(3 Hours) [Total Marks: 80]

N.B.:

1. Question No.1 is compulsory.

2. Attempt any three from questions no.2 to 6.

3. Design data book is permitted in examination hall.

Q1 Attempt **ANY FOUR**:

a) Explain the series and parallel connection of spring 05

b) Prove that, the energy stored in flywheel is given by,

$$\Delta E = I\omega^2 C_s$$ 05

where all notations have their usual meanings.

c) What is the function of keys? Explain different types of keys. 05

d) State and explain any four Desirable properties of good bearing materials. 05

e) Why is cotter provided with a taper? Why is the taper provided only on one side? 05

Q2) a) In an automobile plate clutch, six helical compression spring arranged in parallel provide the axial thrust of 1500 N. The spring are compressed by 10 mm to provide this thrust force, the spring are identical and the spring index is 6. the spring is made cold-drawn Steel wire with ultimate tensile strength of 1200 N/mm^2 .the permissible shear stress for the spring wire can be taken as 50 % of ultimate tensile strength (G = 81370 N/ mm^2).The Spring have Square and ground ends. There should be a gap of 1 mm between adjacent coils when spring is subjected to maximum force. Design and draw the spring showing all dimensions. 12

b) Design the cotter joint to transmit the load a load of 60 KN in tension or compression. Take the stresses as:

Allowable tensile stress= 60 N/mm^2

Allowable Shear stress= 48 N/mm^2

Allowable crushing stress =110 N/mm^2 08

Sketch the elevation of joints showing all dimension on its.

TURN OVER

Q3) a) A shaft is supported by two bearings placed 1 m apart. A 600 mm diameter pulley is mounted at a distance of 300 mm to the right of left hand bearing and this drives a pulley directly below it with the help of belt having maximum tension of 2.25 kN. Another pulley 400 mm diameter is placed 200 mm to the left of right hand bearing and is driven with the help of electric Motor and belt, which are placed horizontally to the right. The angle of contact for both the pulleys is 180° and μ = 0.24. Determine the suitable diameter for a solid shaft, allowing working stress of 63 MPa in tension and 42 MPa in shear for the material of shaft. Assume that the torque on one pulley is equal to that on the other pulley. **12**

b) The steel plate subjected to a force of 3 KN and fixed to vertical channel by means of four identical bolts is shown in fig.(1) the bolt are made of plain carbon steel 45C8 (S_{yt} = 400 N/mm²)and factor of safety is 3.Determine the diameter of shank.**08**

Fig. (1)
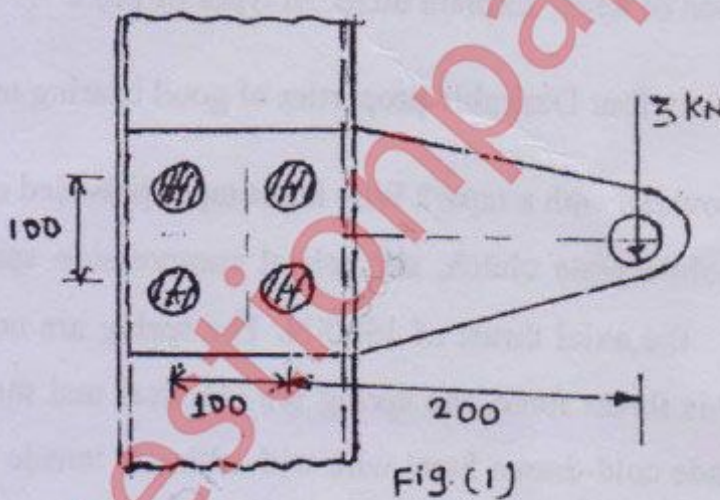
Q4) a) The following data is given for a 360° hydrodynamic bearing:

Radial load = 3.2 KN

Journal speed = 1490 rpm

Journal diameter = 50 mm

Bearing length = 50 mm

Radial clearance = 0.05 mm

Viscosity of lubricant = 25 cP

Assuming that the total heat generated in bearing is carried by the total oil flow in the bearing Calculate:

(i)   Coefficient of friction; **14**

    (ii)   Power lost in friction;

    (iii)   Minimum oil film thickness;

    (iv)   Flow requirement in litres/min:and

    (v)   Temperature rise.

b) A protective flange coupling is used to connect two shafts and transmit 7.5 KW power at 720 rpm. The design torque is 150% of the rated torque. The shaft and bolt are made of plain carbon steel 30 C 8 (S_{yt} = 400 N/mm2) and factor of safety is 5 Assume,

    S_{yc} =1.5 S_{yt} and S_{sy} = 0.5 S_{yt}

The flange is made of cast iron

Calculate the diameter of shaft, number of bolts and diameter of bolts.

             06

Q5) a) The Torque developed by a three crank engine is given by the following expression:

    $Ti = 19000 + 7000 \sin(3\theta)$ N-m

The resisting torque of a machine is given by the following Expression:

    $T_o = 19000 + 3000\sin\theta$ N-m

Where, θ is the crank angle, the engine is running at a mean speed of 300 r.p.m and coefficient of speed fluctuations is limited to 0.03.It can be assumed that the contributes 90 % of the required moment of inertia. The rimmed flywheel is made of gray cast iron FG 200 (density = 7100 kg/m^3). The cross-section of rim is rectangle and the ratio of width to thickness is 1.5.Determine the dimension of the rim.   10

b) A transmission shaft of cold drawn steel 27 Mn2 (S_{ut} =500 N/mm^{2}and S_{yt} =300 N/mm$_2$)is subjected to a fluctuating torque which varies from - 100 N-m to + 400 N-m.the factor of safety is 2 and expected reliability is 90 % .Neglecting the effect of stress concentration, determine the diameter of shaft.   10

Assume distortion energy theory of failure.

Q6 a) State and explain maximum principle stress theory failure. 06

b) Explain design consideration in casting. 06

c) A C-Frame subjected to a force of 15KN is shown in Fig. (2) It is made of gray Cast iron F.G 300 and factor of safety is 2.5.Determine the dimension of the cross-section. 08
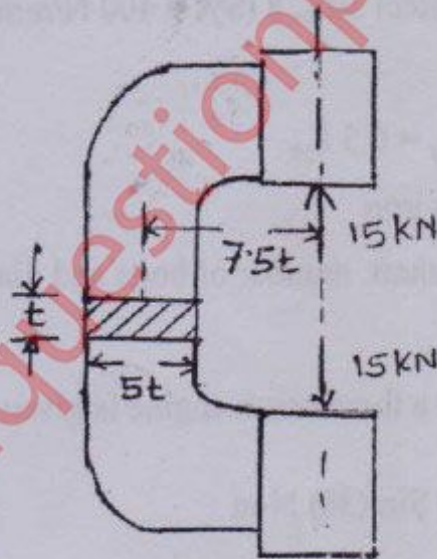

Fig :(2)