USN ☐☐☐☐☐☐☐☐☐☐   **21AE/AS51**

Fifth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
Mechanism and Machine Theory

Time: 3 hrs.   Max. Marks: 100

Note: 1. *Answer any FIVE full questions, choosing ONE full question from each module.*
        2. *Assume the suitable Missing data if necessary.*

Module-1

1 a. Define the following with atleast one example each
      i) Mechanism   ii) Inversion   iii) Machine   iv) Completely constrained motion
      iv) Successfully constrained motion.   **(10 Marks)**
   b. With a neat sketch, explain the following inversion of Double slider crank chain
      i) Elliptical trammel   ii) Scotch yoke, mechanism.   **(10 Marks)**

OR

2 a. Determine the mobility of the mechanisms given below using Grubler's crierion.

   (09 Marks)
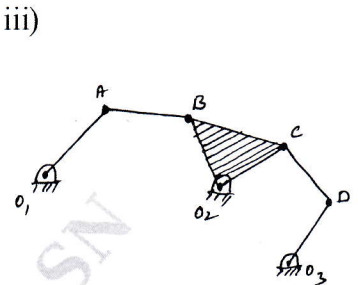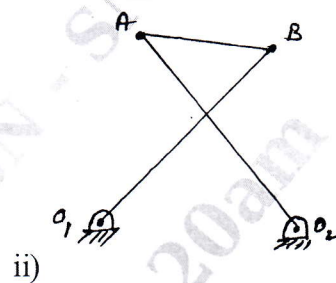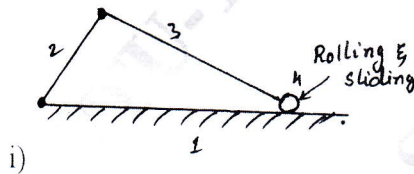
   b. Explain Beam engine and crank and slotted lever quick return motion mechanism with the
      help of neat sketch.   **(11 Marks)**

Module-2

3 A four bar mechanism ABCD is made up of four links, pin jointed at the ends. AD is a fixed
   link which is 180 mm long. The links AB, BC and CD are 90 mm 120 mm and   120
   mm long respectively. At certain instant, the link AB makes an angle of 60° with the link
   AD. If the link AB rotates at uniform speed of 100 rpm clockwise determine,
      i)   Angular velocity of the links BC and CD
      ii) Angular acceleration of the links CD and CB   **(20 Marks)**

OR

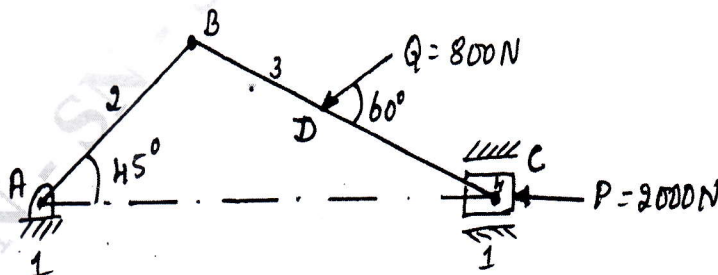4 Determine the various forces on the links and couple T_2 for the mechanism shown in Fig Q4.

Fig·Q4   **(20 Marks)**

Module-3

5 a. With the help of suitable sketch. Explain spur Gear Terminology. **(10 Marks)**

b. Two gear wheel mesh externally and are to give a velocity ratio of 3. The teeth are of involutes form of module 6 mm and standard addendum one module. Pressure angle = 18° Pinion rotates at 90 rpm. Find : i) Number of teeth on each wheel so the interference is just avoided   ii) Length of path of contact   iii) Length of arc of contact   iv) Maximum velocity of sliding between teeth   v) Number of pair of teeth in contact. **(10 Marks)**

OR

6 a. Explain Interference in involutes gears and list the methods of avoiding interference. **(06 Marks)**

b. In an epicyclic gear train shown in Fig Q6(b). The arm A is fixed to a shaft 'S'. The wheel B having 100 teeth rotates freely on this shaft 'S', wheel 'F' 150 teeth is separately driven. If arm 'A' runs at 200 rpm and wheel 'F' at 100 rpm in the same direction, find i) Number of teeth on gear C   ii) speed and direction of wheel 'B'. Use Algebraic method.
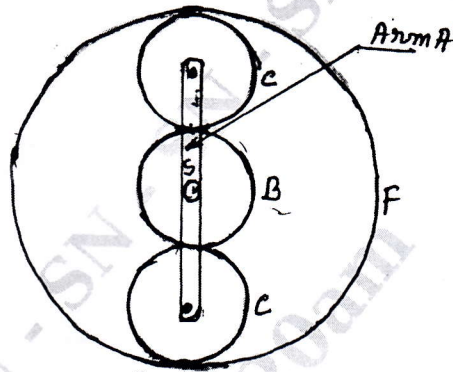

