

PRAGATI ENGINEERING COLLEGE: SURAMPALEM
(AUTONOMOUS)
III B.Tech I Semester Supplementary Examinations, May - 2024

DYNAMICS OF MACHINERY
(Mechanical Engineering)

Time: 3 hours

Max. Marks: 70 M

Answer ONE Question from each Unit
 All Questions Carry Equal Marks

Q. No.	Questions	BTL	CO	Marks
UNIT – I				
1.	a) In a four link mechanism ABCD, the link AB revolves with an angular velocity of 10 radians/second and angular acceleration of 20 radians/sec ² . The instant when it makes an angle of 45° with AD the fixed link. The lengths of the links are AB=CD=800 mm, BC=1000 mm and AD=1500 mm. The mass of the links is 4kg/m length. Determine the torque required to overcome the inertia forces, neglecting the gravitational effects. Assume the links to be of uniform cross-section.	K4	CO1	10M
	b) Discuss briefly D'Alembert's Principle	K2	CO1	4M
OR				
2.	A multi-cylinder engine is to run at a speed of 600 r.p.m. On drawing the turning moment diagram to a scale of 1 mm = 250 N-m and 1 mm = 30 N-m, the areas above and below the mean torque line in mm ² are : + 160, - 172, + 168, - 191, + 197, - 162 mm ² . The speed is to be kept within ± 1% of the mean speed of the engine. Calculate the necessary moment of inertia of the flywheel. Determine the suitable dimensions of a rectangular flywheel rim if the breadth is twice its thickness. The density of the cast iron is 7250 kg/m ³ and its hoop stress is 6 MPa. Assume that the rim contributes 92% of the flywheel effect	K4	CO1	14M
UNIT – II				
3.	a) In a belt transmission dynamometer, the driving pulley rotates at 300rpm. The distance between the centre of the driving pulley and the dead mass is 800mm. The diameter of each of the driving as well as the intermediate pulleys is equal to 360mm. Find the value of the dead mass required to maintain the lever in a horizontal position when the power transmitted is 3kW. Also find its value when the belt just begins to slip on the driving pulley. Coefficient of friction being 0.25 and the maximum tension in the belt 1200N.	K4	CO2	7 M
	b) Explain the working of internal expanding shoe brake with the help of neat sketch	K3	CO2	7 M
OR				
4.	a) Determine the axial force required to engage a cone clutch transmitting 25 kW of power at 750 rpm. Average friction diameter of the cone is 400 mm and average pressure intensity is 60 kN/m ² . Semi cone angle is 10° and coefficient of friction is 0.25. Also find the width of the friction cone	K4	CO2	7 M
	b) A Single Plate clutch with both sides of the plate effective is required to transmit 25 kW at 1600 r.p.m. The outer diameter of the plate is limited to 300 mm and the intensity of pressure between the plates does not exceed 0.07 N/mm ² . Assuming uniform wear and coefficient of friction	K3	CO2	7 M

		as 0.3, find the inner diameter of the plates and the axial force necessary to engage the clutch			
UNIT – III					
5.	Four masses A, B, C and D are attached to a shaft and revolve in the same plane. The masses are 12kg, 10kg, 18kg and 15kg respectively and their radii of rotations are 40mm, 50mm, 60mm and 30mm. The angular position of the masses B, C and D are 60° , 135° and 270° from mass A. Find the magnitude and position of the balancing mass at a radius of 100mm		K4	CO3	14 M
OR					
6.	A four crank engine has two outer cranks set at 120° to each other, and their reciprocating masses are each 400 kg. The distance between the planes of rotation of adjacent cranks are 450 mm, 750 mm and 600 mm. If the engine is to be in complete primary balance, find the reciprocating mass and the relative angular position for each of the inner cranks. If the length of each crank is 300 mm, length of each connecting rod is 1.2 m and the speed of rotation is 240 rpm, what is maximum secondary unbalanced force?		K4	CO3	14 M
UNIT – IV					
7.	A ship is propelled by a rotor of mass 2000kg rotates at a speed of 2400rpm. The radius of gyration of rotor is 0.4m and spins clockwise direction when viewed from bow (front) end. Find the gyroscopic couple and its effect when: i) The ship takes left turn at a radius of 350 m with a speed of 35kmph ii) The ship pitches with the bow rising at an angular velocity of 1rad/s iii) The ship rolls at an angular velocity of 0.15rad/s		K3	CO4	14 M
OR					
8.	a)	In a Hartnell governor the radius of rotation is 7 cm when speed is 500 rpm. At this speed, ball arm is normal and sleeve is at mid position. The sleeve movement is 2 cm with +5% of change in speed. The mass of sleeve is 6 kg and friction is equivalent to 25 N at the sleeve. The mass of the ball is 2 kg. If ball arm and sleeve arms are equal, find, (i) Spring rate (ii) Initial compression in the spring, and (iii) Governor effort and power for 1% change in the speed if there is no friction.	K4	CO4	10 M
	b)	What are the limitations of a Watt governor	K2	CO4	4 M
UNIT – V					
9.	a)	Derive the differential equation of motion for a free damped vibration	K2	CO5	7 M
	b)	A shaft of 40mm diameter and 2.5m length has a mass of 15kg per meter length. It is simply supported at the ends and carries three masses of 90kg, 140kg and 60kg at 0.8m, 1.5m and 2m respectively from the left support. Taking $E=200\text{GN/m}^2$, find the frequency of the transverse vibrations and whirling speed	K3	CO5	7 M
OR					
10.	a)	What do you mean by whirling of shafts? What is critical speed? Explain	K2	CO5	7 M
	b)	In a spring-mass vibrating system, the natural frequency of vibration is 3.56 Hz. When the amount of suspended mass is increased by 5 kg, the natural frequency is lowered to 2.9 Hz. Determine the original unknown mass and the spring constant	K3	CO5	7 M