Total No. of Questions : 6]

SEAT No. :

P5660

[Total No. of Pages : 4

TE/INSEM./OCT.-106

T. E. (Mechanical)

DESIGN OF MACHINE ELEMENTS - I

(302041) (2015 Pattern) (Semester - I)

Time : 1½ Hours] *[Max. Marks : 30*

Instructions to the candidates:

1) ***Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6.***
2) ***Draw neat diagrams wherever necessary.***
3) ***Figures to right indicate full marks.***
4) ***Assume suitable data if necessary and clearly mention the assumed data.***

UNIT-I

Q1) a) A manufacturer of induction motors needs to decide the range of the motors to be made available in the market. The power rating of the motors ranges from 1 kW to 15 kW. Determine the variety of electric motors based on the R5, R10 preferred series. Also comment on which series shall be followed by the motor manufacturer. **[4]**

b) A foot operated lever shown in figure 1 is 900 mm long. It is loaded with a load of 600 N at the end with an offset of 120 mm from the centre of the shaft bearing centre. For the lever corss section assuming width to thickness ratio of 3:1 and using permissible tensile stress of 70 N/mm^2, permissible shear stress of 50 N/mm^2, design the lever cross section at critically loaded section. Take d=40 mm; d_1=42 mm; and d_2=64 mm. **[6]**

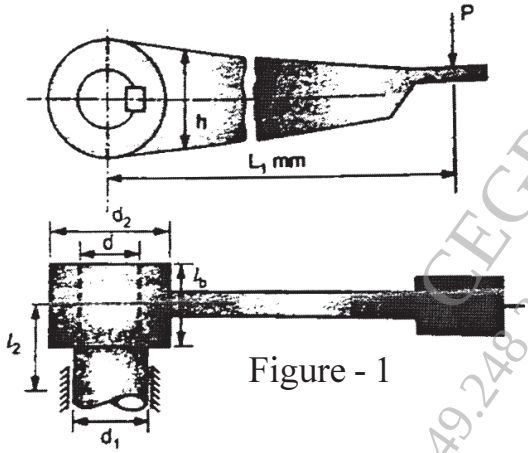

Figure - 1

OR

P.T.O.

Q2) a) A knuckle joint is used to connect the tractor with a trolley with a total weight of 3000 N. If the tractor takes a turn at 30° towards left, Determine the diameter of the pin of the knuckle joint. All the parts of the joint are made of forged steel with Ultimate tensile strength of 480 MPa and Yield tensile strength of 360 MPa. Use a factor of safety 3. Choose appropriate theory of failure. **[4]**

b) The figure 2 shows a 'S' hook made from 30 mm diameter rod and subjected to a tensile load 700 N as shown in figure. Determine the stresses in the inner and outer surface of the hook at a section XX. **[6]**

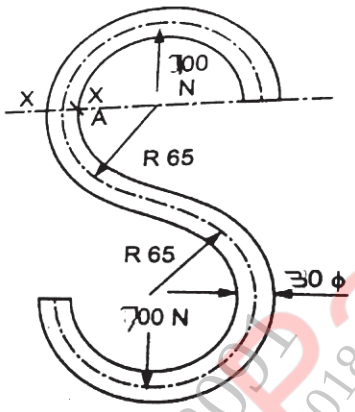

Figure 2

UNIT-II

Q3) a) Suggest the suitable type of coupling in the following cases and justify.**[4]**

i) Coaxial shafts with linear misalignment (up to 10 mm)

ii) Coaxial shafts with angular misalignment (up to 4 degrees)

iii) Coaxial shafts with angular misalignment (up to 40 degrees)

iv) Coaxial shafts prcisely aligned.

b) A lathe spindle 290 mm long is subjected to the following forces. The ratio of the inner to outer diameter is 0.12. The spindle material has yield tensile strength of 480 MPa and the Ultimate tensile strength of 520 MPa. Using ASME code by taking K_b=1.5 and K_t=1 obtain the diameters of the spindle. **[6]**

i) Axial load 1200 N directed towards the headstock acting along a circle of 200 mm radius (Moment seen in vertical plane).

ii) Transverse cutting force producing anticlockwise moment of 137 Nm. (moment seen in horizontal plane)

iii) Tangential force producing a torque of 180 Nm.

