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Design of Machine Elements-II VTU CBCS Question Paper Set 2018

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10ME62

Sixth Semester B.E. Degree Examination, Dec.2014/Jan.2015
Design of Machine Elements – II

Time: 3 hrs. Max. Marks:100

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

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

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PART – A

1 a. Determine the dimensions of I-section, shown in Fig. Q1 (a) in which maximum fibre stresses are numerically equal in pure bending, given $b_i + b_0 = 120$ mm. **(10 Marks)**

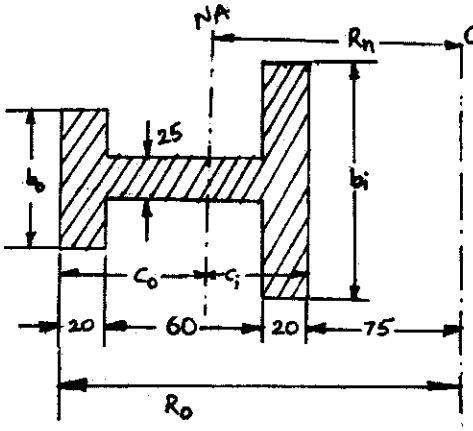

Fig. Q1 (a)

b. A solid shaft of 125 mm diameter is to be pressed into a steel flange which has an outside diameter of 150 mm and length of 100 mm. Take E = 210 GPa, v = 0.3. Determine,
i) Pressure between hub and shaft.
ii) Proper size of bore, if maximum stress does not exceed 160 MPa.
iii) Force required to press the parts together. Assume $\mu = 0.1$ for press fit.
iv) Torque capacity of press fit. **(10 Marks)**

2 a. Select a V-belt drive to transmit 18 kW at 1500 rpm to another pulley to run at 750 rpm. The dia of smaller pulley is 100 mm. The centre distance is 2 times the diameter of larger pulley. **(10 Marks)**

b. Select a number of wire ropes required to be used with a drum diameter of 2 meter. A load of 30 kN is to be lifted by 25 mm diameter 6×7 ropes form a height of 480 meter. A velocity of 15 m/sec is to be attained in 10 second. Assume the skip weight to be 30% of load capacity and factor of safety of 6. **(10 Marks)**

3 a. A free end of a torsional spring deflects through 60° when subjected to a torque of 6 N-m. The allowable stress in the spring material is 400 MPa and the spring index is 6. Determine the wire diameter and the number of effective turns. Take $E = 206.8 \times 10^3$ N/mm^2. **(08 Marks)**

b. A Belleville spring made from 5 mm thick steel sheet having outside diameter 150 mm and inside diameter 70 mm. The height of the spring is 10 mm. Using $\gamma = 0.3$, $E = 20 \times 10^4$ MPa. Find i) The deflectionn of spring. ii) The load the spring can carry. iii) Stress at the outer edge.
Limit the maximum stress at the inner edgee to 450 MPa. **(12 Marks)**

4 a. Design a pair of spur gear to transmit 40 kW at 4000 rpm of pinion to the gear 800 rpm. Select Chromium – Nickel steel for both gears. Assume pinion teeth as 20 and service factor as 1.5. Determine dynamic load, wear load and recommend BHN values. Assume $\alpha = 20^0$ FDI. **(12 Marks)**

b. A 24 teeth cast steel gear pinion (σ_{0_1} = 51.7 MPa) drives a high grade C.I. gear having (σ_{0_2} = 31 MPa) 50 teeth. The teeth are 20° full depth involute in the normal plane. The helix angle is 45°. Normal module is 3 mm. Find the safe power that can be transmitted by these gears at a pinion speed of 500 rpm. Assume face width is 10 times normal module and scant lubrication $C_W = 1.25$. **(08 Marks)**

PART – B

5 a. Design a pair of mitre bevel gears to transmit 9 kW at 1200 rpm. The pitch line velocity of gear is not exceed 15 m/sec. **(12 Marks)**

b. A hardened steel worm at 1250 rpm transmits power to a phosphor bronze gear with a transmission ratio of 20 : 1. The centre distance is 200 mm. Determine the input power capacity. Assume $\alpha = 14\frac{1}{2}^{\circ}$ FDI. **(08 Marks)**

6 a. Design a cone clutch to transmit 15 kW at 1200 rpm. Assume semi cone angle as 12.5°, co-efficient of friction for lining 0.4 and P = 0.2 MPa. **(08 Marks)**

b. A single band brake shown in Fig. Q6 (b) is to be designed to stop the rotation of a shaft transmitting a power of 45 kW at a rated speed of 500 rpm. Selecting suitable materials determine,
i) Dimensions of rectangular cross section of band.
ii) Dimensions of rectangular cross section of brake lever. (Assume $h_1 = 2\ b_1$).
iii) Diameter of fulcrum pin.
Assume $l_p = 1.5$ dp, bearing stress σ_b = 10 MPa. **(12 Marks)**

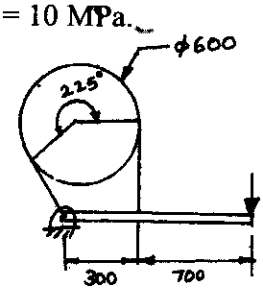

Fig. Q6 (b)

7 a. A full journal bearing of length 100 mm and the journal diameter of 80 mm supports a load of 2.5 kN at 600 rpm. What viscosity oil should be used to limit the bearing surface temperature to 60°C . The room temperature is 20°C and the clearance ratio is 0.001, use Mckee's equation. **(08 Marks)**

b. Determine the power loss for a Petroff bearing 100 mm in diameter and 150 mm long. The radial clearance is 0.05 mm. Speed of the journal is 1000 rpm. The lubricating oil is SAE10 and bearing operating temperature is 60°C. **(12 Marks)**

8 a. List and explain the functions of parts of internal combustion engine. **(04 Marks)**

b. Design a cast iron trunk type piston for four stroke internal combustion engine for the following data: Cylinder bore = 150 mm, Stroke = 200 mm, Indicated mean effective pressure = 6 bar, Fuel consumption = 4 kg/hr, Maximum gas pressure = 5 MPa,
Higher calorific value of fuel = 4100 KJ/kg, Speed of engine = 600 rpm,
Mechanical efficiency = 75% , Allowable stress for piston = 30 N/mm^2,
Allowable tensile stress for piston ring = 90 MPa,
Allowable bending stress in piston pin = 80 MPa. **(16 Marks)**

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10ME62

Sixth Semester B.E. Degree Examination, Dec.2015/Jan.2016

Design of Machine Elements – II

Time: 3 hrs. Max. Marks:100

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

1 a. A ring is made from a 75mm diameter bar. The inside diameter of the ring is 100mm. For the load shown in figure Q1(a), Calculate the maximum shear stress in the bar and specify its location. **(10 Marks)**

