

Code No: 07A6EC05

R07**Set No. 2**

III B.Tech II Semester Examinations, December 2010

DESIGN OF MACHINE MEMBERS - II

Common to Mechanical Engineering, Production Engineering

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions

All Questions carry equal marks

1. Figure 1 shows a press applying 200 kN force on a job. Determine the stresses at the points A and B. The section is hollow as shown. [16]

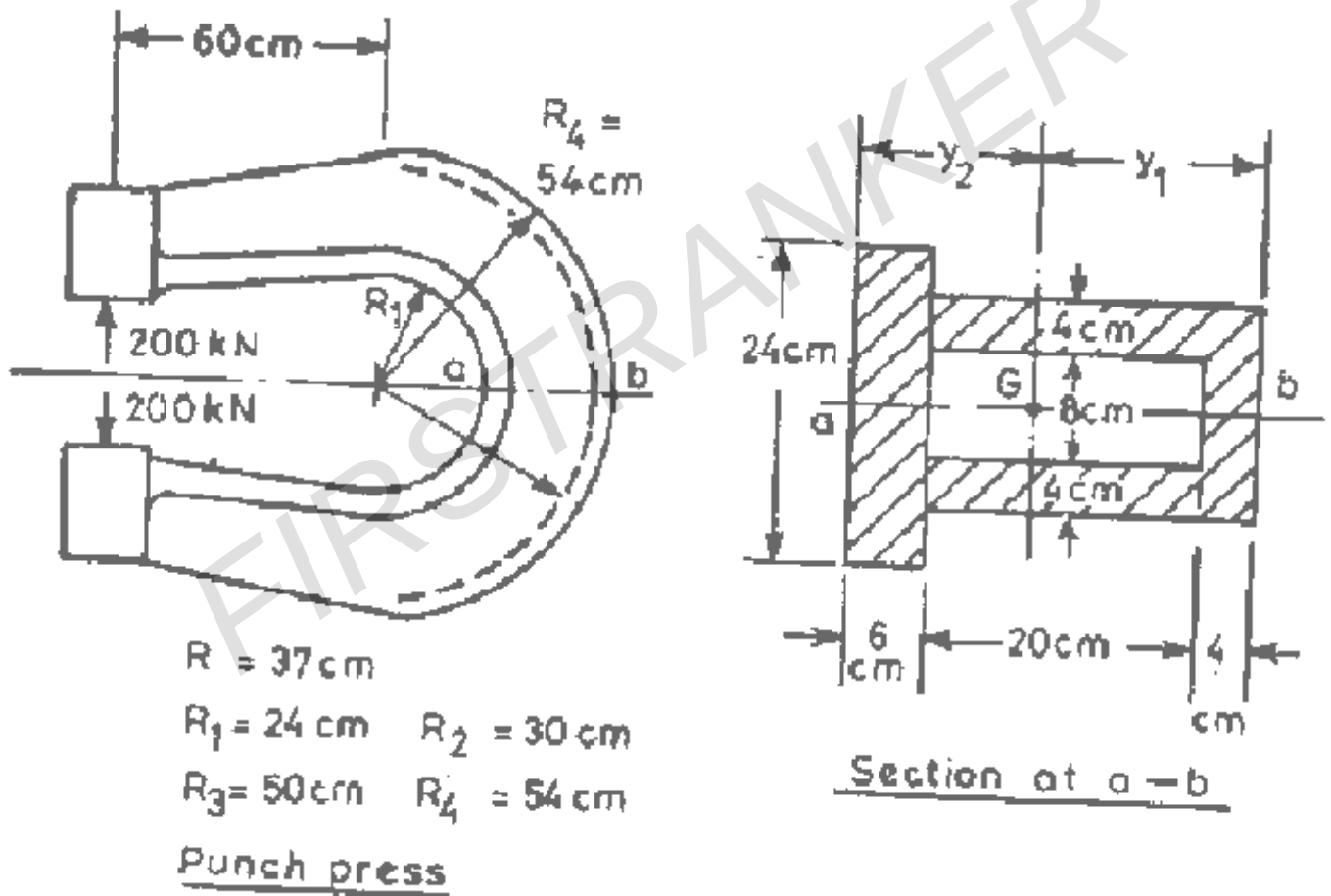


Figure 1

2. Design a connecting rod of I-section for an engine for the following data.
 Crank radius = 300 mm
 Connecting rod length = 1800 mm
 Speed of the crank = 400 rpm
 Specific weight of material = 7.2 gm/cm^3
 Explosion pressure = 3.5 N/mm^2
 Neglect weight of the reciprocating parts. Assuming suitable data if necessary. [16]
3. A power screw having double start threads of 25 mm nominal diameter and 5 mm