OR

Q4) A shaft carrying two gears in between the bearings situated at both the ends receives power from another shaft situated above this shaft through left side spur gear located at a distance of 250 mm from the left side bearing. The shaft transmits the power to another shaft situated on front side of it through a helical gear located at leaft from right side bearing at a distance 250 mm. The centre to centre distance between two gears is 250 mm. The force magnitudes are as follows. **[10]**

a) Forces on spur gear with p.c.d. 300 mm.

   i) Tangential force : 1140 N (producing clock wise torque seen from right side bearing)

   ii) Radial force : 140 N (vertically downwards)

b) Forces on helical gear with p.c.d. 250 mm.

   i) Tangential load : 1368 N (producing counterclockwise moment seen from right side bearing)

   ii) Radial load : 240 N (horizontally towards the centre of shaft)

c) Axial load : 360 N. (producing clockwise moment in horizontal plane)

If the material for the shaft has yield and ultimate tensile strengths 480 MPa and 600 MPa respectively and ASME code is to be used with K_b=2 and K_t=1.5, determine the diameter of the shaft. The gears are keyed to the shaft.

UNIT - III

Q5) a) Suggest the selection of following design criteria for the given application. **[4]**

   i) S-N Diagram

   ii) Soderberg diagram

   iii) Goodman diagram

   iv) Gerber parabola

b) Figure 3 shows a faceplate variator used to transmit power between two coaxial shafts. The current position of the roller traces a circle of 150 mm diameter. The shafts are made of steel with ultimate and yield tensile strengths 900 and 750 MPa respectively. The roller at the given position transmits a torque of 20 Nm. Considering a coefficient of friction between the faceplates and the roller as 0.3 determine the factor of safety for fatigue failure of the shaft. Take the correction factors for the approximate estimation of the endurance limit as **[6]**

Surface finish factor =0.7,

Size factor = 0.8,

Reliability factor =0.897,

Fatigue stress concentration factor K_f = 1.97;

Load factor for axial loading = 0.85 and for torsional loading = 0.58

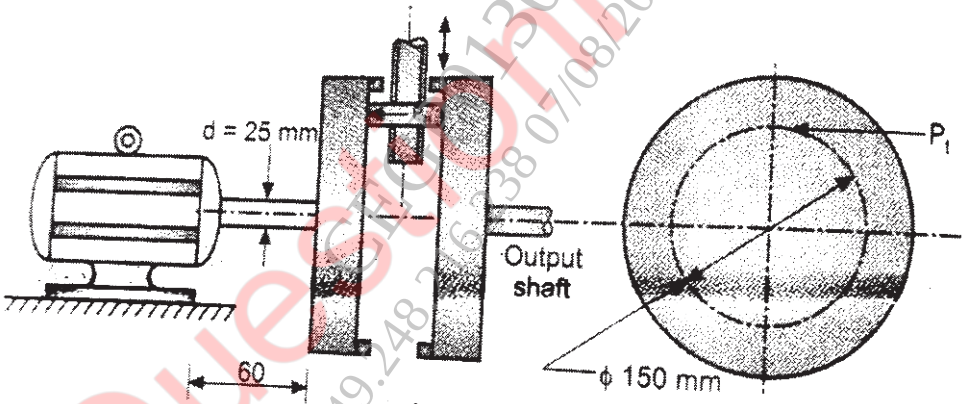

Figure - 3

OR

Q6) a) What is low cycle and high cycle fatigue? State the application of each.**[4]**

b) A cantilever beam of circular cross section made of high strength alloy steel with ultimate tensile strength of 1200 N/mm^2. It is subjected to a completely reversed force of 1500 N at the free end. The span of this beam is 500 mm. Take corrected endurance limit for the beam material as 332.85 N/mm^2. Determine the diameter of the beam. **[6]**