GUJARAT TECHNOLOGICAL UNIVERSITY
BE – SEMESTER- V EXAMINATION-SUMMER 2023

Subject Code: 2151902   **Date: 30/06/2023**

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.**
4. **Simple and non-programmable scientific calculators are allowed.**

Q.1	**(a)**	Write short note on 'coefficient of insensitiveness' of governors.	**03**
	(b)	What are the leading and trailing shoes of an internal expanding shoe brake?	**04**
	(c)	Establish a formula for the maximum torque transmitted by a single plate clutch of external and internal radii R_1 and R_2, if the limiting coefficient of friction is µ and the axial spring load is W. Assume that the pressure intensity on the contact faces is uniform.	**07**

Q.2	**(a)**	Describe the gyroscopic effect on sea going vessels.	**03**
	(b)	Distinguish Brake, Clutch and Dynamometer.	**04**
	(c)	A ship propelled by a turbine rotor which has a mass of 5 tones 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: **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. Determine also the maximum angular acceleration during pitching. Explain how the direction of motion due to gyroscopic effect is determined in each case.	**07**

OR

	(c)	What do you understand by gyroscopic couple? Derive a formula for its magnitude.	**07**

Q.3	**(a)**	Explain precisely the uses of turning moment diagram of reciprocating engines.	**03**
	(b)	Define and explain the following terms relating to governors : 1. Stability, 2. Sensitiveness, 3. Isochronism, and 4. Hunting.	**04**
	(c)	The turning moment diagram for a multi cylinder engine has been drawn to a scale 1 mm = 600 N-m vertically and 1 mm = 3° horizontally. The intercepted areas between the output torque curve and the mean resistance line, taken in order from one end, are as follows : + 52, – 124, + 92, – 140, + 85, – 72 and + 107 mm², when the engine is running at a speed of 600 r.p.m. If the total fluctuation of speed is not to exceed ± 1.5% of the mean, find the necessary mass of the flywheel of radius 0.5 m.	**07**

OR

Q.3 **(a)** What are the limitations of a Watt governor? **03**

(b) Prove that the sensitiveness of a Proell governor is greater than that of a Porter **04** governor.

(c) A porter Governor has equal arms each 250 mm long and pivoted on the axis of **07** 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 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.

Q.4 **(a)** What is the function of a flywheel? How does it differ from that of a governor? **03**

(b) Which of the two assumptions-uniform intensity of pressure or uniform rate of **04** wear, would you makeuse of in designing friction clutch and why?

(c) A single dry plate clutch transmits 7.5 kW at 900 r.p.m. The axial pressure is **07** limited to 0.07 N/mm^2. If the coefficient of friction is 0.25, find **1.** Mean radius and face width of the friction lining assuming the ratio of the mean radius to the face width as 4 and **2.** Outer and inner radius of the clutch plate.

OR

Q.4 **(a)** Explain the application of gyroscopic principles to aircrafts. **03**

(b) What is the difference between absorption and transmission dynamometers? **04** What are torsion dynamometers?

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

Q.5 **(a)** State and explain parallel axis theorem. **03**

(b) Enlist the factors affecting capacity of brakes. **04**

(c) Evaluate braking analysis of four wheeler with the help of neat sketch. **07**

OR

Q.5 **(a)** Explain planner rotation about fixed Centre. **03**

(b) State and explain Lami's theorem with suitable example. **04**

(c) Analyze of dynamics force analysis of slider crank mechanism. **07**

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