CBCS SCHEME

USN | | | | | | | | | | |

15ME52

Fifth Semester B.E. Degree Examination, Dec.2018/Jan.2019
Dynamics of Machinery

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. State the condition for static equilibrium of a body subjected to a system of
i) two forces ii) three forces iii) member with two forces and a torque. **(06 Marks)**

b. For the 4 bar mechanism shown in Fig.Q.1(b), find the required torque T_2 and various P in forces on the links for the equilibrium of the system. **(10 Marks)**

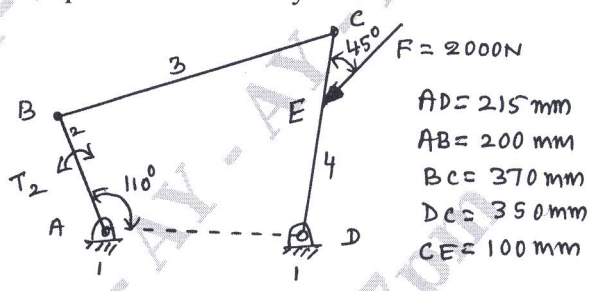

Fig.Q.1(b)

OR

2 a. Explain D'Almerts principle and state its significance. **(04 Marks)**

b. In a vertical double acting steam engine, the connecting rod is 4.5 times the crank. The weight of the reciprocating parts is 120kg and the stroke of the Piston is 440mm. The engine runs at 250rpm. If the net load on the Piston due to steam pressure is 25kN when the crank has turned through an angle of 120° from the top dead centre, determine:
i) Thrust in the connecting rod
ii) Pressure on slide bars
iii) Tangential force on the crank pin
iv) Thrust on the bearings
v) Turning moment on the crank shaft. **(12 Marks)**

Module-2

3 a. What do you mean by static and dynamic balancing? **(04 Marks)**

b. A, B, C and D are 4 masses carried by a rotating shaft at radii 100, 125, 200 and 150mm respectively. The planes in which the masses revolve are spaced 600mm apart and the mass of B, C and D are 10kg, 5kg and 4kg respectively. Find the required mass A and the relative angular settings of the 4 masses so that the shaft shall be in complete balance. **(12 Marks)**

OR

4 A four crank engine has the two outer cranks set at 120° to each other, and their reciprocating masses are each 400kg. The distance between the planes of rotation of adjacent cranks are 450mm, 750mm and 600mm. If the engine is to be in complete primary balance, find the reciprocating mass and the relative angular position for each of the inner cranks. If the length of each crank is 300mm, the length of each connecting rod is 1.2m and the speed of rotation is 240rpm. What is the maximum secondary unbalanced force? **(16 Marks)**

Module-3

5 a. Explain the following terms relative to governors: i) Stability ii) Sensitiveness iii) Isochronism iv) Hunting. **(08 Marks)**

b. A porter governor has equal arms each 250mm long and pivoted on the axis of rotation. Each ball has a mass of 5kg and the mass of the central load on the sleeve is 15kg. The radius of rotation of the ball is 150mm when the governor begins to lift and 200mm when the governor is at maximum speed. Find the minimum and maximum speeds and the range of speed of the governor. **(08 Marks)**

OR

6 a. With neat sketches, explain the effect of gyroscopic couple on steering, pitching and rolling of a ship. **(06 Marks)**

b. An aeroplane flying at 240km/h turns towards the left and completes a quarter circle of 60m radius. The mass of the rotor engine and the propeller of the plane is 450kg with a radius of gyration of 320mm. The engine speed is 2000 rpm clockwise when viewed from the rear. Determine the gyroscopic couple on the aircraft and its effect. In what way is the effect changed when the

i) Aeroplane turns towards right

ii) Engine rotates clockwise when viewed from the front (nose end) and the aeroplane turns left and right. **(10 Marks)**

Module-4

7 a. Add the following harmonic motions analytically and check the solutions graphically:

$x_1 = 4 \cos (wt + 10°)$

$x_2 = 6 \sin (wt + 60°)$ **(08 Marks)**

b. Find the natural frequency of the system shown in the Fig.Q.7(b) using energy method. **(08 Marks)**

Fig.Q.7(b)

OR

8 a. Find the natural frequency of the system shown in Fig.Q.8(a) using Newton's method. **(08 Marks)**

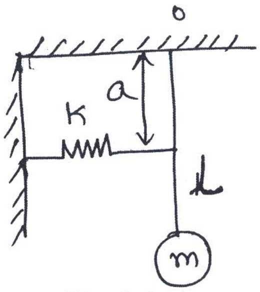

Fig.Q.8(a)

b. Find the natural frequency of the system shown in Fig.Q.8(b), K = 2 × 10^5 N/m, m = 20kg. **(08 Marks)**

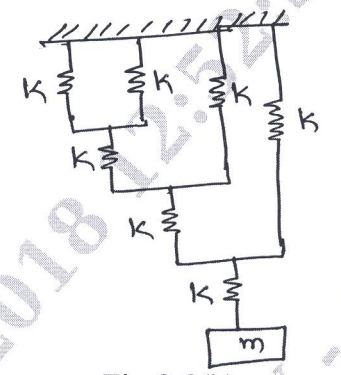

Fig.Q.8(b)

Module-5

9 a. Set up the differential equation for a spring mass damper system and obtain complete solution for the critically damped condition. **(08 Marks)**

b. Determine:

i) Critical damping coefficient
ii) Damping factor
iii) Natural frequency of damped vibrations
iv) Logarithmic decrement
v) Ratio of two consecutive amplitude of vibrating system which consists of mass of 25kg, a spring of stiffness 15 kN/m and a damper. The damping provided is only 15% of the critical value. **(08 Marks)**

OR

10 a. Define transmissibility and derive an expression for the transmissibility ratio and the phase angle for transmitted force. **(08 Marks)**

b. A machine of mass one ton is acted upon by an external force 2450N at a frequency of 1500rpm. To reduce the effects of vibration, isolator and rubber having a static deflection of 2mm under the machine load and an estimated damping factor of 0.2 are used. Determine :

i) Force transmitted to the foundation
ii) Amplitude of vibration of the machine
iii) Phase lag of the transmitted force with respect to the external force. **(08 Marks)**

* * * * *