USN ☐☐☐☐☐☐☐☐☐☐

17MT45

Fourth Semester B.E. Degree Examination, Aug./Sept.2020
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 degree of freedom of a body in the space and write the number of degrees of freedom. (04 Marks)

   b. Explain the following:
      i) Lower pair and Higher pair
      ii) Kinematic chain
      iii) Binary and Quaternary joint. (06 Marks)

   c. Explain the mechanism. Show that the following Fig.Q1(c)(i), (ii), (iii) and (iv) has 2, 1, 1, and 2 degrees of freedom respectively. (10 Marks)
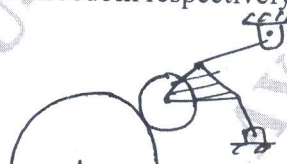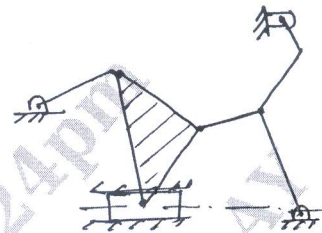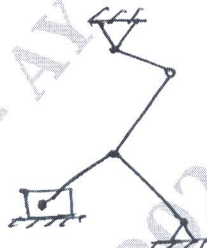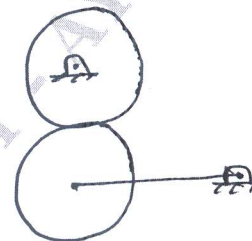

Fig.Q1(c)(i) Fig.Q1(c)(ii)

Fig.Q1(c)(iii) Fig.Q1(c)(iv)

OR

2 a. Explain the classification of kinematic pair (lower pairs) according to type of relative motion between links. Also indicate the degrees of freedom associated with each pair. (10 Marks)

   b. Explain Geneva mechanism and Ratchet and pawl mechanism with neat sketch. (10 Marks)

Module-2

3 a. Deduce the equation for length of path of contact. (10 Marks)

   b. The arm of an epicyclic gear train rotates at 100rpm in clockwise direction. The arm carries two wheels A and B having 36 and its teeth respectively. The wheel A is fixed and the arm rotates about the centre of wheel "A". Find the speed of wheel 'B'. What will be the speed of B, if the wheel "A" instead of being fixed, makes 200rpm clockwise? Solve by the tabular method and show the arrangement. (10 Marks)

OR

4 a. With neat sketch explain:
   i) Simple gear train
   ii) Compound gear train
   iii) Reverted gear train and
   iv) Epicyclic gear train. **(10 Marks)**

   b. In an epicyclic gear train of the sun and planet type, the pitch circle diameter of the internally toothed ring is to be 22.5cm and the teeth are to have a diametral pitch of 0.24. When the ring is stationary the spider, which carries three planet wheels of equal size, is to be make one revolution for every five revolution of driving shaft. Determine the suitable number of teeth for all the wheels and the exact pitch circle diameter of ring. **(10 Marks)**

Module-3

5 a. Draw the displacement velocity and acceleration diagram of follower with simple Harmonic motion and uniform acceleration and retardation. **(04 Marks)**

   b. Draw the profile of cam operating a knife edge follower from the following data:
   i) Follower to move outward through a distance of 20mm during -120°
   ii) Follower to dwell for the next -60°
   iii) Follower to return to its initial position during -90°
   iv) Follower to dwell for the remaining 90° of ram rotation.
   The cam is rotating clockwise at a uniform speed of 500rpm. The minimum radius of the cam is 40mm and the line of stroke of follower is offset 15mm from the axis of the cam and the displacement of the follower is to take place with uniform acceleration and retardation both inward and outward stroke. **(16 Marks)**

OR

6 Using the following data synthesize the cam profile operating a roller follower:
   i) Motion for outstroke SHM and cam rotation for outstroke -120°
   ii) Maximum lift of follower 40mm
   iii) Offset of follower 10mm and dia of roller 14mm.
   iv) Diameter of base circle 40mm and speed of cam 1000rpm clockwise.
   v) Motion of return stroke uniform acceleration and retardation and cam angle during return stroke -80°
   vi) Angle of dwell in highest position of follower -60°.
   Determine maximum velocity and acceleration during out stroke and return stroke of follower. **(20 Marks)**

Module-4

7 a. Why balancing of rotating parts necessary for high speed engines? **(04 Marks)**

   b. Four masses M_1 = 100kg, M_2 = 175kg, M_3 = 200kg and M_4 = 125g are fixed to the crank of 200mm radius and revolve in planes 1, 2, 3 and 4 respectively. The angular position of the planes 2, 3 and 4 with respect to 1 are 75°, 135° and 240° taken in the same sense. Distances of the planes 2, 3 and 4 from 1 are 600mm, 1800mm and 2400mm. Determine the magnitude and position of the balancing mass at radius 600mm, 1800mm and 2400mm. Determine the magnitude and position of the balancing mass at radius 600mm in planes "L" and "M" located in middle of 1 and 2 and in the middle of 03 and 4 respectively. **(16 Marks)**

OR

8 a. Explain open and cross belt drive. **(04 Marks)**
   b. Deduce the mathematical model for ratio of belt tensions in flat belt. **(06 Marks)**
   c. A belt drive is required to transmit 10kW from a motor running at 600rpm. The belt if 12mm thick and has a mass density of $0.001 g/mm^3$. Safe stress in the belt is not exceed $2.5N/mm^2$. Diameter of the driving pulley is 250mm whereas the speed of driven pulley is 220rpm. Two shafts are 1.25m apart. The $\mu = 0.25$, determine the width of the belt. **(10 Marks)**

Module-5

9 a. Derive an expression for heal angle of a motor cycle to avoid skidding. **(10 Marks)**
   b. Explain the gyroscopic effect of steering, pitching and rolling of a ship moving in a heavy sea and assume the rotor turn clockwise and viewing from stern (or) aft. **(10 Marks)**

OR

10 a. Explain the term height of the governor and derive an expression for height of portor governor considering sleeve friction into account. **(10 Marks)**
   b. The radius of rotation of the balles of a Hartnell governor is 8cm at the minimum speed of 300rpm. Neglecting gravity effect determine the speed after the sleeve is lifted by 6cm, also determine the initial compression of spring, governor effort and power. The particulars of the governor are, length of ball arm = 15cm, length of sleeve arm = 10cm, mass of each ball = 4kg and stiffness = 25000N/m. **(10 Marks)**

* * * * *