INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

MECHANICAL ENGINEERING

COURSE DESCRIPTOR

Course Title	**METALLURGY AND MECHANICS OF SOLIDS LABORATORY**				
Course Code	AME104				
Programme	B. Tech				
Semester	III	ME			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	-	-	-	3	2
Chief Coordinator	Dr. K. Viswanath Allamraju, Professor,				
Course Faculty	Dr. K. Viswanath Allamraju, Professor. Mr A.Somaiah, Assistant Professor. Mr M.Prashanth Reddy, Assistant Professor. Mr. G. Aravind Reddy, Assistant Professor.				

I. COURSE OVERVIEW:

The aim of this course is to study the mechanical properties of materials such as tensile strength, modulus of rigidity, hardness, impact strength and compressive strength through experimentation. Experimental results are verified analytically. Preparation of the samples of ferrous and non-ferrous materials can be done and observation of microstructures can be done under supervision.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AME002	II	Engineering Mechanics	4

III. MARKSDISTRIBUTION

Subject	SEE Examination	CIA Examination	Total Marks
Computational Mechanical Engineering Laboratory	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

√	Marker & talk	√	Quiz	√	Assignments	✘	Moocs
√	Lcd / ppt	√	Seminars	✘	Mini project	✘	Videos
✘	Open ended experiments						

V. EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks for internal assessment and 70 marks for semester end lab examination. Out of 30 marks of internal assessment, continuous lab assessment will be done for 20 marks for the day to day performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end lab examination for 70 marks shall be conducted by two examiners, one of them being Internal Examiner and the other being External Examiner, both are nominated by the Principal from the panel of experts recommended by Chairman, BOS.

The emphasis on the experiments is broadly based on the following criteria:

20 %	To evaluate the preparedness for the programme.
20 %	To write the programme with input and computational variables.
20 %	To study the calculations and graphs related to the concern programme.
20 %	To interpret the results and the error analysis of the programme.
20 %	To test the subject knowledge through viva – voce.

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Table 1: Assessment pattern for CIA

Component	Laboratory		Total Marks
Type of Assessment	Day to day performance	Final internal lab assessment	
CIA Marks	20	10	30

Continuous Internal Examination (CIE):

One CIE exams shall be conducted at the end of the 16th week of the semester. The CIE exam is conducted for 10 marks of 3 hours duration.

Preparation	Performance	Calculations and Graph	Results and Error Analysis	Viva	Total
2	2	2	2	2	10

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes		Level	Proficiency assessed by
PO1	Engineering Knowledge: Capability to apply the knowledge of mathematics, science and engineering in the field of mechanical engineering.	3	Presentation on real-world problems
PO2	Problem Analysis: An ability to analyze complex engineering problems to arrive at relevant conclusion using knowledge of mathematics, science and engineering.	3	Seminar
PO3	Design/ development of solutions: Competence to design a system, component or process to meet societal needs within realistic constraints.	3	Seminar
PO4	Conduct investigations of complex problems: To design and conduct research oriented experiments as well as to analyze and implement data using research methodologies.	3	Term Paper

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes		Level	Proficiency assessed by
PSO1	**Professional Skills:** To produce engineering professional capable of synthesizing and analyzing mechanical systems including allied engineering streams.	3	Lecture, Assignments.
PSO2	**Problem solving skills**: An ability to adopt and integrate current technologies in the design and manufacturing domain to enhance the employability.	3	Projects
PSO3	**Successful career and Entrepreneurship**: To build the nation, by imparting technological inputs and managerial skills to become technocrats.	3	Projects

3= High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Determination of mechanical properties of different materials.
II	Establish the constitutive relations in metals using destructive methods.
III	Understand the behavior of members during twisting and transverse loading.
IV	Familiarize with standard test specimens.
V	Prepare samples for investigating micro structure of different materials.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AME104.01	CLO1	Able to draw the stress strain diagram of ductile materials.	PO 1	3
AME104.02	CLO2	Able to draw the stress strain diagram of brittle materials.	PO 1, PO 3	3
AME104.03	CLO3	Calculate the ultimate tensile strength , percentage of elongation ,percentage of reduction of area of ductile materials by	PO 1, PO 3	3

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
		using UTM.		
AME104.04	CLO4	Calculate the ultimate tensile strength , percentage of elongation ,percentage of reduction of area of brittle materials by using UTM.	PO 1, PO 2, PO 4	2
AME104.05	CLO5	Analyze the applicability and accuracy of numerical solutions to diverse mechanical engineering problems.	PO 1, PO 3	2
AME104.06	CLO6	Calculate the modulus of rigidity of a given specimen by using torsion testing machine.	PO 1, PO 2, PO 4	2
AME104.07	CLO7	Able to understand the hardness of copper, mild steel, aluminium and brass materials.	PO 1, PO 2, PO 3	1
AME104.08	CLO8	Able to draw the relation between T-Ɵ diagram.	PO 1, PO 2, PO 3	1
AME104.09	CLO9	Preparation and study of the microstructure of mild steels, low carbon steels, high–C steels.	PO 1, PO 2	2
AME104.10	CLO10	Understand torsion equation of circular shaft which is fixed at one end and free at other end.	PO 1, PO 3	2
AME104.11	CLO11	Calculate compressive strength of a given specimen by using compression testing machine.	PO 1, PO 3	3
AME104.12	CLO12	Able to prepare and study the micro Structure of pure metals like iron, cu and Al.	PO 1, PO 2	3
AME104.13	CLO13	Calculate impact strength of a given specimen.	PO 1, PO 3	3
AME104.14	CLO14	Able to understand hardenability of steels by jominy end quench test.	PO 1, PO 2	2
AME104.15	CLO15	Analyze the micro structures of cast irons	PO 1, PO 3, PO 4	2
AME104.16	CLO16	Study of the micro structures of non-ferrous alloys	PO 1, PO 2	2
AME104.17	CLO17	Study of the micro structures of heat treated steels.	PO 1, PO 2	3
AME104.18	CLO18	Analyze the micro structures of non-ferrous alloys	PO 1, PO 2	2
AME104.19	CLO19	Able to understand the behavior of spring under gradually applied load.	PO 1, PO 3, PO 4	1
AME104.20	CLO20	Study the variation of stress along the cross section of the beam under uniformly distributed load.	PO 1, PO 2	1

