B.E / B. Tech(Full Time) END SEMESTER EXAMINATIONS, NOV / DEC 2012
FOURTH SEMESTER MECHANICAL ENGINEERING Regulation 2008

ME 9253 DYNAMICS OF MACHINES

Time : 3 hr Max Mark : 100

Drawing sheet will be provided on request

Part A (10 X 2 = 20 mark)

(5)

1. Distinguish static and dynamic equilibrium of a machine part.
2. Why flywheel is required in the operation of mechanical type punching presses?
3. Define 'crank effort' and 'crank pin effort'.
4. What is dynamic balancing ? Under what operating conditions this type balancing is necessary?
5 What is meant by 'direct crank' and 'reverse crank' in balancing ?
6. Define i. Natural frequency ii. Critical Damping constant
7. What are the main excitation sources which make the mechanical system to vibrate ?
8. Define the critical speed of a shaft-rotor system . On what parameters does it depend ?
9. Derive an expression for the gyroscopic acceleration of uniform rotating disc executing precessional motion.
10. What do you understand by the term stability of a governor mechanism? Sketch the controlling force curve of a stable spring controlled governor.

Part –B (5 X 16 = 80 mark)

11(.a). A single cylinder reciprocating engine is having bore of 175 mm , stroke of 200 mm . The length of the connecting rod is 400 mm and the mass of the reciprocating parts is 200 kg. The engine runs at a speed of 600 rpm. When the crank is at 45 ° from the top dead centre position, find the following due to the inertia of the reciprocating parts.

i. force in the connecting rod (6 mark)
ii. torque on the crank (6 mark)
iii. force on the main bearing (4mark)

12. (a). The areas of the turning moment diagram for one revolution of a multi cylinder engine with reference to the mean torque below and above the line (in mm^2) are -32, 408, -267, 333, -310, 226, -374, 260, and -244. The scale for the abscissa and ordinate are 1mm = 2.4 ° and 1 mm = 650 Nm respectively. The mean speed is 300 rpm with percentage speed fluctuation of $\pm$ 1.5 % . Determine the mass of the flywheel if the maximum speed is 25 m /s.

OR

(b) . The connecting rod of a vertical IC engine is 600 mm long between centres and has a mass of 3 kg. The mass centre of the connecting rod is 200 mm away from the big end When the rod is suspended as pendulum from the small end ,it makes 45 oscillations in 30 seconds. The crank radius is 125 mm and the mass of the piston is 1.2 kg. Determine the inertia torque on the crank shaft when the crank makes an angle of 140 ° from the top dead centre and the speed is 1500 rpm

3 .a i. Describe with neat sketch any one type of dynamic balancing machine. (6 mark)

ii. A three cylinder radial engine has line of stroke at 120 ° to one another and their connecting rods ıre connected to a single common crank. Sketch the direct and reverse crank layouts and evaluate ›alancing condition of the engine for the primary and secondary effects. (10 mark)

OR

13 (b). A four cylinder inline engine has two outer cranks set at 120 ° to each other and their reciprocating nasses are each 400 kg. The distance between the planes of rotation of adjacent crank are 450 mm, 750 nm 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 (6 mark)

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

iii. maximum unbalanced secondary force. (6 mark)

14 (a) i .A railroad bumper is designed as a spring in parallel with a viscous damper. The stiffness of the damper is 2 X 10^5 N /m and damping constant is 1.58 X 10^5 N –s / m . If the bumper is used to engage a 0.2 Mg railroad car , is the resulting motion under damped , critically damped or over damped ? Why ? (8 mark)

(a) ii. A 200 kg machine is placed at the end of the 1.8 m long steel cantilever beam . The machine is observed to vibrate with natural frequency of 21 Hz . Find the moment of inertia of the cross section of the beam about its neutral axis. (8 mark)

OR

14 (b) The springs of an automobile are compressed by 100 mm under its own weight. When the automobile is traveling on a road which is approximated by a sine wave of amplitude 0.8 m and wave length 14 m , determine the speed of the automobile at which it experiences maximum amplitude of vibration. Determine also the amplitude of vibration at a speed of 60 km / hour

15(a) A motorcycle and its rider together weighs 2000 N and their combined centre of gravity is 550 mm above the road when the motorcycle is upright. Each wheel is of 580 mm diameter and has moment of inertia of 1.0 kg .m^2 . The moment of inertia rotating parts of the engine is 0.15 kg .m^2 . The engine rotates at 5 times the speed of the wheel and in the same sense. Determine the angle of heel necessary when the motorcycle is taking a turn over a track of 35 m radius at a speed of 60 km / h.

OR

15.b. i. Explain the following with respect to governor mechanisms.

1. sensitiveness and Hunting (3 mark)
2. Friction and coefficient of insensitiveness (3 mark)

ii. The length of the upper arms and lower arms of a Porter governor are 200 mm and 250 mm respectively. Both the arms are pivoted on the axis of rotation. The central sleeve weight is 150 N and weight of each ball is 20 N and friction resistance is equal to a force of 30 N at the sleeve. If the limiting inclination of the upper arms to the vertical are 30 ° and 40 ° , determine the range of speed of the governor. (10 mark)

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