AU53

NEW SCHEME

Reg. No.

Fifth Semester B.E. Degree Examination, January/February 2006

Automobile Engineering

Design of Machine Elements - II

Time: 3 hrs.) (Max.Marks : 100

Note: *1. Answer any FIVE full questions.*
2. Use of design data hand book is permitted.
3. Missing data may be suitably assumed.

1. (a) Determine a safe value for load P for a machine element loaded as shown in figure 1, limiting the maximum normal stress induced on the cross section XX to 120 MPa. **(10 Marks)**

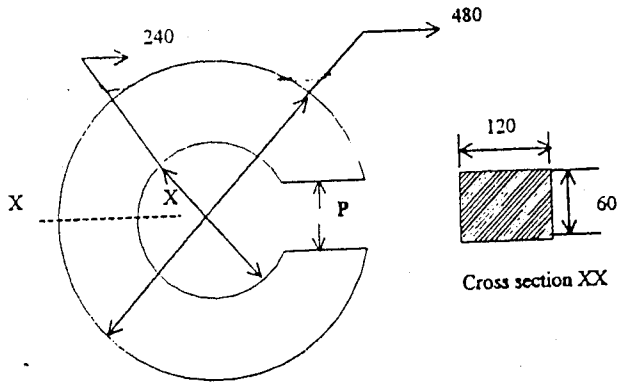

Figure 1.

(b) Select a suitable ball bearing required to be mounted on a shaft of diameter 50 mm, capable of sustaining a radial load of 6 kN and a thrust load of 3 kN at a rated speed of 750 rpm. The desired life of the bearing is 8000 hrs. **(10 Marks)**

2. (a) Design a helical compression spring required for a spring loaded safety value mounted on a pressure vessel. The spring is subjected to an initial compression of 50 mm at the time of assembly and will open by 10 mm when the pressure approaches 6 MPa. The diameter of the valve is 25 mm. **(10 Marks)**

(b) A semi elliptical laminated leaf spring with two full length leaves the ten graduated leaves are to be designed to support a central load of 6 kN over two points 1000 mm apart. The central band width is 100 mm. The ratio of total depth of the spring to its width is 2.5. The design normal stress of the material of the leaves is 400 MPa and the modulus of elasticity is 208 GPa. Determine :

i) Width and thickness of leaves
ii) The initial gap between full length and graduated leaves
iii) The central bolt load. **(10 Marks)**

Contd.... 2

(a) Select a V belt drive to transmit a load of 6 kW from a shaft rota[illegible] 000 rpm to a parallel shaft to be rotated at 350 rpm. The space limits the center distance between shafts to 500 mm. The pitch diameter of the smaller pulley could be assumed to be 150mm. (10 Marks)

(b) Select a suitable wire rope of a standard strand to raise a load of 10 kN through 400m. The load has to achieve a desired linear speed of 20 m/min while traversing through a distance of 15m from the start. (10 Marks)

4. (a) Design a cone clutch to transmit a power of 40 kW at a rated speed of 750 rpm. Also determine

i) Axial force necessary to transmit torque

ii) Axial force necessary to engage the cone clutch. (10 Marks)

(b) A simple band brake shown in figure.2 is to be designed to stop the rotation of a shaft transmitting a power of 45 kW at rated speed of 500 rpm. Selecting suitable materials determine

i) dimensions of the rectangular cross section of the band

ii) dimensions of the rectangular cross section of the brake lever.

iii) diameter of the fulcrum pin. (10 Marks)

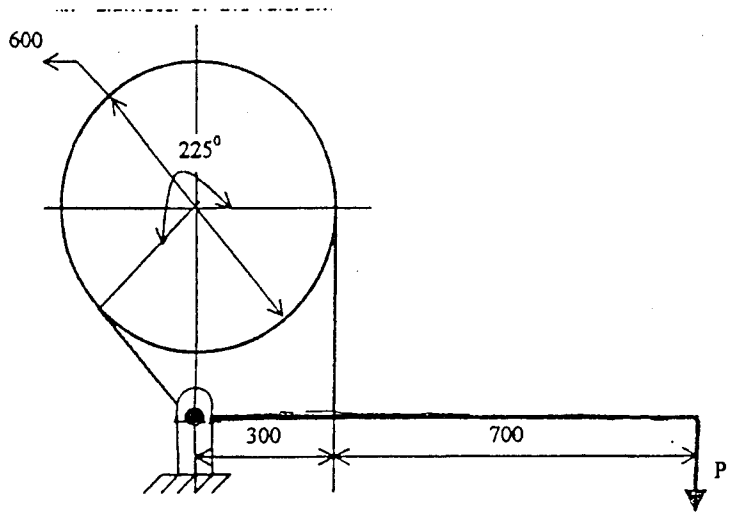

Figure 2.