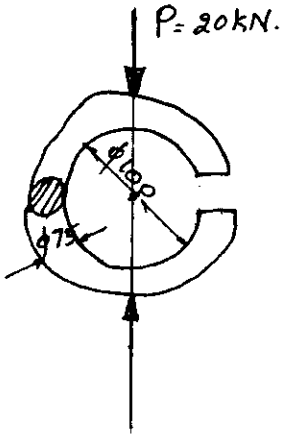

Fig Q1 (a)

b. An engine's chest is covered by a flat rectangular head of 200mm × 300mm dimensions. The plate is made of grey cast iron FG150 with ultimate stress of the material is 150N/mm^2, supported at the edges and subjected to a uniform pressure of 1.5N/mm^2. Determine the thickness of the head for a factor of safety 5. **(10 Marks)**

2 a. A 'V' belt is to be arranged between two shafts whose centers are 3000mm. The driving pulley is of 850mm effective diameter and is to be supplied with 75kW at 960 rpm. The follower pulley is to run at 480rpm. Determine the number of belts required for the following particulars :
Area of belt section – 400mm^2
Weight of belt – 0.01 N/cm^3
Safe working tensile stress – 2.1 N/mm^2
Coefficient of friction – 0.27
Groove angle of pulley - 40°
Also find the initial tension required in each belt. **(12 Marks)**

b. A 20mm 8 × 19 steel wire rope is used with a hoisting drum of 1m diameter to lift a load of 20kN. The depth of mine is 800m and the acceleration is 3m/sec^2. Determine the number of ropes required using a factor of safety 5. Neglect weight of skip. **(08 Marks)**

3 a. Design a valve spring of a petrol engine for the following operating conditions.
Spring load when the valve is open – 400N
Spring load when the valve is closed – 250N
Maximum inside dia of spring – 25mm
Length of spring when the valve is open – 40mm
Length of spring when the valve is closed – 50mm
Maximum permissible shear stress – 400MPa **(10 Marks)**

b. i) Define nipping in the leave springs. **(02 Marks)**

ii) A locomotive spring has an overall length of 1100mm and sustain 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 stressed at 0.4 GPa when fully loaded. The ratio of total spring depth to width is 2. Determine
i) Width and thickness of leaves ii) nipping
iii) What load is exerted on the band after the spring is assembled? **(08 Marks)**

4 a. Derive the Lewis equation for the beam strength of a spur gear tooth. Also list the assumptions. **(03 Marks)**

b. A 55kW motor running at 450rpm is geared to a pump by means of a double helical gearing. The forged steel pinion on motor shaft has a PCD of around 200mm and it drives a good grade C.I gear over the pump shaft at 120rpm. The allowable stress for both pinion and gear material should be taken as 224 N/mm^2 and 56 N/mm^2 respectively. Assuming $14\frac{1}{2}^\circ$ form teeth with $\beta = 20^\circ$ and $Z_1 = 24$. Design the gears. **(17 Marks)**

PART – B

5 a. Explain with a sketch, the formative number of teeth of bevel gear. **(06 Marks)**

b. A two teeth right hand worm transmits 2kW at 1500rpm to a 36 teeth wheel. The module of the wheel is 5mm and the pitch diameter of the worm is 60mm. The normal pressure angle is 14.5°. The coefficient of friction is found to be 0.06.
i) Find the centre distance, the lead and lead angle.
ii) Determine the forces.
iii) Determine the efficiency of the drive. **(14 Marks)**

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

b. A 400mm radius brake drum contacts a single shoe as shown in Fig.Q6(b) and sustains 200N – m toque at 500rpm. For a coefficient of friction 0.25, determine
i) Normal force on the shoe.
ii) Required force F to apply the brake for clockwise rotation.
iii) Required force F to apply the brake for counterclockwise rotation.
iv) The dimension 'C' required to make the brake self locking, assuming the other dimensions remains the same.
v) Heat generated. **(10 Marks)**

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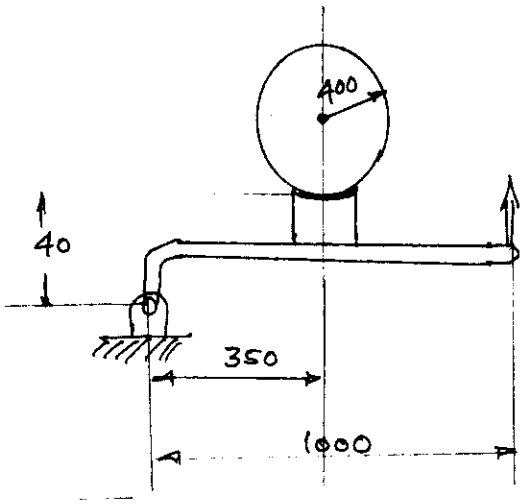

Fig. Q6 (b)

7 a. Explain the following :
   i) Hydrodynamic theory of lubrication.
   ii) Bearing characteristics number and bearing modulus.
   iii) Sommerfield number. **(08 Marks)**

b. A 75mm long full journal bearing of diameter 75mm supports a radial load of 12kN at the shaft speed of 1800 rev/min. Assume ratio of diameter to the diametral clearance as 1000. The viscosity of oil is 0.01 Pas at operating temperature. Determine the following:
   i) Sommerfield number
   ii) The coefficient of friction based on Mckee's equation
   iii) Amount of heat generated
   iv) Power loss due to friction. **(12 Marks)**

8 a. The following data is given for the piston of a four stroke diesel engine:
Cylinder bore – 250mm
Maximum pressure – 4MPa
Bearing pressure at small end of connecting rod = 15MPa
Length of piston pin in bush of small end = 0.45D
Ratio of inner to outer dia of piston pin = 0.6
Mean diameter of piston boss = 1.4 × outer dia of pin
Allowable bending stress for piston pin = 84N/mm^2.
Calculate
   i) Outer dia of the piston pin
   ii) Inner dia of piston pin
   iii) Mean dia of piston boss
   iv) Check for bending stress **(10 Marks)**

b. Determine the dimensions of cross section of the connecting rod for a diesel engine with the following data :
Cylinder bore = 100mm
Length of connecting rod = 350mm
Maximum gas pressure = 4MPa
Factor of safety = 6. **(10 Marks)**

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10ME62

Sixth Semester B.E. Degree Examination, Dec.2016/Jan.2017
Design of Machine Elements – II

Time: 3 hrs. Max. Marks:100

Note: *1. Answer FIVE full questions, selecting at least TWO questions from each part.*
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PART – A

