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Subject Code:- AME0601

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NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA

(An Autonomous Institute Affiliated to AKTU, Lucknow)

B.Tech

SEM: VI - THEORY EXAMINATION (20 - 20)

Subject: Design of Machine Elements

Time: 3 Hours

Max. Marks: 100

General Instructions:

IMP: Verify that you have received the question paper with the correct course, code, branch etc.

1. This Question paper comprises of **three Sections -A, B, & C**. It consists of Multiple Choice Questions (MCQ's) & Subjective type questions.
2. Maximum marks for each question are indicated on right -hand side of each question.
3. Illustrate your answers with neat sketches wherever necessary.
4. Assume suitable data if necessary.
5. Preferably, write the answers in sequential order.
6. No sheet should be left blank. Any written material after a blank sheet will not be evaluated/checked.

SECTION-A

20

1. Attempt all parts:-

- 1-a. What are machine elements? (CO1, K1) 1
- (a) The moving parts of a machine
 - (b) The individual parts or components of a machine that perform specific functions
 - (c) The tools used to manufacture machines
 - (d) The electronic components of a machine
- 1-b. What is the first step in the design procedure for machine elements? (CO1, K1) 1
- (a) Determining the load and stress conditions
 - (b) Selecting the material
 - (c) Deciding on the manufacturing process
 - (d) Establishing the design requirements
- 1-c. What are the limitations of the Goodman criterion? (CO2, K1) 1
- (a) It is only applicable to ductile materials
 - (b) It is only applicable to brittle materials
 - (c) It does not take into account the effects of stress concentration
 - (d) It does not take into account the effects of temperature on the material
- 1-d. Which of the following is not a measure to reduce stress concentration in a shaft? (CO2, K1) 1
- (a) Using a shoulder fillet
 - (b) Using a chamfer

- (c) Using a square corner
- (d) Using a keyway
- 1-e. Which tooth form is most commonly used for spur gears? (CO3, K1) 1
- (a) Cycloidal
- (b) Involute
- (c) Epicycloidal
- (d) Hypocycloidal
- 1-f. What is contact ratio in gear systems? (CO3, K1) 1
- (a) Ratio of the length of the contact arc to the pitch circle circumference
- (b) Ratio of the module to the pitch diameter
- (c) Ratio of the tooth thickness to the circular pitch
- (d) Ratio of the addendum to the dedendum
- 1-g. What is the terminology used for the largest diameter of a bevel gear? (CO4, K1) 1
- (a) Pitch diameter
- (b) Base diameter
- (c) Outside diameter
- (d) Root diameter
- 1-h. What is the beam strength of a bevel gear? (CO4, K1) 1
- (a) The ability of the gear to resist bending stresses
- (b) The ability of the gear to withstand deformation
- (c) The ability of the gear to resist wear due to sliding contact
- (d) The ability of the gear to resist fatigue failure
- 1-i. Which of the following is not a type of sliding contact bearing? (CO5, K1) 1
- (a) Thrust bearing
- (b) Pivot bearing
- (c) Collar bearing
- (d) Ball bearing
- 1-j. What is a rolling contact bearing? (CO5, K1) 1
- (a) A type of bearing that uses a sliding contact between the bearing surfaces
- (b) A type of bearing that uses a rolling contact between the bearing surfaces
- (c) A type of bearing that uses a combination of sliding and rolling contacts between the bearing surfaces
- (d) All of the above
2. Attempt all parts:-
- 2.a. Distinguish between design and analysis. (CO1, K2) 2
- 2.b. What is stress concentration? (CO2, K1) 2
- 2.c. State any two disadvantages of gear drive over other types of drives. (CO3, K1) 2
- 2.d. What is the difference between straight and bevel gears? (CO4, K2) 2

2.e. What are the different types of sliding contact bearings? (CO5, K2) 2

SECTION-B 30

3. Answer any five of the following:-

3-a. Enumerate the various manufacturing methods of machine parts which a designer should know. (CO1, K2) 6

3-b. Explain the following materials used in Engineering 6
(a) Steel
(b) copper
(c) Aluminum . (CO1, K2)

3-c. Explain the different methods of reducing stress concentration? (CO2, K2) 6

3-d. Write Soderberg's equation and state its application to different type of loadings. (CO2, K2) 6

3.e. Why is the tangential component of gear tooth force is responsible for power transmission? Discuss. (CO3, K3) 6

3.f. How do you calculate the virtual number of teeth in a bevel gear system? (CO4, K2) 6

3.g. Discuss the different types of bearing materials. (CO5, K2) 6

SECTION-C 50

4. Answer any one of the following:-

4-a. Explain the different theory of failure in detail. (CO1, K2) 10

4-b. It is required to standardise load-carrying capacities of dumpers in a manufacturing unit. The maximum and minimum capacities of such dumpers are 40 and 630 kN, respectively. The company is interested in developing seven models in this range. Specify their load carrying capacities. (CO1, K3) 10

5. Answer any one of the following:-

5-a. A rod of a linkage mechanism made of steel 40Cr1($S_{ut} = 550 \text{ N/mm}^2$) is subjected to a completely reversed axial load of 100KN. The rod is machined on a lathe and the expected reliability is 95%. There is no stress concentration. determine the diameter of the rod using a factor of safety of 2 for an infinite life condition. (CO2, K3) 10

5-b. A rotating bar made of steel 45C8 ($S_{ut} = 630 \text{ N/mm}^2$) is subjected to a completely reversed bending stress. The corrected endurance limit of the bar is 315 N/mm². Calculate the fatigue strength of the bar for a life of 90,000 cycles. (CO2, K3) 10

6. Answer any one of the following:-

6-a. It is required to design a pair of spur gears with 20° full-depth involute teeth based on the Lewis equation. The velocity factor is to be used to account for dynamic load. The pinion shaft is connected to a 10 kW, 1440 rpm motor. The starting torque of the motor is 150% of the rated torque. The speed reduction is 4 : 1. The pinion as well as the gear is made of plain carbon steel 40C8 ($S_{ut} = 600 \text{ N/mm}^2$). The factor of safety can be taken as 1.5. Design the gears, specify their dimensions and suggest suitable surface hardness for the gears. (CO3, K3) 10

- 6-b. Discuss a general procedure for designing a spur gear.(CO2, K3) 10
7. Answer any one of the following:-
- 7-a. Explain the steps involve in design a worm gearing system? (CO4, K3) 10
- 7-b. A pair of bevel gears consists of a 30 teeth pinion meshing with a 48 teeth gear. The gears are mounted on shafts, which are intersecting at right angles. The module at the large end of the tooth is 4 mm. Calculate
(i) the pitch circle diameters of the pinion and the gear;
(ii) the pitch angles for the pinion and gear; and
(iii) the cone distance. (CO4, K3) 10
8. Answer any one of the following:-
- 8-a. Explain the following: (CO5, K2) 10
(a) Static Load Capacity
(b) Dynamic load capacity
(c) L_{10} Life
- 8-b. A single row deep groove ball bearing is subjected to a radial force of 8KN and a thrust force of 3KN . The shaft rotates at 1200 rpm. The expected life is L_{10h} of the bearing is 20000hrs The minimum acceptable diameter is 75 mm. select the suitable ball bearing for this application. (CO5, K3) 10

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