Menoufia University
Faculty of Engineering
Shebin El -Kom
Final First Term Examination
First Semester Examination,2015-2016
Date of Exam: 17/1/2016

Dept: Mechanical Power
Year: Second
Subject : Mechanical Vibrations
Code : PRE 218
Time Allowed : 3 hours
Total Marks: 60 Marks

Examiner: Prof . Dr. Sobhy Mohamed Ghoneam
. Prof .Dr. Ahmed A bd–El Hamid Hamada

Answer all the following Questions :

Question (1): (12 Mark)

The pump operates at steady state rotational speed of 750 rpm, and is observed to pass through resonance at 500 rpm. The mass of the pump and rotor is M= 1000 kg , while the imbalance is me = 2.5 kg.m .The pump support frame has an equivalent stiffness of k N/m and damping c= 15700 Ns/m .

(a) Determine the magnitude of the force due to the imbalance when the pump is a running at the operating speed , and the stiffness of the support frame .

(b) determine the damping ratio , the amplitude of vibration of the pump as it passes through resonance , and the steady state amplitude of vibration of the pump (you may refer to the relevant graphs or calculate) .

(c) determine the force transmitted to the foundation at resonance and at the steady state operating speed , would you recommend that the damping should be increased or decrease

Question 2 [12Marks]

The rotor of the turbine weighting 20kg and is mounted at the mid-point of a steel shaft 25mm diameter , in self-aligning bearing over a span of 75cm.[the ends are simply supported , Esteel= 2.1x106 kg/cm2] if the rotor has unbalance equal 0.25 kg.cm.Determine1-the critical speed of the shaft , 2- the amplitude vibration of the rotor at speed 3000r.p.m, 3-the dynamic force transmitted to each bearing at this speed, 4- the change in the force if diameter increased to 30mm.

Question 3 [12 Marks]

A reciprocating pump, weighing 65kg, is mounted at middle of steel plate of thickness 1.5cm,width 30cm, and length 200cm ,clamped along two edges as shown in figure.3.During the operation of the pump ,the plate is subjected to a harmonic force,F(t)=1000cos80t ,and E=2.1x106 kg/cm2.Determine

1- the steady-state amplitude and also if the damping factor 0.4 to the

system

2- Design un-damped dynamic absorber taken into the account the mass ratio is 0.5.

3-for new system find the natural frequencies and mode shapes ,and sketch these mode

Question 4 [12Marks]

A uniform shaft of length L, specific mass ρ and torsional rigidity GIp has one end fixed and the other end is connected to a disc of mass moment of inertia J and torsional spring of Kt as shown in Fig.4 . If the system performs torsional vibration,

Determine the natural frequency equation, .

For GIp=15[Jω2-Kt]L, find the frequency equation and determine the first four frequencies and modes.

Question 5 [12Marks]

A shaft with four unbalanced masses is required to be completely balanced

By two masses situated at radius ro in two respective planes PL and PR

Determine the balancing masses mL, mR and as well as angular locations ϕL ,ϕR

Given: m1=10 gm, m2=15gm, m3=m4=20gm,ϕ1=30°, ϕ2 =90° , ϕ3 =240°, ϕ4 =300°, r1=25cm, r2=30cm,r3=r4=20cm, ro=25cm

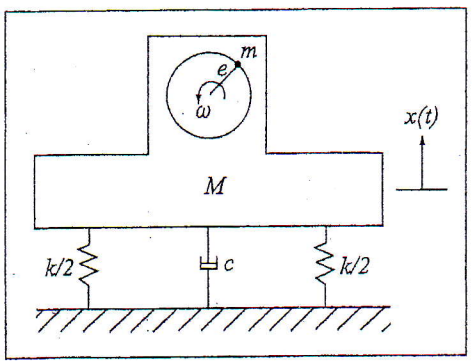

Fig.1 : Pump with rotating imbalance

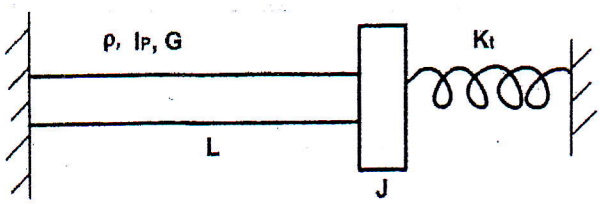

Fig.. 4

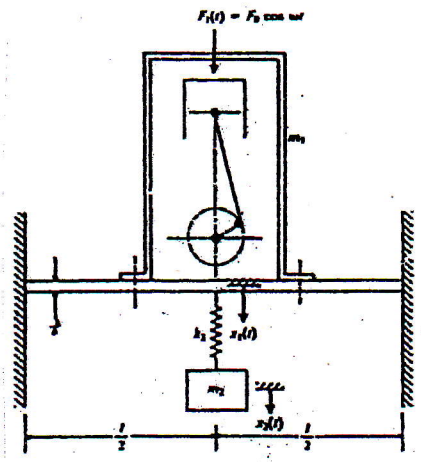

Fig.(3)

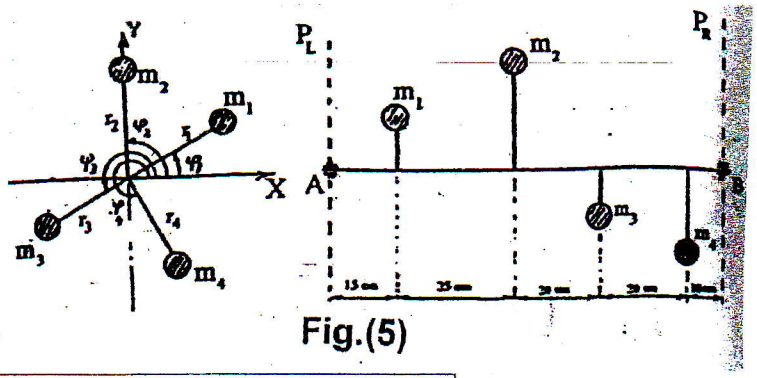

Fig.(5)

This exam measures the following ILOS															
Question Number	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Skills	a-1	a-19	a-12			b17-1	b17-2	b17-3			c-1	c-2	c-3		