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pitch is acted upon by an axial load of 10kN. The outer and inner diameters of screw collar are 50mm and 20mm respectively. The coefficient of thread friction and collar friction may be assumed as 0.2 and 0.15 respectively. The screw rotates at 12rpm. Assuming uniform wear condition at the collar and allowable thread bearing pressure of 5.8 N/mm² find:

- (a) The torque required to rotate the screw.
 - (b) The stress in the screw and
 - (c) The number of threads of nut in engagement. [16]
4. (a) What are the causes of failure of gear tooth?
 - (b) Design a pair of spur gears with stub teeth to transmit 55kW from 175 mm pinion running at 2500 r.p.m. to a gear running at 1500 r.p.m. Both the gears are made of steel having B.H.N 260. Approximate the pitch by means of Lewis equation and then adjust the dimensions to keep within the limits set by the dynamic load and wear equation. [4+12]
5. (a) Write a design procedure on the following with suitable expressions.
 - i. Piston head
 - ii. Piston rings
 - (b) Design cylinder for an engine with bore= 100mm and the maximum combustion pressure = 5.5 MPa. [8+8]
6. (a) How do you classify the chain drives.
 - (b) Design a wire rope for a vertical mine hoist to lift 12.40MN of ore in each 8hr shift from a depth of 720m. Assume a two compartment shaft with the hoisting skips in balance. [4+12]
7. (a) Explain the principle of hydrodynamic lubrication
 - (b) Design 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]
8. Briefly explain the procedure of speed diagram. [16]

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1. (a) What is the herringbone gear? Where are they used?
 (b) A helical cast steel gear with 30° helix angle has to transmit 35kW at 2000 r.p.m. If the gear has 25 teeth, find the necessary module, pitch diameters and face width for 20° full-depth involute teeth. The static stress for cast steel may be taken as 100MPa. The face width may be taken as 3 times the normal pitch. The tooth form factor is given by expression $y^I = 0.154 - 0.912 / T_E$, where T_E represents the equivalent number of teeth. The velocity factor is given by $C_v = 6 / (6 + V)$ where V is the peripheral speed of the gear in m/s. [4+12]
2. With neat Sketch, explain the design procedure for the Crank Shaft. [16]
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 = 1.15MPa
 Fuel consumption = 0.22kg/kW/hr
 Speed = 50rev/min. [16]
4. (a) Draw the different profiles used for the screws and explain their merits and demerits.
 (b) A square threaded bolt of 25mm nominal diameter and 5mm pitch, is tightened by screwing a nut, whose mean diameter of the bearing surface is 35mm. If the coefficient of friction for the nut and the bolt is 0.12, and for the nut and bearing surface is 0.15, determine the force required at the end of a 250mm long spanner, when the load on the bolt is 12kN. [6+10]
5. From amongst the slide ways combinations flat-flat, flat-V, and V-V of a lathe, which one would provide for the least radial deflection? Substantiate your conclusion with mathematical proof. [16]
6. The following data relate to an overhang flat belt drive:
 Power transmitted = 22kW
 Rev/min = 300
 Angle of contact = 165degrees
 $\mu = 0.3$

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Distance of centre of pulley from centre of nearest bearing = 0.25m

Take into account centrifugal tension, but neglecting weight of CI pulley, find:

- (a) Diameter of pulley
- (b) Width of 8mm thick leather belt.
- (c) Diameter of shaft (d) size of key
- (d) Dimensions of four elliptical arms having minor axis is 0.6 major axis with permissible stresses as below:
 Shaft and key = 42MPa
 Arms = 14MPa
 Pulley = 4.9MPa
 Belt = 2.1MPa. [16]

