	1	11-08-2018		**TLM2**	CO3	**R5,T2**	
38.	**Tutorial-VI**	1	20-08-2018		**TLM3**			
No. of classes required to complete UNIT-III		12			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 Outcome COs	Text Book followed	HOD Sign Weekly
39.	**MEASUREMENT OF DISPLACEMENT** INTRODUCTION, CLASSIFICATION	1	23-08-2018		**TLM2**	CO4	**T1,T3**	
40.	DIMENSIONAL MEASUREMENT, GAUGE BLOCKS	1			**TLM2**	CO4	**T1,T3**	
41.	OPTICAL METHODS, PNEUMATIC GAUGE	1	27-08-2018		**TLM2**	CO4	**T1,T3**	
42.	APPLICATIONS OF DISPLACEMENT MEASUREMENT	1	29-08-2018		**TLM2**	CO4	**T1,T3**	
43.	**Tutorial-VII**	1	30-08-2018		**TLM3**			
44.	**MEASUREMENT OF STRESS AND STRAIN** INTRODUCTION,	1	01-09-2018		**TLM2**	CO4	**T1,T3**	

	STRAIN MEASUREMENTS ELECTRICAL RESISTANCE STRAIN GAUGE, GAUGE FACTOR							
45.	MEASUREMENT OF RESISTANCE STRAIN-GAGE OUTPUTS	1	05-09-2018		**TLM2**	CO4	**T1,T3**	
46.	TEMPERATURE COMPENSATION	1	06-09-2018		**TLM1**	CO4	**T1,T3**	
47.	STRAIN GAGE ROSETTES, APPLICATIONS OF STRAIN MEASUREMENT	1	08-09-2018		**TLM2**	CO4	**T1,T3**	
48.	**Tutorial-VIII**	1	10-09-2018		**TLM3**			
49.	**MEASUREMENT OF FORCE AND TORQUE** INTRODUCTION, ELASTIC TRANSDUCER	1	12-09-2018		**TLM2**	CO4	**T1,T3**	
50.	STRAIN GAGE LOAD CELLS	1	15-09-2018		**TLM2**	CO4	**T1,T3**	
51.	DYNAMOMETERS-MECHANICAL, HYDRAULIC, ELECTRICAL	1	17-09-2018		**TLM2**	CO4	**T1,T3**	
52.	APPLICATIONS OF FORCE AND TORQUE MEASUREMENT	1	19-09-2018		**TLM2**	CO4	**T1,T3**	
53.	**Tutorial-IX**	1	20-09-2018		**TLM3**			
No. of classes required to complete UNIT-IV		15			No. of classes taken:			

UNIT-V

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
54.	**MEASUREMENT OF PRESSURE** INTRODUCTION, MANOMETERS	1	22-09-2018		**TLM2**	CO5	**T1,T3**	**T1,T3**
55.	DIAL TYPE PRESSURE GAUGE, PRESSURE TRANSDUCERS	1	24-09-2018		**TLM2**	CO5	**T1,T3**	
56.	PITOT, STATIC, AND PITOT-STATIC TUBE AND ITS CHARACTERISTICS	1	26-09-2018		**TLM2**	CO5	**T1,T3**	
57.	LOW PRESSURE MEASUREMENT GAUGES APPLICATIONS OF PRESSURE MEASUREMENT	1	27-09-2018		**TLM2**	CO5	**T1,T3**	
58.	**Tutorial-X**	1	29-09-2018		**TLM3**			
59.	**MEASUREMENT OF FLUID FLOW** INTRODUCTION, ROTAMETER	1	01-10-2018		**TLM2**	CO5	**T1,T3**	
60.	TURBINE FLOW METER, LASER DOPPLER	1	03-09-2018		**TLM2**	CO5	**T1,T3**	
61.	ANEMOMETER, HOT-WIRE ANEMOMETER, APPLICATIONS OF FLUID FLOW MEASUREMENT	1	05-09-2018		**TLM2**	CO5	**T1,T3**	
62.	**Tutorial-XI**	1	06-09-2018		**TLM3**			
63.	**MEASUREMENT OF TEMPERATURE** INTRODUCTION, TYPES OF THERMOMETERS	1	08-09-2018		**TLM2**	CO5	**T1,T3**	
64.	THERMOCOUPLES, RTD	1	10-09-2018		**TLM2**	CO5	**T1,T3**	
65.	THERMISTERS, PYROMETERS, APPLICATIONS OF	1	11-09-2018		**TLM2**	CO5	**T1,T3**	

	TEMPERATURE MEASUREMENT							
66.	**Tutorial-XII**	1	13-09-2018		**TLM3**			
No. of classes required to complete UNIT-V		13			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
67.	INTRODUCTION TO GEAR MEASUREMENTS	1	15-09-2018		**TLM2**	CO2	**T1,T3**	
68.	INTRODUCTION TO COMPARATORS	1	20-09-2018		**TLM2**	CO2	**T1,T3**	
69.	MEASUREMENT OF SPEED	1	22-09-2018		**TLM2**	CO4	**T1,T3**	

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/Assignment/Quiz

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**

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

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

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

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

PROGRAMME OUTCOMES (POs):

Engineering Graduates will be able to:

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

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

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

P.Sandeep Kumar	P.Sandeep Kumar	Prof. S Pichi Reddy	Prof. S Pichi Reddy
Course Instructor	**Course Coordinator**	**Module Coordinator**	**HOD**

COURSE HANDOUT

PROGRAM : B.Tech, VII-Sem., MECH
ACADEMIC YEAR : 2018-19
COURSE NAME & CODE : **Automation in manufacturing - S 138**
L-T-P STRUCTURE : 4-0-0
COURSE CREDITS : 3
COURSE INSTRUCTOR : **R.PRAVEEN KUMAR**
COURSE COORDINATOR : **R.PRAVEEN KUMAR**
PRE-REQUISITE : **PRODUCTION TECHNOLOGY**

COURSE OBJECTIVE : The main objective of this course is to emphasize the role of automation in manufacturing industries.

COURSE OUTCOMES (CO):
CO1: Accomplish automation in manufacturing industry.
CO2: Apply the techniques of automation in material handling and storage equipment's in industries.
CO3: Comprehend the knowledge on manufacturing systems and able to design single station manufacturing cell.
CO4: Apply various algorithms to solve manual and automated flow lines.
CO5: Apply the optimized Adaptive Control System in automation.

