TE - sem - V - CBSGS - Mechanical - MQE

16/5/17

Q.P. Code :09947

[Time: 3 Hours] **[Marks:80]**

Please check whether you have got the right question paper.

N.B:
1. Question No. 1 is compulsory.
2. Solve any three out of remaining questions.
3. Assume suitable data if required and mention it clearly.
4. Figures to right indicate full marks.

Q.1 A]	Explain concept of quality and quality control	5
B]	State and explain most primitive length standard used in measurements. State reasons why these standards were replaced by optical/length standards.	5
C]	What do you mean by waviness and roughness?	5
D]	Explain concept of flatness.	5
Q.2 A]	Explain different types of fits with suitable examples and sketches. Also explain various tolerance grades.	10
B]	Explain Construction and working of Pneumatic Comparators. State their advantages and limitations.	10
Q.3 A]	Explain Tomlinson's surface roughness measuring instrument in detail.	10
B]	Explain different types of quality costs in detail	10
Q.4 A]	Explain principle, construction, working of optical interferometer in details.	10
B]	Explain various modern SQC tools.	10
Q.5 A]	Explain three wire method used in screw thread measurements.	10
B]	With example of your choice explain procedure to prepare P charts and np charts. What inferences you can draw from these charts?	10
Q.6 A]	Explain principle, construction and working of Tool maker's Microscope	10
B]	Sketch typical OC curve and Explain:-	10

1) Acceptable Quality level
2) Producers Risk
3) Consumers Risk
4) Lot Tolerance Percent Defective (LTPD)

(157) TE-sem-VI -CBSGS- MD-I 22/5/17

T0526/ T0845 MACHINE DESIGN I

Q.P.Code:13217

(3 Hours) **Total Marks:80**

N.B. 1) **Question No. 1 is compulsory**
2) Solve **Any Three** from remaining **Five** questions.
3) Use of standard data book like PSG and Mahadevan is permitted
4) Assume suitable data if necessary, giving justification

Q1 Answer any **Four** from the following

a) How do you classify materials for engineering use? **5**

b) List and explain the important factors that influence the magnitude of factor of safety? **5**

c) What are the assumptions made in analysis of curved beam? **5**

d) Discuss on various types of threads used for power screw? **5**

e) Explain clearly the bearing stress developed at the area of contact between two members? **5**

Q2 A screw press is to be designed to exert an axial force of 80 KN. **20**

a) Select suitable material and design the nut and screw assume the height of the screw press to be 250 mm.

b) Design the horizontal section of the frame if the axis of the screw is at a distance of 210 mm from the inner edge of the frame. Give the reasons for the selection of material of the frame.

Q3 a) A solid circular shaft of 30mm diameter is welded to a vertical plate by fillet weld all around. It carries a vertical load of 10KN at a distance of 100 mm from the plate. Determine the size of weld if permissible shear stress for the weld is 90 N/mm^2. **10**

Q3 b) The leaf spring has 12 numbers of leaves, two of which are full length leaves. The spring supports are 1.1 m apart and the central band is 90 mm wide. The central load is to be taken 5.5 KN with the permissible stress of 300 N/mm^2. Determine i) thickness and width of the steel leaves ii) deflection of the spring Take the ratio of the total depth to the width of the spring as 3. **10**

Turn Over

Q4 Two tie rods are connected by sleeve using cotter. They are subjected to an axial pull of 50KN. Design the joint using following stresses. **20**

For rod and cotter (C-30): $\sigma_t = 60$ N/mm^2, $\sigma_c = 70$ N/mm^2 and $\tau = 30$ N/mm^2. For sleeve (cast iron): $\sigma_t = 65$ N/mm^2, $\sigma_c = 100$ N/mm^2 and $\tau = 45$ N/mm^2.

