INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

MECHANICALENGINEERING

COURSE DESCRIPTOR

Course Title	DESIGN OF MACHINE MEMBERS				
Course Code	AME012				
Programme	B.Tech				
Semester	V	ME			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	-	-
Chief Coordinator	Dr. GVR Seshagiri Rao, Professor				
Course Faculty	Mr. VKVS Krishnam Raju, Associate Professor				

I. COURSE OVERVIEW:

Machine design occupies an important role in the mechanical engineering course. The design of machine members focus mainly on design of machine elements subjected to various types of loads and components include joints; Riveted, Welded, threaded joints shafts and springs. Design basis is strength and stiffness of the parts and selection of material for manufacture of machine elements.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AME002	II	Engineering Mechanics	4
UG	AME005	III	Metallurgy and material science	3
UG	AME004	III	Mechanics of solids	4
UG	AME009	IV	Kinematics of machinery	4

III. MARKSDISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Design of Machine Members	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✘	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✔	Videos
✘	Open Ended Experiments						

V. EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into five units and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

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

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz / AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Presentation on Real-world problems
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	2	Seminar
PO 3	**Design/ development of solutions:** Competence to design a system, component or process to meet societal needs within realistic constraints.	2	Assignment
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	2	Publication

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Professional Skills:** To produce engineering professional capable of synthesizing and analyzing mechanical systems including allied engineering streams.	3	Seminar/ Project reviews
PSO 2	**Problem-Solving Skills :** An ability to adopt and integrate current technologies in the design and manufacturing domain to enhance the employability.	2	Project works major and mini
PSO 3	**Successful Career and Entrepreneurship:** To build the nation, by imparting technological inputs and managerial skills to become technocrats.	2	Internship/ Industrial visit/work shops

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES :

The course should enable the students to:	
I	Develop an ability to apply knowledge of mathematics, science, and engineering Outcomes
II	Knowledge of various design standards, safety, reliability, importance of dimensional parameters and manufacturing aspects in mechanical design.
III	Understanding the concepts of stresses, theories of failure and material science to analyze, design and/or select commonly used machine components.
IV	To develop an ability to identify, formulate, and solve various machine members problems

IX. COURSE OUTCOMES (COs):

COs	Course Outcome	CLOs	Course Learning Outcome
CO 1	Understanding design and analysis of power transmitting elements, selection of suitable materials and manufacturing processes.	CLO 1	Understand various design variables and factors in the study of machine elements.
		CLO 2	Explain the steps involved in design process, BIS Codes of Steels.
		CLO 3	Understand the various Theories of failure, Design for Strength and rigidity.
		CLO 4	Understand theories of failures, stress concentration and fluctuating stresses.
		CLO 5	Explain estimation of endurance strength.
CO 2	Analyzing the forces acting on various joints and their design.	CLO 6	Ability to design lap and butt joints in riveted joints.
		CLO 7	Explain design of welded joints, effects various stresses.
		CLO 8	Explain the design procedure of various joints.
		CLO 9	Understand the applications and comparison of various joints.
		CLO 10	Explain bolts of uniform strength.
CO 3	To develop an ability to identify, formulate, and solve various machine members problems	CLO 11	Understand various stresses in keys.
		CLO 12	Ability to design procedure for keys.
		CLO 13	Ability to design spigot and socket joint.
		CLO 14	Understand Jib and Cotter joint and design procedure.
		CLO 15	Ability to design knuckle joints.
CO 4	Ability to design and analyze shafts with different geometrical features under various loading conditions.	CLO 16	Explain the design of shafts for complex loads.
		CLO 17	Explain the design procedures of various shaft couplings.
		CLO 18	Ability to design shafts for various types of loading.
		CLO 19	Compare various shaft couplings and applications.
		CLO 20	Ability to Design of various shaft couplings.
CO 5	Ability to analyze and design of different Springs for required application.	CLO 21	Understand of the basic features of springs.
		CLO 22	Explain the design procedure for various springs.
		CLO 23	Ability to design the various springs.
		CLO 24	Compare applications of Extension springs.
		CLO 25	Explain different types of end styles for helical compression and tension springs.