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	PSO 3
CO1	1	2		3	2							3		3	
CO2		2		2	2							3		3	
CO3		2	3	2	2							3		3	
CO4	2	2	2	3	3							3		3	
CO5	2	2	2	3	2							3		3	

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

BOS APPROVED TEXT BOOKS:

T1 Mikell P. Groover,"Automation, Production systems and computer integrated manufacturing", prentice Hall of India Private Ltd, New Delhi,3rd edition, 2008.

T2 Yoramkorem,"Computer Control of Manufacturing Systems", Tata McGraw Hill publishing company private Ltd,New Delhi.

BOS APPROVED REFERENCE BOOKS:

R1 P.Radhakrishan,S.Subramanyan,V.Raju,"CAD/CAM/CIM",New age International publishers,3rd edition,2010.

R2 Pessan David W,"Industrial Automation" first edition, Wiley publishers, 2011.

COURSE DELIVERY PLAN (LESSON PLAN): Section-A

UNIT-I: INTRODUCTION TO AUTOMATION

S.No.	Topics to be covered	No. of Classes	Tentative Date of	Actual Date of	Teaching Learning	Learning Outcome	Text Book	HOD Sign

		Required	Completion	Completion	Methods	COs	followed	Weekly
1.	Introduction of Manufacturing	1	11-06-18		TML1	CO1	T1/T2	
2.	Introduction of Automation in Manufacturing	1	12-06-18		TML1	CO1	T1/T2	
3.	Production system facilities	1	13-06-18		TML1	CO1	T1/T2	
4.	Manufacturing Support systems	1	16-06-18		TML1	CO1	T1/T2	
5.	Automation in Production systems	1	18-06-18		TML1	CO1	T1/T2	
6.	Tutorial	1	19-06-18		TML3	CO1	T1/T2	
7.	Basic elements of automated system	1	20-06-18		TML2	CO1	T1/T2	
8.	Advanced automation functions	1	23-06-18		TML1	CO1	T1/T2	
9.	Levels of automation	1	25-06-18		TML1	CO1	T1/T2	
10.	Automation principles & Strategies	1	26-06-18		TML2	CO1	T1/T2	
11.	Automation principles & Strategies	1	27-06-18		TML2	CO1	T1/T2	
12.	Tutorial	1	30-06-18		TML1	CO1	T1/T2	
No. of classes required to complete UNIT-I		12			No. of classes taken:			

UNIT-II: AUTOMATED MATERIAL HANDLING, MATERIAL TRANSPORT SYSTEMS AND STORAGE SYSTEMS.

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
13.	Introduction to Material Handling, overview of Material Handling	1	02-07-18		TML1	CO2	T1/T2	
14.	Considerations in Material Handling System Design	1	03-07-18		TML1	CO2	T1/T2	
15.	The 10 Principles of Material Handling	1	04-07-18		TML2	CO2	T1/T2	
16.	Industrial trucks, automated guided vehicle systems	1	07-07-18		TML2	CO2	T1/T2	
17.	Rail guided vehicles, conveyor systems, cranes and hoists.	1	09-07-18		TML2	CO2	T1/T2	
18.	Rail guided vehicles, conveyor systems, cranes and hoists.	1	10-07-18		TML2	CO2	T1/T2	
19.	Tutorial	1	11-07-18		TML3	CO2	T1/T2	
20.	Storage system performance, storage location strategies	1	16-07-18		TML1	CO2	T1/T2	
21.	Conventional storage methods and equipment, automated storage systems	1	17-07-18		TML1	CO2	T1/T2	
22.	Analysis of AS/RS	1	18-07-18		TML4	CO2	T1/T2	
23.	Analysis of AS/RS	1	21-07-18		TML4	CO2	T1/T2	
24.	Analysis of AS/RS	1	23-07-18		TML4	CO2	T1/T2	
25.	Revision	1	24-07-18		TML3	CO2	T1/T2	

No. of classes required to complete UNIT-II	13			No. of classes taken:

UNIT-III: INTRODUCTION TO MANUFACTURING SYSTEMS, SINGLE STATION MANUFACTURING CELLS

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
26.	Components of manufacturing systems	1	25-07-18		TML1	CO3	T1/T2	
27.	Classification of Manufacturing Systems	1	28-07-18		TML1	CO3	T1/T2	
28.	Overview of Classification Scheme,	1	20-08-18		TML1	CO3	T1/T2	
29.	Manufacturing progress functions	1	21-08-18		TML1	CO3	T1/T2	
30.	Tutorial	1	25-08-18		TML3	CO3	T1/T2	
31.	Single station manned workstations	1	27-08-18		TML3	CO3	T1/T2	
32.	Single station automated cells,	1	28-08-18		TML1	CO3	T1/T2	
33.	Applications	1	29-08-18		TML1	CO3	T1/T2	
34.	ANALYSIS OF single station cells.	1	01-09-18		TML4	CO3	T1/T2	
35.	Tutorial	1	03-09-18		TML3	CO3	T1/T2	
No. of classes required to complete UNIT-III		10			No. of classes taken:			

UNIT-IV: MANUAL ASSEMBLY LINES AND AUTOMATED FLOW LINES

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
36.	MANUAL ASSEMBLY LINES-fundamentals	1	04-09-18		TML1	CO4	T1/T2	
37.	Alternative assembly systems, design for Assembly	1	05-09-18		TML1	CO4	T1/T2	
38.	Analysis of single model assembly lines	1	10-09-18		TML4	CO4	T1/T2	
39.	Line balancing algorithms	1	11-09-18		TML1	CO4	T1/T2	
40.	Line balancing algorithms	1	12-09-18		TML1	CO4	T1/T2	
41.	Computer aided line balancing Algorithms	1	15-09-18		TML1	CO4	T1/T2	
42.	Mixed model assembly lines	1	17-09-18		TML1	CO4	T1/T2	
43.	Fundamentals of automated production lines, applications of automated production lines	1	18-09-18		TML1	CO4	T1/T2	
44.	Analysis of transfer lines with no internal storage	1	19-09-18		TML4	CO4	T1/T2	
45.	Analysis of transfer lines with internal storage	1	22-09-18		TML4	CO4	T1/T2	
46.	Tutorial	1	24-09-18		TML3	CO4	T1/T2	

No. of classes required to complete UNIT-IV	10			No. of classes taken:

UNIT-V: AUTOMATED ASSEMBLY SYSTEMS AND ADAPTIVE CONTROL SYSTEMS

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
47.	Automated assembly systems-fundamentals	1	25-09-18		TML1	CO5	T1/T2	
48.	Design for automated assembly,	1	26-09-18		TML1	CO5	T1/T2	
49.	Quantitative analysis of assembly systems.	1	29-09-18		TML4	CO5	T1/T2	
50.	Adaptive control with optimization	1	01-10-18		TML1	CO5	T1/T2	
51.	Application of A.C. in Machining operations.	1	03-10-18		TML1	CO5	T1/T2	
52.	Use of various parameters such as cutting force, Temperatures, vibration and acoustic emission	1	06-10-18		TML1	CO5	T1/T2	
53.	Use of various parameters such as cutting force, Temperatures, vibration and acoustic emission	1	08-10-18		TML1	CO5	T1/T2	
54.	Tutorial	1	09-10-18		TML3	CO5	T1/T2	
55.	Revision	1	10-10-18		TML3	CO5	T1/T2	
56.	Revision	1	13-10-18		TML3	CO5	T1/T2	
No. of classes required to complete UNIT-V		9			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
57.	Introduction Quality control	1	15-10-18		TML1	CO5		
58.	Advanced Quality Control processes	1	16-10-18		TML1	CO5		
59.	JIT, Lean manufacturing	1	20-10-18		TML1	CO5		

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

ACADEMIC CALENDAR:

Description	From	To	Weeks
I Phase of Instructions-1 + CRT Classes	11-06-2018	11-08-2018	7W+2W
I Mid Examinations	13-08-2018	18-08-2018	1W
II Phase of Instructions + CRT Classes	20-08-2018	27-10-2018	9W+1W
II Mid Examinations	29-10-2018	03-11-2018	1W
Preparation and Practical's	05-11-2018	17-11-2018	2W
Semester End Examinations	19-11-2018	01-12-2018	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
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**

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

Graduates of Mechanical Engineering programme will be:

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

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

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

PROGRAMME OUTCOMES (POs):

Engineering Graduates will be able to:

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

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

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

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

5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and 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.

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

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10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and

write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

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

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

PSOs:

Graduate of the Mechanical Engineering will have the ability to

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

Course Instructor	Course Coordinator	Module Coordinator	HOD
Mr.R.Praveen kumar	Mr.R.Praveen kumar	Mr.J.Subba Reddy	Dr.S.Pichi Reddy

COURSE HANDOUT

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

ACADEMIC YEAR : 2018-19

COURSE NAME & CODE : **Automation in manufacturing - S 138**

L-T-P STRUCTURE : 4-1-0

COURSE CREDITS : 3

COURSE INSTRUCTOR : **J. Venkata SomiReddy**

COURSE COORDINATOR : **R.PRAVEEN KUMAR**

PRE-REQUISITE : **PRODUCTION TECHNOLOGY**

COURSE OBJECTIVE : The main objective of this course is to emphasize the role of automation in manufacturing industries.

COURSE OUTCOMES (CO):

CO1: Accomplish automation in manufacturing industry.
CO2: Apply the techniques of automation in material handling and storage equipment's in industries.
CO3: Comprehend the knowledge on manufacturing systems and able to design single station manufacturing cell.
CO4: Apply various algorithms to solve manual and automated flow lines.
CO5: Apply the optimized Adaptive Control System in automation.

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	PSO 3
CO1	1	2		3	2							3		3	
CO2		2		2	2							3		3	
CO3		2	3	2	2							3		3	
CO4	2	2	2	3	3							3		3	
CO5	2	2	2	3	2							3		3	

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

BOS APPROVED TEXT BOOKS:

T1 Mikell P. Groover," Automation, Production systems and computer integrated manufacturing", prentice Hall of India Private Ltd, New Delhi, 3rd edition, 2008.

T2 Yoramkorem, "Computer Control of Manufacturing Systems", Tata McGraw Hill publishing company private Ltd,New Delhi.

BOS APPROVED REFERENCE BOOKS:

R1 P.Radhakrishan,S.Subramanyan,V.Raju,"CAD/CAM/CIM",New age International publishers, 3rd edition, 2010.

R2 Pessan David W,"Industrial Automation" first edition, Wiley publishers, 2011.

COURSE DELIVERY PLAN (LESSON PLAN): Section-A

UNIT-I: INTRODUCTION TO AUTOMATION

S.No.	Topics to be covered	No. of Classes	Tentative Date of	Actual Date of	Teaching Learning	Learning Outcome	Text Book	HOD Sign

		Required	Completion	Completion	Methods	COs	followed	Weekly
1.	Introduction of Manufacturing	1	11-06-18		TML1	CO1	T1/T2	
2.	Introduction of Automation in Manufacturing	1	12-06-18		TML1	CO1	T1/T2	
3.	Production system facilities	1	13-06-18		TML1	CO1	T1/T2	
4.	Manufacturing Support systems	1	18-06-18		TML1	CO1	T1/T2	
5.	Automation in Production systems	1	19-06-18		TML1	CO1	T1/T2	
6.	Tutorial	1	20-06-18		TML3	CO1	T1/T2	
7.	Basic elements of automated system	1	23-06-18		TML2	CO1	T1/T2	
8.	Advanced automation functions	1	25-06-18		TML1	CO1	T1/T2	
9.	Levels of automation	1	26-06-18		TML1	CO1	T1/T2	
10.	Automation principles & Strategies	1	27-06-18		TML2	CO1	T1/T2	
11.	Automation principles & Strategies	1	30-06-18		TML2	CO1	T1/T2	
12.	Tutorial	1	2-07-18		TML1	CO1	T1/T2	
No. of classes required to complete UNIT-I		12			No. of classes taken:			

UNIT-II: AUTOMATED MATERIAL HANDLING, MATERIAL TRANSPORT SYSTEMS AND STORAGE SYSTEMS.

