INSTITUTE OF AERONAUTICAL ENGINEERING

(AUTONOMOUS) Dundigal, Hyderabad - 500 043

MECHANICAL ENGINEERING

COURSE DESCRIPTION

Course Title	DESIGN OF MACHINE MEMBERS-II								
Course Code	A60329								
Regulation	R15								
Course Structure	Lectures	Tutorials	Practicals	Credits					
	4	1	-	4					
Course Coordinator	Dr. G.V.R.Sesha	Dr. G.V.R.Seshagiri Rao, Professor							
Team of Instructors	Dr. G.V.R.Sesha Mrs. D. Krishnaj	Dr. G.V.R.Seshagiri Rao, Professor Mrs. D. Krishnaja, Assistant Professor							

I. COURSE OVERVIEW: The design of machine members-II course focus mainly on design of power transmitting elements like gears, connecting rod, crankpin, crankshafts, pistons, cylinders, bearings, belts, ropes, chain's, pulleys, Power screws and nuts. Design basis is strength and stiffness of the parts and selection of material for manufacture of machine elements.

II. PREREQUISITE(S):

Level	Credits	Periods / Week	Prerequisites
UG	4	4	Engineering Mechanics, Material Science and Engineering, Kinematics of Machinery, Design of Machine Members

III. MARKS DISTRIBUTION:

Sessional Marks (25)	University End Exam Marks	Total Marks
Continuous Assessment Tests (Midterm examinations): There shall be 2 midterm examinations. Each midterm examination consists of one objective paper, one subjective paper and four assignments. The objective paper is for 10 marks and subjective paper is for 10 marks, with duration of 1 hour 20 minutes (20 minutes for objective and 60 minutes for subjective paper). Objective paper is set for 20 bits of – multiple choice questions, fill-in the blanks, 10 marks. Subjective paper contains of 4 full questions (one from each unit) of which, the student has to answer 2 questions, each question carrying 5 marks. First midterm examination shall be conducted for 2.5 units of syllabus and second midterm examination shall be conducted for another 2.5 units. 5 marks are allocated for Assignment. The total marks secured by the student	75	100

IV. EVALUATION SCHEME:

S. No.	Component	Marks	
1	I Mid Examination	80 Minutes	20
2	I Assignment		5
		TOTAL	25
3	II Mid Examination	80 Minutes	20
4	II Assignment		5
	25		
5	EXTERNAL Examination	3 hours	75
	100		

V. COURSE OBJECTIVES:

The objective of the course is to enable the student in

- I. Design and analyze the power transmitting elements.
- II. Apply the theories of failures and design optimization procedures using strength and stiffness criteria.
- III. Select the bearings for industrial applications using design data hand book.
- IV. Comprehend the principles of standardization and interchangeability.

VI. COURSE OUTCOMES:

At the end of this course, the student shall have

- 1. Potential to identify design variables and performance factors in the study of journal bearings.
- 2. Capability to design of journal bearings.
- 3. Awareness of Modes of lubrication and their Importance in bearing Design.
- 4. Ability to identify different types of rolling contact bearings, their basic features, related terminology and designations.
- 5. Knowledge to select rolling contact bearings for a given application.
- 6. Competence to design and failures of I.C Engine components.
- 7. understanding of the basic features of power transmission commonly used in mechanical engineering,
- 8. Acquaintance with the terminology and geometry of gears.
- 9. Expertise to analyze and design all types of gears for given application
- 10. Proficiency in using and obtaining information from engineering data handbooks.
- 11. Knowledge to identify the different types of power screws and its applications
- 12. Apply the design procedure for different power screws.

VII. HOW PROGRAM OUTCOMES ARE ASSESSED :

	Program Outcomes	Level	Proficiency assessed by
PO 1	Engineering Knowledge : Capability to apply the knowledge of mathematics, science and engineering in the field of mechanical engineering.	Н	Assignments and University Examinations
PO 2	Problem Analysis: An ability to analyze complex engineering problems to arrive at relevant conclusion using knowledge of mathematics, science and engineering.	Н	Midterm examinations
PO 3	Design/ development of solutions: Competence to design a system, component or process to meet societal needs within realistic constraints.	Н	Assignments
PO 4	Conduct investigations of complex problems: To design and conduct research oriented experiments as well as to analyze and implement data using research methodologies.	Н	Assignments
PO 5	Modern tool usage: An ability to formulate solve complex engineering problem using modern engineering and information Technology tools.	Н	Midterm examinations
PO 6	The engineer and society: To utilize the engineering practices, techniques, skills to meet needs of the health, safety, legal, cultural and societal issues.	S	University Examinations
PO 7	Environment and sustainability: To understand impact of engineering solutions in the societal context and demonstrate the knowledge for sustainable development.	S	Assignments
PO 8	Ethics: An understanding and implementation of professional and ethical responsibilities.	S	-
PO 9	Individual and team work: To function as an effective individual and as a member or leader in multi disciplinary environment and adopt in diverse teams.	S	_
PO 10	Communication: An ability to assimilate, comprehend, communicate, give & receive instructions to present effectively with engineering community and society.	S	-
PO 11	Project management and finance: An ability to provide leadership in managing complex engineering projects at multidisciplinary environment and to become a Technocrat.	Н	-
PO 12	Life-long learning: Recognition of the need and an ability to engage in lifelong learning to keep abreast with technological changes.	S	University Examinations