X. 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
AME012.01	CLO 1	Understand various design variables and factors in the study of machine elements.	PO 2	2
AME012.02	CLO 2	Explain the steps involved in design process, BIS Codes of Steels.	PO 2	2
AME012.03	CLO 3	Understand the various Theories of failure, Design for Strength and rigidity.	PO 2	2
AME012.04	CLO 4	Understand theories of failures, stress concentration and fluctuating stresses.	PO 2	2
AME012.05	CLO 5	Explain estimation of endurance strength.	PO 2	2
AME012.06	CLO 6	Ability to design lap and butt joints in riveted joints.	PO 3	2
AME012.07	CLO 7	Explain design of welded joints, effects various stresses.	PO 2	2
AME012.08	CLO 8	Explain the design procedure of various joints.	PO 2	2
AME012.09	CLO 9	Understand the applications and comparison of various joints.	PO 3	2
AME012.10	CLO 10	Explain bolts of uniform strength.	PO 2	2
AME012.11	CLO 11	Understand various stresses in keys.	PO 3	2
AME012.12	CLO 12	Ability to design procedure for keys.	PO 1	3
AME012.13	CLO 13	Ability to design spigot and socket joint.	PO 1	3
AME012.14	CLO 14	Understand Jib and Cotter joint and design procedure.	PO 3	2
AME012.15	CLO 15	Ability to design knuckle joints.	PO 1	3
AME012.16	CLO 16	Explain the design of shafts for complex loads.	PO 3	2
AME012.17	CLO 17	Explain the design procedures of various shaft couplings.	PO 4	2
AME012.18	CLO 18	Ability to design shafts for various types of loading.	PO 1	3
AME012.19	CLO 19	Compare various shaft couplings and applications.	PO 1	3
AME012.20	CLO 20	Ability to Design of various shaft couplings.	PO 1	3
AME012.21	CLO 21	Understand of the basic features of springs.	PO 1	3
AME012.22	CLO 22	Explain the design procedure for various springs.	PO 3	2
AME012.23	CLO 23	Ability to design the various springs.	PO 1	3
AME012.24	CLO 24	Compare applications of Extension springs.	PO 1	3
AME012.25	CLO 25	Explain different types of end styles for helical compression and tension springs.	PO 2	2

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XI. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes (COs)	Program Outcomes (POs)			
	PO 1	**PO 2**	**PO3**	**PO4**
CO 1	3	2	**3**	1
CO 2	**2**		1	
CO 3		3	2	1
CO 4	3	2	3	1
CO 5		3	2	**1**

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XII. 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		2											3		
CLO 2		2												2	
CLO 3		2												2	
CLO 4		2												2	
CLO 5		2											3		
CLO 6			2										3		
CLO 7		2											3		
CLO 8		2													2
CLO 9			2										3		
CLO 10		2												2	
CLO 11			2											2	
CLO 12	3												3		
CLO 13	3												3		
CLO 14			2										3		
CLO 15	3												3		
CLO 16			2										3		
CLO 17				2									3		
CLO 18	3												3		

CLO 19	3												2	
CLO 20	3											3		
CLO 21	3													2
CLO 22			2											2
CLO 23	3											3		
CLO 24	3												2	
CLO 25		2											2	

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XIII. ASSESSMENT METHODOLOGIES–DIRECT

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

XIV. ASSESSMENT METHODOLOGIES–INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XV. SYLLABUS

UNIT-I	FUNDANTAMENTALS OF MACHINE DESIGN
Introduction: General considerations in the design of Engineering Materials and their properties Selection – Manufacturing consideration in design. Tolerances and fits – BIS codes of steels. Theories of failure – Factor of safety – Design for strength and rigidity – preferred numbers. Fatigue loading: Stress concentration –Theoretical stress Concentration factor – Fatigue stress concentration factor – Notch Sensitivity – Design for fluctuating stresses – Endurance limit – Estimation of Endurance strength – Goodman's life – Soderberg"s line.	
UNIT-II	**DESIGN OF FASTENERS AND WELDED JOINTS**
Design Of Fasteners: Riveted joints-methods of failure of riveted joints – strength equations – efficiency of riveted joints – eccentrically loaded riveted joints. Welded Joints: Design of fillet welds-axial loads-circular fillet welds-bending-bolts of uniform strength	
UNIT-III	**DESIGN OF KEYS, COTTERS AND KNUCKLE JOINTS**
Keys, Cotters and Knuckle Joints: Design of Keys-stress in keys. Cotter joints-spigot and socket, sleeve and cotter, jib and cotter joints-Knuckle joints	
UNIT-IV	**DESIGN OF SHAFTS AND SHAFT COUPLINGS**
Design of Shafts: Design of solid and hollow shafts for strength and rigidity –Design of shafts for complex loads – Shaft sizes –BIS code – Design of shafts for gear and belt drives. Shaft couplings: Rigid couplings – Muff, Split muff and Flange couplings. Flexible couplings-PIN-Bush coupling.	