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
13.	Introduction to Material Handling, overview of Material Handling	1	3-07-18		TML1	CO2	T1/T2	
14.	Considerations in Material Handling System Design	1	4-07-18		TML1	CO2	T1/T2	
15.	The 10 Principles of Material Handling	1	7-07-18		TML2	CO2	T1/T2	
16.	Industrial trucks, automated guided vehicle systems	1	9-07-18		TML2	CO2	T1/T2	
17.	Rail guided vehicles, conveyor systems, cranes and hoists.	1	10-07-18		TML2	CO2	T1/T2	
18.	Rail guided vehicles, conveyor systems, cranes and hoists.	1	11-07-18		TML2	CO2	T1/T2	
19.	Tutorial	1	16-07-18		TML3	CO2	T1/T2	
20.	Storage system performance, storage location strategies	1	17-07-18		TML1	CO2	T1/T2	
21.	Conventional storage methods and equipment, automated storage systems	1	18-07-18		TML1	CO2	T1/T2	

22.	Analysis of AS/RS	1	21-07-18		TML4	CO2	T1/T2	
23.	Analysis of AS/RS	1	23-07-18		TML4	CO2	T1/T2	
24.	Analysis of AS/RS	1	24-07-18		TML4	CO2	T1/T2	
25.	Revision	1	25-07-18		TML3	CO2	T1/T2	
No. of classes required to complete UNIT-II		13			No. of classes taken:			

UNIT-III: INTRODUCTION TO MANUFACTURING SYSTEMS, SINGLE STATION MANUFACTURING CELLS

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
26.	Components of manufacturing systems	1	20-08-18		TML1	CO3	T1/T2	
27.	Classification of Manufacturing Systems	1	21-08-18		TML1	CO3	T1/T2	
28.	Overview of Classification Scheme,	1	25-08-18		TML1	CO3	T1/T2	
29.	Manufacturing progress functions	1	27-08-18		TML1	CO3	T1/T2	
30.	Tutorial	1	28-08-18		TML3	CO3	T1/T2	
31.	Single station manned workstations	1	29-08-18		TML3	CO3	T1/T2	
32.	Single station automated cells,	1	01-09-18		TML1	CO3	T1/T2	
33.	Applications	1	04-09-18		TML1	CO3	T1/T2	
34.	ANALYSIS OF single station cells.	1	05-09-18		TML4	CO3	T1/T2	
35.	Tutorial	1	10-09-18		TML3	CO3	T1/T2	
No. of classes required to complete UNIT-III		10			No. of classes taken:			

UNIT-IV: MANUAL ASSEMBLY LINES AND AUTOMATED FLOW LINES

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
36.	MANUAL ASSEMBLY LINES-fundamentals	1	11-09-18		TML1	CO4	T1/T2	
37.	Alternative assembly systems, design for Assembly	1	12-09-18		TML1	CO4	T1/T2	
38.	Analysis of single model assembly lines	1	15-09-18		TML4	CO4	T1/T2	
39.	Line balancing algorithms	1	17-09-18		TML1	CO4	T1/T2	
40.	Computer aided line balancing Algorithms	1	18-09-18		TML1	CO4	T1/T2	

41.	Mixed model assembly lines	1	19-09-18		TML1	CO4	T1/T2	
42.	Fundamentals of automated production lines, applications of automated production lines	1	22-09-18		TML1	CO4	T1/T2	
43.	Analysis of transfer lines with no internal storage	1	24-09-18		TML4	CO4	T1/T2	
44.	Tutorial	1	25-09-18		TML3	CO4	T1/T2	
No. of classes required to complete UNIT-IV		10			No. of classes taken:			

UNIT-V: AUTOMATED ASSEMBLY SYSTEMS AND ADAPTIVE CONTROL SYSTEMS

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
45.	Automated assembly systems-fundamentals	1	26-09-18		TML1	CO5	T1/T2	
46.	Design for automated assembly,	1	29-09-18		TML1	CO5	T1/T2	
47.	Quantitative analysis of assembly systems.	1	01-10-18		TML4	CO5	T1/T2	
48.	Adaptive control with optimization	1	03-10-18		TML1	CO5	T1/T2	
49.	Application of A.C. in Machining operations.	1	06-10-18		TML1	CO5	T1/T2	
50.	Use of various parameters such as cutting force, Temperatures, vibration and acoustic emission	1	08-10-18		TML1	CO5	T1/T2	
51.	Use of various parameters such as cutting force, Temperatures, vibration and acoustic emission	1	09-10-18		TML1	CO5	T1/T2	
52.	Tutorial	1	10-10-18		TML3	CO5	T1/T2	
53.	Revision	1	13-10-18		TML3	CO5	T1/T2	
No. of classes required to complete UNIT-V		9			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
54.	Introduction Quality control	1	15-10-18		TML1	CO4		
55.	Advanced Quality Control processes	1	16-10-18		TML1	CO4		

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

ACADEMIC CALENDAR:

Description	From	To	Weeks
I Phase of Instructions-1	11-06-18	11-08-18	7W+2W
I Mid Examinations	13-08-18	18-08-18	1W
II Phase of Instructions	20-08-18	27-10-18	9W+1W
II Mid Examinations	29-10-18	3-11-18	1W
Preparation and Practical's	05-11-18	17-11-18	2W
Semester End Examinations	19-11-18	01-12-18	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
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**

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

COURSE HANDOUT

Part-A

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

ACADEMIC YEAR : 2018-19

COURSE NAME & CODE : Renewable Energy Sources - S 370

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

COURSE CREDITS : 3

COURSE INSTRUCTOR : K.Lakshmi Prasad

COURSE COORDINATOR : K.Lakshmi Prasad

PRE-REQUISITES: None

COURSE EDUCATIONAL OBJECTIVES (CEOs): To provide students an insight of various Renewable energy sources potential, energy conversion principles, technologies and capacities for generating power.

COURSE OUTCOMES (COs)

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

CO1: Comprehend the potential of Renewable energy sources and solar energy harnessing devices.

CO2: Apply the principles of energy conversion to study wind and Geothermal energy plants.

CO3: Analyze the power generating capacities of wave energy and ocean thermal energy plants.

CO4: Describe the biomass production system technologies and their capacities for generating power.

CO5: Comprehend different direct energy conversion principles, systems and potential for power generation.

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

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

BOS APPROVED TEXT BOOKS:

T1 G.D.Rai, Non-Conventional Energy Sources, 5th Edition 2011, Khanna Publishers, New Delhi, India.

T2 Kreith, F and Kreider, J. F., Principles of Solar Engineering, McGraw-Hill, 1978.

BOS APPROVED REFERENCE BOOKS:

R1 John Twidell&Tony Weir, Renewable Energy Resources - 2nd Edition ,Taylor & Francis

R2 Malcolm Flesher &ChrrisLawis Biological Energy Resources - Routledge Publishers

R3 G.N.Tiwari, Solar Energy - Fundamentals, Design, Modelling and Applications -
Narosa Publication Ltd.,2000.

