Code No: 07A52402 **R07** **Set No. 2**

III B.Tech I Semester Examinations,November 2010
DESIGN OF MACHINE ELEMENTS
Automobile Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Explain stress concentration with suitable examples and discuss the methods to reduce stress concentrations.
   (b) A steel link having a rectangular section is subjected to a repeated axial load of 50,000 N with a medium shock. Determine the section if the endurance limit be 250 MPa with a design factor 1.5. Take side ratio as 2:1. Size factor may be taken as 0.85 and surface finish factor as 0.88. [6+10]

2. (a) Explain the design considerations for engineering design.
   (b) Calculate the diameter of the solid shaft to transmit 50 kW at 180 rpm. If the angle of twist in a length of 4 meters is not to exceed 0.40^0. The allowable stress in the material is 70 MPa and modulus of rigidity is 84 GPa. [6+10]

3. Design a cast iron cylinder for an IC engine whose a bore diameter is 100 mm and the maximum combustion pressure is 5 N/mm^2. Assume suitable permissible stresses. [16]

4. A shaft is mounted on two roller bearings, which are 350 mm apart. The shaft carries a bevel gear at the middle. At a shaft speed of 900 r.p.m; the gear forces are: radial load = 10 kN, and the thrust load=3.5 kN. Determine the rated dynamic Capacity of the bearing, for a desired life of 10000 hours. The service factor is 0.67, and radial load factor is 0.67. [16]

5. (a) Why bearing edges of the cotter and bearing slots in the rods of a cotter joint are made semi-circular
   (b) Two round steel rods 5 cm diameter are connected by a sleeve and cotter joint. Design and draw the joint. Assume tensile stress in rods 80 Mpa, shearing stress in cotter 70 MPa and crushing stress in cotter 60 MPa. [4+12]

6. Design a spring for an engine indicator of the following specifications:
   Maximum pressure in the engine cylinder: 1000 N/cm^2
   Diameter of the indicator cylinder: 40 mm
   Mean diameter of the indicator spring: 20 mm
   Height of the indicator drum: 80 mm
   Mechanical amplification of the linkage: 5
   Approximate number of turns in the spring: 8
   Rigidity modulus of the spring material: 0.85x10^5 N/mm^2 [16]

7. The base of a pillar crane is fastened to the foundation by eight bolts spaced equally on a bolt circle of diameter 1.6 m. The diameter of the pillar base is 2 m. Determine the size of bolts when the crane carries a load of 100 kN at a distance of 5 m from the centre of the base. The allowable stress for the bolt material is 100 MPa. [16]

8. The following particulars refer to four stroke cycle diesel engine cylinder:

   Cylinder bore =160 mm

   Stroke =200 mm

   Length of the connecting rod =3100 mm

   RPM =1410

   Maximum gas pressure =5.25 MPa

   Determine:

   (a) The dimensions of an I-section connecting rod of forged steel with an elastic limit compressive stress of 340 MPa. The ratio of length of the connecting rod to the length of the crank is 4 and the factor of safety is 5.

   (b) The wrist pin and crank pin dimensions on the basis of the bearing pressure of 10.2 MPa and 0.6 MPa of the projected area respectively.

   (c) The size of the securing bolts of crank pin end if the allowable stress not to exceed 34 MPa.

   Draw freehand dimensioned sketches of connecting rod showing provision if any made for lubrication and wear adjustment. [16]

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Code No: 07A52402 **R07** **Set No. 4**

III B.Tech I Semester Examinations,November 2010
DESIGN OF MACHINE ELEMENTS
Automobile Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. Design a connecting rod of I-section for an engine for the following.
   Crank radius = 300 mm
   Connecting rod length = 1800 mm
   Speed of the crank = 400 rpm
   Specific weight of material = 7.2 gm/c.c
   Explosion pressure = 3.5 N/mm^2
   Neglect weight of the reciprocating parts. Assuming suitable data if necessary. [16]

