Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V • EXAMINATION – SUMMER 2013

Subject Code: 151902 Date: 16-05-2013

Subject Name: Theory of Machines

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) What is the function of a governor? How does it differ from a flywheel? **07**
(ii) Explain the terms relating to governor.
Sensitiveness, Hunting and Stability

(b) Explain gyroscopic effect in case of naval ships with a diagram. Show the terminologies used to indicate sides, front and back of ship. Explain effect of steering, pitching and rolling, assuming ship moves left and right direction sequentially. **07**

Q.2 **(a)** (i) What is gyroscopic couple? Derive a relation for its magnitude. **07**
(ii) The moment of inertia of an aero plane air screw is 20 kg.m^2 and the speed of rotation is 1250 rpm clockwise when viewed from the front. The speed of the flight is 200 km/hr. Calculate the gyroscopic reaction of the air screw on the aero plane when it makes a left hand turn on a path of 150 m radius.

(b) A Porter governor has arms of 380 mm long. The upper arms are pivoted at the axis of the sleeve and lower arms are attached to the sleeve at a distance of 40 mm from the axis. Each fly ball has a mass of 5 kg. and weight on sleeve is 45 kg. Find the range of speed of the governor if the extreme radii of rotation of the balls are 250 mm and 300 mm. The force of friction on sleeve of mechanism is 30 N. **07**

OR

(b) The following data refers to a **Hartnell governor**. **07**
Length of horizontal arms of bell crank lever = 40 mm and
Length of vertical arms of bell crank lever = 80 mm
Mass of each flying ball 1.2 kg. , The maximum radius of rotation = 100 mm, The minimum radius of rotation = 70 mm, The distance of fulcrum to axis of rotation = 75 mm, Minimum equilibrium speed = 400 rpm, Maximum equilibrium speed 5 % higher than minimum equilibrium speed. Neglecting obliquity of arms determine: (i) spring stiffness (ii) initial compression

Q.3 **(a)** (i) What is a flywheel? What is its function in reciprocating engine? **07**
(ii) What are turning moment diagrams? What information can be avail from them?

(b) Determine the maximum torque for a shoe brake shown in figure 1. The diameter of the brake drum is 400 mm and the angle of contact is 96. The applied force is 3 kN on each arm and the coefficient of friction between the drum and the lining is 0.35. **07**

OR

Q.3 **(a)** (i) What is a brake? What is the difference between a brake and a clutch? **07**
(ii) What is meant by a self locking and self energized brake?

(b) The turning moment diagram for a petrol engine is drawn to a vertical scale of 1 mm = 5 N.m and a horizontal scale of 1 mm = 1^0. The turning moment repeats itself after every half revolution of engine. The areas above and below the mean torque line are 305, 710, 50, 350, 980 and 275 mm^2. The rotating parts amount to a mass of 40 kg at a radius of gyration of 140 mm. Calculate the coefficient of fluctuation of speed if the speed of the engine is 1400 rpm. **07**

Q.4 **(a)** (i) Define these terms: Coefficient of fluctuation of speed and coefficient of fluctuation of energy. **07**
(ii) Derive a relation for the coefficient of fluctuation of speed in terms of maximum fluctuation of energy and the kinetic energy at mean speed.

(b) A horizontal gas engine running at 200 rpm has a bore of 200 mm and stroke of 400 mm. The connecting rod is 920 mm long and the reciprocating parts weigh 20 kg. When the crank has turned through an angle of 30^0 from inner dead center, the gas pressure on the cover and the crank sides are 460 kN/m^2 and 70 kN/m^2 respectively. Diameter of piston rod is 50mm. Determine **07**
(i) turning moment on the crank shaft, and (ii) thrust on the bearings.

OR

Q.4 **(a)** (i) State: DôAlembertôs principle. **07**
(ii) Explain: Dynamically equivalent system.

Q.4 **(b)** The crank and connecting rod of a vertical petrol engine running at 1800 rpm are 60 mm and 260 mm respectively. The diameter of piston is 100 mm and the mass of the reciprocating parts is 1.2 kg. During the expansion stroke when the crank has turned 20^0 from the top dead center, the gas pressure is 600 kN/m^2. Determine (i) net force on the piston, (ii) net load on gudgeon pin, (iii) Thrust on the cylinder walls. **07**

Q.5 **(a)** (i) Explain the terms: Function generation, path generation and motion generation **07**
(ii) What is Chebychev spacing? What is its significance?

(b) Design and draw a four bar mechanism to coordinate three positions of input and output links as given below using **Relative Pole method**. Take L_1 = 60 mm (fixed) and L_2 = 40 mm (crank). Find the length L_3 and L_4 graphically. **07**
$ď_1 = 38^0$, $ď_2 = 90^0$, $ď_3 = 142^0$ and $ű_1 = 45^0$, $ű_2 = 80^0$, $ű_3 = 115^0$.

OR

Q.5 **(a)** What is Frudensteinôs equation? How it is helpful in designing a four link mechanism when three positions of the input ($ď_1$, $ď_2$, $ď_3$) and the output link ($ű_1$, $ű_2$, $ű_3$) are known. **07**

(b) Design and draw a four bar mechanism to coordinate three positions of input and output links as given below using **Inversion method**. Take L_1 = 50 mm (fixed) and L_2 = 40 mm (crank). Find the length L_3 and L_4 graphically. **07**
$ď_1 = 38^0$, $ď_2 = 90^0$, $ď_3 = 142^0$ and $ű_1 = 45^0$, $ű_2 = 80^0$, $ű_3 = 115^0$.

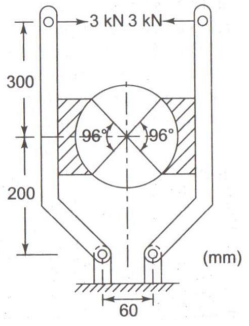

Figure 1, Que. 3 (b)