5. A sh[illegible]ng at a speed of 1000 rpm is to transmit a power of 40 kW to a parallel shaft to be rotated at 350 rpm. The distance between the shaft-centers is 160 mm. Design a pair of spur gears to connect these two shafts. (20 Marks)

6. Design a pair of helical gears to transmit a power of 30 kW from a shaft rotating at 1500 rpm to a parallel shaft to be rotated at 450 rpm. (20 Marks)

7. Design a pair of bevel gears to transmit a power of 25 kW from a shaft rotating at 1200 rpm to a perpendicular shaft to be rotated at 400 rpm. (20 Marks)

8. (a) Derive Petroff's equation for coefficient of friction of a lightly loaded journal bearing. (6 Marks)

(b) It is required to design a main bearing of a four stroke oil engine to sustain a load of 6 kN over a shaft of diameter 50mm. The operating speed of the shaft is 1000 rpm and the operating temperature 50^0 C. Determine

i) Dimensions of the bearing.

ii) The viscosity of the oil to be used for the bearing and hence suggest appropriate oil.

iii) Coefficient of friction

iv) Heat generated

v) Heat dissipated

vi) Heat to be removed by the artificial cooling if necessary

vii) Sommerfeld number. (14 Marks)

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AU53

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NEW SCHEME

Fifth Semester B.E. Degree Examination, Dec.06/Jan. 07
ME / IP / IM / MA / AU
Design of Machine Elements - II

Time: 3 hrs.] [Max. Marks:100

Note: *1. Answer any FIVE questions.*
2. Use of machine design data hand book is permitted.
3. Missing data may be suitably assumed.

1 a. Compute the combined stresses at the inner and outer fibres in the critical cross section of a crane hook which is required to lift loads upto 25 kN. The hook has trapezoidal cross section with parallel sides 60mm and 30mm, the distance between them being 90mm. The inner radius of the hook is 100mm. The load line is nearer to the inner surface of the hook by 25mm than the centre of curvature at the critical section. What will be the stresses at the inner and outer fibre, if the beam is treated as straight beam for the given load. **(12 Marks)**

b. Select a suitable ball bearing for the spindle of a drilling machine rotating at 1200 rpm. The bearing is subjected to a radial load of 3000N and a thrust load of 2000N. The machine is to work for 8 hours/day and a service time of 5 $\frac{1}{2}$ years is desired. Based on strength the minimum diameter of spindle is 50mm. Assume the load application factor is one and inner race rotates. **(08 Marks)**

2 a. What is surging in helical springs and how it can be eliminated? **(04 Marks)**

b. A railway wagon weighing 50kN and moving with a speed of 8km/hr has to be stopped by four buffer springs in which the maximum compression allowed is 220mm. Find the number of active turns in each spring of mean diameter 150mm. The diameter of spring wire is 25mm. Also determine the maximum shear stress in each spring. Take G = 84 GPa. **(08 Marks)**

c. A locomotive spring has an overall length of 1100mm and sustains a load of 75kN at its centre. The spring has 3 full length leaves and 15 graduated leaves with a central band of 100mm. All the leaves are to be stressed at 0.4GPa. when fully loaded. The ratio of total depth of spring to its width is to be 2. Determine i) width and thickness of leaves ii) The initial gap between full length and graduated leaves. Take E = 206.8 GPa. **(08 Marks)**

3 a. Select a V belt drive to transmit 10 kW of power from a pulley of 200mm diameter mounted on an electric motor running at 720 rpm to another pulley mounted on compressor tunning at 200 rpm. The approximate centre distance between the two pulleys is 600mm. The correction factor for service is 1.3. Find the number of belts and the correct centre distance. **(10 Marks)**

b. Select a suitable wire rope of a standard strand to lift a load of 10kN through a height of 600m from a mine. The weight of bucket is 2.5kN. The load should attain a maximum speed of 50 m/min in 2 seconds. **(10 Marks)**

4 a. A multiple plate clutch with steel on bronze is to transmit 8kW at 1440 rpm. The inner diameter of the contact is 80mm and the outer diameter of contact is 140mm. The clutch operates in oil with expected coefficient of friction of 0.1 and allowable pressure of 0.35 MPa. Assume uniform wear theory and determine the number of steel and bronze plates. **(10 Marks)**

Contd... 2

b. A differential band brake shown in fig. Q.4(b) operates on a drum diameter of 600mm. The band is 3.2mm × 100mm and coefficient of friction is 0.22. Determine
   i) Least force required at the end of operating lever when the band is subjected to a stress of 55N/mm^2.
   ii) Torque applied to the brake drum shaft.
   iii) Is this brake self locking? Prove your answer.

