CSM : 14

MECHANICAL ENGINEERING
PAPER - I

Time Allowed : 3 hours   Full Marks : 100

Marks for each question is indicated against it.

Attempt <u>any 5 (five)</u> questions taking not more than 3 (three) questions from each Part.

PART A

1. (a) Define D'Alembert's theorem of dynamic equilibrium of a rigid body and give an example of its application. **(5)**

    (b) State the laws of friction and also define angle of friction with suitable sketch. **(5)**

    (c) Define kinematic pair and name different types of kinematic pairs according to nature of contact. Also give examples of each type. **(10)**

2. (a) In a flat belt drive, find the expression $\frac{T_1}{T_2} = e^{\mu\theta}$ where T_1 = Tension on the right side of the belt, T_2 = Tension on the slack side of the belt, θ = Angle of lap in radians, μ = Coefficient of friction between belt and pulley. **(8)**

    (b) A shaft running at 200 rpm drives on the shaft at 400 rpm and transmits 7.7kW through an open belt. The belt is 80mm wide and 10mm thick. The centre distance is 4m. The smaller pulley is of 500mm diameter and the coefficient of friction between belt and pulley is 0.3. Calculate the stress in the belt. **(12)**

3. (a) What are the most common types of crystal structures for metallic elements? Describe each type briefly. **(4+6=10)**

    (b) What are carbon-steels? Explain various types of carbon-steel together with their applications. **(3+7=10)**

4. (a) Explain the working of epicyclic gear train with suitable sketch. **(5)**

    (b) Clearly write the function of governor. Also name the different types of governors. **(2+3=5)**

    (c) Determine the range of speed of a porter governor having equal arms each 250mm long and pivoted on the axis of rotation. Each ball has a mass of 5kg and the mass of the central load of the sleeve is 25kg. The radius of rotation of the ball is 150mm when the governor begins to lift and 200mm when the governor is at maximum speed. Given that the friction at the sleeve is equivalent to 10N. **(10)**

PART B

5. (a) Express mathematically with the Merchants' circle diagram the shear force, normal force, frictional force and back-up force in terms of F_1, F_t, f and a, where the symbols have their usual meanings. **(12)**

   (b) What do you understand by tool life? Discuss the different methods of assessment of tool life. **(3+5=8)**

6. (a) Briefly explain the working of an EDM machine with neat sketches showing important elements. **(10)**

   (b) What are the functions served by the electrolyte in ECM? Describe the factors that should be considered in selecting an electrolyte in ECM. **(5+5=10)**

7. (a) A factory producing one single item, which is sold for Rs.15.00 per unit has a fixed cost of Rs.50,000.00 and variable cost of Rs.10.00 per unit. Find (i) the number of units to be produced to get break even, (ii) Number of units to be produced to earn a profit of Rs.20,000.00, (iii) The profit or loss, if 24,000 units are produced and sold. **(3+3+4=10)**

   (b) State the concept of Just-In-Time (JIT) production. What are the pre-requisites to hive JIT production? Explain. **(3+3+4=10)**

8. (a) Explain the various charts usually adopted for quality control. **(5)**

   (b) Write the advantages and limitations of moving average method of forecasting. **(5)**

   (c) What is operation research? Give some names of simple operation research (OR) models and write their objective functions. Also mention their applications. **(3+5+2=10)**

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