# Vidyavardhini's College of Engineering & Technology, Vasai

**Department of Mechanical Engineering**

**Sample Test paper**

**Sub: MEC504/Dynamics of Machinery (DOM)**

**Year/Sem:- TE- CBCGS MECH V$^{th}$ Sem** **Marks: 80**

**N.B.: (1) Assume data if required**

**(2) Draw diagrams wherever required**

**(3) Figures to the right indicate full marks**

**CO1:** Apply principles of different types of governors and Gyroscopic effects on the mechanical systems

**CO2:** Illustrate basic of static and dynamic forces

**CO3:** Determine the natural frequency of element/system

**CO4:** Determine vibration response of mechanical elements/systems

**CO5:** Select vibration isolation system for a specific application

**CO6:** Demonstrate basis concepts of balancing of forces and couples.

**SECTION - I (MCQ)** **Marks : 40**

**Each question carries 2 marks**

**1) Identify the case from following which applies to isochronous governor**

a) Equilibrium speed is constant for a particular radius of rotation of governor balls
b) Equilibrium speed is constant for only one radius of rotation of governor balls
c) Equilibrium speed is variable for different radii of rotation of governor balls
d) Equilibrium speed is constant for all radii of rotation of the balls within the working range

**2) Identify the case from following which applies to stable governor**

a) radius of rotation of balls increases as the equilibrium speed decreases
b) radius of rotation of balls decreases as the equilibrium speed decreases
c) radius of rotation of balls increases as the equilibrium speed increases
d) radius of rotation of balls decreases as the equilibrium speed increases

**3) Identify which of the following gives the lift of sleeve, when $r_1$ and $r_2$ are the minimum and maximum radii of ball rotation and x, y are the lengths of the ball arm and sleeve arm respectively**

a) $(r_2 - r_1)\frac{x}{y}$
b) $(r_2 - r_1)\frac{y}{x}$
c) $(r_1 + r_2)\frac{x}{y}$
d) $(r_1 + r_2)\frac{y}{x}$

**4) Predict the effect on gyroscopic couple when rotor of a ship rotates in clockwise direction when viewed from the aft and the ship takes a right turn.**

a) to raise the bow and stern
b) to lower the bow and stern
c) to raise the bow and lower the stern
d) to lower the bow and raise the stern

**5) Calculate the thrust in connecting rod, if piston effort is 200 kN and crank makes an angle of 45º from TDC. Assume obliquity ratio = 2.5**

a) 900.80 kN
b) 204.20 kN
c) 312.77 kN
d) 970.02 kN

**6) Predict the work done in a cycle by inertia force in an engine**

a) Negative
b) Zero
c) Positive
d) Fixed or constant

**7) Write the appropriate term for: the inertia forces and couples, and the external forces and torque on a body together to give statical equilibrium**

a) D'Alembert's principle
b) Correction couple
c) Inertia forces
d) Crank effort

**8) Relate the term longitudinal vibrations are said to occur when particles of a body move**

a) In a circle about its axis
b) Parallel to its axis
c) Perpendicular to its axis
d) In any inclined plane about its axis

**9) Apply basis principles and predict the natural frequency of torsional vibrations of a shaft, if kt = torsional stiffness of shaft and I = mass moment of inertia of the disc attached at the end of the shaft**

a) $2\sqrt{(k_t . I)}$
b) $0.5\ (\sqrt{(k_t / I)}$
c) $2\sqrt{(k_t / I)}$
d) $0.5\sqrt{(k_t . I)}$

**10) Calculate the natural frequency in Hz of the free longitudinal vibrations if the displacement is 4 mm.**

a) 11.15
b) 8.88
c) 7.88
d) 9.1

**11) Identify the case from following which applies to underdamping**

a) roots are real and equal
b) roots are real and unequal
c) roots are complex conjugate
d) roots are complex and equal

**12) Calculate the logarithmic decrement for a vibrating system, if the actual damping coefficient is 40 N-s/m and critical damping coefficient is 400 N-s/m**

a) 0.601
b) 0.631
c) 0.501
d) 0.731

**13) Select the effect of damping on phase angle at frequency ratio equal to unity?**

a) Phase angle increases as damping decreases
b) Damping has no effect on phase angle
c) Phase angle increases as damping increases
d) For zero damping factor phase angle is $180^0$

