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Paper Code : PC-ME602 Design of Machine Elements

UPID : 006618

Time Allotted : 3 Hours

Full Marks : 70

The Figures in the margin indicate full marks.

Candidate are required to give their answers in their own words as far as practicable

Group-A (Very Short Answer Type Question)

[1 x 10 = 10]

1. Answer any ten of the following :

- (i) What type of load is transmitted by a cotter joint?
- (ii) What is the thread angle of an ISO metric thread?
- (iii) Why are Flexible Coupling popular?
- (iv) Which type of Power screw thread has highest efficiency?
- (v) What is module of gear?
- (vi) Which system of tolerance is used hole basis or shaft basis?
- (vii) What are the properties of PTFE, that has made it a very useful Engineering Material?
- (viii) Which theory gives most accurate result among the Maximum Shear Stress theory and Distortion Energy Theory?
- (ix) Nearly after how many no of cycles the S-N curve becomes asymptotic?
- (x) What is the main disadvantage of welding thin walled components?
- (xi) For which application the Distortion Energy theory is to be used?
- (xii) A rotating shaft is supported at the ends and subjected to a point load at the centre. Maximum bending stress developed is 120 MPa. If the yield, ultimate and corrected endurance strength of the material are 360 MPa, 600 MPa and 240 MPa. What is the Factor of Safety?

Group-B (Short Answer Type Question)

Answer any three of the following :

[5 x 3 = 15]

2. The Principal stresses at a point in three perpendicular directions are 200 N / sq mm, 150 N / sq mm and 0. Material is 50C 4 ($S_{yt} = 460$ N / sq mm). Find the Factor of Safety using Maximum Shear Stress theory. [5]
3. A rotating bar of steel ($S_{ut} = 630$ N / sq mm) is subjected to completely reversed bending stress. Corrected endurance limit of the bar is 315 N / sq mm. Calculate the fatigue strength of the bar for a life of 90,000 cycles. [5]
4. Name the various elements used in alloy steel and their effects. [5]
5. In a particular application, the radial load acting on a ball bearing is 5 kN and the expected life for 90% bearing is 8000 hr. Calculate the dynamic load carrying capacity of the bearing. RPM of the shaft is 1450. [5]
6. Explain briefly the factors that affect the Endurance limit of a component? [5]

Group-C (Long Answer Type Question)

Answer any three of the following :

[15 x 3 = 45]

7. (a) Write a short note on different types of keys with sketches to connect the shaft with rotating element. [9]
- (b) The standard cross section for a flat key which is fitted to a 50 mm diameter shaft is 16 x 10 mm. The key is transmitting 475 N m torque from the shaft to the hub. Key is made of commercial steel ($S_{yt} = S_{yc} = 230$ N / mm²). Determine the length of the key, if the factor of safety = 3. [6]
8. (a) A bronze spur pinion rotating at 600 rpm drives a Cast iron spur gear at a transmission ratio of 4 : 1. The allowable static stresses for the bronze pinion and the cast iron gear are 84 MPa and 105 MPa respectively. [8]
- The pinion has 16 standard 20° full depth involute teeth of module 8. The face width of the gear is 90 mm.

Calculate the power that can be transmitted from the standpoint of strength.

- (b) A single plate clutch consists of one pair of contacting surfaces. It is used for an engine that develops a maximum torque of 120 Nm. Assume a factor of safety of 1.5 to account slippage at full engine torque. The permissible intensity of pressure is 350 kPa and coefficient of friction is 0.35. Assuming uniform wear theory, calculate the inner and outer diameter of the friction lining. [7]
9. Design a turnbuckle to connect tie rods of roof structure. Maximum pull in the tie rods is 50 kN. The material of the coupler is FG 200 ($S_{ut} = 200 \text{ N/mm}^2$) and that of tie rod is 30 C8 ($S_{yt} = 400 \text{ N/mm}^2$). Factor of safety is 5. [15]
Data for threads M 36 x 3 thread core dia = 31.093 mm M42 x4.5 thread core dia = 36.479 mm
10. (a) What are the modes of failure? Explain with examples [7]
(b) A machine element subjected to following stresses: in the x direction 60 MPa, in the y direction 45 MPa, shear stress from x to y = 30 MPa. The material is 45 C 8 for which yield stress is 353 MPa. Find the FOS using [8]
1) Maximum Shear Stress theory 2) Distortion energy theory [3]
11. (a) What is Standardisation in Machine Design? Explain its importance. [3]
(b) Describe the various standards used in Engineering Design. [9]
(c) What is Code? What is the difference between Standards and Codes? [3]

*** END OF PAPER ***

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