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RM-7169

B. E. III (Sem. VI) (Mech.) Examination

May / June – 2010

Tribology & Machine Dynamics

Time : **3** Hours] [Total Marks : **100**

Instructions :

(1)

નીચે દર્શાવેલ ☛ નિશાનીવાળી વિગતો ઉત્તરવહી પર અવશ્ય લખવી.
Fillup strictly the details of ☛ signs on your answer book.

Name of the Examination :

☛ **B. E. 3 (Sem. 6) (Mech.)**

Name of the Subject :

☛ **Tribulogy & Machine Dynamics**

☛Subject Code No. : **7 1 6 9** ☛Section No. (1, 2,.....) : **1&2**

Seat No. :

Student's Signature

(2) Attempt all questions.
(3) Figures to the **right** indicate full marks.
(4) Assume suitable data if necessary.
(5) Use **separate** answer book for each section.

SECTION - I

1 (a) Attempt the following questions: **10**
- (i) What is surface roughness?
- (ii) Define viscosity and viscosity index.
- (iii) Discuss the effect of temperature on viscosity of lubricants.
- (iv) State the laws of wear.
- (v) Write down assumptions to be made in derivation of Reynold equation.

(b) (i) Write down short note : Taylsurf
(ii) What is the tribology? Discuss the significance of Tribology.

2 Attempt any **two** : **14**

(a) Derive an expression for load carrying capacity of a circular step thrust bearing operating under hydrostatic pressure.

(b) Show that volume of wear due to adhesion and abrassion is $V_w = K_w \frac{W_x}{H}$

where Kw = wear constant

(c) Derive the equation for the coefficient of friction due to the free rolling. Write your assumptions.

3 Attempt any **two** : **16**

(a) Justify 'Wear" and "friction" are desirable as well as undesirable. Also write down various causes of friction.

(b) A surface profile record from taylurf instruments shows an uniform triangular surface aspirities. The pitch of the aspirities is 20 mm and height of 35 mm, of a scale of 100 x in x-axis and 5000x in Y-axis. Determine the c.l.a. and R.M.S. value with considering sample length 1mm.

(c) In a pin on disc experiment the disc specimens made of steel and pin specimens made of brass, the disc is rotating at constant speed. 700 rpm and the radius of contact pin is 50 mm from centre. The pin is under constant load of 60N, the coefficient of friction is 0.2 then determine power required to drive the disc. Also find out average aspirity angle of disc. surface.

SECTION - II

4 (a) Answer the following :

(i) Define **3**

(a) Free vibration

(b) Resonance

(c) Degree of freedom

(ii) Explain in brief : **2**

Beats phenomenon

(iii) Write down differential equation of motion for a single degree of freedom free vibration. **1**

(iv) Derive the equation for equivalent spring stiffness when three springs are connected parallel. **2**

(v) Define transmissibility. **2**

(b) The disc of a torsional pendulum has a moment of inertia 600 kg-cm^2 and is immersed in a viscous fluid. The brass shaft attached to it is of 10 cm diameter and 40 cm long. When the pendulum is vibrating, the observed amplitudes on the same side of the rest position for successive cycles are 9°, 6° and 4°. Determine

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

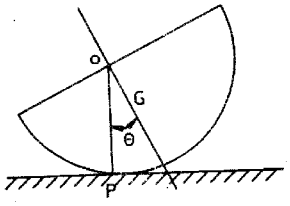
Assume for the brass shaft

$G = 4.4 \times 10^{10}$ N/m^2.

What would the frequency be if the disc is removed from the viscous fluid?

5 (i) Find the natural frequency of vibration of the half solid cylinder as shown in figure 1, when slightly displaced from the equilibrium position and released. 8

(ii) A spring-mass system (spring stiffness K_1 and mass m_1) has a natural frequency f_1. Calculate the value of K_2 for another spring which when connected to K_1 in parallel increases the frequency by 30%. 4



A half cylinder oscillating on a flat surface

Fig. 1

OR

5 (i) Using energy method find the natural frequency of the system shown in figure 2. The cord may be assumed inextensible in the spring mass pulley system and no slip. 7

Given $J = 1/2\ mr^2$ for pulley.

(ii) A U tube, open to atmosphere at both ends contains a column length l of certain liquid. Find the natural period of oscillation of the liquid column (figure 3).

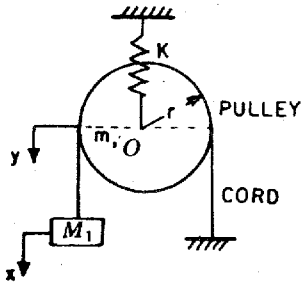
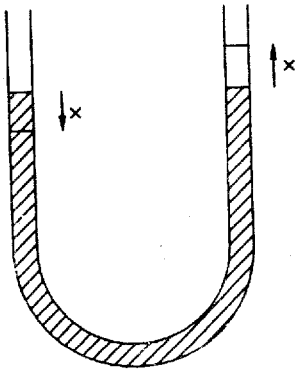


Fig. 2



Vibrating liquid column in u-tube

Fig. 3

6 Attempt any **three** : 18

(i) 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. If the damping factor is 0.3. Determine.

(a) The amplitude caused by the unbalance and its phase angle.

(b) The transmissibility and

(c) The actual force transmitted and its phase angle.

(ii) A shaft 1.5 cm dia and 1 m long is held in long bearings. The weight of the disc at the centre of the shaft is 15 kg. The eccentricity of the centre of gravity of the disc from centre of rotor is 0.03 cm. The modulus of elasticity of the material of shaft is 2×10^6 kg/cm^2. The permissible stress in the shaft material is 700 kg/cm^2.

Find :

(a) the critical speed of the shaft

(b) the range of speed over which it is unsafe to run the shaft considering shaft is horizontal. Neglect the weight of the shaft.

(iii) Derive the equation of velocity, acceleration and jerk for 3-4-5 polynomial D-R-D Cam.

The boundry conditions are following:

(a) When θ = 0, y = 1, y' = 0, and y" = 0

θ = 1, y = 0, y' = 0 and y" = 0

where θ y, y', y" are anagular displacement of cam follower displacement, velocity and acceleration respectively.

(iv) Write short notes for the following :

(a) Vibration isolation

(b) Types of damping.