3= High; 2 = Medium; 1 = Low

X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

CLOs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3												1	2	

CLOs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 2	3		3										1		
CLO 3	3		3										1	2	
CLO 4	2	2		2									1	2	
CLO 5	2		2										1	2	
CLO 6	2	2		2										2	
CLO 7	1	1	1										1		
CLO 8	1	1	1											2	
CLO 9	2	2												2	
CLO 10	2		2										1		
CLO 11	3		3											2	
CLO 12	3	3											1		
CLO 13	3		3										1	2	
CLO 14	2	2											1		
CLO 15	2		2	2									1	2	
CLO 16	2	2											1		
CLO 17	3	3											1		
CLO 18	2	2											1	2	
CLO 19	1		1	1										2	
CLO 20	1	1												2	

3= High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO1, PO2,PO3	SEE Exams	PO1,PO4	Assignments	-	Seminars	PO4
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	PO4						

XII. ASSESSMENT METHODOLOGIES–INDIRECT

√	Assessment of course Outcomes (by feedback, once)	√	Student feedback on faculty (twice)
✘	Assessment of mini projects by experts		

XIII. SYLLABUS:

Week-I	**MICROSTRUCTURE OF PURE METALS**
Preparation and study of the micro Structure of pure metals like iron, cu and al.	
Week -II	**MICROSTRUCTURE OF STEELS.**
Preparation and study of the microstructure of mild steels, low carbon steels, high–C steels.	
Week -III	**MICROSTRUCTURE OF CAST IRON.**
Study of the micro structures of cast irons.	
Week -IV	**MICROSTRUCTURE OF NON FERROUS ALLOYS.**
Study of the micro structures of non-ferrous alloys.	
Week -V	**MICROSTRUCTURE OF HEAT TREATED STEELS.**
Study of the micro structures of heat treated steels.	
Week-VI	**HARDENABILITY OF STEELS.**
Hardenability of steels by Jominy end quench test.	
Week -VII	**HARDNESS OF STEELS.**
To find out the hardness of various treated and untreated steels.	
Week -VIII	**TENSION TEST.**
To Find % of elongation and young's modulus of a material.	
Week-IX	**TORSION TEST.**
To find the torsional rigidity of a material.	
Week –X	**HARDNESS TEST.**
a) Brinell's hardness test. b) Rockwell hardness test.	
Week -XI	**SPRING TEST**
Testing on compressive and elongation springs.	
Week -XII	**SHEAR TEST AND COMPRESSION TEST**
Punch shear test on aluminium sheet. Finfd out the compression strength of a given specimen.	
Text Books:	

1. Sidney H Avner, "Introduction to Physical Metallurgy", McGraw Hill Education, 2nd Edition, 2008.
2. William, Callister, "Material Science and Engineering", Wiley, 9th Edition, 2014.
3. V Raghavan, "Elements of Material Science", PHI Learning Company Pvt Ltd, 6th Edition, 2015.

Reference Books:

1. Er.Amandeep Singh Wadhva, "Engineering Materials and Metallurgy", Laxmi Publications, 1st Edition, 2008.
2. Traugott Fisher, "Material Science", 1st Edition, Academic Press Elsevier, 2013.

Web References:

1. http://www.tutorialspoint.com /MOS lab
2. www.iare.ac.in

XIV. COURSE PLAN:

The course plan is meant as a guideline. There may probably be changes.

Week No	Topic/s to be covered	Course Learning Outcomes (CLOs)	Reference
1	Mechanical properties of materials.	CLO1	T1-1.1 , R1- 1.31.4 ,R2.1.7
2	Stress strain diagrams of ductile materials.	CLO1	T1- 1.2, R1-1.8,
3	Stress strain diagram of brittle materials.	CLO1,CLO19	T1- 1.15, R1- 1.16
4	Normal stress and shear stress calculations.	CLO2,CLO17	T1- 1.6
5	Elastic constants.	CLO2	T1- 2.2, R2-2.6
6	Poison's ratio of ductile and brittle materials.	CLO2,CLO15	T1-2.6, R3-2.10
7	Modulus of rigidity of a material by torsion test rig.	CLO6	T1-3.2, R2-3.3,
8	Preparation of samples of Cu for studying the microstructure.	CLO12	T1-3.5
9	Compressive strength of a given specimen.	CLO11	T1-2.13, 2.14,R1- 2.16
10	Study of microstructure of non- ferrous alloys.	CLO16	T1-2.15, R1-2.15
11	Hardness of materials	CLO12,CLO13	T1-3.9, R1-3.9
12	Modulus of rigidity under gradually applied loads.	CLO19	T1-6.1, R2-6.3

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Parametric program of calculations in softwares.	Seminars	PO 1, PO 4	PSO 1
2	Interpretation of results by testing various materials	Seminars / NPTEL	PO 4, PO3	PSO 1
3	Encourage students to design beams by writing MATLAB code to solve the mode shapes	NPTEL	PO 2	PSO 1

Prepared by:
Dr. K. Viswanath Allamraju, Professor.

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