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

III B.Tech I Semester Examinations,May 2011
DESIGN OF MACHINE ELEMENTS
Automobile Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. (a) Define "Rigidity". What are the requirements to design a solid shaft for rigidity ?
   (b) A shaft 150cm long is supported at the ends of journal bearings and rotates at 125rpm. A vertical load of 8kN is applied 30cm from the left hand bearing. A load of 12kN acting downward and forward at an angle of 45^0 with the horizontal is applied midway between bearings and a load of 10kN acting downward and forward at an angle of 60^0 with the horizontal and 25 cm to the left of right hand bearing. Power of 14kW is supplied at the first load, a power of 8.5kW is taken off at the second load and the remainder at the third load. Determine the suitable diameter for the shaft if the permissible shear stress is limited to 50MPa. Draw the bending moment diagram for the shaft. [4+12]

2. (a) Compare and Constant the Journal bearings and antifriction bearings.
   (b) The rolling contact ball bearing are to be selected to support the overhung countershaft. The shaft speed is 720r.p.m. The bearing are to have 99% reliability corresponding to a life of 24000 hours. The bearing is subjected to an equivalent radial load of 1kN.Consider life adjustment factors for operating condition and material as 0.9 and 0.85 respectively. Find the basic dynamic load rating of the bearing from manufacturers catalogue, specified at 90% reliability. [4+12]

3. Design an aluminum alloy piston for a single acting four stroke engine for the following data:

   Cylinder bore = 0.3m

   Stroke = 0.375m

   Maximum gas pressure = 8 MPa

   Break mean effective pressure = 1.15 MPa

   Fuel consumption = 0.22kg/kW/hr

   Speed =50rev/min. [16]

4. A diesel engine weighs 800kN and is mounted on 16 springs in order to protect the building from vibrations. The section of the spring wire is rectangular with side ratio1.8. One spring has four effective coils and the spring index is 6.

   Determine:

(a) Section of the spring so that long side is parallel to the axis of the spring

(b) Deflection under load when engine is stationary.

(c) Maximum coil diameter.

(d) Shear stress induced if shorter side is parallel to the spring axis. Permissible shear stress in spring wire material is 300N/mm^{2}and modulus of rigidity is 0.8x10^{5}N/mm^2. [16]

5. A 125 mm × 95 mm × 10 mm angle is welded to a frame by two 10 mm fillet welds, as shown in Figure 1. A load of 16 kN is applied normal to the gravity axis at a distance of 300 mm from the centre of gravity of welds. Find maximum shear stress in the welds, assuming each weld to be 100 mm long and parallel to the axis of the angle. [16]

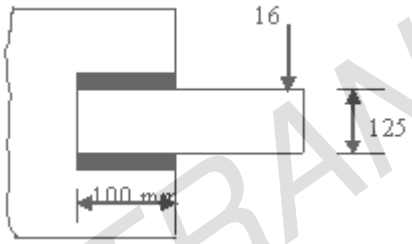

Figure 1:

6. (a) In what respect does bending stress differ from the direct tensile or compressive stress

(b) Give the dimensions for the hole and shaft for the following :

i. A 12mm electric motor sleeve bearing

ii. A medium force fit on a 200 mm shaft and

iii. A 50mm sleeve bearing on the elevating mechanism of a road grader. [4+12]

7. The big end bearing of the connecting rod of a petrol engine having the following particulars is to be designed:

Piston diameter =75mm.

Stroke of the piston =100mm

Weight of reciprocating parts =1.125kg

Length of the connecting rod =200mm

Speed(maximum) =2500r.p.m.

Maximum explosion pressure =2.45MPa

Width of cap =35mm

Distance between the cap bolts =70mm

(a) The diameter and length of the bearing if the permissible bearing pressure is 7MPa and the length of the bearing is $4/5^{th}$ of its diameter.

