R18

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year II Semester Examinations, August/September - 2021
DESIGN OF MACHINE MEMBERS - II
(Mechanical Engineering)

Time: 3 Hours   **Max. Marks: 75**

Answer any five questions
All questions carry equal marks
- - -

1.a) What are the various terms used in journal bearings analysis and their design? And also discuss the factors that influence most the formation and maintenance of the thick oil film in hydrodynamic bearings.

b) Explain the significance bearing modulus.   [7+8]

2. A shaft is supported by two bearings placed 1m apart. A 600 mm diameter pulley is mounted at a distance of 300 mm to the right of left hand bearing and this drives a pulley directly below it with the help of belt having maximum tension of 2.25 kN. another pulley 400 mm diameter is placed 200 mm to the left of right hand bearing and is driven with the help of electric motor and belt, which is placed horizontally to the right. The angle of contact for both the pulleys is 180^0 and $\mu = 0.24$. Determine the suitable diameter for a solid shaft, allowing working stress of 63 MPa in tension and 42 MPa in shear for the material of shaft. Assume that the torque on one pulley is equal to that on the other pulley.   [15]

3.a) How do you express the life of a bearing? What is an average or median life? Explain.

b) Define the following terms as applied to rolling contact bearings:
(i) Basic static load rating *(ii)* Static equivalent load *(iii)* Basic dynamic load rating.

[6+9]

4. A ball bearing subjected to a radial load of 4000 N is expected to have a satisfactory life of 12000 hours at 720 r.p.m. with a reliability of 95%. Calculate the dynamic load carrying capacity of the bearing, so that it can be selected from manufacturers catalogue based on 90% reliability. If there are four such bearings each with a reliability of 95% in a system, what is the reliability of the complete system?   [15]

5. Design the various components of the valve gear mechanism for a horizontal diesel engine for the following data: Bore = 140 mm; Stroke = 270 mm; Power = 8.25 kW; Speed = 475 r.p.m.; Maximum gas pressure = 3.5 N/mm^2. The valve opens 33^0 before outer dead centre and closes 1^0 after inner dead centre. It opens and closes with constant acceleration and decleration for each half of the lift. The length of the rocker arm on either side of the fulcrum is 150 mm and the included angle is 160^0. The weight of the valve is 3 N.   [15]

6.a) What is the function of a connecting rod of an internal combustion engine and explain its design procedure?

b) Why the area of the inlet valve port is made larger than the area of exhaust valve port? Discuss.   [7+8]

7.   A semi-elliptical laminated spring is made of 50 mm wide and 3 mm thick plates. The length between the supports is 650 mm and the width of the band is 60 mm. The spring has two full length leaves and five graduated leaves. If the spring carries a central load of 1600 N, find:

a) Maximum stress in full length and graduated leaves for an initial condition of no stress in the leaves.

b) The maximum stress if the initial stress is provided to cause equal stress when loaded.   [7+8]

8.   A gear drive is required to transmit a maximum power of 22.5 kW. The velocity ratio is 1:2 and r.p.m. of the pinion is 200. The approximate centre distance between the shafts may be taken as 600 mm. The teeth have 20^0 stub involute profiles. The static stress for the gear material (which is cast iron) may be taken as 60 MPa and face width as 10 times the module. Find the module, face width and number of teeth on each gear. Check the design for dynamic and wear loads. The deformation or dynamic factor in the Buckingham equation may be taken as 80 and the material combination factor for the wear as 1.4.   [15]

---ooOoo---

R15

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year II Semester Examinations, December - 2018
DESIGN OF MACHINE MEMBERS – II
(Common to ME, AME)

Time: 3 hours   **Max. Marks: 75**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A. Part B
consists of 5 Units. Answer any one full question from each unit. Each question carries
10 marks and may have a, b, c as sub questions.

