Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

PDDC - SEMESTER–V EXAMINATION – WINTER 2015

Subject Code:X51903 **Date:05/12/2015**

Subject Name: Machine Design-I

Time: 10:30pm to 1:00pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** A flat belt is required to transmit 30 KW from a pulley of 1.5 m effective diameter running at 300 r.p.m. The angle of contact is spread over 11/24 of the circumference. The coefficient of friction between belt and pulley is 0.3. Determine taking centrifugal tension into account, width of the belt required. It is given that the belt thickness is 9.5 mm, density of material is 1100 kg/m^3 and related working stress is 2.5 MPa. **07**

(b) A belt drive consists of two v-belts in parallel, on grooved pulleys of the same size. The angle of groove is 30^0. The cross sectional area of each belt is 750 mm^2 and coefficient of friction is 0.12. The density of the belt material is 1.2 Mg/m^3 and maximum safe stress is 7 MPa.Calculate the power that can be transmitted between pulleys of 300 mm diameter rotating at 1500 rpm. Find also the shaft speed in r.p.m. at which the power transmitted would be maximum. **07**

Q.2 **(a)** Design a spring for a balance to measure 0 to 1000 N over a scale of length 80 mm. The spring is to be enclosed in a casing of 25 mm diameter. The approximate number of turns is 30. The modulus of rigidity is 85 KN/mm^2. Also calculate the maximum shear stress induced. **07**

(b) Discuss the design procedure of leaf spring. **07**

OR

(b) The hydraulic cylinder 400 mm bore operates at maximum pressure of 5 N/mm^2 The piston rod is connected to the load and the cylinder to the frame through hinged joints. Design (1) Cylinder (2) piston rod (3) hinge pin (4) flat end cover. The allowable tensile stress for cast steel cylinder and end cover is 80 MPa and for piston rod is 60 MPa. **07**

Q.3 **(a)** What are rolling contact bearings? Discuss their advantages over sliding contact bearings. **07**

(b) A load on the journal bearing is 150 kN due to turbine shaft of 300 mm diameter running at 1800 rpm. Determine the following: **07**

1. Length of the bearing if the allowable bearing pressure is 1.6 N/mm^2
2. Amount of heat to be removed by the lubrication if the bearing temperature is 60^{0}C and the viscosity of the oil at 60^{0}C is 0.02 and the bearing clearance is 0.25 mm.

OR

Q.3 **(a)** A shaft rotating at constant speed is subjected to variable load. The bearings supporting the shaft are subjected to stationary equivalent radial load of 3 KN for 10 percent of time,2 KN for 20 percent of time, 1 KN for 30 percent of time If the total life expected for the bearing is 20×10^6 revolutions at 95 percent reliability calculate the dynamic load rating of the ball bearing. **07**

(b) State the advantages and disadvantages of the chain drive over belt and rope **07**

drive.

Q.4 **(a)** Describe with the help of neat sketch the principle of operation of internal expanding shoe brake. Derive the expression for the braking torque. **07**

(b) A single plate clutch effective on both sides is required to transmit 25 KW at 3000 rpm. Determine the outer and inner diameter of frictional surface if the coefficient of friction is 0.255, ratio of diameters is 1.25 and the maximum pressure is not to exceed 0.1 N/mm^2. Also determine the axial thrust to be provided by springs. Assume the theory of uniform wear. **07**

OR

Q.4 **(a)** Why a positive clutch is used? Describe with the help of neat sketch the working of jaw or claw clutch. **07**

(b) Explain wedge film and squeeze film journal bearings. **07**

Q.5 **(a)** Derive an expression for Lami's equation for finding the wall thickness of single thick cylinder subjected to internal pressure only. **07**

(b) Determine the diameter of circular rod made of ductile material with a fatigue strength endurance limit stress=265 MPa with tensile yield stress of 350 MPa. The member is subjected to variable axial load from W_{min}= -300 KN to W_{max}=700 KN and has a stress concentration factor=1.8. Use factor of safety as 2. **07**

OR

Q.5 **(a)** Prove the equations of Solder berg and Goodman's theorem. **07**

(b) Discuss the following: **07**

(a) Compare the simple band brake and differential band brake

(b) List and explain the friction materials used in clutch

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