T.E. SEM V / MECH / 20.11.17/NOV 2017

Q.P. Code: 22664

(3 Hours) **Total Marks: 80**

N.B. 1) Question No.1 is compulsory.
2) Attempt any three questions out of the remaining five questions.
3) Figures to the right indicate full marks.
4) Assume suitable data wherever required but justify the same.

Q1. Attempt any four **(20)**

A. Describe with a neat sketch a centrifugal clutch and deduce an equation for the total torque transmitted.

B. Explain the working of an internal expanding shoe brake.

C. What is stability of a governor? Sketch the controlling force versus radius diagrams for a stable, unstable and isochronous spring controlled governor.

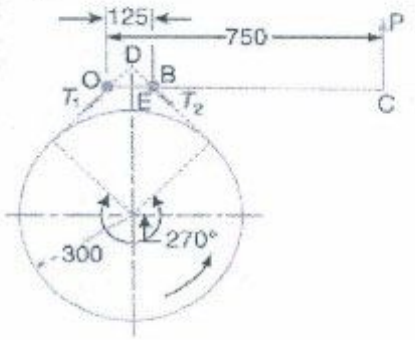
D. What will be the effect of the gyroscopic couple on a disc fixed at a certain angle to a rotating shaft?

E. Prove that maximum fluctuation of energy,
$\Delta E = E \times 2Cs$
Where, E = mean kinetic energy of the flywheel
Cs = coefficient of fluctuation of speed

Q2. A. A centrifugal clutch has four shoes which slide radially in a spider keyed to the driving shaft and make contact with the internal surface of a rim keyed to the driven shaft. When the clutch is at rest, each shoe is pulled against a stop by using a spring and leaves a clearance of 6 mm between the shoe and rim. The pull force exerted by the spring is 600 N. The C.G. of the shoe is 180 mm from the axis of the clutch. The internal diameter of the rim is 450 mm, stiffness of each spring is 50 kN/m. If the mass of each shoe is 10 kg and coefficient of friction between the rim and the shoe is 0.4, find the power transmitted by the clutch. Take speed of the shaft as 600 rpm. **(10)**

B. A simple band brake operates on a drum of 600 mm in diameter that is running at 200 rpm. The coefficient of friction is 0.25. The brake band has a contact of 270^0, one end is fastened to a fixed pin and the other end to the brake arm 125 mm from the fixed pin. The straight brake arm is 750 mm long and placed perpendicular to the diameter that bisects the angle contact. **(10)**

1) What is the pull necessary on the end of the brake arm to stop the wheel if 35 kW is being absorbed? What is the direction for this minimum pull?
2) What width of steel band of 2.5 mm thick is required for this brake if the maximum tensile stress is not to exceed 50 N/mm^2?



Q3. A. A Hartnell governor having a central sleeve spring and two right angled bell crank levers moves between 290 rpm and 310 rpm for a sleeve lift of 15 mm. The sleeve arms and ball arms are 80 mm and 120 mm respectively. The levers are pivoted at 120 mm from the governor axis and mass of each ball is 2.5 kg. The ball arms are parallel to the governor axis at lower equilibrium speed. Determine i) Loads on the spring at the lowest and highest equilibrium speed ii) Stiffness of the spring. (10)

B. A four wheel car has a total mass of 3000 kg. Each wheel is of 450 mm radius. The center distance between two wheels on an axle is 1.5 m and wheel base is 2.5 m. The height of the C.G. is 0.5 m above the road surface and located at 1 m from front axle. Each wheel has moment of inertia of 32 kg-m^2. The engine axis is along the longitudinal axis of the vehicle. The engine rotates 4 times the speed of wheels in clockwise direction when viewed from front. The mass of rotating parts of engine is 70 kg having radius of gyration of 100 mm. If the car is taking a left turn of 70 m radius at 50 km/hr, find the ground reaction on each wheel. (10)

Q4. A In the epicyclic gear train as shown in figure, the driving gear A rotating in clockwise direction has 14 teeth and the fixed annular gear C has 100 teeth. The ratio of teeth in gears E and D is 98:41. If 1.85 kW is supplied to the gear A rotating at 1200 rpm, find: 1) the speed and direction of rotation of gear E and 2) the fixing torque required at C, assuming 100% efficiency throughout and that all teeth have the same pitch. (10)

B. Find the dynamically equivalent two mass system for a connecting rod when one third of the mass is located at the small end. Center of mass is at two third length from the small end and its moment of inertia is $mL^2/20$. (10)

Q5. A. The turning moment diagram for a multi cylinder engine has been drawn to a scale of 1 mm to 500 N-m torque and 1 mm to 6^0 of crank displacement. The intercepted areas between output torque curve and mean resistance line taken in order from one end, in sq. mm are -30, +410, -280, +320, -330, +250, -360, +280, -260 sq. mm, when the engine is running at 800 rpm. The engine has a stroke of 300 mm and the fluctuation of speed is not to exceed $\pm$2% of the mean speed. Determine a suitable diameter and cross section of the flywheel rim for a limiting value of the safe centrifugal stress of 7 MPa. The material density may be assumed as 7200 kg/m^3. The width of the rim is to be 5 times the thickness. (10)

B. Derive the equation for the stability of two wheeler taking a turn considering gyroscopic and centrifugal couple. (10)

Q6. Write short notes on:- (20)

A. Necessity of gear box
B. Wilson Hartnell governor
C. Froude hydraulic dynamometer.
D. Friction clutches.