PART - A

(25 Marks)

1.a)	Define static load carrying capacity of ball bearing.	[2]
b)	What is bearing characteristic number as applied to journal bearing?	[3]
c)	Why are more number of thin piston rings preferred over small number of thick rings?	
		[2]
d)	What is the difference between centre and overhung crankshafts?	[3]
e)	What are the advantages of fabric rubber belts?	[2]
f)	Explain the designation of V-belt with the help of examples.	[3]
g)	What is the minimum number of teeth on spur gear? Why?	[2]
h)	Why are crossed helical gears not used for high power transmission?	[3]
i)	Why are V threads not used in power screws?	[2]
j)	What is 'self locking' of power screw? What is the condition for it?	[3]

PART - B

(50 Marks)

2.a) What is meant by L_{10} life and L_{50} life?
   b) A single-row deep groove ball bearing is subjected to a pure radial force of 3 kN from a
      shaft that rotates at 500 rpm. The expected life L_{10h} of the bearing is 30000 h. The
      minimum acceptable diameter of the shaft is 40 mm. Select a suitable ball bearing for
      this application.   [5+5]

OR

3. The following data is given for a full hydrodynamic bearing:
   Radial load = 10 kN; journal speed = 1440 rpm; unit bearing pressure = 1000 kPa;
   Clearance ratio (r/c) = 800; viscosity of lubricant = 30 MPa-s. Dimensions of the
   bearing 100×100 mm. Assuming that the total heat generated in the bearing is carried
   by the total oil flow in the bearing, calculate the temperature rise.   [10]

4. Explain the procedure to design centre crankshaft when it is at top dead centre position.
                                                                                          [10]

OR

5. The following data is given for the piston of a four-stroke diesel engine:
   The 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 to outer diameter of piston pin = 0.6
   Mean diameter of piston boss = 1.4 x outer diameter of piston pin
   Allowable bending stress for piston pin = 84 N/mm^2
   Calculate:
   a) Outer and inner diameters of the piston pin
   b) Mean diameter of the piston boss and
   Check the design for bending stresses. [5+5]

6. A belt pulley made of grey cast iron FG 150, transmits 10 kW of power at 720 rpm. The diameter of the pulley is 500 mm. The pulley has four arms of elliptical cross-section, in which the major axis is twice of the minor axis. Determine the dimensions of the cross-section of the arm, if the factor of safety is 5. [10]

OR

7. A temporary elevator is assembled at the construction site to raise building materials to a height of 20 m. It is estimated that the maximum weight of material to be raised is 5 kN. It is observed that the acceleration in such applications is 1 m/s^2. 10 mm diameter, 6 ×19 construction wire ropes with fibre core are used for this application. The tensile designation of the wire is 1570 and the factor of safety should be 10 for preliminary calculations. Determine the number of wire ropes required for this application neglecting bending stresses. Also determine the true factor of safety taking into account the bending stresses. The sheave diameter can be taken as 45 times the rope diameter. [10]

8. The lead screw of a lathe has single-start ISO metric trapezoidal threads of 52 mm nominal diameter and 8 mm pitch. The screw is required to exert an axial force of 2 kN in order to drive the tool carriage during turning operation. The thrust is carried on a collar of 100 mm outer diameter and 60 mm inner diameter. The values of coefficient of friction at the screw threads and the collar are 0.15 and 0.12 respectively. The lead screw rotates at 30 rpm. Calculate
   a) The power required to drive the lead screw and
   b) The efficiency of the screw. [5+5]

OR

9. A differential type of screw jack is shown in figure. In this construction, the two screws do not rotate and the nut is rotated by the operator by applying a force of 100 N at a mean radius of 500 mm. The coefficient of friction at the threads is 0.15. Calculate
a) The load that can be raised and
b) The efficiency of the screw jack. [5+5]
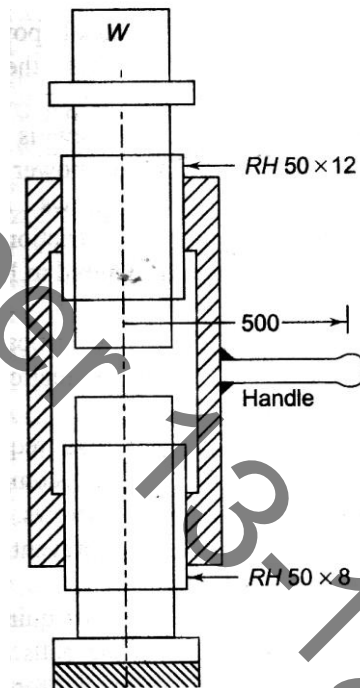
10. A pair of spur gears with 20^0 full-depth involute teeth consists of a 20 teeth pinion meshing with a 41 teeth gear. The module is 3 mm while the face width is 40 mm. the material for pinion as well as gear is steel with an ultimate tensile strength of 600 N/mm^2. The gears are heat-treated to a surface hardness of 400 BHN. The pinion rotates at 1450 rpm and the service factor for the application is 1.75. Assume that velocity factor accounts for dynamic load and the factor of safety is 1.5. Determine the rated power that the gears can transmit. [10]

