### Code No: R32035





#### III B.Tech. II Semester Regular Examinations, April/May -2013 **DESIGN OF MACHINE MEMBERS-II** (Mechanical Engineering)

**Time: 3 Hours** 

Max Marks: 75

#### Answer any FIVE Questions All Questions carry equal marks \*\*\*\*\*

- 1. (a) A bearing has a dynamic capacity of 50 kN. What equivalent load, it can carry for the average life of 6000 hrs at 500 rpm? (b) A journal bearing 100 mm x 100 mm supports a shaft running at 1500 rpm. Radial clearance is 0.1 mm, minimum film thickness is 0.02 mm. Calculate the maximum radial load the bearing can support and for that load calculate the power lost in friction and oil temperature rise. Consider Absolute viscosity =  $20e^{-3}$  Pa.s. Specific gravity of oil = 0.88 and specific heat of oil = 2.1 kJ/kg K. [6+9]
- 2. Design a side crankshaft for 500 mm x 600 mm gas engine. The weight of the flywheel is 80 kN and the explosion pressure is 2.5 MPa. The gas pressure at the maximum torque is 0.9 MPa, when the crank is  $30^{\circ}$  from the Inner Dead Centre. The connecting rod is 4.5 times the crank radius. [15]
- 3. (a) State the function of the Piston Skirt and Piston Rings for an Internal Combustion Engine.

(b) Design a cylinder for a four stoke petrol engine developing 15 kW at 2000 rpm. Assume indicated mean effective pressure to be 1.2 MPa. [5+10]

- 4. The section of a crane hook is rectangular in shape whose width is 30 mm and depth is 60 mm. The centre of curvature of the section is at a distance of 125 mm from the inside section and the load line is 100 mm from the same point. Find the capacity of the hook, if the allowable stress in tension is 75 MPa. Also determine the location of the neutral axis and the stress at inner and outer fiber. [15]
- 5. (a) In chain drives, the sprocket has odd number of teeth and chain has even number of links. Why?

(b) A pump is driven by an electric motor through an open type flat belt drive. Determine the belt specifications for the following data.

Motor pulley diameter  $(d_s) = 300 \text{ mm}$ , Pump pulley diameter  $(d_1) = 600 \text{ mm}$ , Coefficient of friction ( $\mu_s$ ) for motor pulley = 0.25, Coefficient of friction ( $\mu_L$ ) for pump pulley = 0.20, Center distance between the pulleys=1000 mm; Rotational speed of the motor=1440 rpm; Power transmission = 20 kW; Density of belt material ( $\rho$ ) = 1000 kg/m<sup>3</sup>; Allowable stress for the belt material ( $\sigma$ ) = 2 MPa; [5+10]

Thickness of the belt = 5mm.

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# Set No: 1

6. A single stage helical gear reducer is to receive power from a 1440 rpm, 25 kW induction motor. The gear tooth profile is involute full depth with  $20^{0}$  normal pressure angle. The helix angle is  $23^{0}$ . The gear ratio is 3. The number of teeth on pinion is 20. Both the gears are made of steel with allowable beam stress of 90 MPa and hardness 250 BHN.

(i) Design the gears for 20% over load carrying capacity from stand point of bending strength and wear.

(ii) If the incremental dynamic load of 8 kN is estimated in tangential plane, what will be the safe power transmitted by the pair at the same speed? [10+5]

- 7. A screw of nominal diameter 17 mm and pitch 5 mm is subjected to an axial compression of 4000 N, calculate maximum shearing stress and bearing pressure between threads of screw and nut. Calculate factor of safety in compression of screw, shearing of screw and bearing pressure, if allowable stress in axial and shear are 320 MPa and 212 MPa respectively. Maximum bearing pressure is 12 MPa. Take coefficient of friction = 0.12. There are 5 threads in nut. [15]
- A lever loaded safety valve is 70 mm in diameter and is to be designed for a boiler to blow off at gauge pressure of 1 MPa. Design a suitable mild steel lever of rectangular cross section using the following permissible stresses: Tensile stress = 70 MPa; Shear stress = 50 MPa; Bearing Pressure = 25 MPa.

