

April 2019

Time - Three hours
(Maximum Marks: 75)

- (N.B: (1) Answer all questions choosing either (a) or (b) of each question.
(2) All question carry 15 marks.
(3) P.S.G. Data book and approved data books are permitted.

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|-----|---|-------|
| I. | (A) (i) Define maximum shear stress theory and maximum distortion energy theory. | 5 |
| | (ii) In a steam engine cylinder of 300mm diameter the maximum pressure across the piston is 0.65 N/mm^2 . Determine the diameter of the piston rod, if the maximum tensile or compressive stress on the piston is limited to 40 N/mm^2 . | 10 |
| | (Or) | |
| | (B) A plate 90mm wide and 15mm thick is welded onto another plate by a single transverse weld and double parallel fillet weld. Find the length of the parallel fillet weld, if the plate is loaded by a static tensile load. Take allowable tensile stress as 70 N/mm^2 and shear stress as 55 N/mm^2 . | 15 |
| II. | (A) A steel solid shaft transmitting 15 kW at 200 rpm is supported on two bearings 750mm apart. It has two gears keyed to it. The pinion having 30 teeth of 5mm module is located 100mm to the left of the right hand bearing and delivers power horizontally to the right. The gear having 100 teeth of 5mm module is located 150mm to the right of the left hand bearing and receives power in a vertical direction from below. The allowable shear stress is 54 N/mm^2 . Determine a suitable diameter of the shaft. | 15 |

(Or)

[Turn over...]

- (B) Two shafts are connected by C.I protected type flange coupling to transmit 10 kW at 600 rpm. The permissible shear stress for shaft, coupling and bolt material is 50 N/mm² and permissible crushing stress for bolt material is 80 N/mm². Assume the following. 15
1. No of coupling bolts = 4,
 2. Pitch circle dia. of bolts = 3 x dia. of shaft,
 3. Thickness of flange = 0.5 x dia. of shaft,
- Design the coupling, shaft, key and coupling bolts.
- III (A) Design a flat belt drive to transmit 22.5 kW at 740 rpm to an aluminium rolling machine. The speed ratio is 3. The distance between the pulleys is 3m. Diameter of rolling machine pulley is 1.2m. Use manufacture's data. Assume the following: 15
1. Load correction factor $K_s = 1.5$,
 2. Pulley correction factor $K_d = 0.9$,
 3. Open belt drive,
 4. Use fabric - high speed duck belt.
- (Or)
- (B) Design a V-belt drive using manufacturer's data for a compressor receives power from a motor rated at 30 kW at 1320 rpm by means of V belts. The pulley diameters are 300mm and 750mm, centre distance is 1.4m. Take C-type belt and $K_s = 1.2$. 15
- IV (A) (i) Describe radial and thrust ball bearings. 5
(ii) Design a journal bearing for a centrifugal pump from the following data. 10
- | | | |
|---|-------------------------------|----|
| Load on the journal | = 20 kN. | |
| Speed of journal | = 900 rpm. | 10 |
| Type of oil used is SAE 10 for which the absolute viscosity at 55°C | = 17 cP. | |
| Ambient temperature of oil | = 15.5°C. | |
| Maximum bearing pressure for the pump | = 1.5 N/mm ² . | |
| Heat dissipation Co-efficient | = 1232J/s/m ² /°C. | |
- Calculate also the mass of lubricating oil required for artificial cooling, if rise of temperature of oil is limited to 10°C.

(Or)

- (B) (i) Draw the sketch of a rolling contact bearing and mention the parts. 5
(ii) A steam turbine shaft 200mm diameter turns at 1800 rpm and is supported in a journal bearing on which the total load is 90 kN. The room temperature is 30°C. If the bearing temperature is 60°C and allowable bearing pressure 1.5 N/mm². Determine the length of bearing and amount of heat to be removed by lubricant per minute. Viscosity of the oil at 60°C is 21 centipoises. 10
- V (A) Design a hand lever of rectangular section subjected to a maximum load of 300 N at the end of moment arms of 1.2m. The thickness of the lever is constant and is equal to 0.375 times the width of the lever near the boss. Permissible shear stress for the shaft material is 42 N/mm² and the permissible bending stress for the lever material is 80 N/mm². 15
- (Or)
- (B) (i) Illustrate any five terms used in spur gear terminology. 15
(ii) A spur gear pinion running at 600 rpm drives a spur gear at transmission ratio of 4:1. The allowable static stresses for pinion and gear are 84 N/mm² and 110 N/mm² respectively. The pinion has 16 teeth, standard 20° full depth involute and module of 8 mm. The face width of both the gears is 90mm. Find the power that can be transmitted from the point of strength.