INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad - 500 043

MECHANICAL ENGINEERING

COURSE DESCRIPTION FORM

Course Title	**DESIGN OF MACHINE MEMBERS-I**			
Course Code	**A50316**			
Course Structure	**Lectures**	**Tutorials**	**Practicals**	**Credits**
	4	1	-	4
Course Coordinator	Mr G. V. R. Seshagiri Rao, Associate Professor			
Team of Instructors	Mr. V. K. V. S. Krishnam Raju, Associate Professor, Mr G. V. R. Seshagiri Rao, Associate Professor			

I. COURSE OVERVIEW

The design of machine members-I 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. PREREQUISITE(S)

Level	Credits	Periods	Prerequisite
UG	4	4	Engineering mechanics, Material Science and Engineering, Kinematics of machinery, Strength of Materials, Machine Drawing

III. MARKS DISTRIBUTION

Sessional Marks	University End Exam Marks	Total Marks
There shall be 2 midterm examinations. Each midterm examination consists of subjective type and Objective type tests. The subjective test is for 10 marks, with duration of 1 hour. Subjective test of each midterm exam shall contain 4 questions. The student has to answer 2 questions, each carrying 5 marks. The objective type test is for 10 marks with duration of 20minutes. It consists of 10 Multiple choice and 10 objective type questions. The student has to answer all the questions and each carries half mark. First midterm examination shall be conducted for the first 2 ½ units of syllabus and second midterm examination shall be conducted for the remaining 2 ½ units. Five marks are earmarked for assignments. There shall be two assignments in every theory course. Marks shall be awarded considering the average of two assignments in each course reason whatsoever, will get zero marks(s).	75	100

IV. EVALUATION SCHEME

S.No	Component	Duration	Marks
1	I Mid examination	90 minutes	20
2	I Assignment	--	05
3	II Mid examination	90 minutes	20
4	II Assignment	--	05
5	External examination	3 hours	75

V. COURSE OBJECTIVES

I. **Understanding** design and analysis of load transmitting elements and selection of suitable materials and manufacture of these components.
II. **Demonstration** Analyzing the forces acting on various components and their design.
III. **Enhance** the knowledge to applying the theories of failure and select optimum design size for various machine elements.
IV. **Understanding** need for joints and their application for different purposes in transmission of static loads.

VI. COURSE OUTCOMES

After completing this course the student must demonstrate the knowledge and ability to:

1. **Identify** design variables and performance factors in the study machine elements.
2. **Identify** different types of fastener and their basic features, related terminology and designations.
3. **Design** lap and butt joints in case of riveted joints and to design welded joints for given application.
4. **Design** shafts for various types of loading.
5. **Awareness** of the basic features of springs, and means of transfer of motion commonly used in mechanical engineering.

VII. HOW PROGRAM OUTCOMES ARE ASSESSED

Program outcomes		Level	Proficiency assessed by
PO1	Capability to apply the knowledge of Mathematics, science and Engineering in the field of Mechanical Engineering.	S	Assignments and Exams
PO2	An Ability to analyze complex engineering problems to arrive at relevant conclusions using knowledge of Mathematics, Science and Engineering.	S	Assignments and Exams
PO3	Competence to design a system, component or process to meet societal needs within realistic constraints.	S	Assignments and Exams
PO4	To design and conduct research oriented experiments as well as to analyze and implement data using research methodologies.	S	Assignments and Exams
PO5	An ability to formulate solve complex engineering problem using modern engineering and Information technology tools.	S	Assignments and Exams
PO6	To utilize the engineering practices, techniques, skills to meet needs of the health, safety, legal, cultural and societal issues.	H	Assignments and Exams
PO7	To understand impact of engineering solutions in the societal context and demonstrate the knowledge for sustainable development.	N	--
PO8	An understanding and implementation of professional and Ethical responsibilities.	H	Assignments and Exams
PO9	To function as an effective individual and as a member or leader in Multi-disciplinary environment and adopt in diverse teams.	S	Assignments and Exams
PO10	An ability to assimilate, comprehends, communicate, give and receive instructions to present effectively with engineering community and society.	S	Assignments and Exams
PO11	An ability to provide leadership in managing complex engineering projects at multi-disciplinary environment and to become a professional engineer.	S	Assignments and Exams

PO12	Recognition of the need and an ability to engage in lifelong learning to keep abreast with technological changes.	S	Assignments and Exams

VIII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED

Program Specific Outcomes		Level	Proficiency Assessed by
PSO 1	**Professional Skills**: To produce engineering professional capable of synthesizing and analyzing mechanical systems including allied engineering streams.	H	Lectures, Assignments
PSO 2	**Design/ Analysis:** An ability to adopt and integrate current technologies in the design and manufacturing domain to enhance the employability.	S	Lectures, Assignments
PSO 3	**Successful Career and Entrepreneurship**: To build the nation, by imparting technological inputs and managerial skills to become Technocrats.	H	Guest Lectures

N - None **S - Supportive** **H – Highly Related**

IX. SYLLABUS

UNIT-I

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 : 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

Keys, Cotters and Knuckle Joints: Design of Keys-stress in keys-cottered joints-spigot and socket, sleeve and cotter, jib and cotter joints-Knuckle joints.

UNIT-IV

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 coulings. Flexible couplings- PIN-Bush coupling.

UNIT-V

Mechanical Springs: Stresses and deflections of helical springs-extension compression springs-springs for static and fatigue loading-natural frequency of helical springs-energy storage capacity-helical torsion springs-co-axial springs.