The pin is also made of mild steel. The distance from fulcrum to the weight of the lever is 880 mm and the distance between fulcrum and pin connecting the valve spindle links to lever is 80 mm. [15]

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- 1. (a) Load cycle for 312 bearing is as follows:
- Radial load 5000 N and axial load of 3000 N at 900 rpm for 25% of time, Radial load of 6000 N and axial load of 1000 N at 1200 rpm for 25% of time, Radial load of 4000 N and axial load of 1500 N at 1000 rpm for remaining time, The loads are steady. Find the rating life of this bearing in year with 2 hrs per day. (b) A 50 mm diameter 75 mm long journal bearing is loaded with bearing pressure of 2 MPa. The shaft in bearing rotates at 500 rpm. Heat is lost from surface at the rate of 11.6 Joules/m<sup>2</sup> per sec per <sup>0</sup>C. The housing area is 8 times the projected area. If the room temperature is 28 <sup>0</sup>C, determine the surface temperature of bearing. Coefficient of friction is 0.0015.
- 2. Design a connecting rod for a petrol engine from the following data. [15] Diameter of the piston = 120 mm; Weight of the reciprocating part = 2.0 kg. Length of the connecting rod = 300 mm Stroke length = 140 mm; speed = 2000 rpm; Maximum explosion pressure = 2.25 MPa
- 3. (a) Why are more number of thin piston rings preferred over small number of thick rings?

(b) The cylinder of a four stroke diesel engine has the following specifications:

Brake Power = 3 kW; Speed = 800 rpm;

Indicated Mean Effective Pressure = 0.3 MPa; Mechanical efficiency = 80% Determine the bore and length of the cylinder line. [4+11]

- 4. A crane hook of trapezoidal cross section has an inner fiber width = 120 mm, depth = 100 mm and inner radius = 120 mm. Calculate the width if stresses are numerically equal at inner and outer fibers. Also determine the capacity of the hook, if the permissible stress is 100 MPa. [15]
- 5. Design a chain drive to connect 5 kW, 1400 rpm electric motor to a drilling machine. The speed reduction is 3:1. The centre distance should be approximately 500 mm. [15]
- 6. (a) For a helical gear, derive an expression for the virtual number of teeth in terms of the helix angle and the actual number of teeth.
  (b) A helical gear is required to transmit 25 kW power at 1250 rpm. The gear has 24 teeth, 30<sup>0</sup> helix angle and 20<sup>0</sup> full depth teeth. Determine the module, pitch diameter and face width of gear. The allowable stress is 103 MPa. [6+9]

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- 7. A single square thread power screw is to raise a load of 45 kN. A screw thread of nominal diameter of 60 mm and a pitch of 9 mm is used. The coefficient of friction at the thread is 0.12. Neglecting the collar friction calculate the torque required to raise the load, to lower the load and efficiency of the screw. Find the induced stress in the core area of the screw using the maximum distortion energy theory. [15]
- 8. A hand lever for a brake is 0.8 m long from the center of gravity of the spindle to the point of application of the pull of 300 N. The effective overhang from the nearest bearing is100 mm. If the permissible stress in tension, shear and crushing is not to exceed 66 MPa, design the spindle, key and lever. Assume the arm of the lever to be rectangular having width twice of its thickness [15]

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### III B.Tech. II Semester Regular Examinations, April/May -2013 **DESIGN OF MACHINE MEMBERS-II**

**Time: 3 Hours** 

(Mechanical Engineering)

Max Marks: 75

Answer any FIVE Questions All Questions carry equal marks \*\*\*\*\*

1. (a) Define static load capacity, dynamic load capacity and life of a roller contact bearings.

(b) A shaft with two supports is loaded in such a way that the axial thrust on each bearing is 500 N and the radial thrust is 2000 N and 1000 N respectively at left and right hand bearing. The shaft rotates at 1440 rpm. The bearing is to be selected on the basis of 3 hrs per day for 10 years. The shaft diameter is 40 mm. Select the suitable bearings at both the ends. [5+10]

- 2. Design a suitable connecting rod for a car with the following data: [15] Piston diameter = 68 mm; Stroke length = 80 mm; Length of the connecting rod = 160 mm; Maximum explosion pressure = 3.5 MPa; Weight of the reciprocating part = 2.5 kgSpeed = 4000 rpm; Compression Ration = 8:1
- 3. (a) Discuss the relative merits and demerits of aluminum piston over cast iron piston.
  - (b) The cylinder of a four stroke diesel engine has the following specifications:

Brake Power = 3.75 kW; Speed = 1000 rpm;

Indicated Mean Effective Pressure = 0.35 MPa; Mechanical efficiency = 80%Determine the bore and length of the cylinder line. [5+10]

4. The C frame of a 100 kN capacity press is shown in figure 1. The material of frame is grey cast iron whose ultimate tensile stress is 200 MPa and Factor of Safety =3. Determine the maximum stress at both inner fiber and outer fiber. [15]