1 a. Crane hook of trapezoidal cross-section with an inner side of 120mm and outer side of 60mm. The depth of the section is 90mm. The centre of curvature is at a distance of 120mm from the inner edge of the section and the line of action of load is at a distance of 135mm from the inner edge. Determine the safe load that the hook can carry if it is made of steel having an allowable stress of 90 MPa. **(10 Marks)**

b. A 100mm inside and 150mm outside sleeve is press fitted on to a shaft of 100mm diameter? The modulus of elasticity of material is 210 GPa and Poisson ratio is 0.28. The contact pressure is not to exceed 60 MPa. Determine:
i) Tangential stress at inner and outer surface of the sleeve and outside diameter of the shaft.
ii) The radial stresses in the sleeve and shaft.
iii) The original diameters of the shaft and hub before press fit.
iv) The total interference. **(10 Marks)**

2 a. For a flat belt drive, the following data are given power transmitted = 9kW, speed of motor = 1500rpm, speed of driven pulley = 500 rpm, velocity of belt 16 m/sec, load factor = 1.2, density of leather = 9.8 kN/m^3. Small diameter to thickness of belt ratio = 36, factor of safety = 10, ultimate strength of belt material = 24 MPa, centre distance = 2.1m, coefficient of friction = 0.36. Design the belt. **(10 Marks)**

b. Select a r-belt drive to transmit 9 kW from a shaft rotating at 1200rpm to a parallel shaft to run at 300rpm. The diameter of smaller pulley is 120mm. The centre distance between shafts is 1.2m. **(10 Marks)**

3 a. Design a rectangular section helical spring to mount a buffer to sustain a load of 30kN. The deflection under load is 90mm. The spring is made of Z-nickel having a torsional ultimate stress of 830 MPa. The longer side of rectangle is twice the shorter side and the spring is wound with longer side of rectangle parallel to the axis. The spring index is 10. Take factor of safety = 2.5 and G = 75.51 GPa. **(12 Marks)**

b. A laminated spring having 6 graduated leaves is simply supported at ends at a distance of 0.9m. It is made of steel having allowable bending stress of 360 MPa. The width and thickness of leaves are 90mm and 6mm. Find the safe load that can be carried by this spring at the middle and the deflection under that load. Take $\in$ = 206 GPa. **(08 Marks)**

4 Design a pair of steel spur gears required to transmit 12kW at 2000 rpm of pinion. The velocity ratio received is 2.5:1. The allowable static stress for both may be taken as 138 MPa. Not less than 24 teeth are to be used on either gear. The teeth are 20° stub teeth. **(20 Marks)**

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PART – B

5 Two shafts inclined at 60° are connected by a pair of bevel gears to transmit 9kW at 900rpm of 24 tooth cast steel pinion having allowable static stress of 138 MPa. The gear is made of high grade CI having allowable static stress of 103 MPa and is to run at 300rpm. The teeth are 14 ½° involute form. Design the gears completely. **(20 Marks)**

6 a. A multiplate clutch consists of 5 steel and 4 bronze plates. The inner and outer diameters of friction discs are 75mm and 150mm respectively. The coefficient of friction is 0.1 and allowable pressure is to be limited to 0.3 MPa. Assuming uniform pressure. Calculate:
i) The required axial force.
ii) Power that can be transmitted at 750 rpm. **(10 Marks)**

b. A 360mm radius brake drum contacts a single shoe as shown in Fig.Q.6(b) and sustains a power of 23.5 kW at 1000 rpm. Determine:
i) The normal force F_n on the shoe.
ii) The tangential force.
iii) The operating force for clockwise rotation.
iv) The value of distance 'C' for the brake to be self locking and
v) The rate of heat generated. **(10 Marks)**

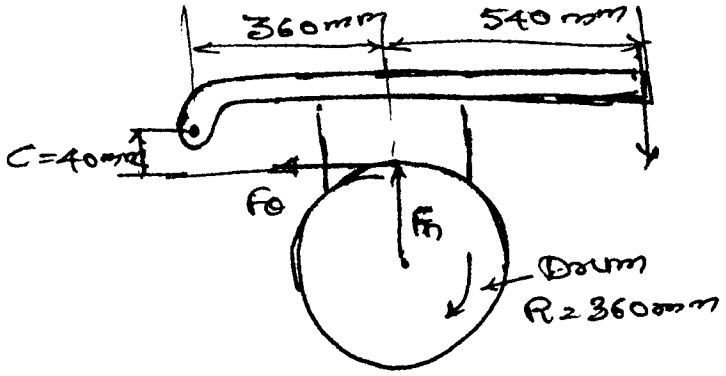

Fig.Q.6(b)

7 a. Derive the Petroff's equation for coefficient of friction. **(08 Marks)**

b. A full journal bearing 90mm diameter and 150mm long has a radial load of 2MPa per unit projected area. Shaft speed is 500rpm. The bearing is operating with SAE 20 oil at 50°C. The specific gravity of oil at the operating temperature is 0.985. Calculate the following:
i) Minimum film thickness
ii) Heat lost due to friction
iii) Whether artificial cooling is necessary. **(12 Marks)**

8 Design a cast iron piston for a single acting four stroke engine for the following data: Cylinder bore: 100mm, stroke = 125mm, maximum gas pressure = 5 N/mm^2, indicated mean effective pressure = 0.75 N/mm^2, mechanical efficiency = 80%, fuel consumption = 0.15 kg, per brake power per hour, higher calorific value of fuel = 42 × 10^3 kJ/kg, speed = 2000 rpm. **(20 Marks)**

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10ME62

Sixth Semester B.E. Degree Examination, Dec.2017/Jan.2018

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.***
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PART – A

1 a. A chain link is made up of 40 mm diameter rod is semicircle at each end. The mean diameter of which is 80 mm. The straight side of the link are also 80 mm. If the link carry a load of 90 kN, estimate the tensile and compressive stresses in the link along the section of load line. Also find the stresses at a selection 90° away from the load line. **(15 Marks)**

b. A cast steel cylinder of 300 mm internal diameter is to contain liquid at a pressure of 12.5 N/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 75 N/mm^2. **(05 Marks)**

2 a. A belt drive of two V-belt in parallel on ground pulleys of the same size. The angle of the groove is 30°. The cross section area of each belt is 750 mm^2 and $\mu = 0.12$. The density of the belt material is 1.2 g/cc and the mass safe stress in the material is 1.2 g/cc and the mass of safe stress in the material is 7 MPa. Calculate the power that can be transmitted between pulleys of 300 mm diameter rotating at 1500 rpm. Find the shaft speed at which power transmitted would be a maximum. **(15 Marks)**

b. Derive an expression for centrifugal tension in belt drive. **(05 Marks)**

3 a. Helical compression spring is subjected to 1960 N force, as to deflect by 50 mm. Under this load the outside diameter is not to exceed 70 mm and inside diameter not less than 20 mm. Take allowable shear stress is 430 MPa, spring index is 6. Design the spring. **(12 Marks)**

b. Derive an expression of deflection in helical spring. **(08 Marks)**

4 A pair of steel helical gear is to transmit 15 kW at 5000 rpm of the pinion both the gears are made of the same material, hardened steel with allowable bending stress of 120 MPa. The gears are to be operated at a centre distance of 200 mm, speed reduction ration is 4:1. The teeth are 20° FDI profile on transverse plane (diameter plane), helix angle is 45°. The gears are manufactured to class-3 accuracy (precision class). Face width can be taken as 16 times the normal module. The wear strength has to be more than the dynamic load. **(20 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 worn gear reducer unit which consists of a hardened steel worn and a phosphor bronze gear having 20° stub involute teeth. The centre distance is to be 200 mm and the transmission ratio is 10 and the worn speed is 2000 rpm. Assuming the temperature of gear and ambient temperature as 65° and 25° respectively. **(15 Marks)**

