Name:

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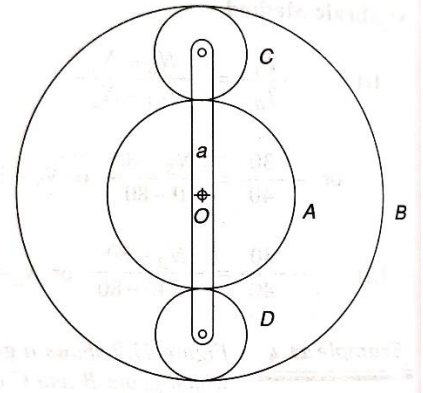
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2019

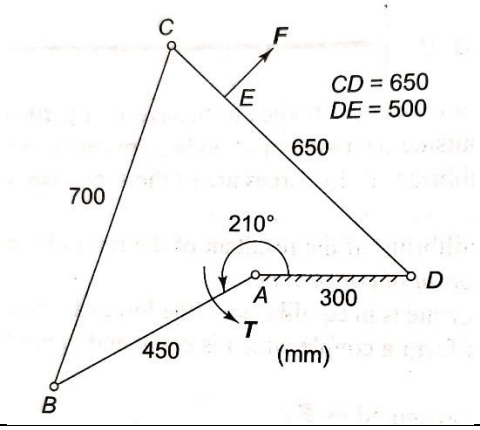
Course: Theory of Machines **Semester: IV**
Program: B.Tech – Mechatronics **Time 03 hrs.**
Course Code: MECH 2006 **Max. Marks: 100**
No. of Pages: 03
Instructions: The marks for each question is mentioned on the right hand side. Each question is mandatory. Question No. 5 and 9 have internal choices.

SECTION A

S. No.		Marks	CO
Q 1	Differentiate between Whitworth quick return mechanism and Crank and Slotted lever mechanism.	**5**	**CO1**
Q 2	State and explain D'Alembert's Principle.	**5**	**CO1**
Q 3	Explain different kinematic pairs according to nature of contact.	**5**	**CO1**
Q 4	Explain the process of undercutting in gears with a suitable sketch.	**5**	**CO1**

SECTION B

Q 5	An epicyclic gear train is shown in figure. The number of teeth on A and B are 80 and 200. Determine the speed of the arm 'a' (i) if A rotates at 100 rpm clockwise and B at 50 rpm counterclockwise. (ii) if A rotates at 100 rpm clockwise and B is stationary.  **OR** Two 20º full-depth involute spur gears having 30 and 48 teeth are in mesh. The pinion rotates at 840 rpm. The module is 4 mm. If the interference is just avoided, determine (i) addenda on the wheel and the pinion, (ii) the path of contact, (iii) the maximum velocity of sliding at engagement and disengagement of a pair of teeth, and (iv) contact ratio.	**10**	**CO2**
Q 6	Each wheel of a four-wheeled rear engine automobile has a moment of inertia of 2.2 kg.m^2 and an effective diameter of 600 mm. The rotating parts of the engine have a	**15**	**CO4**

	moment of inertia of 1.25 kg.m^2. The gear ratio of the engine to the back wheel is 3.2. The engine axis is parallel to the rear axle and the crankshaft rotates in the same sense as the road wheels. The mass of the vehicle is 2050 kg and the centre of the mass is 520 mm above the road level. The track width of the vehicle is 1.6 m. Determine the limiting speed of the vehicle around a curve with 120 m radius so that all the four wheels maintain contact with the road surface.		
Q 7	Determine the torque required to be applied to link AB of the linkage shown in figure to maintain the static equilibrium. Take force F = 100 N. The lengths of the links are mentioned beside each link in mm.  	**15**	**CO3**
	SECTION-C		
Q 8	Use the following data in drawing the profile of a cam in which a knife-edge follower is raised with uniform acceleration and deceleration and is lowered with simple harmonic motion: Least radius of cam = 60 mm Lift of follower = 45mm Angle of ascent = 60º Angle of dwell between ascent and descent = 40º Angle of descent = 75º If the cam rotates at 180 rpm, determine the maximum velocity and acceleration during ascent and descent.	**20**	**CO4**
Q 9	A rotor has the following properties: Mass | Magnitude | Radius | Angle | Axial Distance from 1st mass 1 | 9 kg | 100 mm | 0º | 2 | 7 kg | 120 mm | 60º | 160 mm 3 | 8 kg | 140 mm | 135º | 320 mm 4 | 6 kg | 120 mm | 270º | 560 mm If the shaft is balanced by two counter-masses located at 100 mm radii and revolving in planes midway of planes 1 and 2, and midway of 3 and 4, determine the magnitude of the masses and their respective angular positions. Justify your answer by graphical method. **OR**	**20**	**CO3**

	Differentiate between static and dynamic balancing of rotating masses. Four masses A, B, C and D are completely balanced. Masses C and D make angles of 90º and 210º respectively with that of mass B in the counterclockwise direction. The rotating masses have the following properties- m_b = 15 kg r_a = 360 mm m_c = 25 kg r_b = 480 mm m_d = 20 kg r_c = 240 mm r_d = 300 mm Planes B and C are 250 mm apart. Determine the mass A and its angular position with that of mass B. Also find the positions of all the planes relative to plane of mass A.	**5+15**	