5E6202

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5E6202

B.Tech. V Semester (Main/Back) Examination, Nov./Dec. - 2017

Mechanical Engineering

5ME2A Dynamics of Machines

Common with AE

Time : 3 Hours

Maximum Marks : 80

Min. Passing Marks : 26

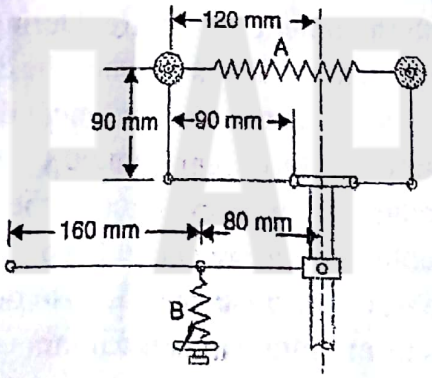
Instructions to Candidates :

*Attempt any **five questions**, selecting **one question** from **each unit**. All Questions carry **equal** marks. (Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly.) Units of quantities used/calculated must be stated clearly.*

Unit - I

1. a) Compare the working and role of governor and flywheel. **(6)**

b) A spring loaded governor is shown in figure. The two balls, each of mass 6 kg, are connected across by two springs. An auxiliary spring B provides an additional force at the sleeve through a lever which pivots about a fixed centre at its left hand end. In the mean position, the radius of the governor balls is 120 mm and the speed is 600 r.p.m. The tension in each spring is then 1 kN. Find the tension in the spring B for this position. When the sleeve moves up 15 mm, the speed is to be 630 r.p.m. Find the necessary stiffness of the spring B, if the stiffness of each spring A is 10 kN/m. Neglect the moment produced by the mass of the balls. **(10)**



OR

1. a) Define the terms sensitiveness of governors, stability of governors and governor effort. **(6)**

b) In a Porter governor, each of the four arms is 400 mm long. The upper arms are pivoted on the axis of the sleeve, whereas the lower arms are attached to the sleeve at a distance of 45 mm from the axis of rotation. Each ball has a mass of 8 kg and the load on the sleeve is 30 kg. What will be the equilibrium speeds for the two extreme radii of 250 mm and 300 mm of rotation of the governor balls? **(10)**

Unit - II

2. a) Describe the gyroscopic effect on aircraft with the help of neat sketches. **(6)**

b) An automobile having rear engine is travelling along a track of 100 metres mean radius. Each of the four wheels has a moment of inertia of 2.5 kg-m^2 and an effective diameter of 0.6 m. The rotating parts of the engine have a moment of inertia of 1.2 kg-m^2. The engine axis is parallel to the rear axle and the crankshaft rotates in the same sense as the road wheels. The ratio of engine speed to back axle speed is 3:1. The automobile has a mass of 3200kg and has its centre of gravity 0.5m above road level. The width of the track of the vehicle is 1.5m. Determine the limiting speed of the vehicle around the curve for all four wheels to maintain contact with the road surface. Assume that the road surface is not cambered and centre of gravity of the automobile lies centrally with respect to the four wheels. **(10)**

OR

2. a) Derive a formula for the magnitude of gyroscopic couple $C = I\omega\omega_p$.

Where, I = moment of inertia, ω=angular velocity of axis of spin and ω_p=angular velocity of precession. **(6)**

b) During forward stroke of the piston of the double acting steam engine, the turning moment has the maximum value of 2000 N-m when the crank makes an angle of 80° with the inner dead centre. During the backward stroke, the maximum turning moment is 1500 N-m when the crank makes an angle of 80° with the outer dead centre. The turning moment diagram for the engine may be assumed for simplicity to be represented by two triangles. If the crank makes 100 r.p.m. and the radius of gyration of the flywheel is 1.75m, find the coefficient of fluctuation of energy and the mass of the flywheel to keep the speed within ± 0.75%, of the mean speed. Also determine the crank angle at which the speed has its minimum and maximum values. **(10)**

Unit - III

3. a) State the law of gearing and compare cycloidal gear tooth profile with involute gear tooth profile. **(6)**

b) The gear ratio (T/t) of two spur gears in mesh externally is 4:1. The two gears in mesh have a module of 6mm and a pressure angle of 20 degree. The addendum on both the gears is equal to one module. The pinion rotates at 100 rpm. Determine the number of teeth on pinion for avoiding interference, the length of path of contact and the number of pairs of teeth in contact. **(10)**