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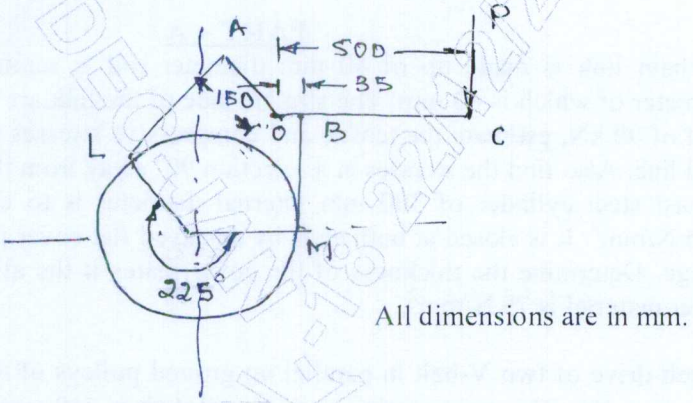
6 a. A cone clutch has a semi-cone angle of 12° to transmit 10 KW at 750 rpm. The width of the face is one fourth of the mean diameter of friction lining. If the normal intensity of pressure between the contacting surface is not to exceed 0.85 bar, assuming uniform wear criterion and taking $\mu = 0.2$, calculate dimensions of clutch. Also find the axial force while running. **(10 Marks)**

b. A differential band brake as shown in Fig.Q6(b), has an angle of contact of 225°. The band has a compressed woven lining and bears against a CI drum of 350 mm diameter. The brake is to sustain a torque of 350 N-m and the coefficient of friction between the band and the drum is 0.3. Find: (i) The necessary force, F 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.



All dimensions are in mm.

Fig.Q6(b) **(10 Marks)**

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

b. A bearing for an axial flow compressor is to carry a radial load of 4905 N and thrust load of 2452 N. The service imposes light shock and the bearing is used for 40 hr/week for 5 years. The speed of shaft is 300 rpm and diameter of shaft is 60 mm. Select a suitable bearing. **(15 Marks)**

8 a. The following data is given for the piston of a four-stroke diesel engine. Cylinder bore = 250 mm, maximum gas pressure = 4 MPa, bearing pressure at small end of connecting rod = 15 MPa, length of piston pin in bush of small end = 0.45D, ratio of inner of outer diameter of piston pin = 0.6, mean diameter of piston boss = 1.4 × outer diameter of piston pin, allowable bending stress for piston pin = 84 N/mm^2. Calculate:

i) Outer diameter of the piston pin
ii) Inner diameter of the piston pin
iii) Mean diameter of the piston boss
iv) Check the design for bending stress. **(16 Marks)**

b. List and explain the functions of parts of internal combustion engine. **(04 Marks)**

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10ME62

Sixth Semester B.E. Degree Examination, June/July 2013
Design of Machine Elements – II

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PART – A

1 a. The cross section of a steel crane hook is a trapezium with an inner side of 50 mm and outer side of 25 mm. The depth of the section is 64 mm. The centre of curvature of the section is at a distance of 64 mm from the inner edge of the section and the line of action of load is 50 mm from the same edge. Determine the maximum load hook can carry if the allowable strength is limited to 60 MPa. **(10 Marks)**

b. A cast iron cylindrical pipe of outside diameter – 300 mm and inside diameter 200 mm is subjected to an internal pressure of 20 N/mm^2 and external fluid pressure of 5 N/mm^2. Determine the tangential and radial stresses at the inner, middle and outer surface. Sketch the tangential and radial distribution across its thickness. **(10 Marks)**

2 a. Select a V-belt drive to transmit 10 kW power from a pulley of 200 mm diameter mounted on an electric motor running at 720 rpm to another pulley mounted on compressor running at 200 rpm. The service is heavy duty varying from 10 hrs to 14 hrs per day and distance between centre of pulley is 600 mm. **(10 Marks)**

b. A roller chain is to transmit 66.24 kW from a 17 tooth sprocket to a 34 tooth sprocket at a pinion speed of 300 rpm. The loads are moderate shock. The equipment is to run 18 hrs/day. Specify the length and size of the chain required for a centre distance of about 25 pitches. **(10 Marks)**

3 a. The laminated leaf spring has an overall length of 1.1 m and has a central load of 160 kN. The spring has 3 full length leaves and 15 graduated leaves with a central band of 100 mm wide. All the leaves are to be stressed to 400 N/mm^2, when fulley loaded. The ratio of total spring depth to width is approximately 2. Determine
i) The width and thickness of the leaves.
ii) Initial space must be provided between full length and graduated leaves.
iii) What load is exerted on the band when the leaves are assembled? **(10 Marks)**

b. Design a value spring for an automobile engine, when the valve is closed, the spring produces a force of 45 N and when it opens produces a force of 55 N. The spring must fit over the valve bush which has an outside diameter of 20 mm and must go inside a space of 35 mm. The lift of the valve is 6 mm. The spring index is 12. The allowable stress may be taken as 0.33 GPa. Modulus of rigidity 80 GPa. **(10 Marks)**

4 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 300 mm. The material used for pinion is 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 and wear. **(20 Marks)**

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PART – B

5 Complete the design and determine the input capacity of worm gear speed reducer unit which consists of hardened steel worm and phosphor bronze gear having 20° stub involute teeth. The centre distance is to be 200 mm and transmission ratio is 10, speed of the worm is 2000 rpm. **(20 Marks)**

6 a. A multiplate clutch has steel on bronze is to transmit 8 kW at 1440 rev/min. The inner diameter of the contact is 80 mm and the outer diameter of contact is 140 mm. The clutch operates in oil with expected co-efficient of friction of 0.1. The average allowable pressure is 0.35 MPa. Assume uniform wear theory and determine the following:
i) Number of steel and bronze plates.
ii) Axial force required.
iii) Actual maximum pressure. **(10 Marks)**

b. A simple band brake of drum diameter 600 mm has a band passing over it with an angle of contact of 225°, while one end is connected to the fulcrum, the other end is connected to the brake lever at a distance of 400 mm from the fulcrum. The brake lever is 1 m long. The brake is to absorb a power of 15 kW at 720 rpm. Design the brake lever of rectangular cross section assuming depth to be thrice the width. Take allowable stress 80 MPa. **(10 Marks)**

