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6E7114		
B.Tech. VI-Sem. (Main/Back) Examination, April/May - 2026 Automobile Engineering 6AE4-05 Design of Machine Elements II ME, AE		

Time : 3 Hours

Maximum Marks : 70

Instructions to Candidates:

Attempt all Ten questions from Part A, Five questions out of seven questions from Part B and Three questions out of five questions from Part C.

Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.

Use of following supporting material is permitted during examination. (Mentioned in form No. 205).

PART-A

(Answer should be given up to 25 words only)

All questions are compulsory.

(10×2=20)

1. Differentiate between steady and alternating stresses.
2. Explain the concept of the Goodman line in fatigue design.
3. Discuss the design factors influencing the cylinder of an IC engine.
4. Explain the major stresses acting on a connecting rod in an engine.
5. Define the concept of a helical tension spring.
6. Discuss the design factors for a belt-pulley drive system.
7. Explain the Lewis equation for gear teeth design.
8. Compare and contrast spur and helical gears in terms of design.
9. Explain the concept of minimum film thickness in bearing design.
10. How do you select anti-friction bearings based on load cycles?

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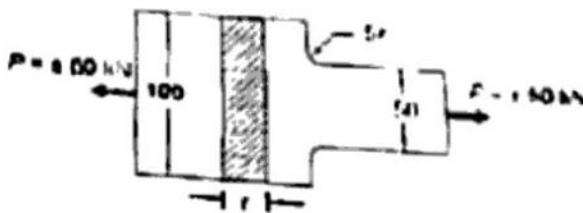
PART - B

(Analytical/Problem solving questions)

Attempt any Five questions.

(5×4=20)

1. Describe the concept of notch sensitivity and its effect on the design of machine elements subjected to fatigue.
2. A component machined from a plate of steel 45C8 ($S_u = 630 \text{ N/mm}^2$) as shown below. It is subjected to completely reversed axial force of 50 kN. The reliability factor is 90% and factor of safety is 2. Determine the endurance limit stress for the plate, if the notch sensitivity factor is 0.8. (Take size factor = 0.85).



3. Explain the influence of material selection for the crankshaft on its performance and reliability.
4. It is required to design a helical compression spring subjected to a maximum force of 1250 N. The deflection of the spring corresponding to the maximum force should be approximately 30 mm. The spring index can be taken as 6. The spring is made of patented and cold drawn steel wire of Grade 4. The constants A and m can be taken as 1753 and 0.182 respectively ($G = 81.370 \text{ N/mm}^2$). The permissible shear stress for the spring wire should be taken as 50% of the ultimate tensile strength. Determine the wire diameter of the spring.
5. Explain the Buckingham equation and its application in gear tooth design.
6. A ball bearing, subjected to a radial load of 5 kN is expected to have a life of 8000 hours at 1450 rpm with a reliability of 99%. Calculate the dynamic load capacity of the bearing so that it can be selected from the manufacturer's catalogue based on a reliability of 90%.
7. Discuss the importance of bearing mounting and lubrication methods in anti-friction bearing design.

PART - C

(Descriptive/Analytical/Problem solving/Design questions)

Attempt any three questions.

(3×10=30)

1. Discuss the different methods used to design machine members subjected to combined steady and alternating stresses. Explain how the Goodman and Soderberg lines are used in the design process.

2. The cylinder of a four stroke diesel engine has following specifications:
Cylinder bore = 150 mm
Factor of safety = 5
Maximum gas pressure = 3.5 MPa
Poisson's ratio = 0.25
If the cylinder material is grey cast iron FC1200 ($S_{ut} = 200 \text{ N/mm}^2$), determine the thickness of cylinder wall.
3. Elaborate on the design of helical compression springs subjected to variable stresses. Discuss factors like spring index, stress concentration, and fatigue life in the design process.
4. Explain the design process for spur gears using the Lewis and Buckingham equations. Include an analysis of factors such as gear tooth profile, material selection, and load distribution in your explanation.
5. A single row deep groove ball bearing no. 6002 is subjected to an axial thrust of 1 kN and a radial load of 2200 N. Find the expected life that 50% of the bearings will complete under this condition.
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