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



**End Semester Examination – Nov/Dec– 2017**

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| **Code :** | **14ME2027** | **Duration :** | **3hrs** |
| **Sub. Name :** | **DYNAMICS OF MACHINERY** | **Max. marks :** | **100** |

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

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| **Sl. No.** | **Sub Div** | **Questions** | **Course Outcome** | **Marks** |
| 1. | a. | The four-bar linkage has crank 2 driven by torque **M**12; an external load P=120 N at an angle of 40º on link 4. For the particular position of the linkage shown find all the constraint forces and their reactions necessary for this link to be a position of equilibrium.  B  A  2  135º  4  Q  P  3  O4  O2  RO4O2=20cm  RAO2=15cm  RBO4=30cm  RBA=46cm  RQO4=12.5cm  40º | CO1 | 15 |
|  | b. | Define static equilibrium and briefly explain the equilibrium of members with two forces and a torque. | CO1 | 5 |
| (OR) | | | | |
| 2. | a. | A horizontal steam engine running at 120 r.p.m. has a bore of 250 mm and a stroke of 400 mm. The connecting rod is 0.6 m and mass of the reciprocating parts is 60 kg. When the crank has turned through an angle of 45o from the inner dead centre, the steam pressure on the cover end side is 550 kN/m2 and that on the crank end side is 70 kN/m2. Considering the diameter of piston rod equal to 50 mm, determine   1. Turning moment on the crank shaft 2. Thrust on the bearings, and 3. Acceleration of the flywheel, if the power of the engine is 20 kW, mass of the flywheel 60 kg and radius of gyration 0.6 m. | CO1 | 16 |
| b. | Define D’Alembert’s Principle, inertia force and inertia torque. | CO1 | 4 |
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| 3. |  | A steam engine runs at 150 r.p.m. its turning moment diagram gave the following area measurements in mm2 taken in order above and below the mean torque line are,500, –250, 270, –390, 190, –340, 270, –250. The scale for the turning moment is 1 mm = 500 N-m, and for crank angle is 1 mm = 5o. The function of speed is not to exceed ±1.5% of the mean, determine the cross-section of the rim of the flywheel assumed rectangular with axial dimension equal to 1.5 times the radical dimension. The hoop stress is limited to 3 MPa and the density of the material of the flywheel is 7500 kg/m3. | CO2 | 20 |
| (OR) | | | | |
| 4. |  | A shaft carries four masses in parallel planes A, B, C and D in this order along its length. The masses at B and C are 18 kg and 12.5 kg respectively, and each has an eccentricity of 60 mm. The masses at A and D have an eccentricity of 80 mm. The angle between the masses at B and C is 100° and that between the masses at B and A is 190°, both being measured in the same direction. The axial distance between the planes A and B is 100 mm and that between B and C is 200 mm. If the shaft is in complete dynamic balance, determine :   1. The magnitude of the masses at A and D ; 2. The distance between planes A and D ; and 3. The angular position of the mass at D. | CO3 | 20 |
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| 5. | a. | Define frequency, cycle, period and free vibration | CO4 | 4 |
|  | b. | A vibrating system consists of a mass of 8 kg, spring of stiffness 5.6 N/mm and dashpot of damping coefficient of 40 N/m/s. Find, i. Critical damping coefficient ii. Damping factor iii. Logarithmic decrement iv. Natural frequency of damped vibration v. Ratio of two consecutive amplitude vi. Number of cycle after which the original amplitude is reduced to 20%. | CO4 | 16 |
| (OR) | | | | |
| 6. | a. | Define critical or whirling speed. What are the causes of critical speed? | CO4 | 4 |
|  | b. | A vertical steel shaft 15 mm diameter is held in long bearings 1 m apart and carries at its middle a disc of mass 15 kg. The eccentricity of the centre of gravity of the disc from the centre of the rotor is 0.30 mm. The modulus of elasticity for the shaft material is 200 GN/m2 and the permissible stress is 70 MN/m2. Determine:   1. The critical speed of the shaft and 2. The range of speed over which it is unsafe to run the shaft. Neglect the mass of the shaft. | CO4 | 16 |
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| 7. | a. | Derive the expression for the equivalent length of a stepped shaft. | CO4 | 5 |
|  | b. | A steel shaft ABCD 1.5 m long has flywheel at its ends A and D. The mass of the flywheel A is 600 kg and has a radius of gyration of 0.6 m. the mass of the flywheel D is 800 kg and has a radius of gyration of 0.9 m. the connecting shaft has a diameter of 50 mm for the portion AB which is 0.4 m long; and has a diameter of 60 mm for the portion BC which is 0.5 m long; and has a diameter of d mm for the portion BC which is 0.6 m long. Determine :   1. The diameter ‘d’ of the portion CD so that the node of the torsional vibration of the system will be at the centre of the length BC; and 2. The natural frequency of the torsional vibrations. The modulus of rigidity of the shaft material is 80 GN/m2. | CO4 | 15 |
| (OR) | | | | |
| 8. | a. | A motor drives a centrifugal pump through gearing, the pump speed being one-third that of the motor. The shaft from the motor to the pinion is 60 mm diameter and 300 mm long. The moment of inertia of the motor is 400 kg-m2. The impeller shaft is 100 mm diameter and 600 mm long. The moment of inertia of the impeller is 1500 kg-m2. Neglecting inertia of the gears and the shaft. Determine the frequency of torsional vibration of the system. The modulus of rigidity of the shaft material is 80 GN/m2. | CO4 | 15 |
|  | b. | A shaft of 100 mm diameter and 1 m long has one of its end fixed and the other end carries a disc of mass 500 kg at a radius of gyration of 450 mm. the modulus of rigidity is 80 GN/m2. Determine the frequency of torsional vibrations. | CO4 | 5 |
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|  | | **Compulsory:** |  |  |
| 9. | a. | A porter governor has equal arms each 250 mm long and pivoted on the axis of rotation. Each ball has a mass of 5 kg and mass of the central load on the sleeve is 25 kg. The radius of rotation of the ball is 150 mm when governor begins to lift and 200 mm when the governor is at maximum speed. Find the maximum and minimum speed and range of speed of the governor. | CO5 | 16 |
|  | b. | Define gyroscopic couple. What is the effect of gyroscopic couple on an automobile taking a turn? | CO5 | 4 |

**ALL THE BEST**