Code No: R1631033 **R16** SET - 1

III B. Tech I Semester Regular Examinations, October/November - 2018

DESIGN OF MACHINE MEMBERS– II

(Mechanical Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**
Note: Data Book Allowed

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PART –A

1. a) What is meant by bearing modulus? [2M]
b) List various stresses induced in the connecting rod. [2M]
c) Write an expression for resultant stresses in a curved beam subjected to direct stress and bending stress. [2M]
d) Name the cross-sections of flat belt, V-belt, and rope. [2M]
e) Differentiate between gear and belt drives. [3M]
f) State the application of hand and foot levers. [3M]

PART –B

2. a) A bearing, 50 mm in diameter and 75 mm in length supports a overhanging shaft, running at 900 r.p.m. the room temperature is 30^0C, and the bearing temperature is 75^0C. The viscosity of the oil used is 0.012 kg/m-s at the operating temperature of 120^0C. The diametral clearance is 0.05 mm, and the bearing is to operate in still air, without any artificial cooling. Determine [8M]
i) the permissible load on the bearing, and ii) power loss
b) Explain design of ball bearings. [6M]

3. Design a cast iron piston for a four stroke I.C engine, for the following specifications: [14M]
Cylinder bore = 120 mm
Stroke length = 150 mm
Maximum gas pressure = 5 MPa
Brake mean effective pressure = 0.7 MPa
Fuel consumption =0.25 kg/kW/hr
Speed = 2400 r.p.m
Assume any other data necessary for the design.

4. For a square 50 x 50 mm cross-section, find the maximum tensile and compressive stress if P = 9.5 kN and plot the total stress across the cross section [14M]

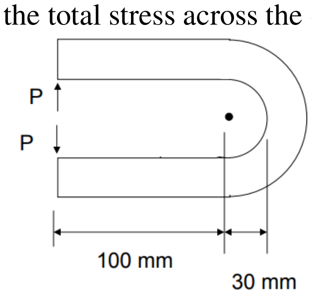

Fig.1

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5. a) Design a chain drive to actuate a compressor from 15 kW electric motor running at 1000 RPM, the compressor speed being 350 RPM, the minimum centre distance is 500 mm; the compressor operates 16 hours per day. The chain tension may be adjusted by shifting the motor on slides. [10M]

   b) How does the helix angle influence on the efficiency of square threaded screw? [4M]

6. A helical cast steel gear with 30^0 helix angle, has to transmit 25 kW at 2000 r.p.m. if the gear has 24 teeth, determine the necessary module and face width of the gear. The tooth profile is 20^0 full depth involute, and static strength of the gear material is 56 MPa Take the face width of the gear as 3 times the normal pitch, and velocity factor, C_v= 15/15+v ,where v is pitch line velocity in m/s. [14M]

7. A foot lever is 500 mm from the centre of the shaft to the point of application of the load; whose magnitude is 700 N. Determine [14M]
   i) the diameter of shaft where the lever is fitted,
   ii) the dimensions of the key, and
   iii) The size of the cross-section of the arm of the foot lever at the boss.
   Assume that the depth of the arm as three times the width. Take σ_t = 60 MPa, σ_c= 100 M Pa, and τ= 50 M Pa for the shaft key, and lever.

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(Mechanical Engineering)

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Note: Data Book Allowed

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PART –A

1. a) What are rolling contact bearings? [2M]
   b) State the function of pistons used in IC engine. [2M]
   c) What are the assumptions made in the derivation of stresses in a curved beam subjected to bending moments? [2M]
   d) How will you designate a chain drive? [3M]
   e) What is the significance of determining the beam strength of a gear tooth? [3M]
   f) State some of the applications of levers in engineering practice. [2M]

PART –B

2. a) A 6203 single row deep groove ball bearing has a basic static load rating of 4500 N, and basic dynamic load rating of 7500 N. A radial load of 1600 N, and an axial load of 1400 N are acting on the bearing. Calculate the rated life of the bearing. [7M]
   b) What procedure would you follow while designing a journal bearing? Explain. [7M]

3. Design a centre crankshaft for a single cylinder vertical engine using the following data: [14M]
Cylinder bore = 125mm, (L/r) ratio = 4.5, Maximum gas pressure = 2.5MPa, length of the stroke =150 mm, weight of flywheel cum belt pulley = 1KN, Total belt pull = 2 KN, Width of the hub for flywheel cum belt pulley = 200 mm. The torque on the crankshaft is maximum when the crank turns through 25^0 from the top dead centre and at this position the gas pressure inside the cylinder is 2MPa. The belts are in the horizontal direction. Assume suitable data and state the assumptions you make.