R4 Ashok V Desai, Non-Conventional Energy- Wiley Eastern, 2000.

R5 Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press, U.K, 1996.

R6 G S Sawhney, Non-Conventional Energy Sources, Edition 2012, PHI Learning Private Limited, New Delhi, India

Part-B

COURSE DELIVERY PLAN (LESSON PLAN): Section-A

UNIT-I : Introduction

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 Subject	1	11.06.18		**TLM1**			
2.	Course Outcomes	1	12.06.18		**TLM1**			
3.	INTRODUCTION: Energy Scenario, Survey of Energy Resources	1	14.06.18		**TLM1**	CO1	T1,R6	
4.	Classification, Need for Non-Conventional Energy Resources	1	15.06.18		**TLM1**	CO1	T1	
5.	SOLAR ENERGY: The Sun - Sun-Earth Relationship	1	02.07.18		**TLM1**	CO1	T1	
6.	Solar radiation	1	03.07.18		**TLM1**	CO1	T1	
7.	Radiation measuring Instruments	1	05.07.18		**TLM1**	CO1	T1	
8.	SOLAR ENERGY APPLICATIONS: Solar water Heating	1	06.07.18		**TLM1**	CO1	T1	
9.	Space Heating	1	09.07.18		**TLM1**	CO1	T1,R6	
10.	Active and passive heating	1	10.07.18		**TLM1**	CO1	T1	
11.	Energy storage methods	1	12.07.18		**TLM1**	CO1	T1	
12.	solar stills & Solar ponds	1	13.07.18		**TLM1**	CO1	T1,R6	
13.	Solar refrigeration refrigeration	1	16.07.18		**TLM1**	CO1	T1	
14.	photovoltaic generation	1	17.07.18		**TLM1**	CO1	T1	
15.	**Quiz/Assignment**	1	19.07.18					
No. of classes required to complete UNIT-I		13			No. of classes taken:			

UNIT-II : Z-WIND ENERGY & GEOTHERMAL 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

16.	WIND ENERGY: Wind Radiation measuring Instruments	1	20.07.18		**TLM1**	CO2	T1,R6	
17.	Characteristics of wind energy& wind energy conversion systems	1	23.07.18		**TLM1**	CO2	T1	
18.	Types of wind	1	24.07.18		**TLM1**	CO2	T1	
19.	Betz model & Interference factor	1	26.07.18		**TLM1**	CO2	T1	
20.	Power Coefficient Torque Coefficient and thrust coefficient	1	27.07.18		**TLM1**	CO2	T1	
21.	Lift machines	1	30.07.18		**TLM1**	CO2	T1	
22.	drag machines	1	31.07.18		**TLM1**	CO2	T1	
23.	Matching& electricity generation	1	02.08.18		**TLM1**	CO2	T1	
24.	GEOTHERMAL ENERGY: Structure of Earth, Geothermal Regions	1	03.08.18		**TLM1**	CO2	T1	
25.	Hot springs, Hot Rocks& Hot Aquifers	1	06.08.18		**TLM1**	CO2	T1	
26.	Analytical Methods to estimate Thermal Potential	1	07.08.18		**TLM1**	CO2	T1	
27.	Electricity Generation Systems	1	09.08.18		**TLM1**	CO2	T1	
28.	**Quiz/Assignment**	1	10.08.18					
No. of classes required to complete UNIT-II		13			No. of classes taken:			

UNIT-III : ENERGY FROM OCEANS & WAVE 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
29	ENERGY FROM OCEANS: Tidal Energy	1	20.08.18		**TLM1**	CO3	T1,R6	
30	Tides – Diurnal and Semi	1	21.08.18		**TLM1**	CO3	T1	
31	Diurnal Nature of waves	1	23.08.18		**TLM1**	CO3	T1	
32	Power from Tides	1	24.08.18		**TLM1**	CO3	T1	
33	**WAVE ENERGY** : Introduction to waves	1	27.08.18		**TLM1**	CO3	T1,R6	

34	Theoretical Energy Available from waves	1	28.08.18		**TLM1**	CO3	T1	
35	Calculation of period and phase velocity of waves	1	30.08.18		**TLM1**	CO3	T1	
36	Wave energy conversion systems, submerged devices	1	31.08.18		**TLM1**	CO3	T1	
37	OCEAN THERMAL ENERGY: Principles	1	04.09.18		**TLM1**	CO3	T1,R6	
38	Heat Exchangers	1	06.09.18		**TLM1**	CO3	T1	
39	Pumping requirements& Practical Considerations.	1	07.09.18		**TLM1**	CO3	T1	
40	**Quiz/Assignment**	1	10.09.18		**TLM1**	CO3	T1	
No. of classes required to complete UNIT-III		12			No. of classes taken:			

UNIT-IV : BIO – 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
41.	BIO – ENERGY: Introduction, Biomass Energy Sources	1	11.09.18		**TLM1**	CO4	T1,R6	
42.	Plant Productivity Biomass Wastes	1	14.09.18		**TLM1**	CO4	T1	
43.	Aerobic and Anaerobic bio-conversion processes	1	17.09.18		**TLM1**	CO4	T1	
44.	Raw Materials and properties of Bio-gas	1	18.09.18		**TLM1**	CO4	T1	
45.	Bio-gas plant Technology and Status	1	20.09.18		**TLM1**	CO4	T1	
46.	The Energetic and Economics of Biomass systems	1	24.09.18		**TLM1**	CO4	T1	
47.	Biomass gasification	1	25.09.18		**TLM1**	CO4	T1	
48.	**Quiz/Assignment**	1	27.09.18		**TLM1**	CO4	T1	
No. of classes required to complete UNIT-IV		8			No. of classes taken:			

UNIT-V : DIRECT ENERGY CONVERSION SYSTEMS

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
49.	DIRECT ENERGY CONVERSION SYSTEMS: Introduction to direct energy conversion	1	28.09.18		**TLM1**	CO5	T1,R6	

	systems conversion							
50.	Peltier effect, seebeck effect, Thomson effect,	1	01.10.18		**TLM1**	CO5	T1	
51.	Fuel Cells	1	04.10.18		**TLM1**	CO5	T1	
52.	Efficiency of Fuel Cells and Solar Cells	1	05.10.18		**TLM1**	CO5	T1	
53.	Thermoelectric power, Thermionic electro power Generation	1	08.10.18		**TLM1**	CO5	T1	
54.	MHD Generator	1	09.10.18		**TLM1**	CO5	T1,R6	
55.	Open and closed systems	1	11.10.18		**TLM1**	CO5	T1	
56.	applications of direct energy energy conversion systems	1	15.10.18		**TLM1**	CO5	T1	
57.	**Quiz/Assignment**	1	16.10.18		**TLM1**	CO5	T1	
No. of classes required to complete UNIT-V		10			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
58.	Power production from Blue energy	1	18.10.18		**TLM1, TLM2**	CO1	T1,R6	
59.	Methanol production & applications	1	18.10.18		**TLM1, TLM2**	CO1	T1,R6	