OR

11. Derive the expression to estimate beam strength in bevel gears. [10]

---ooOoo---

R16

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year II Semester Examinations, February/March - 2022
DESIGN OF MACHINE MEMBERS - II
(Mechanical Engineering)

Time: 3 Hours   **Max. Marks: 75**

Answer any five questions
All questions carry equal marks
- - -

1.a) Distinguish between rolling contact bearing and sliding contact bearing.
  b) A journal bearing is proposed for a steam engine. The load on the journal is 3 kN, diameter 50 mm, length 75 mm, speed 1600 r.p.m., diametral clearance 0.001 mm, ambient temperature 15.5^0C. Oil SAE 10 is used and the film temperature is 60^0C. Determine the heat generated and heat dissipated. Take absolute viscosity of SAE10 at 60^0C = 0.014 kg/m-s.   [8+7]

2.a) Enumerate the factors that influence most the formation and maintenance of the thick oil film in hydrodynamic bearings.
  b) The thrust of propeller shaft is absorbed by 6 collars. The rubbing surfaces of these collars have outer diameter 300 mm and inner diameter 200 mm. If the shaft runs at 120 r.p.m., the bearing pressure amounts to 0.4 N/mm^2. The coefficient of friction may be taken as 0.05. Assuming that the pressure is uniformly distributed, determine the power absorbed by the collars.   [8+7]

3. A rolling contact bearing is subjected to the following work cycle: (*a*) Radial load of 6000 N at 150 r.p.m. for 25% of the time; (*b*) Radial load of 7500 N at 600 r.p.m. for 20% of the time; and (*c*) Radial load of 2000 N at 300 r.p.m. for 55% of the time. The inner ring rotates and loads are steady. Select a bearing for an expected average life of 2500 hours.   [15]

4.a) Explain how the following factors influence the life of a bearing:
     (*i*) Load (*ii*) Speed (*iii*) Temperature (*iv*) Reliability
  b) A single row angular contact ball bearing number 310 is used for an axial flow compressor. The bearing is to carry a radial load of 2500 N and an axial or thrust load of 1500 N. Assuming light shock load, determine the rating life of the bearing.   [8+7]

5. The following data refer to a 4-stroke cycle, single cylinder diesel engine Suction pressure = 0.095 MPa, Cylinder diameter = 200 mm, Stroke = 200 mm Ratio of compression = 15, Engine speed = 7450 rpm, Equivalent mass of reciprocating parts 2 N/mm^2 of piston area, Ratio of connecting rod length to crank length is 4. Design Nickel steel connecting rod of I section choosing the suitable values for the permissible stresses for the material.   [15]

6. Determine the dimensions of an *I*-section connecting rod for a petrol engine from the following data: Diameter of the piston = 110 mm; Mass of the reciprocating parts = 2 kg; Length of the connecting rod from centre to centre = 325 mm; Stroke length = 150 mm; speed = 1500 r.p.m with possible over speed of 2500 rpm; Compression ratio = 4 : 1; Maximum explosion pressure = 2.5 N/mm^2. [15]

7.a) What are the advantages and disadvantages of *V*-belt drive over flat belt drive? Discuss.
  b) A concentric spring for an aircraft engine valve is to exert a maximum force of 5200 N under an axial deflection of 40 mm. Both the springs have same free length, same solid length and are subjected to equal maximum shear stress of 880 MPa. If the spring index for both the springs is 6, find (i) the load shared by each spring, (ii) the main dimensions of both the springs, and (iii) the number of active coils in each spring. Assume, $G = 85kN/mm^2$ and diametral clearance to be equal to the difference between the wire diameters. [8+7]

8.a) Write the expressions for static strength, limiting wear load and dynamic load for helical gears and explain the various terms used therein
  b) Design and draw a spur gear drive transmitting 30 kW at 400 r.p.m. to another shaft running approximately at 100 r.p.m. The load is steady and continuous. The materials for the pinion and gear are cast steel and cast iron respectively. Take module as 10 mm. Also check the design for dynamic load and wear. [8+7]