7. A curved bar of rectangular cross section 40 mm × 60 mm is subjected to a bending moment of 2×10^6 N-mm, its center line is curved to a radius of 200 mm. Determine the maximum tensile and compressive stress in beam, if the bending moment tends to increase the curvature. What is the stress at the CG of the section. Plot the stress distribution diagram to a suitable scale along any section. [16]

8. (a) Define the following terms:
- i. Clearance
 - ii. Minimum film thickness
- (b) A 75mm diameter machine shaft is to be supported at the ends .It operates continuously for 8h/day,300days/year for 10 years. The load and speed cycle for one of the bearings is given below. [2+14]

S.no	Fraction of Cycle	Radial load (N)	Thrust load (N)	Speed (rpm)	Load condition
1.	0.25	3500	2000	1000	Steady
2.	0.25	2500	2000	1500	Steady
3.	0.5	4000	2000	800	Light shock

Design the suitable bearing.

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- Design a CI piston for a single acting four stroke IC engine for the following specifications: Cylinder bore 120mm, Stroke 140mm, maximum gas pressure 6N/mm^2 , bmep is 0.7N/mm^2 , fuel consumption is 0.23kg/kW/hr , and speed is 2400 rpm. [16]
- Show that $T_1/T_2 = e^{\mu\theta}$
 Where T_1 = tension in tight side in the belt, N
 T_2 = tension in slack side in the belt, N
 μ = coefficient of friction between belt and pulley
 θ = arc of contact in radians.
 - A crossed belt drive is to transmit 10kW at 1200r.p.m of the smaller pulley, which is 250mm in diameter. The velocity ratio is 1.2m. It is desired to use a 6mm thick leather belt with coefficient of friction equal to 0.25. If the permissible stress for the belt material is 2N/mm^2 ; determine the width of the belt. Take the mass density of the belt material as 1000kg/m^3 . [8+8]
- 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 = 100mm
 Stroke = 125mm
 Weight of reciprocating parts = 1.1kg
 Length of the connecting rod = 313mm
 RPM of the engine-normal = 1200
 RPM of the engine-over speed = 2000
 Maximum explosion pressure = 2.8MPa
 State clearly the values adopted for the factors of safety and the ultimate stresses and underline them. Draw freehand sketch to about full size, a proportionate elevation of the connecting rod and add either an end view or a sectional plan. [16]
- Discuss about the various forms of thread forms used for the power screws
 - Find the load that can be lifted by applying a force of 200N at the end of 450mm long lever of a screw jack, with single-start square threads. The load does not rotate with the spindle, and is carried on a swivel head having a bearing surface of 120mm diameter. The nominal diameter of the screw is 50mm and the pitch of the thread is 8mm. The coefficient of friction between the nut and screw is 0.15; and between the spindle and swivel head is 0.18. Also, determine the efficiency of the screw jack. [6+10]

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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. Determine the safe power which can be transmitted by a pair of helical gears. 20 degree full depth helix, having a normal module of 5mm. Both the gears are made of forged C-30 steel and have a face width of 76.2mm. The pinion speed is 2000rev/min and it has 20 teeth. The velocity ratio is to be 5:1. [16]
7. A lathe has two flat, CI slide ways of equal width and height half the width. While turning a 200 mm diameter work piece, the tangential, radial and axial components of the cutting force were found to be $P_x=1400\text{N}$, $P_y=1600\text{N}$ and $P_z=5000\text{N}$ respectively. Calculate the lathe slide ways width assuming suitable values. Cast iron slide ways can withstand a maximum pressure of 2500 kN/m². [16]
8. The section of a crane hook is a trapezium. At the critical section, the inner and outer sides are 40 mm and 25 mm respectively and depth is 75 mm. The center of curvature of the section is at a distance of 60 mm from the inner fibers and the load line is 50 mm from the inner fibers. Determine the maximum load the hook can carry if the maximum stress is not to exceed 1220 N/mm². [16]

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1. (a) Explain the design procedure for drives
(b) Explain the significance of preferred numbers in machine tool design. [8+8]
2. (a) Differentiate between pitch and lead of a screw.
(b) The nominal diameter of a square threaded screw is 50mm, and pitch of the threads is 10mm. A load of 20kN is lifted through a distance of 150mm. Find the work done in lifting the load and the efficiency of the screw, when
 - i. the load rotates with the screw, and
 - ii. the load rests on a swivel cup, which does not rotate with the screw.

