Code No: RR312404 **Set No.1**

III B.Tech. I Semester Regular Examinations, November -2006
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) What are fits and tolerances? How are they designated? [6]
   (b) The load on a bolt consists of an axial pull of 10kN together with a transverse shear force of 5kN. Find the diamater of bolt required according to
      i. maximum principal stress theory
      ii. maximum shear stress theory. [10]

2. (a) What is meant by endurance strength of a material? How do the size and surface condition of a component and type of load and effect such strength? [6]
   (b) A circular bar of 500mm length is supported freely at its two ends. It is acted upon by a centrol concentrated cyclic load having a minimum value of 20kN and maximum value of 50kN. Determine the dia. of bar by taking a factor of safety of 1.5, size effect of 0.85, surface finish factor of 0.9. The material properties of bar are given by ultimate strength of 650 MPa, yield strength of 500 MPa and endurance strength of 350 MPa. [10]

3. (a) What do you understand by the term welded joint? How it differs from riveted joint? [6]
   (b) Determine the length of the weld run for a plate size 120mm wide and 15mm thick to be welded to another plate by means of
      i. A single transverse weld and
      ii. Double parallel fillet welds
      when the joint is subjected to variable loads. [10]

4. Design a hollow steel shaft to transmit 20 kW at 300 rpm. The loading is such that the maximum bending moment is 1000 N-m, the maximum torsional moment is 500 N-m, and axial compressive load is 15 kN. The shaft is supported on rigid bearings 1.5m apart. The maximum permissible shear stress on the shaft is 40 MPa. The inside diameter is 0.8 times the outside diameter. The load is cyclic in nature and applied with shocks. The values for the shock factors are k_t=1.5 and k_m=1.6. [16]

5. (a) Derive an expression for stresses in helical springs of circular wire. [6]
   (b) A helical spring is made from a wire of 6mm diameter and has outside diamter of 75mm. If the permissible shear stress is 350 MPa and modulus of rigidity 84 kN/mm^2, find the axial load which the spring can carry and the deflections per active turn. [10]

6. (a) What are the advantages of roller bearings over ball bearigns? [6]
   (b) A journal bearing 80mm in diameter and 120mm long runs at 600 rpm. It uses oil having viscosity of 60 centipoises. Radial clearance provided is 0.15mm. Determine the safe load bearing can take. Assume Sommerfeld number = 1.43×10^9. [10]

7. (a) Explain the various stresses induced in the connecting rod. [8]
   (b) Find the diameter of steel connecting rod for an engine in which the maximum load on the piston is 700 kN, crank of the engine is 0.6m, radius of connecting rod length 3m, factor of safety is 8. [8]

8. (a) Explain the various types of cylinder liners. [8]
   (b) Discuss the design of piston for an IC engine. [8]

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Code No: RR312404 **Set No.2**

III B.Tech. I Semester Regular Examinations, November -2006
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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. (a) What are the factors to be considered for the selection of materials for the design of machine elements? [6]
   (b) A cylinderical shaft made of steel of yield strength 700 MPa is subjected to static loads, consisting of bending moment of 10 kN-m and a torsional moment 30 kN-m. Determine the diameter of the shaft using two different theories of failure and assuming a factor of safety of 2. Take E=210 Gpa and Poisson's ratio=0.25. [10]

2. (a) Write Soderberg's equation and state its application to different types of loading. [6]
   (b) A 50mm diameter shaft is made from carbon steel having ultimate tensile strength of 630 MPa. It is subjected to a torque which fluctuates between 2000 N-m to 800 N-m. Using Soderberg method, calculate the factor of safety. Assume suitable values for any other data needed. [10]

3. Design a cutter joint to connect piston rod to the cross head of a double acting steam engine. The diameter of the cylinder is 300mm and the steam pressure is 1 N/mm^2. The allowable stresses for the material of cutter and piston rod are as follows:

   σ_E=50 MPa ζ40 MPa

   σ_C=84 MPa [16]

4. (a) Enumerate the different types of riveted joints and rivets. [4]
   (b) Design a lap joint for a mild steel flat tie-bar 200 mm × 10mm thick, using 24mm dimater rivets. Assume allowable stresses in tension and compression of the plate material as 112MPa and 200 MPa respectively and shear stress of the rivets as 84 MPa. Show the disposition of the rivets for maximum joint efficiency and determine the joint efficiency. Take dia of rivet hole as 25.5mm for a 24mm diameter rivet. [12]

5. Design a helical compressiion spring for a maximum load of 1000N for deflection of 25mm using the value of spring index as 5. The maximum permissible shear stress for spring wire is 420 MPa and modulus of rigidity is 84 kN/mm^2.