---ooOoo---

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year II Semester Examinations, February/March - 2022
DESIGN OF MACHINE MEMBERS - II
(Mechanical Engineering)

Time: 3 Hours   **Max. Marks: 75**

Answer any five questions
All questions carry equal marks
- - -

1.a)   A journal bearing for a steam turbine is required to support a radial load of 2650 N. The shaft diameter at the bearing is 60 mm. The speed of rotation is 1800 rpm. Design the bearing. Design should clearly indicate requirement of artificial cooling.

  b)   Discuss the significance of bearing modulus in the design of journal bearing.   [8+7]

2.a)   Design a suitable journal bearing for a centrifugal pump from the following available data: Load on the bearing = 13.5 kN; Diameter of the journal = 75 mm; Speed = 1440 rpm; Bearing characteristic number at the working temperature of 75^0 C = 30; Permissible bearing pressure intensity = 0.7 N/mm^2 to 1.4 N/mm^2; Average atmospheric temperature = 30^0 C. Calculate the cooling requirements, if any.

  b)   Explain the various types of lubrication methods for journal bearings.   [8+7]

3.a)   A single row deep groove ball bearing has a dynamic load capacity of 40210 N and operates on the work cycle consisting of radial load of 2000 N at 1000 rpm for 25 % of the time, radial load of 5000 N at 1500 rpm for 50 % of time, and radial load of 3000 N at 700 rpm for the remaining 25 % of time. Calculate the expected life of the bearing in hours.

  b)   Enumerate any two advantages and disadvantages of rolling-contact bearings over sliding contact bearings. What is the reliability of rolling-contact bearing selected from the manufacturer's catalogue?   [8+7]

4.a)   A roller bearing is selected to withstand a radial load of 40 kN and life of 1200 hrs at 600 rpm. What load rating would you look for in searching from manufacturers catalogue if it specifies load at speed 500 rpm and life 3000 hrs.

  b)   Select a suitable rolling bearing for a 55 mm diameter shaft. The bearing should be capable of withstanding 3 kN radial and 1.5 kN axial load at 750 rpm. The bearing is to have a desired rated life of 2000 hrs at a reliability of 94%. There is a light shock load and inner ring rotates.   [7+8]

5.a)   Explain the stresses developed in the connecting rod. What do you mean by whipping stress?

  b)   The following data is given for the cap and bolts of the big end of a connecting rod: Engine speed = 1500 rpm, Length of connecting rod = 320 mm, Length of stroke = 140 mm, Mass of reciprocating parts = 1.75 kg, Length of crank pin = 54 mm, Diameter of crank pin = 38 mm, Permissible tensile stress for bolts = 120 N/mm^2, Permissible bending stress for cap = 120 N/mm^2. Calculate the nominal diameter of bolts and thickness of cap for the big end.   [7+8]

6. Design a connecting rod of a diesel engine for the following data:
    Cylinder bore = 85 mm, Length of connecting rod = 350 mm, Maximum gas pressure = 3 MPa, Factor of safety against buckling failure = 5, (l/d) ratio for piston pin bearing = 1.5, (l/d) ratio for crank pin bearing = 1.25, Allowable bearing pressure for piston pin bearing = 13 MPa, Allowable bearing pressure for crank pin bearing = 11 MPa, Length of stroke = 140 mm, Mass of reciprocating parts = 1.5 kg, Engine speed = 2000 rpm, Thickness of bearing bush = 3 mm, Material of cap = 40 C8 (S_{yt} = 380 N/mm^2), Material of bolts = Alloy steel (S_{yt} = 450 N/mm^2), Factor of safety for cap and bolts = 4 and 5 respectively, Density of connecting rod material = 7800 kg/m^3. [15]

7.a) "The springs subjected to fluctuating stresses are designed on the basis of two criteria" – what are they? Explain.
  b) Design the cross section of a flat belt drive to run a compressor having a reduction ratio of 3, 15. The input speed is 960 rpm, and power to be transmitted is 15 kW. The compressor runs for 10 to 12 hours per day, and expected life of the belt is 1.5 years. [8+7]

