Code No: R05320305

Set No. 1

III B.Tech II Semester Regular Examinations, Apr/May 2008
DESIGN OF MACHINE MEMBERS-II
(Common to Mechanical Engineering and Production Engineering)
Time: 3 hours   **Max Marks: 80**
Answer any FIVE Questions
All Questions carry equal marks
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1. (a) Explain the principle of hydrodynamic lubrication.

   (b) Select a single row deep groove ball bearing for a radial load of 4000N and an axial load of 5000 N, operating at a speed of 1600r.p.m for an average life of 5 years at 10 hours per day. Assume uniform and steady load.   [6+10]

2. Design a mild steel connecting rod with an I section for a single cylinder spark ignition engine from the following data :
   Diameter of piston, D=0.104m
   Weight of reciprocating parts =18.2N
   Length of connecting rod from centre to centre=0.314m
   Stroke length=0.14m
   Speed of the engine=1500rev/min
   Maximum explosion pressure = 2.28MPa gauge
   Assume that the maximum thrust takes place at T.D.C. during the explosion stroke.
   [16]

3. Design an aluminum alloy piston for a single acting four stroke engine for the following data: [16]
   Cylinder bore   = 0.3m
   Stroke   = 0.375m
   Maximum gas pressure   = 8 M Pa
   Break mean effective pressure   = 1.15MPa
   Fuel consumption   = 0.22kg/kW/hr
   Speed   =50rev/min.

4. Determine the maximum stress in the frame of the 100 kN punch press as shown in the figure 4.   [16]
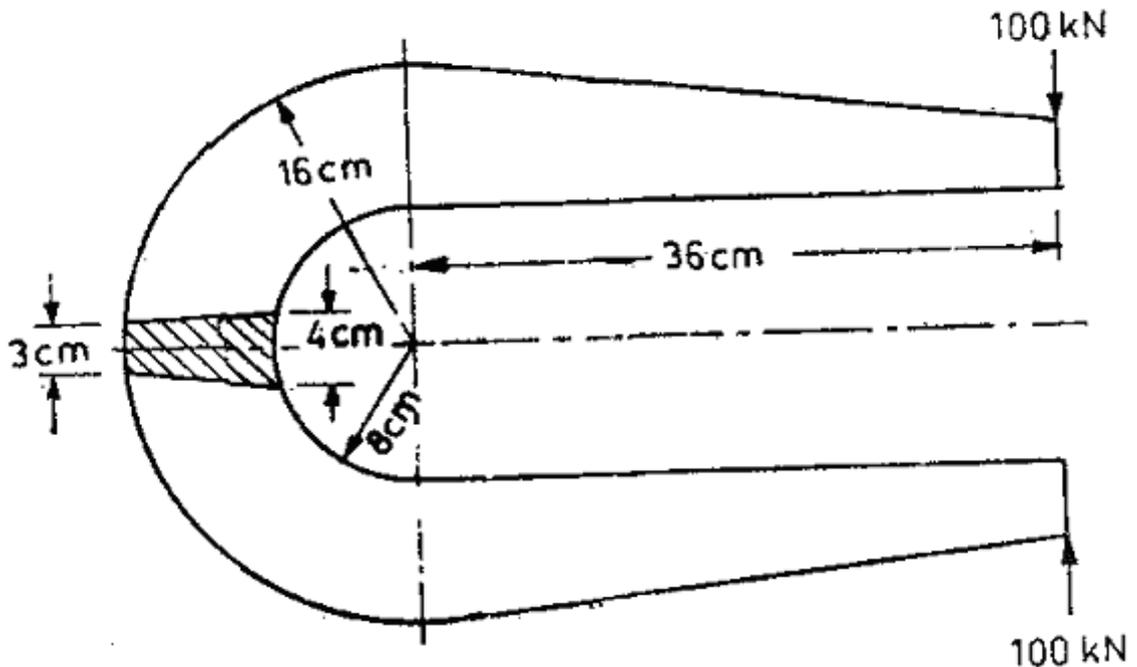
Figure 4