Q5 a) Design and draw a protective type of cast iron flange coupling for a steel shaft transmitting 15 kW at 200 r.p.m. and having an allowable shear stress of 40 MPa. The working stress in the bolts should not exceed 30 MPa. Assume that the same material is used for shaft and key and that the crushing stress is twice the value of its shear stress. The maximum torque is 25% greater than the full load torque. The shear stress for cast iron is 14 MPa. **10**

Q5 b) A helical spring is subjected to the load varying from 500 N to 1100 N having spring index 6, free length is to be lie between 100 mm to 150 mm The maximum compression under the variation of load is 3 cm. Assume stresses for spring material and G = 0.8 X 10^5 N/mm^2. Design the spring and find out the energy stored in spring. **10**

Q6 a) Design a Knuckle joint to transmit a reversible load of 12 KN. The material of all parts is C-20 steel. **15**

Q6 b) Explain use of preferred numbers in engineering design? **05**

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(162) TE - Sem - VI - Mech - CBSGS 26/5/17

T3526 / T0846 MECHANICAL VIBRATIONS

Q. P. Code: 17183

Con. (REVISED COURSE)

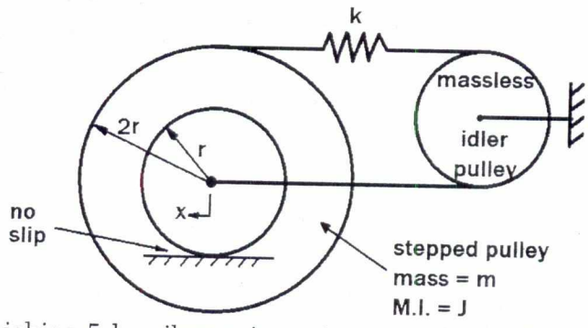
[Total Marks : 80

(3 Hours)

N.B : 1. Question No.1 is **compulsory.**
2. Attempt **any three** from the remaining five questions.
3. **Assume suitable data wherever required** with proper justification.

1. Attempt **any four** of the following. **All sub-questions carry equal marks.** 20
   (a) Derive the differential equation for a simple harmonic motion. Hence, represent displacement, velocity and acceleration in the form of rotating vectors. Indicate clearly the magnitude of the vectors and the relative phase differences.
   (b) A spring of mass m_s and stiffness **k** fixed at one end is connected to a lumped mass **m**. The spring is inclined to the direction of movement of mass by an angle α. Find the time period of vibration of the system, for small amplitudes.
   (c) A semi-definite system consists of 2 lumped masses 1 kg each and a helical spring of stiffness 50 N/m connecting them. Estimate the values of the natural frequencies in rad/s, and draw the corresponding mode shapes. Find the position of the nodes, if any.
   (d) How does the force transmitted to the base change as the speed of the machine increases? Explain using an equation and the corresponding graph.
   (e) Stating the formula, sketch the dimensionless amplitude versus frequency curves of a vibration measuring instrument. Explain in what regions it can be used as an accelerometer and as a vibrometer.
   (f) Two identical discs are connected by four bolts of different sizes and mounted on a shaft. The masses and locations of three bolts are as follows—m_1 = 35 gm, r_1 = 110 mm, and Θ_1 = 40°; m_2 = 15 gm, r_2 = 90 mm, and Θ_2 = 220°; and m_3 = 25 gm, r_3 = 130 mm, and Θ_3 = 290°. Find the mass and location of the fourth bolt (m_4, r_4 and Θ_4) which results in the static balance of the discs.

2. (a) Considering generalized coordinate **x**, evaluate the time period of vibration for the system shown below. 10



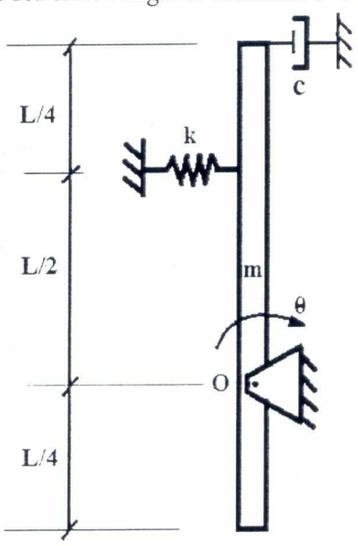
   (b) A machine part weighing 5 kg vibrates in a viscous medium. Determine the damping coefficient when a harmonic force of 36 N results in 15 mm resonant amplitude with a period of 0.32 s. 10

