# Model Question Paper -1 with effect from 2020-21(CBCS Scheme)

USN | | | | | | | | | |

## Fifth Semester B.E. Degree Examination

## Dynamics of Machines

**TIME: 03 Hours** **Max. Marks: 100**

Note: 01. Answer any **FIVE** full questions, choosing at least **ONE** question from each **MODULE**.

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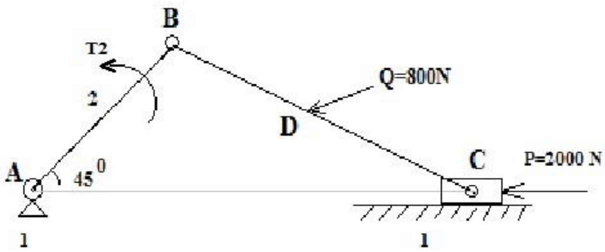
| | | **Module – 1** | |
| **Q.1** | **(a)** | Explain with an example the usefulness of free body diagram in the static force analysis of machinery. | 5 |
| | **(b)** | Determine the various forces on the links and couple $T_2$ shown in figure.  | 15 |
| | | **OR** | |
| **Q.2** | **(a)** | Explain D'Alemberts principle and state why it is used. | 4 |
| | **(b)** | The radius of crank of a horizontal engine is 300 mm. The mass of the reciprocating parts is 200 kg. The difference between driving and back pressure is 0.4 N/mm$^2$ when the crank has travelled 60$^0$ from I.D.C. The length of connecting rod is 1.2 m and the cylinder bore is 0.5 m. The engine runes at 240 rpm. Neglecting the effect of piston rod, find (a) Pressure on the slide bar, (b) thrust in the connecting rod, (c) tangential force, and (d)Turning moment on the crankshaft. | 16 |
| | | **Module – 2** | |
| **Q.3** | **(a)** | State the necessity of balancing of high speed machinery. | 3 |
| | **(b)** | Explain static and dynamic balance of machinery. | 4 |
| | **(c)** | A rotating shaft carried four masses 1, 2, 3 and 4 which are radially attached to it. The mass centers are 30, 38, 40 and 35mm respectively from the axis of rotation. The masses 1, 3 and 4 are 7.5, 5 and 4Kg respectively. The axial distance between the planes 1 and 2 is 400mm and, between 2 and 3 is 500mm. The masses 1 and 3 are at right angles to each other. Find for complete balance (i) Angle between planes 1, 2 and 1, 4. (ii) Axial distance between planes 3 and 4.(iii) Magnitude of mass 2. | 13 |
| | | **OR** | |
| **Q.4** | **(a)** | Discuss primary and secondary unbalance in reciprocating engines. | 4 |
| | **(b)** | Define (a) Hammer blow, (b) Tractive effort and (c) Swaying couple. | 6 |
| | **(c)** | A six cylinder two stroke single acting diesel engine with cylinder centre lines are spaced at 650 mm. In the end view the cranks are 60$^0$ apart and in order 1-4-5-2-3-6. The stroke of each piston is 400 mm and the crank to C.R ratio is 1:5. The mass of reciprocating part is 100 kg per crank. The engine rotates at 240 rpm. Investigate the engine for out of balance primary and secondary forces and couples. | 10 |
| | | **Module – 3** | |

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| **Q.5** | **(a)** | Define the following (a) Sensitiveness,(b) Governor effort,(c) Governor power, (d) Hunting,(e) Stability and (d) Isochronous governor. | 6 |