100 kN



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**R10** 

# Set No: 3

- 5. Design a v-belt drive to connect a 20 kW, 1440 rpm motor to a compressor running at 480 rpm for 15 hours per day. The approximate center distance is 1.2 m. [15]
- 6. Design a pair of helical gears to transmit 20 kW at pinion speed of 1800 rpm. The pinion has 24 teeth with helix angle of 35<sup>0</sup>. Take the allowable static stress of 60 MPa for the gears. The gear ratio is 3:1. Check the designed gears for wear and dynamic load carrying capacity. [15]
- 7. A single square thread power screw is to raise a load of 50 KN. A screw thread of major diameter of 34 mm and a pitch of 6 mm is used. The coefficient of friction at the thread and collar are 0.15 and 0.1 respectively. If the collar frictional diameter is 100 mm and the screw turns at a speed of 1 rev per second, find
  - (a) The power input to the screw.

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(b) The combined efficiency of the screw and collar

(c) Find the stress induced in the core area of the screw using maximum distortion energy theory. [5+5+5]

 Design a foot brake lever from the following data: Length of lever from the center of gravity of the spindle to the point of application of the load is 1 m. Maximum load on the foot plate is 800 N. The effective overhang from the nearest bearing is100 mm. The permissible stress in tension and shear is not to exceed 70 MPa. [15]

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#### III B.Tech. II Semester Regular Examinations, April/May -2013 DESIGN OF MACHINE MEMBERS-II (Mechanical Engineering)

Time: 3 Hours

Max Marks: 75

[6+9]

#### Answer any FIVE Questions All Questions carry equal marks \*\*\*\*\*

- 1. (a) What are the desirable properties of the bearing material?
  - (b) The following data is given for a  $360^{\circ}$  hydrodynamic bearing.

Radial Load = 2 kN; Journal Diameter = 50 mm; Bearing length = 50 mm; Viscosity of oil = 20 mPa s.

Specify the radial clearance that needs to be provided so that when the journal is rotating at 2800 rpm, the minimum film thickness is 30 microns. Evaluate the corresponding coefficient of friction. [5+10]

- 2. Design an overhung crankshaft for 250 mm x 300 mm gas engine when the crank is at the dead center. The weight of the flywheel is 30 kN and the explosion pressure is 2.1 N/mm<sup>2</sup>. The gas pressure at the maximum torque is 0.9 MPa, when the crank is  $35^{0}$  from the Inner Dead Centre. The connecting rod is 4.5 times the crank radius. [15]
- 3. Design a cast iron piston for a single acting four stroke diesel engine with the following data;

Cylinder Bore = 200 mm; Length of Stroke = 250 mm; Speed = 600 rpm; Brake mean effective pressure = 0.6 MPa; Maximum Gas Pressure = 4 MPa; Fuel Consumption = 0.25 kg per BHP; L/D ratio for bush in small end of connecting rod = 1.5. Assume suitable data, if required and state the assumptions made. [15]

- 4. (a) Derive the bending stress equations for a curved beam subjected to bending only. State the assumptions made in the theory.
  (b) Derive an expression for the neutral axis if the cross section of the curved beam is rectangular. [10+5]
- 5. Design a flat belt drive for the following data: Drive: AC motor, operating speed is 1440 rpm and operates for over 10 hours. The equipment driven is a compressor, which runs at 900 rpm and the required power transmission is 20 kW [15]
- 6. (a) Draw the force diagram on the helical gear tooth and explain the relationships between the components of force.
  (b) A helical gear has 30 teeth and pitch diameter 264 mm. the normal module is 6.5 mm and normal pressure angle is 20°. The force acting normal to the tooth surface is 6000 N. Find the power transmitted at 600 rpm and also the formative number of teeth.

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**R10** 

## Set No: 4

- 7. The lead screw of a lathe has trapezoidal threads. To drive the tool carriage the screw has to exert an axial force of 20 kN. The thrust is carried by the collar. The length of the lead screw is 1.5 m. Coefficient of friction at the collar and nut are 0.1 and 0.15 respectively. Suggest suitable size of the screw and height of the nut if the permissible bearing pressure is 4 MPa. [15]
- 8. The maximum load at the roller end of a rocker arm is 2000 N. The distance between the center of boss and the load line is 200 mm. suggest a suitable I-section of the rocker arm, if the permissible normal stress is limited to 70 MPa. Consider length of the web is 4 times the thickness and the length of top and bottom flanges is 2.5 times the thickness.
  [15]

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