R10

Set No: 1

Code No: R31035

III B.Tech. I Semester Supplementary Examinations, June/July - 2014
Design of Machine Members-I
(Mechanical Engineering)

Time: 3 Hours   **Max Marks: 75**

Answer any FIVE Questions
All Questions carry equal marks
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1. (a) A weight of 1400 N is dropped on to a collar at the lower end of a vertical steel shaft of 3m long and 25 mm. diameter, calculate the height of drop if the maximum instantaneous stress produced is not to exceed 120 MPa. Take $E = 2.1 \times 10^5$ MPa.
(b) Explain the influence of stress raiser on impact strength
(c) Explain the term 'factor of safety'.

2. A steel member of circular cross section is subjected to a torsional stress that varies from 0 to 35 MPa and at the same time it is subjected to an axial stress that varies from 14 MPa to 28 MP(a)Neglecting stress concentration and column effect determine
(i) the maximum equivalent shear stress.
(ii) the design factor of safety based upon yield in shear. The material has an endurance limit = 260 MPa and a yield strength = 480 MP(a)The size factor may be taken as UNITY and the surface has a mirror polish

3. (a) What is the difference between caulking and fullering? Explain with neat diagrams?
(b) Determine the safe tensile, shear and bearing loads and the efficiency for a 300 mm section of single-riveted lap joint made from 6mm plates using six 16-mm diameter rivets. Assume that the drilled holes are 1.5 mm larger in diameter than the rivets. The values for the design limits for tensile, shear and bearing stress can be taken as 75, 60 and 131MPa, respectively.

4. (a) What do you understand by the single start and double start threads? Explain with neat diagrams.
(b) A steam engine cylinder has an effective diameter of 350mm and the maximum steam pressure acting on the cylinder cover is 1.25N/mm^2. Calculate the number and size of studs required to fix the cylinder cover, assuming the permissible stress in the studs as 33MPa.

5. Design a socket and spigot type of cotter joint to sustain an axial load of 100kN. The material selected for the joint has the following design stresses. $\sigma t = 120$ MPa, $\sigma c = 160$ MPa and $pb = 60$ MPa

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6. In a design of transmission shafting determine a sensible minimum nominal diameter for the drive shaft illustrated in Figure:1 consisting of a midmounted spur gear and overhung pulley wheel. The shaft is to be manufactured using 817M40 hot rolled alloy steel with UTS 1000MPa, YS 770MPa and Brinell Hardness approximately 220 BHN. The radius of the fillets at the gear and pulley shoulders is 3mm.The power to be transmitted is 8 kW at 900 rpm.The pitch circle diameter of the 20° pressure angle spur gear is 192 mm and the pulley diameter is 250mm.The masses of the gear and pulley are 8 and 10 kg, respectively. The ratio of belt tensions should be taken as 2.5. Profiled keys are used to transmit torque through the gear and pulley. A shaft nominal reliability of 90 per cent is desired. Assume the shaft is of constant diameter for the calculation.
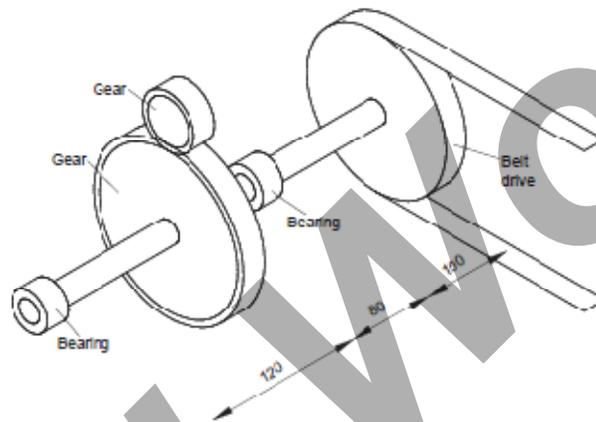

Fig:1

7. Design a bush type flexible coupling to connect motor and centrifugal pump shafts. Motor transmits 10 KW at 1440 RPM. Allowable stress in shear for shaft, key and bolts are 40 MPa. Allowable bearing pressure for rubber bush is 0.3 MPa. Check for stresses.

