4 Hours / 100 Marks   Seat No.

Instructions :
- (1) **All** questions are **compulsory**.
- (2) Illustrate your answers with **neat** sketches **wherever** necessary.
- (3) Figures to the **right** indicate **full** marks.
- (4) Assume suitable data, if **necessary**.
- (5) Use of Non-programmable Electronic Pocket Calculator is **permissible**.
- (6) Mobile Phone, Pager and any other Electronic Communication devices are **not permissible** in Examination Hall.

Marks

1. Attempt **any ten** :   **20**

- a) Define machine design.
- b) Give the composition of
    - i) FeE220
    - ii) 20C8
- c) State four types of loads acting on machine elements.
- d) What do you mean by creep ?
- e) Define Ergonomics.
- f) Give two application of knuckle joint.
- g) Define following terms of spring.
    - i) Spring rate
    - ii) Spring index
- h) What do you express the life of bearings ?
- i) Draw the different thread profile used for powers screws.
- j) State four types of keys.
- k) Give two examples, where screwed joints are preferred over welded joints.
- l) State any four applications of rolling contact bearings.
- m) What are the requirement of the good coupling ?
- n) Draw stress-strain diagram for brittle material.

Marks

2. Attempt **any two** of the following : **16**

a) Explain various failures to be considered in designing a cotter joint along with the necessary sketches and strength equations. **8**

b) State the theories of elastic failure. Explain maximum normal stress theory and maximum shear stress theory with equations. **8**

c) i) State and describe in brief about four ergonomic considerations in the designing of machine elements. **4**

   ii) How will you select bearing from manufacturer catalogue ? **4**

3. Attempt **any two** of the following : **16**

a) Fig. 1 shows a hacksaw. The blade is assembled with tension of $W = 320$ N. The frame of hacksaw is made out of cold drawn steel, for which, yield point value in tension is 360 N/mm^2. Design a rectangular cross-section of U-Frame at section 'A-A' and 'B-B'. Assume factor of safety = 4 and b = 2.5t. **8**
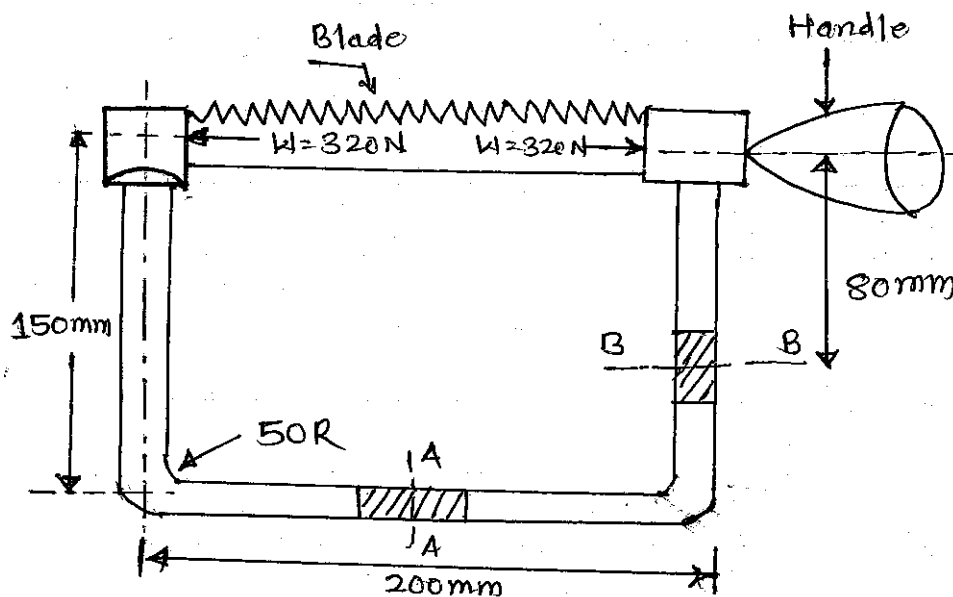

