CBCS SCHEME

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

17ME52

Fifth Semester B.E. Degree Examination, Aug./Sept.2020
Dynamics of Machinery

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. State the conditions for the equilibrium of the following systems:
i) Two force member
ii) Three force member
iii) Member with two forces and a torque. **(06 Marks)**

b. In the slider crank mechanism shown in Fig.Q.1(b). The value of force applied to slider 4 is 2kN the dimensions of the various links are AB = 80mm, BC = 240mm, θ = 60°. Determine the forces on various links and the driving torque T_2. **(14 Marks)**

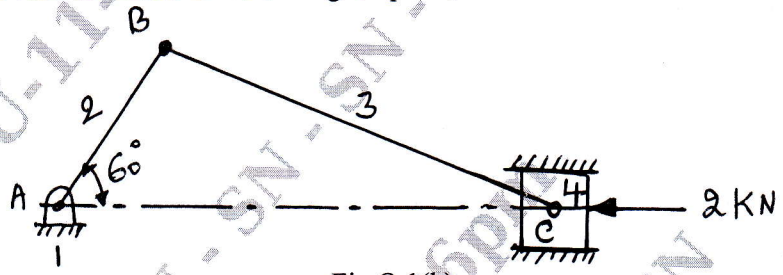

Fig.Q.1(b)

OR

2 a. What is the principal of virtual work? Explain. **(06 Marks)**

b. A four bar mechanism under the action of external force is shown in Fig.Q.2(b). Determine the torque T_2 and various forces on links for the equilibrium of the system. F = 2000N at 45° on CD, AB = 200mm, AD = 215mm, BC = 370mm, DC = 350mm, CE = 100mm. **(14 Marks)**

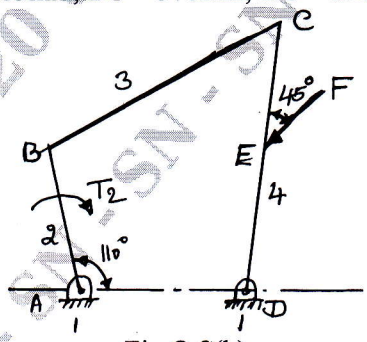

Fig.Q.2(b)

Module-2

3 a. Explain briefly static and dynamic balancing of rotating masses. **(04 Marks)**

b. A, B, C and D masses carried by a rotating shaft at radius 100, 125, 200 and 150mm respectively. The planes in which the masses revolving are spaced 600mm apart and the masses B, C and D are 10, 5, 4kg respectively. Find the required mass A and the relative angular positions of the masses to keep the shaft in balance. **(16 Marks)**

OR

4 Crank and connecting rods of a 4 cylinder inline engine running at 1800rpm are 60mm and 240mm respectively and the cylinders are spaced 150mm apart. If the cylinders are numbered 1 to 4 in sequence from one end. The cranks appear at intervals of 90° in an view in the order 1-4-2-3. Reciprocating mass corresponding to each cylinder is 1.5kg. Determine:

a. Unbalanced primary and secondary forces

b. Unbalanced primary and secondary couples with reference to central plane of the engine. **(20 Marks)**

Module-3

5 a. Derive an expression for the equilibrium speed of a porter governor. **(06 Marks)**

b. The arms of a porter governor are each 300mm long and are hinged on the axis of rotation. The mass of each ball is 5kg and mass of the sleeve is 15kg. The radius of rotation of the ball is 200mm when the governor begins to lift and 250mm when the governor is at the maximum speed. Determine:

i) Range of speed neglecting the sleeve friction

ii) Range of speed if the frictional force at the sleeve is 30N. **(14 Marks)**

OR

6 a. With usual notations and diagram derive an expression for the gyroscopic couple produced by a rotating disc: **(06 Marks)**

b. A rare engine automobile is travelling along a track of 100m mean radius each of the four road wheels has a mass moment of inertia 2kg-m^2 and effective diameter of 600mm. The rotating parts of the engine have a moment of inertia of 1kg-m^2. The engine axles parallel to the rare axle. When the crank shaft rotates in the same sense as the road wheels, the gear ratio of engine to back axle is 3:1. The vehicle weighs 15000N and has its centre of gravity 500mm above the road level. Determine the limiting speed of the vehicle around the curve for all 4-wheels to maintain contact with the road surface if this is not cambered. **(14 Marks)**

Module-4

7 a. Define the following:

i) Time period

ii) Amplitude

iii) Frequency **(06 Marks)**

b. A body is subjected to two harmonic motions as given below:

$x_1 = 15\sin(wt + 30°)$

$x_2 = 8\cos(wt + 60°)$

Add the two harmonic motions and check it graphically. **(14 Marks)**

OR

8 a. A spring mass system has spring stiffness of K N/m and a mass of M kg. It has a natural frequency of vibration as 10Hz. An extra 3 kg mass is coupled to M and the natural frequency reduces by 3Hz. Find the value of M and spring constant K. **(05 Marks)**

b. A vertical shaft of 100mm in diameter and 1m long has its upper end fixed at the top as shown in Fig.Q.8(b). At the other end it carries a disc of 500kg at a radius of gyration of 450mm. The modulus of rigidity and modulus of elasticity (Young's modulus) for the shaft material are 80GN/m^2 and 200GN/m^2 neglecting the weight of the shaft. Determine:
   i) Frequency of longitudinal vibration
   ii) Frequency of torsional vibration
   iii) Frequency of transverse vibration. **(15 Marks)**

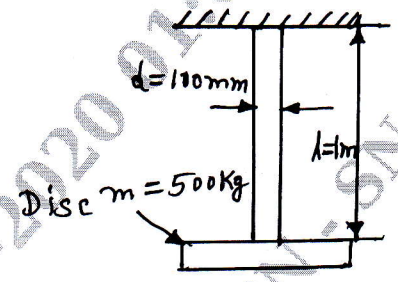

Fig.Q.8(b)

Module-5

9 a. Derive an expression for logarithmic decrement for an under damped case. **(10 Marks)**

b. Determine:
   i) Critical damping coefficient
   ii) Damping factor
   iii) Natural frequency of damped vibrations
   iv) Logarithmic decrement
   v) Ratio of two consecutive amplitudes of a vibrating system which consists of a mass of 25kg, a spring of stiffness 15kN/m and a damper. The damping provided is only 15% of the critical value. **(10 Marks)**

OR

10 a. Derive for transmissibility ratio due to harmonic excitation. **(10 Marks)**

b. A mass of 100kg been mounted a spring dashpot system having spring stiffness of 19,600N/m and damping coefficient of 100N-s/m. The mass is acted upon by a harmonic force of 39N at the undamped natural frequency of the system. Determine:
   i) Amplitude of vibration of the mass.
   ii) Phase difference between the force and displacement.
   iii) Forced transmissibility ratio. **(10 Marks)**

* * * * *