Turn Over

3. (a) In a simple spring-mass-damper system, the mass is 20 kg, spring constant is 10 kg/cm, and the damping coefficient has a value of 0.15 kg-s/cm, and the system is initially at rest. When a velocity of 10 cm/s is given to it, determine the displacement and velocity of the mass after 1 second. 10

(b) A spring-mass system, having a static deflection of 10 mm and negligible damping, is used as a vibrometer. When mounted on a machine operating at 4000 rpm, the relative amplitude is recorded as 1 mm. Find the maximum values of displacement, velocity, and acceleration of the machine. 10

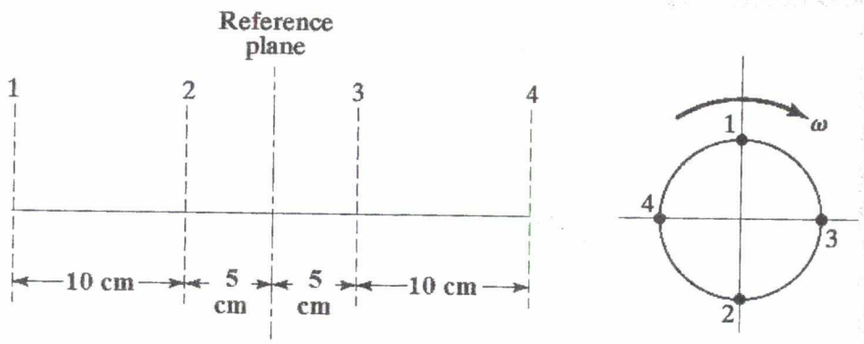
4. (a) Figure below shows an inverted pendulum connected to a spring and viscous damper. Assuming that the inverted pendulum is in stable equilibrium while in motion, derive the equivalent system parameters for small angular oscillation Θ. 8



(b) Four masses A, B, C and D are completely balanced. Masses C and D make angles of 90° and 195° respectively with that of mass B in the counter-clockwise direction. The rotating masses have following properties—m_B = 25 kg, m_C = 40 kg, m_D = 35 kg, r_A = 150 mm, r_B = 200 mm, r_C = 100 mm, r_D = 180 mm. Planes B and C are 250 mm apart. Determine—(i) the mass A and its angular position w.r.t. mass B (ii) the positions of all the planes relative to plane of mass A. 8

(c) Compare Dunkerley's and Rayleigh's methods for analyzing beam vibrations. 4

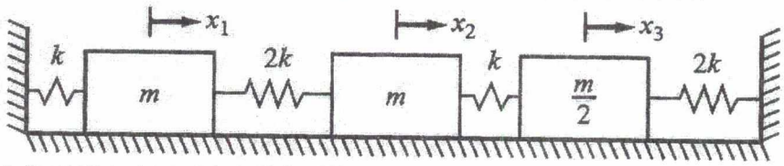
5. (a) A four-cylinder in-line engine has a reciprocating mass of 1.6 kg, a stroke of 15 cm, and a connecting rod length of 25 cm in each cylinder. The cranks are separated by 10 cm axially and 90° radially, as shown in the following figure. Find the unbalanced primary and secondary forces and couples with respect to the reference plane shown in figure, at an engine speed of 1500 r.p.m. 10



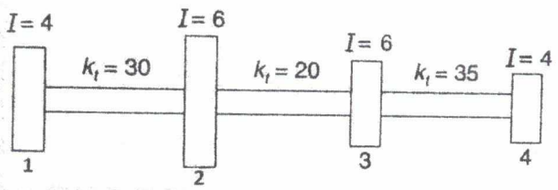
(b) When a washing machine, of mass 200 kg and an unbalance 0.02 kg-m, is mounted on an isolator, the isolator deflects by 5 mm under the static load. Find (i) the amplitude of the washing machine, and (ii) the force transmitted to the foundation at the operating speed of 1200 rpm. **10**

6. (a) What are the steps followed in the vibration analysis? Briefly explain. **5**

(b) Using exact analysis, calculate the natural frequencies and draw the corresponding mode shapes for the three degree of freedom system as shown below. **10**



(c) For the torsional multi-degree of freedom semi-definite system shown below, investigate whether $\omega = 1.78$ rad/s (approximately) is one of the natural frequencies, or not. Also, state the value of the fundamental frequency. Use Holzer's method. Here, I is expressed in kg-m^2 and k_t is expressed in Nm/rad. **5**



166

2/6/17

TE-sem-V]-CBSGS-Mechanical

Q. P. Code: 18032

3 Hours **80 Marks**

NOTE:

- Question No 1 is **COMPULSORY**.
- Attempt any **THREE** questions from question number 2 to 6.
- Assume suitable data wherever required.
- Illustrate answers with sketches wherever required.
- Use of steam table is permitted.

