Hall Ticket No | | | | | | | | | | | Question Paper Code: AME015

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

MODEL QUESTION PAPER

B. Tech VI Semester End Examinations (Regular), May – 2020

Regulations: IARE-R16

MACHINE DESIGN

(MECHANICAL ENGINEERING**)**

Time: 3 hours **Max. Marks: 70**

Answer ONE Question from each Unit
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

UNIT – I

1. a) What are rolling contact bearings? Discuss their advantages over sliding contact bearings. **[7M]**

   b) A journal bearing of 50mm diameter and 80mm long, has a bearing pressure of 6 N/mm2, the speed of the journal is 1000 rpm. The ratio of journal diameter to the diametral clearance is 1000. The bearing is lubricated with oil, whose absolute viscosity at the operating temperature of 750C may be taken as 0.015 kg/m-s. The room temperature is 250C, Determine (i) the amount of artificial cooling required and (ii) the mass of the coolant oil required, if the difference between the outlet and inlet temperature of the oil is 100C. the specific heat of the oil is 1900 J/kg/0C and heat dissipation coefficient is 500 W/m2/0C. **[7M]**

2. a) Explain the following terms: i) Static load carrying capacity, ii) Dynamic load carrying capacity **[7M]**

   b) A single row deep groove ball bearing is subjected to a radial load of 8 kN and a axial load of 3 kN. The shaft rotates at 1200 rpm. The expected life of the bearing is 20000 hours. The minimum acceptable diameter of the shaft is 75mm. select a suitable ball bearing for this application. **[7M]**

UNIT-II

3. a) Discuss the design of piston for an internal combustion engine. **[7M]**

   b) Design a cast iron piston for a single acting four stroke diesel engine with the following data Cylinder bore = 300mm Length of stroke = 250mm Speed = 600 rpm Brake mean effective pressure = 0.6 MPa Maximum gas pressure = 4MPa Fuel consumption = 0.25 kg per BP per h l/d ratio for bush in small end of connecting rod = 1.5 Assume suitable data if required and state the assumptions made. **[7M]**

4. a) Explain the design procedure of piston rod. **[7M]**

b) Design a connecting rod for an IC engine running at 1800 rpm and developing a maximum pressure of 3.15 N/mm2. The diameter of the piston is 100mm, mass of the reciprocating parts per cylinder 2.25kg, length of connecting rod 380 mm, stroke of piston 190 mm and compression ratio 6:1.take factor of safety of 6 for the design. Take length to diameter ratio for big end bearing as 1.3 and small end bearing as 2 and the corresponding bearing pressure as 10 N/mm2 and 15 N/mm2. The density of rod material may be taken as 8000 kg/m3 and the allowable stress in the bolts as 60 N/mm2 and in cap as 80 N/mm2. Assume I cross section for the connecting rod. The elastic limit of compressive stress is 350 MPa and rankine constant 1/7500. Draw a neat dimensioned sketch **[7M]**

UNIT-III

5. a) What are different types of belts and material used for belts. **[7M]**

What is velocity ratio of a belt drive.

b) A pulley is driven by a flat belt running at a speed of 600 m/min. The coefficient of friction between the pulley and the belt is 0.3 and the angle of lap is 160°. If the maximum tension in the belt is 700 N; find the power transmitted by a belt. **[7M]**

6. a) What are the advantages and dis advantages of chain drive and classify chain drives. **[7M]**

b) A V belt drive is required for a 15 KW, 1440 rpm electric motor, which drives a centrifugal pump running at 360 rpm for a service of 24 hours per day. From space considerations, the centre distance should be approximately1m. Determine (i) Belt specifications (ii) Number of belts (iii) Correct centre distance and (iv) Pulley diameters **[7M]**

UNIT-IV

7. a) Explain surface compressive strength, bending strength in gears. **[7M]**

b) Design a pair of spur gears with 20^0 full-depth involute teeth consisting of a 20 teeth pinion meshing with a 50 teeth gear. The pinion shaft is connected to a 22.5 kW, 1450 rpm electric motor. The starting torque of the motor can be taken as 150% of the rated torque. The material for the pinion is plain carbon steel Fe410 (S_{ut} = 410 N/mm2), while the gear is made of grey cast iron FG200 (S_{ut} = 200 N/mm2). The factor of safety is 1.5. design the gears based on the Lewis equation and using velocity factor to account for the dynamic load **[7M]**

8 a) Explain the design procedure of helical gear. **[7M]**

b) A pair of helical gears is to transmit 15 kW. The teeth are 200 stub in diametral plane and have a helix angle of 450. The pinion runs at 10000 rpm and has 80mm pitch diameter. The gear has 320 mm pitch diameter. if the gears are made of cast steel having allowable static strength of 100 MPa, determine a suitable module and face width from static strength considerations and check the gears for wear, given σes = 618 MPa **[7M]**