(b) The size of the bolts-2 in nos -if the stress on the cores-area is not to exceed 42MPa.The bolts may be designed to withstand the maximum inertia force of the reciprocating parts at the end of the exhaust stroke.

(c) Thickness of the cap along the longitudinal axis of the connecting rod if the bending stress in the material of the cap is limited to 840kg/cm^2.

(d) An economical cross-section for the connecting rod of M.S. forging I -section .Width of flanges and overall depth of section are 4 times the web thickness respectively.

(e) Necessary dimensions for the small end, allowing a bearing pressure of 14MPa. Indicate how you will arrange to lubricate the gudgeon pin. [16]

8. (a) Define stress concentration factor.

(b) A hot rolled shaft is subjected to torsional load that varies from 320 Nm clockwise to 120Nm anti-clockwise and an applied bending moment at a critical section varies from 400Nm to 200Nm. Determine the required shaft diameter. The material has an ultimate strength of 560MPa and yield strength of 420 MPa. Assume factor of safety to be 2. [6+10]

⋆ ⋆ ⋆ ⋆ ⋆

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

III B.Tech I Semester Examinations,May 2011
DESIGN OF MACHINE ELEMENTS
Automobile Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. (a) What are the advantages of Plastics over the other materials? Give some examples.
   (b) A shaft transmits 60kW at 240 rpm. The maximum twisting moment exceeds the mean by 30%.Determine the diameter of the shaft, if the permissible shear stress for the shaft material is 45MPa. [4+12]

2. Design a suitable connecting rod for a car with the following data:
   Piston diameter = 68mm.
   Stroke length = 80mm
   Weight of reciprocating parts = 2.5kg
   Length of the connecting rod =160mm
   Speed =4000rpm
   Compression ratio =8:1
   Maximum explosion pressure =3.5N/mm^2 [16]

3. (a) Explain the following terms with respect to screwed joints:
   i) Major diameter
   ii) Minor diameter
   iii) Pitch
   iv) Lead
   v) Single and multi-start threads.
   (b) Two shafts are connected by means of a flange coupling to transmit 260 W at 100 rpm. The flanges of the coupling are fastened by four bolts of same material at radius of 30 mm. Find the size of the bolts if the allowable shear stress for the bolt material is 30 MPa. [10+6]

4. A semi - elliptical laminated spring is to carry a load of 3000N and consists of seven leaves 60mm wide ,two of the leaves extending the full length of the spring. The spring is to be 1.1m long and is to be attached to the axle by two U-bolts 75mm apart. The leaves are to be made of silica manganese steel. Assuming an allowable stress of 350N/mm^2. Determine the thickness for the leaves and the deflection. Draw to half or quarter size the elevation and plan of the spring. [4+12]

5. (a) Differentiate between rated and average life of anti-friction bearings

   (b) A 6203 single row deep groove ball bearing has a basic static load rating of 4500N, and basic dynamic load rating of 7350N. A radial load of 1600 N, and an axial load of 1400N are acting on the bearing. Calculate the rated life of the bearing. [4+12]

6. (a) Explain the effect of the following factors on the type of fatigue failure

      i. Stress distribution
      ii. Manner of loading
      iii. Surface treatment
      iv. Type of material

   (b) A cold drawn steel rod of circular cross-section is subjected to a variable bending moment of 565 N-m as the axial load varies from 4,500 N to 13,500 N. The maximum bending moment occurs at the same instant that the axial load is maximum. Determine the required diameter of the rod for a factor of safety 2. Neglect any stress concentration and column effect. Assume the following values

   Ultimate Strength = 550 MPa,

   Yield strength = 470 MPa,

   Size factor = 0.85,

   Surface finish factor = 0.89,

   Correction Factors = 1.0 for bending

   = 0.7 for axial load

   The endurance limit in reversed bending may be taken as one-half the ultimate strength. [8+8]

7. An automobile transmission shaft is required to transfer 45KW at 500rpm. The outside diameter must not exceed 50mm and the maximum shear stress is not to exceed 84Mpa. Compare the weights of solid and hollow shafts which would just meet their requirements [16]

