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Instructions – (1) All Questions are *Compulsory.*

(2) Answer each next main Question on a new page.

(3) Illustrate your answer with neat sketches wherever necessary.

(4) Figures to the right indicate full marks.

(5) Assume suitable data, if necessary.

(6) Use of Non-programmable Electronic Pocket Calculator is permissible.

(7) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

Marks

1.   **Attempt any FIVE of the following:**   **10**

a)   State any two applications of knuckle joint.

b)   State the function of key.

c)   Define stress and state its formula and unit.

d)   List four important physical characteristics of good bearing material.

e)   Define neutral axis.

f)   State any two requirements of good shaft coupling.

g)   Define factor of safety.

Marks

2. Attempt any THREE of the following: **12**

a) Find the required diameter of steel rod that has to carry an axial pull of 40 kN, if the permissible stress is 150 MPa.

b) State equation of Torque required to raise the load and torque required to lower the load in power screw.

c) Write equation with Wahl's factor, used for design of helical coil spring. State the SI unit of each term in equation.

d) List any four industrial application of rolling contact bearing.

3. Attempt any THREE of the following: **12**

a) Write a flexural formula and state meaning of each term used in it.

b) Compare solid shaft and hollow shaft. (Any four points)

c) Give one example each of the power screws –

   i) Where the screw has axial travel.

   ii) Where the nut has axial travel.

d) Explain any four aesthetic consideration in design by giving suitable example.

e) State any four desirable properties for a good spring material.

4. Attempt any THREE of the following: **12**

a) A cylindrical pipe of external diameter 100 mm and thickness 20 mm is subjected to an axial pull of 80 kN, Calculate stress induced in it.

b) Differentiate between welded joint and riveted joint. (Any four points)

c) Define following terms with reference to compression spring –

   i) Solid Length

   ii) Free Length

   iii) Spring Index

   iv) Spring Rate.

d) A line shaft rotating at 200 rpm is to transmit 20 kW power. The allowable shear stress for the shaft material is 42 kN/mm^2. Determine the diameter of the shaft.

Marks

e) Explain different forms of threads with their relative advantage and application.

5. **Attempt any TWO of the following:** **12**

a) Suggest suitable coupling in the following cases with figure –

    i)   Shaft having parallel axes with distance apart.

    ii)   Shaft having intersecting axes.

b) Explain design procedure of foot lever with neat sketch.

c) Design a helical compression spring with ground ends. The spring index is 12. Maximum load on the spring is 100 N and deflection under maximum load is 15 mm. Allowable shear stress of the material is 100 MPa and modulus of rigidity is 84×10^3 N/mm^2. Find wire and spring diameters, numbers of coils and stiffness of spring.

6. **Attempt any TWO of the following:** **12**

a) Explain various failure to be considered in designing a cotter joint with necessary sketches and strength equations.

b) Explain selection procedure of ball bearing from manufacturer's catalogue.

c) Explain in brief any six ergonomics consideration in designing of machine elements.

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