VIII. SYLLABUS:

DESIGN OF MACHINE MEMBERS-II

UNIT-I

Bearings: Types of journal bearings, basic modes of lubrication, bearing modulus, full and partial bearings, Clearance ratio, Heat dissipation of bearings, bearing materials, Journal bearing design. Ball and roller bearing, Static load- dynamic load, equivalent radial load-design and selection of ball and roller bearings.

UNIT-II

Design of IC Engine parts: connecting rod: thrust in connecting rod-stress due to whipping action on connecting rod ends-cranks and crank shafts, strength and proportions of over hung and center cranks-crank pins, crank shafts, piston, forces acting on piston-construction design and proportions of piston.

UNIT-III

Power Transmission Systems, Pulleys: Transmission of power by belt and rope drives, transmission efficiencies, Belts-Flat and V belts-ropes-pulleys for belt and rope drives, materials- chain drives.

UNIT-IV

Spur Gear: Load concentration factor-dynamic load factor, surface compressive strength-bending strength

Design analysis of spur gear, check for plastic deformation, check for dynamic and wear considerations.

Helical and Bevel Gear Drives: Load concentration factor-dynamic load factor, Analysis of helical and bevel gears, check for plastic deformation, check for dynamic and wear considerations.

Design of Worm gears: worm gear-properties of worm gears-selections of materials-strength and wear rating of worm gears-force analysis-friction in worm gears-thermal considerations.

UNIT-V

Design of power screws: Design of screw, design of nut, compound screw, differential screw, ball screw-possible failures

TEXT BOOKS:

T1. Machine Design/ Pandya & Shah / Charotar Publishing house pvt. Ltd.

T2. Machine Design/ PV SoundaraRajan Murthy and N.shanmugam / Anuradha publishers.

REFERENCES:

- R1. Design of Machine Elements / V.M.Faires.
- R2. Machine design / schaum Series.
- R3. Mechanical Engineering Design / J.E.Shigley
- R4. Machine Design / S. Md Jalauddine/Anuradha Publishers
- R5. Machine design / U.C. Jindal/ Pearson
- R6. Design of Machine Elements (Vol.1) / T.Krishnarao/ IK International publishing house/ Second Edition.

IX. COURSE PLAN:

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

Lecture	Course Learning Outcomes	Topics and / Sub-Topics Covered	Reference		
No.					
1	Classify journal bearings	UNIT-I SLIDING CONTACT	T1 9.3, R2 23.3		
		BEARINGS : Types of journal bearings			
2	Explain lubrication process	Basic modes of lubrication	T1 9.5, R2 23.1		
3	Illustrate various parts of bearing	Bearing modulus-full and partial	T1 9.8, R2 23.2		
		bearings, clearance ratio			
4	Analyze heat dissipation in bearings	Heat dissipation in bearing	T1 9.8, R2 23.4		
5	List various materials for bearings	Bearing materials	T1 9.9, R2 23.1		
6-10	Select the lubricants for various applications	Journal bearing design	T1 9.8, R2 23.3		
11	Categorize rolling contact bearings	Types of rolling contact bearings	T19.13,9.14,		
			9.15, R2 22.1		
12	Discuss types of bearings for required	Selection of bearing type	T1 9.16, R2		
	application.		22.2		