8. The following data have been obtained on the basis of heat, speed characteristic and dynamic analysis of a carburetor engine:

   cylinder dia 100mm Piston stroke- 100mm

   Maximum combustion pressure 7.2MPa at speed 4200 rpm

   Maximum thrust on cylinder wall- 0.0055MN at an angle of 3700

   mass of piston group- 0.58kg

   design the Piston. [16]

⋆ ⋆ ⋆ ⋆ ⋆

Code No: 07A52402 **R07** **Set No. 1**

III B.Tech I Semester Examinations,May 2011
DESIGN OF MACHINE ELEMENTS
Automobile Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. (a) With neat sketch explain the difference between a close coiled and open coiled helical spring?
   (b) Design a coil spring for a spring-loaded governor to give a deflection of 125 mm under an axial load of 115N. The mean radius of the coil is 25mm and the wire diameter is 6mm.Take C= 0.8x10^5N/mm^2. Check the spring for buckling. Give a neat sketch of the spring in the uncompressed state [6+10]

2. (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]

3. (a) What is Factor of Safety ? Explain its role in Machine Design.
   (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]

4. Design a piston for four stroke single acting engine developing 90bhp per cylinder when running at 700 rpm.

   The following data are given

   maximum gas pressure =57kg/mm^2

   Average mean effective pressure = 6.4 kg/mm^2

   specific fuel consumption =0.218kg/bhp/hr.

   calorific value of fuel = 10,554kcal/kg.

   take allowable stresses as 334kg/cm^2 piston. 800kg/cm^2 for piston rings and piston pin and allowable bearing pressure in gudgeon pin is 170kg/cm^2.

   Assume 5% of the total heat generated to be absorbed by the piston head and thermal heat conductivity for cast iron as 0.393kcal /cm/hour/^{0}C.

   Temperature at the centre and at the edges may be assumed approximately 350^{0}C and 150^{0}C respectively. Mechanical efficiency is 85%. The ratio l/r =4 and radius

of crank is 11cm. Allowable bearing pressure on the piston barrel is not to exceed 4 kg/mm^2. [16]

5. (a) Differentiate between the eye end and fork end of a knuckle joint
   (b) A gear is fastened by means of sunk keys to the shaft, subjected to torsion Only
      i. Find the ratio of sectional areas of the shaft and key, for equality of strength of the key and shaft.
      ii. Find the length of the key of 20mm width on 70mm dia shaft. The Permissible shear stresses for the key and shaft materials are 50 and 60Mpa respectively. [4+12]

6. (a) A 75mm journal bearing 100mm long is subjected to 2.5kN at 600r.p.m.If the room temperature is 24^{0}C. What viscosity of oil should be used to limit the bearing surface temperature at 55^{0}C.D/C=1000.
   (b) A roller bearing is selected to withstand a radial load of 40kN and life of 1200 hours at 600r.p.m. What load rating would you look for in searching from manufacturers catalogue if it specifies loud at speed 500r.p.m and life 3000hours. [8+8]

7. (a) Show by neat sketches the various modes of failure of riveted joints.
   (b) The pull in the tie rod of an iron truss is 50kN. Design a suitable adjustable steel screwed joint. The permissible stresses are 75MPa in tension ; 45MPa in shear; and 90MPa in crushing. [8+8]

8. Design a Connecting rod for a slow running four-cylinder engine. Rod is made of a material of ultimate strength 450Mpa and factor of safety of 9 is used for design. Following additional data are available:

