(Pages : 4) **A – 2815**

Reg. No. : .....

Name : .....

Sixth Semester B.Tech. Degree Examination, May 2016
(2008 Scheme)
08.602 : DYNAMICS OF MACHINERY
(MP)

Time : 3 Hours Max. Marks : 100

PART – A **(10×4=40 Marks)**

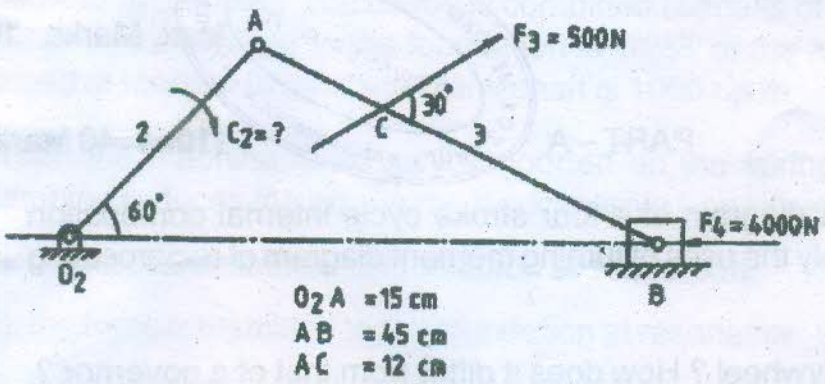
1. Draw the turning moment diagram of a four stroke cycle internal combustion engine and explain precisely the uses of turning moment diagram of reciprocating engines.
2. What is the function of a flywheel ? How does it differ from that of a governor ?
3. The inertia of the connecting rod can be replaced by two masses concentrated at two points and connected rigidly together. Illustrate how to determine the two masses so that it is dynamically equivalent to the connecting rod ?
4. Explain the application of gyroscopic principles to aircrafts.
5. Explain clearly how would you determine from the controlling force curve whether a governor is stable, unstable or isochronous. Show also how the effect of friction may be indicated on the curve.
6. Explain the method of balancing of different masses revolving in the same plane.
7. What are in-line engines ? How are they balanced ? It is possible to balance them completely ?
8. What is the effect of inertia of the shaft in longitudinal and transverse vibrations ?
9. What is meant by torsionally equivalent length of a shaft as referred to a stepped shaft ?
10. Explain the terms 'under damping, critical damping' and 'over damping' with regard to free vibrations.

P.T.O.

PART – B

Module – I

11. Refer to the figure below and determine the couple C_2 on the crank 2 to be applied for equilibrium of the system. Also determine the resultant of forces F_{23} and F_{41} exerted on the frame of the engine. **20**



OR

12. The following data relate to a horizontal reciprocating engine : Mass of the reciprocating parts = 120 kg, crank length = 90 mm, engine speed = 600 rpm.

Connecting rod :

Mass = 90 kg

Length between centres = 450 mm

Distance of centre of mass from bid end centre = 180 mm

Radius of gyration about an axis through centre of mass = 150 mm

Find the magnitude and direction of the inertia torque on the crank shaft when the crank has turned 30° from the inner dead centre. **20**

Module – II

13. a) The arms of a Porter governor are 300 mm long. The upper arms are pivoted on the axis of rotation and the lower arms are attached to the sleeve at a distance of 35 mm from the axis of rotation. The load on the sleeve is 54 kg and the mass of each ball is 7 kg. Determine the equilibrium speed when the radius of the balls is 225 mm. What will be the range of speed for this position, if the frictinal resistances to the motion of the sleeve are equivalent to a force of 30 N ? **10**

b) The mass of a turbine rotor of a ship is 8 tonnes and has a radius of gyration 0.6 m. It rotates at 1800 r.p.m. clockwise when looking from the stern. Determine the gyroscopic effects in the following cases :

i) If the ship travelling at 100 km/h stress to the left in a curve of 75 m radius,