UNIT-V	DESIGN OF MECHANICAL SPRINGS
Mechanical Springs: Stresses and deflections of helical springs-extension compression springs-springs for static and fatigue loading-natural frequency of helical springs-energy storagecapacity-helical torsion springs-co-axial springs.	
Text Books:	
1. P. Kannaiah, "Machine Design", 2nd Edition, Scitech Publications India Pvt. Ltd, New Delhi, 2012 2. V.B Bandari, "A Text Book of Design of Machine Elements", 3rd Edition, Tata McGraw Hill Education (P) Ltd, New Delhi, India. 2011.	
Reference Books:	
1. Richard G. Budynas, J. Keith Nisbett, "Shiegly"s Mechanical Engineering Design", 10th Edition, 2014. 2. S. Md. Jalaluddine, "Machine Design", Anuradha Publishers, 1st Edition, 2004. 3. R.L. Norton, "Machine Design-An Integrated approach", Person Publisher, 2nd Edition, 2012. 4. U.C. Jindal, "Machine Design", Pearson, 1st Edition, 2010. 5. R.S. Khurmi, A. K. Gupta, "Machine Design", S. Chand & Co, New Delhi, 1st Edition, 2014. 6. PSG College, "Design Data: Data Book of Engineers", 1st Edition, 2012.	

XVI. COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1	Introduction, General considerations in the design	CLO 1	T1:1.2 R6:1.5
2-3	Identify Engineering Materials and their properties. Tolerances and fits BIS codes of steels.	CLO 1	T1:3.1 R4:3.16
4	Explain theories of failure	CLO 1	T1:7.59
5-7	Explain Reversed Stresses	CLO 2	T2:5.11
8	Explain Factor of safety – Design for strength and rigidity – preferred numbers	CLO 3	T2:7.3 R4:3.21
9	Understand Stress concentration –Theoretical stress Concentration factor Fatigue stress concentration factor Notch Sensitivity	CLO 4	T1:7.63 R4:6.11
10-11	Explanation and problems on stress concentration. Endurance limit – Estimation of Endurance strength	CLO 5	T1:7.89 R6:6.4
12-15	Explain Goodman's life – Soderberg"s line. Solutions of problems on various types of loading.	CLO 2	T1:7.9 R4:6.20
16-17	Compare Fasteners methods	CLO 6	T1:11.2 R4:11.6
18	Explanation about Lap and but joints and various parameters involved in design of riveted joints.	CLO 6	T1:9.2 R4:9.8
19	Understand efficiency of riveted joints Calculate stress induced in rivets	CLO 7	T1:9.5 R4:9.14
20-21	Analyze Eccentrically loaded riveted joints. Problems in design of riveted joints.	CLO 8	T2:8.3 R6:9.21
22-23	Understand design of fillet welds-axial loads-circular fillet welds	CLO 8	T1:106 R6:10.17
24	Analyze Bending-bolts of uniform strength Construction design and proportions of bolts	CLO 9	T1:11.9 R6:11.16
25	Explanation of various stresses induced in bolted joints and solution of problems in various applications	CLO 10	T2:11.5 R6:11.10

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
26	Explanation of the procedure for finding size of bolts	CLO 9	T2:11.9 R1:11.12
27	Bolted joints and associated parts for locking purpose	CLO 11	T2:11.21 R1:11.7
28	Sketches for keys, cotters, knuckle joints and explanation of the purpose of each joint	CLO 12	T1:12.1
29	Estimate Design of Keys, stress in keys	CLO 12	T2:9.9 R4:13.8
30-32	Describe Cotter joints, Spigot and socket	CLO 13	T1:12:10 R4:12.4
33	Compare Jib and cotter joints, knuckle joint	CLO 14	T1:12.15 R4:12.7
34	Solution of problems under application load	CLO 15	T1:12.16
35-36	Apply Formulas for determining size of both hollow and solid shafts and various conditions of loading for strength and Rigidity criteria	CLO 16	T1:13.2 R4:14.6
37	Analyze Design of shafts for complex loads	CLO 17	T1:13.8, R4:14.11
38-39	Distinguish Shaft size –BIS codes. Applications and solution of problems for transmission of power by shafts loaded with belt and gear drives	CLO 18	T1:13.9 R4:14:13
40	Sketches of different couplings and various parameters to be explained	CLO 18	T2:15.1 R4:14.16
41-42	Rigid couplings – Muff, Split muff and Flange couplings	CLO 19	T2:15.2.
43	PIN-Bush coupling.	CLO 20	T2:9.24
44	Problems of different couplings	CLO 18	T2:9.30
45	Sketches of different springs with relevant parameters Stresses and deflections of helical springs	CLO 21	T2:16.2 R4:23.8
46	Extension compression springs-springs for static and fatigue loading	CLO 22	T2:10.3 R6:23.18
47	Natural frequency of helical springs- energy storage capacity	CLO 22	T2:10.5
48-49	Helical torsion springs	CLO 23	T2:10.10
50-51	Co-axial springs.	CLO 24	T1:10.15
52	Design of Helical Torsional Springs	CLO 25	T2:10.21

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

S No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Advances in Designingprocesses	Seminars / Guest Lectures / NPTEL	PO1, PO2, PO 3	PSO 1
2	Advanced topics	Seminars / Guest Lectures / NPTEL	PO2, PO4	PSO 2
3	Recommended practices in design and analysis using software's.	Assignments / Laboratory practices	PO1, PO 3PO 4	PSO 3

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