USN | | | | | | | | | | 06ME62

Sixth Semester B.E. Degree Examination, December 2012

Mechanical Vibration

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer FIVE full questions, selecting at least TWO questions from each part.***
2. ***Missing data may be suitably assumed.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

PART – A

1 a. Add the following motions analytically:
$x_1 = 4\cos(\omega t + 10°)$, $x_2 = 6\sin(\omega t + 60°)$ **(10 Marks)**

b. Develop a periodic function in terms of sines and cosines of a Fourier series and determine a_o, a_n and b_n. **(10 Marks)**

2 a. Determine the effect of the mass of the spring on the natural frequency of the spring-mass-system. **(10 Marks)**

b. A bifiliar suspension consists of thin cylindrical rod of mass m suspended symmetrically by two equal strings as shown in Fig.Q2(b). Find the frequency of oscillation of the rod about vertical axis Y-Y. **(10 Marks)**

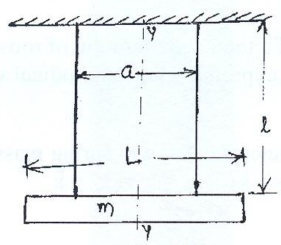

Fig.Q2(b)

3 a. Obtain the response of viscous damped system for underdamped case. **(10 Marks)**

b. Find the equation of motion for the system shown in Fig.Q3(b) when ξ = 1, 0.3 and 2. If the mass m is displaced by a distance of 30 mm and released. **(10 Marks)**

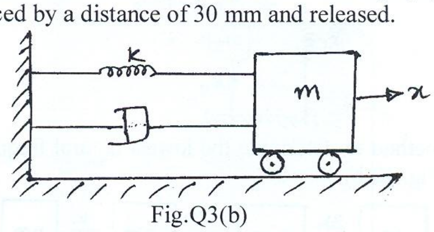

Fig.Q3(b)

4 a. Derive an expression for a steady state solution with viscous damping due to harmonic force. **(10 Marks)**

b. A vibrating body is supported by six isolators each having stiffness 32000 N/m and 6 dashpots each have 400 N-s/m. The vibrating body is to be isolated by a rotating device having an amplitude of 0.06 mm at 600 rpm. Take m = 30 kg. Determine the amplitude of vibration of the body and dynamic load on each isolator. **(10 Marks)**

PART – B

5 a. Explain and discuss vibrometer and accelerometer devices with the help of relative amplitude ratio versus frequency ratio plot. **(10 Marks)**

b. Obtain an expression for whirling of shaft with air damping. **(10 Marks)**

6 a. Set up the differential equation of motion for the system shown in Fig.Q6(a) and hence derive the frequency equation and obtain the two natural frequencies of the system. Sketch the mode shapes for $m_1 = m_2 = m$, $k_1 = k_2 = k_3 = k$. **(10 Marks)**

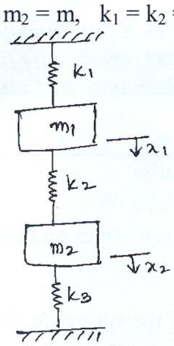

Fig.Q6(a)

b. Explain the principle of undamped dynamic vibration absorbers. Obtain an expression for $\frac{X_1}{X_{st}}$ for main mass and $\frac{X_2}{X_{st}}$ for absorber mass. **(10 Marks)**

7 a. Derive the general solution of a torsional vibration of rods. **(10 Marks)**

b. Derive suitable mathematical expression for longitudinal vibration of a rod of uniform c/s. **(10 Marks)**

8 a. Calculate the influence coefficients of 3-DOF spring mass system shown in Fig.Q8(a). Take $m_1 = m_2 = m_3 = m$ and $k_1 = k_2 = k_3 = k_4 = k_5 = k_6 = k$. **(10 Marks)**

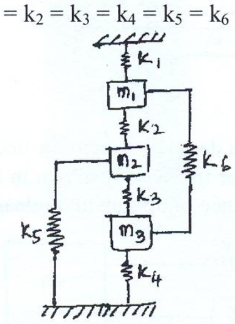

Fig.Q8(a)

b. Use the Stodola method to determine the lowest natural frequency of a 4-DOF spring mass system shown in Fig.Q8(b). **(10 Marks)**