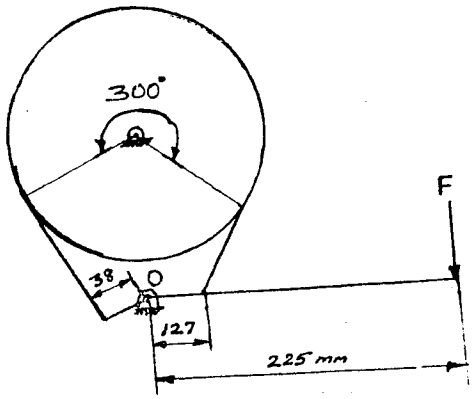

fig Q. 4(b)

(10 Marks)

5 a. Derive an expression for beam strength of a spur gear tooth with standard notations. **(04 Marks)**

b. A pair of spur gears has to transmit 20 kW from a shaft rotating at 1000 rpm to a parallel shaft which is to rotate at 310 rpm. Number of teeth on pinion is 31 with 20^0 full depth involute tooth form. The material for pinion is steel SAE1040 untreated with allowable static stress 206.81 MPa and the material for gear is cast steel 0.20%C untreated with allowable static stress 137.34 MPa. Determine the module and face width of the gear pair. Also find the dynamic tooth load on the gears. Take the service factor as 1.5. **(16 Marks)**

6 A pair of carefully cut helical gears for a turbine has a transmission ratio of 10%. The teeth are 20^0 stub involute in the normal plane. Pinion has 25 teeth and rotates at 5000 rpm. Material for pinion and gear is 0.4% carbon steel untreated with allowable static stress of 69.66 MPa. Helix angle = 30^0. Power transmitted = 90 kW. Service factor = 1.25. Wear and lubrication factor = 1.25. Determine the module in normal plane and face width of the gears. Suggest suitable surface hardness for the gear pair. **(20 Marks)**

7 a. A pair of straight bevel gears transmits 15kW at 1250 rpm of 120mm diameter pinion. The speed reduction is 3.5. Use 14 $\frac{1}{2}^0$ involute tooth system. The angle between the shaft axes is 90^0. The pinion is made of case hardened alloy steel with allowable static stress 343.34 MPa and gear is cast steel of 0.20%C heat treated with allowable static stress 191.295 MPa. Determine module, face width, number of teeth on pinion and gear. Suggest suitable surface hardness for the gear pair. Take the service factor as 1.5 and assume the teeth are generated. **(17 Marks)**

b. Explain formative number of teeth in bevel gears. **(03 Marks)**

8 a. Explain the Bearing modulus. **(03 Marks)**

b. Derive Petroff's equation for a lightly loaded bearing. **(05 Marks)**

c. A 75mm long full journal bearing of diameter 75mm supports a radial load of 12kN at the shaft speed of 1800 rpm. Assume ratio of diameter to the diametral clearance as 1000. The viscosity of oil is 0.01 Pas at the operating temperature. Determine
   i) Sommerfeld number.
   ii) Coefficient of friction based on Mckee's equation.
   iii) Amount of heat generated. **(12 Marks)**

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AU53

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NEW SCHEME

Fifth Semester B.E. Degree Examination, July 2007
ME / IP / IM / MA / AU
Design of Machine Elements – II

Time: 3 hrs.] [Max. Marks:100

Note : ***1. Answer any FIVE full questions.***
2. Assume missing data suitably.
3. Use of machine design data handbook is permitted.

1 a. Calculate the stresses at points A and B for a circular beam as shown in fig.1(a). The circular beam is subjected to a compressive load of 6 kN. **(10 Marks)**

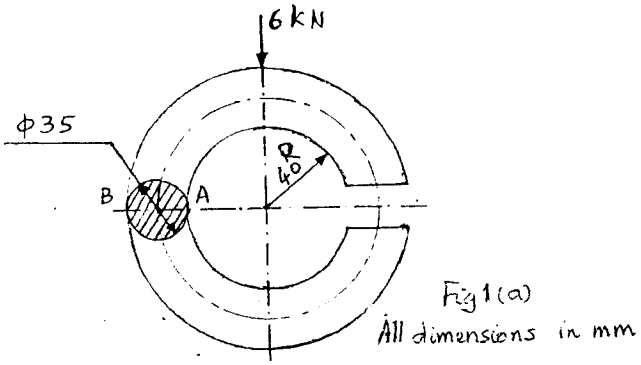


Fig 1(a)
All dimensions in mm

b. A ball bearing operates on the following work cycle:

Element	Radial load (N)	Speed (rpm)	Element time (%)
1	3000	720	30
2	7000	1440	40
3	5000	900	30

The dynamic load capacity of the bearing is 16500 N. Calculate:
i) Average speed of rotation ii) Equivalent radial load iii) Bearing life. **(10 Marks)**

2 a. Derive the equation for energy stored in a helical spring. **(05 Marks)**

b. Design a helical spring for a spring loaded safety valve (Rams bottom safety valve) for the following conditions:
Diameter of valve seat = 60 mm, Operating pressure = 0.7 N/mm^2, Maximum pressure when the valve blows off freely = 0.75 N/mm^2, Maximum lift of the valve when the pressure rises from 0.7 to 0.75 N/mm^2 = 3.5 mm, Maximum allowable stress = 550 N/mm^2, Modulus of rigidity = 84 kN/mm^2, Spring index = 6. **(15 Marks)**

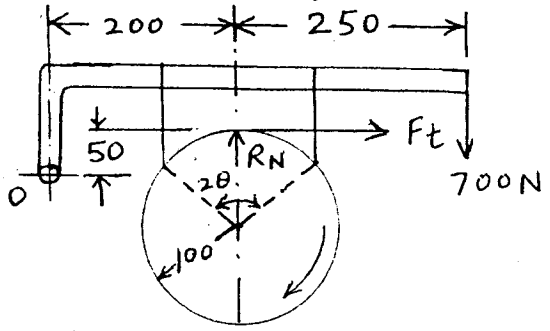
3 a. Derive the equation $\frac{T_1}{T_2} = e^{\mu\theta}$, where T_1 = Tension in the belt on the tight side, T_2 = Tension in the belt on the slack side, μ = The coefficient of friction between the belt and pulley, θ = Angle of contact in radians. **(08 Marks)**

b. A compressor, requiring 85 kW, is to run at 250 rpm. The drive is by V-belts from an electric motor running at 800 rpm. The diameter of the pulley on the compressor shaft must not be grater than 1.0 meter while the center distance between the pulleys is limited to 1.8 meters. The belt speed should not exceed 1500 m/min. Determine the number of V-belts required to transmit the power if each belt has a cross-sectional area of 360 mm^2, density 1000 kg/m^3 and an allowable tensile stress of 2.5 N/mm^2. The groove angle of pulley is 35^0. The coefficient of friction between the belt and the pulley is 0.25. **(12 Marks)**

Contd.... 2

4 a. An engine developing 50 kW at 1000 rpm is fitted with a cone clutch. The cone has a face angle of 12.5^0 and width of face is one fourth of mean diameter of friction lining. If the normal intensity of pressure between the contact surface is not to exceed 0.1 N/mm^2, assuming uniform wear criterion and taking $\mu = 0.2$, calculate dimensions of the clutch. **(10 Marks)**

b. The diameter of the drum of a single block brake shown in fig.4(b) is 200 mm and the angle of contact is 90^0. If the operating force of 700 N is applied at the end of a lever and the coefficient of friction between the drum and the lining is 0.35, determine the torque that may be transmitted by the block brake. **(10 Marks)**



All dimensions in mm

Fig.4(b)

5 a. Derive an expression for beam strength of a spur gear tooth. **(05 Marks)**

b. Design a pair of spur gears to transmit 15 kW from a shaft rotating at 1000 rpm to a parallel shaft which is to rotate at 310 rpm. Assume number of teeth on pinion 31 and 20^0 full depth tooth form. The material for pinion is C-40 steel untreated and for gear, cast steel 0.20%C untreated. **(15 Marks)**

6 a. Explain formative number of teeth in helical gears. **(05 Marks)**

b. A pair of helical gears are to transmit 16 kW. The teeth are 20^0 stub in diametral plane and have a helix angle of 45^0. The pinion runs at 10000 rpm and has 80 mm pitch diameter. The gear has 320 mm pitch diameter. If the gears are made of cast steel having allowable static strength of 100 Mpa; determine module and face width from static strength considerations and check the gears for wear, given $\sigma_{es} = 618$ Mpa. **(15 Marks)**

7 A pair of 20^0 full depth involvte teeth bevel gears connect two shafts at right angles having velocity ratio 3:1. The gear is made of cast steel, 0.20% untreated and the pinion material is of steel, C 30 heat-treated. The pinion has 20 number of teeth and transmits 40 kW at 750 rpm. Determine: i) Module ii) Face width and iii) Pitch diameters. Assume width of gear face as one third of the length of pitch cone. **(20 Marks)**

