



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 Kutzbach 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	2	L1	CO5
	Assume the propeller to be rotating in the clockwise direction when viewed from the front end of the aeroplane.			
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

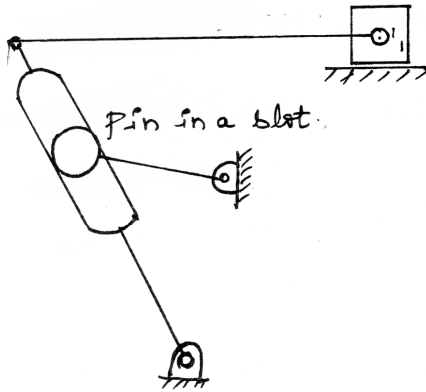


Fig. 1(c) i

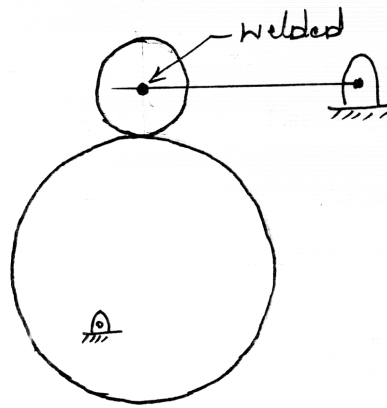


Fig. 1(c) ii

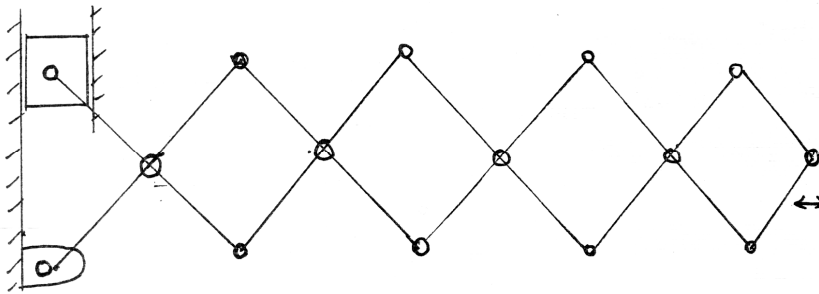


Fig. 1(c) iii

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 fixed 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 collar 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. 9 L3 CO3
 Cross section of the belt = 300 mm x 12 mm
 Ratio of friction tensions = 2.2
 Maximum permissible tension in belt = 2 N/mm²
 Mass density of the belt material = 0.0011 gm/mm³

UNIT - IV

18

4 a. The rotor has the following properties:

$$m_1=3kg \quad r_1=30mm \quad \phi_1=30^\circ \quad l_1=100mm$$

$$m_2=4kg \quad r_2=20mm \quad \phi_2=120^\circ \quad l_2=300mm$$

$$m_3=2kg \quad r_3=25mm \quad \phi_3=270^\circ \quad l_3=600mm$$

$$r_{c_1} = 35mm \text{ and } r_{c_2} = 20mm$$

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 Hashtell 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

9 L3 CO5

i) Maximum angular velocity of the rotor axis

ii) Maximum value of the gyroscopic couple

iii) Gyroscopic effect as the bow dips.

* * * *