Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– V(OLD) EXAMINATION – SUMMER 2019

Subject Code:151902 Date:15/06/2019

Subject Name:Theory Of Machines

Time:02:30 PM TO 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)** Define and explain the following terms relating to governors **07**
1. Stability 2. Sensitiveness 3. Hunting.

(b) A Porter governor has equal arms each 250 mm long and pivoted on the axis of rotation. Each ball has a mass of 5 kg and the mass of the central load on the sleeve is 25 kg. The radius of rotation of the ball is 150 mm when the governor begins to lift and 200 mm when the governor is at maximum speed. Find the minimum and maximum speeds and range of speed of the governor. **07**

Q.2 **(a)** Define Synthesis. Explain in brief the classifications of synthesis **07**

(b) Synthesize a four-bar mechanism to generate a function $y = \sin x$ for $0 \leq x \leq 90°$. The range of the output crank may be chosen as 60° while that of input crank be 120°.Assume three precision points which are to be obtained from Chebyshev spacing. Assume fixed link to be 52.5 mm long and $\theta_1 = 105°$ and $\phi_1 = 66°$. **07**

OR

(b) A four bar mechanism is to be designed by using three precision points, to generate the function $y = x^{1.5}$, for the range $1 \leq x \leq 4$. Assuming 30° starting position and 120° finishing position for the input link and 90° starting position and 180° finishing position for the output link, find the values of x, y, θ and ϕ corresponding to the three precision points. **07**

Q.3 **(a)** Define: 'Co-efficient of fluctuation of Energy' and 'Co-efficient of fluctuation of Speed'. Also prove that the maximum fluctuation of energy, $\Delta E = 2.E.Cs$ Where, E = Mean kinetic energy of flywheel, and Cs = Coefficient of fluctuation of speed. **07**

(b) A torsion dynamometer is fitted to a propeller shaft of a marine engine. It is found that the shaft twists 2° in a length of 20 meters at 120 r.p.m. If the shaft is hollow with 400mm external diameter and 300 mm internal diameter, find the power of the engine. Take modulus of rigidity for the shaft material as 80GPa **07**

OR

Q.3 **(a)** Distinguish between brakes and dynamometer **07**

(b) A band and block brake, having 14 blocks each of which subtends an angle of 15° at the center, is applied to a drum of 1 m effective diameter. The drum and flywheel mounted on the same shaft has a mass of 2000 kg and a combined radius of gyration of 500 mm. The two ends of the band are attached to pins on opposite sides of the brake lever at distances of 30 mm and 120 mm from the fulcrum. If a force of 200 N is applied at a distance of 750 mm from the fulcrum, find: 1. maximum braking torque, 2. angular retardation of the drum, and 3. time taken by the system to come to rest from the rated speed of 360 r.p.m. The coefficient of friction between blocks and drum may be taken as 0.25 **07**

Q.4 **(a)** What is turning moment diagrams? What information can be avail from them? **07**

(b) A rear engine automobile is travelling along a track of 100 meters mean radius. Each of the four road wheels has a moment of inertia of 2.5 $kg\text{-}m^2$ and an effective **07**

diameter of 0.6 m. The rotating parts of the engine have a moment of inertia of 1.2 kg-m^2. The engine axis is parallel to the rear axle and the crankshaft rotates in the same sense as the road wheels. The ratio of engine speed to back axle speed is 3:1. The automobile has a mass of 1600 kg and has its center of gravity 0.5 m above road level. The width of the track of the vehicle is 1.5 m. Determine the limiting speed of the vehicle around the curve for all four wheels to maintain contact with the road surface. Assume that the road surface is not cambered and center of gravity of the automobile lies centrally with respect to the four wheels.

OR

Q.4 **(a)** Explain gyroscopic couple and discuss its effect on an aero plane taking turns when viewed from rear. **07**

(b) A ship propelled by a turbine rotor which has a mass of 5 tonnes and a speed of 2100 r.p.m. The rotor has a radius of gyration of 0.5 m and rotates in a clockwise direction when viewed from the stern. Find the gyroscopic effects in the following conditions : **07**

(1.) The ship sails at a speed of 30 km/h and steers to the left in a curve having 60 m radius.

(2.) The ship pitches 6 degree above and 6 degree below the horizontal position. The bow is descending with its maximum velocity. The motion due to pitching is simple harmonic and the periodic time is 20 seconds.

(3). The ship rolls and at a certain instant it has an angular velocity of 0.03 rad/s clockwise when viewed from stern. Explain how the direction of motion due to gyroscopic effect is determined in each case.

Q.5 **(a)** The crank and connecting rod of a petrol engine, running at 1800 r.p.m. are 50 mm and 200 mm respectively. The diameter of the piston is 80 mm and the mass of the reciprocating parts is 1 kg. At a point during the power stroke, the pressure on the piston is 0.7 N/mm^2, when it has moved 10 mm from the inner dead Centre. Determine : 1. Net load on the gudgeon pin, 2. Thrust in the connecting rod, 3. Reaction between the piston and cylinder **07**

(b) Explain dynamically equivalent two mass systems **07**

OR

Q.5 **(a)** A punching press is required to punch 40 mm diameter holes in a plate of 15 mm thickness at the rate of 30 holes per minute. It requires 6 N-m of energy per mm^2 of sheared area. If the punching takes 1/10 of a second and the r.p.m. of the flywheel varies from 160 to 140, determine the mass of the flywheel having radius of gyration of 1 meter. **07**

(b) Explain inertia force analysis of a reciprocating engine using Klein's construction. **07**

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