7 a. Derive Petroff's equation for coefficient of friction in journal bearings. **(08 Marks)**

b. The main bearing of a steam turbine runs at 1500 rpm and has a diameter of 40 mm. The load on a bearing is estimated to be 3 kN. Assume clearance ratio of 0.001 mm, length to diameter ratio is 1.5 and well ventilated. The operating temperature of the oil fill is 60°C and oil used is turbine oil SAE10. Determine wether,
i) Fluid film lubrication can be expected.
ii) Is artificial cooling is necessary.
iii) The amount of oil flow. **(12 Marks)**

8 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 = 0.60 MPa, maximum gas pressure = 4 MPa, fuel consumption = 0.25 kg per BP per hour. μd ratio for bush in small end of connecting rod = 1.5. **(20 Marks)**

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10ME62

Sixth Semester B.E. Degree Examination, June / July 2014
Design of Machine Elements – II

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer FIVE full questions, selecting at least TWO questions from each part.***
2. ***Design data handbook is permitted.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

PART – A

1 a. Determine the maximum tensile stress and maximum shear stress of the component shown in Fig. Q1(a) and indicate the location. **(10 Marks)**

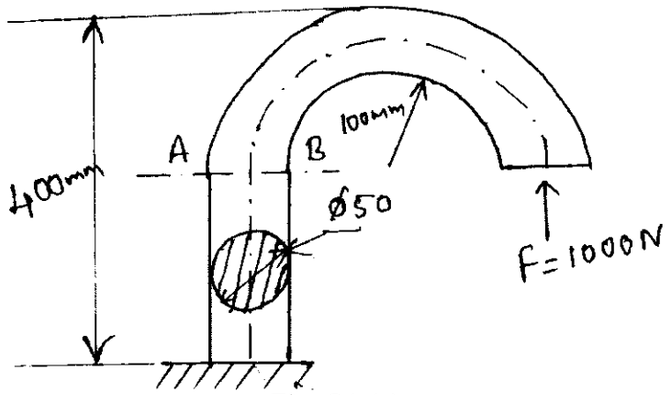

Fig. Q1 (a)

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 compressor is driven by a motor of 2.5 kW, running at 1200 rpm to a 400 rpm compressor. Select a suitable V-belt. **(10 Marks)**

b. Explain Hoisting tackle mechanism to raise and lowering load for a rope. **(10 Marks)**

3 a. Derive an expression for the stres induced in a helical spring with usual notations. **(10 Marks)**

b. Design a leaf spring for the following specification for a truck total load = 120 KN, number of springs = 4, material for the spring is chrome-vanadium steel permissible stress in 0.55 GPa. Span of spring = 1100 mm, width of central band = 100 mm and allowable deflection = 80 mm, number of full length leaves are 2 and graduated leaves 6. **(10 Marks)**

4 Design a pair of spur gear to transmit a power of 18 kW from a shaft running at 1000 rpm to a parallel shaft to be run at 250 rpm maintaining a distance of 160 mm between the shaft centres. Suggest suitable surface hardness for the gear pair. **(20 Marks)**

PART – B

5 A pair of bevel gear wheels with 20° pressure angle consists of 20 teeth pinion meshing with 30 teeth gear. The modulus is 4 mm while is 20 mm. The surface hardness of both pinion and gear is 400 BHN. The pinion rotates at 500 rpm and receives power from an electric motor. The starting torque of the motor is 150 percent of the rated torque. Determine the safe power that can be transmitted considering the dynamic load wear strength and endurance strength. The allowable bending stress may be taken as 240 MPa. **(20 Marks)**

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6 a. A plate clutch with a maximum diameter of 600 mm has maximum lining pressure of 0.35 MPa. The power to be transmitted at 400 rpm is 135 kW and μ= 0.3. Find inside diameter and spring force required to engage the clutch, if the spring with spring index 6 and material of spring the wire diameter if 6 springs are used. **(10 Marks)**

b. The torque absorbed in the band break shown in Fig. Q6 (b) is 400×10^3 Nmm. Design the band and lever taking μ = 0.27 and diameter of drum as 400 mm. The allowable stress in band may be taken as 70 N/mm^2. **(10 Marks)**

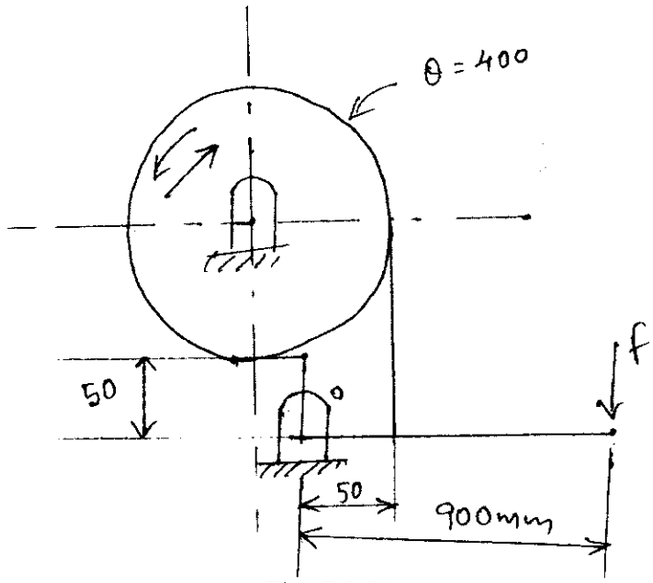

Fig. Q6 (b)

7 a. Derive Petroff's equation for co-efficient of friction in journal bearings. **(08 Marks)**

b. Design the main bearing of a steam turbine that runs at 1800 rpm and 70°C . The load on the bearing is estimated to be 2500 N. **(12 Marks)**

8 Design a cast iron piston for a single acting four stroke diesel engine from the following data:
Cylinder bore = 100 mm
Length of stroke = 125 mm
Speed = 2000 rpm
Brake mean effective pressure = 0.5 MPa,
Maximum gas pressure = 5 MPa,
Fuel consumption = 0.25 kg/ Brake Power in kW/hour
Assume any further data required for the design. **(20 Marks)**

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10ME62

Sixth Semester B.E. Degree Examination, June/July 2015
Design Machine Elements – II

Time: 3 hrs. Max. Marks:100

Note: ***1. Answer any FIVE full questions, selecting atleast TWO questions from each part.***
2. Use of machine design data handbook is permitted.