8.a) Derive the Buckingham's equation for wear of gear teeth.
  b) A pair of helical gears consists of a 25 teeth pinion meshing with a 50 teeth gear. The normal module is 4 mm. Find the required value of the helix angle, if the center distance is exactly 165 mm. [7+8]

---ooOoo---

Code No: 136BA

R16

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year II Semester (Special) Examinations, January/February - 2021
DESIGN OF MACHINE MEMBERS - II
(Mechanical Engineering)

Time: 2 Hours   Max. Marks: 75

Answer any five questions
All questions carry equal marks
- - -

1.a) Explain the terms 'Bearing characteristic number' and 'Bearing modulus' as applied to the journal bearings.
   b) Derive Petroffs equation for the co-efficient of friction in a lightly loaded bearing.[8+7]

2. Determine the dimension of the bearing and journal to support a load of 6 kN at 750 rpm using hardened steel journal and bronze backed babit bearing. An abundance of oil is provided which has a specific gravity of 0.95 at 15.5^0 C and viscosity of 9.5 centistokes at 82^0 C that may be taken to the limiting temperature of oil. Assume a clearance of 0.001 mm per mm of diameter is allowed.   [15]

3. Design a helical coil spring for an engine valve to exert force of 700 N in the open and 450 N in the closed position. The lift of the valve is 16 mm. Keep the outside spring coil diameter between 4 cm and 5 cm. The spring ends are square and ground. The allowable shear stress of spring material is 450 MPa. For the material of the spring τ_y =700 MPa. S_{en} = 365 MPa. Take G= 80 GPa.   [15]

4. Design the connecting rod for a petrol engine, from the following data**:** 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.[15]

5.a) Why is the cross-section of the pulley an elliptical arm? Why is the major axis of the cross-section in the plane of rotation?
   b) Design a Flat belt drive to transmit 25 kw at 720 rpm to an aluminium rolling machine the speed reduction being 3.0. The distance between the shaft is 3 m. Diameter of rolling machine pulley is 1.2m.   [7+8]

6. The following particulars of a single reduction spur gear are given: Gear ratio = 10 : 1; Distance between centres = 660 mm approximately; Pinion transmits 500 kW at 1800 r.p.m.; Involute teeth of standard proportions (addendum = m) with pressure angle of 22.5^0; Permissible normal pressure between teeth = 175 N per mm of width. Find: a) The nearest standard module if no interference is to occur; b) The number of teeth on each wheel; c) The necessary width of the pinion; and d) The load on the bearings of the wheels due to power transmitted.   [15]

7. Write the expressions for static, limiting wear load and dynamic load for spur gears and explain the various terms used there in.   [15]

8. What is helical torsion spring? How does it differ from helical compression spring? Explain.   [15]

---ooOoo---

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech III Year II Semester Examinations, May - 2019
DESIGN OF MACHINE MEMBERS – II
(Common to ME, AME)

Time: 3 hours   **Max. Marks: 75**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A. Part B
consists of 5 Units. Answer any one full question from each unit. Each question carries
10 marks and may have a, b, c as sub questions.

PART - A

(25 Marks)

1.a)   What do you mean by hydrodynamic lubrication?   [2]
  b)   Why are ball bearings preferred to journal bearings for a shaft mounted on a gear
        box?   [3]
  c)   Why hollow piston pin is preferred to a solid one?   [2]
  d)   Enumerate the design considerations for crank pin.   [3]
  e)   What is meant by creep of a belt and what is its effect.   [2]
  f)   What are the simple and duplex rollers chains?   [3]
  g)   What is law of gearing?   [2]
  h)   What is the relation between the transverse and normal pressure angles and the
        helix angles?   [3]
  i)   What is differential screw?   [2]
  j)   What is acme thread? What is the difference between acme and trapezoidal
        threads?   [3]

PART - B

(50 Marks)

2.   Design a full hydro dynamic journal bearing with following specifications for machine
        tool applications: Journal diameter =75mm, radial load=10kN, journal speed =1440
        rpm, minimum film thickness =22.5 microns, inlet temperature =40^0C, bearing material
        =babbit. Determine the length of bearing and select suitable oil for this application. [10]

OR

3.   A shaft rotating at 1440 rpm is supported by two bearings. The forces acting on each
        bearing are 6000N radial load and 3500 N axial thrust. If the shaft diameter is 40mm
        and the expected life of the bearing is 500h, select a suitable bearing if the required
        reliability of the bearing is to be 99percent.   [10]