8 a. Explain the significance of the bearing characteristic number in the design of sliding contact bearings. **(05 Marks)**

b. A full journal bearing of 60 mm diameter and 100 mm long has a bearing pressure of 1.4 N/mm^2. The speed of the journal is 800 rpm and the ratio of journal diameter to the diametral clearance is 1000. The bearing is lubricated with oil whose absolute viscosity at the operating temperature of 75^0C may be taken as 0.011 kg/ms. The room temperature is 30^0C. Find: i) The amount of artificial cooling required, and ii) The mass of the lubricating oil required, if the difference between the outlet and inlet temperature of the oil is 10^0C. Take specific heat of the oil as 1850 J/kg/^{0}C. **(15 Marks)**

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06ME61

Sixth Semester B.E. Degree Examination, June-July 2009
Design of Machine Elements - II

Time: 3 hrs. Max. Marks:100

Note: ***1. Answer any FIVE full questions, selecting at least TWO questions from each part.***
2. Use of design data hand book is permitted.
3. Missing data, if any, may suitably be assumed.

PART – A

1 a. What are the assumptions made in finding stress distribution for a curved flexural member? Also state two major differences between a straight beam and a curved beam. **(05 Marks)**

b. Determine the value of steam thickness 't' in the T – cross section of a curved beam shown in Fig.Q.1(b) such that the normal stresses due to bending at the extreme inner and outer fibres are numerically equal. **(15 Marks)**

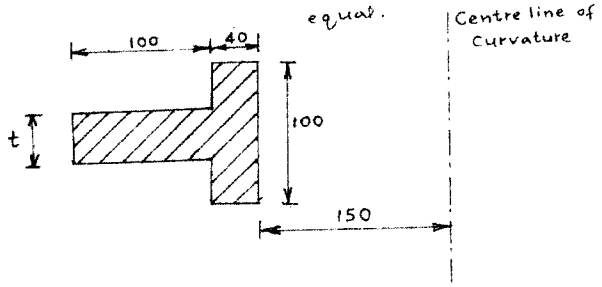

Fig.Q.1(b).

2 a. A cast steel cylinder of 300mm internal diameter is to contain liquid at a pressure of 12.5N/mm^2. It is closed at both ends by unstayed flat cover plates rigidly bolted to the shell flange. Determine the thickness of the cover plates if the allowable working stress for the cover material is 75N/mm^2. **(05 Marks)**

b. Design a shrink fit joint to join two cylinders of diameter 150mm x 200mm and 200mm x 250mm. Maximum tangential stress in the components due to shrink fitting is to be limited to 40MPa. Also determine the axial force necessary to dis-engage the joint if the length of the joint is 200mm and the maximum power that can be transmitted at a rated speed of 1000rpm. The cylinder material has a modulus of elasticity 210 GPa and Poisson's ratio 0.3. **(15 Marks)**

3 a. Derive the expression for the stress induced in helical coil spring. **(05 Marks)**

b. Design a valve spring for an automobile engine, when the valve is closed, the spring produces a force of 45N and when it opens, produces a force of 55N. The spring must fit over the valve bush which has an outside diameter of 20mm and must go inside a space of 35mm. The lift of the valve is 6mm. The spring index is 12. The allowable stress may be taken as 330 MPa and modulus of rigidity, G 80GPa. **(15 Marks)**

4 a. Define "Formative number of teeth" as applied to Helical gears and explain its importance in the design of Helical gears. **(05 Marks)**

b. Design a pair of spur gears to transmit 20 kW of power while operating for 8 to 10 hours per day sustaining medium shock, from a shaft rotating at 1000rpm to a parallel shaft which is to rotate at 310rpm. Assume the number of teeth on pinion to be 31 and 20° full depth involute tooth profile. The material for pinion is C40 steel, untreated whose σ_o = 206.81 N/mm^2 and for gear is cast steel, 0.2% c, untreated whose σ_o = 137.34 N/mm^2. Check the design for Dynamic load if Load factor, C = 522.464 N/mm and also for wear load taking Load stress factor, K = 0.279 N/mm^2. Suggest suitable hardness. **(15 Marks)**

PART - B

5 a. Under what circumstances the Bevel gears are used? Give a detailed classification of Bevel gears. **(05 Marks)**

b. Design a worm gear drive to transmit a power of 2kW at 1000 rpm. The speed ratio is 20 and centre distance is 200mm. Assume the number of teeth on worm wheel to be 40 and number of starts on worm to be 2. Assume hardened steel worm and phosphor bronze wheel for which $\sigma_o = 55$ N/mm^2.
Check the gear from stand point of strength and wear if load stress factor, K = 0.69 MPa. If the amount of Heat generated is 1.7 kW, check whether artificial cooling arrangement is necessary or not for a temperature rise of 40°K. **(15 Marks)**

