BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: B.TECH **SEMESTER : IV**
BRANCH: MECHANICAL/PRODUCTION **SESSION : SP/2023**

SUBJECT: ME207 KINEMATICS AND DYNAMICS OF MACHINES

TIME: 3 Hours **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

			CO	BL
Q.1(a)	Derive Grubler's criterion for determining degrees of freedom for plane mechanisms. Applying Grubler's criterion for single degree of freedom, show that the number of links should be even for the mechanism.	[3+2]	1,2	3,6
Q.1(b)	For the position of the mechanism shown in Figure 1, determine the velocity of the slider B for the given configuration if the velocity of the slider A is 3 m/s. Take the help of velocity diagram. The sliders A and B have relative motions with respect to the fixed points O and G, respectively.	[5]	1,2	3

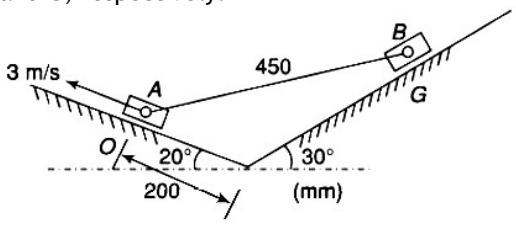

Figure 1

Q.2(a)	With the help of a neat sketch, explain the working principle of a centrifugal governor.	[5]	1,2	2
Q.2(b)	A Porter Governor has sleeve of mass *M* and each ball A and D has mass *m* as shown schematically in Figure 2. The height of the governor is *h* and *r* is the distance of the center of each ball from the axis of rotation. The angular velocity of the balls, arms, and sleeve is *ω*. Show the free-body diagram of the left-hand half of the governor. Considering equilibrium condition of the left-hand half of the governor, derive the expression of the height of the governor *h* in terms of angular velocity *ω* and other parameters associated with the governor. Assume suitable notations for the length and angular positions required.	[2+3]	1,2	3,6

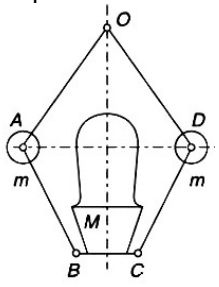

Figure 2

Q.3(a)	Explain primary and secondary unbalance in reciprocating engines?	[5]	1,2	2
Q.3(b)	The rotors shown in Figure 3 have the following properties: m_1 = 3 kg r_1 = 30 mm $\theta_1 = 30^o$ m_2 = 4 kg r_2 = 20 mm $\theta_2 = 120^o$ m_3 = 2 kg r_3 = 25 mm $\theta_3 = 270^o$ Find the amount of countermass m_c at a radial distance r_c of 35 mm for the static balance.	[5]		

PTO

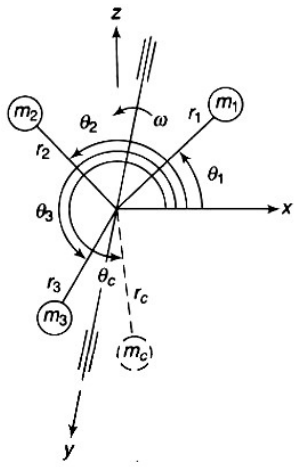

Figure 3

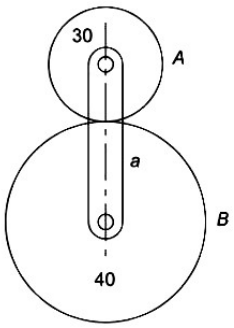

Figure 4

Q.4(a)	An epicyclic gear train consists of an arm a and two gears A and B having 30 and 40 teeth, respectively as shown in Figure 4. The arm rotates about the center of the gear A at a speed of 80 rpm counter-clockwise. Determine the speed of the gear B if (i) the gear A is fixed and (ii) the gear A revolves at 240 rpm clockwise instead of being fixed.	[5]	3	3
Q.4(b)	Describe the method to construct displacement profile of a follower following cycloidal motion in a cam-follower mechanism. The follower achieves maximum displacement *h* for the cam rotation angle φ.	[5]	1,2,4	2
Q.5(a)	A rotor is rotating with angular velocity ω about *x*-axis in anticlockwise direction when it is looked from positive *x*- direction towards origin as shown in Figure 5. The rotor is given an infinitesimal angular displacement $\delta\theta$ in time δt about *y*-axis. In the new position, the magnitude of the angular velocity changes to $\omega + \delta\omega$. Derive the angular acceleration as well as gyroscopic couple of the rotor. The mass moment of inertia of the rotor is *I*.	[5]	5	6

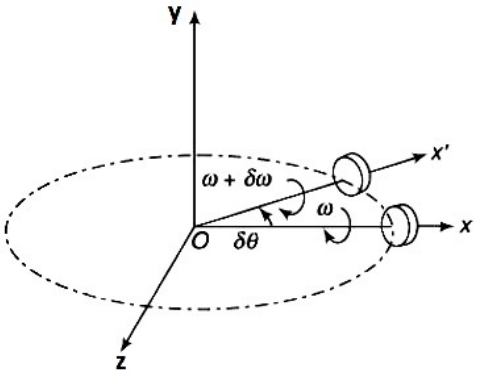

Figure 5

Q.5(b)	A four-wheeled vehicle is running with velocity v. Each wheel of the vehicle has mass moment of inertia I_w and radius r. The engine is rotating in the opposite direction to the wheel. The mass moment of inertia of the engine rotating parts is I_e and gear ratio of the engine is *G*. Determine the reaction forces of the ground on each wheel due to gyroscopic couple when the vehicle is taking right turn of radius of curvature *R* as viewed from rear end.	[5]	5	3

::::::24/04/2023::::::M