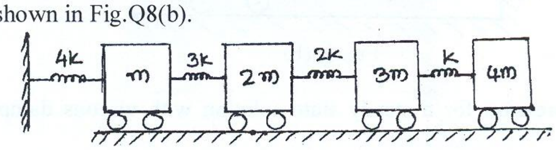

Fig.Q8(b)

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06ME63

Sixth Semester B.E. Degree Examination, December 2012
Modeling and Finite Element Analysis

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
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PART – A

1 a. Using Rayleigh-Ritz method, derive an expression for maximum deflection of the simply supported beam with point load P at centre. Use trigonometric function. **(08 Marks)**

b. Solve the following system of simultaneous equations by Gauss elimination method.

$$x + y + z = 9$$
$$x - 2y + 3z = 8$$
$$2x + y - z = 3$$

(08 Marks)

c. Explain the principle of minimum potential energy and principle of virtual work. **(04 Marks)**

2 a. Explain the basic steps involved is FEM. **(10 Marks)**

b. Explain the concepts of iso, sub and super parametric elements. **(05 Marks)**

c. Define a shape function. What are the properties that the shape functions should satisfy? **(05 Marks)**

3 a. What are the convergence requirements? Discuss three conditions of convergence requirements. **(05 Marks)**

b. What are the considerations for choosing the order of the polynomial functions? **(05 Marks)**

c. Derive the shape functions for CST element. **(10 Marks)**

4 a. Derive the Hermite shape function for a 2-noded beam element. **(10 Marks)**

b. Derive the shape functions for a four noded quadrilateral element in natural coordinates. **(10 Marks)**

PART – B

5 a. Derive an expression for stiffness matrix for a 2-D truss element. **(10 Marks)**

b. Derive the strain displacement matrix for 1-D linear element and show that $\sigma = E[B]\{u\}$ **(10 Marks)**

6 a. Discuss the various steps involved in the finite element analysis of a one dimensional heat transfer problem with reference to a straight uniform fin. **(10 Marks)**

b. Derive the element matrices, using Galerkin for heat conduction in one dimensional element with heat generation Q. **(10 Marks)**

7 a. A bar is having uniform cross sectional area of 300 mm^2 and is subjected to a load P = 600kN as shown in Fig.Q7(a). Determine the displacement field, stress and support reaction in the bar. Consider two element and rise elimination method to handle boundary conditions. Take E = 200 GPa. **(10 Marks)**

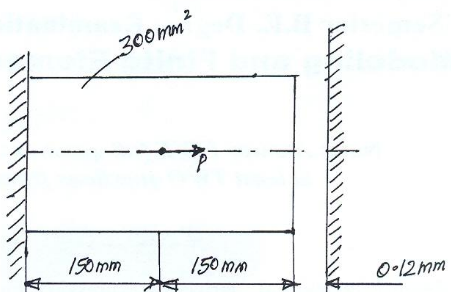

Fig.Q7(a)

b. For the two bar truss shown in Fig.Q7(b), determine the nodal displacements and stress in each number. Also find the support reaction. Take E = 200 GPa. **(10 Marks)**

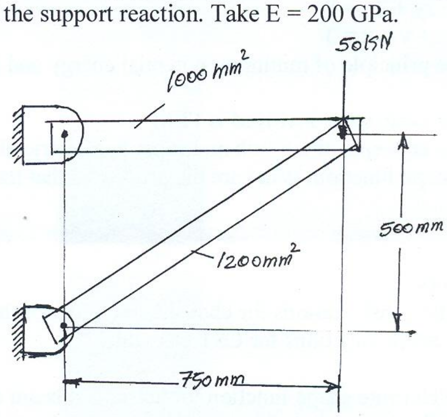

Fig.Q7(b)

8 a. For the beam shown in Fig.Q8(a), determine the end reaction and deflection at mid span. Take E = 200 GPa, I = 4×10^6 mm^4. **(10 Marks)**

