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10ME54

Fifth Semester B.E. Degree Examination, June/July 2015
Dynamics of Machines

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions, selecting at least TWO questions from each part.

PART – A

- 1 a. What is the principle of virtual work? Explain. (06 Marks)
b. In an I.C. engine mechanism the crank is 100mm, connecting rod is 300mm. The crank has turned by 60° from I.D.C. A force of $F = 3000\text{N}$ acts on the Piston towards crank shaft. Determine all the forces at various points of mechanism and torque applied on crank. (14 Marks)
- 2 a. Define the terms coefficient of fluctuation of speed and coefficient of fluctuation of energy. (04 Marks)
b. A certain machine requires a torque of $(500 + 50 \sin\theta)$ N.m to drive it, where θ is the angle of rotation of shaft measured from certain datum. The machine is directly coupled to an engine which produces a torque of $(500 + 60 \sin 2\theta)$ Nm. The flywheel weighs 500N and has radius of gyration of 0.4m. The mean speed is 180rpm. Determine: i) Fluctuation of energy; ii) % fluctuation of speed; iii) minimum and maximum angular acceleration of flywheel and corresponding shaft positions. (16 Marks)
- 3 a. Derive an expression to find frictional torque for a flat pivot considering uniform wear theory. (05 Marks)
b. In a thrust bearing the external and internal radii of the contact surfaces are 210mm and 160mm respectively. The total axial load is 60kN and coefficient of friction is 0.05. The shaft is rotating at a speed of 380 rpm. Intensity of pressure is not to exceed 350 kN/m^2 . Calculate: i) Power lost in friction; ii) Number of collars required for thrust bearing. (05 Marks)
c. A pulley is driven by a flat belt 100mm wide and 6mm thick. The density of belt material is 1000 kg/m^3 . The angle of lap is 120° and the coefficient of friction is 0.3. The maximum stress in the belt is not to exceed 2 MPa. Find the maximum power that can be transmitted and corresponding speed of the belt. (10 Marks)
- 4 a. Explain the static and dynamic balancing. (05 Marks)
b. A rotating shaft carries four unbalanced masses 18kg, 14kg, 16kg and 12kg at radii 50mm, 60mm, 70mm and 60mm respectively. The second, third and fourth masses revolve in planes 80mm, 160mm and 280mm respectively measured from the plane of first mass and are angularly located at 60° , 135° and 270° respectively measured anticlockwise from the first mass looking from this mass end of the shaft. The shaft is dynamically balanced by two masses, both located 50mm radii and revolving in planes midway between those of first and second masses and midway between those of third and fourth masses. Determine the magnitudes of the masses and their respective angular positions. (15 Marks)

Important Note : 1. On completing your answers, carefully draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and/or equations written eg. $42+8=50$, will be treated as malpractice.



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PART – B

- 5 a. Explain direct and reverse crank method of balancing. (10 Marks)
b. A V-twin engine has the cylinder axes at right angle and connecting rods operate a common crank. The reciprocating mass per cylinder is 10kg. The crank is 75mm long and each connecting rod is 350mm long. Show that the engine may be balanced for primary effects by means of a revolving balance mass. If the speed of crank is 500 rpm, what is the maximum value of resultant secondary force and in which direction does it act? (10 Marks)
- 6 a. Derive an expression for determining speed of spindle of a porter governor taking into account the friction at the sleeve. (08 Marks)
b. In a spring loaded Hartnell governor, the extreme radii of rotation of balls are 80mm and 120mm. The ball arm and the sleeve arm of the bell crank lever are equal in length. Mass of each ball is 2kg. If the speed at the extreme positions are 400 rpm and 420 rpm, find
i) spring constant and ii) Initial compression of the spring. (12 Marks)
- 7 a. Derive an expression for gyroscopic couple. (06 Marks)
b. With a neat sketch show the following axis of spin, axis of precession, axis of couple, planes of spin, precession and couple. (06 Marks)
c. An aeroplane makes a complete half circle of 50 meter radius, towards left when flying at 200 km/hr. The rotary engine and the propeller of the plane have a mass 40kg with a radius of gyration of 0.30m. The engine runs at 2400 rpm clock wise, when viewed from the rear. Find the gyroscopic couple on the plane and state its effect on it. What will be the effect, if the aeroplane turns to its right instead of left? (08 Marks)
- 8 A tangent cam with a base circle diameter of 50mm operates a roller follower 20mm in diameter. The line of stroke of the roller passes through the axis of cam. The angle between the tangential faces of cam is 60° , speed of the cam shaft 250rpm and the lift of the follower 15mm. Calculate:
a. The main dimensions of the cam
b. The accelerations of the follower at
i) The beginning of the lift
ii) Where the roller just touches the nose
iii) The apex of the circular nose. (20 Marks)

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