Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

DEPARTMENT OF MECHATRONICS

V SEMESTER B.TECH. MECHATRONICS

END SEMESTER MAKE-UP EXAMINATION, Dec 2022

SUBJECT: THEORY OF MACHINES [MTE 3154]

(30-12-2022)

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.	Classify the kinematic pairs based on relative motion between the links. Explain in detail with suitable example.	**5**	**1**	**1**	**1**	**2**
1B.	A crank and slotted lever mechanism used in a shaper has a centre distance of 300mm between the centre of oscillation of the slotted lever and the centre of rotation of the crank. The radius of the crank is 120 mm. Find the inclination of the slotted bar with the vertical in the extreme position and the ratio of the time of cutting to the time of return stroke.	**3**	**1**	**2**	**2**	**3**
1C.	Identify the application of double crank mechanism (inversion of four bar chain).Explain it's working with a sketch	**2**	**1**	**2**	**1**	**3**
2A.	PQRS is a four bar chain with link PS fixed. The lengths of the links are PQ=62.5 mm; QR = 175 mm; RS = 112.5 mm; and PS = 200 mm. The crank PQ rotates at 10 rad/sec clockwise. Draw the velocity and acceleration diagram when angle QPS = 60 degree and Q and R lie on the same side of PS. Find the angular velocity and angular acceleration of links QR and RS (Use Graphical Method, Write Graph sheet No in EPAD, Show all calculation in EPAD, and diagram in Graph sheet).	**5**	**2**	**1**	**1,4**	**4**
2B	A four bar mechanism is to be designed, by using three precision points to generate the function $y^2 = x^3$ 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.	**3**	**5**	**4**	**4**	**3**
2C	How the direction of Coriolis component of acceleration is determined? Explain with relevant sketches.	**2**	**2**	**4**	**2,3**	**2**
3A	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	**5**	**3**	**1**	**1**	**4**

	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)					
3B	A riveting machine is driven by a constant torque 3kW motor. The moving parts including the flywheel are equivalent to 150 kg at 0.6 m radius. One riveting operation takes 1 second and absorbs 10000 N-m energy. The speed of the flywheel is 300 rpm before riveting. Find the speed immediately after riveting. How many rivets can be closed per minute?	**3**	**3**	**3**	**1**	**3**
3C	Derive an expression for maximum fluctuation of energy in a flywheel.	**2**	**3**	**2,3**	**2,3**	**2**
4A	Two involute gears in a mesh have a module of 8 mm and a pressure angle of 20 degree. The larger gear has 57 while the pinion has 23 teeth. If the addendum on pinion and gear wheels are equal to one module, find the, (i) contact ratio (the number of pairs of teeth in contact), (ii) angle of action of the pinion and the gear wheel.	**5**	**4**	**1**	**1**	**4**
4B	Two 20 degree involute spur gears have a module of 10 mm. The addendum is one module. The larger gear has 50 teeth and pinion has 13 teeth. Does interference occurs? If it occurs, to what value should the pressure angle be changed to eliminate interference?	**3**	**4**	**2**	**2,3**	**3**
4C	The following data relate to two meshing gears. Velocity ratio = 1/3; Module = 4 mm, Pressure angle 20 degree, Centre distance = 200 mm. Determine number of teeth and the base circle radius of the gear wheel.	**2**	**4**	**3**	**1**	**3**
5A	A sliding mesh type motor car gear box with 4 forward and reverse gear has the following gear ratio; Top gear 1:1, 3rd gear 1.5:1, 2nd gear 2.5:1, First gear 4:1, Reverse gear 4.2:1, Design the gearbox, if the smallest gear has 15 teeth, module is same for all gears. Take Lay shaft/constant shaft speed is ½ of primary shaft speed.	**5**	**4**	**3**	**1**	**4**
5B	An epicyclic gear consists of three gears A, B and C. The gear A 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 gears B and C.	**3**	**4**	**4**	**4**	**4**
5C	Compare compound and reverted gear train.	**2**	**4**	**4**	**2,3**	**2**