Fig. 1

b) In a rigid flanged coupling to transmit 20 kW at 700 r.p.m., the flanges are of cast iron and other parts of C – 40. Assume stresses for C.I. Tensile = 28 N/mm^2, Compressive = 60 N/mm^2, Shear = 10 N/mm^2, Stresses for C–40, Tensile = Compressive = 110 N/mm^2, Shear = 40 N/mm^2, Bearing = 25 N/mm^2. Determine diameter of shaft, diameter of bolts, if 6 bolts are used and various flange dimensions. **8**

c) Define stress concentration. What are the causes of stress concentration ? State any four methods of reducing stress concentration with neat sketches. **8**

Marks

4. Solve **any two** of the following : **16**

  a) Fig. 2 shows a C.I. bracket to carry a shaft and belt pulley. The bracket is fixed to the main body by means of standard bolts. The tensions in the slack side and tight side are 5000 N and 10,000 N respectively. The safe stress for the bolt is 60 N/mm². Determine the size of bolts. **8**
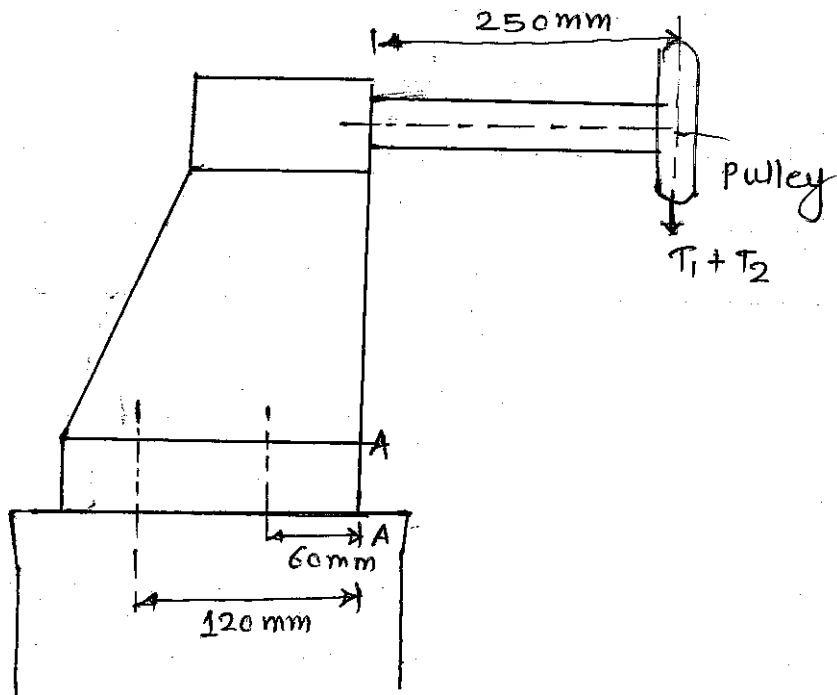

Fig. 2

  b) A helical compression spring carries a load of 500 N with a deflection 25 mm. The spring index may be taken as 8. Assume permissible shear stress as 350 MPa, modulus of rigidity 85 kN/mm².

    Wahl's factor is $\dfrac{4C-1}{4C-4} + \dfrac{0.615}{C}$. Find number of active turns of spring. **8**

  c) Explain with neat sketches and equations. How the screw spindle and nut of a screw jack is designed. **8**

5. Attempt **any two** of the following : **16**

  a) Write the strength equations for designing a symmetrically loaded parallel and transverse weld along with neat sketches. **8**

  b) A double start square thread power screw of nominal dia. 100 mm and pitch 12 mm is to be used to raise load of 300 kN. The coefficient of friction at screw thread is 0.15. Neglect collar friction. Calculate : **8**

    i) Torque   ii) Efficiency of screw

  c) Find inside dia. and outside dia. of a hollow shaft of transmit 20 kW at 200 rpm. Given ultimate shear stress = 360 MPa. F.S. = 8 and K = 0.5. **8**

Marks

6. Attempt **any two** of the following : **16**

   a) i) State the effect of key way on the strength of shaft with suitable diagram.

   ii) State the four different causes of a gear tooth failure. Explain in brief.

   b) i) Identify the material and its composition.

   A) X10Cr18Ni9Mo4Si2

   B) XT72W18Cr4V1

   ii) State design consideration while designing the spur gear.

   c) i) State any four areas of application of springs.

   ii) State the classification of shaft coupling.

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