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

Part - C

EVALUATION PROCESS:

Evaluation Task	**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**

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

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

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

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

PROGRAMME OUTCOMES (POs)

Engineering Graduates will be able to:

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

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

PSOs

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

Course Instructor	Course Coordinator	Module Coordinator	HOD

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

COURSE HANDOUT

Part-A

PROGRAM : B.Tech., VII Sem, Bsec, ME

ACADEMIC YEAR : 2018-19

COURSE NAME & CODE : Renewable Energy Sources - S 370

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

COURSE CREDITS : 3

COURSE INSTRUCTOR : Mr.K.Soma sekhar

COURSE COORDINATOR : Dr.P.Ravindra kumar

PRE-REQUISITES: None

COURSE EDUCATIONAL OBJECTIVES (CEOs): To provide students an insight of various Renewable energy sources potential, energy conversion principles, technologies and capacities for generating power.

COURSE OUTCOMES (COs)

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

CO1: Comprehend the potential of Renewable energy sources and solar energy harnessing devices.

CO2: Apply the principles of energy conversion to study wind and Geothermal energy plants.

CO3: Analyze the power generating capacities of wave energy and ocean thermal energy plants.

CO4: Describe the biomass production system technologies and their capacities for generating power.

CO5: Comprehend different direct energy conversion principles, systems and potential for power generation.

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

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

BOS APPROVED TEXT BOOKS:

T1 G.D.Rai, Non-Conventional Energy Sources, 5th Edition 2011, Khanna Publishers, New Delhi, India.

T2 Kreith, F and Kreider, J. F., Principles of Solar Engineering, McGraw-Hill, 1978.

BOS APPROVED REFERENCE BOOKS:

R1 John Twidell&Tony Weir, Renewable Energy Resources - 2nd Edition ,Taylor & Francis

R2 Malcolm Flesher &ChrrisLawis Biological Energy Resources - Routledge Publishers

R3 G.N.Tiwari, Solar Energy - Fundamentals, Design, Modelling and Applications - Narosa Publication Ltd.,2000.

R4 Ashok V Desai, Non-Conventional Energy- Wiley Eastern, 2000.

R5 Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press, U.K, 1996.

R6 G S Sawhney, Non-Conventional Energy Sources, Edition 2012, PHI Learning Private Limited, New Delhi, India

Part-B

COURSE DELIVERY PLAN (LESSON PLAN): Section-A

UNIT-I : INTRODUCTION TO SOLAR ENERGY, SOLAR ENERGY 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
1.	Introduction to Subject	1	11-6-2018		**TLM1**			
2.	Course Outcomes	1	13-6-2018		**TLM1**			
3.	INTRODUCTION: Energy Scenario, Survey of Energy Resources	1	15-6-2018		**TLM1 & TLM2**	CO1	T1,R6	
4.	Classification, Need for Non-Conventional Energy Resources	1	18-6-2018		**TLM1**	CO1	T1	
5.	SOLAR ENERGY: The Sun - Sun-Earth Relationship	1	20-6-2018		**TLM1 & TLM2**	CO1	T1	
6.	Solar radiation	1	22-6-2018		**TLM1**	CO1	T1	
7.	Radiation measuring Instruments	1	22-6-2018		**TLM1**	CO1	T1	
8.	SOLAR ENERGY APPLICATIONS: Solar water Heating	1	23-6-2018		**TLM1 & TLM2**	CO1	T1	
9.	Space Heating	1	25-6-2018		**TLM1**	CO1	T1,R6	
10.	Active and passive heating	1	27-6-2018		**TLM1**	CO1	T1	
11.	Energy storage methods	1	29-6-2018		**TLM1**	CO1	T1	
12.	solar stills & Solar ponds	1	30-6-2018		**TLM1**	CO1	T1,R6	
13.	Solar refrigeration refrigeration	1	2-7-2018		**TLM1**	CO1	T1	

14.	photovoltaic generation	1	4-7-2018		**TLM1 & TLM2**	CO1	T1	
15.	**Quiz/Assignment**	1	6-7-218		**TLM6**			
No. of classes required to complete UNIT-I		13			No. of classes taken:			

UNIT-II : Z-WIND ENERGY & GEOTHERMAL 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
16.	WIND ENERGY: Wind Radiation measuring Instruments	1	7-7-2018		**TLM1**	CO2	T1,R6	
17.	Characteristics of wind energy& wind energy conversion systems	1	9-7-2018		**TLM1**	CO2	T1	
18.	Types of wind	1	11-7-2018		**TLM1**	CO2	T1	
19.	Betz model & Interference factor	1	13-7-2018		**TLM1**	CO2	T1	
20.	Power Coefficient Torque Coefficient and thrust coefficient	1	14-7-2018		**TLM1**	CO2	T1	
21.	Lift machines	1	16-7-2018		**TLM1 & TLM2**	CO2	T1	
22.	drag machines	1	18-7-2018		**TLM1 & TLM2**	CO2	T1	
23.	Matching& electricity generation	1	20-7-2018		**TLM1**	CO2	T1	
24.	GEOTHERMAL ENERGY: Structure of Earth, Geothermal Regions	1	21-7-2018		**TLM1**	CO2	T1	
25.	Hot springs, Hot Rocks& Hot Aquifers	1	23-7-2018		**TLM1**	CO2	T1	
26.	Analytical Methods to estimate Thermal Potential	1	25-7-2018		**TLM1**	CO2	T1	
27.	Electricity Generation Systems	1	27-7-2018		**TLM1**	CO2	T1	
28.	**Quiz/Assignment**	1	28-7-2018		**TLM6**			
No. of classes required to complete UNIT-II		13			No. of classes taken:			
CRT CLASSES (2Weeks)								

