BT-4/J04
Dynamics of Machines
Paper : MET-212

Time : 3 Hours] [Maximum Marks : 75

Note : Attempt any **FIVE** questions.

1. A connecting rod of length $37 \cdot 5$ cm between centres has a mass of 4 kg. The centre of gravity is 25 cm from the small end and the radius of gyration about an axis through the centre of gravity perpendicular to the plane of motion is 12 cm. Determine dynamically equivalent system having one mass at the centre of small end and the other at a point somewhere in between the centre of big end and the C.G. 15

2. (a) What is the function of a flywheel and how it differs from that of a governor ? 5

   (b) A single cylinder four stroke petrol engine develops 25 hp at a mean speed of 300 rpm. The work done during the suction and exhaust stroke can be neglected, while the work done by the gases during the explosion stroke is three times the work done on the gases during the compression stroke. Determine the size of a suitable flywheel to prevent a fluctuation of speed greater than 2% from the mean speed. The flywheel diameter may be taken as $1 \cdot 5$ m. Assume that the torque curve to be vertical upto the average torque line at the beginning and completion of the explosion stroke. 10

3. A pair of spiral gears is required to connect two shafts $17 \cdot 5$ cm apart, the shaft angle being 70°. The speed ratio is $1 \cdot 5$ and the faster wheel has 80 teeth and a pitch circle diameter of 10 cm. Find the spiral angle of each wheel. 15

4. In an epicyclic gear train of the sun and planet type the annular gear A has 48 teeth cut and meshes internally. Three planet wheels of equal size mesh with the annular gear A and sun wheel B. When the gear A is stationery, the spider C which carries the planet wheels is to make one revolution for every five revolutions

of the spindle carrying the sun wheel B. Determine the number of teeth on sun and planet wheels.   15

5. A band and block brake having 14 blocks, each of which subtends an angle of $15°$ at the centre is applied to a drum of 90 cm effective diameter. The drum and the flywheel mounted on the same shaft weigh 2000 kg and have a combined radius of gyration of 50 cm. The two ends of the band are attached to pins on opposite sides of the brake lever at distances of 3 cm and 12 cm from the fulcrum. If a force of 20 kg is applied at a distance of 75 cm from the fulcrum, find :   15

    (i) maximum braking torque

    (ii) angular retardation of the drum, and

    (iii) time taken by the system to come to rest from the rated speed of 360 rpm, $\mu = 0 \cdot 25$.

6. The arms of a porter governor are 30 cm long. The upper arms are pivoted on the axis of rotation and the lower arms are attached to the sleeve at distance of $3 \cdot 75$ cm from the axis of rotation. The load on the sleeve is 75 kg and the weight of each ball is 10 kg. Determine the equilibrium speed when the radius of rotation of the balls is $22 \cdot 5$ cm. What will be the range of speed for this position, if the frictional resistance to the motion of the sleeve is equivalent to a force of $2 \cdot 5$ kg ? Find also the coefficient of insensitiveness.   15

7. The mass moment of inertia of a blade of an airscrew is 100 kg m^2 about the axis of rotation and the direction of rotation is clockwise when viewed at the front of the machine. The speed of the airscrew is 1600 rpm, when the speed of the flight is 250 kmph. If the airplane makes a right turn on a path r = 150 m radius, find the gyroscopic reaction on the airplane, if :

    (i) the airscrew has three blades and

    (ii) the airscrew has two blades   15

8. Three masses A, B and C weighing 2 kg, 6 kg and 5 kg respectively are rigidly attached to a disc at radius of 10 cm, 5 cm and 9 cm respectively. The angles between A and B, B and C and

C and A are 60, 165 and 135 deg respectively. A fourth mass D is attached to the disc at a radius of 4 cm. Determine the magnitude and angular position of D so that the four masses may completely balance one another when the disc is rotated.

Explain why, for complete balance, mass D must be placed in the same plane as the masses A, B and C.   15