2. A bracket is riveted to a column by 6 rivets (A,B,C,D,E and F) of equal size as shown in Figure 1 The centres of rivets A,B,C are on the same vertical line and the centres of E , F are on the another vertical line. The centres of B, D are on the same horizontal line. The centres of A, E are on one horizontal line and the centres of C,F are on another horizontal line. The vertical distance between A,B and B,C are 75 mm and 75 mm respectively. The horizontal distance between B,D and C,F are 75 mm and 150 mm respectively.
   It carries a load of 100 kN at a horizontal distance of 250 mm from the central line of rivet D. If the maximum shear stress in the rivet is limited to 63 MPa, find the diameter of the rivet. [16]

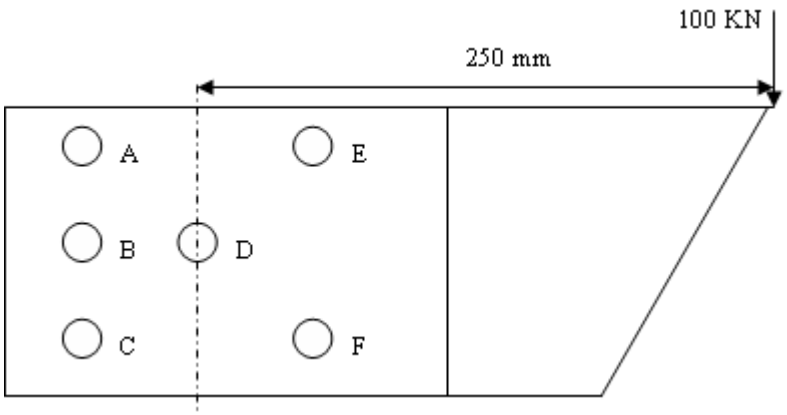

Figure 1

3. A ball bearing is required to resist a radial load of 10 kN and a thrust load of 5 kN. The average life of the bearing is to be 5000 hours, with inner race rotation at 980 r.p.m. What basic dynamic load rating must be used in selecting the bearing?

If the bearing is to have a life of 5000 hours at a reliability of 97%,what is the required basic dynamic load rating? [16]

4. (a) Write the comparison between solid shafts, hollow shafts and spindles.
   (b) Compute the diameter of a solid shaft which has to transmit 16 kW power at 300 rpm. Ultimate shear stress per shaft material is 350 N/mm^2 and factor of safety for design is 6. If a hollow shaft replaces the solid shaft, find the inside and outside diameters if the ratio is 0.5. [6+10]

5. (a) Plot the stress distribution around an elliptical hole in an infinite plate subjected to normal stress. Assume the major axis of elliptical hole is oriented along the direction of normal stress.
   (b) A 0.05 m diameter shaft is made from carbon steel having ultimate tensile strength of 630 MPa. It is subjected to a torque, which fluctuates between 2 kN-m to -0.8 kN-m. Using Soderberg method, Calculate the factor of safety. Assume suitable values for any other data needed. [6+10]

6. (a) What is nip and express its importance in leaf springs
   (b) A semi- elliptic laminated truck spring to carry a load of 6000 N is to consist of seven leaves 64 mm wide ,two of the leaves extending the full length of the spring. The spring is to be 1.1 m long and attached to the axle by two U-bolts 80mm apart. The bolts hold the central portion of the spring so rigidly that they may be considered equivalent to a band having width equal to the distance between the bolts. Assume a design stress for spring material as 350 N/mm^2. Determine
      i. Thickness of leaves,
      ii. Deflection of spring
      iii. Diameter of eye
      iv. Initial bending radius of the leaves
      v. length of leaves. [4+12]

7. A beam of length 5 m and of uniform rectangular section is simply supported at the ends. It carries a uniformly distributed load of 9 kN/m run over the entire length. Calculate the width and depth of the beam if the allowable bending stress is limited to 70 MPa and central deflection should not exceed 10 mm. Assume the width of beam as one half of its depth. Neglect the weight of the beam. [16]

8. Design a suitable aluminum alloy piston with two compression rings and one oil ring for a petrol engine of following particulars:

   Cylinder diameter = 0.1 m

   Peak gas pressure = 3.2 MPa.

