Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

PDDC - SEMESTER–V • EXAMINATION – SUMMER • 2015

Subject Code: X51901 **Date: 07/05/2015**

Subject Name: Theory of Machines

Time: 02:30 pm - 05:00 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1	**(a)**	Describe the working of a 'Double Block Brake' with the help of a neat sketch. Also discuss about its advantages.	**07**
	(b)	Explain the working of a 'Prony Brake Dynamometer' with the help of a neat sketch and derive the equation of power measured by it.	**07**
Q.2	**(a)**	A simple band brake is applied to a rotating drum of diameter 500 mm. The angle of lap of the band on the drum is 270°. One end of the band is attached to a fulcrum pin of the lever and other end is to a pin 100 mm on the lever from the fulcrum. If the coefficient of friction is 0.25 and a braking force of 90 N is applied at a distance of 600 mm from the fulcrum on the lever, determine the braking torque when the drum rotates in (i) anticlockwise direction and (ii) clockwise direction.	**07**
	(b)	A car having a wheel base of 2.85 m is moving along a level road at a speed of 60 km/hr. The center of mass of the car is 600 mm above the road level and is at a distance of 1.2 m from the rear axle. The coefficient of friction between tyres and road surface is 0.1. Determine the minimum distance in which the car may be stopped when brakes are applied to (i) the rear wheels and (ii) the front wheels.	**07**
		OR	
	(b)	Calculate the minimum speed of a Proell governor, which has four equal arms each 200 mm and pivoted on the axis of rotation. The mass of each ball is 4 kg and the central load on the sleeve is 20 kg. The extension links of the lower arms are each 60 mm long and parallel to the axis of rotation when the minimum radius of rotation of the ball is 100 mm.	**07**
Q.3	**(a)**	Discuss about the working of the 'Centrifugal Governor' with the help of a neat sketch and define the following terms: (i) Radius of rotation (ii) Height of governor (iii) Equilibrium speed and (iv) Lift of the sleeve	**07**
	(b)	A Porter governor has all four arms 300 mm long. The upper arms are pivoted on the axis of rotation and lower arms are attached to the sleeve at a distance of 35 mm from the axis of rotation. The mass of each ball is 7 kg and the mass of the sleeve is 54 kg. If the extreme radii of rotation of the balls are 200 mm and 250 mm, determine the range of speed of the governor.	**07**
		OR	
Q.3	**(a)**	Define the following terms in context with governor: (i) Sensitiveness (ii) Stability (iii) Isochronism (iv) Hunting (v) Effort (vi) Power (vii) Coefficient of insensitiveness	**07**
	(b)	The mass moment of inertia of a propeller of an aircraft is 150 $kg.m^2$ and rotates at 3600 rpm clockwise when observed from rear. The aircraft takes a turn with radius 100 m towards left when flying at 360 km/hr. Determine the gyroscopic couple acting on the aircraft and state its effect.	**07**

Q.4 **(a)** Explain the effect of gyroscopic couple on the two-wheeled vehicle and derive the relationship of angle of heel in usual notations. **07**

(b) A rotor of a ship turbine has a mass moment of inertia 2000 kg.m^2. The turbine rotates at a speed of 360 rpm in clockwise sense when observed from stern. If the ship pitches and moving up with angular SHM having amplitude 10° and periodic time 20 s, find maximum value of the gyroscopic couple and its effect. **07**

OR

Q.4 **(a)** The crank and the connecting rod of a horizontal reciprocating engine are 100 mm and 500 mm respectively. The crank is rotating at 400 rpm. When the crank has turned through 30° from IDC, find analytically (i) velocity of the piston, (ii) acceleration of the piston, (iii) angular velocity of the connecting rod and (iv) angular acceleration of the connecting rod. **07**

(b) The length of the connecting rod of an engine is 500 mm measured between the centres and its mass is 18 kg. The centre of gravity is 125 mm from the crank pin centre and crank radius is 100 mm. It oscillates 43 times per minute when suspended from the small end centre. Determine the dynamically equivalent system keeping one mass at the small end centre. **07**

Q.5 **(a)** How the flywheel defers from governor? Also discuss about the different types of flywheel used. **07**

(b) A turning moment diagram for a multi-cylinder engine has been drawn to a scale of 1 mm = 325 Nm vertically and 1 mm = 3° horizontally. The areas above and below the mean torque line are –26, 378, –256, 306, –302, 244, –380, 261 and –225 mm^2. The engine is running at a mean speed of 600 rpm. The coefficient of fluctuation of speed is 0.036. If the radius of flywheel is 0.7 m, find the mass of the flywheel. **07**

OR

Q.5 **(a)** What is Freudenstein's equation? How is it helpful in designing the four-bar mechanism when three positions of the input (θ_1, θ_2, θ_3) and the out put link (ϕ_1, ϕ_2, ϕ_3) are known? **07**

(b) Describe the procedure to design a four-bar mechanism by relative pole method when three positions of the input link (θ_1, θ_2, θ_3) and the out put link (ϕ_1, ϕ_2, ϕ_3) are known. **07**

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