

Fourth Semester B.E. Degree Examination, Dec.2023/Jan.2024 Mechanism and Machine Theory

Time: 3 hrs.

Max. Marks: 100

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

Module-1

- 1 a. Define 'Kinematic Pair' and 'degree of freedom'. Sketch spherical pair and state its degree of freedom. (10 Marks)
- b. Name an exact straight line motion mechanism having only turning pairs. Draw a neat proportionate sketch of the same. State geometric relationships among its links. Indicate the point tracing straight line and prove that the point can trace straight line. (10 Marks)

OR

- 2 a. State an application for the following :
i) Drag link mechanism ii) Geneva wheel iii) Oldham coupling iv) Toggle mechanism. (04 Marks)
- b. Draw a neat proportionate sketch of 'Whitworth mechanism'. Indicate clearly the positions of driver crank corresponding to the extreme positions of shaper tool. (08 Marks)
- c. In a 4-bar mechanism the length of the driver crank, coupler and follower links are 150mm, 250mm and 300mm respectively. The fixed link length is L_0 . Find the range of values for L_0 to make it a crank rocker mechanism. (08 Marks)

Module-2

- 3 A four bars chain ABCD has a fixed link $AD = 1\text{m}$. The driving crank $AB = 0.3\text{m}$. The follower link $CD = 0.6\text{m}$ and the connecting link $BC = 1.2$. Find the velocity and acceleration of point 'P' midway between B and C, when the angle $BAD = 135^\circ$ and AB rotates clockwise at a speed of 300rpm with an angular acceleration of 20rad/sec^2 in C.C.W direction. (20 Marks)

OR

- 4 For the static equilibrium of the mechanism shown in Fig Q4. Find the required input torque. The dimensions are $AB = 150\text{mm}$, $BC = AD = 500\text{mm}$, $DC = 300\text{mm}$, $CE = 100\text{mm}$ and $EF = 450\text{mm}$.

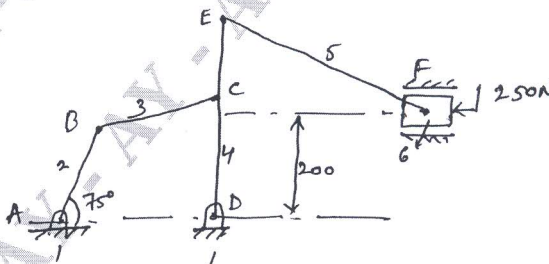


Fig Q4

(20 Marks)

Module-3

- 5 a. What is Involutometry? Derive an expression for finding the tooth thickness of a given joint, if the tooth thickness of some other point is known. (10 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

- b. A pinion of 32 involute teeth and 4mm module driver a rack. The pressure angle is 20° . The addendum of both pinion and rack is the same. Determine the maximum permissible value of addendum to avoid interference. Also find the number of pairs of teeth in contact. (10 Marks)

OR

- 6 In an epicyclic gear train of sun and planet type the pitch circle diameter of the annular wheel A is 425mm and the module is 5mm. When the annular wheel is stationary, the spider which carries 3 planets gears P of equal size has to make one revolution for every revolutions of the driving spindle carrying sun wheel S. Determine the number of teeth on all the wheels. (20 Marks)

Module-4

- 7 Four masses $M_1 = 100\text{Kg}$; $M_2 = 175\text{Kg}$, $M_3 = 200\text{Kg}$ and $M_4 = 125\text{Kg}$ are fixed to the crank of 200mm radius and revolve in planes 1, 2, 3 and 4 with 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. Distance of the planes 2, 3 and 4 from 1 are 600mm, 1800mm and 2400mm. Determine the magnitude and position of the balancing masses at radius 600mm in plane '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 cranks and connecting rod of a 4 cylinder in line engine running at 1800 rpm are 50mm, 250mm each respectively and the cylinder are spaced 150mm apart. If the cylinders are numbered 1 to 4 in sequence from one end and the crank appear at intervals of 90° in the end view in the order 1 - 4 - 2 - 3. The reciprocating mass corresponding to each cylinder is 1.5Kg. Determine :
 i) Unbalanced primary and secondary forces if any
 ii) Unbalanced primary and secondary couples with reference to central plane of engine. (20 Marks)

Module-5

- 9 a. Define : i) Sensitiveness ii) Governor effort iii) Governor power iv) Hunting. (08 Marks)
 b. In a spring controlled governor, the curve of controlling force is a straight line. When the balls are 0.4m apart the controlling force is 1500N and when 0.25m apart, it is 750N. At the what speed, the governor will run when the balls are 0.3m apart. What initial tension will be required for isochronisms and what would be then the speed mass of each ball 6Kg. (12 Marks)

OR

- 10 a. Derive an expression for the gyroscopic couple. (08 Marks)
 b. An aeroplane make a complete half the circle of 40m radius towards left when flying at 175Km/hr. The mass of the rotary engine and propeller is 400Kg with radius of gyration 300mm. The engine runs at 2500rpm clockwise when viewed from the rear. Find the gyroscopic couple on the aircraft. What will be the effect if the aeroplane turn towards right instead of left. (12 Marks)