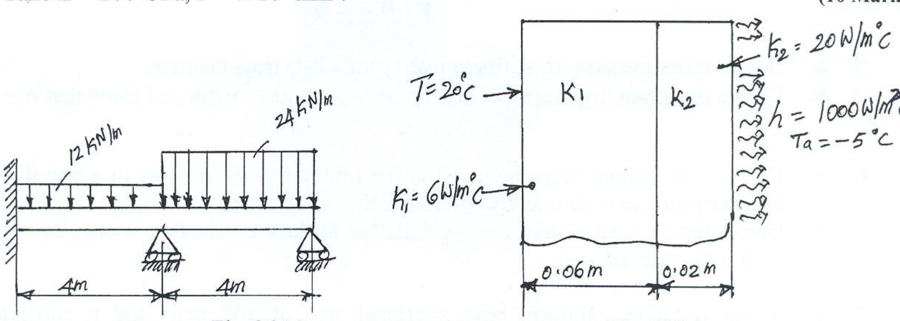

Fig.Q8(a) Fig.Q8(b)

b. Determine the temperature distribution through the composite wall subjected to convection heat loss on the right side surface with convection heat transfer coefficient shown in Fig.Q8(b). The ambient temperature is –5°C. **(10 Marks)**

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06ME64

Sixth Semester B.E. Degree Examination, December 2012

Mechatronics and Microprocessor

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. What is mechatronics? What are the objectives of mechatronics? **(05 Marks)**
b. Explain briefly the elements of a measuring system, with an example. **(05 Marks)**
c. Explain with the block diagram, how a microprocessor based control system is used to control the focusing and exposure of an automatic camera. **(10 Marks)**

2 a. What is the difference between a sensor and transducer? **(04 Marks)**
b. What is Hall effect? Explain with a neat sketch the principle of Hall effect sensor. **(06 Marks)**
c. What are light sensor? Explain briefly the following:
i) Photo emissive cell ii) Photo conductive cell iii) Photovoltaic cell **(10 Marks)**

3 a. What is an actuator? List the various types of actuators. **(04 Marks)**
b. Explain the terms bouncing and debouncing as applied to mechanical switches? Mention the various methods which can be to tackle the problem of bouncing in mechanical switches. **(08 Marks)**
c. What are stepper motors? State the advantages and applications. **(08 Marks)**

4 a. Define signal conditioning. What are the necessity for signal conditioning? **(05 Marks)**
b. What is an operational amplifier (op-amp)? Why it is called an operational amplifier? **(05 Marks)**
c. What do you mean by the term filtering and filter? How are filters classified? **(05 Marks)**
d. List the functions of signal conditioning equipment. Explain the function of these equipments. **(05 Marks)**

PART – B

5 a. Explain briefly the evolution of microprocessor. **(06 Marks)**
b. Represent the real numbers +16.5 ad –16.5 in a 32 bit memory using floating point notation. **(06 Marks)**
c. Explain the concept of overflow and underflow with an example. **(08 Marks)**

6 a. Enumerate the difference between microprocessor and microcontroller. **(04 Marks)**
b. What is a clock? Why a clock is necessary in a microprocessor? Draw the ideal and non-ideal clock. **(06 Marks)**
c. What is meant by instruction set? Discuss the five group of instruction set with an example (for each group). **(10 Marks)**

7 a. Draw the functional block diagram of the Intel 8085 microprocessor. **(04 Marks)**
b. Explain with a block diagram the flow of instruction word and flow of data word in a microprocessor. **(12 Marks)**
c. What are the functions of CPU? **(04 Marks)**

8 Write short notes on the following:
a. Assembly language programming
b. Fetch cycle and write cycle
c. System timing
d. Character representation **(20 Marks)**

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Sixth Semester B.E. Degree Examination, December 2012

Heat and Mass Transfer

Time: 3 hrs. Max. Marks:100

Note:1. ***Answer FIVE full questions, selecting at least TWO questions from each part.***
2. ***Use of HMT data book is permitted.***

PART – A

1 a. Starting from fundamental principles, derive the general, three-dimensional heat conduction equation in Cartesian co-ordinates. **(09 Marks)**

b. A liquid at 100°C flows through a pipe of 40 mm outer and 30 mm inner diameter. The thermal conductivity of pipe material is 0.5 W/mK. The pipe is exposed to air at 40°C. The inner and outer convective heat transfer coefficients are 300 W/m^2K and 5 W/m^2K respectively. Calculate the overall heat transfer coefficient and the heat loss per unit length of pipe. **(08 Marks)**

c. What is the technical need to under take a detailed study of heat transfer, having studied thermodynamics already? **(03 Marks)**

