Reg. No. \_\_\_\_\_\_\_\_\_\_\_\_\_

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**End Semester Examination – Nov / Dec – 2019**

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| **Code :** | **17ME2019** | **Duration :** | **3hrs** |
| **Sub. Name:** | **DYNAMICS OF MACHINERY** | **Max. Marks:** | **100** |

**ANSWER ALL QUESTIONS (5 x 20 = 100 Marks)**

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| **Q.**  **No.** | | **Sub.div.** | **Questions** | **Course Outcome** | **Marks** |
| 1. | | a. | Compare flywheel with governor. | CO2 | 5 |
| b. | The turning moment diagram for a multi cylinder engine has been drawn to a scale 1 mm = 600 N-m vertically and 1 mm = 30 horizontally. The intercepted areas between the output torque curve and the mean resistance line, taken in order from one end are as follows: 52,-124, 92,-140, 85,-72 and 107 mm2, when the engine is running at a speed of 600 r.p.m. If the total fluctuation of speed is not to exceed + 1.5 % of the mean, find the necessary mass of the flywheel of radius 0.5 m. | CO3 | 15 |
| **(OR)** | | | | | |
| 2. | | a. | State D’Alembert’s principle. | CO1 | 5 |
| b. | The length of crank and connecting rod of a horizontal reciprocating engine are 200 mm and 1.0 meter respectively. The crank is rotating at 400 rpm. When the crank has turned through 300 from the inner dead centre, the difference of pressure between cover end and piston rod is 0.4 N/mm2. If the mass of the reciprocating parts is 100 kg and cylinder bore is 0.4 meters, then calculate: (i) Inertia force, (ii) Force on piston, (iii) Piston effort (iv) Thrust on the sides of the cylinder walls, (v) Thrust in the connecting rod and (vi) crank effort. | CO3 | 15 |
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| 3. | | a. | Write the need of balancing. | CO2 | 5 |
| b. | Four masses A, B, C and D as shown below are to be completely balanced.   |  |  |  |  |  | | --- | --- | --- | --- | --- | |  | A | B | C | D | | Mass (kg) | - | 30 | 50 | 40 | | Radius (mm) | 180 | 240 | 120 | 150 |   The planes containing masses B and C are 300 mm apart. The angle between planes containing B and C is 900. B and C make angles of 2100 and 1200 respectively with D in the same sense. Find (i) The magnitude and the angular position of mass A and (ii) The position of planes A and D. | CO3 | 15 |
| **(OR)** | | | | | |
| 4. | | a. | Define swaying couple. | CO1 | 5 |
| b. | An inside cylinder locomotive has its cylinder centre lines 0.7m apart and has a stroke of 0.6 m. The rotating masses per cylinder are equivalent to 150 kg at the crank pin and the reciprocating masses per cylinder to 180 kg. The wheel centre lines are 1.5 m apart. The cranks are at right angles.  The whole of the rotating and 2/3 of the reciprocating masses are to be balanced by masses placed at a radius of 0.6 m. Find the magnitude and direction of the balancing masses. | CO3 | 15 |
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| 5. | | a. | When resonance will occur? | CO2 | 5 |
| b. | A machine of mass 75 kg is mounted on spring and is fitted with a dashpot to damp out vibrations. There are three springs each of stiffness 10 N/mm and it is found that the amplitude of vibration diminishes from 38.4 mm to 6.4 mm in two complete oscillations. Assuming that the damping force varies as the velocity, determine: (i) the resistance of the dash pot at unit velocity (ii) the ratio of the frequency of the damped vibration to the frequency of the undamped vibrations and (iii) the periodic time of the damped vibrations. | CO3 | 15 |
| **(OR)** | | | | | |
| 6. | | a. | Define magnification factor. | CO1 | 5 |
| b. | A mass of 10 kg is suspended from one end of a helical spring, the other end being fixed. The stiffness of the spring is 10 N/mm. The viscous damping causes the amplitude to decrease to one- tenth of the initial value in four complete oscillations. If a periodic force of 150 cos50t N is applied at the mass in the vertical direction, find the amplitude of the forced vibration. What is its value of resonance? | CO3 | 15 |
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| 7. | | a. | What is critical speed (or) whirling speed of a shaft? | CO2 | 5 |
| 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/m3 and young’s modulus is 200 GN/ m2. Assume the shaft to be freely supported. | CO3 | 15 |
| **(OR)** | | | | | |
| 8. | | a. | Define torsionally equivalent shaft. | CO2 | 5 |
| 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 the free torsional vibration of the system. The modulus of rigidity of shaft material may be taken as 80 GN/m2. | CO3 | 15 |
|  |  | | **Compulsory:** | | |
| 9. | | a. | What is gyroscopic torque? | CO2 | 5 |
| b. | A porter governor has all four arms 250 mm long. The upper arms are attached on the axis of rotation and the lower arms are attached to the sleeve at a distance of 30 mm from the axis. The mass of each ball is 5 kg and the sleeve has a mass of 50 kg. The extreme radii of rotation are 150 mm and 200 mm. Determine the range of speed of the governor. | CO3 | 15 |