Fig Q6(b)   **(05 Marks)**

c. An epicyclic gear train of sun and planet type is shown in Fig Q6(c), The pitch diameter of internally toothed ring D is approximately 228 mm and the module is 4 mm. When the ring is stationary, the spider A which carries three planet wheels 'C' of equal size is to make one revolution for every five revolutions of the spindle carrying the sun wheel 'B'. Determine the suitable number of teeth for all the wheel and exact pitch circle diameter of ring D. use tabular column method.
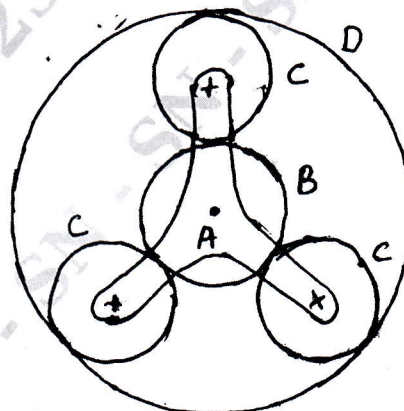

Fig Q6(c)   **(09 Marks)**

Module-4

7 Four masses M_1 = 100Kg, M_2 = 175Kg, M_3 = 200Kg and M_4 = 125Kg are fixed to a crank of 200 mm 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 75º, 135º and 240º taken in the same sense. Distances of the planes 2, 3 and 4 from 1 are 600 mm, 1800 mm and 240 mm. Determine the magnitude and position of the balancing masses at radius 600 mm in planes 'L' and 'M' located in the middle of 1 and 2 and in the middle of 3 and 4 respectively. **(20 Marks)**

OR

8 The firing order in a 6 cylinders vertical 4 stroke in line engine is 1-4-2-6-3-5 the piston stroke is 100 mm length of each connecting rod = 200 nm. The pitch distance between cylinder centerlines are 100 mm, 100 mm, 150 mm, 100mm and 100mm. Determine the out of balance primary and secondary forces and couples on this engine taking a plane midway between cylinder 3 and 4 as reference plane. The reciprocating mass per cylinder is 2 Kg and the engine runs at 1500 rpm. **(20 Marks)**

Module-5

9 a. The upper arms of the porter governor are pivoted to the axis of rotation. The length is 40 cm. The lower arm pivoted on the sleeve at a distance of 2 cm from the axis, its length is 30 cm. Mass of each ball is 5 Kg and the sleeve mass is 50 Kg. Determine the equilibrium speed for the radius of rotation of 20 cm and also the effort and power for 1% speed change. **(10 Marks)**

b. In a hatnell Governor the length of the ball and sleeve arms are 12 and 10cm respectively. The distance of fulcrum of the bell crank lever from the governor axis is 14cm. Mass of each ball is 4 Kg. when the governor runs at mean speed of 300 rpm, The ball arm is vertical and sleeve arm is horizontal. For an increase of speed of 4% the sleeve moves 10mm upword. Neglecting the friction find : i) minimum equilibrium speed if the total sleeve movement is 20 mm. ii) Spring stiffness iii) Sensitiveness of governor iv) spring stiffness if governor is to be isochronous at 300 rpm. **(10 Marks)**

OR

10 a. An aeroplane make a complete half circle of 40 m radius towards left when flying at 175 Km/hr. The mass of the rotary engine and propeller is 400Kg with radius of gyration 300 mm. The engine runs at 2500 rpm clockwise when viewed from the rear end. Find the gyroscopic couple and its effect on aircraft. What will be the effect, if the aeroplane turns towards right instead of left? **(08 Marks)**

b. Define the following with respect to centrifugal governor i) Sensitiveness ii) Power iii) Hunting iv) Stability v) Isochrnous vi) Controlling force. **(12 Marks)**

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