1. Solve the following **(any Five)** **20**

   (a) Explain nozzle efficiency with the help of h-s diagram.

   (b) Write applications of gas turbine.

   (c) Differentiate between impulse and reaction type steam turbines.

   (d) State the purpose of draft tube incase of water turbine.

   (e) Write the detail classification of jet propulsion engine.

   (f) Define unit speed and specific speed.

2. (a) What are the different methods used to improve efficiency of gas turbine plant? **4**

   (b) Write the comparison between closed and open cycle gas turbine for the following criteria: type of working fluid, type of fuel, efficiency and size of plant. **4**

   (c) The following reading were recorded during two hour trial on a boiler :

Feed water supplied	=	14000 kg
Boiler working pressure	=	10 bar
Dryness fraction of steam	=	0.96
Temperature of feed water entering	=	35 °C
Temperature of feed water leaving	=	90 °C
Coal burnt	=	1500 kg
Temp of steam leaving superheater	=	335 °C
C V of coal	=	25000 kJ/kg

   Find:

   i) Enthalpy received by feed water in economizer, boiler and super heater. **6**

   ii) percentage of heat supplied in boiler & superheater **4**

   iii) Overall thermal efficiency of plant **2**

Turn Over

3. (a) Explain the construction and working of once through boiler with neat sketch. **8**

(b) In an impulse turbine, steam issues from the nozzle with a velocity of 850 m/s. The nozzle angle is 20°. Mean blade velocity is 350 m/s and blades are equiangular. Mass flow rate of steam is 1000 kg/min. The friction factor is 0.8 determine: **12**

i) Blades angles
ii) Power developed in kW
iii) Blade efficiency
iv) Stage efficiency if nozzle efficiency is 93%.

4. (a) What is the purpose of compounding of steam turbine? Explain pressure compounding method with neat sketch. **8**

(b) In a gas turbine plant compressor takes in air at a temperature of 15°C and compresses it to four times the initial pressure with an isentropic efficiency of 85%. The air is then passed through a heat exchanger, heated by turbine exhaust before combustion chamber. Turbine inlet temperature is 600 °C and its efficiency is 80%. Neglecting all losses except mentioned and considering air as the working fluid calculate thermal efficiency and work ratio of the cycle if (i) heat exchanger is perfect (ii) effectiveness of heat exchanger = 0.85. **12**

5. (a) Explain 'cavitation' in hydraulic turbines. What are its effects? How it can be reduced? **6**

(b) Explain the difference between mountings and accessories. **4**

(c) A turbine is to operate under a head of 25 m at 200 rpm. If the discharge is 9 m^3/s and turbine efficiency is 90%, calculate power generated by turbine, specific speed of the turbine and performance of the turbine under a head of 20 m. **10**

6. (a) A Pelton wheel has to be designed for the following data. Power developed = 6000 kW, net head available = 300 m, speed = 550 rpm, ratio of jet diameter to wheel diameter = 1/10 and overall efficiency = 85%. Find number of jets, diameter of jet, diameter of wheel and quantity of water required. Assume K_v= 0.98 and K_u = 0.46 **10**

(b) Explain construction and working of ramjet. Write its applications also. **6**

(c) Write the working principle of rocket engine. **4**

TE - SEM-VI - Mech - CBSGS

163

8/6/14

T3526 / T0848 MECHATRONICS

Q.P. Code:13867

03 Hrs **[Total Marks 80]**

N.B.:
(1) **Question No.1 is compulsory**
(2) Attempt any **three** questions out of remaining **five** questions
(3) Figures to right indicate full marks
(4) Assume suitable data if **necessary**.
(5) Notations carry usual meaning.