4. An open ring having channel section as shown in fig.1 is subjected to compressive load of 75 kN. Determine the stresses at A and B. [14M]

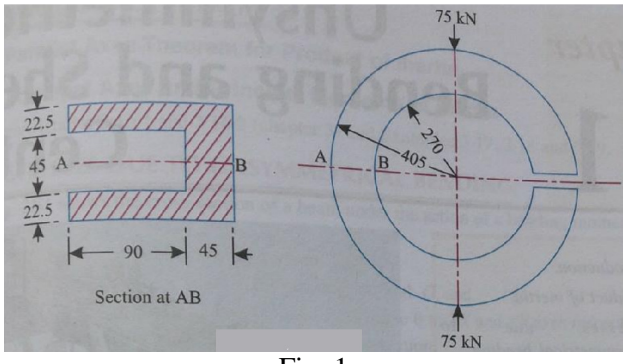

Fig. 1

Note: All Dimensions are in mm.

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5. a) In a crossed belt drive the diameters of the driver and follower pulleys are 200 mm and 400 mm respectively. The centre distance of the drive is 2 m. The driver pulley rotates at 400 r.p.m. Find the angle of contact between belt and both the pulleys, and the length of the belt required. What is the power capacity of the drive, if the permissible tension in the belt is 1.2 kN, and the coefficient of friction between the belt and both the pulleys is 0.25. [8M]

   b) Differentiate between differential and compound screws. [6M]

6. Design a pair of spur gears with stub teeth, and to transmit 50 KW. From 180 mm pinion, running at 2400 r.p.m to a gear running at 1400 r.p.m. Both the gears are made of steel having BHN of 260. Determine the pitch of the gears by means of Lewis equation, and then modify the dimensions if required, to keep within the limits set by the dynamic and wear load requirements. [14M]

7. A lever loaded safety valve is 70 mm in diameter. It is required to blow-off at a pressure of 1.5 N/mm^2. The length of the lever is 1000 mm. The distance between the fulcrum and toggle is 100 mm. determine the amount of dead weight to be put at the end of the lever. Also, determine the size of the cross-section of the lever, which is rectangular in form, and the size of the pins at the fulcrum and the toggle. Use the following stress values: [14M]
   Tensile stress, σt = 60 MPa ,
   Shear stress t= 50 MPa
   Bearing pressure, p= 12 MPa
   Assume forked end connections for the pins at the fulcrum and toggle.

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Code No: R1631033 **R16** SET - 3

III B. Tech I Semester Regular Examinations, October/November - 2018

DESIGN OF MACHINE MEMBERS– II

(Mechanical Engineering)

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Note: Data Book Allowed

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PART –A

1. a) Define the term static equivalent load as applied in rolling contact bearing. [2M]
   b) What is the function of piston skirt of an IC engine? [2M]
   c) Write down expression for winkler-bach formula. [2M]
   d) Name the types of stresses induced in wire ropes. [3M]
   e) What is meant by wear load of a gear tooth? [3M]
   f) Classify and describe the various types of levers. [2M]

PART –B

2. a) A bearing for a centrifugal pump is 75 mm in diameter, and 125 mm in length. The journal is machined so as to give a radial clearance of 0.0015 mm per mm radius. The journal rotates at 1440 r.p.m, and resists a load of 10 KN. Oil is supplied with a viscosity of 0.03 kg/m-s at the operating temperature. Determine the coefficient of friction, the value of the bearing characteristic number, and the heat generated. [8M]
   b) What are the advantages and disadvantages of rolling contact bearings? [6M]

3. Design the connecting rod for a petrol engine, from the following data: [7M]
Diameter of the piston = 110 mm
Mass of the reciprocating parts = 2 kg
Length of the connecting rod =325 mm
Stroke length = 150 mm
Speed = 1500 r.p.m, with permissible over speed of 2500 r.p.m
Compression ratio = 4
Maximum explosion pressure = 2.5 N/mm^2.

4 Figure.1 shows an open ring having T section. Determine the stresses at the points A and B if the ring is subjected to a load of 150 kN. [7M]

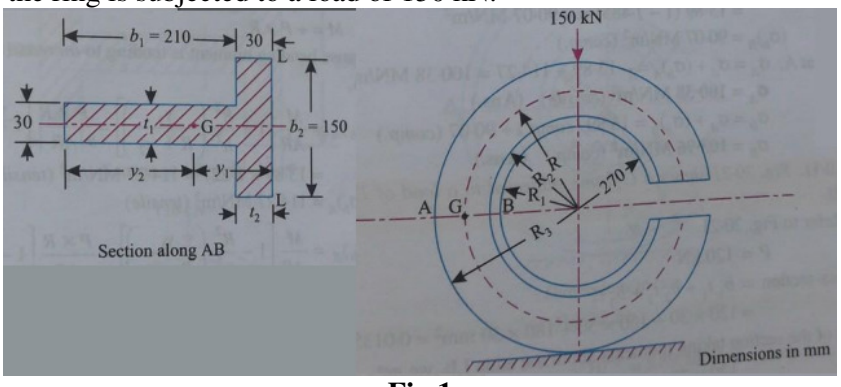

Fig.1

Note: All Dimensions are in mm.

