Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V (NEW) - EXAMINATION – SUMMER 2016

Subject Code:2151902 **Date:06/05/2016**

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.**

Q.1 **(a)** Illustrate the effect of Gyroscopic couple on a car. **06**

(b) The ship is propelled by a turbine rotor having mass of 6 tonnes and speed of 2400 rpm. The direction of rotation of the rotor is clockwise when viewed from the stern. The radius of gyration of the rotor is 450 mm. Determine the gyroscopic effect when **08**

1. The ship steers the left in curve of 60 m radius at a speed of 33.48 km/hr.
2. The ship pitches 7.5 degree above and 7.5 degree below the normal position and the bow is descending with its maximum velocity. The pitching motion is simple harmonic with periodic time of 18 seconds.
3. The ship rolls and at the instant, its angular velocity is 0.035 rad/sec counter clockwise when viewed from the stern.

Q.2 **(a)** Describe with the help of a neat sketch the principles of operation of an internal expanding shoe. Derive the expression for the braking torque. **06**

(b) A car moving on a level road at a speed 50 km/h has a wheel base 2.8 meters, distance of C.G. from ground level 600 mm, and the distance of C.G. from rear wheels 1.2 meters. Find the distance travelled by the car before coming to rest when brakes are applied, 1. to the rear wheels, 2. to the front wheels, and 3. to all the four wheels. The coefficient of friction between the tires and the road may be taken as 0.6. **08**

OR

(b) A band and block brake, having 14 blocks each of which subtends an angle of 15° at the centre, is applied to a drum of 1 m effective diameter. The drum and flywheel mounted on the same shaft has a mass of 2000 kg and a combined radius of gyration of 500 mm. The two ends of the band are attached to pins on opposite sides of the brake lever at distances of 30 mm and 120 mm from the fulcrum. If a force of 200 N is applied at a distance of 750 mm from the fulcrum, find: 1. maximum braking torque, 2. angular retardation of the drum, and 3. time taken by the system to come to rest from the rated speed of 360 r.p.m. The coefficient of friction between blocks and drum may be taken as 0.25. **08**

Q.3 **(a)** Elaborate following terms in context of Governor. **06**

1. Sensitiveness of Governors
2. Stability of Governors
3. Isochronous Governor

(b) A Porter governor has equal arms each 250 mm long and pivoted on the axis of 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 mm when the governor begins to lift and 200 mm when the governor is at maximum speed. Find the range of speed, sleeve lift, governor effort and power of the governor when the friction at the sleeve is neglected. **08**

OR

Q.3 **(a)** Derive the expression for Effort and Power of a Porter Governor **06**

(b) A Hartnell governor with central sleeve, spring and two right angled bell cranked levers rotates between 288 and 320 rpm, for sleeve lift of 3 cm. the sleeve arm and the ball arm are 10 and 14 cm respectively. The levers are pivoted at 12 cm from the governor axis and the mass of each ball is 3 kg. The space restriction imposes the condition that maximum radius of rotation of the fly ball not to exceed 15 cm. calculate 1. Load on the spring at the lowest and the highest equilibrium speed and 2. Stiffness of spring **08**

Q.4 **(a)** Derive expression for frictional torque for centrifugal clutch. **06**

(b) The equation of the turning moment curve of a three crank engine is (5000 + 1500 sin 3θ) N-m, where θ is the crank angle in radians. The moment of inertia of the flywheel is 1000 kg-m^2 and the mean speed is 300 rpm. Calculate : 1. power of the engine, and 2. the maximum fluctuation of the speed of the flywheel in percentage when (i) the resisting torque is constant, and (ii) the resisting torque is (5000 + 600 sinθ) N-m. **08**

OR

Q.4 **(a)** Derive expression for frictional torque for single plate clutch considering uniform wear and uniform pressure condition. **06**

(b) A machine punching 38 mm holes in 32 mm thick plate requires 7 N-m of energy per sq. mm of sheared area, and punches one hole in every 10 seconds. Calculate the power of the motor required. The mean speed of the flywheel is 25 metres per second. The punch has a stroke of 100 mm. Find the mass of the flywheel required, if the total fluctuation of speed is not to exceed 3% of the mean speed. Assume that the motor supplies energy to the machine at uniform rate. **08**

Q.5 **(a)** Discuss the dynamic force effect on reciprocating engine using Klein's construction. **05**

(b) The following data relate to a horizontal reciprocating engine: **09**
Mass of reciprocating parts = 120 kg, Crank length = 90 mm, Engine speed = 600 rpm, Connecting rod: Mass = 90 kg, Length between centres = 450 mm, Distance of center of mass from big end centre = 180 mm, Radius of gyration about an axis through centre of mass = 150 mm. Find the magnitude and the direction of inertia torque on the crankshaft when the crank has turned 30° from the inner dead centre.

OR

Q.5 **(a)** Discuss the effect of inertia force on connecting rod. **05**

(b) Neglecting the friction determine the magnitude and direction of the couple which must be applied to link 2 to drive the linkage against the forces shown in Fig.1. Draw a free body diagram of each link and show forces acting. O_2A = 4 cm, AB=14 cm, AC=18 cm, BC=8 cm, O_4D=7 cm, O_4C=10 cm, O_2O_4=14 cm **09**

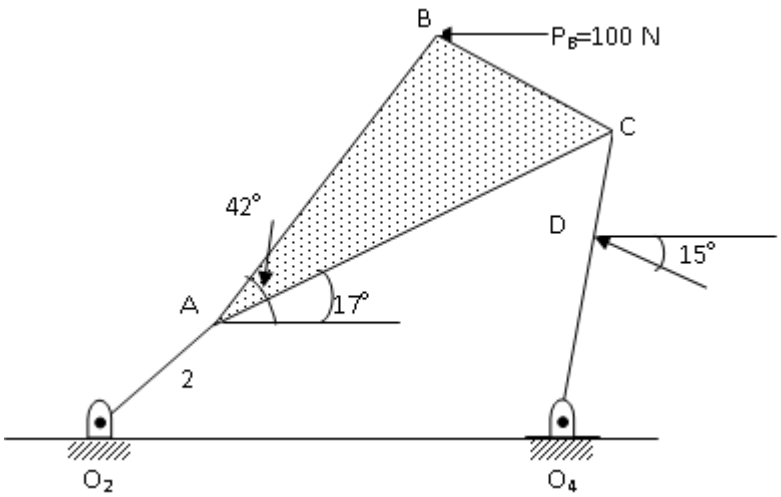

Fig.1