Printed Page:- 05 **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 (2023 - 2024)

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 is the purpose of Indian Standards designation of carbon and alloy steels? [CO1] 1

(a) To establish guidelines for the manufacturing process of steels

(b) To specify the chemical composition and mechanical properties of steels

(c) To define the minimum requirements for the use of steels

(d) To regulate the import and export of steels

1-b. Which of the following best defines machine elements? (CO1) 1

(a) The physical components that make up a machine

(b) The instructions that guide a machine's operation

(c) The software programs that control a machine's functions

(d) The electrical systems that power a machine

1-c. Which of the following is the correct definition of cyclic stress? (CO2) 1

(a) Stress that is constant over time

(b) Stress that varies over time

(c) Stress that only occurs in metals

(d) Stress that only occurs in non-metal materials

1-d. How is notch sensitivity measured? [CO2] 1

(a) By calculating the stress concentration factor

(b) By measuring the fatigue strength of the material

(c) By measuring the fatigue limit of the material

(d) By measuring the stress concentration factor

1-e. What is interference in involute gears? (CO3) 1

(a) The overlap of the addendum and the dedendum of adjacent teeth

(b) The difference between the actual tooth thickness and the theoretical tooth thickness

(c) The difference between the addendum and the dedendum

(d) The mismatch between the pitch circles of mating gears

1-f. What is the beam strength of a gear tooth? (CO3) 1

(a) The ability of the gear tooth to resist bending under load

(b) The ability of the gear tooth to resist shearing under load

(c) The ability of the gear tooth to resist wear under load

(d) The ability of the gear tooth to resist fatigue failure under load

1-g. Which force is responsible for transmitting power in a bevel gear system?[CO4] 1

(a) Axial force

(b) Tangential force

(c) Radial force

(d) None of the above

1-h. Which of the following is a measure of the distance between the apex of the gear tooth and the axis of the gear? (CO4) 1

(a) Cone distance

(b) Pitch diameter

(c) Base diameter

(d) None of the above

1-i. Which of the following is not a type of sliding contact bearing? (CO5) 1

(a) Thrust bearing

(b) Pivot bearing

(c) Collar bearing

(d) Ball bearing

1-j. What is a journal bearing? (CO5) 1

(a) A type of sliding contact bearing designed to handle axial loads

(b) A type of sliding contact bearing designed to handle radial loads

(c) A type of rolling contact bearing designed to handle axial loads

(d) A type of rolling contact bearing designed to handle radial loads

2. Attempt all parts:-

2.a. Distinguish between design and analysis. [CO1] 2

2.b. What are the machine components that fail by fatigue? (CO2) 2

2.c. What are the advantages of 20° stub involute teeth gears? (CO3) 2

2.d. What is the difference between a single enveloping and double enveloping worm gear system? (CO4) 2

2.e. How is heat dissipated from a bearing? (CO5) 2

SECTION B **30**

3. Answer any <u>five</u> of the following:-

3-a. What are the three basic modes of failure of mechanical components?**[CO1]** 6

3-b. What do you understand by torsional rigidity? how torsional rigidity measured.[CO1] 6

3-c. What is fluctuating stress? Draw a stress–time curve for fluctuating stress. (CO2) 6

3-d. What are the different factors used for estimating allowable strength of a component having discontinuity under fluctuating load. (CO2) 6

3.e. State any four advantages of gear drive over other types of drives. (CO3) 6

3.f. What factors should be considered when selecting materials for worm gears? (CO4) 6

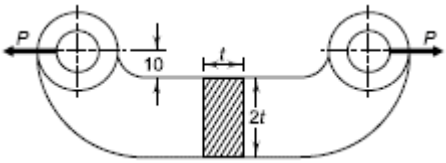
3.g. Discuss the important properties of bearing materials. (CO5) 6

SECTION C **50**

4. Answer any <u>one</u> of the following:-

4-a. Discuess maximum shear stress theory and distortion energy theory of failure with neat sketch. (CO1) 10

4-b. An offset link subjected to a force of 25 kN is shown in Fig. It is made of grey cast iron FG300 and the factor of safety is 3. Determine the dimensions of the cross-section of the link. (CO1) 10

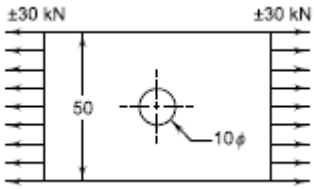


5. Answer any <u>one</u> of the following:-

5-a. A railway wagon weighing 50 kN and moving with a speed of 8 km per hour has to be stopped by four buffer springs in which the maximum compression allowed is 220 mm. Find the number of turns in each spring of mean diameter 150 mm. The diameter of spring wire is 25 mm. Take G = 84 kN/mm^2. (CO2) 10

5-b. A plate made of steel 20C8 (Sut = 440 N/mm^2) in hot rolled and normalized condition is shown in Fig. 10

It is subjected to a completely reversed axial load of 30 kN. The notch sensitivity factor q can be taken as 0.8 and the expected reliability is 90%. The size factor is 0.85. The factor of safety is 2. Determine the plate thickness for infinite life. (CO2)



6. Answer any <u>one</u> of the following:-

6-a. It is required to design a pair of spur gears with 20° 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 Fe 410 (Sut = 410 N/mm^2), while the gear is made of grey cast iron FG 200 (Sut =200 N/mm^2). 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. (CO3) 10

6-b. A helical cast steel gear with 30° helix angle has to transmit 35 kW at 1500 r.p.m. If the gear has 24 teeth, determine the necessary module, pitch diameter and face width for 20°full depth teeth. The static stress for cast steel may be taken as 56 MPa. The width of face may be taken as 3 times the normal pitch. What would be the end thrust on the gear? The tooth factor for 20°. **[CO3]** 10

7. Answer any <u>one</u> of the following:-

7-a. A triple threaded worm has teeth of 7 mmm. module and pitch circle diameter of 55 mm. if the worm gear has 40 teeth of 14^0 and the coefficient of friction of the worm gearing is 0.06, find 10

(i) The lead angle of the worm.
(ii)Velocity ratio.
(iii) Centre distance .
(iv) Efficiency of the worm gearing. [CO4]

7-b. A pair of straight bevel gears is made of grey cast iron FG 200 (E = 114 000 N/mm2). The surface endurance strength is 90 N/mm2. The number of teeth on the pinion and gear are 30 and 40 respectively. The module and the face width are 6 mm and 50 mm respectively. The pressure angle is 20°. Determine the wear strength of the tooth. (CO4) 10

8. Answer any <u>one</u> of the following:-

8-a. Explain the following: (CO5) 10
(a) Static Load Capacity
(b) Dynamic load capacity
(c) L_{10} Life

8-b. A single-row deep groove ball bearing has a dynamic load capacity of 40500 N and operates on the following work cycle: 10
(i) radial load of 5000 N at 500 rpm for 25% of the time;
(ii) radial load of 10000 N at 700 rpm for 50% of the time; and
(iii) radial load of 7000 N at 400 rpm for the remaining 25% of the time.
Calculate the expected life of the bearing in hours. (CO5)