Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MAY 2019

Course Code: ME402

Course Name: Design of Machine Elements-II

Max. Marks: 100 Duration: 3 Hours

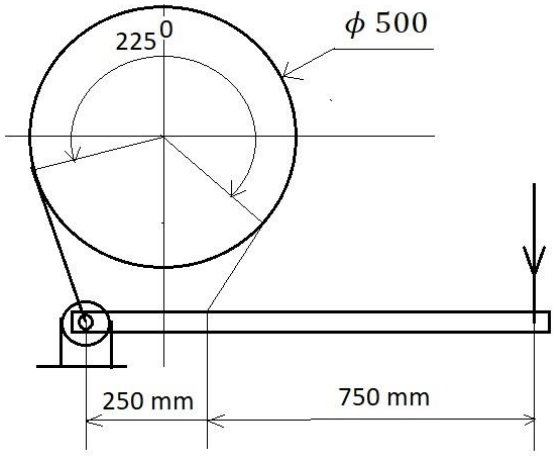
Use of design data book is permitted

Missing data may be suitably assumed

PART A

Answer any two full questions, each carries 15 marks. Marks

1 a) A simple band brake as shown in figure below is to be designed to absorb a power of 32 kW at a rated speed of 850 rpm. Assume μ = 0.25. Determine, (i) The effort required to stop clockwise rotation of the brake drum, (ii) The effort required to stop counter clockwise rotation of the brake drum,(iii) The dimensions of the rectangular cross-section of the brake lever assuming its depth to be twice the width, and (iv) the dimensions of the cross-section of the band assuming its width to be ten times the thickness. (11)



b) What are the advantages and disadvantages of band brake? (4)

2 a) A single row deep groove ball bearing has a dynamic load capacity of 40210 N and operates on the work cycle consists 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. (10)

b) Define static and dynamic load carrying capacity of ball bearing. (5)

3 A 360 ^{0} hydrodynamic journal bearing operates at 1200 rpm and carries a load of 5.5 k N. The journal diameter is 55 mm and length is 55 mm. The bearing is lubricated with SAE 20 oil and the operating temperature of oil is 79^0C. Assume radial clearance as 0.025 mm and the attitude angle as 60^0. Determine: (i) bearing pressure, (ii) Attitude, (iii) minimum film thickness, (iv) heat generated, (v) heat dissipated, if the ambient temperature is 25^0C, and (vi) amount of artificial cooling if necessary. (15)

PART B

Answer any two full questions, each carries 15 marks.

4 A motor shaft rotating at 1440 rpm has to transmit 15 kW power to a low speed shaft running at 500 rpm. A 20^0 pressure angle full depth involute system of gear tooth is used. The pinion has 25 teeth. Both gear and pinion are made of cast iron having allowable static strength of 55 MPa. Design a suitable spur gear drive and check the design for dynamic load and wear. (15)

5 a) State and explain law of gearing with a neat sketch. (7)

b) Give an account on different modes of failure of gear tooth. (4)

c) Explain why dynamic factors need to be considered in the design of gears. (4)

6 A helical gear speed reducer is to be designed. The rated power of the speed reducer is 75 kW at a pinion speed of 1200 rpm. The speed ratio is 3:1. For medium shock conditions and 24 hr operation, design the gear pair. The teeth are 20^o full depth involute in the normal plane and helix angle is 30^o. (15)

PART C

Answer any two full questions, each carries 20 marks.