5. Design a belt pulley for transmitting 10kW at 180 rpm. The velocity of the belt is not to exceed 10m/s, and the maximum tension is not to exceed 15N/mm width. The tension on the slack side is one half of that on the tight side. Determine all the principal dimensions of the pulley. [16]

6. A pair of helical gears consists of a 30 teeth pinion meshing with a 80 teeth gear. The pinion rotates at 900 rpm. The normal pressure angle is 20^0 while the helix angle is 25^0. The face width is 50mm and the normal module is 4mm. The pinions as well as gear are made of steel having ultimate strength of 600MPa and heat treated to a surface hardness of 300BHN. The service factors of safety are 5 and 2 respectively. Assume that the velocity factor accounts for the dynamic load and calculate the power transmitting capacity of the gears. [16]

7. A screw jack suitable to lift a maximum load of 50kN through a height of 200mm with a ground clearance of 300mm is to be designed with the following:
   Allowable stress for screw,
Tensile stress	$=90\text{N/mm}^2$
Compressive stress	$=110 \text{ N/mm}^2$
Shearing stress	$=60 \text{ N/mm}^2$

   Allowable stress for nut,
Tensile stress	$= 60 \text{ N/mm}^2$
Compressive stress	$=50 \text{ N/mm}^2$
Shearing stress	$=45 \text{ N/mm}^2$

   Allowable bearing pressure between nut and screw is 16 N/mm^2, Coefficient of friction of threads and collar may be taken as 0.14. allowable bending stress for MS handle is 100 N/mm^2 Design

(a) Screw

(b) Nut

(c) Handle. [16]

8. Design the gear box of a center lathe. Given swing over = 300mm. [16]

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$$\boxed{\textbf{Set No. 2}}$$

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1. (a) Define the terms:
    i. Bearing characteristic number
    ii. Bearing modulus.

   (b) Select a suitable ball bearing for the following data:
       Diameter of the shaft = 90mm, radial load = 4000N, Thrust load = 500N
       Speed =1000 rpm. Shaft runs continuously on load for 10 hrs per day and the
       life expected is 8 yrs. Shaft is subjected to moderate shock loads.   [4+12]

2. Design a connecting rod of I cross section for an automobile diesel engine of the
   following specifications.
   Diameter of cylinder=100mm
   Stroke length =125mm
   Maximum combustion pressure =2.8MPa
   Maximum engine speed=2000rpm
   Weight of the reciprocating parts =1.1kg
   Length of connecting rod between centers=31.5cm
   Assume an allowable crushing stress =3000kg/cm^2.   [16]

3. (a) What is the function of Skirt?

   (b) What is the function of piston pin?

   (c) Design an aluminum alloy piston for a single acting four stroke engine for the
       following data: [2+2+12]

Cylinder bore	= 400mm
Cylinder bore	= 400mm
Stroke	= 375mm
Maximum gas pressure	= 9 M Pa
Break mean effective pressure	= 2MPa
Fuel consumption	= 0.22kg/kW/hr
Speed	=50rev/min.

4. The section of a crane hook is a rectangle 60 mm × 40 mm. The center of curvature
   of the section is at a distance of 80 mm from the centroid of the section. A load
   of 15 kN is acting through the center of curvature. Determine the maximum and
   minimum bending stresses induced in the hook.   [16]

5. (a) What are the advantages and disadvantages of V- belt drive?

(b) A fly wheel having four arms is brought to rest from an angular velocity of 36 rad/s in three revolutions, by the application of a brake. The mass of the rim is 250kg and the radius of gyration of the rim is 0.75m. Determine the size of the cross section of the rims; assuming it to be elliptic with minor axis equal to 0.6 times the major axis, and permissible bending stress for the flywheel material as 30MPa. [4+12]

6. Two parallel shafts are connected by a pair of steel helical gears. The power transmitted is 15kW at 4000rpm of the pinion. The safe static strength for the material is 100MPa. Gear ratio is 4:1 Stub teeth with 20^0 pressure angle in diameter plane have helix angle of 45^0. Also calculate the necessary BHN with the standard point of wear. Check the design for dynamic load and suggest modification if necessary. Use 30 teeth on the pinion. [16]