2 a. A tube with an outer diameter of 20 mm is covered with insulation. The thermal conductivity of insulating material is 0.18 W/mK. The outer surface losses heat by convection with a heat transfer coefficient of 12 W/m^2K. Determine the critical thickness of insulation. Also calculate the ratio of heat loss from the tube with critical thickness of insulation to that from the bare tube (without insulation). **(10 Marks)**

b. Derive the one-dimensional fin equation for a fin of uniform cross section. By integrating the fin equation, obtain the expression for the temperature variation in a long fin. **(10 Marks)**

3 a. Consider a solid, with an uniform initial temperature, suddenly immersed in a liquid. Derive the relevant governing differential equation, considering the system as lumped. By solving the differential equation, obtain the expression for the temperature variation with time. **(10 Marks)**

b. A 50 mm thick iron plate (K=60 W/mK, C_p=460 J/kg K, ρ=7800 kg/m^3, $\alpha = 1.6\times10^{-5}\,m^2/s$) is initially at 225°C. Suddenly both surfaces are exposed to a fluid at 25°C, with a heat transfer coefficient of 500 W/m^2K. Calculate the centre and the surface temperatures 2 minutes after the cooling begins using Heisler's charts. **(10 Marks)**

4 a. The velocity profile for boundary layer flow over a flat plate is given by, $\frac{u(x,y)}{u_\infty} = \frac{3}{2}\frac{y}{\delta(x)} - \frac{1}{2}\left\{\frac{y}{\delta(x)}\right\}^3$, where boundary layer thickness $\delta(x) = \sqrt{\frac{280\gamma x}{13u_\infty}}$. Develop an expression for local drag coefficient. Also develop an expression for average drag coefficient for a length of L. **(10 Marks)**

b. Consider a square plate of size 0.6 m in a room with stagnant air at 20°C. One side of plate is maintained at 100°C, while the other side is adiabatic. Determine the heat loss if the plate is, i) vertical and ii) horizontal with hot surface facing up. **(10 Marks)**

PART – B

5 a. Air at 0°C and 20 m/s flows over a flat plate of length 1.5 m, that is maintained at 50°C. Calculate the average heat transfer coefficient over the region where flow is laminar. Find the average heat transfer coefficient and the heat loss for the entire plate per unit width. **(12 Marks)**

b. Air at -20°C and 30 m/s, flows over a sphere of diameter 25 mm, which is maintained at 80°C. Calculate the heat loss from sphere. **(08 Marks)**

6 a. Derive an expression for the logarithmic mean temperature difference (LMTD) for a parallel flow heat exchanger **(12 Marks)**

b. A cross flow heat exchanger, with both fluids unmixed, has an area of 8.4 m^2, is used to heat air (Cp = 1005 J/kgK) with water (Cp = 4180 J/kgK). Air enters at 15°C, at a rate of 2 kg/s, while water enters at 90°C at a rate of 0.25 kg/s. The overall heat transfer coefficient is 250 W/m^2K. Calculate exit temperatures of both fluids and the heat transfer, using effectiveness – NTU method. **(08 Marks)**

7 a. Saturated steam at 65°C condenses on a vertical tube with an outer diameter of 25 mm, which is maintained at 35°C. Determine the length of tube needed, if the condensate flow needed is 6×10^{-3} kg/s. **(10 Marks)**

b. Water at atmospheric pressure and saturation temperature is boiled in a 250 mm diameter, polished stainless steel pan, which is maintained at 116°C. Calculate the heat flux and the evaporation rate. **(10 Marks)**

8 a. State and prove Kirchoff's law of radiation. **(06 Marks)**

b. Two large parallel plates with emissivities 0.5 and 0.8 are maintained at 800 K and 600 K respectively. A radiation shield having an emissivity of 0.1 on one side and 0.05 on the other side is placed in between. Calculate the heat transfer per unit area with and without the radiation shield. **(08 Marks)**

c. Determine the view factors from the base of a cube to each of its five surfaces. **(06 Marks)**

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