17610

15116

4 Hours / 100 Marks Seat No. | | | | | | | | |

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

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

(3) Illustrate your answers 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. a) **Attempt any <u>THREE</u> of the following:** **12**

(i) What are the steps involved in general design procedure? Explain.

(ii) Differentiate between Knuckle joint and Cotter joint. (any four points of difference)

(iii) Write Lewis equation for strength of gear tooth. State the meaning of each term.

(iv) State four different thread profiles used in power transmission. Draw neat sketches of any two of them.

Marks

b) **Attempt any ONE of the following:** **6**

(i) What is stress concentration? Explain any four methods to reduce it.

(ii) A shaft 1000 mm long is supported between two bearings. A pulley of 250 mm diameter is keyed at 400 mm distance away from left hand bearing. The power transmitted by shaft is 10 kW at 800 r.p.m. The pulley gives power to another pulley vertically below it having an angle of contact between pulley and belt as 180°. The weight of pulley is 300 N. The coefficient of friction between belt and pulley is 0.15. Take shear stress for shaft material as 60 MPa. Find the diameter of the shaft.

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

a) Explain the design procedure of handlever with neat sketch.

b) Explain the design procedure of bush pin type flexible coupling with neat sketch.

c) (i) Explain with neat sketch the stress-strain diagram for ductile material.

(ii) Design "C" clamp frame for a total clamping force of 20 kN. The cross-section of the frame is rectangular and width to thickness ratio is 2. The distance between the load line and natural axis of rectangular cross section is 120 mm and the gap between two faces is 180 mm. The frame is made of cast steel for which maximum permissible tensile stress is 100 N/mm^2.

Marks

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

a) State the composition of following materials.

(i) Fe E 230

(ii) X 20 Cr 18 Ni 2

(iii) 35 C 8

(iv) 40 Ni 2 Cr 1 Mo 28

b) Design an offset link for a load of 1000 N. Maximum permissible stress in tension for link material is 60 N/mm^2. Assume $b = 3t$ for rectangular cross section of the link.

c) Prove that for square key equally strong in shear and crushing, the permissible crushing stress is twice the permissible shear stress.

d) Explain with neat sketch the bolts of uniform strength.

e) How keys are classified? Give detailed classification of keys with neat sketches; also state their applications.

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

(i) State the meaning of following colour codes in aesthetic consideration while designing the product:

(1) Red

(2) Orange

(3) Green

(4) Blue

(ii) Define the following terms with respect to springs:

(1) Spring index

(2) Spring stiffness

(3) Free length of spring

(4) Solid length of spring.

Marks

(iii) State the effect of keyway on the strength of the shaft.

(iv) A cylinder head of steam engine is held in position by M20 bolts. The effective diameter of cylinder is 350 mm and the steam pressure is 0.75 N/mm^2. If the bolts are not initially stressed, find the number of bolts required. Take working stress for bolt material as 20 N/mm^2.

b) **Attempt any ONE of the following:** **6**

(i) State the different modes of failure of gear teeth and their possible remedies to avoid the failure.

(ii) Explain the following types of stresses:

(1) Transverse shear stress

(2) Compressive stress

(3) Torsional shear stress

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

a) A vertical double start square threaded screw of 120 mm mean diameter and 24 mm pitch supports a vertical load of 20 kN. The axial thrust in screw is taken by collar bearings of 300 mm outside and 150 mm inside diameter. Find the force required at the end of the lever which is 400 mm long in order to lift and lower the load. The coefficient of friction for screw and nut is 0.18 and for collar bearing it is 0.25.

b) A safety valve of 60 mm diameter is to blow off at a pressure of 1.2 N/mm^2. It is held on its seat by a close coiled helical spring. The maximum lift of the valve is 10 mm. Design a suitable compression spring of spring index 5 with an initial compression of 35 mm. The shear stress for spring material is limited to 500 MPa. Take $G = 80\ kN/mm^2$.

c) (i) Differentiate between sliding contact and rolling contact bearings. (any four points of difference)

(ii) Explain the terms self locking and overhauling of screw.

Marks

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

a) State the strength equations of double parallel fillet weld and single transverse fillet weld with neat sketches.

b) A semi-elliptical carriage spring of 1200 mm length withstands a load of 60 kN with maximum deflection of 90 mm. Assume breadth to thickness ratio as 8. Design the spring if bending stress of spring material is 540 MPa and $E = 2 \times 10^5$ N/mm^2.

c) A wall bracket is fixed to the wall by means of three bolts, one bolt at a distance of 25 mm from the lower edge and remaining two bolts at a distance of 175 mm from the lower bolts. It supports a load of 7.5 kN at a distance of 250 mm from the wall. The bolts are made from plain carbon steel 45C8 with tensile yield strength of 380 N/mm^2. If factor of safety is 2.5, estimate the size of the bolts. Sketch the arrangement.

d) Explain the selection procedure of bearings from manufacturer's catalogue.

e) State the applications of following bearings with suitable reasons:

(i) Deep grove ball bearing

(ii) Taper roller bearing

(iii) Thrust coller bearing

(iv) Needle roller bearing