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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Fourth Semester, B. E. - Industrial and Production Engineering

Semester End Examination; July / Aug. - 2022

Theory of Machines

Time: 3 hrs *Max. Marks: 100*

Course Outcomes

The Students will be able to:

CO1 - Calculate mobility (number of degrees-of-freedom) and enumerate rigid links and types of joints within mechanisms, and to Understand gear mechanism classification and to become familiar with gear standardization and specification in design.

CO2 - Explain Terminology of gears and Importance of gear trains and their practical applications.

CO3 - Know uses and advantages of belt drives Types and their nomenclature, Relationship between belt tensions commonly used design parameters.

CO4 - Draw inversions and determine velocity and acceleration of different mechanisms, and to Calculate loss of power due to friction in various machine elements and Importance of Governors.

CO5 - Explain Gyroscopic Effects and Gyroscope in automobile sector.

***Note**: I) **PART - A** is compulsory. **Two** marks for each question.*

*II) **PART - B**: Answer any **Two** sub questions (from a, b, c) for a Maximum of **18 marks** from each unit.*

Q. No.		Questions	Marks	BLs	COs
		PART -A	**10**		
I	a.	Define Kutzback criterion.	2	L1	CO1
	b.	List the methods to avoid interface for a pair of spur gears in contact.	2	L1	CO2
	c.	Define the maximum power transmission condition in a belt drive.	2	L1	CO3
	d.	Explain sensitiveness in a governor.	2	L1	CO4
	e.	Explain the Gyroscopic effect while the aeroplane takes a; i) Left turn ii) Right turn Assume the propeller to be rotating in the clockwise direction when viewed from the front end of the aeroplane.	2	L1	CO5
		PART - B	**90**		
		UNIT - I	**18**		
1	a.	Derive the condition for the Ackerman steering gear mechanism.	9	L3	CO1
	b.	With a neat sketch explain any one inversion of four bar chain.	9	L1	CO1
	c.	Determine the mobility of the members shown in fig. 1(c)i, 1(c)ii and 1(c)iii and state that whether it is a mechanism or not.	9	L3	CO1

Contd... 2

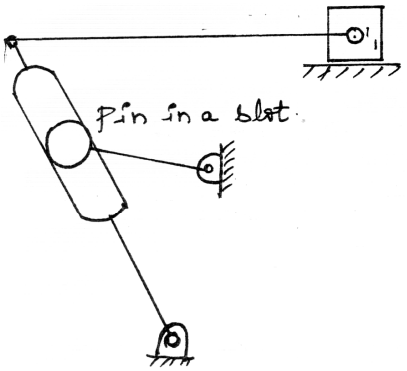

Fig. 1(c) i

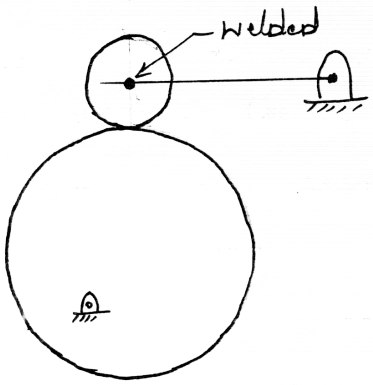

Fig. 1(c) ii

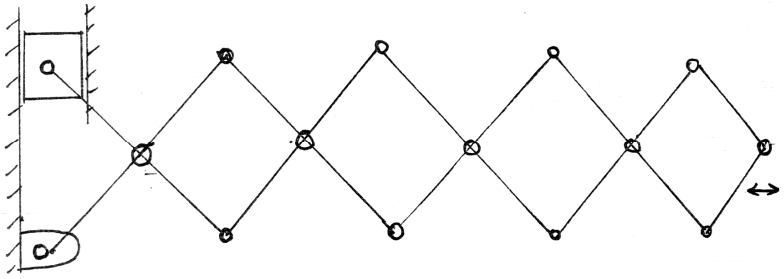

Fig. 1 (c) iii

UNIT - II **18**

2 a.	Derive an expression for the path of contact for a pair of spur gears in mesh.	9	L3	CO2
b.	With a neat sketch explain simple, compound and epicyclic gear train.	9	L1	CO2
c.	An epicyclic gear train consists of an arm and two gears A and B having 30 and 40 teeth respectively. The arm rotates about the centre 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 fired and ii) The gear A revolves at 240 rpm clockwise instead of being fixed Use tabular column method.	9	L3	CO2

UNIT - III **18**

3 a.	Derive an expression for friction torque of a flat collor based on uniform pressure theory.	9	L3	CO3
b.	Derive an expression for ratio of belt tension.	9	L3	CO3
c.	Determine the maximum power that can be transmitted through a flat belt having the following data. Cross section of the belt = 300 mm x 12 mm Ratio of friction tensions = 2.2 Maximum permissible tention in belt = 2 N/mm^2 Mass density of the belt material = 0.0011 gm/mm^3	9	L3	CO3

Contd... 3

UNIT - IV **18**

4 a.	The rotor has the following properties: $m_1=3kg$ $r_1=30mm$ $\phi_1=30^o$ $l_1=100mm$ $m_2=4kg$ $r_2=20mm$ $\phi_2=120^o$ $l_2=300mm$ $m_3=2kg$ $r_3=25mm$ $\phi_3=270^o$ $l_3=600mm$ $r_{c_1}=35mm$ *and* $r_{c_2}=20mm$ l_1, l_2 and l_3 are the distances from the bearing 1. The axial distance between the bearings is 500 mm. Determine the counter mass to be placed in places of m_1 and mid way between m_2 and m_3 for complete balance.	14	L3	CO4
b.	Derive an expression for the governor speed for a porter governor.	14	L3	CO4
c.	Define controlling force for a porter and Hashthell governor.	4	L1	CO4

UNIT - V **18**

5 a.	Explain the gyroscopic effects on an aeroplane.	9	L1	CO5
b.	Explain the gyroscopic effects on a Naval ship.	9	L1	CO5
c.	The rotor of a marine turbine has a moment of inertia of 750 kg/m^2 and rotates at 3000 rpm. Clockwise when viewed from left. If the ship pitches with angular simple harmonic motion having a periodic time of 16 seconds and an amplitude of 0.1 rad, find the i) Maximum angular velocity of the rotor axis ii) Maximum value of the gyroscopic couple iii) Gyroscopic effect as the bow dips.	9	L3	CO5

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