7. A vertical square threaded screw of a 75mm nominal diameter and 10mm pitch, supports a vertical load of 50kn. It passes through the boss of a spur gear of 72 teeth, which acts as a nut. For raising or lowering the load, the spur gear is turned by means of a pinion having 24 teeth. The mechanical efficiency of the gear is 90%. The axial thrust on the screw is taken-up by a collar bearing having a mean diameter of 110mm. The coefficient of friction for the screw and nut is 0.15, and that for collar bearing is 0.12. Determine,

   (a) the torque applied to the pinion shaft,

   (b) the maximum (principal) shear stress induced in the screw, and

   (c) height of the nut, if the permissible bearing pressure is 12MPa. [16]

8. (a) What are the functions and general requirement of spindle unit?

   (b) What are the functional requirements of guide ways and explain the types of slide ways? [6+10]

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$\boxed{\textbf{Set No. 3}}$

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1. (a) Distinguish between "Hydrodynamic lubrication" and "Hydrostatic bearings".

   (b) A shaft rotating at constant speed is subjected to variable load. The bearings supporting the shaft are subjected to stationary equivalent radial load of 3kN for 10% of time, 2kN for 20% of time, 1kN for 30% of time and no load for remaining time of cycle. If the total life expected for the bearing is 20×10^6 revolutions at 95% reliability, calculate dynamic load rating of the ball bearing. [4+12]

2. The following projected data refer to a four-cylinder petrol engine connecting rod of a car to be designed:
   Piston diameter = 68mm.
   Stroke = 75mm
   Weight of reciprocating parts = 2kg
   Length of the connecting rod =175mm
   Bsfc =0.33kg/kWh
   Brake power =32kWat 5000rpm
   Maximum explosion pressure =2.5N/mm^2 [16]

3. Design an aluminum alloy piston for a single acting four stroke engine for the following data: [16]
   Cylinder bore = 400mm
   Stroke = 375mm
   Maximum gas pressure = 9 M Pa
   Break mean effective pressure = 2MPa
   Fuel consumption = 0.22kg/kW/hr
   Speed =50rev/min.

4. A load of 10 kN is applied to a steel curved beam as shown in the figure 4. Compute the increase in distance between the points A and B due to the load. Assume G = 0.84×10^5 N/ mm^2 , E = 2.10×10^5 N/ mm^2. [16]
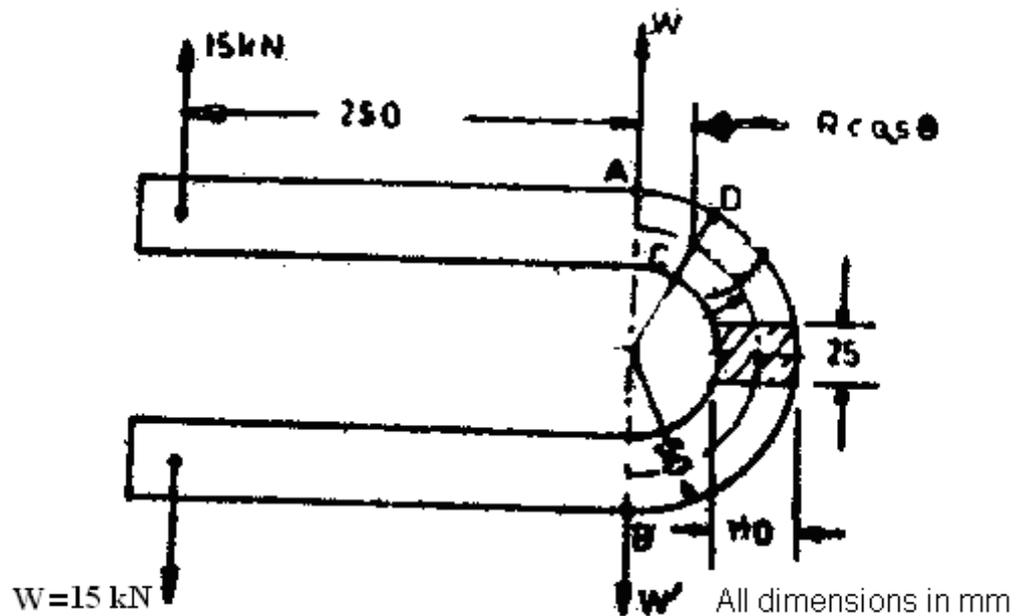
Figure 4

5. A CI flat pulley transmits 20kW at a sped of 560 rpm. The pulley overhangs the nearest bearing by 200mm. assuming the ratio of the belt tension as 2: determine

   (a) Shaft diameter

   (b) Pulley diameter and Cross section of eight arms. [16]

6. (a) What is herringbone gear? State its applications.