UNIT-III : ENERGY FROM OCEANS & WAVE 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
29	ENERGY FROM OCEANS: Tidal Energy	1	20-8-2018		**TLM1**	CO3	T1,R6	
30	Tides – Diurnal and Semi	1	24-8-2018		**TLM1**	CO3	T1	
31	Diurnal Nature of waves	1	25-8-2018		**TLM1**	CO3	T1	
32	Power from Tides	1	27-8-2018		**TLM1 & TLM2**	CO3	T1	
33	**WAVE ENERGY** : Introduction to waves	1	29-8-2018		**TLM1**	CO3	T1,R6	
34	Theoretical Energy Available from waves	1	31-8-2018		**TLM1**	CO3	T1	
35	Calculation of period and phase velocity of waves	1	1-9-2018		**TLM1**	CO3	T1	
36	Wave energy conversion systems, submerged devices	1	3-9-2018		**TLM1**	CO3	T1	
37	OCEAN THERMAL ENERGY: Principles	1	5-9-2018		**TLM1**	CO3	T1,R6	
38	Heat Exchangers	1	7-9-2018		**TLM1 & TLM2**	CO3	T1	
39	Pumping requirements& Practical Considerations.	1	10-9-2018		**TLM1**	CO3	T1	
40	**Quiz/Assignment**	1	12-9-2018		**TLM6**	CO3	T1	
No. of classes required to complete UNIT-III		12			No. of classes taken:			

UNIT-IV : BIO – 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
41.	BIO – ENERGY: Introduction, Biomass Energy Sources	1	14-9-2018		**TLM1 & TLM2**	CO4	T1,R6	
42.	Plant Productivity Biomass Wastes	1	15-9-2018		**TLM1**	CO4	T1	
43.	Aerobic and Anaerobic bio-conversion processes	1	17-9-2018		**TLM1**	CO4	T1	
44.	Raw Materials and properties of Bio-gas	1	21-9-2018		**TLM1**	CO4	T1	
45.	Bio-gas plant Technology and Status	1	22-9-2018		**TLM1**	CO4	T1	

46.	The Energetic and Economics of Biomass systems	1	24-9-2018		**TLM1**	CO4	T1	
47.	Biomass gasification	1	26-9-2018		**TLM1 & TLM2**	CO4	T1	
48.	**Quiz/Assignment**	1	28-9-2018		**TLM6**	CO4	T1	
No. of classes required to complete UNIT-IV		8			No. of classes taken:			

UNIT-V : DIRECT ENERGY CONVERSION SYSTEMS

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
49.	DIRECT ENERGY CONVERSION SYSTEMS: Introduction to direct energy conversion systems conversion	1	29-9-2018		**TLM1**	CO5	T1,R6	
50.	Peltier effect, seebeck effect, Thomson effect,	1	1-10-2018		**TLM1**	CO5	T1	
51.	Fuel Cells	1	3-10-2018		**TLM1 & TLM2**	CO5	T1	
52.	Efficiency of Fuel Cells and Solar Cells	1	5-10-2018		**TLM1**	CO5	T1	
53.	Thermoelectric power, Thermionic electro power Generation	1	6-10-2018		**TLM1**	CO5	T1	
54.	MHD Generator	1	8-10-2018		**TLM1**	CO5	T1,R6	
55.	Open and closed systems	1	10-10-2018		**TLM1**	CO5	T1	
56.	applications of direct energy energy conversion systems	1	12-10-2018		**TLM1**	CO5	T1	
57.	**Quiz/Assignment**	1	15-10-2018		**TLM6**	CO5	T1	
No. of classes required to complete UNIT-V		10			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
58.	Power production from Blue energy	1	17-10-2018		**TLM1, TLM2**	CO1	T1,R6	
59.	Methanol production & applications	1	19-10-2018		**TLM1, TLM2**	CO1	T1,R6	

CRT CLASSES (1 Week)

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

Part - C
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**

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

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

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

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

PROGRAMME OUTCOMES (POs)

Engineering Graduates will be able to:

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

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

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

cultural, societal, and environmental considerations.

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

5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

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

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

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

9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

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

11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinaryenvironments.

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

PSOs

1. To apply the principles of thermal sciences to design and develop various thermal systems.

2. To apply the principles of manufacturing technology, scientific management towards improvement of quality and optimization of engineering systems in the design, analysis and manufacturability of products.

3. To apply the basic principles of mechanical engineering design or evaluation of performance of various systems relating to transmission of motion and power, conservation of energy and other process equipment.

Course Instructor	Course Coordinator	Module Coordinator	HOD
K.Soma sekhar	Dr.Ravindra kumar	Dr.P.Vijay kumar	Dr.S. Pichi Redddy

LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING

(Autonomous)

Affiliated to JNTUK, Kakinada & Approved by AICTE New Delhi

Accredited by NBA (Tier – I), New Delhi & certified by ISO 9001:2015

DEPARTMENT OF MECHANICAL ENGINEERING

Laboratory Code	**: L117**	**Lab:**	**CAD/CAM Lab**
Lab/Practicals	**: 2 hrs/ Week**	**Continuous Internal Assessment**	**: 25**
A.Y.	**: 2018-19**	**Semester End Examination**	**: 75**
Class & Semester	**: B. Tech – VII Semester**	**Section**	**: A**
Instructors	**: Dr. M. Pulla Rao, Associate Professor**		
	Mr. J. Venkata SomiReddy, Assistant Professor		

COURSE EDUCATIONAL OBJECTIVES: To Familiarize the students with

1. Modelling and Assembly of part bodies using graphic packages.
2. Perform kinematic and interference analysis.
3. Apply FEA principles in designing of components.
4. Develop NC code for different part profiles and perform machining on CNC machines.
5. Manipulate the robot by writing programs and executing them.

COURSE OUTCOMES:

CO 1	Design and assemble of the parts using geometric modeling.
CO2	Perform kinematic and interference analysis.
CO3	Apply FEA principles in designing of components.
CO4	Develop NC code for different part profiles and perform machining on CNC Machines.