Q.1 (A)	With a neat sketch explain basic components of pneumatic systems.	5
(B)	With a neat sketch explain working principle of comb drive actuator	5
(C)	Write short note on supervisory control and data acquisition (SCADA)	5
(D)	Explain with neat sketch principle of operation of DC motor	5
Q.2 (A)	With neat sketch explain the constructional feature and working of relief valve used in hydraulic system	5
(B)	Explain the central theme of velocity profile optimization of DC motor	5
(C)	Write short notes on (i) Universal Asynchronous Receiver and Transmitter (UART) (ii) Peizoelectric drive	10
Q.3(A)	Two double acting pneumatic cylinders A, B are selected for an industrial application. The sequence of movement for piston of the cylinder is proposed as below— **A+ Delay B+(AB)-** Develop the electropneumatic circuit using 5/2 double solenoid as final directional control valves. The piston motions mentioned in bracket is simultaneous.	10
(B)	Explain impedance matching for a part of electromechancial system that consists of transmission of power using motor-gear drive system.	10
Q.4 (A)	What are the different elements of a CNC machine? Explain in detail.	10
(B)	With neat diagrams illustrate the working of Filter-Regulator-Lubricator (FRL) unit in a pneumatic system.	5
(C)	Explain with neat sketch working principle of AC induction motor	5
Q.5(A)	Piezo sensor and actuators are proposed in cantilever beam vibration control application. For such application student shall propose the conceptual design under considering following aspects	10

Q.P. Code:13867

(i) Modeling of Beam
(ii) Sensor and actuator interfacing
(iii) Beam experimental set up (Draw block diagram of proposed designed set up)
(iv) Instrumentation set up (comprise of charge amplifier voltage amplifier, and data acquisistion)

(B) Describe possible speed control strategies of A.C. Induction motors 5

(C) Write a short note on servo amplifier for DC motors 5

Q.6 (A) A Process tank shown in figure is sequenced to mix liquid fertilizer according to following sequence of operation. 10

(i) A start push button is pressed to start the operation and V_1 is being operated to open in order to fill tank up to a preset level sensed by level switch A. (ii) As the tank fills, a level switch A closes NO contact to energize the stirrer motor to start automatically and operate for 5 sec to mix the fluid. (iii) When stirrer motor stops, the solenoid operated water valve V_2 is energized to empty the tank. (iv) When tank is completely empty, the level switch B opens and de-energizes solenoid operated water valve V_2 (v) A Stop button is pressed to stop operation.

Draw PLC ladder diagram to achieve the above sequence of operation.

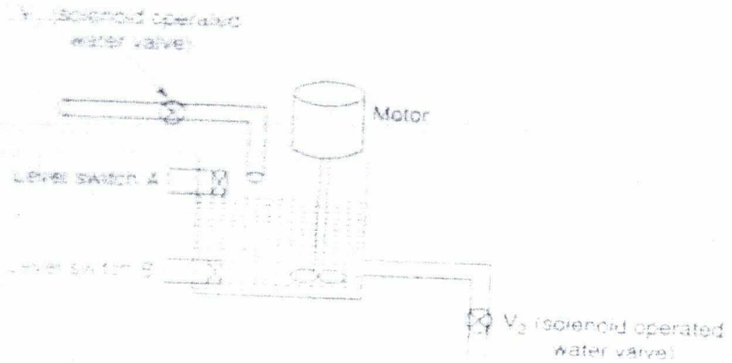


Figure 1

(B) Write short note on (i) Peripheral Interface Device (PIA) 10
(ii) Voice-coil actuator

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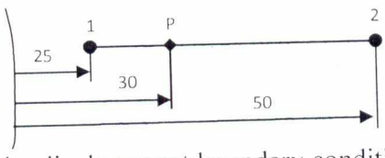
Q.P. Code:18542

(3 Hours) **Max. Marks: 80**

Note:

1. Question 1 is Compulsory
2. Solve any three from remaining five
3. Figures to right indicate full marks
4. Assume suitable data if necessary

Question No.		Max. Marks
Q.1	Attempt any four:	20
	a) Explain the terms "Preprocessor", "Solver" and Postprocessor"	
	b) Explain the characteristics of shape function.	
	c) A 1D spar element having a linear shape function is as shown below. Find the natural co ordinate of point P. If the temperature at node 1 is 50°C and at node 2 is -20°C, find the temperature at point P.	



