PART C — (1 × 15 = 15 marks)

16. (a) A four cylinder vertical engine has cranks 150 mm long. The planes of rotation of the first, second and fourth cranks are 400 mm, 200 mm and 200 mm respectively from the third crank and their reciprocating masses are 50 kg, 60 kg and 50 kg respectively. Find the mass of the reciprocating parts for the third cylinder and the relative angular positions of the cranks in order that the engine may be incomplete primary balance.

Or

(b) A commercial type vibration pick-up has a natural frequency of 5.75 Hz and a damping factor of 0.65. What is the lowest frequency beyond which the amplitude can be measured within one percent error?

Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 20816

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2018.

Fourth/Fifth Semester

Mechanical Engineering

ME 6505 — DYNAMICS OF MACHINES

(Common to Mechanical Engineering (Sandwich)/Mechatronics Engineering)

(Regulations 2013)

(Also common to : PTME 6505 – Dynamics of Machines for B.E (Part-Time) Fourth Semester – Mechanical Engineering – Regulations 2014)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is meant by crank-pin effort?
2. Define coefficient fluctuation of speed.
3. Mention the importance of Dynamic balancing.
4. What do you mean by swaying couple in locomotives?
5. Differentiate transverse and torsional vibrations.
6. Define logarithmic decrement.
7. Write the equation of motion of a damped forced system.
8. Define dynamic magnifier.
9. How are centrifugal governors classified?
10. What is axis of precession?

PART B — (5 × 13 = 65 marks)

11. (a) An electric motor drives a punching machine. A flywheel fitted to the press has a radius of gyration of 0.5 m and runs at 250 rpm. The press is capable to punch 800 holes per hour with each punching operation taking 1.5 seconds and requiring 12000 Nm of work. Determine the rating of the machine in kW and the mass of the flywheel if the speed of the flywheel does not drop below 230 rpm.

Or

(b) A vertical double acting steam engine has a cylinder 300 mm diameter and 450 mm stroke and runs at 200 rpm. The reciprocating parts has a mass of 225 kg and the piston rod is 50 mm diameter. The connecting rod is 1.2 m long. When the crank has turned through 125° from the top dead centre, the steam pressure above the piston is 30 kN/m² and below the piston is 1.5 kN/m². Calculate the effective turning moment on the crank shaft.

12. (a) A shaft carries four masses A, B, C and D of magnitude 200 kg, 300 kg, 400 kg and 200 kg respectively and revolving at radii 80 mm, 70 mm, 60 mm and 80 mm in planes measured from A at 300 mm, 400 mm and 700 mm. The angles between the cranks measured anticlockwise are A to B 45°, B to C 70° and C to D 120°. The balancing masses are to be placed in planes X and Y. The distance between the planes A and X is 100 mm. between X and Y is 400 mm and between Y and D is 200 mm. If the balancing masses revolve at a radius of 100 mm, find their magnitudes and angular positions.

Or

(b) A twin cylinder V-engine having V angle of 60° has strokes of 120 mm and the connecting rods of length 240 mm. The mass of reciprocating parts per cylinder is 2 kg. If the crank speed is 2000 rpm, determine the magnitude of the primary and secondary forces.

13. (a) In a damped free vibrations mass is 2 kg and Spring stiffness is 100 N/m. It is observed that an initial amplitude of 100 mm is reduced to 1 mm in 10 oscillations. Find the damping constant and the natural frequency of vibrations.

Or

(b) Calculate the whirling speed of a shaft 20 mm diameter and 0.6 m long carrying a mass of 1 kg at its mid-point. The density of the shaft material is 40 Mg/m³, and Young's modulus is 200 GN/m². Assume the shaft to be freely Supported.

14. (a) A 1000 kg machine is mounted on four identical springs of total spring constant K and having negligible damping. The machine is subjected to a harmonic external force of amplitude $F_0 = 490$ N and frequency 180 rpm. Determine the amplitude of motion of the machine and the maximum force transmitted to the foundation because of the unbalanced force when $K = 1.96 \times 10^6$ N/m.

Or

(b) The springs of an automobile trailer are compressed 0.1m under its own weight. Find the critical speed when the trailer is travelling over a road with a profile approximated by a sine wave of amplitude 0.08 m and wave length of 14 m. What will be the amplitude of vibration at 60 km/hr?

15. (a) Calculate the minimum and maximum speeds and the range of the speed of a Porter governor, which has equal arms each 200 mm long and pivoted on the axis of rotation. The mass of each ball is 4 kg and the central mass on the sleeve is 20 kg. The radius of rotation of the ball is 100 mm when the governor begins to lift and 130 mm when the governor is at the maximum speed.

Or

(b) A ship propelled by a turbine rotor which has a mass of 5 tonnes and a speed of 2100 r.p.m. The rotor has a radius of gyration of 0.5 m and rotates in a clockwise direction when viewed from the stern. Find the gyroscopic effects in the following conditions:

(i) The ship sails at a speed of 30 km/h and steers to the left in a curve having 60 m radius.

(ii) The ship pitches 6 degree above and 6 degree below the horizontal position. The bow is descending with its maximum velocity. The motion due to pitching is simple harmonic and the periodic time is 20 seconds.

(iii) The ship rolls and at a certain instant it has an angular velocity of 0.03 rad/s clockwise when viewed from stern.

Determine also the maximum angular acceleration during pitching. Explain how the direction of motion due to gyroscopic effect is determined in each case.