   (b) A pair of helical gear has 20^0 stub teeth in the diameteral plane. Helix angle is 45^0. The pinion rotates at 8,000rpm. And transmits 12kW. Gear ratio is 4:1.Safe static stress for the material for pinion and gear 100MPa. The BHN for the pinion 300 and that of gear 200. Find the module and face width, if the center distance is 200mm. And check the design for dynamic load and wear strength if error is 0.01mm. [4+12]

7. A screw jack is to be lift a load of 80kN through a height of 400mm. The elastic strength of screw material in tension and compression is 200MPa and in shear 120MPa. The material for the nut is phosphor-bronze for which the elastic limit may be taken as 100MPa in tension, 90MPa in compression and 80MPa in shear. The bearing pressure between the nut and the screw is to exceed 18N/mm². Design and the screw jack. The design should include the design of

   (a) screw

   (b) nut,

   (c) handle and cup and

   (d) body. [16]

8. (a) What are the basic requirements of a machine tools?

   (b) Explain the design procedure for tailstock. [6+10]

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Set No. 4

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1. (a) What are the commonly used materials for sliding contact bearings?

   (b) A ball bearing subjected to a radial load of 5kN is expected to have a life of 8000 hours at 1450r.p.m with a reliability of 99%. Calculate the dynamic load capacity of the bearing so that it can be selected from the manufacturer?s catalogue based on a reliability of 90%.   [2+14]

2. Design a connecting rod for a single acting internal combustion engine that runs at 600rpm and develops a maximum pressure of 3.4MPa. Other particulars of the engine are 140mm bore, 190mm stroke, and length of connecting rod 380mm. Weigth of the reciprocating parts may be taken as 4 kg. Use suitable values of the stresses. Connecting rod is made of alloy steel 37Mn2. Take l/d ratio for crank pin and wrist pin as 1.5 and corresponding allowable bearing pressure as 10MPa and 50 MPa. Take ρ=0.008 Kg/cm^3 and allowable stress in bolts as 60MPa and in cap as 80MPa. Draw a neat dimensioned sketch of the connecting rod designed.   [16]

3. Design a suitable aluminum alloy piston with two compression rings and one oil ring for a petrol engine of following particulars:
Cylinder diameter =0.1m
Peak gas pressure =3.2MPa.
Mean effective pressure = 0.8 MPa
Average side thrust = 2400N
Skirt bearing pressure = 0.22MPa
Bending stress in piston crown =36MPa
Crown temperature difference = 70°C
Heat dissipated thorough crown = 157kJ/m^{2}s
Allowable radial pressure = 0.04MPa
Bending Stress in rings = 90MPa
Heat conductivity = 160W/m/^{o}C.
Draw a full scale dimensioned drawing and indicate the method of reducing the thermal expansion in the skirt of designed piston.   [16]