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

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Class & Semester	**: B. Tech – VII Semester**		**Section**	**: A**
Instructors	**: Dr. M. Pulla Rao, Associate Professor**			
	Mr. J. Venkata SomiReddy, Assistant Professor			

CAD/CAM Lab list of experiments and the schedule
VII, Section-A, Mechanical Engineering, AY:2018-19

Tuesday batch (14761A0301 to 336)			
Planned Date	**Expt. Number**	**Title of the experiment**	**Actual Date**
12-06-18		Introduction	
	1(a)	Knuckle joint - Part drawing	
3-07-18	1(b)	Knuckle joint - Assembly	
	2(a)	Universal coupling - Part drawing	
10-07-18	2(b)	Universal coupling - Assembly	
	3(a)	Piston-Connecting rod - Part drawing	
17-07-18	3(b)	Piston-Connecting rod - Assembly	
24-07-18	4	Cant-lever beam structural analysis	
31-07-18	5	Truss structural analysis	
07-08-18	6	Knuckle joint structural analysis	
21-08-18	7	Spring-mass system modal analysis	
28-08-18	8	Pin Fin heat transfer analysis	
04-09-18	9	Linear and circular interpolation using XL mill	
11-09-18	10	CNC programming for turning operation	
18-09-18		Repetition	
25-09-18		Repetition	
9-10-18		Internal Exam	

Thursday batch (14761A0337 to 358 and 15765A0301 to L-315)			
Planned Date	**Expt. Number**	**Title of the experiment**	**Actual Date**
14-06-18		Introduction	14-07-2017
	1(a)	Knuckle joint - Part drawing	
5-07-18	1(b)	Knuckle joint - Assembly	21-07-2017
	2(a)	Universal coupling - Part drawing	
12-07-18	2(b)	Universal coupling - Assembly	04-08-2017
	3(a)	Piston-Connecting rod - Part drawing	
19-07-18	3(b)	Piston-Connecting rod - Assembly	18-08-2017
26-07-18	4	Cant-lever beam structural analysis	01-09-2017
02-08-18	5	Truss structural analysis	22-09-2017
09-08-18	6	Knuckle joint structural analysis	06-10-2017
23-08-18	7	Spring-mass system modal analysis	13-10-2017
30-08-18	8	Pin Fin heat transfer analysis	20-10-2017
06-09-18	9	Linear and circular interpolation using XL mill	27-10-2017
20-09-18	10	CNC programming for turning operation	27-10-2017
27-09-18		Revision	
04-10-18		Revision	03-11-2017
11-10-18		Internal Exam	13-11-2017

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

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

COURSE HANDOUT

PROGRAM : B.Tech., VII-Sem., MECH (B)
ACADEMIC YEAR : 2018-19
COURSE NAME & CODE : **CAD/CAM LAB – L117**
L-T-P STRUCTURE : 0-0-2
COURSE CREDITS : **2**
COURSE INSTRUCTOR : **A NAGESWARA RAO/ B KAMALA PRIYA**
COURSE COORDINATOR : **A NAGESWARA RAO**
PRE-REQUISITE: CAD/CAM

COURSE EDUCATIONAL OBJECTIVES: To familiarize the students with

6. Modelling and Assembly of part bodies using graphic packages.
7. Analysis of modeled parts.
8. Finite element analysis of given continuum.
9. Part programming and machining on CNC machines.
10. Robotic programming, simulation and execution.

COURSE OUTCOMES:

CO1	Design and assemble of the parts using geometric modelling.
CO2	Perform kinematic and interference analysis.
CO3	Apply FEA principles in designing of components.
CO4	Develop NC code for different part profiles and perform machining on CNC Machines.
CO5	Manipulate the robot by writing programs and executing them.

MATERIAL:
T1 Lab Manual

COURSE DELIVERY PLAN (LESSON PLAN): Section-B
BATCH - 1

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
379.	Introduction	2	12-06-18		TLM8	CO1	T1	
380.	Knuckle joint - Part drawing	2			TLM8	CO1	T1	
381.	Knuckle joint - Assembly	2	03-07-18		TLM8	CO1	T1	
382.	Universal coupling - Part drawing	2			TLM8	CO1	T1	
383.	Universal coupling - Assembly	2	10-07-18		TLM8	CO1	T1	
384.	Piston-Connecting rod - Part drawing	2			TLM8	CO2	T1	
385.	Piston-Connecting rod - Assembly	2	17-07-18		TLM8	CO2	T1	
386.	Cantilever beam structural analysis	2	24-07-18		TLM8	CO3	T1	
387.	Truss structural analysis	2	31-07-18		TLM8	CO3	T1	

388.	Knuckle joint structural analysis	2	07-08-18		TLM8	CO4	T1	
389.	Spring-mass system modal analysis	2	21-08-18		TLM8	CO4	T1	
390.	Pin Fin heat transfer analysis	2	28-08-18		TLM8	CO4	T1	
391.	Linear and circular interpolation using XL mill	2	04-09-18		TLM8	CO5-	T1	
392.	CNC programming for turning operation	2	11-09-18		TLM8	CO5	T1	
393.	Repetition	2	18-09-18					
394.	Repetition	2	25-09-18					
17	Internal Exam	2	9-10-18					
No. of classes required to complete		**34**			**No. of classes taken:**			

BATCH-2

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	2	15-06-18		TLM8	CO1	T1	
2.	Knuckle joint - Part drawing	2			TLM8	CO1	T1	
3.	Knuckle joint - Assembly	2	06-07-18		TLM8	CO1	T1	
4.	Universal coupling - Part drawing	2			TLM8	CO1	T1	
5.	Universal coupling - Assembly	2	13-07-18		TLM8	CO1	T1	
6.	Piston-Connecting rod - Part drawing	2			TLM8	CO2	T1	
7.	Piston-Connecting rod - Assembly	2	20-07-18		TLM8	CO2	T1	
8.	Cantilever beam structural analysis	2	27-07-18		TLM8	CO3	T1	
9.	Truss structural analysis	2	03-08-18		TLM8	CO3	T1	
10.	Knuckle joint structural analysis	2	10-08-18		TLM8	CO4	T1	
11.	Spring-mass system modal analysis	2	17-08-18		TLM8	CO4	T1	
12.	Pin Fin heat transfer analysis	2	24-08-18		TLM8	CO4	T1	
13.	Linear and circular interpolation using XL mill	2	31-08-18		TLM8	CO5-	T1	
14.	CNC programming for turning operation	2	07-09-18		TLM8	CO5	T1	
15.	Repetition	2	21-09-18					
16.	Repetition	2	28-09-18					
17	Internal Exam	2	05-10-18					
No. of classes required to complete		**34**			**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

PROGRAMME EDUCATIONAL OBJECTIVES:

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

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

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

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyse 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.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

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

Course Instructor	Course Coordinator	Module Coordinator	HOD
A Nageswara Rao	A Nageswara Rao	J SUBBA REDDY	S PICHI REDDY