4.   Design an aluminum alloy piston for a single acting four stroke engine for the
        following:
        Specifications:
        Cylinder bore =0.30 m, Stroke=0.375 m, Maximum gas pressure =8 N/mm^2
        Brake mean effective pressure=1.15 MPa, Fuel consumption= 0.22 kg/KW/hr
        Speed=500 rev/min.   [10]

OR

5.   Design a connecting rod of I cross section for an automobile diesel engine of the
        following specifications.
        Diameter of cylinder=100mm, Stroke length =125mm, Maximum combustion pressure
        =2.8MPa, Maximum engine speed=2000rpm, Weight of the reciprocating parts =1.1kg,
        Length of connecting rod between centers=31.5cm, Assume an allowable crushing
        stress =3000kg/cm^2.   [10]

6. An open belt connects to flat pulleys. The pulley diameter are 300m and 450mm and the corresponding angles of the lap are 160^0 and 210^0. The smaller pulley runs at 200 r.p.m . The coefficient of friction between pulley and belt is 0.25. It is found that the belt is on the point of slipping when 3 KW is transmitted. To increase the power transmitted two alternatives are suggested, namely (a) increasing the initial tension by 10%, and (b) increasing the coefficient of friction by 10% by the application of a suitable dressing to the belt. [10]

OR

7. It is required to design a chain drive to connect a 5 kW, 1400 rpm electric motor to a drilling machine. The speed reduction is 3:1. The center distance should be approximately 500mm. (a) select a proper roller chain for the drive (b)Determine the pitch circle diameters of driving and driven sprockets (c) determine the number of chain links (d) specify the correct center distance between the axes of sprockets. [10]

8. Design a pair of spur gear with stub teeth to transmit 55kW from 175 mm pinion running at 2500 rpm to a gear running at 1500 rpm. Both the gears are made of steel having B.H.N 260. Approximate the pitch by means of Lewis equation and then adjust the dimensions to keep within the limits set by the dynamic load and wear equation.

[10]

OR

9. A helical cast steel gear with 30^0 helix angle has to transmit 35KW at 1500 r.p.m if the gear has 24 teeth , determine the necessary module , pitch diameter and face width for 20^0 full depth teeth , the static stress for cast steel may be taken as 56MPa . The width of the face may be taken as 3 times the normal pitch. What would be end thrust of the gear? The tooth factor for 20^0 full depth involute gear may be taken as $\left(0.154 - \dfrac{0.912}{T} \right)$,

there T represents the equivalent number of teeth. [10]

10. In a machine tool application, the tool holder is pulled by means of an operating nut mounted on a screw. The tool holder travels at a speed of 5m/min. The screw has single start square threads of 48mm nominal diameter and 8mm pitch. The operating nut exerts a force of 500N to drive the tool holder. The mean radius of the friction collar is 40mm.The coefficient friction at thread collar surfaces is 0.15. Calculate (a) Power required driving the screw and (b) the efficiency of the mechanism. [5+5]

OR

11. A vertical square threads screw of a 70 mm mean diameter and 10 mm pitch supports a vertical load of 50 k N. It passes through the boss of a spur gear wheel of 70 teeth which acts as a nut. In order to raise the load, the spur gear wheel is turned by means of a pinion having 20 teeth. The mechanical efficiency of pinion and gear wheel drive is 90%. The axial thrust on the screw is taken up by a collar bearing having a mean radius of 100 mm. The coefficient of friction for the screw and nut is 0.15 and that for collar bearing is 0.12. Find:
a) Torque to be applied to the pinion shaft,
b) Maximum principal and shear stresses in the screw; and
c) Height of nut, if the bearing pressure is limited to 12 N/mm^2. [3+3+4]

---ooOoo---

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year II Semester Examinations, May - 2019
DESIGN OF MACHINE MEMBERS - II
(Mechanical Engineering)

Time: 3 hours
Max. Marks: 75

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A. Part B
consists of 5 Units. Answer any one full question from each unit. Each question carries
10 marks and may have a, b, c as sub questions.

