

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-V (OLD) EXAMINATION – WINTER 2018****Subject Code:151902****Date: 04/12/2018****Subject Name: Theory Of Machines****Time: 10:30 AM TO 01:00 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) Explain the terms 'fluctuation of energy' and 'fluctuation of speed' as applied to flywheels. Define the terms 'coefficient of fluctuation of energy' and 'coefficient of fluctuation of speed', in the case of flywheels. **07**

(b) Prove that the maximum fluctuation of energy, **07**
 $\Delta E = E \times 2CS$
where E = Mean kinetic energy of the flywheel, and
CS = Coefficient of fluctuation of speed.

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 a relation for the angle of heel. **07**

(b) Describe the working of a band and block brake with the help of a neat sketch. Deduce the relation for ratio of tight and slack side tensions. **07**

OR

(b) The turning moment diagram for a multi-cylinder engine has been drawn to a scale of 1 mm to 500 N-m torque and 1 mm to 6° of crank displacement. The intercepted areas between output torque curve and mean resistance line taken in order from one end, in sq. mm are – 30, + 410, – 280, + 320, – 330, + 250, – 360, + 280, – 260 sq. mm, when the engine is running at 800 r.p.m. **07**
The engine has a stroke of 300 mm and the fluctuation of speed is not to exceed $\pm 2\%$ of the mean speed. Determine a suitable diameter and cross-section of the flywheel rim for a limiting value of the safe centrifugal stress of 7 MPa. The material density may be assumed as 7200 kg/m³. The width of the rim is to be 5 times the thickness.

Q.3 (a) 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.

Determine also the maximum angular acceleration during pitching. Explain how the direction of motion due to gyroscopic effect is determined in each case.

(b) Explain the effect of the gyroscopic couple on the reaction of the four wheels of a vehicle negotiating a curve. **07**

- Q.3 (a)** What is Brake? What is meant by a self locking and a self energized brake? **07**
(b) What is meant by dynamically equivalent system? State and prove conditions for it. **07**

- Q.4 (a)** Explain the term height of governor. Derive an expression for height in case of Watt governor. What are the limitations of Watt governor? **07**
(b) What is the main function of a governor? How does it differ from flywheel? Differentiate between inertia and centrifugal governor. **07**

OR

- Q.4 (a)** A band brake acts on the $\frac{3}{4}$ th of circumference of a drum of 450 mm diameter which is keyed to the shaft. The band brake provides a braking torque of 225 N-m. One end of the band is attached to a fulcrum pin of the lever and the other end to a pin 100 mm from the fulcrum. If the operating force is applied at 500 mm from the fulcrum and the coefficient of friction is 0.25, find the operating force when the drum rotates in the (a) anticlockwise direction, and (b) clockwise direction. **07**
- Q.5 (a)** What are the leading and trailing shoes of an internal expanding shoe brake? **07**
(b) What is the difference between absorption and transmission dynamometers? What are torsion dynamometers? Describe the construction and operation of a prony brake or rope brake absorption dynamometer. **07**

OR

- Q.5 (a)** Explain in brief the working of flywheel in punching Press. **07**
(b) What do you understand by type synthesis, number synthesis and dimensional synthesis? Describe the classification of the synthesis problem with suitable examples. **07**

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