6 a. A multiple disc clutch has five plates having four pairs of active friction surfaces. If the intensity of pressure is not to exceed 0.127N/mm^2, find the power transmitted at 500 rpm. The outer and inner radii of friction surfaces are 125mm and 75mm respectively. Assume uniform wear and take co-efficient of friction as 0.3. **(05 Marks)**

b. A differential band brake as shown in Fig.Q.6(b), has an angle of contact of 225°. The band has a compressed woven lining and bears against a cast iron drum of 350mm diameter. The brake is to sustain a torque of 350 N.m. and the co-efficient of friction between the band and the drum is 0.3. Find:
i) The necessary force, P for the clockwise and anticlockwise rotation of the drum and
ii) The value of 'OA' for the brake to be self locking, when the drum rotates clockwise.
(15 Marks)

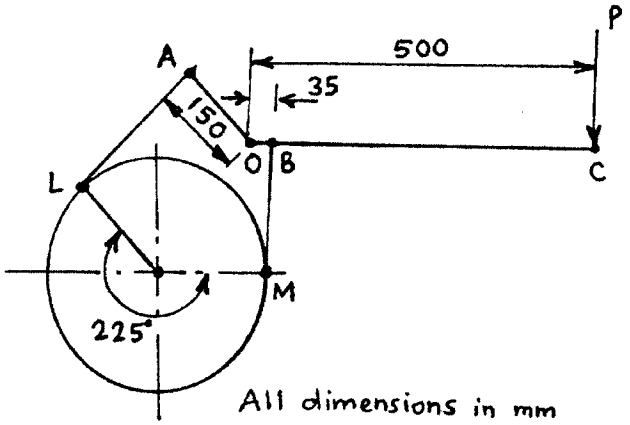

Fig.Q.6(b).

7 a. Derive Petroff's equation for a lightly loaded bearing. **(05 Marks)**

b. Design a full journal bearing subjected to 6kN at 1000rpm of the journal. The journal is of hardened steel and the bearing is of babbit material. The bearing is operated with SAE40 oil at 70°C and the ambient temperature is 30°C. Also determine the amount of artificial cooling required. **(15 Marks)**

8 a. Derive the expression for the ratio of Tensions in belt drive without considering the effect of centrifugal Tension. **(05 Marks)**

b. Two shafts 1 metre apart are connected by a V-belt to transmit 90kW at 1200 rpm of a driver pulley of 300mm effective diameter. The driver pulley rotates at 400 rpm. The angle of groove is 40° and the co-efficient of friction between the belt and the pulley rim is 0.25. The area of the belt section is 400mm^2 and the permissible stress is 2.1 MPa. Density of belt material is 1100kg/m^3. Calculate the number of belts required and the length of the belt. **(15 Marks)**

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06ME61

Sixth Semester B.E. Degree Examination, Dec.09/Jan.10
Design of Machine Elements – II

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer any FIVE full questions, selecting at least TWO questions from each part.***
2. ***Use of Design Data Hand Book is permitted.***

Part – A

1 a. Determine the maximum stress induced in a ring cross section of 50 mm diameter rod subjected to a compressive load of 20 kN. The mean diameter of the ring is 100 mm. **(10 Marks)**

b. A cast iron cylinder of internal diameter 200 mm and thickness 50 mm is subjected to a pressure of 5 N/mm^2. Calculate the tangential and radial stresses at the inner, middle and outer surface. **(10 Marks)**

2 a. A railway wagon weighing 40 kN and moving with a speed of 10 km/hour has to be stopped by four buffer springs in which the maximum compression allowed is 200 mm. Find the number of turns in each spring of mean diameter 150 mm. The diameter of spring wire is 25 mm. Take $G = 82.7 \times 10^3$ MN/m^2. **(10 Marks)**

b. A multi-leaf spring with camber is fitted to the chasis of a automobile over a span of 1.2 meter to absorb shocks due to a maximum load of 20 kN. The spring material can sustain a maximum stress of 0.4 GPa. All the leaves of the spring were to receive the same stress. The spring should have at least 2 full length leaves out of 8 leaves. The leaves are assembled with bolts over a span of 150 mm width at the middle. Design the spring for a maximum deflection of 50 mm. **(10 Marks)**

3 Design a pair of spur gears to transmit 20 kW from a shaft rotating at 1000 rpm to a parallel shaft which is to rotate at 310 rpm. Assume number of teeth on pinion 31 and 20° full depth tooth form. **(20 Marks)**