   Mean effective pressure = 0.8 MPa

   Average side thrust = 2400 N

   Skirt bearing pressure = 0.22 MPa

Bending stress in piston crown = 36 MPa

Crown temperature difference = 70^0C

Heat dissipated thorough crown = 157kJ/m^2s

Allowable radial pressure = 0.04 MPa

Bending Stress in rings = 90 MPa

Heat conductivity= 160 W/m/^{0}C.

Draw a full scale dimensioned drawing and indicate the method of reducing the thermal expansion in the skirt of designed piston. [16]

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1. (a) What are the design considerations in the following parts in a knuckle joint?
   i. Pin diameter
   ii. Inner part rod
   iii. Outer part rod
   iv. Thickness of outer part
   (b) Design a cotter joint of socket and spigot type, which may be subjected to a pull or push of 30 kN. All the parts of the joint are made of the same material with the permissible stresses, 55 MPa in tension , 70 MPa compression, and 40 MPa in shear. [8+8]

2. (a) Why leaf springs are made in layers instead of single plate ?
   (b) Design a spring for a spring-loaded safety valve for the following conditions. Operating pressure 10 bar. Diameter of the valve seat 100mm. Design shear stress for the spring material is 400 N/mm^2. Modulus of rigidity is 8x10^{4}N/mm^2. The spring is to be kept in a casing of 120 mm inner diameter and 350 mm long. The spring should be at maximum lift to 6 mm, when the pressure is at 11 bar. [4+12]

3. (a) Explain the effect of the following factors on the type of fatigue failure
   i. Strain rate
   ii. Type of material
   iii. Manner of loading
   (b) A steel connecting rod is subjected to a completely reversed axial load of 1,600 MPa. Suggest the suitable diameter of the rod using a factor of safety 2. The ultimate tensile strength of the material is 1,100 MPa and yield strength 930 MPa. Neglect column action and the effect of stress concentration. [6+10]

4. Design a single throw, double view crank shaft made of forged steel for a single cylinder, vertical I.C engine having cylinder diameter of 120 mm and stroke length of 160 mm. The engine develops 10kW at 300 rpm. The explosion pressure is 2.5 N/mm gauge. The maximum torque is developed when the crank shaft turns through 25^0 from the TDC position during the expansion stroke. The burnt gas pressure at that moment is 2.0N/mm^2. The crankshaft main bearings are 320 mm apart. Assume suitable data. [16]

5. (a) Differentiate the following

i. Strength from Stress
ii. Brittle fracture from ductile fracture
iii. Resilience from Toughness

(b) Define the failure? What are the possible modes of failures? [6+10]

6. A bearing is fastened to the frame by 6 bolts spaced equally on a 250 mm bolt circle. The bearing flange diameter is 300 mm. A load of 45 kN is applied at 280 mm from the frame. Determine the size of bolts when

(a) two bolts are located in the vertical plane of symmetry of the bearing

(b) two bolts are located in the horizontal plane of symmetry of the bearing. Assume allowable tensile stress in the bolt material to be 90 MPa. [16]

7. A ball bearing is operating on a work cycle consisting of three parts-a radial load of 3000 N at 1440 rpm for one quarter cycle, a radial load of 5000 N at 720 rpm for one half cycle, and radial load of 2500 N at 1440 rpm for the remaining cycle. The expected life of the bearing is 1000 hr. Calculate the dynamic load carrying capacity of the bearing [16]

8. (a) Briefly write the design procedure for piston pin and liners

(b) Why a piston clearance is necessary? What is its value?

