T.E. (Mechanical) (Sem-V) (CBSGS)

Paper / Subject Code: 31001 / THEORY OF MACHINES-II

Date-15/11/19

(3 Hours) [Total Marks ; 80]

N.B.
1) Question No. 1 is **compulsory**
2) Answer any **Three** questions from remaining **Five**
3) Assume suitable data wherever required, justify the same
4) Answer to questions showed be grouped and written together.

Qu. 1 Solve **any Four** — **20**

a) Define dynamically equivalent systems. State the condition necessary to make two systems dynamically equivalent.

b) How does a brake differ from that of a dynamometer?

c) What do you understand by gyroscopic couple? Derive a formula for its magnitude

d) Explain the necessity of gear box in automobile.

e) Why single plate clutches are dry whereas multi plate clutches are wet?

Qu. 2

a) The upper arms of a porter governor are pivoted on the axis of rotation and the lower arms are attached to the sleeve at a distance of 3.76 cm from the axis. The length of the arm and suspension links are 30 cm. the weight of each ball is 60 N and load on the sleeve is 480 N. if the extreme radii of rotation of governor balls are 20 cm and 25 cm. find the corresponding equilibrium speeds. **10**

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 diameter to external diameter for the same axial load. Consider both the sides of the clutch plate to be effective. **10**

Qu. 3

a) The turbine rotor of ship has a mass 2.2 tonnes and rotates at 1800 rpm clockwise when viewed from the aft. The radius of gyration of the rotor is 320 mm. Determine the gyroscopic couple and its effect when **10**

   a) The ship turns right at a radius of 250 m with a speed of 25 km/h.
   b) The ship pitches with the bow rising at an angular velocity of 0.8 rad/s
   c) The ship rolls at an angular velocity of 0.1 rad/s.

b) The semi-cone angle of a clutch is 12.5^0 and the contact surfaces have a mean diameter of 80 mm, coefficient of friction is 0.32. What is the minimum torque required to produce slipping of clutch for an axial force of 200N? **10**
If the clutch is used to connect an electric motor with a stationary flywheel, what is the time needed to attain the full speed and the energy lost during slipping? Motor speed is 900 rpm and the moment of inertia of the flywheel is 0.4 kg-m^2.

Qu. 4

a) The crank and the connecting rod of a vertical single cylinder gas engine running at 1800 rpm are 60 mm and 240 mm respectively. The distance of the piston is 80 mm and mass of the reciprocating parts is 1.2 kg. At a point during the power stroke when **10** the piston has moved 20 mm from the top dead center position, the pressure on the piston is 800 kN/m^2. Determine

i) The net force on the piston
ii) The thrust in the connecting rod
iii) The thrust on the sides of the cylinder walls
iv) The engine speed at which the above values are zero.

b) In the band and block brake, having 14 blocks each of which subtends an angle of 15^0 at the center, is applied to drum of 1m effective diameter. The drum and flywheel mounted on the same shaft has a mass of 2000 kg and a combined radius of gyration of 500 mm. The two ends of the band are attached to pins on opposite sides of the brake lever at distances of 30mm and 120mm from the fulcrum. If a force of 200 N is applied at a distance of 750 mm from the fulcrum, find **10**
a) Maximum braking torque, b) Angular retardation of drum, and c) time taken by the system to come to rest from the rated of 360 rpm. Take $\mu = 0.25$

Qu. 5 a) The total mass of a four-wheeled trolley car is 1800 kg. The car runs on rails of 1.6m gauge and rounds a curve of 24 m radius at 36 km/hr. the track is banked at 10^0. The external diameter of the wheel is 600 mm and each pair with the axle has a mass of 180 kg with radius of gyration of 240 mm. The height of the center of mass of the car above the wheel base is 950 mm. Determine the pressure on each rail allowing for centrifugal force and gyroscopic couple actions. **10**

b) A punching press executes 20 holes of 2cm diameter per minute in a plate 1.5 cm thick. This causes the variation of speed in the flywheel attached to the press from 250 rpm to 225 rpm. The punching operation takes 1.5 second per hole. **10**
Assume 500 N-m of the work to be done to shear 1 cm^2 of the area and that the frictional losses account for 15% of the work supplied for punching. Find

(i) Power needed to operate the punching press in kW.
(ii) Mass of flywheel with radius of gyration 0.5 m

Qu. 6 a) In a spring controlled Hartung type governor, the length of the ball arm is 84 mm and the sleeve arm 126 mm. when in the mid-position, each spring is compressed by 60 mm and the radius of rotation of the mass centers is 160 mm. The mass of sleeve is 18 kg and of each ball 4 kg. Spring stiffness is 12 kN/m of compression and total lift of the sleeve 24 mm. Determine the ratio of the range of speed to the mean speed of the governor. Also, find the speed in the mid-position. Neglect the moment due to the revolving masses when the arms are inclined. **10**

b) In an epicyclic gear train, the internal wheels A and B and compound wheels C and D rotate independently about axis O. the wheels E and F rotate on pins fixed to the arm G. E gears with A and C and F gears with B and D. all wheels have same module and number of teeth are $T_C = 28$, $T_D = 26$, $T_E = T_F = 18$ **10**

1) Find the number of teeth on A and B
2) If the arm G makes 100 rpm clockwise and A is fixed. find the speed B;
3) If the arm G makes 100 rpm clockwise and A makes 10 rpm counter clockwise, find the speed of wheel B.

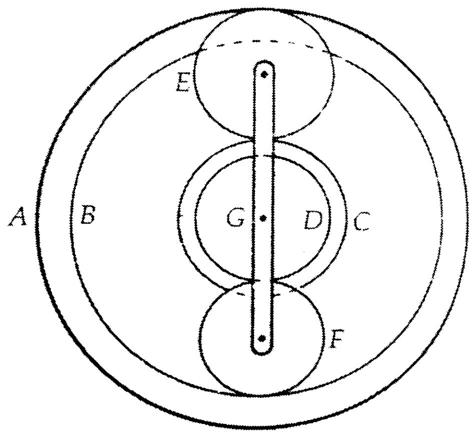

Fig. No. 1

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