B.E. (Mechanical Engineering) Model Curriculum Semester-VI

PCC-ME308 - Dynamics of Machines

P. Pages : 3 **GUG/W/24/14076**

Time : Three Hours * 5 5 9 3 * Max. Marks : 80

Notes : 1. All questions carry equal marks.
2. Due credit will be given to neatness and adequate dimensions.
3. Assume suitable data wherever necessary.
4. Diagrams and Chemical equation should be given wherever necessary.
5. Illustrate your answers wherever necessary with the help of neat sketches.
6. Answer Q1 or Q2 / Q3 or Q4 / Q5 or Q6 / Q7 or Q8 / Q9 or Q10.

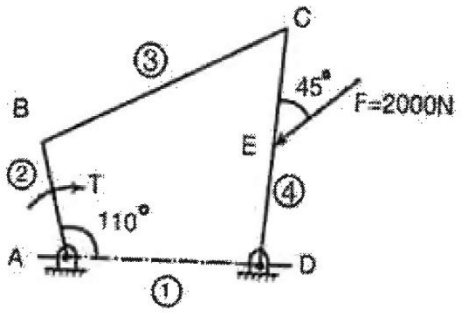
1. a) State and explain D-Alembert's principle. **4**

b) A horizontal steam engine running at 210 r.p.m has a bore diameter of 190 mm and stroke 350 mm. The piston rod is 20 mm in diameter and connecting rod length is 950 mm. Mass of reciprocating part is 8 kg and frictional resistance is equivalent to a force of 350 N. Determine the following when crank is at 115 degree from IDC. The mean pressure being 450 N/m^2 on cover side and 100 N/m^2 on crank side. **12**

i) Thrust on connecting rod
ii) Thrust on the cylinder walls
iii) Load on the bearings
iv) Turning moment on crankshaft

OR

2. A four bar chain mechanism ABCD is shown in fig. below. Calculate the value of torque required (T) and all the constraint forces in links for the static equilibrium of the mechanism, if F=2000 N in the direction shown. The dimensions of linkages are given as: AB =200 mm, BC=370, CD=250 mm, AD=215 mm, CE=100 mm. **16**



3. a) What is the function a governor? How does it differ from that of a flywheel? **4**

b) In a single acting four-stroke engine, the work done by the gases during the expansion stroke is three times the work done during the compression stroke. The work done during the suction and exhaust strokes is negligible. The engine develops 14 kW at 280 rpm. The fluctuation of speed is limited to 1.5% of the mean speed on either side. The turning moment diagram during the compression and the expansion strokes may be assumed to be triangular in shape. Determine the inertia of the flywheel. **12**

OR

4. a) Explain the effect of gyroscopic couple on an aeroplane taking a turn. **4**

b) Each road wheel of a motorcycle has a mass moment of inertia of 1.5 kg - m^2. The rotating parts of the engine of the motorcycle have a mass moment of inertia of, 0.25 kg-m^2. The speed of the engine is 5 times the speed of the wheels and is in the same sense. The mass of the motorcycle with its rider is 250 kg and its centre of gravity is 0.6 m above the ground level. **12**

Find the angle of heel if the motor cycle is travelling at 50 km/hr and is taking a turn of 30 m radius. The wheel diameter is 0.6 m.

5. a) Find out an expression for natural frequency of free transverse vibrations of shaft fixed at both ends carrying a uniformly distributed load. **8**

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/m^3, and Young's modulus is 200 GN/m^2. Assume the shaft to be freely supported. **8**

OR

6. a) A mass of 20 kg is supported vertically at the free end of, a spring of stiffness 4 N/mm. It's motion is resisted by the oil dashpot. It is observed that the amplitude at the beginning of fourth cycle is 0.8 times the amplitude of previous cycle. Determine: **8**

i) The damping force per unit velocity.

ii) The ratio of frequency of damped and undamped vibrations.

b) Write down a short note on any two of the following. **8**

i. Logarithemic decrement

ii. Vibration isolation

iii. Forced vibration of single degree of freedom.

iv. Critical speed of shaft.

7. a) Derive an expression for the frequency of free torsional vibrations for a shaft fixed at one end and carrying load on the free end. **8**

b) The two rotors A & B are attached to the end of a shaft 500 mm long. The mass of the rotor A is 300 kg and its radius of gyration is 300 mm. The corresponding values of the rotor B are 500 kg and 450 mm respectively. The shaft is 70 mm in diameter for the first 250 mm, 120 mm for the next 70 mm and 100 mm diameter for the remaining length. The modulus of rigidity of the shaft material is 80 GN/m^2 Find: **8**

i) The position of the node.

ii) The frequency of torsional vibration.

OR

8. a) Explain the terms: **8**

i) under damping,

ii) critical damping

iii) over damping'

iv) Free and forced Vibration

b) A steel shaft 1.5 m long is 95 mm in diameter for the first 0.6 m of its length, 60 mm in diameter for the next 0.5 m of the length and 50 mm in diameter for the remaining 0.4 m of its length. The shaft carries two flywheels at two ends, the first having a mass of 900 kg and 0.85 m radius of gyration located at the 95 mm diameter end and the second having a mass of 700 kg and 0.55 m radius of gyration located at the other end. Determine the location of the node and the natural frequency of free torsional vibration of the system. The modulus of rigidity of shaft material may be taken as 80 GN/m^2. **8**

9. The following data refers to an outside cylinder uncoupled locomotive: Mass· of rotating parts per cylinder = 350 kg, Mass of reciprocating parts per cylinder = 300 kg, Angle between cranks = 90°, Crank radius = 0.25 m, Cylinder centers = 1.70 m, Radius of balance masses= 0.7 m, Wheel centres= 1.5 m. **16**

If whole of the rotating and two-third of the reciprocating parts are to be balanced in planes of the driving wheels, find:

i) Magnitude and angular positions of balance masses.

ii) Speed in kilometers per hour at which the wheel will lift off the rails when the load on each driving wheel is 28 kN and the diameter of thread of driving wheel is 1.6 m, and

iii) Swaying couple.

OR

10. Four masses A, B, C and D are attached to a shaft and revolve in the same plane. The masses are 12 kg, 10 kg, 18 kg and 15 kg respectively and their radii of rotations are 40 mm, 50 mm, 60 mm and 30 mm. The angular position of the masses B, C and D are 60°, 135° and 270° from the mass A. **16**

Find the magnitude and position of the balancing mass at a radius of 100 mm.

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