   Take Wahls factor

   $K = \frac{4c-1}{4c-4} + \frac{0.615}{c}$ [16]

   where C=spring index

6. (a) How is lubracating oil designated? [4]

   (b) Design a full journal bearing for the following specifications:
   Dia of the journal = 75mm
   Load on the journal = 3500 N
   Length of the journal = 75 mm
   Speed = 400 rpm
   Minimum film thickness = 0.02 mm [12]

7. Check the suitablity of I section 15mm ×12mm ×3mm for designing the connecting rod in the case of single cylinder motor cycle engine of 40mm bore and 50mm stroke wherein the maximum pressure produced is 3.6 MPa and in which the C.R is 4 times crank. [16]

8. Design a cast Iron piston for a single acting four stroke engine for the following data.

   Cylinder bore= 100 mm
   Stroke = 125 mm
   maximum gas pressure=5N/mm^2 Indicated mean effective pressure = 0.75 N/mm^2
   mechanical efficiency = 80%

   Fuel consumption = 0.15kg per brake power/hr

   Higher calorific value of fuel = 42×10^3 kJ/kg

   Speed = 2000 rpm

   Any other data required for the design may be assumed. [16]

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Code No: RR312404 **Set No.3**

III B.Tech. I Semester Regular Examinations, November -2006
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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. (a) How do you classify materials for engineering use? [6]
   (b) An unknown weight falls through 10mm on a collar rigidly attached to the lower end of a vertical bar 3m long and 600 mm^2 in section. If the maximum instantaneous extension is known to be 2mm, what is the corresponding stress and the value of unknown weight? Take E=200 kN/mm^2. [10]

2. (a) What is meant by stress concentrations? How do you take it into consideration in case of a component subjected to dynamic loading? [6]
   (b) A simply supported beam has a concentrated load at the centre which fluctuates from a value of P to 4P. The span of the beam is 500mm and its cross section is circular with a diameter of 60mm. Taking for the beam material an ultimate stress of 700 MPa of yeild stress of 500 MPa, endurance limit of 330 MPa for a reversed bending and a factor of safety of 1.3. Calculate the maximum value of P. Take a size factor of 0.85 and a surface finish factor of 0.9. [10]

3. Design the longitudinal joint for a 1.25m diameter steam boiler to carry a steam pressure of 2.5 N/mm^2. The ultimate strength of the boiler plate may be assumed as 420 MPa, crushng strength as 650 MPa and shear strength as 300 MPa. Take the joint efficiency as 80%. Sketch the joint with all the dimensions. Adopt the suitable factor of safety. [16]

4. (a) What is a key? State its functions. [4]
   (b) Design the rectangular key for a shaft of 50mm diameter. The shearing and crushing stresses for the key material are 42 MPa and 70 MPa. [12]

5. A helical compression spring made of oil tempered carbon steel, is subjected to a load which varies from 400N to 1000N. The spring index is 6 and the design factor of safety is 1.25. If the yield stress in shear is 770 MPa and endurance stress in shear is 350 MPa, find
   (a) Size of the spring wire
   (b) Diameters of the spring coil
   (c) Number of turns of the spring and
   (d) Free length of the spring.

   The compression of the spring at the maximum load is 30mm. The modulus of rigidity for the spring material may be taken as 80 kN/mm^2. [16]

6. Design a journal bearing for a centrifugal pump from the following data:

   Load on the journal = 20000 N
   Speed of the journal = 900rpm
   Type of oil is SAE10, for which the absolute viscosity at 55^0C = 0.017 kg/m-se

   Ambient temperature of oil=15.5^0C.

