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UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, May 2018

Program: B. Tech. – ASE

Subject (Course): Design of Machine Elements

Course Code : ADEG – 225

No. of page/s: 03

Semester – IV

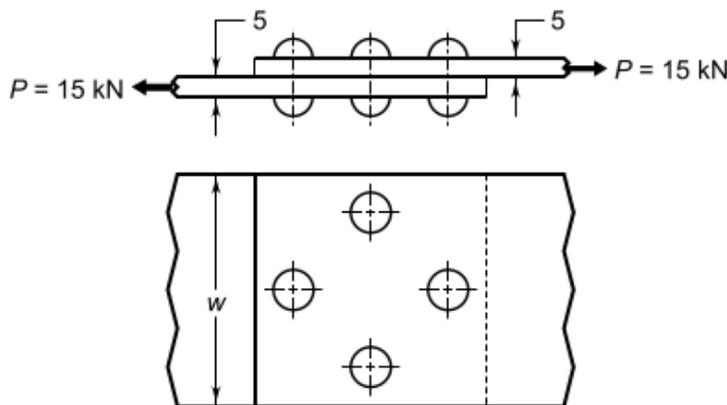
Max. Marks : 100

Duration : 3 Hrs

The paper contains three sections A, B and C. You have to attempt every section. Marks for each question is given on the right hand side of the question in brackets.

SECTION A

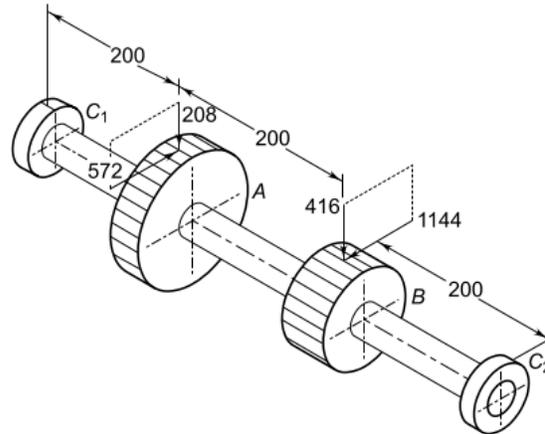
- | | Marks | CO |
|---|-------|-----|
| 1. Explain the causes of stress concentration. | (5) | CO1 |
| 2. Differentiate between fluctuating, repeated and reversed stress with the help of a stress-time curve. | (5) | CO2 |
| 3. A flat key is used to connect a pulley to a 45 mm diameter shaft. The standard cross-section of the key is 14×9 mm. The key is made of commercial steel ($S_{yt} = S_{yc} = 230$ N/mm ²) and the factor of safety is 3. Determine the length of the key on the basis of shear and compression considerations, if 15 kW power at 360 rpm is transmitted through the keyed joint. | (5) | CO4 |
| 4. Two plates each of thickness 5mm, are connected by means of four rivets as shown in figure. The permissible stresses for rivet and plates in tension and shear are 80 and 60 N/mm ² respectively. Determine the diameter of the rivets and width of the plate. | (5) | CO3 |



SECTION B

- | | | |
|---|------|-----|
| 5. An intermediate shaft of a gearbox, supporting two spur gears A and B and mounted between two bearings C_1 and C_2 is shown in figure. The pitch circle diameters of gears A and B are 500 and 250 mm respectively. The shaft is made of alloy steel 20MnCr5 | (15) | CO4 |
|---|------|-----|

($S_{ut} = 620 \text{ N/mm}^2$ and $S_{yt} = 480 \text{ N/mm}^2$). The gears are keyed to the shaft. Design the shaft using ASME code. All dimensions are in mm and forces are in N.



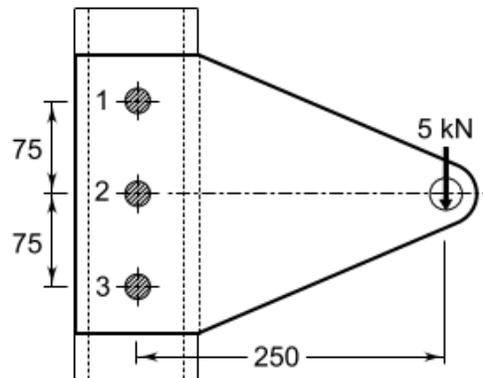
6. Select a single row deep groove ball bearing for a radial load of 4000 N and an axial load of 5000 N, operating at a speed of 1600 rpm for an average life of 5 years at 10 hours per day. Draw the sectional view of the bearing with all important dimensions. (15) CO6

OR

Design a journal bearing for a centrifugal pump from the following data: (15) CO6

Load on the journal = 20000 N; speed of journal = 900 rpm and shaft diameter = 100 mm. Assume the operating temperature as 70°C and ambient temperature as 15.5°C .

7. A steel plate subjected to a force of 5 kN and fixed to a channel by means of three identical bolts is shown in figure below. The bolts are made of plain carbon steel 30C8 ($S_{yt} = 400 \text{ N/mm}^2$) and the factor of safety is 3. Determine the diameter of the bolts. All dimensions are in mm. (10) CO3



SECTION C

8. A pair of carefully cut gears with 20° full depth teeth is to transmit 22.5 kW at 300 rev/min of the gear with a speed reduction of 5:1. Selecting a suitable material for gear and pinion, design the gear system in the diameter of the pinion is 76 mm. Assume suitable data. (20) CO5

9. Two shafts made of plain carbon steel are connected by a rigid type flange coupling. Shafts are running at 500 rpm and transmit 25kW power. Design the coupling completely for design torque 25% more than the rated torque and draw a sectional view of the designed coupling. Assume the following permissible stresses for the coupling components: (20) CO4

Shaft – Permissible tensile stress = 60 MPa; Permissible shear stress = 35 MPa

Keys & Bolts– Permissible compressive strength = 60 MPa; permissible shear stress = 28 MPa

Bolts – Six numbers made of steel

Flanges – Cast iron having permissible shear stress = 12 MPa

OR

Design a bushed-pin type flexible coupling to connect a pump shaft to a motor shaft transmitting 32 kW at 960 rpm. The service factor is 1.2 and the material properties are as given below: (20) CO4

- (a) The allowable shear and crushing stresses for shaft and key material are 40 MPa and 80 MPa respectively.
- (b) The allowable shear stress for cast iron is 15 MPa.
- (c) The allowable bearing pressure for rubber bush is 0.8 N/mm².
- (d) The material of pin is same as that of shaft and key.

Draw a neat sketch of the coupling