

GUJARAT TECHNOLOGICAL UNIVERSITY**B.E. Sem-Vth Examination December 2010****Subject code: 151902****Subject Name: THEORY OF MACHINES****Date: 15 /12 /2010****Time: 03.00 pm - 05.30 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) What is meant by a self locking and a self energized brake? **07**
(b) A simple band brake (refer fig-1) is applied to a shaft carrying a flywheel of 250 kg mass and of radius of gyration of 300 mm. The shaft speed is 200r.p.m. The drum diameter is 200 mm and the coefficient of friction is 0.25. Determine the **07**
(1) The brake torque when a force of 120 N is applied at the lever end.
(2) Number of turns of the flywheel before it comes to rest.

- Q.2** (a) Prove that a governor is stable if $dF/dr > F/r$, Where F is controlling force and r is corresponding radius of rotation. **07**
(b) A porter governor has equal arms 200mm long pivoted on the axis of rotation. The mass of each ball is 3 kg and the mass on the sleeve is 15kg. The ball path is 120 mm when the governor begins to lift and 160mm at the maximum speed. Determine the range of speed. **07**
If the friction at the sleeve is equivalent to a force of 10 N, find the coefficient of insensitiveness.

OR

- (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**

- Q.3** (a) Discuss gyroscopic effects on naval ships. **07**
(b) The turbine rotor of a ship has a mass of 2.2 tones and rotates at 1800 r.p.m. clockwise when viewed from the left. The radius of gyration of the rotor is 320mm. Determine the gyroscopic couple and its effect when **07**
(1) Ship turns right at a radius of 250m. with a speed of 25 km/hr. (2) Ship pitches with the bow rising at an angular velocity of 0.8 rad/sec. (3) Ship rolls at an angular velocity of 0.1 rad/sec.

OR

- Q.3** (a) Derive an expression for angle of heel of a two wheeler taking turn. **07**
(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 32kg.m². Each wheel is of 450mm radius. The centre distance between two wheels on an axle is 1.4m. 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 kg.m² 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 250m. radius without the wheel leaving the rails. **07**

- Q.4 (a)** Draw and explain to the point turning moment diagram of a 4-Stroke single cylinder Engine. **07**
- (b)** The turning moment diagram for a multi cylinder engine has been to 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 RPM. The engine has a stroke of 300mm 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/m^3 . The width of Rim is to be 5 times the thickness. **07**

OR

- Q.4 (a)** Define the flywheel and state its importance. What are the types of flywheels? **07**
- (b)** In I.C .Engine Mechanism the Crank radius is 400mm and Connecting rod is 950 mm long. The diameter of piston is 100mm and net gas pressure acting on the piston is 15 MPa. Find **07**
 (1) Thrust in connecting rod (2) Piston side exhaust (3) Torque acting on Crankshaft (4) Radial force or load on main bearings when crank has made 45° from TDC.

- Q.5 (a)** Draw and explain Klein's construction for determining the velocity of the piston of a Reciprocating engine. **07**
- (b)** A connecting rod is suspended from the point 25 mm above the small end centre and 650 mm above its C.G. it takes 35 seconds for 20 oscillations. Find dynamically equivalent system of two masses when the mass is located at small end centre. Mass of the connecting rod is 40 Kg. **07**

OR

- Q.5 (a)** Explain two Position Synthesis for Slider Crank Mechanism. **07**
- (b)** Explain Synthesis of a Function generation **07**