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

PART – A

1 a. Determine the value of 't' in the cross section of a curved machine member shown in Fig. Q1(a), so that the normal stresses due to bending at extreme fibers are numerically equal. Also determine the normal stresses so induced at extreme fibers due to a bending moment of 10 KN – m. **(10 Marks)**

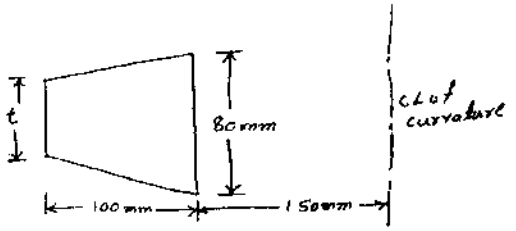

Fig. 1Q(a)

b. A cast iron cylindrical pipe of outside diameter 300 mm and inside diameter 200 mm is subjected to an internal fluid pressure of 20 N/mm^2 and external fluid pressure of 5 N/mm^2. Determine the tangential and radial stresses at the inner, middle and outer surface. Sketch the tangential and radial stress distribution across its thickness. **(10 Marks)**

2 a. A nylon core flat belt 200 mm wide weighing 20 N/m, connecting a 300mm diameter pulley to a 900 mm diameter driven pulley at a shaft spacing of 6 m, transmits 55.2 kW at a belt speed of 25 m/sec i) calculate the belt length and the angles of wrap ii) compute the belt tensions based on a co-efficient of friction 0.38. **(10 Marks)**

b. Two shafts one metre apart are connected by a V – belt to transmit 90 kW at 1200 rpm of a driver pulley of 300 mm effective diameter. The driven 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 400 mm^2 and the permissible stress is 2.1 MPa. Density of belt material is 1100 kg/m^3. Calculate the number of belts required and the length of the belt. **(10 Marks)**

3 a. A railway wagon weighting 50 kN and moving with a speed of 8 km/hr has to be stopped by four buffer springs in which the maximum compression allowed is 220 mm. Find the number of turns or coils in each spring of mean diameter 150mm. The diameter of spring wire is 25 mm. Take G = 84 GPa. Also find the shear stress. **(10 Marks)**

b. A multi leaf spring with camber is fitted to the chassis of an automobile over a span of 1.2 m 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 is required 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)**

4 Design a bronze spur gear 81.4 MN/m^2 and mild steel pinion 101 MN/m^2 to transmit 5 KW at 1800 rpm. The velocity ratio is 3.5 : 1. Pressure angle is 14½°. Not less than 15 teeth are to be used on either gear. Determine the module and face width. Also suggest suitable surface hardness for the weaker member based on dynamic and wear considerations. **(20 Marks)**

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PART – B

5 a. A pair of mitre gears have pitch diameter 280 mm and face width of 36 mm and run at 250 rpm. The teeth are of 14½° involute and accurately cut and transmit 6 KW. Neglecting friction angle, find the following : i) outside diameter of gears ii) resultant tooth load tangent to pitch cone iii) radial load on the pinion iv) trust on the pinion. Assume low carbon cast steel 0.2 %C heat treated as the material for both the gears. **(12 Marks)**

b. The following data refer to a worm and worm gear drive that has to transmit 15 KW at 1750 rpm of the worm. Centre distance = 200 mm number of starts = 4, transmission ratio = 20 pitch circle diameter of worm = 80 mm, axial module = 8 mm tooth form = 20°FDI. The worm gear has an allowable bending stress of 55 MPa. The worm is made of hardened and ground steel. Determine : i) the number of teeth on the worm gear ii) the lead angle iii) face width of the worm gear based on the beam strength of the worm gear. **(08 Marks)**

6 a. In a multiple disc clutch the radial width of the friction material is to be 0.2 of maximum radius. The co-efficient of friction is 0.25. The clutch is to transmit 60 KW at 3000 rpm. Its maximum diameter is 250 mm and the axial force is limited to 600 N. Determine i) number of driving and driven discs ii) mean unit pressure on each contact surface. Assume uniform wear. **(10 Marks)**

b. A differential band brake shown in Fig. Q6(b) operates on a drum diameter of 500 mm. The drum rotates at 300 rpm in counter clockwise direction and absorbs 36 KW, $\mu = 0.25$ determine : i) force F required to operate the brake ii) width of band required for this brake if thickness is 5 mm and allowable tensile stress on band material is 72 N/mm^2 iii) design the lever if the maximum force is twice that of calculated force. Use C30 steel (σ_u = 540 MPa) and FOS = 4 based on ultimate stress. And also depth equal to thrice the width. **(10 Marks)**

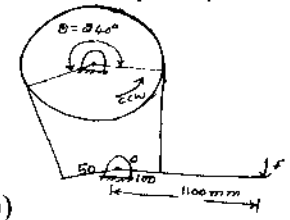

Fig.6Q(b)

7 a. Derive Pertroff's equation for a lightly loaded bearing. **(10 Marks)**

b. A full journal bearing 50 mm in diameter and 50 mm long operates at 1000 rpm and carries a load 5 kN. The radial clearance is 0.025 mm. The bearing is lubricated with SAE 30 oil and the operating temperature of oil is 80°C. Assume the attitude angle as 60°. Determine : i) bearing pressure ii) sommerfield number iii) attitude iv) minimum film thickness v) heat generated vi) heat dissipated if the ambient temperature is 20°C vii) amount of artificial cooling if necessary. **(10 Marks)**

8 Design a suitable aluminium alloy piston with two compression rings and one oil ring for a petrol engine of following particulars :

Cylinder diameter	= 0.10 m
Peak gas pressure	= 3.2 MPa
Mean effective pressure	= 0.8 MPa
Average side thrust	= 2400 N
Skirt bearing pressure	= 0.22 MPa
Bending stress in piston crown	= 36 MPa
Crown temperature difference	= 70°C.
Heat dissipated through crown	= 157 kJ/m^{2}s = 157 KW/m^2
Allowable radial pressure	= 0.04 MPa
Bending piston on rings	= 90 MPa
Heat conductivity k	= 160 W/m/°C

Assume any further data required for the design. **(20 Marks)**

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10ME62

Sixth Semester B.E. Degree Examination, June/July 2016
Design of Machine Elements – II

Time: 3 hrs. Max. Marks:100

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

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

PART – A

1 a. Determine the dimensions of the curved bar shown in Fig.Q1(a). Assume σ_{yt} = 400 MN/m^2 and FOS = 3.5. **(10 Marks)**

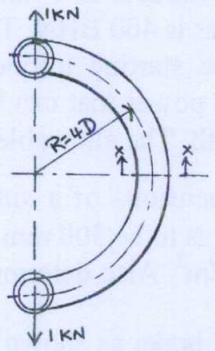

Fig.Q1(a)

b. A circular plate made of steel and of diameter 200 mm with thickness 10 mm is subjected to a load inducing a pressure of 4 MN/m^2. Taking E = 201 kN/mm^2, Poisson's ratio 0.3, determine (i) Maximum stress, its location and maximum deflection when the edges of the plate are supported. (ii) Maximum stress, its location and maximum deflection when the edges of the plate is fixed. **(10 Marks)**