The inner and outer diameters of the bearing surface of the swivel cup are 20mm and 60mm respectively. The coefficient of friction for the screw threads and the bearing surface may be taken as 0.12. [4+12]
3. (a) Define the following terms:
 - i. Attitude angle
 - ii. Bearing characteristic number
 (b) Design a journal bearing to carry a radial load of 3000N. The journal having 50mm diameter rotates at 1500rpm. The viscosity of oil at the operating temperature is 25cP. [4+12]
4. The following particulars refer to belt drive;

Power transmitted = 11kW
 Speed = 600rev/min
 Angle of contact = 210°
 μ = 0.22
 Pulley material CI having its density = 7200kg/m³
 Four arms of rectangle section having sides in the ratio 2:1
 Safe tensile stress of pulley and arms = 14MPa
 Determine

 - (a) The mean diameter of pulley.
 - (b) Width of belt 6.5mm thick and having a safe tensile stress of 2.1 MPa
 - (c) Shaft diameter, neglecting the bending in the shaft due to loads if any, and the maximum shear stress in the shaft as 42MPa
 - (d) Size of pulley boss and arms. [16]

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5. (a) Figure 5a shows a crane hook with trapezoidal section. Determine the stresses at the points, P and Q.

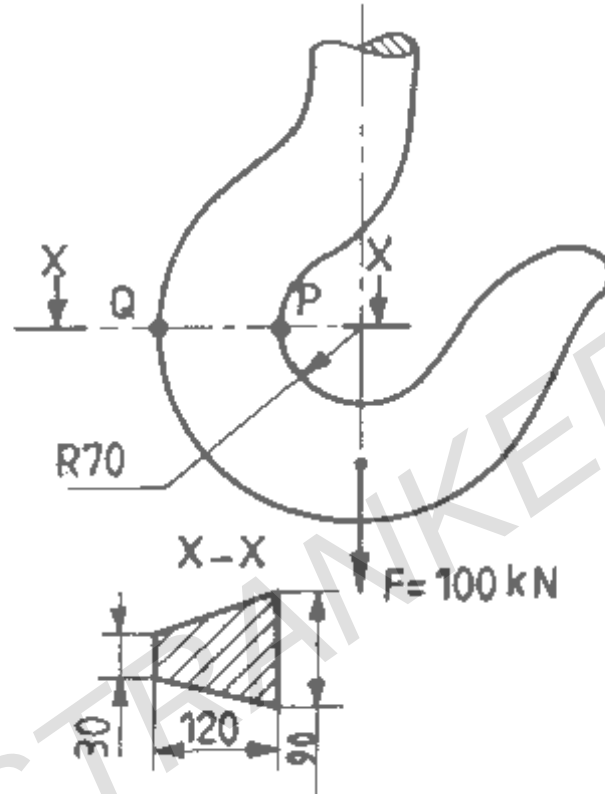


Figure 5a

- (b) What are the assumptions made in Winkler-Bach Theory. [12+4]
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° while the helix angle is 25° . The face width is 50mm and the normal module is 4mm. The pinion as well as gear are made of steel having ultimate strength of 600MPa and heat treated to a surface hardness of 300BHN. The service factor and factor 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) What kind of engines are employed in the following applications?
- Air craft
 - Automobile
 - Compressor
 - Motor cycle
- (b) Design a piston, piston rings and gudgeon pin for a single stroke engine for the following given data :
- Cylinder bore = 100mm
 Stroke = 120mm
 Maximum gas pressure = 7MPa

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b.m.e.p = 0.8MPa

Fuel consumption = 0.16kg/brake kW/hr

Speed = 1000rpm.

[16]

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/cm³

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 $\sigma_c = 315\text{Mpa}$ 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]