PART - A

(25 Marks)

1.a)	What are journal bearings? Give a classification of these bearings.	[2]
b)	Explain with sketches the working of different types of thrust bearing.	[3]
c)	What are rolling contact bearings?	[2]
d)	Write short note on classifications and different types of antifriction bearings.	[3]
e)	Explain the various types of crankshafts.	[2]
f)	Discuss the materials commonly used for making the valve of an I. Engine.	[3]
g)	Discuss the different types of belts and their material used for power transmission.	[2]
h)	Discuss the materials and practical applications for the various types of springs.	[3]
i)	What is a herringbone gear? Where they are used?	[2]
j)	Write a short note on gear drives giving their merits and demerits.	[3]

PART - B

(50 Marks)

2. Design a journal bearing for a centrifugal pump running at 1440 r.p.m. The diameter of the journal is 100 mm and load on each bearing is 20 kN. The factor ZN/p may be taken as 28 for centrifugal pump bearings. The bearing is running at 75^0C temperature and the atmosphere temperature is 30^0C. The energy dissipation coefficient is 875 W/m2/^0C. Take diametral clearance as 0.1 mm. [10]

OR

3. A wall bracket supports a plummer block for 80 mm diameter shaft. The length of bearing is 120 mm. The cap of bearing is fastened by means of four bolts, two on each side of the shaft. The cap is to withstand a load of 16.5 kN. The distance between the centre lines of the bolts is 150 mm. Determine the thickness of the bearing cap and the diameter of the bolts. Assume safe stresses in tension for the material of the cap, which is cast iron, as 15 MPa and for bolts as 35 MPa. Also check the deflection of the bearing cap taking $E = 110$ kN / mm^2. [10]

4.a) A ball bearing subjected to a radial load of 4000 N is expected to have a satisfactory life of 12 000 hours at 720 r.p.m. with a reliability of 95%. Calculate the dynamic load carrying capacity of the bearing, so that it can be selected from manufacturer's catalogue based on 90% reliability. If there are four such bearings each with a reliability of 95% in a system, what is the reliability of the complete system?

b) Explain how the following factors influence the life of a bearing:
(i) Load (ii) Speed (iii) Temperature (iv) Reliability. [6+4]

OR

5.a)   A single row deep groove ball bearing operating at 2000 r.p.m. is acted by a 10 kN radial load and 8 kN thrust load. The bearing is subjected to a light shock load and the outer ring is rotating. Determine the rating life of the bearing.

 b)   Select appropriate type of rolling contact bearing under the following condition of loading giving reasons for your choice.   [6+4]
      i) Light radial load with high rotational speed.
      ii) Heavy axial and radial load with shock.

6.   A four stroke internal combustion engine has the following specifications: Brake power = 7.5 kW; Speed = 1000 r.p.m.; Indicated mean effective pressure= 0.35 N/mm^2; Maximum gas pressure = 3.5 N/mm^2; Mechanical efficiency = 80 %. Determine:
      a) The dimensions of the cylinder, if the length of stroke is 1.4 times the bore of the cylinder; b) Wall thickness of the cylinder, if the hoop stress is 35 Mpa; c) Thickness of the cylinder head and the size of studs when the permissible stresses for the cylinder head and stud materials are 45 Mpa and 65 Mpa respectively.   [10]

OR

7.   Design a plain carbon steel centre crankshaft for a single acting four stroke, single cylinder engine for the following data:
      Piston diameter = 250 mm; Stroke = 400 mm; Maximum combustion pressure = 2.5 N/mm^2; Weight of the flywheel = 16 kN; Total belt pull = 3 N; Length of connecting rod = 950 mm. When the crank has turned through 30^0 from top dead centre, the pressure on the piston is 1 N/mm^2 and the torque on the crank is maximum. Any other data required for the design may be assumed.   [10]

8.a)   A compression spring of spring constant K is cut into two springs having equal number of turns and the two springs are then used in parallel. What is the resulting spring constant of the combination? How does the load carrying capacity of the resulting combination compare with that of the original spring?

 b)   Explain, with the help of neat sketches, the types of various flat belt drives.   [6+4]

OR

9.   Design a flat belt drive to transmit 110 kW at a belt speed of 25 m/s between two pulleys of diameters 250 mm and 400 mm having a pulley centre distance of 1 metre. The allowable belt stress is 8.5 Mpa and the belts are available having a thickness to width ratio of 0.1 and a material density of 1100 kg/m^3. Given that the coefficient of friction between the belt and pulleys is 0.3, determine the minimum required belt width. What would be the necessary installation force between the pulley bearings and what will be the force between the pulley bearings when the full power is transmitted?   [10]