   Maximum bearing pressure for the pump = $1.5N/mm^2$

   Calculate also mass of the lubricating oil required for artificial cooling, if rise of temperature of oil be limited to 10^0C. Heat dissipation coefficient=1232 $W/m^2/^0C$. [16]

7. Design a connecting rod for a an I.C engine running at 1800 rpm and developing a maximum pressure of 3.15 N/mm^2. The diameter of the piston is 100mm. Mass of the reciprocating parts per cylinder 2.25kg; length of connecting rod 380mm: stroke of piston 190mm and compression ratio 6:1. Take a factor of safety of 6 for the design. Take length to diameter ratio for bearing as 1.3 and small end bearing as 2 and the corresponding bearning pressures as 10N/mm^2 and 15 N/mm^2. The density of material of the rod may be taken as 8000 kg/m^3 and the allowable stress in the bolts as 60 N/mm^2 and in cap as 80 N/mm^2. The rod is to be of I-section for which you can choose your own proportions.

   Draw a neat dimensioned sketch showing provision for lubrication. Use Rankine formula for which the numerator constant may be taken as 320 N/mm^2 and the denominator constant 1/7500. [16]

8. (a) Discuss the design of piston for an internal combustion engine. [12]
   (b) State the functions of the following:
      i. piston pin
      ii. piston skirt [4]

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Code No: RR312404 **Set No.4**

III B.Tech. I Semester Regular Examinations, November -2006
DESIGN OF MACHINE ELEMENTS
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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. (a) Enumerate the most commonly used engineering materials and state at least one important property and one applicatin of each. [8]
   (b) A shaft is transmitting 100 KW at 160 rpm. Find a suitable diamter for the shaft, if the maximum torque transmitted exceeds the mean by 25%. Take maximum allowable shear stress as 70 MPa. [8]

2. Design a double riveted double strap butt joint for the longitudinal seam of a boiler shell, 750mm in diameter, to carry a maximum steam pressure of 1.05 N/mm^2 gauge. The allowable stresses are as:

   σ_e=35 MPa ζ= 28MPA

   σ_c=52.5 MPa

   Assume the efficiency of the joint as 75%. [16]

3. (a) Illustrate how the stress concentration in a component can be reduced? [8]
   (b) Determine the diameter of a circular rod made of ductile material with a Fatigue strength (complete stress reversal) σ_e=280 MPa and a tensile yieled strength of 350 MPa. The member is subjected to a varying axial load from 700 kN to -300 kN. Assume K_t=1.8 and F.S=2. [8]

4. Design a cutter joint to connect two mild steel rods for a pull of 30 kN. The maximum permissible stresses are 55 MPa in tension: 40 MPa in shear and 70 Mpa in crushing. Draw a neat sketch of the joint designed. [16]

5. Design a helical spring for a spring loaded safety valve for the following conditions:

   Diameter of valve seat = 65mm

   Operating pressure = 0.7N/mm^2

   Maximum pressure when the valve blows off freely = 0.75N/m^2

   Maximum lift of the valve when the pressure raises from 0.7 to 0.75 N/mm^2=3.5mm
   Maximum allowable stress = 550 MPa
   Modulus of rigidity = 84 kN/mm^2
   Spring index = 6
   Draw a neat sketch of the free spring showing the main dimensions. [16]

6. (a) What is meant by hydrodynamic lubrication? [6]
   (b) A 75mm journal bearing 100mm long is subjected to 2.5 kN at 600 rpm. If the room temperature is 24^0C what viscosity of oil should be used to limit the bearing surface temperature at 55^0C. D/C = 1000 . [10]

7. Following data referes to 4 stroke cyclic diesel engine cylinder

   Cylinder bore =0.15 mm

   Stroke =0.1875 m

   Speed = 1200 rpm

   Maximum gas pressure = 5.6 MPa.

   Determine:

   (a) the dimensions of an I-section connecting rod of forged steel with an elastic limit compressive stress of 350 MPa. The ratio of length of connecting rod to the length of crank is 4 and factor of safety is 5.

   (b) The wrist pin and crank pin dimensions on the basis of the bearing pressure of 10.5 MPa and 6.5 MPa. 16]

8. (a) State the function of the following for an Internal combustion engine.

      i. Ribs

      ii. piston rings

      iii. piston skirt

      iv. piston pin [4×2=8]

   (b) Discuss the design of piston for an internal combustion engine. [8]

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