Seat No.: ________ Enrolment No.______________

# GUJARAT TECHNOLOGICAL UNIVERSITY
## BE SEM-VI Examination-Nov/Dec-2011

**Subject code: 161901** **Date: 21/11/2011**
**Subject Name: Dynamics of Machinery**
**Time: 10.30 am -1.00 pm** **Total marks: 70**
**Instructions:**

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

**Q-1 (a).** A five cylinder in-line engine running at 750 r.p.m. has successive cranks $144^0$ apart, the distance between the cylinder centre lines being 375 mm. The piston stroke is 225 mm and the ratio of the connecting rod to the crank is 4. Examine the engine for balance of primary force and couple. Find the maximum values of these and the position of the central crank at which these maximum values occurs. The reciprocating mass for each cylinder is 15 kg. (7)

**(b)** Attempt the following questions.

(i) Need of balancing (3)

(ii) Primary unbalanced force in reciprocating engine. (2)

(iii) Four examples of practical problems where balancing is done. (2)

**Q-2 (a)** Four masses A, B, C, and D are completely balanced. Masses C and D make angles of $90^0$ and $195^0$ respectively with B in the same sense. The rotating masses have following properties. (7)

$m_b = 25$ kg  $r_a = 150$ mm

$m_c = 40$ kg  $r_b = 200$ mm

$m_d = 35$ kg  $r_c = 100$ mm

$r_d = 180$ mm

Planes B and C are 250 mm apart. Determine using analytical method,

(i) The mass A and its angular position
(ii) The positions of planes A and D.

**(b)** The three cranks of three cylinder locomotive are all on the same axle and are set at $120^0$ .The pitch of the cylinders is 1 meter and the stroke of each piston is 0.6 m. The reciprocating masses are 300 kg for inside cylinder and 260 kg for each outside cylinder and the planes of rotation of the balance masses are 0.8 m from the inside crank. If 40% of the reciprocating parts are to be balanced, (7) Find:-

1. The magnitude and the position of the balancing masses required at a radius of 0.6 m.

2. The hammer blow per wheel when the axle makes 6 r.p.s

OR

**(b)** The reciprocating mass per cylinder in a $60^0$ twin engine is 1.5 kg. The stroke and connecting rod length are 100 mm and 250 mm respectively. If the engine runs at 2500 r.p.m. Determine the maximum and minimum values of the primary forces. Also find out the resultant secondary force. (7)

**Q-3 (a)** Find the natural frequency of vibration of the half solid cylinder shown in Fig.1, when slightly displaced from the equilibrium position and released. (7)

**(b)** A disc of torsion pendulum has a moment of inertia of 0.05 kg-m$^2$ is immersed in a viscous fluid. During vibration of pendulum, the observed amplitudes on the same side of the neutral axis for successive cycles are found to decay 50% of the initial value. (7)

Determine

(i) Logarithmic decrement.
(ii) Damping torque per unit velocity
(iii) The periodic time of vibration.

Assume G = $4.5 \times 10^{10}$ N/m$^2$ for the material of shaft.

for shaft d = 0.10 m and l = 0.50 m



OR

**Q-3 (a)** Two rotors A and B are attached to the end of a shaft 50 cm long. Weight of the rotor A is 300 N and its radius of gyration is 30 cm and the corresponding values of B are 500 N and 45 cm respectively. The shaft is 7 cm in diameter for the first 25 cm,12 cm diameter for the next 10 cm and 10 cm diameter for the remainder of its length. Modulus of rigidity for the shaft material is $8 \times 10^6$ kg/cm$^2$. Find (i) the position of the node and (ii) the frequency of torsional vibration (7)

**(b)** Answer the following questions.

(i) Explain briefly energy method to find out characteristic equation for free vibration of single degree of freedom system. (3)

(ii) Define under-damped system. (2)

(iii) Define briefly whirling speed of shaft with single disc without damping. (2)

**Q-4 (a)** The electric motor is supported on a spring and a dashpot. The spring has the stiffness 6400 N/m and the dashpot offers resistance of 500 N at 4.0 m/sec. The unbalanced mass 0.5 kg rotates at 50 mm radius and the total mass of vibratory system is 20 kg. The motor runs at 400 r.p.m. (7)

Determine (a) damping factor (b) amplitude of vibration and phase angle

(c) resonant speed and amplitude

**(b)** Write short notes on different types of damping methods. (7)

OR

**Q-4 (a)** Write a short note on vibration isolation. (7)

**(b)** A vibratory body of mass 150 kg supported on springs of total stiffness 1050 kN/m has a rotating unbalance force of 525 N at a speed of 6000 r.p.m. (7)

If the damping factor is 0.3, Determine

(i) the amplitude caused by the unbalance and its phase angle

(ii) the transmissibility

**Q-5 (a)** A shaft of negligible weight 6 cm diameter and 5 metres long is simply supported at the ends and carries four weights 50 kg each at equal distance over the length of the shaft. Find the frequency of vibration by Dunkerley's method. Take $E = 2 \times 10^6$ kg/cm$^2$. (7)

**(b)** Write down the step by step procedure of stodola method to find out fundamental natural frequency of system having three degree of freedom. (7)

OR

**Q-5 (a)** Write a short note on seismometer. (7)

**(b)** The vibrations of a cantilever are given by $y = y_l\,[1 - \cos(\pi x/2l)]$.Calculate the natural frequency with following data for the cantilever using Rayleigh's method. Modulus of elasticity of the material $2 \times 10^{11}$ N/m$^2$.Second moment of area about bending axis 0.02 m$^4$, Mass = $6 \times 10^4$ kg, Length = 30 m. (7)

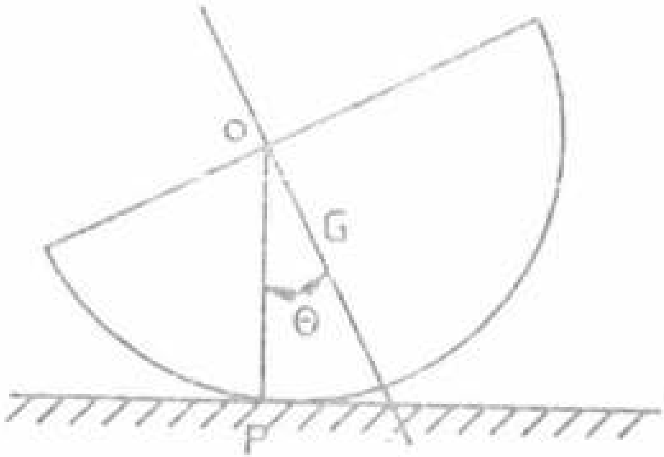


Fig. 1 A half cylinder oscillating on a flat surface