UNIT-V

9.	a)	Explain torque Required to Raise Load by Square Threaded Screws.	**[7M]**
	b)	A power screw having double start square threads of 25 mm nominal diameter and 5 mm pitch is acted upon by an axial load of 10 kN. The outer and inner diameters of screw collar are 50mm and 20 mm respectively. The coefficient of thread friction and collar friction may be assumed as 0.2 and 0.15 respectively. The screw rotates at 12 rpm. Assuming uniform wear condition at the collar and allowable thread bearing pressure of 5.8 N/mm2. Find i) The torque required to rotate the screw ii) The stresses in the screw and	**[7M]**
10.	a)	Explain efficiency of self-locking screws	**[7M]**
	b)	The lead screw of lathe has ACME threads of 50mm outside diameter and 8 mm pitch. The screw must exert an axial pressure of 2500N in order to drive the tool carriage. The thrust is carried on a collar 110mm outside diameter and 55mm inside diameter and lead screw rotates at 30r.p.m. Derive i)the power required to drive the screw, ii) the efficiency of the lead screw. Assume coefficient of friction of 0.15 for screw and 0.12 for collar	**[7M]**

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COURSE OBJECTIVES:

I	Ability to identify design variables and performance factors in the study of journal bearings.
II	Ability to identify different types of rolling contact bearings, their basic features, related terminology and designations
III	Ability to select rolling contact bearings for a given application
IV	Awareness of the basic features of prime movers and the means of power transmission commonly used in mechanical engineering
V	Ability to analyze and design all types of gears for given application

COURSE OUTCOMES (COs)

I	Understand various design variables and factors in the study of bearings
II	Ability to analyze and design of I.C Engines components.
III	Identify the various power transmission systems
IV	Analyze of forces and design of various gears.
V	Ability to identify the different types screws and its terminology.

COURSE LEARNING OUTCOMES:

AME012.01	Explain various lubrication process, Illustrate various parts of bearing
AME012.02	Analyze heat dissipation in bearings
AME012.03	Select the lubricants for various applications
AME012.04	Discuss types of bearings for required application
AME012.05	Describe static and dynamic rating of roller bearings
AME012.06	Explain various parts of connecting
AME012.07	Illustrate about thrust acting on a connecting Rod
AME012.08	Categorize & Describe about stresses induced and find suitable cross section
AME012.09	Classify the various types of Crankshafts.
AME012.10	Calculate the sizes of different parts of crankshaft and crank pin
AME012.11	Explain the various parts of the piston and forces acting on each of these parts
AME012.12	Construct the piston diagram and generate formulae
AME012.13	Describe the various types of belt drives and transmission power and V.R
AME012.14	Describe the construction of ropes
AME012.15	Define the efficiency of power transmission and explain factors effecting efficiency
AME012.16	Distinguish different pulleys for belt and rope drives
AME012.17	Describe load transmission between gear teeth and Illustrate dynamic load factors
AME012.18	Compare the equations for compressive and bending strength

AME012.19	Explain the Procedure design of spur gears
AME012.20	Describe the governing equation and find the dynamic and wear strength
AME012.21	Explain Procedure for design of helical and bevel gears
AME012.22	Describe the terminology of power screws
AME012.23	Describe construction and explain failure mechanism
AME012.24	Design of Differential screw
AME012.25	Ball screw-possible failures

Mapping of Semester End Examinations to Course Learning Outcomes:

SEE Question No.		Course Learning Outcomes		Course Outcomes	Blooms Taxonomy Level
1	a	AME012.01	Explain various lubrication process, Illustrate various parts of bearing	CO1	Understand
	b	AME012.03	Select the lubricants for various applications	CO1	Understand
2	a	AME012.04	Discuss types of bearings for required application	CO1	Understand
	b	AME012.03	Select the lubricants for various applications	CO1	Understand
3	a	AME012.08	Categorize & Describe about stresses induced and find suitable cross section	CO2	Understand
	b	AME012.08	Categorize & Describe about stresses induced and find suitable cross section	CO2	Understand
4	a	AME012.08	Categorize & Describe about stresses induced and find suitable cross section	CO2	Understand
	b	AME012.08	Categorize & Describe about stresses induced and find suitable cross section	CO2	Understand
5	a	AME012.09	Classify the various types of Crankshafts.	CO3	Understand
	b	AME012.13	Describe the various types of belt drives and transmission power and V.R	CO3	Understand
6	a	AME012.13	Describe the various types of belt drives and transmission power and V.R	CO3	Understand
	b	AME012.08	Categorize & Describe about stresses induced and find suitable cross section	CO3	Understand
7	a	AME012.15	Define the efficiency of power transmission and explain factors effecting efficiency	CO4	Understand
	b	AME012.15	Define the efficiency of power transmission and explain factors effecting efficiency	CO4	Understand
8	a	AME012.15	Define the efficiency of power transmission and explain factors effecting efficiency	CO4	Understand
	b	AME012.15	Define the efficiency of power transmission and explain factors effecting efficiency	CO4	Understand
9	a	AME012.16	Distinguish different pulleys for belt and rope drives	CO5	Understand
	b	AME012.16	Distinguish different pulleys for belt and rope drives	CO5	Understand
10	a	AME012.16	Distinguish different pulleys for belt and rope drives	CO5	Understand
	b	AME012.16	Distinguish different pulleys for belt and rope drives	CO5	Understand

Signature of the Faculty **HOD, ME**