b) The turbine rotor of a ship has 2.4 tonnes and rotates at 1750 rpm clockwise when viewed from the aft. The radius of gyration of the rotor is 300 mm. Determine the gyroscopic couple and its effect when :

i) the ship turns right at a radius of 250 m with a speed of 22 kmph.

ii) the ship pitches with the bow rising at an angular velocity of 0.85 rad/s, and

iii) the ship rolls with angular velocity of 0.15 rad/s.

PART – C **(1×15=15 Marks)**

16. a) The turning moment diagram of a four-stroke engine is assumed to be represented by four triangles, the areas of which from the line of zero pressure are

Suction stroke	=	440 mm^2
Compression stroke	=	1600 mm^2
Expansion stroke	=	7200 mm^2
Exhaust stroke	=	660 mm^2

Each mm^2 of area represents 3 Nm of energy. If the resisting torque is uniform, determine the mass of the rim of a flywheel to keep the speed between 218 rpm and 222 rpm, when the mean radius of the rim is to be 1.25 m.

(OR)

b) A shaft 30 mm diameter and 1.5 m long has a mass of 16 kg per metre length. It is simply supported at the ends and carries three isolated loads 1 kN, 1.5 kN, and 2 kN at 0.4 m, 0.6 m and 0.8 m respectively from the left support. Find the frequency of the transverse vibrations.

i) Neglecting the mass of the shaft and

ii) Considering the mass of the shaft

Take the Young's modulus of the shaft material E as 200 GPa.

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Question Paper Code : 50876

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2017

Fourth/Fifth Semester

Mechanical Engineering

ME 6505 – DYNAMICS OF MACHINES

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

(Regulations 2013)

Time : Three Hours Maximum : 100 Marks

A3 size drawing sheet may be provided on request.

Answer ALL questions.

PART – A **(10×2=20 Marks)**

1. State D'Alembert's principle.

2. Define coefficient fluctuation of energy.

3. What are primary and secondary unbalanced forces ?

4. Give the conditions of dynamic balancing.

5. Differentiate node and antinode with respect torsional vibrations.

6. What is damping ?

7. List the types of external excitations.

8. What are the instruments used for measurement of vibration levels in a body ?

9. What is the effect of gyroscopic couple when the engine or propeller of an aeroplane rotates in anticlockwise direction when viewed from the rear or tail end while turning towards left ?

10. Define sleeve lift.

PART – B (5×13=65 Marks)

11. a) The lengths of crank and connecting rod of a horizontal engine are 200 mm and 1 m respectively. The crank is rotating at 400 rpm. When the crank has turned through 30° from the inner dead centre, the difference of pressure between cover and piston rod 0.4 N/mm^2. If the mass of the reciprocating parts is 100 kg cylinder bore is 0.4 m, then calculate, the inertia force, force on piston, piston effort, thrust on the sides of the cylinder walls, the thrust in the connecting rod, and the crank effort.

(OR)

b) In a four-link mechanism shown in Fig. 1, torques T_3 and T_4 have magnitudes of 30 Nm and 20 Nm respectively. The link lengths are AD = 800 mm, AB = 300 mm, BC = 700 mm and CD = 400 mm. For the static equilibrium of the mechanism, determine the required input torque T_2.

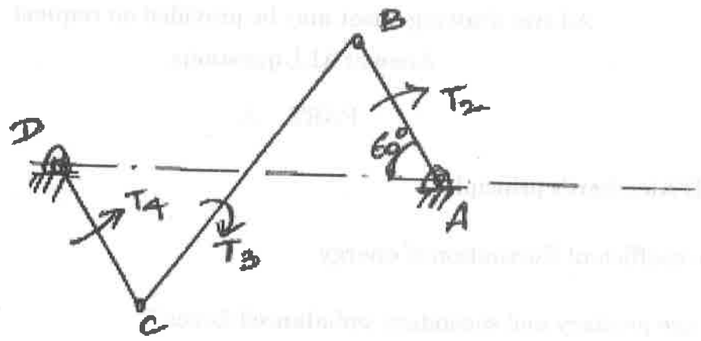

Fig. 1

12. a) A shaft carries four masses in parallel planes A, B, C, and D in this order along its length. The masses at B and C are 20 kg and 15 kg respectively, and each has an eccentricity of 60 mm. The masses at A and D have eccentricity of 80 mm. The angle between the masses at B and C is 100° and that between the masses at B and A is 190°, both being measured in the same direction. The axial distance between the planes A and B is 100 mm and that between B and C is 200 mm. If the shaft is in complete dynamic balance, determine the magnitude of the masses at A and D, the distance between the planes A and D and the angular position of the mass at D.

(OR)

b) The reciprocating mass per cylinder in a 60° V-twin engine is 1.5 kg. The stroke is 100 mm for each cylinder. If the engine runs at 1800 rpm, determine the maximum and minimum values of the primary forces and find out the corresponding crank position.

13. a) A machine mounted on springs and fitted with a dashpot has a mass of 60 kg. There are three springs, each of stiffness 12 N/mm. The amplitude of vibrations reduces from 45 to 8 mm in two complete oscillations. Assuming that the damping force varies as the velocity, determine the damping coefficient, the ratio of frequencies of damped and undamped vibrations and the periodic time of damped vibrations.

(OR)

b) A rotor has a mass of 12 kg and is mounted midway on a 24 mm diameter horizontal shaft supported at the ends by two bearings. The bearings are 1 m apart. The shaft rotates at 2400 rpm. If the centre of mass of the rotor is 0.11 mm away from the geometric centre of the rotor due to certain manufacturing defect, find the amplitude of the steady-state vibration and the dynamic force transmitted to the bearing. Take E as 200 GN/m^2.

14. a) A single-cylinder vertical petrol engine of total mass of 200 kg is mounted upon a steel chassis frame. The vertical static deflection of the frame is 2.4 mm due to the weight of the engine. The mass of the reciprocating parts is 18 kg and the stroke of the piston is 160 mm with SHM. If dashpot of damping coefficient of 1 N/mm/s is used to dampen the vibrations, calculate at steady state, the amplitude of forced vibrations at 500 rpm engine speed and the speed of driving shaft at which resonance will occur.

(OR)

b) A compressor supported symmetrically on four springs has a mass of 100 kg. The mass of the reciprocating parts is 2 kg which move through a vertical stroke of 80 mm with SHM. Neglecting damping, determine the combined stiffness of the springs so that the force transmitted to the foundation is 1/25th of the impressed force. The machine crankshaft rotates at 1000 rpm. When the compressor is actually supported on springs, it is found that the damping reduces the amplitude of successive free vibrations by 25%. Find the force transmitted to the foundations at 1000 rpm, the force transmitted to the foundation at resonance and the amplitude of the vibrations at resonance.

15. a) Each arm of a Porter governor is 250 mm long. The upper and lower arms are pivoted to links of 40 mm and 50 mm respectively from the axis of rotation. Each ball has a mass of 5 kg and the sleeve mass is 50 kg. The force of friction on the sleeve of the mechanism is 40 N. Determine the range of speed of the governor for extreme radii of rotation of 125 mm and 150 mm.

(OR)