   Diameter of piston, = 98mm

   Weight of reciprocating parts/cylinder = 1.82kg

   Length of connecting rod = 300mm

   Stroke =140 mm

   Speed =2,000rpm

   Compression ratio =4

   Maximum explosion pressure =2.35Mpa

   Density of material of connecting rod =0.008kg/cm^3

   L/d ratio for big end bearing =1.3

   L/d ratio for small end bearing =2.00

   Use Rankine formula for finding the cross section of the rod, in which take σ_c =315Mpa and factor of safety=5 for calculating buckling load. Allowable Stress in big end cap and bolt materials is 85 MPa and allowable pressure of 7MPa and 14MPa may be used for big end bearing and for wrist pin respectively. [16]

Code No: 07A52402 **R07** **Set No. 1**

⋆ ⋆ ⋆ ⋆ ⋆

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

III B.Tech I Semester Examinations,May 2011
DESIGN OF MACHINE ELEMENTS
Automobile Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

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

2. (a) What is a spring and how they are classified?
   (b) Design a spring for spring loaded safety valve for the following Conditions: Operating pressure 100N/cm^2. Diameter of valve seal 100mm.Design shear stress for the string is 400 N/mm^2, G=0.86x10^5 N/mm^2. The spring is to be kept in a casting of 120 mm inner diameter and 400 mm long. The spring should be at maximum lift of 6mm when the pressure is 107.5 N/cm^2. [4+12]

3. (a) Explain the following methods of reducing stress concentration
      i. Using under cut shoulders
      ii. Drilled holes
   (b) A round shaft made of cold finished AISI 1020 steel is subjected to a variable torque whose maximum value is 700 kN-m. For a factor of safety of 1.5 on the Soderberg criterion, determine the diameter of the shaft if
      i. The torque is reversed
      ii. The torque varies from zero to maximum
      iii. The torque varies from 300 N m to a maximum.

      Assume,
      Correction factor for type of
      loading other than bending = 0.6
      Size correction factor = 0.85
      Surface correction factor = 0.87
      Ultimate tensile strength = 550 MPa.
      Yield strength = 460 MPa [4+12]

4. (a) Describe the design procedure of Sleeve & Cotter joint.
   (b) Design a cotter joint with two gibs to transmit an axial force of 130 k N. The permissible stresses are 165 MPa in tension; 100 MPa in shear and 180 M Pa in crushing. [6+10]

5. A wall bracket as shown in Figure 3. is fixed to a wall by means of four bolts. Find the size of the bolts and the width of the bracket. Assume thickness of bracket as

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

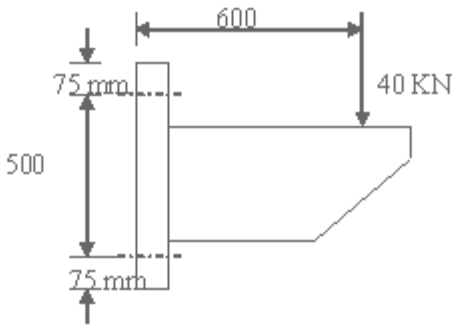

Figure 3:

20 mm. The safe stress in tension for the bolt and bracket may be assumed as 70 MPa. [16]

6. (a) Differentiate between direct shear stress and torsion shear stress
   (b) A 50mm diameter steel shaft is supported on bearings 1.5m apart and carries a fly wheel weighing 'W' . The allowable bending stress for the shaft material and the maximum deflection are limited to 100MPa and 2 mm respectively. The Young's modulus for the shaft material is 210GPa. Determine the Maximum permissible weight of the flywheel. [6+10]

7. Design a centre crank shaft for a single acting four stroke single cylinder engine for the following given data:

   Piston diameter = 400mm

   Stroke = 600 mm

   Speed = 200 rev/min

   I.M.E.P = 0.5Mpa

   Maximum combustion Pressure = 2.5Mpa

   Gas pressure at the maximum torque =1 MPa at 350 crank angle

   Ratio of length of connecting rod to crank radius =5

   Weight of flywheel used as a pulley =5.0kN

   Total belt pull = 6.5kN

   Assume any other missing data. [16]

8. Select a suitable spherical roller from SKF series 222C 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]

⋆ ⋆ ⋆ ⋆ ⋆