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**UNIVERSITY**

(Karunya Institute of Technology & Sciences)

(Declared as Deemed-to-be University under Sec.3 of the UGC Act, 1956)

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

**End Semester Examination – Nov/Dec - 2016**

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|  |  | **Semester :** | **2016-17 ODD** |
| **Code :** | **10ME201/12ME223/ME208/ME255** | **Duration :** | **3 hrs** |
| **Sub. Name :** | **MECHANICS OF MACHINES – II** | **Max. marks :** | **100** |

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| **Q. No.** | **Questions** | **Marks** |
| **PART-A(10X1=10 MARKS)** | | |
| 1. | Define the coefficient of fluctuation of speed of a flywheel. | (1) |
| 2. | What is the function of a flywheel? | (1) |
| 3. | State D’Alembert’s principle. | (1) |
| 4. | Express mathematically primary and secondary unbalanced forces in a reciprocating mass system. | (1) |
| 5. | Give an example of balancing in more than one plane. | (1) |
| 6. | Mention two causes of vibration. | (1) |
| 7. | What is the equivalent stiffness of two springs of stiffness k1 and k2 connected in series? | (1) |
| 8. | What is the condition for whirling speed of a shaft? | (1) |
| 9. | Define torsional stiffness. | (1) |
| 10. | What is the value of amplitude at a node in a torsional vibration system? | (1) |

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| **PART B(5 X 3= 15 MARKS)** | | |
| 11 | With neat sketches, explain the condition of static equilibrium of a member with  (i) two forces, (ii) three forces | (3) |
| 12 | Draw the turning moment diagram for a four stroke IC engine. | (3) |
| 13 | State the condition for the following:  (i) Over-damped system (iii) Under damped system (iii) Critically damped system | (3) |
| 14 | Obtain the natural frequency of a spring mass system with spring stiffness 10000 N/m and mass 10 kg. | (3) |
| 15 | Derive the relation between lengths and diameters of a stepped shaft and an equivalent shaft. | (3) |

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| **PART C(5 X 15= 75 MARKS)** | | |
| 16. | The four-bar linkage has crank 2 driven by torque **T** ; an external load F=66 N at an angle of 42º 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. | 15 |
| T  B  A  2  60º  4  100º  10º  Q  F  3  O4  O2  **O4O2=1100 mm**  **AO2=550 mm**  **BO4=616 mm**  **AB=726 mm**  **QO4=410 mm**  42º | |
| (OR) | | |
| 17. | The stroke of a petrol engine is 120 mm and connecting rod is 5 times the crank length. The crank rotates at 1500 r.p.m. in clockwise direction. Determine: (i) velocity and acceleration of the piston, when the crank has travelled through an angle of 45⁰ from inner dead centre, and (ii) the position of the crank for zero acceleration of the piston. | 15 |
| 18. | The turning moment diagram for a multi-cylinder engine has been drawn to a vertical scale  1mm=600N-m and a horizontal scale of 1mm = 4º. The intercepted areas between the output torque curve and the mean resistance line, taken in order from one end, are as follows: -28, +380, -260, +310, -300, +242,-380, +265 and -229 mm2 , when the engine is running at a speed of 420 r.p.m. If the total fluctuation of speed is not to exceed ± 1.2 % of the mean speed, find the mass of the flywheel. Take radius of gyration of flywheel as 1m. | 15 |
| (OR) | | |
| 19. | The turning moment diagram for a multi-cylinder engine has been drawn to a scale of 1 mm to 500 N-m torque and 1 mm to 5° of crank displacement. The intercepted areas between output torque curve and mean resistance line taken in order from one end, in square mm are 500,– 250, + 270, – 390, + 190, – 340, + 270, and – 250, when the engine is running at 150 r.p.m. The fluctuation of speed is not to exceed ± 1.5 % of the mean speed. Determine the suitable cross-section of the rim of the flywheel assumed rectangular with axial dimension equal to 1.5 times the radial dimension. The hoop stress is limited to 3 MPa and density of the material of the flywheel is 7500 kg/m3. | 15 |
| 20. | Four masses m1, m2, m3 and m4 are 20 kg, 30 kg, 24 kg and 26 kg respectively. The corresponding radii of rotation are 0.2 m, 0.15 m, 0.25 m and 0.3 m respectively and the angles between successive masses are 45°, 75° and 135°. Find the position and magnitude of the balance mass required, if its radius of rotation is 0.25 m. | 15 |
| (OR) | | |
| 21. | A rotor has the following properties.   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Mass | Magnitude (kg) | Radius (mm) | Angle | Axial distance from A (mm) | | A | 90 | 100 | 0° | - | | B | 70 | 120 | 60° | 160 | | C | 80 | 140 | 135° | 320 | | D | 60 | 120 | 270° | 560 |   If the shaft is balanced by two counter masses located at 100 mm radii, revolving in planes mid-way between planes A and B and mid-way between planes C and D. Determine the magnitude of masses and their respective angular positions. | 15 |
| 22. | A single degree damped vibration system consists of a mass of 70 kg, a spring of stiffness 40000 N/m and a damper. The damping provided is only 25 % of its critical value. Determine (i) the damping factor (ii) Critical damping coefficient (iii) the natural frequency of damped vibrations (iv) the logarithmic decrement, and (v) the ratio of two successive amplitudes. | 15 |
| (OR) | | |
| 23. | A shaft 180 mm diameter and 2.5 metres long is simply supported at the ends and carries three loads of 2500 N, 5000 N and 2000 N at 0.6 m, 1.5 m and 2 m from the left end. Determine the natural frequency of transverse vibration using Dunkerly’s method. Take Young's modulus for shaft material is 211 GN/m2. | 15 |
| 24. | A steel shaft 1.6m long is 95mm in diameter for the first 0.6m of its length, 60mm in diameter for the next 0.5 m of the length and 50mm in diameter for the remaining length. The shaft carries two rotors at two ends, the first having a mass of 800kg and 0.85m radius of gyration located at the 95mm diameter end and the second having a mass of 600kg and 0.55m radius of gyration located at the other end. Determine the location of the node and the natural frequency of free torsional vibration of the system. The modulus of rigidity of shaft material is 80GN/m2 | 15 |
| (OR) | | |
| 25. | A centrifugal pump rotating at 400 r.p.m. is driven by an electric motor at 1200 r.p.m. through a single stage reduction gearing. The moments of inertia of the pump impeller and the motor are 1500 kg. m2 and 400 kg. m2 respectively . The lengths of the pump shaft and motor shaft are 500 and 200 mm , and their diameters are 100 and 50 mm respectively. Neglecting the inertia of the gears, find the frequency of torsional oscillations of the system. The modulus of rigidity of the shaft material is 85GN/m2 | 15 |