(3 Hours)

[Total Marks : 100

N.B. : (1) Question No. 1 is **compulsory**.

(2) Attempt any **four** questions out of remaining **six** questions.

(3) Assume **suitable** data wherever **necessary**.

Q (1) Answer **any four** of the following questions.   (20)

(i) Explain self-energizing and self-locking effect in block brake.

(ii) Prove that the sensitiveness of a proell governor is greater than that of a porter governor.

(iii) Explain steering, rolling & pitching of a ship with the help of neat sketches.

(iv) Explain with neat sketch why a roller follower is preferred to that of a knife edged follower.

(v) Why single plate clutches are dry whereas multi plate clutches are wet?

Q(2) (A) A differential band brake acting on the 3/4th of the circumference of a drum of 450 mm diameter is to provide a braking torque of 225 N-m. One end of the band is attached to a pin 100 mm from the fulcrum of the lever and the other end to another pin 25 mm from the fulcrum on the other side of it to where the operating force is also acting. If the operating force is applied at 500 mm from the fulcrum and the coefficient of friction is 0.25, find the two values of the operating force corresponding to two directions of rotation of the drum.   (10)

(B) With the help of neat sketch derive the equation for finding out the mass of the shoes & size of the shoes in case of centrifugal clutch.   (10)

Q (3) (A) The arms of a porter governor are each 250 mm long and pivoted on the governor axis. The mass of each ball is 5 kg and the mass of the central sleeve is 30 kg. The radius of rotation of the balls is 150 mm when the sleeve begins to rise and reaches a value of 200 mm for maximum speed. Determine the speed range of the governor. If the friction at the sleeve is equivalent of 20 N of load at the sleeve, determine how the speed range is modified.   (10)

(B) A motor cycle with rider has a mass of 250 kg. The center of gravity of the 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 mass moment of inertia of 1 kg-m^2. The engine rotates 6 times faster than the wheel in the same direction and the rotating parts of the engine have a mass moment of inertia of 0.175 kg-m^2. Determine the angle of inclination of the motor cycle required if it is speeding at 80 km/hr and rounding a curve of radius 50 m. Also find the magnitude of gyroscopic couple.   (10)

Q (4) (A) A uniform disc of 150 mm diameter has a mass of 4 kg. It is mounted centrally on the horizontal axle of 80 mm length between the bearings. It spins about an axle at 800 rpm in 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 an anticlockwise direction when viewed from top. Determine the resultant reaction at each bearing due to mass and gyroscopic effect.   (10)

(B) In an epicyclic gear train, an arm carries two gears A and B having 36 and 45 teeth respectively. If the arm rotates at 150 rpm in the anticlockwise direction about the center of the gear A which is fixed, determine the speed of the gear B. If the gear A instead of being fixed makes 300 rpm in the clockwise direction, what will be the speed of gear B?   (10)

[TURN OVER

Q(5) (A) Draw the displacement, velocity and acceleration v/s cam angle diagram for the follower moving with S.H.M. during the outward and return stroke for the following data. Follower advances through a distance of 50 mm in 1/3 revolution of cam, takes rest for a period of 1/12 of revolution, return to its initial position in 1/6 of the revolution and then takes rest for the remaining part of the revolution. Cam shaft runs at a speed of 360 rpm.

(12)

(B) A vehicle moves on a road that has a slope of 15°. The wheel base is 1.6 m and the center of mass at 0.72 m from the rear wheels and 0.8 m above the inclined plane. The speed of the vehicle is 45 km/hr. The brakes are applied to all the four wheels and the coefficient of friction is 0.4. Determine the distance moved by the vehicle before coming to rest and the time taken to do so if it moves (i) up the plane (ii) down the plane. **(08)**

Q(6) (A) In a Hartnell governor, the lengths of ball and sleeve arms of a bell crank lever are 120 mm and 100 mm respectively. The distance of the fulcrum of the 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 the ball arms vertical and sleeve arms horizontal. For an increase of speed of 4 % the sleeve moves 10 mm upwards. Neglecting friction, find (i) the 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. **(12)**

(B) If the capacity of a single plate clutch decreases by 13 % during the initial wear period, determine the minimum value of the ratio of internal radius to external radius for the same axial load. Consider both the sides of the clutch plate to be effective.

(08)

Q (7) Write short notes on any four: **(20)**

    (i) Rope brake dynamometer.
    (ii) Differentiation between governor and flywheel
    (iii) Classifications of cams.
    (iv) Compound gear train.
    (v) Cone clutch