

## **GOVERNOR AND GYROSCOPE**

### **PART-A**

1. What is the function of governor?
2. How governors are classified?
3. Differentiate between governors and fly wheel.
4. What is meant by sensitiveness of a governor?
5. What is the effect of friction on the governor?
6. Define coefficient of sensitiveness.
7. What is meant by hunting?
8. What is meant by isochronous conditions governor?
9. Give application of gyroscopic principle.
10. What is gyroscopic torque?
11. What is the effect of gyroscopic couple on rolling of ship? Why?
12. Define gyroscopic couple.
13. Write expression for gyroscopic couple.

### **PART-B**

1. A porter governor has equal arms each 250mm long and pivoted on the axis of rotation. Each ball has a mass of 5kg and mass of the central load on the sleeve is 25kg. The radius of rotation of the ball is 150mm when governor is at maximum speed. Find the maximum and minimum speed and range of speed of the governor.
2. The length of the upper and lower arms of a porter governor is 200mm and 250mm respectively. Both the arms are pivoted on the axis of rotation. The central load is 150N, the weight of the each ball is 20N and the friction of the sleeve together with the resistance of the operating gear is equivalent to a force of 30N at the sleeve. If the limiting inclinations of the upper arms to the vertical are  $30^\circ$  and  $40^\circ$  taking friction in to account. Find the range of speed of the governor.
3. Calculate the range of speed of a porter governor which has equal arms of each 200mm long and pivoted on the axis of rotation. The mass of each ball is 4kg and the central load of the sleeve is 20kg. The radius of rotation of the ball is 100mm when the governor being to lift and 130mm when the governor is at maximum speed.
4. A hartnell governor having a central sleeve spring and two right angled bell crank lever operates between 290rpm and 310rpm for a sleeve lift of 15mm. The sleeve and ball arms are 80mm and 120mm respectively. The levers are pivoted at 120mm from the governor axis and mass of the ball is 2.5kg. The ball arms are parallel at lowest equilibrium speed. Determine
  - Load on the spring at maximum and minimum speeds and
  - Stiffness of the spring.
5. A governor of hartnell type has equal balls of mass 3kg, set initially at a radius of 200mm. The arms of the bell-crank lever are 110mm vertically and 150mm horizontally. Find

- The initial compressive force on the spring at a radius of 200mm at 240rpm
  - The stiffness of the spring required to permit a sleeve movement of 4mm on a fluctuation of 7.5 percent in the engine speed.
6. The controlling force in a spring controlled governor is 1500N when radius of rotation is 200mm and 887.5N when radius of rotation is 130mm. The mass of each ball is 8kg. If the controlling force curve is a straight line, then find
- (i) Controlling force at 150mm radius of rotation
  - (ii) Speed of the governor at 150mm radius.
  - (iii) Increase in initial tension so that governor is isochronous.
  - (iv) Isochronous speed.
7. In a spring controlled governor, the controlling force curve is a straight line. When the balls are 400mm apart, the controlling force is 1200N and when 200mm apart, the controlling force is 450N. Determine the speed at which the governor runs when the balls are 250mm apart. When initial tension on the spring would be required for isochronisms and what would be the speed. Take mass of each ball to be 10kg.
8. Calculate the minimum speed of a proell governor, which has equal arms each of 200mm and are provided on the axis of rotation. The mass of each ball is 4kg and the central mass on the sleeve is 20kg. The extension arms of the lower links are each 60mm long and parallel to the axis when the minimum radius of the ball is 100mm. of load.
9. (i) Explain the effect of Gyroscopic couple on a Naval ship during pitching.  
(ii) Explain the effect of gyroscopic couple on a Aero plane.
10. The rotor of a turbine yacht rotates at 1200rpm clockwise when viewed from stern. The rotor has a mass of 750 kg and radius of gyration of 250mm. Find the maximum gyroscopic couple transmitted to the hull when yacht pitches with a maximum angular velocity of 1 rad/s. What is the effect of this couple?
11. The turbine rotor of a ship has a mass of 20 tonnes and a radius of gyration 0.75. Its speed is 2000rpm. The ship pitches  $6^\circ$  above and below the horizontal position. One complete oscillation takes 18 seconds and the motion is simple harmonic. Determine
- (i) The maximum couple tending to shear the holding down bolt of the turbine
  - (ii) The maximum angular acceleration of the ship during pitching
  - (iii) The direction in which the bow will tend to turn while, if the rotation of the rotor is clockwise when looking from rear.
12. Each paddle wheel of a steamer have a mass of 1600kg and a radius of gyration of 1.2meters. The steamer turns to port in a circle of 160meters radius at 24Km/hr. The speed of the paddle is 90rpm. Find the magnitude and effect of the gyroscopic couple acting on the steamer.