**14) Select the appropriate statement from following for magnification factor**

a) the ratio of the maximum displacement of the forced vibration to the deflection due to the static force
b) The ratio of the minimum displacement of the forced vibration to the deflection due to the static force
c) The ratio of the maximum displacement of the forced vibration to the deflection due to the dynamic force
d) The ratio of the minimum displacement of the free vibration to the deflection due to the static force

**15) Calculate the steady state the amplitude of vibration in m is for a system: A single-degree-freedom spring-mass is subjected to a sinusoidal force of 10 N amplitude and frequency ω along the axis of the spring. The stiffness of the spring is 150 N/m, damping factor is 0.2 and undamped natural frequency is 10 ω.**

a) 0.08
b) 0.07
c) 0.09
d) 0.05

**16) Calculate damped natural frequency, if a spring mass damper system is subjected to periodic disturbing force of 20 N. Damping coefficient is equal to 0.56 times of critical damping coefficient and undamped natural frequency is 4 rad/sec**

a) 3.20 rad/sec
b) 3.31 rad/sec
c) 3.24 rad/sec
d) 3.95 rad/sec

**17) Let the disturbing mass be 500 kg and the radius of rotation be 0.1 m and the rotation speed be 50 rad/s, then calculate the centrifugal force in kN.**

a) 25
b) 75
c) 100
d) 125

**18) Select the correct magnification factor if the damper is not provided at resonance for a system under harmonic excitation**

a) 0
b) 1
c) 0.5
d) Infinite

**19) Calculate the vertical height of a Watt governor when it rotates at 68 r.p.m.**

a) 0.2486 m
b) 0.2118 m
c) 0.1935 m
d) 0.1826 m

**20) Identify the correct statement for the rotating unbalance, in balancing of single-cylinder engine**

a) partially reduced and the reciprocating unbalance is completely made zero
b) completely made zero and so also the reciprocating unbalance
c) completely made zero and the reciprocating unbalance is partially reduced
d) partially reduced and so also the reciprocating unbalance

## SECTION – II
## Descriptive Section

**Marks 40**

Q.1) a) The Hartnell governor having central sleeve spring and two right angled bell crank levers moves between 295 r.p.m. and 315 r.p.m. for sleeve lift of 15mm. The sleeve arms and ball arms are 90 mm and 110 mm respectively. The levers are pivoted at 100 mm from the governor axis and mass of each ball is 2 kg. The ball arms are parallel to the governor axis at lowest equilibrium Speed. Calculate

a. Loads on the spring at lowest and highest equilibrium Speed
b. Stiffness of spring

**(Marks 10)**

b) The torsional pendulum with a disc of moment of inertia I = 0.07 kg-$m^2$ immersed in a viscous fluid. Diameter of shaft attached to the disc is 0.10 m and length of shaft is 050 m. During vibrations of pendulum, the observed amplitudes on the same side of the neutral axis for successive cycles are found to decay 40% of initial value.

Calculate:
a) logarithmic decrement
b) damping torque per unit velocity
c) the periodic time of vibration
d) the frequency when the disc is removed from the fluid
Take : G = 5 X $10^{10}$ $N/m^{2,}$ for the material of shaft

**(Marks 10)**

Q.2 a) A machine of mass 50 kg is supported on openings of total stiffness 900 kN/m and has a rotating unbalanced element which results in a disturbing force of 400 N at a speed of 3000 r.p.m. Assuming the damping ratio as 0.35, calculate: 1. the amplitude of vibrations due to unbalance; and 2. the transmitted force.

**(Marks 10)**

b) The reciprocating masses of the first three cylinders of a four-cylinder engine are 4.2, 6.1 and 7.2 tonnes respectively. The centre lines of the three cylinders are 5.2 m, 3.2 m, and 1.2 m from the fourth cylinder. If the cranks for all the cylinders are equal, determine the reciprocating mass of the fourth cylinder and the angular position of the cranks such that the system is completely balanced for the primary force and couple. If the cranks are 0.6 m long, the connecting rods 3.8 m, and the speed of the engine 70 r.p.m.; calculate the maximum unbalanced secondary force and the crank angle at which it occurs. **(Marks 10)**