

- N.B. :** (1) Question No. 1 is **compulsory**.
(2) Answer any **four** from the remaining **six** questions.
(3) Use of standard **design data book** is **permitted**.
(4) Assume **suitable** data wherever **necessary**.
(5) **Figures** to the **right** indicate **full** marks.

1. Answer any Five of the following:-

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- (a) Explain modes of failure of machine components
(b) Explain the effect of the following parameters on endurance strength
(i) surface condition
(ii) size of a component -
(iii) temperature of the machine component
(iv) loading
(c) Types of fits
(d) Power screws
(e) Soderberg diagram
(f) Theories of Elastic Failures

2..Design a spigot-socket type cotter joint to transmit an axial load of 50 kN. Select appropriate material for its components and draw its neat sketch showing major dimensions on it.

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3. C-clamp is subjected to a clamping force of 4 kN. Maximum distance between the jaws is 270 mm. The distance between screw axis and inner edge of the frame is 150 mm.

- (a) Design screw, nut and frame with appropriate selection of permissible stresses for them. 15
(b) Check screw for buckling. 05

4.(a) Classify the keys. And explain the two basic functions of the key. 05

(b) It is required to design a protected type rigid flange coupling to connect two shafts. The input shaft transmits 22.5 kW power at 180 rpm to the output shaft through the coupling. The service factor for the application is 1.5. Select suitable materials for various parts of the coupling and design should include the followings

- (i) keys and bolts (ii) shaft (iii) flanges

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5. A shaft transmitting 12 kW at 210 rpm is supported in two bearings 600 mm apart and carries two gears. An 18 tooth 20 deg. involute 10 mm module gear is located 125 mm to the right of right hand bearing and delivers power to a gear directly below the shaft. An 80 tooth, 6 mm module gear, is located 150 mm to the right of the left hand bearing and receives power from a gear directly above it. Select suitable material and design the shaft.

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6. (a) A through bolt is used to connect two plates with a gasket in between. The combined stiffness of the parts held together by the bolt is twice the stiffness of the bolt. The bolted assembly is subjected to an external tensile force which fluctuates from 0 to 6 kN. The bolt is initially so tightened that the joint opens up at an external load of 12 kN. The bolt is machined from a plain carbon steel with $S_{ut} = 650 \text{ N/mm}^2$ and $S_{yt} = 400 \text{ N/mm}^2$. Determine the size of the bolt. **14**

(b) A 70 mm diameter solid shaft is to be welded to a flat plate by a fillet weld around the circumference of the shaft. Determine the size of the weld required, if a load of 12 kN is applied at the end of an overhang of 250 mm. The permissible shear stress for the material of the weld may be assumed as 95 N/mm^2 . **06**

7. (a) A helical coil compression spring is to be subjected to a maximum force of 5000 N with a corresponding deflection of 70 mm. The spring is to operate over a 50 mm diameter rod. Determine the wire diameter and no. of active turns. Also, decide other details such free length, pitch, helix angle etc. Check for the solid stress. For the material of the spring— **15**

$$S_u = \frac{2000}{D_w^{0.17}} \text{ N/mm}^2 \quad G = 80000 \text{ N/mm}^2$$

$$S_{ys} = \frac{1200}{D_w^{0.17}} \text{ N/mm}^2$$

Where D_w is the wire diameter.

(b) Explain nipping process in leaf springs. **05**

