| Reg. No. | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|

# MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

*(A constituent unit of MAHE, Manipal)*

**DEPARTMENT OF MECHATRONICS**

**V SEMESTER B.TECH. MECHATRONICS**

**END SEMESTER –MAKEUP -EXAMINATION, JAN 2024**

**SUBJECT: THEORY OF MACHINES [MTE 3154]**

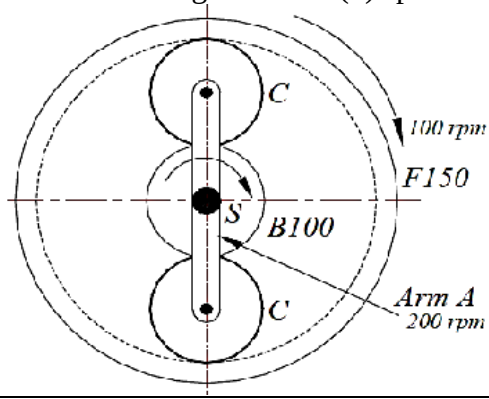
**(06/01/2024)**

**Time: 3 Hours** **MAX. MARKS: 50**

**Instructions to Candidates:**

- Answer **ALL** the questions.
- Data not provided may be suitable assumed.

| Q. No | | M | CO | PO | LO | BL |
|---|---|---|---|---|---|---|
| **1A.** | Differentiate between machine and structure. | **2** | **1** | **1** | **1** | **L2** |
| **1B.** | Identify the kinematic chains to which the following mechanisms belong i) Beam engine, ii) Oscillating cylinder engine, iii) Elliptical trammel, iv) Hand pump. | **4** | **1** | **1** | **1** | **L2** |
| **1C.** | A quick return mechanism is designed by fixing the link 2 (Corresponds to a crank in an IC engine) of single slider crank chain. Explain its working with a neat sketch. | **4** | **1** | **2** | **2** | **L3** |
| **2A.** | Show the directions of coriolis component of acceleration for the known direction of 'ω' (angular velocity of link) and 'v' (velocity of slider). | **2** | **2** | **1** | **1** | **L2** |
| **2B** | A four bar mechanism is to be designed, by using three precision points to generate the function $y = x^{1.5}$ for the range $1 \leq x \leq 4$. Assume 30 degree starting position and 120 degree finishing position for the input link and 90 degree starting position and 180 degree finishing position for the output link, find the values of x, θ and ø corresponding to the three precision points using chebychev spacing. | **4** | **5** | **3** | **3** | **L4** |
| **2C** | In a four bar chain ABCD, AD is fixed and is 150 mm long. The crank AB is 40 mm long and rotates at 120 rpm clockwise, while the link CD = 80 mm oscillates about D. BC and AD are of equal length. Find the angular velocity of link CD when angle BAD = 60 Degree. (Use Graphical Method, Write Graph sheet No in EPAD, Show all calculation in EPAD, and diagram in Graph sheet) | **4** | **2** | **4** | **3,4** | **L4** |
| **3A** | A flywheel with a mass of 3kN has a radius of gyration of 1.6m. Find the i) Coefficient of fluctuation of speed, ii) Energy stored in the flywheel when its speed increases from 315 rpm to 340 rpm. | **2** | **3** | **1** | **1** | **L3** |
| **3B** | A punching press is required to punch 30 mm diameter holes in a plate of 20 mm thickness at the rate of 20 holes per minute. It requires 6 Nm of energy per $mm^2$ of sheared area. If punching takes place in 1/10 of a second and the rpm of the flywheel varies from 160 to 140, | **4** | **3** | **3** | **3** | **L4** |

| | | | | | | |
|---|---|---|---|---|---|---|
| | determine the mass of the flywheel having radius of gyration of 1 meter. | | | | | |
| **3C** | A shaft carries four masses *A, B, C* and *D* placed in parallel planes perpendicular to the shaft axis and in this order along the shaft. The masses *B* and *C* are 40kg and 28kg and both are at 160mm radius. While the masses in planes *A* and *D* are at 200mm radius. Angle between *B* and *C* is 100°, *B* and *A* is 190°, both angles measured in the same sense. Planes *A* and *B* are 250mm apart, *B* and *C* are 500mm apart. If the shaft is to be in complete balance, determine (i) masses in planes *A* and *D*, (ii) distance between planes *C* and *D* and (iii) angular position of mass *D* (Use Graphical Method, Write Graph sheet No in EPAD, Show all calculation in EPAD, and diagram in Graph sheet) | **4** | **3** | **3** | **2,3** | **L4** |
| **4A** | Differentiate between cycloidal and involute teeth (State at-least 6 differences). | **3** | **4** | **1** | **1** | **L2** |
| **4B** | A pinion having 30 teeth drives a gear having 80 teeth. The profile of the gears is involute with 20 degree pressure angle, 12mm module and 10 mm addendum. Find the length of path of contact, arc of contact and the contact ratio. | **4** | **5** | **2** | **2** | **L3** |
| **4C** | Determine the minimum number of teeth required on a pinion, in order to avoid interference which is to gear with, i) A wheel to give a gear ratio of 3 to1; and ii) an equal wheel. The pressure angle is 20 degree and a standard addendum of 1 module for the wheel may be assumed. | **3** | **4** | **3** | **3** | **L4** |
| **5A** | Evaluate the condition (length of each link) at which following mechanisms can be used as straight line mechanism. Also sketch the mechanisms i) Paucellier straight line mechanism and ii) Watt's straight line mechanism. | **4** | **1** | **2** | **2** | **L3** |
| **5B** | Suggest a suitable gear train of wheels to satisfy the requirements of a clock, the minute hand of which is fixed to a spindle and the hour hand to a sleeve rotating freely on the same spindle. Explain it's (gear train's) salient features. | **2** | **4** | **2** | **2** | **L3** |
| **5C** | In an epicyclic gear train shown in figure, the arm A is fixed to the shaft S. The wheel B having 100 teeth rotates freely on the shaft S. The wheel F having 150 teeth driven separately. If the arm rotates at 200 rpm and wheel F at 100 rpm in the same direction; find (a) number of teeth on the gear C and (b) speed of wheel B.   | **4** | **4** | **4** | **4** | **L4** |

L1 – Remembering, L2 – Understanding, L3 - Applying, L4 – Analyzing, L5 – Evaluating, L6 - Creating