7 a) Design a connecting rod of I cross section for an IC engine running at 1800 rpm and developing a maximum pressure of 3.15 N/ mm^2. The diameter of the piston is 100 mm, mass of the reciprocating parts per cylinder is 2.25 kg, length of the connecting rod is 380 mm, stroke of the piston is 190 mm and compression ratio is 6:1. Take a factor of safety of 6 for the design. The maximum allowable bearing pressure at big end and the small end are respectively 10 N/mm^2 and 15 N/mm^2. The density of material of the rod may be taken as 8000 kg/m^3 and allowable stress in the bolts as 85 N/mm^2 and in the cap as 80 N/mm^2. (16)

b) Explain why I section is usually preferred in the case of a connecting rod? (4)

8 a) Explain the main functions of the piston in an internal combustion engine? (4)

b) Make out a systematic classification of pressure vessels and discuss the role of statutory regulations. (4)

c) A seamless cylinder with a storage capacity of 0.025 m^3 is subjected to an internal pressure of 8 MPa. The length of the cylinder is twice its internal diameter. The cylinder is made of plain carbon steel $20C_8$. (Ultimate stress is 380 MPa and Factor of safety is 2.5) Determine the dimensions of the cylinder. (12)

9 a) Enumerate the various types of flat belt drives. (3)

b) Explain galling of Roller chains. (3)

c) Design a flat belt drive for a compressor running at 670 rpm, which is driven by a 25 kW, 1340 rpm motor. Space is available for a centre distance of 3 m. The belt is open type. (14)

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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION(S), OCTOBER 2019

Course Code: ME402

Course Name: Design of Machine Elements-II

Max. Marks: 100 Duration: 3 Hours

Use of design data book is permitted

Missing data may be suitably assumed

PART A

Answer any two full questions, each carries 15 marks. Marks

1 Design a dry single plate clutch having both sides effective to transmit 19 kW at 1500 rpm. The ratio of mean radius to radial width is 4.5. The axial thrust is provided by 6 springs. Take, coefficient of friction = 0.2 and allowable pressure = 0.245 M Pa. Assume, spring index, C = 6, shear stress = 420 MPa and G = 84 GPa. Find (i) mean radius and width of friction surfaces, (ii) dimensions of clutch plate and (iii) dimensions of springs. (15)

2 Design a full hydrodynamic journal bearing operating at 1200 rpm and carrying a load of 6 k N. The journal material is hardened steel and bearing is of babbit material. The bearing is lubricated with SAE 30 oil and the operating temperature of oil is 69^0 C. Assume ambient temperature as 30^0. (15)

3 a) Explain the significance of bearing characteristic number in the design of sliding contact bearing. (5)

b) Explain the mechanism of fluid film lubrication. (5)

c) What is Sommerfeld number? Explain its significance in the design of hydrodynamic bearing. (5)

PART B

Answer any two full questions, each carries 15 marks.

4 A compressor receives power through a pair of spur gears. The compressor shaft runs at 350 rpm while the motor shaft runs at 1450 rpm, delivering 40 kW power. The power transmission is with moderate shock and the drive is to operate 10 hours per day. Pinion is made of steel C-40 heat treated and gear is made of cast steel. Design the spur gear set. (15)

5 A pair of straight tooth bevel gears at right angles is to transmit 5 kW at 1200 rpm of the pinion. The diameter of the pinion is 80 mm and the speed reduction is 3.5:1. The tooth form is 20^o full depth involute. Both the pinion and gear are (15)

made of cast iron with allowable stress of 55 MPa. Determine module and face width from the standpoint of strength. And also check the design from the standpoint of dynamic load and wear.

6 a) Derive Lewis Equation for beam strength of a gear tooth and also state the assumptions. (7)

b) What is pressure angle? Discuss its significance. (4)

c) What are the commonly used tooth profiles for spur gear? Explain the characteristics of each. (4)

PART C

Answer any two full questions, each carries 20 marks.

