

GUJARAT TECHNOLOGICAL UNIVERSITY**BE- Vth SEMESTER-EXAMINATION – MAY/JUNE - 2012****Subject code: 151902****Date: 02/06/2012****Subject Name: Theory of Machines****Time: 02:30 pm – 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) Discuss the effect of the gyroscopic couple on a disc fixed at a certain angle to a rotating shaft. **07**

(b) A car is of total mass 2200 kg has the track width 1.5 m. Each wheel having an effective diameter 0.66 m and the mass moment of inertia 2.4 kg m^2 . The mass moment of inertia of rotating parts of the engine is 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 gear ratio of the engine to the rear wheel is 3. The centre of mass of the car is 0.55 m above the road level. If the car is rounding a curve of 80 m radius at a speed of 100 km/h, determine the load distribution on the inner and outer wheels. **07**

Q.2 (a) Derive an expression of turning moment on crankshaft of a horizontal reciprocating engine neglecting the effect of the mass of the connecting rod. **07**

(b) A vertical IC engine has a cylinder bore of 150 mm and stroke of 200 mm. The connecting rod is 350 mm long. The mass of the reciprocating parts is 1.6 kg. During the expansion stroke with crank angle 30° from top dead centre, the gas pressure is 750 kN/m^2 . Determine the piston effort when engine runs at 1800 rpm. **07**

OR

(b) The connecting rod of a reciprocating engine has a mass of 55 kg, distance between the bearing centers is 850 mm, diameter of small end bearing is 75 mm, diameter of big end bearing is 100 mm, time of oscillation when the connecting rod is suspended from the small end is 1.83 s and time of oscillation when it is suspended from the big end is 1.68 s. Determine:
(i) the radius of gyration of the connecting rod about an axis passing through the mass centre and perpendicular to the plane of oscillation, (ii) the moment of inertia of the connecting rod about an axis passing through its mass centre and (iii) the dynamically equivalent system of the connecting rod comprising two masses, one at the small end bearing centre. **07**

Q.3 (a) What is a function of a governor? How does it differ from that of a flywheel? Also explain the terms sensitiveness, hunting and stability relating to governors. **07**

(b) A porter governor having each of its four arms of 400 mm. The upper arms are pivoted on the axis of the sleeve, whereas the lower arms are attached to the sleeve at a distance of 45 mm from the axis of rotation. Each ball has a mass of 8 kg and the load on the sleeve is 60 kg. Determine the equilibrium speeds for two extreme radii of 250 mm and 300 mm of rotation of the balls. **07**

OR

Q.3 (a) What is a brake? Enlist the various types of brakes and explain the working **07**

of any one of them with neat sketch.

- (b) A simple band brake is applied on a drum of 560 mm diameter which is rotating at 240 rpm. The band having an angle of contact on the drum of 270° . One end of the band is fitted to a fixed pin while the other end is fitted to the lever 140 mm from the fixed pin. The lever is 800 mm long and is perpendicular to the diameter that bisects the angle of contact. If the coefficient of friction is 0.3, what will be the necessary pull at the end of the lever to stop the drum when the power absorbed is 40 kW. Also calculate the width of the band if its thickness is 3 mm and the maximum tensile stress is limited to 40 N/mm^2 . **07**
- Q.4** (a) What is a dynamometer? How the dynamometer differs from the brake? Explain with neat sketch, the working of any one of the transmission type dynamometers. **07**
- (b) A torsion dynamometer is fitted to a shaft of a turbine. The shaft gets twisted by 2° in length of 20 m when it rotates at 120 rpm. If the shaft is hollow with 300 mm internal and 400 mm external diameters, what will be the power of the turbine? If a hollow shaft is replaced by a solid shaft with 350 mm diameter, what will be the power of the turbine? Take the modulus of rigidity of the shaft material as 80 GPa. **07**
- OR**
- Q.4** (a) What do you understand by type synthesis, number synthesis and dimensional synthesis? Describe the classification of the synthesis problem with suitable examples. **07**
- (b) A function $y = 2x^2 - x$ is to be generated by a four bar mechanism for the range $1 \leq x \leq 4$ with three accuracy points. Assuming 30° starting position and 120° final position for input link and 90° starting position and 180° final position for output link, determine the corresponding values of x , y , θ and ϕ . **07**
- Q.5** (a) What is the pole of a coupler link of four bar chain mechanism? Enumerate its properties. What is a relative pole? **07**
- (b) Explain three-position synthesis for slider-crank mechanism on the base of method of inversion. **07**
- OR**
- Q.5** (a) What is a flywheel? What is its use? Derive a relationship for the coefficient of fluctuation of speed in terms of maximum fluctuation of energy and the kinetic energy of the flywheel at mean speed. **07**
- (b) The mass of a flywheel is 5000 kg with radius of gyration 2 m and the mean speed of an engine is 240 rpm. If the fluctuation of energy is 100 kN-m, find the maximum and minimum speeds of the flywheel. **07**
