Kafrelsheikh University
Faculty of Engineering
Mechanical Engineering Department
3rd year

Date: 10/ 3 / 2021
Time allowed: 4 hours.
Full mark:100 Marks
Final year exam, two Pages
Course code: MDP 3235

تصميم ميكانيكى

Answer all the following questions.

Answer all the following four questions

Question No. (1): **(25 Marks)**

a-Prove **clearly and with neat sketch**, that the ratio of the driving tensions on the two sides of a pulley is given by the following expression: $2.3\log(\frac{T_1}{T_2}) = \mu\theta$

Where, T_1 = Tension in the tight side of the belt, T_2 = Tension in the slack side of the belt,
μ = Coefficient of friction between the belt and the pulley,
and θ= Angle of contact in radians. (10 Marks)

b- A 22 kW, 1200 r.p.m. motor has a mild steel shaft of 50 mm diameter and the extension being 90 mm. The permissible shear and crushing stresses for the mild steel key are 60 MPa and 120 MPa. Design the keyway in the motor shaft extension. Check the shear strength of the key against the normal strength of the shaft. (15 Marks)

Question No. (2):- **(30 Marks)**

a- Differentiate between open and crossed flat belts with **the help of clear neat sketch** in view points of - equation of belt length , equation of contact angle θ and equation of angle α (8 Marks)

b- 7-Prove clearly and with neat sketch that that the Centrifugal Tension T_c caused by centrifugal force F_c acting on the belt is given by the following expression : $\boldsymbol{T_c = mv^2}$
Where m is mass of belt per unit length in kg and V the linear velocity of belt in m/s (7 Marks)

c- In a horizontal belt drive for a centrifugal blower, the blower is belt driven at 700 r.p.m. by a 18 kW, 1900 r.p.m. electric motor. The center distance is 2.2 times the diameter of the larger pulley. The density of the belt material = 1660 kg/m^3; maximum allowable stress = 5 MPa; μ_1 = 0.6 (motor pulley); μ_2 = 0.5 (blower pulley); peripheral velocity of the belt = 22 m/s. Determine the following:
1. Pulley diameters; 2. Belt length; 3. Cross-sectional area of the belt; 4. Minimum initial tension for operation without slip; 5. Resultant force in the plane of the blower when operating with an initial tension 60 percent greater than the minimum value. (15 Marks)

Question No. (3):- **(25 Marks)**

a- A solid circular shaft is subjected to a bending moment of 3500 N-m and a torque of 12 000 N-m. The shaft is made of steel having ultimate tensile stress of 750 MPa and a ultimate shear stress of 550 MPa. Assuming a factor of safety as 6, determine the diameter of the shaft. (15 Marks)

b-Prove clearly and with neat sketch that $v = \sqrt{\frac{T}{3m}}$ **(At the Condition for the Transmission of Maximum power in belt drive system)**

Where, T is the maximum tension to which the belt can be subjected in newtons, m is mass of belt per unit length in Kg and V is the linear velocity of the belt in m/s for the Transmission of Maximum power (10 Marks)

Question No. (4):- **(20 Marks)**

A shaft is supported by two bearings placed 1.2 m apart. A 700 mm diameter pulley is mounted at a distance of 400 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 2.5 kN. Another pulley 500 mm diameter is placed 300 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° and $\mu = 0.3$. Determine the suitable diameter for a solid shaft, allowing working stress of 73 MPa in tension and 52 MPa in shear for the material of shaft. Assume that the torque on one pulley is equal to that on the other pulley

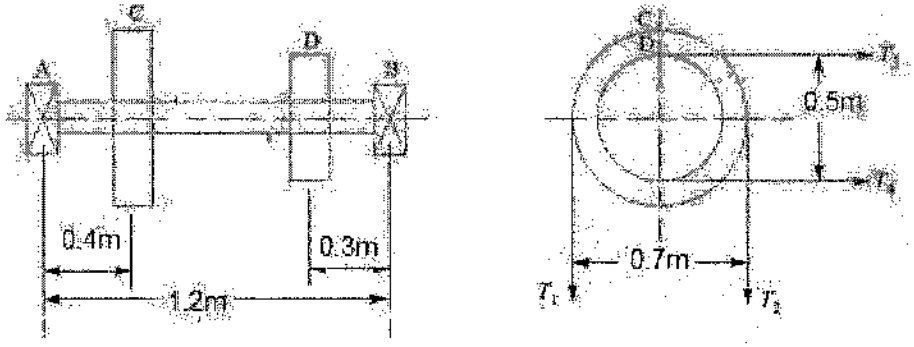

Figure 1

With my best wishes, Dr Ahmed Bahei El-Deen