4 Design a pair of helical gears to transmit power of 15 kW at 3200 rpm with speed reduction 4 : 1 pinion is made of cast steel 0.4% C-untreated. Gear made of high grade CI Helix angle is limited to 26° and not less than 20 teeth are to be used on either gear. Check the gears for dynamic and wear considerations. **(20 Marks)**

Part – B

5 a. A pair of bevel gears transmitting 7.5 kW at 300 rpm of pinion. The pressure angle is 20°. The pitch diameters of pinion and gear at their large ends are 150 mm and 200 mm respectively. The face width of the gears is 40 mm. Determine the components of the resultant gear tooth force and draw free body diagram of forces acting on the pinion and the gear. **(10 Marks)**

b. A two teeth right hand worm transmits 2 kW at 1500 rpm to a 36 teeth wheel. The module of the wheel is 5 mm and the pitch diameter of the worm is 60 mm. The pressure angle is 14.5°. The co-efficient of friction is found to be 0.06.

i) Find the centre distance, the lead and the lead angle.

ii) Determine the forces. **(10 Marks)**

6 a. A single plate friction clutch of both sides effective has 0.3 m outer diameter and 0.16 m inside diameter. The co-efficient of friction is 0.2 and it runs at 1000 rpm. Find the power transmitted for uniform wear and uniform pressure distribution cases if the allowable maximum pressure is 0.08 MPa. **(10 Marks)**

b. In a simple band brake, the length of lever is 440 mm. The tight end of the band is attached to the fulcrum of the lever and the slack end to a pin 50 mm from the fulcrum. The diameter of the brake drum is 1 m and arc of contact is 300°. The co-efficient of friction between the band and the drum is 0.35. The brake drum is attached to a hoisting drum of diameter 0.65 m that sustains a load of 20 kN. Determine

i) Force required at the end of lever to just support the load.

ii) Width of steel band if the tensile stress is limited to 50 N/mm^2. **(10 Marks)**

7 a. Derive Petroff's equation, with usual notations. **(10 Marks)**

b. A lightly loaded bearing of 70 mm long and 70 mm in diameter is acted on by 1.5 kN radial load. The radial clearance is 0.07 mm and the journal is rotating at 25000 rpm. The viscosity of the oil is 3.45×10^{-3} pa.s. Determine frictional power loss using Petroff's equation. **(10 Marks)**

8 a. A compressor is driven by 900 rpm motor by means of 250 mm × 10 mm flat belt. The motor pulley is 0.3 m in diameter and the compressor pulley is 1.5 m diameter. The distance between the centres of the pulleys is 2 m. A jockey pulley is used to make the angle of wrap on the smaller pulley 220° and the larger pulley 270°. The coefficient of friction between the belt and the smaller pulley is 0.3 and between the belt and the larger pulley is 0.22. The maximum allowable belt stress is 2 MN/m^2 and the specific weight of the belt material is 9.515 kN/m^3. Determine the power that can be transmitted by the belt drive. **(10 Marks)**

b. A compressor requiring 90 kW is to run at 250 rpm. The drive is by V-belt from an electric motor running at 750 rpm. The diameter of the pulley on the compressor shaft is 1 m, while the center distance between the pulleys is limited to 1.75 m. The belt speed should not exceed 1600 m/min. Determine the number of V-belts required to transmit the power if each belt has a cross sectional area of 375 mm^2 and density of 1 Mg/m^3 and has an allowable stress of 2.5 N/mm^2. The groove angle of the pulley is 35° and the coefficient of friction between the belt and the pulley is 0.25. **(10 Marks)**

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06ME61

Sixth Semester B.E. Degree Examination, May/June 2010
Design of Machine Elements - II

Time: 3 hrs. Max. Marks:100

Note: ***1. Answer any FIVE full questions, selecting at least TWO questions from each part.***
2. Use of design data hand book is permitted.