2 a. A flat belt 200 mm wide weighing 20 N/m connecting a 300 mm diameter pulley to a 900 mm diameter driven pulley at a shaft spacing of 6 m, transmits 55.2 kW at a belt speed of 25 m/sec (i) Calculate the belt length and the a angles of wrap (ii) Compute the belt tensions based in a coefficient of friction 0.38. **(10 Marks)**

b. A V-belt drive is required to transmit 15 kW at 210 mm sheave running at 750 rpm to another pulley to run at 375 rpm. The belt used is 30 mm wide at top, 21 mm thick with V-angle 40°. The allowable stress for belt material is 2 MPa. Centre distance is 1.2 m. Specific weight of belt material is 1.1 gm/cc. Coefficient of friction of smaller pulley is 0.3 and for large pulley is 0.25. Find the number of bnelts of given cross-section required for this application. **(10 Marks)**

3 a. Derive an expression for the stress induced in a helical spring with usual notations. **(07 Marks)**

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

c. A semi-elliptical leaf spring has a span of 1.8 m. The spring carries a helical spring upon which is imposed an impact of 3 kN-m. The laminated spring has 8 graduated and 3 full length leaves each 60 mm wide and 6 mm thick. The coil spring has 9 coil of 12.5 mm wire diameter and a spring index of 7. Find the stresses induced in each spring. Take G = 80×10^3 MPa, E = 206×10^3 MPa. **(10 Marks)**

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4 a. State any four advantages of gear drive over other types of drives. **(04 Marks)**

b. A pair of spur gears with 20° full depth involute teeth consists of a 20 teeth pinion meshing with a 41 teeth gear. The module is 3 mm while the face width is 40 mm. The material for the pinion as well as the gear is steel with an ultimate tensile strength of 600 MN/m^2. The gears are heat treated to a surface hardness of 400 BHN. The pinion rotates at 140 rpm and the service factor for the application is 1.75. Assume that the velocity factor accounts for the dynamic load and the factor of safety is 1.5. Determine the rated power that the gears can transmit. **(16 Marks)**

PART – B

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

i) The centre distance, lead and lead angle ii) The efficiency of the drive iii) The forces. **(10 Marks)**

b. A pair of bevel gear wheels with 20° pressure angle consists of 20 teeth pinion meshing with 30 teeth gear. The module is 4 mm while the face width is 20 mm. Surface hardness for both pinion and gear is 400 BHN. The pinion rotates at 500 rpm and receives power from an electric motor. The starting torque of the motor is 30% greater than the mean torque, Determine the safe power that can be transmitted. Considering dynamic load, wear strength and bending strength. The allowable bending stress may be taken as 240 MPa. **(10 Marks)**

6 a. Determine the dimensions of a simple cone clutch to transmit 20 kW at 1000 rpm. The minimum diameter is to be 300 mm and the cone angle 20°. Assume $\mu = 0.2$ and permissible pressure = 0.1 MN/m^2. Also determine the axial force required to engage the clutch. **(10 Marks)**

b. A differential band brake as shown in Fig.Q6(b), has an angle of contact of 225°. The band has a compressed woven lining and bears against a cast iron drum of 350 mm diameter. The brake is to sustain a torque of 350 N-m and the coefficient 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. (ii) The value of 'OA' for the brake to be self locking when the drum rotates clockwise. **(10 Marks)**

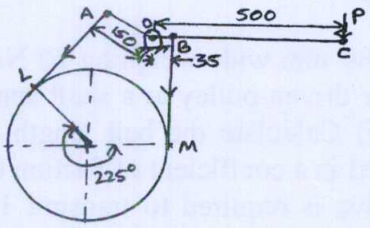

Fig.Q6(b)

7 a. Derive Petroff's equation for coefficient of friction for hydrodynamic bearing. **(08 Marks)**

b. The thrust of a propeller shaft in a ship engine is taken by a number of collars integral with the shaft which is 300 mm diameter. The thrust on the shaft is 200 kN and speed is 75 rpm. Bearing pressure is 0.3 MN/m^2. Find (i) the number of collar required if the outside diameter is 500 mm. (ii) Power lost in friction assuming uniform wear (iii) Heat generated in the bearing. **(12 Marks)**

8 Design a connecting rod for a petrol engine from the following data:

Cylinder bore or diameter of piston = 100 mm. Length of connecting rod = 350 mm
Maximum gas pressure = 3 N/mm^2 Length of stroke = 150 mm
Engine speed = 1500 rpm Weight of reciprocating parts = 25 N
Compression ratio = 4 : 1

Compression rod is made of steel and assume 'I' section. Assume any further data required for the design. **(20 Marks)**

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10ME62

Sixth Semester B.E. Degree Examination, June/July 2017
Design of Machine Elements – II

Time: 3 hrs. Max. Marks:100

Note: *1. Answer any FIVE full questions, selecting atleast TWO questions from each part.*
2. Design data handbook is permitted.
3. Missing data, if any, may be suitably assumed.

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.

PART – A

1 a. Give the differences between a straight and curved beam. **(04 Marks)**

b. Compute the combined stresses at the inner and outer fibres in the critical cross section of a crane hook which is required to lift load 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 inner and outer fibre, if the beam is treated as straight beam for the given load? **(16 Marks)**

2 a. Two shafts 1meter apart are connected by a v-belt to transmit 90 KW at 1200 rpm of a driver pulley of 300mm effective diameter. The driven pulley rotates at 400 rpm. The angle of groove is 40° and the coefficient of friction between the belt and the pulley rim 0.25. The area of the belt section is $400mm^2$ and the permissible stress is 2.1 MPa. Density of the belt material is 1100 kg/m^3. Calculate the number of belts required and the length of the belt. **(10 Marks)**

b. Select a wire rope for a vertical mine hoist to lift a load of 55kN from a depth of 300 meters. A rope speed of 500m/min is to be attained in 10 seconds. **(10 Marks)**

3 a. Design a helical spring used in a recoil system so as to absorb 120 Nm of energy with a maximum force of 3000N. Assume spring index 8 and factor of safety is 2. **(10 Marks)**

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

4 Design a pair of spur gears to transmit a power of 18 kW from a shaft running at 1000rpm to a parallel shaft to be run at 250 rpm maintaining a distance of 160mm between the shaft centers. Suggest suitable surface hardness for the gear pair. **(20 Marks)**

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PART – B

5 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 400rpm. **(20 Marks)**

6 a. Determine the dimensions of a simple cone clutch to transmit 20 KW at 1000 rpm. The minimum diameter is to be 300mm and the cone angle 20°. Assume $\mu = 0.2$ and permissible pressure = 0.1 N/mm^2. Also determine the axial force required to engage the clutch. **(10 Marks)**

b. A simple band broke of drum diameter 600mm has a band passing over it with an angle of contact of 225°, while one end is connected to the fulcrum, the other end is connected to the brake lever at a distance of 400mm from the fulcrum. The brake lever is 1 m long. The brake is to absorb a power of 15 KW at 720rpm. Design the brake lever of rectangular cross-section, assuming depth to the thrice the width. Take allowable stress 80 MPa. **(10 Marks)**

