

**GUJARAT TECHNOLOGICAL UNIVERSITY****BE – SEMESTER V • EXAMINATION – WINTER - 2012****Subject code: 150902****Date: 12-01-2013****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) Describe the function of a Proell governor with the help of a neat sketch. Establish a relation among various forces acting on the bent link . 7
- (b) The arms of a porter governor are each 25 cm long and pivoted on the governor axis. Mass of each ball is 5 kg and mass of the central sleeve is 30 kg. The radius of rotation of the balls is 15 cm when the sleeve begins to rise and reaches a value of 20 cm for maximum speed. Determine the range of the governor. 7
- Q-2** (a) Design a four-link mechanism if the motion of the input and the output links are governed by a function  $y = x^{1.5}$  and  $x$  varies from 1 to 4. Assume  $\theta$  to vary from  $30^\circ$  to  $120^\circ$  and  $\Phi$  from  $60^\circ$  to  $130^\circ$ . The length of the fixed link is 30 mm. Use chebychev spacing of accuracy points. 7
- (b) Explain Frudenstein's method of three point synthesis of mechanism. 7
- OR**
- (b) Define Synthesis. Explain in brief the classification of synthesis. 7
- Q-3** (a) With the help of a neat sketch explain the working of a block of shoe brake. 7
- (b) A simple band brake is applied to a rotating drum of diameter 600 mm. The lap angle of the band on the drum is  $270^\circ$ . The one end of the lever has the fulcrum pin to which is attached, the one end of the band. Other end of the band is attached to a pin 120 mm from the fulcrum. The co-efficient of friction between the band and drum is 0.25. A braking force of 100 N is applied at a distance of 840 mm from the fulcrum. Determine the brake torque for (i) Counter-clockwise rotation of the drum and (ii) clockwise rotation of drum. 7
- OR**
- Q-3** (a) Describe the construction and operation of a prony rope brake absorption dynamometer. 7
- (b) A band and block brake has 14 blocks each of which subtends an angle of  $14^\circ$  at the centre. The brake is applied to a drum of 0.8 m diameter. The blocks are 100 mm thick. The drum and flywheel mounted on the same shaft has a mass of 2000 kg and combined radius of gyration of 500 mm. The two ends of the bands are fastened to pins on the opposite sides of brake lever at distances 35 mm and 140 mm from the fulcrum. An effort of 250 N is applied at a distance 800 mm from the fulcrum. The co-efficient of friction between the blocks and drum is 0.3 Determine (i) Maximum braking torque (ii) angular retardation of the drum (iii) Time taken by the system to come to stop from the rated speed of 300 rpm, 7

- Q-4** (a) Explain the principle of gyroscopic action and determine the magnitude and direction of gyroscopic couple **7**
- (b) A two wheeler motor vehicle and its rider weight 225 kg and their combined center of gravity is 600 mm above the ground level, when the vehicle is upright. Each road wheel is of 600 mm diameter and has a moment of inertia of  $1 \text{ kgm}^2$ . The rotating parts of the engine have a moment of inertia of  $0.175 \text{ kgm}^2$ . The engine rotates at 5.5 times the speed of the road wheels and in the same sense. Determine the angle of heel necessary, when the vehicle is rounding a curve of 30 m radius at a speed of 55 km/hr. **7**

**OR**

- Q-4** (a) Explain the effect of the gyroscopic couple on the reaction of the four wheels of a vehicle negotiating a curve. **7**
- (b) The turbine rotor of a ship has a mass of 3500 kg. It has a radius of gyration of 0.45 m and a speed of 3000 rpm clockwise when looking from stern. Determine the gyroscopic couple and its effect upon the ship: **7**
1. When the ship is steering to left on a curve of 100 m radius at a speed of 36 km/h
  2. When the ship is pitching in a simple harmonic motion, the bow falling with its maximum velocity. The period of pitching is 40 seconds and the total angular displacement between the two extreme positions of pitching is 12 degrees.

- Q-5** (a) The crank and connecting rod lengths of an engine are 125 mm and 500 mm respectively. The mass of the connecting rod is 60 kg and its centre of gravity is 275 mm from the crosshead pin centre, the radius of gyration about centre of gravity being 150 mm. If the engine speed is 600 rpm for a crank position of  $45^\circ$  from the inner dead centre, determine using Klien's construction. (1) the acceleration of the piston (2) The magnitude, position and direction of inertia force due to the mass of the connecting rod. **14**

**OR**

- Q-5** (a) Explain the turning moment diagram for 4 cylinder four stroke cycle internal combustion engine. **7**
- (b) Explain in brief the working of flywheel in punching Press. **7**

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