PART – A

1 a. Derive expressions for extreme fibre stresses in a curved beam subjected to pure bending moment. **(08 Marks)**

b. Determine the combined stresses at the inner and outer fibers at the critical section of a crane hook which is required to lift loads upto 50 kN. The hook has trapezoidal C.S. with inner and outer sides of 90mm and 40mm respectively. Depth is 120mm. The center of curvature of the section is at a distance of 100mm from the inner side of the section and the load line passes through the centre of curvature. Also, determine the factor of safety according to max shear stress theory, if τ_{all} = 80 MPa. **(12 Marks)**

2 a. With reference to pressure vessels, what is autofrettage? Explain. **(04 Marks)**

b. A high pressure cylinder consists of an inner cylinder of ID and OD of 200mm and 300mm respectively. It is jacketed by an outer cylinder of OD 400mm. The difference between the OD of the inner cylinder and inner dia of the jacket before assembly is 0.25mm. E = 2.07×10^5 MPa. Calculate the shrinkage pressure and stresses induced in cylinders due to shrinkage pressure. In service, the cylinder is further subjected to an internal pressure of 200 MPa. Plot the resultant stress distribution. **(16 Marks)**

3 a. Derive an expression for shearing stress induced in a helical spring subjected to a compressive load, P. **(07 Marks)**

b. Write a note on Wahl stress correction factor. **(03 Marks)**

c. A semi-elliptic multi-leaf spring is used for the suspension of the rear axle of a truck. It consists of two extra full length leaves and 10 graduated length leaves including the master leaf. The center to center distance between the spring eyes is 1.2m. The leaves are made of steel with σ_{yt} = 1500 MPa. E = 2.07×10^5 MPa and FOS is 2.5. The spring is to be designed for a maximum force of 30 kN. The leaves are prestressed so as to equalize stresses in all leaves. Determine
i) C.S. of leaves ii) Initial nip iii) Initial pre-load required to close the gap
iv) Deflection of the spring. **(10 Marks)**

4 a. List the advantages and disadvantages of helical gears. **(03 Marks)**

b. It is required to transmit 15 kW power from a shaft running at 1200 rpm to a parallel shaft with speed reduction of 3. The centre distance of shafts is to be 300mm. The material used for pinion in steel (σ_d = 200 MPa) and for gear is CI (σ_d = 140 MPa). Service factor is 1.25 and tooth profile is 20° full depth involute. Design the spur gear and check the design for dynamic load and wear. **(17 Marks)**

PART – B

5 a. List the advantages and disadvantages of worm gear drive. **(03 Marks)**

b. A pair of straight tooth bevel gears at right angles is to transmit 5 kW at 1500 rpm of the pinion at a speed ratio of 3. Diameter of the pinion is 75mm. The tooth form is 14½° involute. Pinion is made of steel (σ_d = 160 MPa) and gear of CI (σ_d = 80 MPa). Design the gear pair and check the design for dynamic load and wear. **(17 Marks)**

6 a. Derive power transmitting capacity of a single plate clutch for
i) Uniform pressure condition and ii) Uniform wear condition. **(10 Marks)**

b. A single block brake with a torque capacity of 250 N.m is shown Fig.Q6(b). The brake drum rotates at 100 rpm and the coefficient of friction is 0.35. Calculate:
i) The actuating force and the hinge-pin reaction. ii) the rate of heat generated during the braking action and iii) The dimensions of the block, if the intensity of pressure between the block and brake drum is 1 MPa. The length of the block is twice its width. **(10 Marks)**

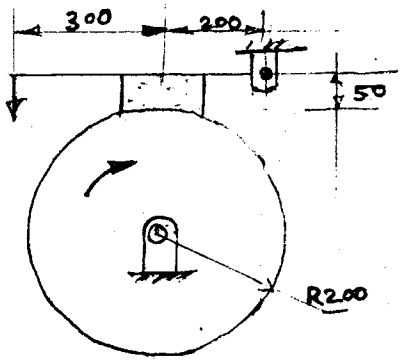

Fig.Q6(b)

7 a. Derive the Petnoff's equation coefficient of friction, in a sliding contact bearing. **(06 Marks)**

b. Following data refers to a 360° hydrodynamic bearing:
Radial load = 3.2 kN Journal speed = 1500 rpm
Journal diameter = bearing length = 50 mm Radial clearance = 0.05 mm
Viscosity of lubricant = 25 cP.
Assume that the total heat generated in the bearing is carried away by total oil flow in the bearing. Calculate:
i) Coefficient of friction ii) Power loss in friction iii) Minimum film thickness
iv) Flow requirement v) Temperature rise. **(14 Marks)**

8 a. Derive the expression for power rating of a V-belt drive. **(08 Marks)**

b. The following data is given for a V-belt drive connecting a 20 kW motor to a compressor:

	Motor pulley	Compressor pulley
Pitch dia (mm)	300	900
Speed (rpm)	1440	480
Coefficient of friction	0.2	0.2

The center distance between pulleys is 1 m. C.S. of belt is trapezoidal with parallel sides being 12mm and 22mm respectively and depth is 14mm. The density of the composite belt is 0.97 gm/cc and the allowable tension per belt is 850 N. Determine he number of belts required for this application. **(12 Marks)**

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