B.TECH. SEM -V MECHANICAL 2014 COURSE (CBCS) :
SUMMER - 2018
SUBJECT : MACHINE DESIGN – I

Day : **Monday** | **S-2018-2365** | Time **10.00 AM TO 02.00 PM**
Date : **21/05/2018** | Max. Marks : 60

N.B.

1) All questions are **COMPULSORY.**
2) Figures to the right indicate **FULL** marks.
3) Use of non-programmable calculator is allowed.
4) Assume suitable data if necessary.

Q.1 What are the advantages of Standardization? Explain with example. **(10)**

OR

What are the basic requirements of machine element?

Q.2 A transmission shaft is supported between two bearings, that are 750 mm apart. Power is supplied to the shaft through a coupling, that is located to the left of left hand bearing. Power is transmitted from the shaft by means of a belt pulley, 450 mm diameter, which is located at a distance of 200 mm to the right of left hand bearing. The weight of the pulley is 300 N and the ratio of belt tension of tight and slack sides is 2;1. The belt tensions act in vertically downward direction. The shaft is made of steel feE 300 (S_{yt} = 300 N/mm^2) and the factor of safety is 3. Determine the shaft diameter, if it transmits 12.5 kw power at 300 rpm from the coupling to the pulley. Assume (S_{sy} = 0.5 S_{yt}) **(10)**

OR

A bushed pin type flexible coupling is used to connect two shafts and transmits 5 kW power at 720 rpm shafts, keys and pins are made of commercial steel (S_{yt} = S_{yc} = 240 N/mm^2) and the factor of safety is 3. The flanges are made of gray cast iron FG 200 (S_{ut} = 200 N/mm^2) and the factor of safety is 6. Assume, S_{sy} = 0.5 S_{yt} and S_{su} = 0.5 S_{st}.

There are 4 pins. The pitch circle diameter of the pins is four times of shaft diameter. The permissible shear stress for pins is 35 N/mm^2. The permissible bearing pressure for rubber bushes is 1 N/mm^2.

Calculate:

1. diameter of the shafts
2. dimensions of the key
3. diameter of the pins
4. outer diameter and effective length of the bushes.

Q.3 A sluice valve, used in water-pipeline, consists of a gate raised by the spindle, that is rotated by the hand wheel. The spindle has single start square threads. The nominal diameter is 36 mm and the pitch is 6 mm. The inner and outer diameters of the friction collar are 30 mm and 50 mm respectively. The coefficients of friction at the threads and the collar are 0.15 and 0.20 respectively. The weight of the gate is 7.5 kN and the frictional resistance to open the valve due to water pressure is 2.5 kN. Using the uniform wear theory for collar friction calculate **(10)**

1. torque required to raise the gate
2. overall efficiency of the mechanism

OR

A screw jack is to lift a load of 80 kN through a height of 400 mm. The elastic strength of screw material in tension and compression is 200 MPa and in shear 120 MPa. The material for nut is phosphor-bronze for which the elastic limit may be taken as 100 MPa in tension, 90 MPa in compression and 80 MPa in shear. The bearing pressure between the nut and the screw is not to exceed 18 N/mm^2. Design a screw for spindle and nut.

P.T.O.

Q.4 A railway wagon moving at a velocity of 2m/s is brought to rest by a bumper consisting of two helical compression springs arranged in parallel. The springs are compressed by 150 mm in bringing the wagon to rest. The mass of the wagon is 1000 kg. The spring index can be taken as 6. The springs are made of oil hardened and tempered steel wire with ultimate tensile strength of 1500 N/mm^2 and modulus of rigidity of 81370 N/mm^2. The permissible shear stress for the spring wire can be taken as 50% of the ultimate tensile strength. Design the spring and calculate **(10)**

1. maximum force on each spring
2. wire diameter
3. mean coil diameter
4. number of active coils

OR

A helical compression spring is required to deflect through approximately 25 mm. When the external force acting on it varies from 500 to 1000 N. The spring index is 8. The spring has square and ground ends. There should be a gap of 2 mm between adjacent coils when the spring is subjected to the maximum force of 1000 N. The spring is made of cold drawn steel wire with ultimate tensile strength of 1000 N/mm^2 and permissible shear stress in the spring wire should be 50% of the ultimate tensile strength (G = 81370 N/mm^2). Design the spring and calculate :

1. Wire diameter
2. mean coil diameter
3. number of active coils
4. total number of coils
5. solid length
6. free length

Q.5 Find the efficiency of the following riveted joints: **(10)**

1. Single riveted lap joint of 6 mm plates with 20 mm diameter rivets having a pitch of 50 mm.
2. Double riveted lap joint of 6 mm plates with 20 mm diameters rivet having a pitch of 65 mm. Assume.
   Permissible tensile stress in plate = 120 MPa
   Permissible shearing stress in rivets = 90 MPa
   Permissible crushing stress in rivets = 180 MPa

OR

How to calculate stresses in eccentrically loaded welded joints.

Q.6 **a)** What are the different types of fluctuating stresses when the mechanical component is subjected to the fatigue. **(05)**

b) How to predict the failure by using Goodman Criterion. **(05)**

OR

A machine component is subjected to fluctuating stress that varies from 40 to 100 N/mm^2. The corrected endurance limit stress for the machine component is 270 N/mm^2. The ultimate tensile strength and yield strength of material are 600 N/mm^2 respectively. **(10)**

Find the factor of safety using

1. Gerber theory
2. Soderberg line
3. Goodman line
4. Also find factor of safety against static failure.

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