R13

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) Is the screw pair a constrained pair or unconstrained pair? Give reason for your answer.   [2]

   b) What type of inversion is the double-rocker mechanism? How is it obtained?   [3]

   c) What is the difference between helical and spiral gears?   [2]

   d) Briefly mention the methods of avoiding interference in gears.   [3]

   e) Define the Coefficient of fluctuation of speed.   [2]

   f) How do you find the velocity ratio of an open belt drive by considering Slip?   [3]

   g) State the Laws of solid dry fiction.   [2]

   h) What is the effect of centrifugal tension on the tight side tension (T_1) and slack side tension (T_2) of a belt drive? Show that it is independent of T_1 and T_2, and depends only on the velocity of the belt over the pulley.   [3]

   i) Define the Power and Effort of a Governor.   [2]

   j) How do you balance several masses rotating in the same plane? Explain.   [3]

PART-B

(50 Marks)

2. The dimensions of the various links of the mechanism shown in figure 1 are OA = 30 mm. AB = 75 mm, BC = 5 mm, and BD = 100 mm. The crank OA rotates at 120 rpm. Determine the velocity and acceleration of the slider D.   [10]
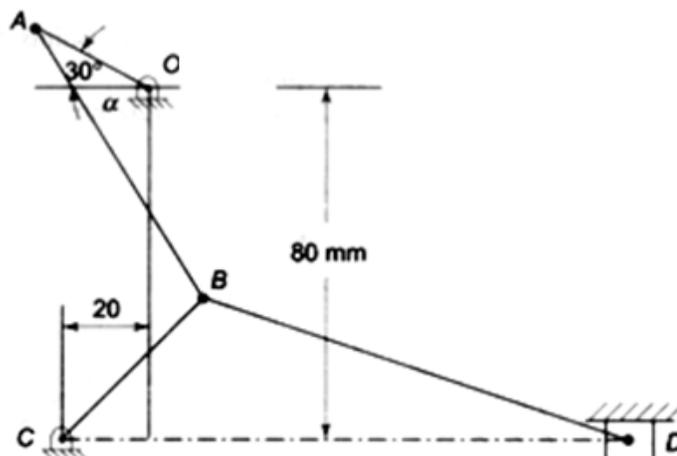

Figure: 1

OR

3. In the mechanism shown in figure 2, link AB rotates clockwise at a speed of 240 rpm. At the instant shown, find the velocity of slider E. AB = 50 mm, BC = 120 mm, BD = DC = 60 mm, DE = 80 mm. *Solve by the Instantaneous center method* [10]
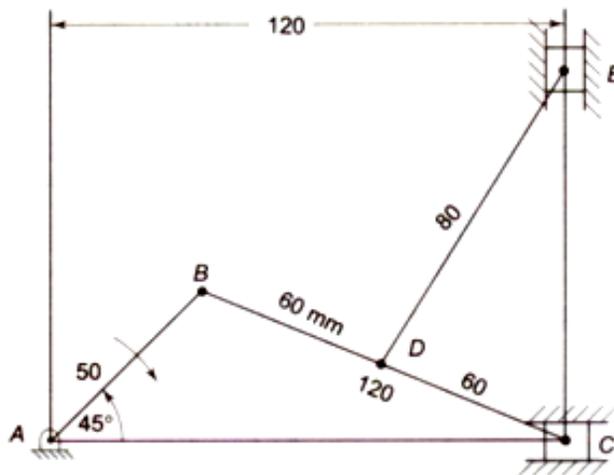

Figure: 2

4. The speed ratio of a reverted gear train, shown in figure 3 is to be 12. The module of gears A and B is 3.125 mm, and that of the gears C and D is 2.5 mm. Calculate the suitable number of teeth for the gears, if no gear is to have less than 24 teeth. [10]
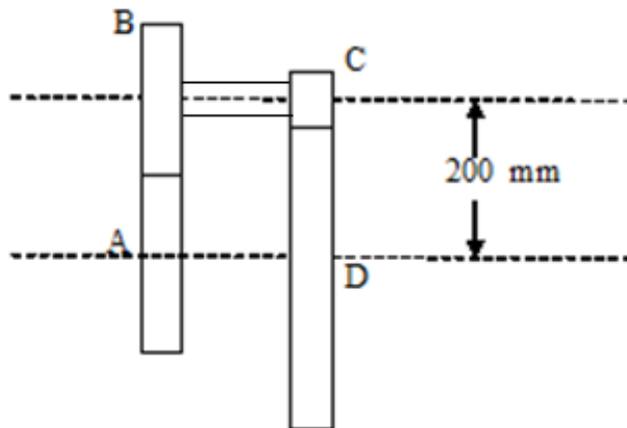

Figure: 3
OR

5. Two mating involute spur gears with module pitch of 5 mm have 20 and 40 teeth of 20^0 pressure angle and 5 mm addendum. Determine the maximum velocity of sliding and the angle turned through by the pinion, when one pair of teeth is in mesh and the pitch line speed is 1.2 m/s. [10]

6.a) Prove that the maximum fluctuation of energy ΔE is given by: $\Delta E = E \cdot 2C_s$ where E = Mean kinetic energy of the flywheel and C_s = Coefficient of fluctuation of speed.

   b) If the difference between the tight and slack side tensions of for a belt drive does not exceed 100 N/cm width of a 5 mm thick belt, the angle of lap is 170^0, the coefficient of friction is 0.25, density of the belt material is 10^{-3} kg/cm^3, and the belt velocity is 1000 m/minute, find the maximum stress in the belt. [5+5]

OR

7. The equation of the turning moment diagram for a three-crank engine is given by T (N-m) = 25000 - 7500 sin 3θ, where θ radians is the crank angle from the inner dead centre. The moment of inertia of the flywheel is 400 kg-m^2, and the mean engine speed is 300 rpm. Calculate the power of the engine and the total percentage fluctuation of speed of the flywheel, if the resisting torque is constant. [10

8. A truncated conical pivot of cone angle ϕ and rotating at a speed N supports a load W. The smallest and the largest diameters of the pivot over the contact area are 'd' and 'D' respectively. Assuming uniform wear, derive the expression for the frictional torque. (Here ϕ means 2α) [10]

OR

9. Find the maximum HP that can be transmitted by a belt of 16 cm × 1.5 cm cross section, if the ratio of belt tensions is 1.8, and the maximum permissible stress in the belt material is 15 kg / cm^2. Density of leather may be taken as 1 gm / cm^3. The centrifugal tension is to be considered. [10]

10. In a Porter governor, the central load is 176.6 N and the weight of each ball is 19.6 N. The top arms are each 25 cm long, while the bottom arms are each 30 cm long. Friction of the sleeve is 1.4 kgf. If the top arms make 45^0 with the axis of rotation in the equilibrium position, find the range of speed of the governor in position. [10]

OR

11. Referring to figure 4, the particulars are:
w_a = 890 N, r_a = 22.9 cm ; w_b = 1335 N, r_b = 17.8 cm
w_c = 1068 N, r_c = 25.4 cm ; w_d = 1157 N, r_d = 30.5 cm
Find out the magnitudes of balancing masses required in planes L and M, and their angular locations with respect to mass w_a. [10]
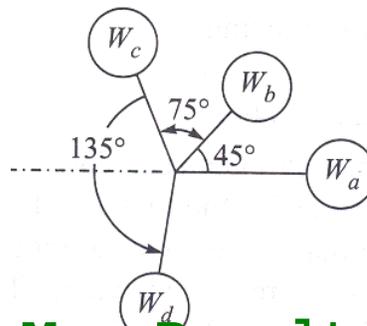
Figure : 4

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