7 a) Design a connecting rod for four stroke petrol engine with the following data; (16)
Diameter of piston-8.8 cm, Stroke-12.5 cm, Weight of reciprocating parts-1.6 Kg, Length of connecting rod (centre to centre)-30 cm, RPM-2200 with possible over speed of 3000, Compression ratio-6.8:1, Maximum explosion pressure-35 Kg/cm^2. The maximum allowable bearing pressure at big end and the small end are respectively 12 N/mm^2 and 16 N/mm^2. The density of material of the rod may be taken as 8000 kg/m^3 and allowable stress in the bolts as 80 N/mm^2 and in the cap as 75 N/mm^2.

b) What is the effect of centrifugal tension in belt on power transmission? (4)

8 a) Enumerate the advantages and disadvantages of a flat belt drive. (4)

b) Design a V-belt drive for the following specifications. Power transmitted is 22 kW, speed of the driving wheel is 1450 rpm, speed of the driven wheel is 400 rpm, centre distance should not exceed 2500 mm, and the service of the equipment is 15 hrs/day. (16)

9 a) Differentiate between a thin and thick pressure vessel. (4)

b) Explain the various types of ends used for pressure vessel giving practical application of each. (4)

c) A cast iron cylinder of internal diameter 200 mm and thickness 50 mm is subjected to a pressure of 5 MPa. Calculate the tangential and radial stresses at the inner, middle (radius-125 mm) and outer surfaces. (12)

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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Eighth semester B.Tech degree examinations, September 2020

Course Code: ME402

Course Name: Design of Machine Elements-II

Max. Marks: 100 Duration: 3 Hours

Use of design data book is permitted

Missing data may be suitably assumed

PART A

Answer any two full questions, each carries 15 marks. Marks

1 a) Determine the main dimensions of a cone clutch faced with leather to transmit 30 kW at 750 rpm from an electric motor to an air compressor. Assume an over load factor of 1.75. Due to possibility of contamination of lining, a low value of coefficient of friction 0.2 is recommended. (12)

b) What is the principle of operation of a centrifugal clutch? What are its applications? (3)

2 a) A bearing is to carry a radial load of 240 kgf and a thrust load of 130 kgf. The load imposes light shock. The desired 90 % life is 10 hrs per day for 5 years at 3000 rpm. (a) Select a deep groove ball bearing. (b) What is the probability of bearing surviving specified life? (12)

b) What is L_{10} and L_{50} life of ball bearing? (3)

3 a) A journal bearing for a steam turbine is required to support a radial load of 270 kgf. 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. (12)

b) Discuss the significance of bearing modulus in the design of journal bearing? (3)

PART B

Answer any two full questions, each carries 15 marks.

4 Design a helical gearing to transmit 60 HP. The pinion runs at 6000 rpm. The speed ratio is 3. Check also the gear pair for safe endurance strength and surface durability based on the estimate of dynamic load from Buckingham's equation. (15)

5 A pair of 20^o full depth involute bevel gears is used to connect two shafts at right angles having a velocity ratio 2.5: 1. The gear is made from cast steel and the pinion is from the forged steel. Pinion transmits 37.5 kW at 750 rpm. (15)

Design the gear drive and check the design for dynamic and wear loads.

6 Design a worm gear drive to transmit 20 HP from worm at 1440 rpm to the worm wheel that should be rotated at $40 \pm 2\%$rpm. (15)

PART C

Answer any two full questions, each carries 20 marks.

7 a) Design a V-belt drive to the following specifications. Power transmitted is 20 kW, speed of the driving wheel is 1440 rpm, speed of the driven wheel is 400 rpm, centre distance should not exceed 2500 mm, and the service of the equipment is 16 hrs/day. (17)

b) How will you designate V belt? (3)

8 a) Design a chain drive to a compressor which receives power 15 HP from an electric motor running at 970 rpm. The compressor speed is being 330 rpm. The centre distance should be maximum 500 mm. The chain tension can be adjusted by shifting the motor on slides. (17)

b) What is the reason for selecting even number of pitches or links for roller chain? (3)

9 Design a connecting rod of a diesel engine for the following data. (20)

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 = 13MPa

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} =450N/mm ^{2})

Factor of safety for cap and bolts = 4 and 5 respectively

Density of connecting rod = 7800 kg/m ^{3}.

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