

Theory of Machine-II
Sem-V [Mechanical Engg.]
Assignment No. 2
[Governor and Gyroscope]

1. a) A Porter governor has rotating masses 5 kg each and mass of sleeve is 30 kg. Upper links are 25 cm long and lower links are 35 cm long. The upper ends of the upper links and lower ends of the lower links are hinged at 4 cm from the shaft axis. Find the equilibrium speed of the governor in rpm when the governor weights rotate at 130 mm radius. Also find the governor effort and governor power if there is sudden change of 1 % in speed of governor.
b)

2. a) A uniform disc of 150 mm diameter has a mass of 4 kg. It is mounted centrally on the horizontal axis of 80 mm length between the bearings. It spins about an axle at 800 rpm in the counter clockwise direction when viewed from the right hand side bearing. The axle is made to precess about a vertical axis at 50 rpm in anticlockwise direction when viewed from the top. Determine the resultant reaction at each bearing due to mass and gyroscopic effect.
b) A motor cycle with rider has mass of 250 kg. The center of gravity of motor cycle and the rider falls 60 cm above the ground when running straight in vertical position. Each road wheel diameter is 60 cm with polar mass moment of inertia of 1 kgm^2 . The engine rotates 6 times faster than the wheels in the same directions and the rotating parts of the engine have mass moment of inertia of 0.175 kgm^2 .
Determine the angle of inclination of motor cycle or the angle of heel required if it is speeding at 80 km/hr and rounding a curve of 50 m.

3. a) The radius of gyration of a turbine rotor in ship with a mass of 20000 kg is 50 cm. The rotor rotates at 2000 rpm in clockwise direction when viewed from the stern of the ship. The ship pitches with total pitch angle of 15° . The motion can be considered to be simple harmonic motion with equal deviation on each side of the axis of spin with time period of 15 seconds. Calculate the maximum gyroscopic couple on the bolt of the turbine and the direction of steering as the bow rises.
b) In a Hartnell governor, the lengths of the ball and sleeve arms of a bell crank lever are 120 mm and 100 mm respectively. The distance of the fulcrum of bell crank lever from the governor axis is 140 mm. Each governor ball has a mass of 4 kg. The governor runs at a mean speed of 300 rpm with ball arms vertical and sleeve arms horizontal. For an increase in the speed of 4 % the sleeve moves 10 mm upwards. Neglecting friction, find (i) minimum equilibrium speed if the total sleeve movement is limited to 20 mm (ii) the spring stiffness (iii) the sensitiveness of the governor and (iv) the spring stiffness if the governor is to be isochronous at 300 rpm.