OR

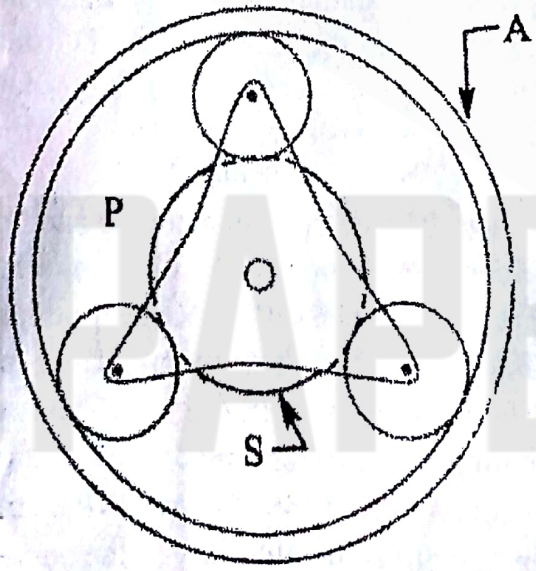
3. a) Derive an expression for the minimum number of teeth required on the wheel in order to avoid interference when it meshes with pinion. **(8)**

b) Two gears in mesh have a module of 8mm and a pressure angle of 20°. The larger gear has 57 teeth while the pinion has 23 teeth. If the addendum on pinion and gear wheels is equal to one module, determine the number of pairs of teeth in contact and the angle of action of the pinion and the gear wheel. **(8)**

Unit - IV

4. a) Explain the construction and working of sliding mesh gear box with the help of a neat sketch. **(6)**

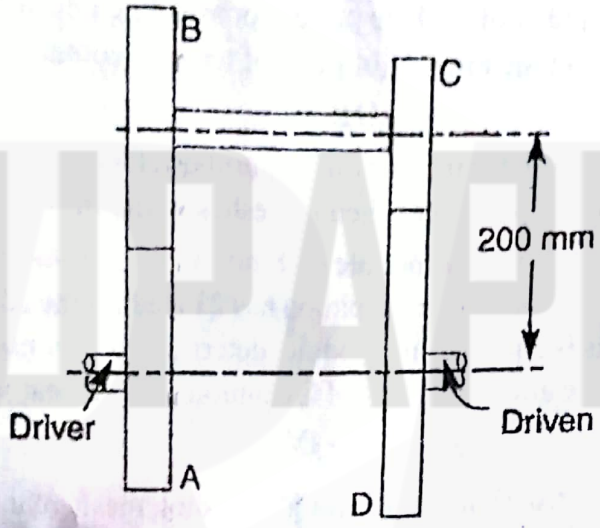
b) An epicyclic gear train for an electric motor is shown in figure. The wheel S has 15 teeth and is fixed to the motor shaft rotating at 1450 r.p.m. The planet P has 45 teeth gears with fixed annulus A and rotates on a spindle carried by an arm which is fixed to the output shaft. The planet P also gears with the sun wheel S. Find the speed of the output shaft. If the motor is transmitting 1.5 kW, calculate the torque required to fix the annulus A. **(10)**



OR

4. a) Explain any three types of gear trains with neat sketches. **(6)**

b) The speed ratio of the reverted gear train, as shown in figure, is to be 12. The module pitch of gears A and B is 3.125mm and of gears C and D is 2.5mm. Calculate the suitable numbers of teeth for the gears. No gear is to have less than 24 teeth. **(10)**



Unit - V

5. a) Explain the static balancing and dynamic balancing. State the necessary conditions to achieve them. **(6)**

b) A rotating shaft carries four masses A, B, C and D which are radially attached to it. The mass centres are 30mm, 38mm 40mm and 35mm respectively from the axis of rotation. The masses, A, C and D are 7.5 kg, 5kg and 4 kg respectively. The axial distances between the planes of rotation of A and B is 400mm and between B and C is 500mm. The masses A and C are at right angles to each other. Calculate the following for a complete balance. **(10)**

i) the angles between the masses B and D from mass A,
ii) the axial distance between the planes of rotation of C and D, and
iii) the magnitude of mass B.

OR

5. a) Explain the Tractive force, Swaying couple and Hammer blow in brief. **(6)**

b) A single cylinder engine runs at 250 r.p.m. and has a stroke of 180mm. The reciprocating parts has a mass of 120kg and the revolving parts are equivalent to a mass of 70kg at a radius of 90mm. A mass is placed opposite to the crank at a radius of 150mm to balance the whole of the revolving mass and two-thirds of the reciprocating mass. Determine the magnitude of the balancing mass and the resultant residual unbalance force when the crank has turned 30° from the inner dead centre, neglect the obliquity of the connecting rod. **(10)**