8. A helical compression spring is required to exert a force of 35 N when compressed to a length of 60mm. At a length of 48 mm the force must be 50N.The spring is to be installed in a hole with a diameter of 24mm.The application involves slow cycling and a total life of 250 000 cycles is required. The maximum temperature of operation is 80°C.

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R10

Set No: 2

Code No: R31035

III B.Tech. I Semester Supplementary Examinations, June/July - 2014
Design of Machine Members-I
(Mechanical Engineering)

Time: 3 Hours   **Max Marks: 75**

Answer any FIVE Questions
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1. (a) A stepped shaft has maximum diameter 45 mm and minimum diameter 30 mm. The fillet radius is 6 mm. If the shaft is subjected to an axial load of 10 kN, find the maximum stress induced, taking stress concentration into account
   (b) Explain in detail about the six theories of failure

2. (a) Explain the influence of stress concentration in the design of machine elements
   (b) Explain the significance of Goodman's line and Soderberg line in design of members subjected to reversal of stresses.

3. Design the longitudinal joint for a boiler for a steam pressure of 2 MPa. Diameter of the boiler is 1 m. Select a double riveted butt joint with a required efficiency of 75%. Take the following allowable stresses. $\sigma t = 80$ MPa, $\tau = 60$MPa, $\sigma c = 120$ MPa

4. (a) Explain the method of determining the size of bolt when the bracket carries an eccentric load perpendicular to the axis of the bolt
   (b) An eye bolt is to be used for lifting a load of 60 kN. Find the nominal diameter of the bolt, if the tensile stress is not to exceed 100MPa. Assume coarse threads.

5. Design a sleeve type of cotter joint to connect two tie rods subjected to an axial pull of 60 kN. The allowable stress of C – 30 material used for rods and cotters are $\sigma t = 65$ N/mm^2, $\sigma c = 75$ N/mm^2 and $\tau = 35$ N/mm^2. Cast steel material used for the sleeve has the allowable stresses $\sigma t = 70$ N/mm^2 and $\tau = 45$ N/mm^2.

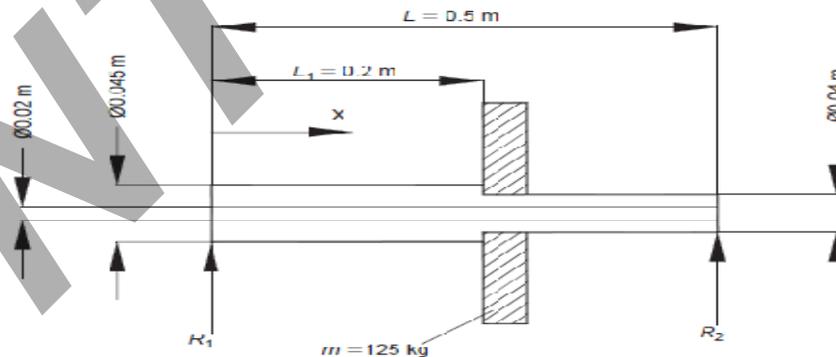6. Determine the deflection of the stepped shaft illustrated in Figure 1 under a single concentrated load.

Figure 1

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Set No: 2

7. Design a cast Iron flange coupling (protected type) to connect two shafts and transmits a torque a 5000 Nm. The following permissible stresses may be used. Permissible shear stress for shaft, bolt and key material = 50 MPa. Permissible shear stress for CI = 16MPa

8. A helical compression spring is required to exert a force of 400 N when compressed to a length of140mm.At a length of 170 mm the force must be 160N. A nominal spring mean diameter of 35 mm has been proposed. The application involves slow cycling and a total life of 150 000 cycles is required. The maximum temperature of operation is 60°C. Determine a suitable wire diameter for this application if ASTM A232 is to be used.