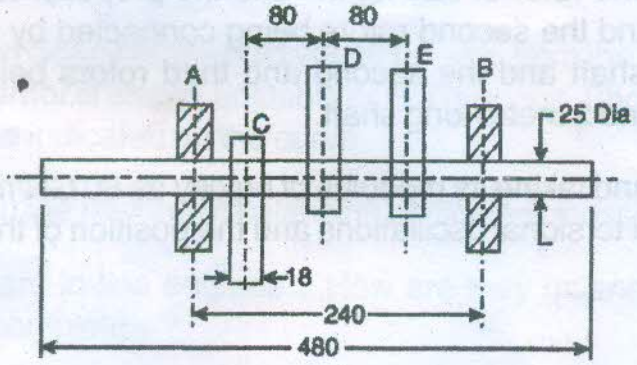
ii) If the ship is pitching and the bow is descending with maximum velocity. The pitching is simple harmonic, the periodic time being 20 seconds and the total angular movement between the extreme positions is 10°, and

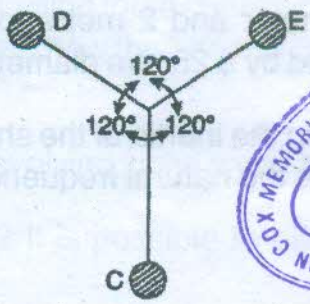
iii) If the ship is rolling and at a certain instant has an angular velocity of 0.03 rad/s clockwise when looking from stern.

In each case, explain clearly how you determine the direction in which the ship tends to move as a result of the gyroscopic action. **10**

OR

14. a) The camshaft of high speed pump consists of a parallel shaft 25 mm diameter and 480 mm long. It carries three eccentrics, each of diameter 60 mm and a uniform thickness of 18 mm. The assembly is symmetrical as shown in Fig. below and the bearings are at A and B. The angle between the eccentrics is 120° and the eccentricity of each is 12.5 mm. The material density is 7000 kg/m^3, and the speed of rotation is 1430 r.p.m. **12**





All dimensions in mm.

b) A vee-twin engine has the cylinder axes at right angles and the connecting rods operate a common crank. The reciprocating mass per cylinder is 11.5 kg and the crank radius is 75 mm. The length of the connceting rod is 0.3 m. Show that the engine may be balanced for primary forces by means of a revolving balance mass. If the engine speed is 500 r.p.m. What is the value of maximum resultant secondary force ? **8**

Module – III

15. A machine has a mass of 100 kg and unbalanced reciprocating parts of mass 2 kg which move through a vertical stroke of 80 mm with simple harmonic motion. The machine is mounted on four springs, symmetrically arranged with respect to centre of mass, in such a way that the machine has one degree of freedom and can undergo vertical displacements only.

    Neglecting damping, calculate the combined stiffness of the spring in order that the force transmitted to the foundation is $1/25^{th}$ of the applied force, when the speed of rotation of machine crank shaft is 1000 r.p.m.

    When the machine is actually supported on the springs, it is found that the damping reduces the amplitude of successive free vibrations by 25%. Find :

    i) the force transmitted to foundation at 1000 r.p.m.

    ii) the force transmitted to the foundation at resonance, and

    iii) the amplitude of the forced vibration of the machine at resonance. **(8+8+4)**

OR

16. A 4-cylinder engine and flywheel coupled to a propeller are approximated to a 3 rotor system in which the engine is equivalent to a rotor of moment of inertia 800 kg-m^2, the flywheel to a second rotor of 320 kg-m^3 and the propeller to a third rotor of 20 kg-m^2. The first and the second rotors being connected by 50 mm diameter and 2 metre long shaft and the second and third rotors being connected by a 25 mm diameter and 2 meter long shaft.

    Neglecting the inertia of the shaft and taking its modulus of rigidity as 80 GN/m^2, determine the natural frequency of torsional oscillations and the position of the nodes. **20**
