17MT45

USN

Theory of Machines

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Explain the inversion of single slides crank mechanism. **(10 Marks)**
   b. Explain the inversion of four bar chain mechanism. **(10 Marks)**

OR

2 a. Explain Whitworth quick returns motion mechanism with neat sketch. **(10 Marks)**
   b. Explain types of constrained motions. **(10 Marks)**

Module-2

3 a. Explain law of gearing with neat sketch. **(10 Marks)**
   b. Derive an expression for minimum number of teeth on the wheel in order to avoid interface. **(10 Marks)**

OR

4 a. An epicyclic gear consists of three gears A, B and C as shown in Fig.Q4(a). The gear has 72 internal teeth and gear C has 32 external teeth. The gear B meshes with both A and C and is carried on an arm EF which rotates about the centre of A at 18 rpm. If the gear A is fixed, determine the speed of gear B and C.
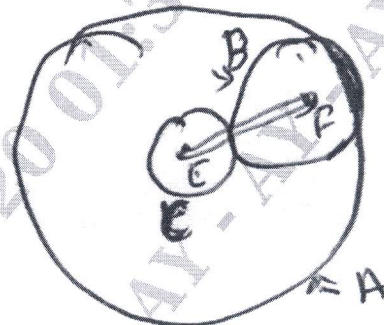

Fig.Q4(a) **(10 Marks)**

   b. What are types of gear train? Explain briefly with respective formula derived for that with diagram. **(10 Marks)**

Module-3

5 a. Explain radial cam with neat sketch and explain terms used in radial cam. **(10 Marks)**
   b. Derive the expression for velocity and acceleration when the follower moves with cycloidal motion. **(10 Marks)**

OR

6   A cam with a minimum radius of 250 mm, rotating clockwise at a uniform speed is to be designed to give a roller follower, at the end of a valve rod, mention described below.
   1. To raise the valve through 500 mm during 120° rotation of the cam.
   2. To keep the valve fully raised through next 30°
   3. To lower the valve fully raised through next 60°
   4. To keep the valve closed during rest of the revolution i.e. 150°

   The diameter of the roller is 20 mm and the diameter of the cam shaft is 25 mm. Draw the profile of the cam when (i) the line of stroke of the valve rod passes through the axis of cam shaft and (ii) the line of the stroke is offset 15 mm from the axis of the cam shaft.

   The displacement of the valve, while being raised and lowered, is to take place with simple harmonic motion. Determine the maximum acceleration of the valve rod when the cam shaft rotates at 100 rpm.

   Draw the displacement, the velocity and the acceleration diagram for one complete revolution of the cam.   (20 Marks)

Module-4

7   a. Four masses A, B, C and D are shown below to be completely balanced. A is 180 mm radius of rotation, B rotates at 240 mm radius, C rotates 120 mm radius and D rotates at 150 mm radius. The mass of B = 30 kg, C = 50 kg, D = 40 kg. The planes containing masses B and C are 300 mm apart. The angle between planes containing B and C is 90°. B and C makes angle of 120° respectively with D in the same sense.
       (i) Find the magnitude and angular position of mass A
       (ii) The position of planes A and D.   (14 Marks)
   b. Explain clearly the term: (i) State balancing   (ii) Dynamic balancing   (06 Marks)

OR

8   a. An open belt running over two pulleys 240 mm and 600 mm diameter connects two parallel shaft 3 meters apart and transmits 4 KW from the smaller pulley that rotates at 300 rpm. Coefficient of friction between belt and pulley is 0.3 and the safe working tension is 10 N per mm width. Determine: (i) Minimum width of the belt   (ii) Initial belt tension (iii) Length of the belt required.   (12 Marks)
   b. Derive the expression for length of a cross belt drive.   (08 Marks)

Module-5

9   a. Explain effect of gyroscopic couple on a naval ship during steering with neat sketch.
                                                                                   (10 Marks)
   b. Derive the expression for stability of a two wheel vehicle taking a turn.   (10 Marks)

OR

10 In a spring loaded governor of the hartnell type, the mass of each ball is 5 kg and the lift of the sleeve is 50 mm. The speed at which the governor begins to float is 240 rpm and at this speed the radius of ball path is 110 mm. The mean working speed of the governor is 20 times the range of speed when friction is neglected. If the length of ball and roller arm of the bell crank lever are 120 mm and 100 mm respectively and if the distance between the center of pivot of bell crank lever and axis of governor spindle is 140 mm, determine the initial compression of the spring taking into account the obliquity arms. If friction is equilant to a force of 30 N at the sleeve. Find the total alteration in speed before the sleeve begins to move from mid position.   (20 Marks)

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