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Code No: R31035

R10

Set No: 3

III B.Tech. I Semester Supplementary Examinations, June/July - 2014

Design of Machine Members-I

(Mechanical Engineering)

Time: 3 Hours   **Max Marks: 75**

Answer any FIVE Questions

All Questions carry equal marks

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1. (a) Discuss the factors influencing selection of an appropriate material for a machine Element

   (b) A weight of 1 kN is dropped from a height of 50 mm at the free end of a cantilever beam of effective length 300 mm. Determine the cross section of the cantilever beam of square cross – section if the allowable stress in the material of the beam is limited to 80MPa.

2. shaft can transmit power of 20 KW at 1000 RPM. The actual torque transmitted by shaft is ± 60% of the mean torque calculated. Shaft is also subjected to a variable bending moment of 500 N-m to 1000 N-m. The maximum bending moment occurs at the same instant as that of maximum torque. Determine the diameter of the shaft required selecting suitable material. Take factor of safety 2, size factor = 0.85, and surface factor = 0.8.

3. (a) What are the various permanent and detachable fastenings? Give a complete list with the different types of each category.

   (b) Determine the maximum safe tensile load that can be supported by a 1 m section of double riveted butt joint with 15 mm thick main plates and two 8 mm thick cover plates. There are six rivets in each of the outer rows and seven rivets in each of the inner rows. The rivets are all 20 mm in diameter. Assume that the drilled holes are 1.5 mm larger in diameter than the rivets. The values for the design limits for tensile, shear and bearing stress can be taken as 75, 60 and 131MPa, respectively.

4. (a) what are the advantages and disadvantages of screwed joints? Explain.

   (b) A bolt in a steel structure is subjected to a tensile load of 9 KN. The initial tightening load on the bolt is 5 KN. Determine the size of the bolt taking allowable stress for the bolt material to be 80 MPa.

5. (a) Select a rectangular parallel key for transmitting a power of 50 KW at a rated speed of 500 RPM to mount a hub of length 60mm on a solid circular shaft of diameter 50 mm.

   (b) Sketch and explain the types of riveted joint failure.

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Set No: 3

6. A shaft is required to transmit 1 MW power at 240RPM. The shaft must not twist more that 1^0 on a length of 15 diameters. If the modulus of rigidity for the material of the shaft is 80 kN/mm^2, find the diameter of the shaft and the shear stress induced.
A line shaft is to transmit 600 KW at 500RPM. The allowable shear stress for the material of the shaft is 42 N/mm^2 (42MPa). If the shaft carries a central load of 900N and is simply supported between bearing 3 meter apart, determine the diameter of the shaft. The maximum tensile or compressive stress in not exceed 50 MPa

7. Design a bushed pin type flexible coupling to transmit 90 KW at 1440 RPM for connecting two shafts of diameter 60 mm. Assume bearing pressure on the bushes as 0.35N/mm2, allowable shear stress in the material of the pins as 45 N/mm2 and allowable bending stress in the material of the pin is 80 N/mm^2

8. A helical extension spring is required to exert a force of 30 N when the length between attachment locations is 70 mm and a force of 20 N at a length of 60mm.The spring will be cycled through its load 100 times a day. ASTM A228 music wire steel has been proposed for the spring. The diameter of the spring should not exceed 20mm.Determine suitable dimensions for the spring wire diameter, number of coils and mean diameter.

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Set No: 4

Code No: R31035

III B.Tech. I Semester Supplementary Examinations, June/July - 2014

Design of Machine Members-I

(Mechanical Engineering)

Time: 3 Hours   **Max Marks: 75**

Answer any FIVE Questions

All Questions carry equal marks

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1. (a).Discuss the factors influencing selection of appropriate value for the factor of safety and List the factors which govern the selection of a material for a machine component

   (b)A round steel bar having σy = 800 MPa is subjected to the loads producing the calculated stresses of P/A = 70MPa, TR/Jp = 200 MPa, My/J = 300 MPa and 4V/3A = 170MPa.