13-16	Describe static and dynamic rating of roller	Static and dynamic loading of ball and	T1 9.17.
	bearings	roller bearings	9.18,R2 22.3
17	Explain various parts of connecting Rod	UNIT-II Design of IC Engine components: Connecting Rod	T1 18.4, R7 32.1
18	Illustrate about thrust acting on a connecting Rod	Thrust in Connecting Rod	T1 18.4 , R 32.13
19-21	Categorize & Describe about stresses induced and find	Stress due to Whipping action on Connecting rod ends.	T1 18.4 , R7 32.14
22	Classify various types of Crankshafts.	Cranks and crankshafts	T1 18.5 , R7 32.16
23-25	Calculate sizes of different parts of crankshaft and crank pin	Strength and proportions of crankshafts	T1 18.5 , R7 32.17-32.21
26-27	Explain various parts of the piston and forces acting on each of these parts	Piston, Forces acting on piston	
28-29	Construct piston diagram and generate formulae	Construction design and proportions of piston	T1 18.2 , R7 32.12
30	Describe various types of belt drives and	UNIT-III Power	T1 1/ 1 & 1/ 3
50	transmission nower and V P	Transmission systems - pulloves	$R^{2} 2/1$
	transmission power and V.K	Transmission of power by belt drives	KZ 24.1
31-32	Describe construction of ropes	Rone drives	T1 R1
51-52	Describe construction of topes	Kope unves	17.24,17.25,17. 26
33	Define efficiency of power transmission and explain factors effecting efficiency	Transmission efficiencies	T1 14.4, R2 24.2
34-35	Calculate sizes of flat and V- belt	Belts-Flat and V belts	T1 14.3, 14.5 & 14.6 R2 24.1
36-37	Distinguish different pulleys for belt and rope drives	Pulleys for belt and rope drives, materials	T1 14.8, 14.9 , R2 24.1
38	Calculate chain length and speed ratios	Chain drives	T114.16& 14.18 , R1 17.21& 17.22
39	Explain loss of gearing	UNIT-IV: Spur Gear Drives: spur gears	T1 16.3, R2 18.1
40	Describe load transmission between gear teeth and Illustrate dynamic load factors	Load concentration factor-dynamic load factor	T1 16.8, R2 18.3
41	Compare the equations for compressive and bending strength	Surface compressive strength-bending strength	T1 16.9, R2 18.3
42	Explain Procedure design of spur gears	Design analysis of spur gear	T1 16.10, R2 18.3
43-44	Discuss relationships between these parameters	Estimation of center distance, module and face width, check for plastic deformation	T1 16.8 , R2 18.3
45	Describe the governing equation and find the	Check for dynamic and wear	T1 16.10 &
	dynamic and wear strength	Considerations	16.11, R2 18.6
46	Distinguish between the two gears	Helical and Bevel Gear Drives: Helical and bevel gears	T1 16.16 & 16.17 , R2 19.1 & 20.1
47	Describe load transmission between gear teeth and illustrate dynamic load factors	Load concentration factor-dynamic load factor	T1 16.17, R2 20.3
48	Compare the equations for compressive and bending strength	Surface compressive, strength-bending strength	T1 16.17 , R2 20.3
49-50	Explain Procedure for design of helical and bevel gears	Design analysis of Helical and Bevel gear	T1 6.17&16.22 R2 20.4

51-52	Discuss the relationships between these	Estimation of center distance, module and	T1 16.22, R2
	parameters	face width, check for plastic deformation	20.1
53-54	Describe the governing equation and find the	Check for dynamic and wear	T1 16.22, R2
	dynamic and wear strength	considerations	20.3
55	Illustrate different types	Design of Worm gears: worm gear-	T1 16.26&
		properties of worm gears-selections of	16.27, R2
		materials	21.1
56-57	Discuss governing relationships between the	Strength and wear rating of worm gears-	T1 16.27, R2
	force and wear characteristics of worm	force analysis	21.1
	gearing		
58-59	Calculate the heat dissipation from the	Friction in worm gears-thermal	T1 16.27, R2
	worm gear drives	considerations	21.1
60	Describe the terminology of power screws	UNIT-V Design of power screws :	T1 1.1, 11.4
		Design of screw	&11.5 R1 8.21
61	Illustrate these types of screws	Square, ACME, Buttress screws	T1 11.1, R2
			12.1
62	Calculate the sizes of nut and screw	Design of nut	T1 11.5, R1
			8.21
63	Describe construction and explain failure	Compound screw	T1 11.7, R1
	mechanism		8.21
64	Describe construction and explain failure	Differential screw	T1 11.8, R1
	mechanism		8.23
65	Describe construction and explain failure	Ball screw-possible failures	T1 11.9, R1
	mechanism		8.21

X. MAPPING COURSE OBJECTIVES LEADING TO 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
Ι	Н		S		Н				Н				S	Н	
Π		Н				Η	S				Н			Н	S
III	Н				Н		S	Н	Η						
IV		Н	S		Η						Η		Η	Н	
S = Supportive								H = Highly Related							

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

Course		Program Outcomes													Program Specific		
Outcomes		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	Н	Н	S		Н		S		Η		Н		Н	S			
2		S				S			Η		Н				Н		
3	S	Н			S		Η		Η		Н						
4			Н		Н	S		Н					Н		S		
5		S		S		Н	Η		Η		Н	Н	S	Н			
6	Н			Η	S	S	S		S		Н	Н					
7	S	Н	S					S									
8		Н	S		Н		S		Η		S	S		S	S		
9	S		Н		S		Η			S			S	Н	S		
10	Н	Н		Н		Н		Н			S		Н	S	Н		
11		Н			S			S		Н			S		S		
12		S		S			S					Н		S	Н		

S = **Supportive**

H = Highly Related

Prepared By: Dr. G.V.R Seshagiri Rao Professor, Mrs. D. Krishnaja, Assistant Professor.

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