Sub Code: R2331033

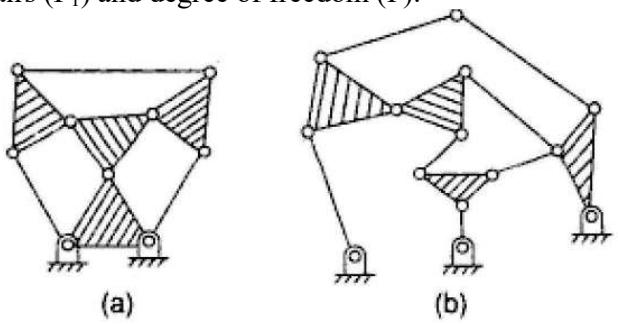
R23

Set No. 1

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY-GURUJADA VIZINAGARAM
III B. Tech I Semester Regular Examinations November -2025
THEORY OF MACHINES
(ME)

Time: 3 hours **Max. Marks: 70**

The Question paper consists of Part A & Part B.
Part A is compulsory, Answer all questions. Part B Answers any one question from each unit.
*****

1		PART-A	(20Marks)
	a)	For the kinematic linkages shown in Fig. 1, find the number of binary links (N_b), ternary links (N_t), Other links (N_o), total links N, loops L, joints of pairs (P_1) and degree of freedom (F).  (a) (b) **Fig. 1**	[2]
	b)	Differentiate between completely constrained motion and incompletely constrained motion with an example.	[2]
	c)	State the advantages of V-belt drive over flat belt drive.	[2]
	d)	What is meant by the law of gearing?	[2]
	e)	List different types of followers used in cam mechanisms.	[2]
	f)	What is the function of a flywheel in an engine?	[2]
	g)	Define sensitiveness of a governor.	[2]
	h)	State Dunkerley's method of determining natural frequency.	[2]
	i)	Differentiate between primary and secondary unbalanced forces in reciprocating engines.	[2]
	j)	What is meant by critical speed of a shaft?	[2]
		PART-B	(50Marks)
		Question from **Unit - I**	
2	a)	With neat sketch, explain the Ackermann steering gear mechanism.	[5]
	b)	The lengths of links in a four-bar chain are 120 mm, 350 mm, 400 mm and 450 mm. Check for Grashof's condition and discuss all possible inversions of this chain by considering each link fixed in turn, and state the type of mechanism obtained in each case.	[5]
		(OR)	
3	a)	A crank-rocker mechanism has a 70mm fixed link, a 20mm crank, a 50mm coupler, and a 70mm rocker. Draw the mechanism determine the maximum and minimum values of the transmission angles. Locate the two toggle positions and find the corresponding crank angles and the transmission angles.	[5]
	b)	Derive expression for degrees of freedom of planar mechanisms using Kutzbach criterion.	[5]
		Question from **Unit - II**	
4	a)	Draw velocity and acceleration diagrams for a crank and slotted lever quick return mechanism.	[5]
	b)	A flat belt drive transmits 25 kW from a pulley of diameter 1.00 m running at 300 rpm. The belt has an angle of contact on the pulley of	[5]

		160° and the coefficient of friction between belt and pulley is 0.30. The belt cross-section is rectangular, 20 mm × 5 mm, and the allowable tensile stress in the belt material is 40 MPa. (a) Calculate the maximum power that can be transmitted without slipping. (b) Determine whether the required 25 kW can be transmitted safely (i.e., check tensions against allowable tension). (c) If the belt is transmitting 25 kW at the limiting condition of impending slip, find the tight-side and slack-side tensions T_1 and T_2.	
		(OR)	
5	a)	Explain compound and epicyclic gear trains with neat sketches.	[5]
	b)	Explain the Law of Gearing and, with a neat labelled sketch, show why the involute profile is a conjugate profile that satisfies this law; then briefly define the terms *pitch circle*, *module*, *addendum* and *dedendum*, and finally state two reasons why a gear drive would be chosen over a belt or chain drive in mechanical power transmission.	[5]
		Question from **Unit - III**	
6	a)	Draw displacement, velocity and acceleration diagrams for a cam with SHM outstroke and UARM return stroke.	[5]
	b)	A cam with a roller follower moves outward 40 mm in 120° with SHM, dwell 30°, return in 90° with uniform acceleration-retardation. Draw displacement diagram with neat sketch.	[5]
		(OR)	
7	a)	Explain turning moment diagram of a single-cylinder four-stroke engine.	[5]
	b)	A flywheel absorbs fluctuation of energy of 2500 Nm at mean speed 250 rpm. The fluctuation of speed is limited to ±1%. Calculate the mass moment of inertia of the flywheel.	[5]
		Question from **Unit - IV**	
8	a)	Compare Watt and Porter governors with neat sketches.	[5]
	b)	A Porter governor has equal arms 250 mm each, revolving ball mass 5 kg, sleeve load 50 kg. Find equilibrium speed when radius of rotation is 200 mm.	[5]
		(OR)	
9	a)	Explain balancing of inline engines.	[5]
	b)	A 4-cylinder inline engine with cranks 90° apart has reciprocating mass 8 kg per cylinder, stroke 120 mm, speed 1200 rpm. Determine unbalanced primary and secondary forces.	[5]
		Question from **Unit - V**	
10	a)	Define damping in vibrations. Explain different types of damping with examples.	[5]
	b)	A single rotor shaft system has a mass of 10 kg mounted at mid-span of a simply supported shaft. The shaft length is 0.6 m and the diameter is 25 mm. Calculate the critical speed of the shaft using Dunkerley's method. (Take $E=2\times10^{11}$ N/m^2)	[5]
		(OR)	
11	a)	Explain Rayleigh's method for estimating the natural frequency of a system. Illustrate its application to a simply supported beam carrying a point load at the center.	[5]
	b)	A 25 mm diameter shaft 0.6 m long carries a disc of mass 5 kg at midspan. Both ends fixed. Determine its critical speed.	[5]

*****