   (i) Determine the safety factor with respect to initial yielding according to maximum shear stress theory and maximum distortion energy theory

   (ii) Draw the sketch showing the location of maximum normal stress and maximum shear stress planes

2. A shaft of circular cross section is subjected to a turning moment that fluctuates between 800 kNm and 600 kNm and also a bending moment that fluctuates between + 500 kNm and – 300 kNm. The material selected for the shaft has a shear stress value of 100 MPa at endurance limit and a shear stress value of 120 MPa of the yield limit. Determine the diameter of the solid circular shaft taking a value of 2.50 for the factor of safety. Surface factor, size factor and load factor can be taken as 0.90, 0.85 and 1.0 respectively. Shear stress concentration factor is 1.80 and the notch sensitivity is 0.95.

3. (a)What are assumptions made in design of welded joints?

   (b)A plate 100mm wide and 10mm thick is to be welded to another plate by means of double parallel fillets. The plates are subjected to a static load of 80 kN. Find the length of weld if the permissible shear stress in the weld does not exceed 55MPa.

4. (a)Discuss on bolts of uniform strength? Mention at least two practical applications of such bolts?

   (b)Two machined parts are fastened together tightly by means of a 24mm tap bolt. If the load tending to separate these parts is neglected, find the stress that is set up in the bolt by the initial tightening?

5. (a)A 100mm shaft rotating at 100 RPM transmit 300 hp power is taken off through a gear whose hub is 200 mm long. The key is made of steel having an ultimate shearing stress of 350N/ mm2. Using a factor of safety of 5, determine the width of key required.

   (b)How are keys classified Draw neat sketches of different types of keys and state their applications

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Set No: 4

6. Determine the diameter of the drive shaft for a chain conveyor, which has the loading parameters illustrated in Figure 1. A roller chain sprocket of 500 mm pitch diameter, weighing 90 kg will be mid-mounted between two bearings. A 400mm, 125 kg roller chain sprocket will be mounted overhung. The drive shaft is to be manufactured using cold drawn 070M20 steel with UTS 1000MPa, YS 770MPa and Brinell Hardness approximately 220 BHN..The shaft will carry a steady driving torque of 1600 N m and rotate at 36 rpm. A sled runner keyway will be used for the overhung pulley and a profile keyway for the mid-mounted pulley
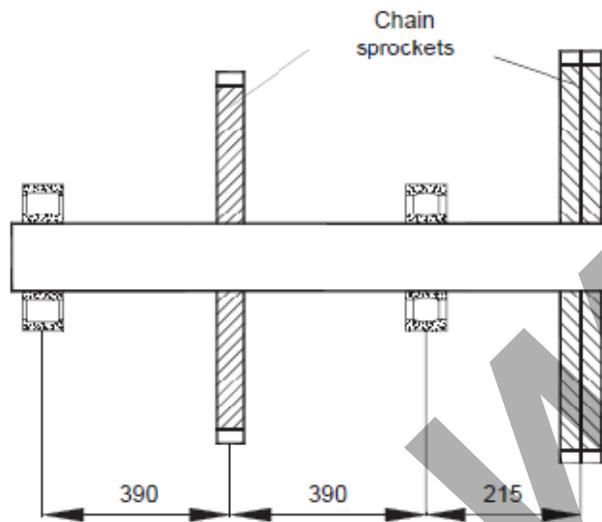

Figure 1

7. Design a cast iron protective flange coupling to connect two shafts in order to transmit 7.5 KW at 720 RPM. the following permissible stresses may be used permissible shear stress for shaft, bolt and key material = 33MPa. Crushing stress for bolt and key material = 60 MPa. Shear stress for cast iron = 15MPa.

8. (a) What are the Principal characteristics of different types of springs
    (b) Classify springs according to their shape. Draw neat sketches indicating in each case whether stresses are induced by bending or by torsion

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