T.E (MECHANICAL & AUTOMOBILE) (SEM V) (CBSGS) 18th November, 2014
Theory of Machines – II 2.30 pm to 5.30 pm

Q.P. Code : 14809

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

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

Q1. Attempt any four (20)

A. How does a clutch differ from that of a brake?

B. Explain the controlling force diagram for a spring controlled governor.

C. Derive the equation for the gyroscopic couple on a naval ship during pitching.

D. What do you mean by gear train? List down all the types of gear train and give one application of each.

E. Determine the minimum value for the radius ratio R_2 / R_1 of a single plate clutch at which the capacity of clutch will decrease by not more than 10 % during the initial wear period.

Q2 A. A plate clutch has three discs on the driving shaft and two discs on the driven shaft. The inside and the outside diameters of the friction surfaces are 125 mm and 250 mm respectively. Assuming uniform pressure and coefficient of friction equal to 0.3, find the total spring load pressing the plates together to transmit 30 kW at 1500 rpm. (7)

B. A simple band brake is applied to a shaft carrying a flywheel of mass 250 kg and radius of gyration 300 mm. The shaft speed is 200 rpm. The drum diameter is 200 mm and the coefficient of friction is 0.25. The free end of band is attached at 100 mm from the fulcrum and effort of 120 N is applied on lever at 280 mm on the other side of the fulcrum. The angle embraced by belt is 225^0. Determine for counter clockwise rotation of drum i) Braking torque ii) The number of turns of flywheel before it comes to rest. (7)

C. What do you mean by a dynamometer? Classify the same. How does a dynamometer differ from a brake? (6)

Q3 A. For a spring controlled Hartnell type governor, following data is provided:- (7)
Mass of the governor ball = 1.80 kg
Length of the vertical arm of the bell crank lever = 8.75 cm
Length of the other arm of bell crank lever = 10 cm
The speeds corresponding to radii of rotations of 12 cm and 13 cm are 296 and 304 rpm respectively. Determine the stiffness of the spring.

B. A solid circular steel disc 250 mm diameter and 50 mm thick is mounted with its polar axis on the line OX, of the three Cartesian axes OX, OY and OZ. If at a particular instant the disc is spinning about OX at 12 rad/sec in anticlockwise direction when viewed from right hand side and the frame is rotated at 5 rad/sec about OY in anticlockwise direction when viewed from top, determine the magnitude and sense of the gyroscopic couple. Density of the steel may be taken as 7.8 gm/cc. (7)

C. With the help of neat sketch explain the following terms with respect to gyroscope i) Spin plane ii) Precession axis iii) Gyroscopic plane (6)

TURN OVER

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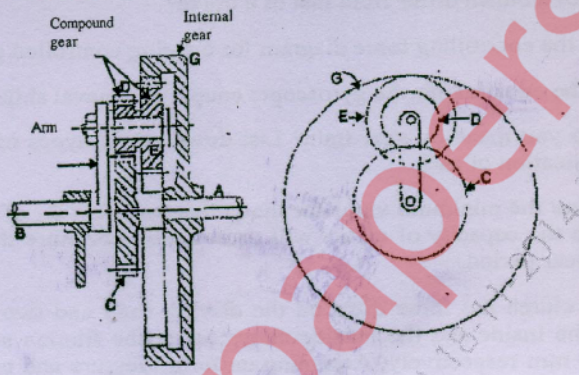
Q4 A. Two shafts A and B are co-axial. A gear C having 50 teeth is rigidly mounted on shaft A. A compound gear D-E gears with C and an internal gear G. D has 20 teeth and gears with C and E has 35 teeth and gears with an internal gear G. The gear G is fixed and is concentric with the shaft axis. The compound gear D-E is mounted on a pin which projects from an arm keyed to the shaft B. Find the number of teeth on the internal gear G assuming that all the gears have the same module. If the shaft A rotates at 110 rpm find the speed of the shaft B. (7)



B. A riveting machine is driven by a constant torque 3 kW motor. The moving parts including the flywheel are equivalent to 150 kg at 0.6 m radius. One riveting operation takes 1 second and absorbs 10000 N-m of energy. The speed of the flywheel is 300 rpm before riveting. Find the speed immediately after riveting. How many rivets can be closed per minute? (7)

C. Derive the equation for the correction couple to be applied to make two mass systems dynamically equivalent. (6)

Q5 A. The turning moment diagram for a four stroke gas engine may be assumed for simplicity to be represented by four triangles, the areas of which from the line of zero pressure are as follows: (10)
Suction stroke = 0.45×10^{-3} m^2; Compression stroke = 1.7×10^{-3} m^2; Expansion stroke = 6.8×10^{-3} m^2; Exhaust stroke = 0.65×10^{-3} m^2. Each m^2 of area represents 3 MN-m of energy. All the areas except expansion stroke are negative. Assuming the resisting torque to be uniform, find the mass of the rim of a flywheel required to keep the speed between 202 and 198 rpm. The mean radius of the rim is 1.2 m.

B. A centrifugal clutch transmits 20 kW of power at 750 rpm. The engagement of the clutch commences at 70 % of the running speed. The inside diameter of the drum is 200 mm and the distance of the centre of the mass of each shoe is 40 mm from the contact surface. Determine the (10)
i) mass of each shoe
ii) net force exerted by each shoe on the drum surface
iii) power transmitted when the shoe is worn 2 mm and is not readjusted.
Assume μ to be 0.25, number of shoes equal to 4 and the stiffness of the spring 150 kN/m.

[TURN OVER

Q6 A. A Porter governor has equal arms each 250 mm long and pivoted on the axis of the rotation. Each ball has a mass of 5 kg and the mass of the central load on the sleeve is 25 kg. The radius of rotation of the ball is 150 mm when the governor begins to lift and 200 mm when the governor is at maximum speed. Find the range of the speed, sleeve lift, governor effort and power of the governor in the following cases :- (10)

i) when the friction at the sleeve is neglected, and

ii) when the friction at the sleeve is equivalent to 10 N.

B. An over drive for a vehicle consists of an epicyclic gear train as shown in the figure, with compound planets B-C. B has 15 teeth and meshes with an annulus A which has 60 teeth. C has 20 teeth and meshes with the sunwheel D which is fixed. The annulus is keyed to the propeller shaft Y which rotates at 740 rad/sec. The spider which carries the pins upon which the planets revolve, is driven directly from main gear box by shaft X, this shaft being relatively free to rotate with respect to wheel D. Find the speed of shaft X, when all the teeth have the same module. (10)