10.a) Design and draw a spur gear drive transmitting 30 kW at 400 r.p.m. to another shaft running approximately at 100 r.p.m. The load is steady and continuous. The materials for the pinion and gear are cast steel and cast iron respectively. Take module as 10 mm. Also check the design for dynamic load and wear.

  b)   Write the expressions for static strength, limiting wear load and dynamic load for helical gears and explain the various terms used therein.   [6+4]

OR

11.   A motor shaft rotating at 1500 r.p.m. has to transmit 15 kW to a low speed shaft with a speed reduction of 3:1. The teeth are $14^{1/2°}$ involute with 25 teeth on the pinion. Both the pinion and gear are made of steel with a maximum safe stress of 200 MPa. A safe stress of 40 Mpa may be taken for the shaft on which the gear is mounted and for the key. Design a spur gear drive to suit the above conditions. Also sketch the spur gear drive. Assume starting torque to be 25% higher than the running torque.   [10]

---ooOoo---

R16

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year II Semester Examinations, November/December - 2020
DESIGN OF MACHINE MEMBERS - II
(Mechanical Engineering)

Time: 2 hours   **Max. Marks: 75**

Answer any five questions
All questions carry equal marks
- - -

1.a) Explain different types of sliding contact bearings with neat sketches.
  b) Explain the factors which are essential for the formation of a thick film of oil in
       hydrodynamic lubricated bearings.   [7+8]

2. Design a journal bearing for a centrifugal pump from the following data:
    Load on the journal = 20 000 N; Speed of the journal = 900 r.p.m; Type of oil is SAE
    10, for which the absolute viscosity at $55^0C = 0.017$ kg / m-s; Ambient temperature of
    oil = 15.5^0C; Maximum bearing pressure for the pump = 1.5 N /mm^2.   [15]

3. The rolling contact ball bearing is to be selected to support the overhung countershaft.
    The shaft speed is 720 r.p.m. The bearings are to have 99% reliability corresponding to
    a life of 24 000 hours. The bearing is subjected to an equivalent radial load of 1 kN.
    Consider life adjustment factors for operating condition and material as 0.9 and 0.85
    respectively. Find the basic dynamic load rating of the bearing from manufacturer's
    catalogue, specified at 90% reliability.   [15]

4. A single-row deep groove ball bearing is subjected to a radial force of 8 kN and a thrust
    force of 3 kN. The shaft rotates at 1200 rpm. The expected life L_{10h} of the bearing is
    20000 h. The minimum acceptable diameter of the shaft is 75 mm. Select a suitable ball
    bearing for this application.   [15]

5. Design a cast iron piston for a single acting four stroke engine for the following data:
    Cylinder bore = 100 mm; Stroke = 125 mm; 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 r.p.m. Any other data required for the design may be
    assumed.   [15]

6.a) Discuss the design of connecting rod for an internal combustion engine.
  b) Explain the various stresses induced in the connecting rod.   [9+6]

7. It is required to design a helical compression spring subjected to a force of 500 N. The
    deflection of the spring corresponding to this force is approximately 20 mm. The spring
    index should be 6. The spring is made of cold-drawn steel wire with ultimate tensile
    strength of 1000 N/mm^2. The permissible shear stress for the spring wire can be taken
    as 50% of the ultimate tensile strength ($G = 81\ 370$ N/mm^2). Design the spring and
    calculate: (a) wire diameter; (b) mean coil diameter; (c) number of active coils; (d) total
    number of coils; (e) free length of the spring; and (f) pitch of the coils. [3+3+3+2+2+2]

8. A pair of parallel helical gears consists of a 20 teeth pinion meshing with a 100 teeth gear. The pinion rotates at 720 rpm. The normal pressure angle is 20^0, while the helix angle is 25^0. The face width is 40 mm and the normal module is 4 mm. The pinion as well as the gear is made of steel 4OC8 ($S_{ut} = 600$ N/mm^2) and heat treated to a surface hardness of 300 BHN. The service factor and the factor of safety are 1.5 and 2 respectively. Assume that the velocity factor accounts for the dynamic load and calculate the power transmitting capacity of gears. [15]

---ooOoo---