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**PRESIDENCY UNIVERSITY**

**Bengaluru**

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| **End - Term Examinations – JANUARY 2025** |
| **Date:** 13 – 01- 2025 **Time:** 09:30 am – 12:30 pm |

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| **School:** SOE | **Program:** B. Tech – MEC/MCM | |
| **Course Code:** MEC3085 | **Course Name:** Dynamics of Machines | |
| **Semester**: V | **Max Marks**: 100 | **Weightage**:50% |

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| **CO - Levels** | **CO1** | **CO2** | **CO3** | **CO4** |
| **Marks** | **26** | **24** | **26** | **24** |

**Instructions:**

1. *Read all questions carefully and answer accordingly.*
2. *Do not write anything on the question paper other than roll number.*

**Part A**

|  |  |  |  |  |
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| **Answer ALL the Questions. Each question carries 2marks. 2Mx10Q=20M** | | | | |
| **1** | Define static equilibrium of two forces. | **2 Marks** | **L1** | **CO1** |
| **2** | Define Fly wheel. | **2 Marks** | **L1** | **CO1** |
| **3** | What is Governor? | **2 Marks** | **L1** | **CO1** |
| **4** | What is sleeve lift in governor? | **2 Marks** | **L1** | **CO2** |
| **5** | What is effort in a governor? | **2 Marks** | **L1** | **CO2** |
| **6** | What is inertia force? | **2 Marks** | **L1** | **CO3** |
| **7** | Define maximum fluctuation of energy? | **2 Marks** | **L1** | **CO3** |
| **8** | List the three cases used in naval ship. | **2 Marks** | **L1** | **CO3** |
| **9** | Define centrifugal force and centripetal force. | **2 Marks** | **L1** | **CO4** |
| **10** | State D’Almbert’s Principle | **2 Marks** | **L1** | **CO4** |

**Part B**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Answer ALL Questions. Each question carries 20 marks. 4QX20M=80M** | | | | | |
| **11** | **11a** | With a suitable sketch explain the static force analysis of four bar mechanism | **10 Marks** | **L2** | **CO1** |
| **11b** | In a fig. A Four bar Mechanism is shown. Calculate the required value of T2 and various forces on the links fo the equilibrium of the system F = 2000N, AD =215mm, AB = 200mm, BC = 370 mm, DC =350mm and CE =100mm. | **10Marks** | **L3** | **CO1** |
| **Or** | | | | | |
| **12** | **12a** | With a suitable sketch explain the static force analysis of slider crank mechanism | **10 Marks** | **L2** | **CO1** |
| **12b** | Figure shows a slider crank mechanism in which the resultant external load P= 2000N ,acts on the piston. The system is kept in equilibrium as a result of the couple applied to the crank 2, The linkage dimensions are AO2 = 100mm,AO2B = 45Omm Determine forces acting on all the links and the couple on link 2. Link 3 = 285mm. | **10Marks** | **L3** | **CO1** |
|  |  |  |  |  |  |
| **13** | **13a** | With a neat sketch explain Turning Moment Diagram for a Four Stroke Cycle Internal Combustion Engine. | **10Marks** | **L2** | **CO2** |
| **13b** | The turning moment diagram for a petrol engine is drawn to the following scales: Turning moment, 1 mm = 5 N-m ; crank angle, 1 mm = 1°. The turning moment diagram repeats itself at every half revolution of the engine and the areas above and below the mean turning moment line taken in order are 295, 685, 40, 340, 960, 270 mm2. The rotating parts are equivalent to a mass of 36 kg at a radius of gyration of 160 mm. Determine the coefficient of fluctuation of speed when the engine runs at 1850 r.p.m. | **10Marks** | **L3** | **CO2** |
| **Or** | | | | | |
| **14** | **14a** | With a neat sketch explain the working principle of fly wheel in punching press. | **10Marks** | **L2** | **CO2** |
| **14b** | A punching press is driven by a constant torque electric motor. The press is provided with a flywheel that rotates at maximum speed of 225 r.p.m. The radius of gyration of the flywheel is 0.5 m. The press punches 720 holes per hour; each punching operation takes 2 second and requires 15 kN-m of energy. Find the power of the motor and the minimum mass of the flywheel if speed of the same is not to fall below 200 r. p. m. | **10Marks** | **L3** | **CO2** |
|  |  |  |  |  |  |
| **15** | **15a** | Discuss the effect of gyroscopic couple on a naval ship during steering. | **10 Marks** | **L2** | **CO3** |
|  | **15b** | A ship propelled by a turbine rotor which has a mass of 6 tonnes and a speed of 2200 r.p.m. The rotor has a radius of gyration of 0.5 m and rotates in a clockwise direction when viewed from the stern. Find the gyroscopic effects in the following conditions:  1. The ship sails at a speed of 30 km/h and steers to the left in a curve having 60 m radius.  2. The ship pitches 6 degree above and 6 degree below the horizontal position. The bow is descending with its maximum velocity. The motion due to pitching is simple harmonic and the periodic time is 20 seconds.  3. The ship rolls and at a certain instant it has an angular velocity of 0.03 rad/s clockwise when viewed from stern.  Determine also the maximum angular acceleration during pitching. Explain how the direction of motion due to gyroscopic effect is determined in each case | **10Marks** | **L2** | **CO3** |
| **Or** | | | | | |
| **16** | **16a** | With a neat sketch explain the stability of a 4 wheel driving moving in a curved path | **10 Marks** | **L2** | **CO3** |
| **16b** | A four-wheeled trolley car of mass 2500 kg runs on rails, which are 1.5 m apart and travels around a curve of 30 m radius at 24 km / hr. The rails are at the same level. Each wheel of the trolley is 0.75 m in diameter and each of the two axles is driven by a motor running in a direction opposite to that of the wheels at a speed of five times the speed of rotation of the wheels. The moment of inertia of each axle with gear and wheels is 18 kg-m2. Each motor with shaft and gear pinion has a moment of inertia of 12 kg-m2. The centre of gravity of the car is 0.9 m above the rail level. Determine the vertical force exerted by each wheel on the rails taking into consideration the centrifugal and gyroscopic effects. State the centrifugal and gyroscopic effects on the trolley. | **10Marks** | **L3** | **CO3** |
|  |  |  |  |  |  |
| **17** | **17a** | Write any five difference between governor and Flywheel. | **10Marks** | **L2** | **CO4** |
| **17b** | The arms of a Porter governor are each 250 mm long and pivoted on the governor axis. The mass of each ball is 5 kg and the mass of the central sleeve is 30 kg. The radius of rotation of the balls is 150 mm when the sleeve begins to rise and reaches a value of 200 mm for maximum speed. Determine the speed range of the governor. If the friction at the sleeve is equivalent of 20 N of load at the sleeve, determine how the speed range is modified | **10Marks** | **L3** | **CO4** |
| **or** | | | | | |
| **18** |  | A Porter governor has equal arms each 300 mm long and pivoted on the axis of rotation. Each ball has a mass of 10 kg and the mass of the central load on the sleeve is 25 kg. The radius of rotation of the ball is 200 mm when the governor begins to lift and 250 mm when the governor is at maximum speed. Find the minimum and maximum speeds and range of speed of the governor. | **20Marks** | **L3** | **CO4** |

**\*\*\*\*\* BEST WISHES \*\*\*\*\***