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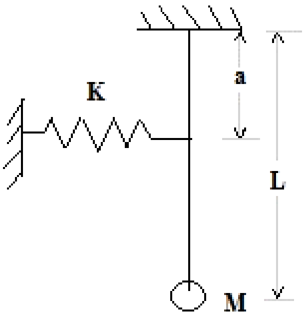
| | (b) | A Hartnell governor moves between 300 rpm an 320 rpm for a sleeve lift of 20 mm. The sleeve arms and ball arms are 80 mm and 120 mm respectively. The levers are pivoted at 120 mm from governor axis. The weight of each ball is 25 N. The ball arms are parallel to the governor axis at the lowest equilibrium speed. Determine the stiffness of the spring. | 14 |
| **OR** | | | |
| **Q.6** | **(a)** | With neat sketch, explain the effect of gyroscopic couple on the ship when the ship is steering, pitching and rolling. | 6 |
| | **(b)** | A ship is propelled by a turbine rotor which has a mass of 5000 Kg and has a speed of 2100 rpm. The turbine rotor has a radius of gyration of 0.5 m and rotates in clockwise direction when viewed from stern. Find the gyroscopic effect in the following conditions. i) The ship runs at a speed of 16 Knots (1 Knot= 1.86 Km/hr), it steers to the left in a curve of 60 m radius. ii) The ship pitches $6^0$ above and $6^0$ below horizontal position. The bow descends with maximum velocity. The motion of pitching is SHM. and time period is 20 secs. iii) The ship rolls with a maximum angular velocity of 0.03 rad/sec clockwise when viewed from the stern. | 14 |
| **Module – 4** | | | |
| **Q.7** | **(a)** | Define SHM, amplitude, time period and natural frequency. | 8 |
| | **(b)** | Derive the differential equation of the pendulum as shown in Figure below and find time period and natural frequency   | 12 |
| **OR** | | | |
| **Q.8** | **(a)** | Define under damped, over damped and critically damped system with respect to damping factor. | 4 |
| | **(b)** | State logarithmic decrement derive the equation for logarithmic decrement. | 6 |
| | **(c)** | A damper offers resistance of 0.05 N at constant velocity of 0.04 m/s. The damper spring is used with k= 9 N/m. Determine damping and frequency of the system when the mass of the system is 0.01 kg. | 10 |
| **Module – 5** | | | |
| **Q.9** | **(a)** | Define the following (a) Magnification factor (b) Resonance (c) critical speed of shafts and (d) absolute motion. | 4 |
| | **(b)** | A vibrating system having the mass of 1 kg is suspended by a spring of stiffness 1000 N/m and it is put to a harmonic excitation of 10 N. Assuming viscous damping ,determine (a) The resonant frequency, (b) the phase angle of resonance, (c)the amplitude at resonance (d) the frequency corresponding to the peak amplitude and (e) damping frequency. | 16 |
| **OR** | | | |
| | **(a)** | Explain vibration transmissibility and vibration isolation. | 4 |

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| Q.10 | (b) | The weight of an electric motor is 125 N and it runs at 1500 rpm. The armature weighs 35 N and its centre of gravity lies 0.05 cm from the axis of rotation. The motor is mounted on five springs of negligible damping so that force transmitted is one-eleventh of the impressed force. Assume that the weight of the motor is equally distributed among the five springs, Determine (a) stiffness of each spring, (b) dynamically transmitted force to the base at operating speed, and (c) natural frequency of the system. | 16 |
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| Table showing the Bloom's Taxonomy Level, Course Outcome and Programme Outcome | | | | |
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| **Question** | | **Bloom's Taxonomy Level attached** | **Course Outcome** | **Programme Outcome** |
| **Q.1** | (a) | L4 | CO1 | PO1,PO12 |
| | (b) | L3 | CO1 | PO1,PO2 |
| **Q.2** | (a) | L2 | CO1 | PO1,PO12 |
| | (b) | L3 | CO1 | PO1,PO2 |
| **Q.3** | (a) | L1 | CO2 | PO1,PO12 |
| | (b) | L2 | CO2 | PO1,PO12 |
| | (c) | L3 | CO2 | PO1,PO2 |
| **Q.4** | (a) | L1 | CO2 | PO1,PO12 |
| | (b) | L2 | CO2 | PO1,PO12 |
| | (c) | L3 | CO2 | PO1,PO2 |
| **Q.5** | (a) | L1 | CO3 | PO1,PO12 |
| | (b) | L3 | CO3 | PO1,PO2 |
| **Q.6** | (a) | L2 | CO3 | PO1,PO12 |
| | (b) | L3 | CO3 | PO1,PO2 |
| **Q.7** | (a) | L1 | CO4 | PO1,PO12 |
| | (b) | L3 | CO4 | PO1,PO2 |
| **Q.8** | (a) | L1 | CO4 | PO1,PO12 |
| | (b) | L1 | CO4 | PO1,PO12 |
| | (c) | L3 | CO4 | PO1,PO2 |
| **Q.9** | (a) | L1 | CO5 | PO1,PO2 |
| | (b) | L3 | CO5 | PO1,PO12 |
| **Q.10** | (a) | L2 | CO5 | PO1,PO2 |
| | (b) | L3 | CO5 | PO1,PO12 |

| **Bloom's Taxonomy Levels** | **Lower order thinking skills** | | |
|---|---|---|---|
| | Remembering( knowledge): $L_1$ | Understanding Comprehension): $L_2$ | Applying (Application): $L_3$ |
| | **Higher order thinking skills** | | |
| | Analyzing (Analysis): $L_4$ | Valuating (Evaluation): $L_5$ | Creating (Synthesis): $L_6$ |