Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE – SEMESTER – V (NEW) EXAMINATION – WINTER 2015

Subject Code: 2151902 Date:05/12/ 2015

Subject Name: Theory of Machines

Time:10:30am to 1:00pm 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)** What is isochronism in governors? Prove that a Porter governor cannot be isochronous. **03**

(b) Explain the terms: Hunting, Effort of a governor **04**

(c) In figure-1, a four bar mechanism is shown. Calculate the required value of torque T_2 and various forces on links for equilibrium of the system. **07**

Q.2 **(a)** How do the effects of gyroscopic couple and of centrifugal force make the rider of a two-wheeler tilt on one side? Derive an expression for its stability. **07**

(b) The mass of a turbine rotor of a ship is 8000 kg and has a radius of gyration of 0.75 m. It rotates at 1800 rpm clockwise when viewed from stern. Determine the gyroscopic couple and its effect in the following cases: **07**
(i) If the ship travelling at 100 km/hr steers to the left along a curve of 80 m radius. (ii) If the ship pitches 5° above and 5° below the normal position and the bow is descending with maximum velocity. The pitching motion is simple harmonic motion with a periodic time of 20 s. (iii) If the ship is rolling with an angular velocity of 0.03 rad/s clockwise when looking from stern.
Also find the maximum angular acceleration during pitching.

OR

(b) A four wheeled trolley car has a total mass of 3000 kg. Each axle with its two wheels and gears has a total moment of inertia of 32 kgm^2. Each wheel is of 450 mm radius. The centre distance between two wheels on an axle is 1.4 m. Each axle is driven by a motor with a speed ratio of 1:3. Each motor along with its gear has a moment of inertia of 16 kgm^2 and rotates in the opposite direction to that of the axle. The centre of mass of the car is 1 m above the rails. Calculate the limiting speed of the car when it has to travel around a curve of 250 m radius without the wheels leaving the rails. **07**

Q.3 **(a)** Define Coefficient of fluctuation of energy and Coefficient of fluctuation of speed for flywheel. Find a relation for the coefficient of speed in terms of maximum fluctuation of energy. **07**

(b) The turning moment diagram for a multi-cylinder engine has been drawn to a vertical scale of 1 mm = 650 Nm and a horizontal scale of 1mm = 4.5°. The areas above and below the mean torque line are -28, +380, -260, +310, -300, +242, -380, +265 and -229 mm^2. The fluctuation of speed is limited to ±1.8% of the mean speed which is 400 rpm. The density of the rim material is 7000 kg/m^3 and width of the rim is 4.5 times its thickness. The centrifugal stress in the rim material is limited to 6 N/mm^2. Neglecting the effect of the boss and arms, determine the diameter and cross section of the flywheel rim. **07**

OR

Q.3 **(a)** With a neat sketch, explain construction, operation and application of a centrifugal clutch. **07**

(b) A punching machine carries out 6 holes per minute. Each hole of 40 mm diameter in 35 mm thick plate requires 8 Nm of energy/mm^2 of the sheared area. The punch has a stroke of 95 mm. Find the power of the motor required if the mean speed of the flywheel is 20 m/s. If total fluctuation of speed is not to exceed 3% of the mean speed, determine the mass of the flywheel. **07**

Q.4 **(a)** Derive an expression of retardation for a vehicle moving up an inclined plane when (i) brakes are applied to front wheels only (ii) brakes are applied to all four wheels. **07**

(b) A differential band brake shown in Figure-2, has an angle of contact of 225°. The band has a lining whose coefficient of friction is 0.3 and the drum diameter is 400mm. The brake is to sustain a torque of 375 Nm. Find (i) the necessary force for the clockwise and counter-clockwise rotation of the drum and (ii) the value of OA for the brake to be self-locking, when the drum rotates clockwise. **07**

OR

Q.4 **(a)** What is the advantage of a transmission type dynamometer over an absorption type dynamometer? Explain the construction and working of any one transmission type dynamometer. **07**

(b) A single plate clutch is required to transmit 8 kW at 1000 rpm. The axial pressure is limited to 70 kN/m^2. The mean radius of the plate is 4.5 times the radial width of the friction surface. If both the sides of the plate are effective and the coefficient of friction is 0.25, find the (i) inner and outer radii of the plate and the mean radius (ii) width of the friction lining (iii) axial force to engage the clutch. **07**

Q.5 **(a)** Explain shaking forces and shaking moments. Derive their expressions for a four bar linkage. **07**

(b) List experimental methods used for finding out the radius of gyration of components having complicated geometry? Explain any one method in detail, with neat sketch. **07**

OR

Q.5 **(a)** Explain impulse and momentum. **07**

(b) How is the effect of friction forces considered in the static force analysis of a mechanism having turning pairs? **07**

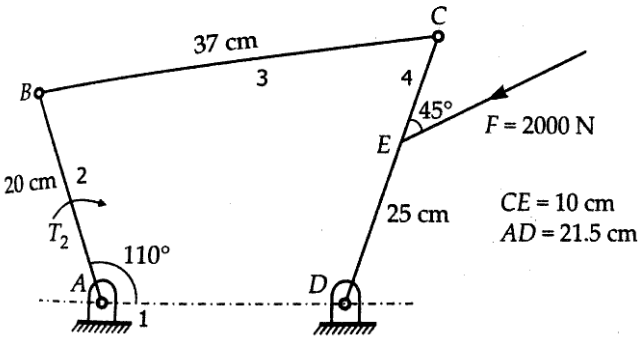

Figure-1 [Q.1 (C)]

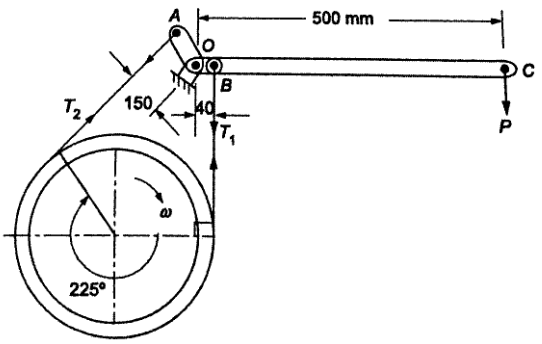

Figure-2 [Q.4 (b)]

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