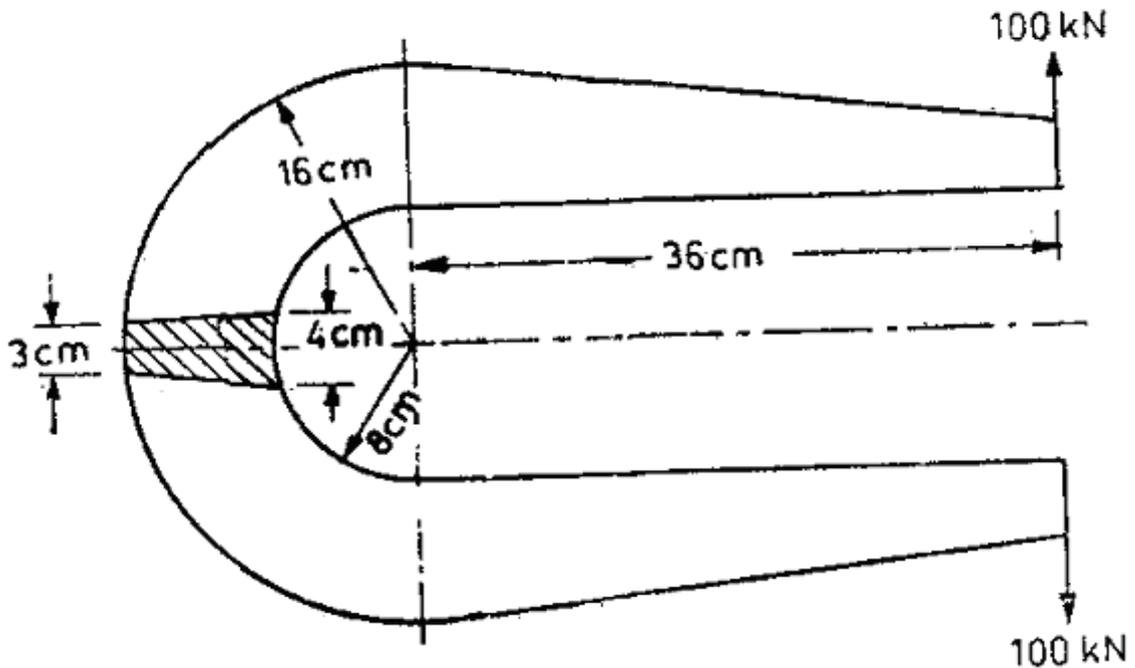4. Determine the maximum stress in the frame of the 100 kN punch press as shown in the figure 4.   [16]

Figure 4

5. (a) Name the cross -sections of flat belt, V- belt, and rope.

   (b) An overhung cast iron pulley transmits 7.5kW at 300 r.p.m. The diameter of the pulley is 500mm and angle of lap is 180^0. Find:

      i. Diameter of the pulley. The density of cast iron is 7200kg/m^3.

      ii. Width of the belt, if the coefficient of fiction between the belt and the pulley is 0.25

      iii. Diameter of the shaft, if the distance of the pulley center line from the nearest bearing is 300mm.

      iv. Dimensions of the key for securing the pulley on to the shaft.

      v. Size of the arms 6 in number the section may be taken as elliptical, the major axis twice the minor axis length. The following stresses may be taken for design purposes:

   Shaft and key : tension-80MPa, Shear -50MPa
   Belt   : tension-2.5MPa
   Pulley rim   : tension-4.5MPa
   Pulley arms   : tension-15MPa.   [2+14]

6. (a) Explain why helical gears are capable of transmitting greater power at high speed as compared to the spur gear.

   (b) A pair of spur gears has pinion made of material with 80MPa safe static bending stresses, gear made of material with safe static bending stresses of 55MPa. The module and face width of the teeth are 5mm and 60mm respectively. The pinion Rotates at 60rpm. The number of teeth on pinions and gear are 20

and 80 respectivly. Find the capacity in kW of the gear drive. The error is limited to e=16+1.25(m+0.25√d) microns. B.H.N. of the pinion material is 250. [4+12]

7. A screw press is to be exerted a force of 40kN. The unsupported length of the screw is 400mm. Nominal diameter of screw is 50mm. The screw has square threads with pitch equal to 10mm. The material of the screw and nut are medium carbon steel and cast iron respectively. For the steel used take ultimate crushing stress as 320MPa, yield stress in tension or compression as 200MPa and that are in shear as 120Mpa. Allowable shear stress for CI is 20MPa and allowable bearing pressure between screw and nut $12N/mm^2$. E for steel=$210kN/mm^2$. Determine the factor of safety of screw against failure. Find the dimension of the nut. What is the efficiency of the arrangement? Take coefficient of friction between steel and Cast iron. [16]

8. (a) What are the basic requirements of a machine tools?

   (b) Explain the design procedure for Spindle. [6+10]

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