B.E / B. Tech Degree End Semester Examinations Apr /May 2011

FIFTH SEMESTER MECHANICAL ENGINEERING BRANCH (FULL TIME)-R2004

ME 373 DYNAMICS OF MACHINES

Time : 3 hr Part- A (10 X 2 = 20 mark) Max .Mark : 100

1. State the concept of D'Alembert in dynamic analysis of machine parts.
2. What is meant by dynamically equivalent system?
3. Justify the need of flywheel using suitable T-θ diagram in the operation of mechanically operated presses.
4. What are the possible reasons for the rotating parts become unbalanced?
5. Write the expression for calculating the primary and secondary disturbing forces in reciprocating engines.
6. Define i. Natural frequency ii. Resonance
7. What is meant by logarithimic decrement ?
8. Define critical speed of a shaft-rotor system ? What are the data required for determining the same?
9. Draw the magnification factor versus frequency ratio curve of a forced vibration system for various damping ratios .
10. How do you evaluate the sensitiveness of a governor mechanism ? What is the influence of friction in determining the sensitiveness ?

Part –B (5 X 16 = 80 mark)

11. The maximum and minimum speed of a flywheel are 242 rpm and 238 rpm respectively. The mass of the flywheel is 2600 kg and its radius of gyration is 1.8 m . Find
    i. maximum fluctuation of energy in the flywheel
    ii. coefficient of fluctuation of speed
    iii, mean speed of the flywheel.

12.(a) The lengths of crank and connecting rod of a horizontal engine are 300 mm and 1200 mm respectively. When the crank has turned 30 o from the inner dead centre , the acceleration of the piston is 35 m / s^2 . The average frictional resistance ot the motion of piston is equivalent of 550 N and effective gas pressure on the piston is 500 k N /m^2 . The diameter of the piston is 300 mm and the mass of the reciprocating parts is 160 kg. Determine :
    i. reaction on the cylinder walls
    ii, thrust on the crank shaft bearing.
    Iii, torque on the crank shaft.

Contd..2

OR

12 (b) A petrol engine connecting rod weighs 9.8 N and its M.I about an axis through c.g is 0.01 kg m^2. The distance of c.g from the small end centre is 165 mm. Find the correction torque when two masses are placed , one at small end and other at big end and the ang. acceleration of the rod is 18,000 rad /s^2.

13.(a). i. Describe with sketch the working principle of any one type balancing machine. (8 mark)

ii. By constructing free body diagrams of piston , connecting rod and crank , show that primary unbalanced inertia force of a single cylinder reciprocating engine is equal to $\mathbf{m r \omega^2 \cos \theta}$ (8 mark)

OR

.(b) A four cylinder inline engine has two outer cranks set at 120 ° to each other and their reciprocating masses are each 400 kg. The distance between the planes of rotation of rotation of adjacent crank are 450 mm, 750 mm and 600 mm. The length of the connecting rod is 120 mm and crank radius is 30 mm and the speed is 240 rpm. If the engine is in complete primary balance , find the following

i. reciprocating masses of inner cylinders (8 mark)

ii. relative angular position of the inner cranks (4 mark)

iii. maximum unbalanced secondary force. (4 mark)

14 (a) A weight of 55 N suspended by a spring of stiffness 1.1 k N /m is forced to vibrate by a harmonic force of amplitude 9 N. Taking viscous damping constant as 77 N .s /m, if the frequency of the excitation force 180 c/ min

Find i. Resonant frequency

ii. amplitude at resonance

iii. Phase angle at resonance

iv .Amplitude of vibration.

OR

. (b) A rotor of mass 225 kg has radius of gyration of 400 mm. It is bolted between the ends of two shafts one of which is 75 mm diameter and 900 mm long and other is 65 mm diameter and 0.45 m long. The other ends of the shafts are rigidly fixed in position. Find the frequency of torsion vibration of the system. Ignore the inertia effect of the shaft and material of the shaft is steel.

Contd..3

15 (a) . A loaded Porter governor has 4 links each of 250 mm long , 2 revolving masses of each weighing 30 N and a central dead weight of 200 N . All the links are attached to the respective sleeve at a radial distance of 40 mm from the axis of rotation. The masses revolve at a radius of 150 mm at a minimum speed and at a radius of 200 mm at a maximum speed. Determine the range of speed

OR

(b) The rotor of a turbo jet engine has a mass of 200 kg and a radius of gyration of 250 mm. The engine rotates at a speed of 10,000 rpm in the clockwise direction if viewed from the front of the airplane. The airplane while flying at 1000 km /hr turns with a radius of 2000 m to the right.

i. sketch the spin , precession and gyroscopic axes. (4 mark)

ii. compute the gyroscopic moment exerted by the rotor on the plane structure (6 mark)

iii. determine the effect of gyroscopic moment on the plane (6 mark)

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