7 a. Derive Petroff's equation for co-efficient of friction for hydro dynamic bearing. **(08 Marks)**

b. Design a journal bearing for a centrifugal pump running at 1200rpm. Diameter of journal is 100mm and load on bearing is 15 kN. Take L/d = 1.5, bearing temperature 50°C and ambient temperature 30°C. Find whether artificial cooling is required. **(12 Marks)**

8 Design a suitable aluminium alloy piston with two compression rings and one oil ring for a petrol engine of following particular :

Cylinder diameter	= 0.10m
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 through crown	= 157 kJ/m^2 s
Allowable radial pressure	= 0.04MPa
Binding piston in rings	= 90MPa
Heat conductivity K	= 160 W/m/°C

Assume any further data required for the design. **(20 Marks)**

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10ME62

Sixth Semester B.E. Degree Examination, Dec.2013/Jan.2014
Design of Machine Elements – II

Time: 3 hrs. Max. Marks:100

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

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

PART – A

1 a. A curved link mechanism made from a round steel bar is shown in Fig.Q1(a). The material for link is plain carbon steel 30C8 with an allowable yield strength of 400 MPa. Determine the factor of safety. **(10 Marks)**

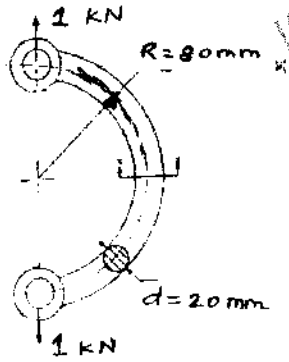

Fig.Q1(a)

b. A high pressure cylinder consists of a steel tube with inner and outer diameter of 20 mm and 40 mm respectively. It is jacketed by an outer steel tube with an outer diameter of 60 mm. The tubes are assembled by shrinking process in such a way that maximum principal stress induced in any tube is limited to 100 MPa. Calculate the shrinkage pressure and original dimensions of the tubes. Take the Young's modulus as 207 GPa. **(10 Marks)**

2 a. Write a note on construction of flat and 'V' belt. **(05 Marks)**

b. It is required to design a 'V' belt drive to connect a 7.5 kW, 1440 r/min induction motor to a fan, running at approximately 480 r/min for a service of 24 hr/day. Space is available for a centre distance of about 1 m. Determine the pitch length of the belt and number of belts required. **(15 Marks)**

3 a. Enumerate the applications of springs. Also derive an expression for the deflection of a close coiled helical spring. **(06 Marks)**

b. A spring is subjected to a load varying from 500 N and 1200 N. It is to be made of oil tempered cold drawn wire. Design factor based on Wahl's line is 1.25. The spring index is to be 6. The compression in the spring for the maximum load is 30 mm. Determine the wire diameter, mean coil diameter and free length of the spring. Take the yield stress in shear as 700 MPa and endurance stress in shear as 350 MPa for the material of the wire. **(14 Marks)**

4 a. Write a note on design of gears based on dynamic loading and wear. **(06 Marks)**

b. A cast steel 24 teeth spur pinion operating at 1150 r/min transmits 3 kW to a cast steel 56 teeth spur gear. The gears have the following specifications:

Module : 3 mm	Allowable stress : 100 MPa
Face width : 35 mm	Tooth form : 14½° full depth profile
Factor of dynamic loading, C= 350N/mm	Wear load factor, K = 0.28 MPa.

Determine the induced stress in the weaker gear. Also determine the dynamic load and wear load. Comment on the results. **(14 Marks)**

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PART – B

5 a. Write a note on formative number of teeth in bevel gear. **(04 Marks)**

b. Hardened steel worm rotates at 1250 r/min and transmits power to a phosphor bronze gear with a transmission ratio of 15:1. The centre distance is to be 225 mm. Design the gear drive and give estimated power input ratings from the stand point of strength, endurance and heat dissipation. The teeth are of 14½° full depth involute. **(16 Marks)**

6 a. A cone clutch has a semi cone angle of 12°. It is to transmit 10 kW power at 750 r/min, the width of the face is one fourth of the mean diameter of friction lining. If the normal intensity of pressure between contacting surfaces is not to exceed 0.085 N/mm^2 and the coefficient of friction is 0.2, assuming uniform wear conditions, calculate the dimensions of the clutch. **(10 Marks)**

b. A band break arrangement is shown in Fig.Q6(b). It is used to generate a maximum braking torque of 200 N-m. Determine the actuating force 'P', if the coefficient of friction is 0.25. The angle of wrap of the band is 270°. Determine the maximum intensity of pressure, if the band width is 30 mm. **(10 Marks)**

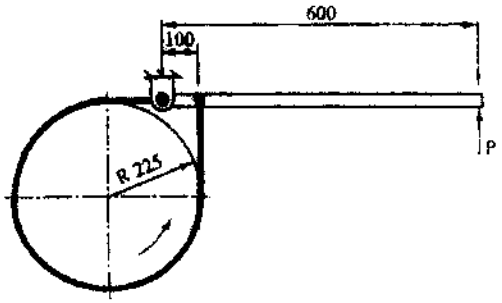

Fig.Q6(b)

7 a. Explain the following types of lubrication:
(i) Hydrodynamic lubrication (ii) Hydrostatic lubrication
(iii) Boundary lubrication (iv) Elasto hydro dynamic lubrication. **(08 Marks)**

b. The following data are given for a 360° hydro-dynamic bearing:

Bearing diameter : 50.02 mm	Journal diameter : 49.93 mm
Bearing length : 50 mm	Journal speed : 1440 r/min
Radial load = 8 kN	Viscosity of lubricant : 12 cp.

The bearing is machined on a lathe from bronze casting, while the steel journal is hardened and ground. The surface roughness values for turning and grinding are 0.8 and 0.4 microns respectively. For thick film lubrication the minimum film thickness should be five times the sum of surface roughness values for the journal and the bearing. Calculate:
(i) The permissible minimum film thickness
(ii) The actual film thickness under the operating conditions
(iii) Power loss in friction.
(iv) Flow requirement. **(12 Marks)**

8 a. Explain the considerations given in the design of pistons for IC engines. **(05 Marks)**

b. Design a trunk piston for an IC engine. The piston is made of cast iron with an allowable stress of 38.5 MPa. The bore of the cylinder is 200 mm and the maximum explosion pressure is 0.4 MPa. The permissible bending stress of the material of the gudgeon pin is 100 MPa. The bearing pressure in the gudgeon pin bearing of the connecting rod is to be taken as 200 MPa. **(15 Marks)**

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