TEXT BOOKS:

T1. P. Kannaiah, (2012), Machine Design, 2nd Edition, Scitech Publications India Pvt. Ltd, New Delhi,
T2. V Bandari (2011), A Text Book of Design of Machine Elements, 3rd edition, Tata McGraw hill education (P) Ltd, New Delhi, India.

REFERENCE BOOKS:

R1. Design of Machine Elements / V.M. Faires.
R2. Machine design/Schaum Series.

R3. Mechanical Engineering Design/JE Shigley.
R4. Machine Design/S. Md. Jalaluddine/Anuradha Publishers.
R5. R.L. Norton (2006), Machine Design (An Integrated approach), 2nd edition, Pearson Publishers, Chennai, India
R6. Machine Design/UC Jindal/Pearson.
R7. Design of Machine Elements (Vol.1)/T. Krishna Rao/IK International Publishing House/2nd Edition.
R8. Machine Design / R.S Khurmi, A K Gupta

X. COURSE PLAN:

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

Lecture No.	Course Learning Outcomes	Topics to be covered	Reference
1	**Introduction**	**UNIT-I** Introduction	T1 R6 & R7
2	**Explain** stages of design procedure	General considerations in the design	T1
3	**Illustrate** various types of materials	Engineering Materials and their properties	R7
4-8	**Analyze** various properties of materials	Consideration in design. Tolerances and fits BIS codes of steels. Theories of failure	R8
9	**List** various preferred numbers	Factor of safety – Design for strength and rigidity – preferred numbers.	R7
10	Explain Stress concentration	Stress concentration –Theoretical stress Concentration factor	T1 R6 & R7
11	**Differentiate** theoretical stress concentration factor Fatigue stress concentration	Fatigue stress concentration factor – Notch Sensitivity	T1 R6
12-14	**Explain** Endurance limit	Explanation and problems on stress concentration. Endurance limit – Estimation of Endurance strength	T1 R6
15-17	**Explain** design criteria based on strength and rigidity.	Goodman's life – Soderberg's line. Solutions of problems on various types of loading.	T8
18	**Explain** various types of Fasteners.	**UNIT-II** Description of Fasteners methods	T1 & R6
19	**Illustrate** various types of riveted joints.	Explanation about Lap and but joints and various parameters involved in design of riveted joints.	T1 & R7
20-22	**Calculate** rivet efficiency by using various strength equations	efficiency of riveted joints Calculate stress induced in rivets	T2 & R8
23	Solve problems on riveted joints	Eccentrically loaded riveted joints. Problems in design of riveted joints.	T1 R7&R8
24-25	**Explain** various types of welded joints.	Design of fillet welds-axial loads-circular fillet welds	R8

26	**Explain** procedure for calculating size of weld	bending-bolts of uniform strength	R8
27	**Describe various types of bolts**	Construction design and proportions of bolts	T1
28-29	**Define pre-stresses and stress induced in working**	Explanation of various stresses induced in bolted joints and solution of problems in various applications	T1 & R9
30	**Describe** procedure for finding size of bolts	**Explanation of the procedure for finding size of bolts**	T1 & R7
31-32	**Explain** the locking purpose	Bolted joints and associated parts for locking purpose	T1 & R7
33	Describe various type of Keys, cotters and knuckle joints	**UNIT-III** **Sketches** for keys cotters knuckle joints and explanation of the purpose of each joint	T2 & R8
34-35	Explain procedure for design of keys in various applications	Design of Keys, stress in keys	T2 R7 & R8
36	Describe procedure for design of cotter joint	Cotter joints, Spigot and socket	T2 & R8
37-39	Describe procedure for design of knuckle joint	Jib and cotter joints, knuckle joint	T2 & R8
40	Solve different problems on different joints	**Solution** of problems under application load	T2 & R8
41	Explain concept of power transmission of power with shafts both solid and Hollow	**UNIT-IV** **Formulas** for determining size of both hollow and solid shafts and various conditions of loading for strength and Rigidity criteria	T2 & R6
42-44	Describe design procedure for design of shafts for complex loads	Design of shafts for complex loads	T2 & R6
45-47	Describe design procedure for finding loads and shafts subjected to gear and belt drives	Shaft sizes –BIS code **Applications** and solution of problems for transmission of power by shafts loaded with belt and gear drives	T2 & R8
48	Describe various types of couplings for power transmission	**Sketches** of different couplings and various parameters to be explained	T2 & R4
49-52	Design procedure for flexible couplings	Rigid couplings – Muff, Split muff and Flange couplings	T2 & R6
53-54	Design procedure for bush coupling	PIN-Bush coupling.	
55	Design Calculations for various couplings	Problems of different couplings	
56-58	Categories various types of springs for engineering applications	**UNIT-V** **Sketches** of different springs with relevant parameters	T2 & R8

		Stresses and deflections of helical springs	
59-61	Design procedure for helical springs	extension compression springs-springs for static and fatigue loading	T2 & R7
62-64	Explain fatigue loading-natural frequency of springs-energy storage capacity	natural frequency of helical springs-energy storage capacity	T2 & R7
65	Describe Helical torsion springs	Helical torsion springs-co-axial springs.	T2 & R7

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

Course Objectives	Program Outcomes												Program Specific Outcomes		
	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
I	H				S			H					S		
II					S						H				S
III	H		S				S					H		H	
IV		S									H				S
V						S			H				H		
VI				H				S			S			H	S

N = None **S = Supportive** **H = Highly related**

XII. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF THE PROGRAM OUTCOMES:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	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
1	H				S										S
2		H									S		S		
3		H			S										
4	S										H			H	
5											H	S			S

N = None **S = Supportive** **H = Highly related**

Prepared by: Mr. V K V S Krishnam Raju**,** Associate Professor
Mr. G. V. R. Seshagiri Rao, Associate Professor

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