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5. a) The lead screw of a lathe has ACME threads of 40 mm nominal diameter and 6 mm pitch. The screw must exert an axial thrust of 20 KN for driving the carriage. The thrust is carried on a collar with 45 mm inner diameter and 90 mm outer diameter. The lead screw rotates at 36 r.p.m. determine [8M]
   i) the power required to operate the screw, and
   ii) the efficiency of the lead screw.
   Take coefficient of friction for the screw thread as 0.15, and for the collar surface as 0.12
   b) Write the design procedure for a rope drive. [6M]

6. a pair of parallel helical gears consists of 24 teeth pinion rotating at 5000 rpm and supplying 2.5 KW power to a gear. The speed reduction is 4:1. The normal pressure angle and helix angle are 20^0 and 23^0 respectively. Both gears are made of hardened steel (S_{ut}=750 N/mm2). The service factor and the factor of safety are 1.5 and 2 respectively. The gears are finished to meet the accuracy of grade 4. In initial stages of gear design, assume that the velocity factor accounts for the dynamic load and that the face width is ten times the normal module. Assuming the pitch line velocity to be 10 m/s, estimate the normal module. Select the first preference module and calculate the main dimensions. [14M]

7. Design a wire rope for a vertical mine hoist to lift a load of 50 kN, from a depth of 250m. Rope speed of 8 m/s is to be attained in 10 seconds. Take factor of safety as 6. [14M]

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Code No: R1631033 **R16** SET - 4

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Note: Data Book Allowed

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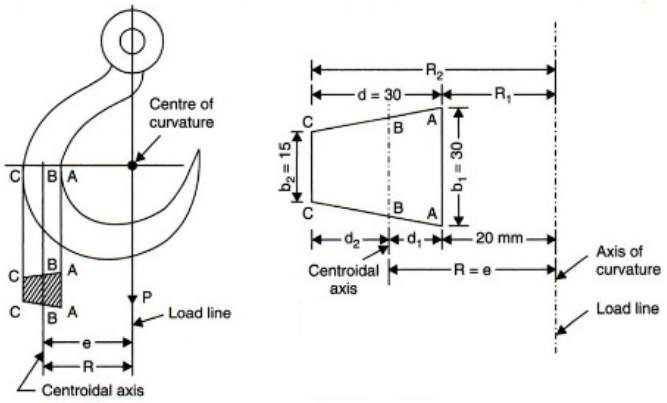
PART –A

1. a) What is meant by hydrodynamic lubrication? [2M]
   b) What is meant by whipping of a connecting rod and what is its effect. [3M]
   c) Compare straight beam and curved beam. [2M]
   d) What are the applications of flat belt drives? [2M]
   e) Operation of helical gearing, compared to spur gearing is relatively silent, justify the statement. [3M]
   f) What is a lever? What is the principle on which it works? [2M]

PART –B

2. a) Specify a suitable deep groove ball bearing for a radial load of 2.5 KN, and a thrust load of 0.9 kN. The operating speed is 3000 r.p.m. Assume steady load, and life of 15000 hours at 95% reliability. Recommend the bearing with the maximum possible bore size. [8M]
   b) Sketch the pressure distribution in a journal bearing with thick film lubrication in axial, and radial directions. [6M]
3. In an overhung crank, the axial distance between the axis of the crankshaft journal and the crank pin is 350 mm, and the length of the crank is 450 mm. if the maximum tangential force acting on the crank pin is 100 kN; design the crank pin. Take the safe bearing pressure as 6 MPa, and bending stress as 60 MPa. Determine the diameter of the crankshaft, if the principal stress is limited to 60 MPa. [14M]
4. A hook carries a load of 7.5 kN and the load line is at a distance of 20 mm from the inner edge of the section which is trapezoidal. The load line also passes through the center of curvature of the hook. The dimensions of the central horizontal trapezoidal section are: inner width 30mm; outer width =15 mm; depth=30 mm. calculate the maximum and minimum stresses. Also plot the variation of stress across the section. [14M]



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5. a) A cast iron flat pulley transmits 20 kW at a speed of 560 r.p.m. The pulley overhangs the nearest bearing by 200 mm. Assuming the ratio of belt tensions as 2; determine [8M]
   i) shaft diameter
   ii) pulley diameter, and
   iii) cross-section of eight arms.
   b) List out the steps to be followed while designing a wire rope. [6M]

6. It is required to design a pair of spur gears with 200 full depth involute teeth consisting of a 20-teeth pinion meshing with a 50 teeth gear. The pinion shaft is connected to 22.5 KW, 1450 rpm electric motor. The starting torque of the motor can be taken as 150% of the rated torque .the material for pinion is plain carbon steel Fe 420 (Sut = 410 N/mm^2), while the gear is made of grey cast iron FG 200 (Sut= 200 N/mm^2). The factor safety is 1.5. Design the gears based on the lewis equation and using velocity factor to account for the dynamic load. [14M]

7. Design a right angled bell crank lever having one arm 500 mm and the other 150 mm long. The load of 5 kN is to be raised acting on a pin at the end of 500 mm arm and the effort is applied at the end of 150 mm arm. The lever consists of a steel forging, turning on a point at the fulcrum. The permissible stresses for the pin and lever are 84 MPa in tension and compression and 70 MPa in shear. The bearing pressure on the pin is not to exceed 10 N/mm^2. [14M]

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