(c) What kind of engines are employed in the following applications.

i. Air craft
ii. automobile
iii. Compressor
iv. Motor cylcle [6+4+6]

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Code No: 07A52402 **R07** **Set No. 3**

III B.Tech I Semester Examinations,November 2010
DESIGN OF MACHINE ELEMENTS
Automobile Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. (a) Explain the following methods of reducing stress concentration.
   i. Removal of undesired material
   ii. Added grooves
   (b) A steel connecting rod is subjected to a completely reversed axial load of 120 KN. Suggest the suitable size of the rod using a factor of safety 1.8. The ultimate strength of the material is 1000 MPa.
   Load correction factor 0.7
   Size factor 0.85
   Surface finish factor 0.8 [4+12]

2. A bracket is supported by means of 4 rivets of same size, as shown in Figure 2 Determine the diameter of the rivet if the maximum shear stress is 140 MPa.

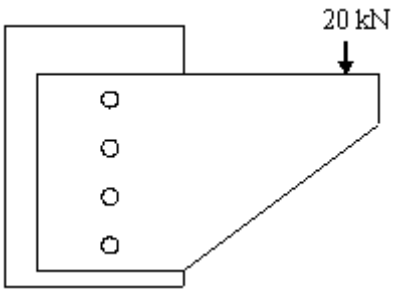

Figure 2:

The load 20 kN is applied at an eccentric distance of 80 mm from the line passing through the centers of rivets and center to center distance of rivets is 30 mm. [16]

3. Design a cast iron piston for a single acting four stroke IC Engine for the following data. Cylinder bore = 100 mm, stroke length = 120 mm, Maximum gas pressure =6 MPa, bmep = 0.7 MPa, Fuel consumption= 0.24 kg/kW/hr, Speed = 2200 rpm. [16]

4. Design completely a connecting rod, the bolts for the big end cap for a medium speed, four cylinders I.C. Engine, given the following data:
   Piston diameter =100 mm
   Stroke =125 mm

Weight of reciprocating parts = 1.1 kg

Length of the connecting rod = 313 cm

RPM of the engine -normal = 1200

-over speed = 2000

Maximum explosion pressure = 2.8 MPa

Start clearly the values adopted for the factors of safety and the ultimate stresses and underline them. Draw free hand, to about full size, a proportionate elevation of the connecting rod and add either an end view or a sectional plan. [16]

5. (a) State and explain the maximum principal stress theory and maximum shear stress theory?

   (b) Determine the maximum thickness of the steel sheet into which holes of 20mm size can be punched. The ultimate tensile strength of the sheet material is 250 MPa. The allowable compressive stress during the punching operation in the hardened end of the punch is limited to 400 MPa. [6+10]

6. (a) For any sunk key, the crushing strength should be at least twice the shear strength, prove it?

   (b) A 63mm dia shaft has a key 16 mm × 16 mm. The shaft material has a yield strength of 324 N/mm^2. Asssume shear yield strength to be half of the tensile yield strength and factor of safety to be equal to 2. The shaft fits in to a cast iron hub for which the working stress in compression is 125MPa. Determine the length of the key in the hub to carry the torque of the solid shaft. [8+8]

7. Select a suitable spherical roller from SKF series 222 C to support a radial load of 4kN and an axial load of 2 kN. Minimum life required is 10,000 hours at 1000 rpm. For the selected bearing find

   (a) the expected life under the given loads

   (b) the equivalent load that can be supported with a probability of survival of 95% with 10,000 hrs [16]

8. (a) How the surge in the spring is eliminated?

   (b) A cylinder relief valve should blow at a pressure of 1.5 N/mm^2 and should lift by 6 mm for a 5 % increase in pressure. The diameter of the valve is 60 mm. Design the valve spring giving a suitable combination of

      i. Mean coil diameter,
      ii. Wire diameter,
      iii. Number of active and Inactive coils,
      iv. Pitch of coils,
      v. Type of ends,
      vi. Solid and free length of spring.

Permissible shear stress for the spring material may be taken as 500 N/mm^2 and C=0.85 x 10^5N/mm^2.

Spring wire sizes are 2, 3, 4, 5, 6, 7. 1, 8, 9,10 and 11.23 mm. Also for S =4, 5, 6, 7, 8, 9 and 10 the stress factor K is 1.32, 1.2525, 1.21, 1.184, 1.187,1.15 respectively.[4+12]

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