

GUJARAT TECHNOLOGICAL UNIVERSITY**B. E. Sem. - V - Examination – June- 2011****Subject code: 151902****Subject Name: Theory of Machines****Date: 22/06/2011****Time: 10:30 am – 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) (i) Explain: Function generation, path generation & motion generation. **07**
 (ii) Derive Freudenstein's Equation.
- (b) Using relative pole method synthesize a four bar mechanism by taking **07**
 $\theta_{12} = 50^\circ$ $\phi_{12} = 30^\circ$, $\theta_{13} = 60^\circ$ $\phi_{13} = 40^\circ$.
 Draw again your mechanism by taking fixed link length = 60 mm.

- Q.2** (a) State Chebyshev theorem and find three precession points for the function **07**
 $f(x) = x^{1.2}$ in the interval $0 \leq x \leq 6$.
 Take $\theta_i = 60^\circ$, $\Delta \theta = 90^\circ$, $\phi_i = 50^\circ$, and $\Delta \phi = 100^\circ$.
- (b) A porter governor has equal arms each 200 mm in length and pivoted on the **07**
 axis of rotation. The mass of each ball is 5 kg and the mass of sleeve is 25 kg.
 The radius of governor is 100 mm when governor begins to lift. If the
 frictional increase of speed is 1%, then determine the governor effort and
 power.

OR

- (b) A Hartnell governor having a central sleeve spring and two right angled bell **07**
 crank lever operates between 290 r.p.m. and 310 r.p.m. for a sleeve lift of 15
 mm. The sleeve arms and the ball arms are 80 mm and 120 mm respectively.
 The levers are pivoted at 120 mm from the governor axis and mass of each
 ball is 2.5 kg. The ball arms are parallel to the governor axis at the lowest
 equilibrium speed. Determine stiffness of the spring.
- Q.3** (a) List and explain mechanical brakes and also derive condition of self locking **07**
 for simple shoe or block brake.
- (b) A torsion dynamometer is fitted to a propeller shaft of a marine engine. It is **07**
 found that the shaft twists 2° in a length of 20 m at 120 r.p.m. If the shaft is
 hollow with O.D. = 400 mm and I. D. = 300 mm, and modulus of rigidity of
 shaft material is 8×10^{10} N/mm². Find the power of the engine.

OR

- Q.3** (a) Classify 'governors' and prove for Watt governor, height of the governor **07**
 $h = 895 / N^2$. where N is speed of rotation of sleeve.
- (b) Find the angle of inclination with respect to the vertical of a two wheeler **07**
 negotiating a turn. Following data is given: combined mass of the vehicle with
 its rider 250 kg, moment of inertia of the engine flywheel 0.3 kg.m^2 , moment
 of inertia of each road wheel 1 kg.m^2 , speed of engine flywheel five times that
 of road wheels and in the same directions, height of centre of gravity of rider
 with vehicle 0.6 m, two wheeler speed 90 km/h, wheel radius 300 mm, radius
 of turn 50 m.

- Q.4 (a)** Explain gyroscopic couple and discuss its effect on an aeroplane taking turns when viewed from rear. **07**
- (b)** The turbine of rotor of a ship has mass of 3000 kg. & radius of gyration of 0.4 m, and clockwise speed of 2500 r.p.m. when looking from stern. Determine gyroscopic couple and its effect when **07**
- The ship steers to the left on curve of 100 m radius at a speed of 36 km/hr. and
 - When the ship is pitching in S.H.M., the bow falling with its maximum velocity .The period of pitching is 40 Sec. and the total angular displacement between the bow extreme positions of pitching is 12° .

OR

- Q.4 (a)** Explain the term 'turning moment diagram', 'Coefficient of fluctuation of speed' and 'Coefficient of fluctuation of energy'. **07**
- (b)** A flywheel, which is rotating at a maximum speed of 250 r.p.m. and is having radius of gyration as 0.5 m, is attached to a punching press. The press is driven by a constant torque electric motor and punches 750 holes per hour. Each punching operation requires 14000 N-m of energy and takes 1.8 seconds. If the speed of the flywheel is not to fall below 225 r.p.m. Find: **07**
- power of the motor and
 - mass of the flywheel

- Q.5 (a)** What is meant by dynamically equivalent system? State and prove conditions for it. **07**
- (b)** The lengths of crank and the connecting rod of a horizontal reciprocating engine are 300 mm and 1.5 m respectively. The crank is rotating at 120 r.p.m. clockwise .The mass of the reciprocating parts of the engine is 290 kg whereas the mass of the connecting rod is 250 kg. The C.G. of the connecting rod is 475 mm from the crank pin centre and the radius of gyration of the connecting rod about an axis passing through the C.G. is 625 mm .Find the inertia torque on the crank shaft analytically, when $\theta = 40^\circ$. **07**

OR

- Q.5 (a)** A single cylinder vertical engine has a bore of 150 mm and a stroke of 200 mm. The connecting rod is 350 mm long. The mass of piston is 1.6 kg and engine speed is 1800 r.p.m. On the expansion stroke with a crank at 30° from the top dead centre, the gas pressure is 750 kN/m^2 . Determine the net thrust on the engine. **07**
- (b)** Solve the problem of Que. 5 (b) above, graphically using Klein's construction method. **07**