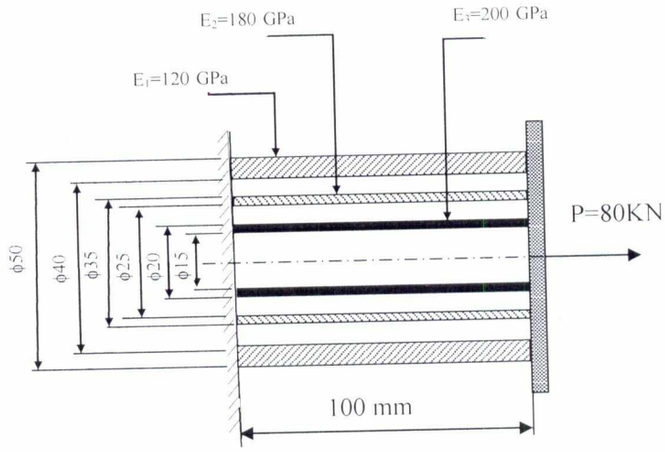
	d) Mention the displacement boundary conditions for different support condition – free, fixed, roller and pinned.	
	e) What do you mean by consistent and lumped mass matrices?	
Q.2	a) Solve the following differential Equation using Galerkin Method.	10

$$\frac{d^2u}{dx^2} + 5 = 0 \quad \text{for } 0 < x < 1$$

Boundary Conditions are: u = 0 at x = 0 and $\frac{du}{dx} + u = 0 \; at \; x = 1.$

Find u(0.2) and compare with exact solution.

	b) Three concentric rings of different materials are joined together as shown in figure. Determine the displacement at the free end.	10

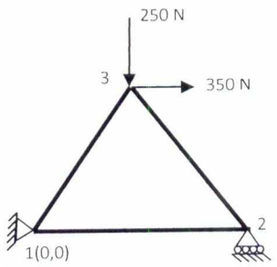


Q.P. Code:18542

Q.3 a) Write a note on skyline and banded matrix of storing data. 6

b) A three bar equilateral triangular truss has the three members of length 1m each. The bottom support are 1 and 2, whereas the top joint is 3. Support at the end 1 is fixed, while end 2 has a roller support. It is subjected to load as shown. Assuming the modulus of elasticity of the material as 2 x 10^5 N/mm^2 and the cross sectional area as 600 mm^2, determine 14

1. Displacement at each node.
2. Stresses induced in each element.
3. Reaction at supports



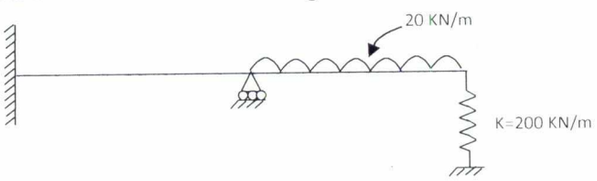
Q.4 a) Using R-R Method mapped over general element solve, 10

$$\frac{d}{dx}\left(a\frac{du}{dx}\right) + bu + c = 0;\ 0 \le x \le L$$

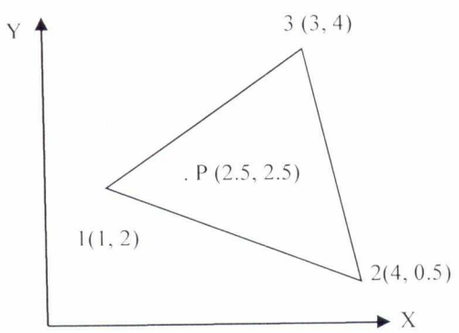
Global boundary conditions are, u(0) = u_0 and $a\left(\frac{du}{dx}\right)\Big|_{x=L} = 0$

Use Lagranges Linear shape functions.

b) Find the deflection and slopes at nodes and reactions at supports for the beam as shown in figure. The beam is fixed at node 1, has a roller support at node 2 and has an elastic spring support at node 3. Assume E = 210 GPa and I = 2 x 10^4 m^4 throughout the beam. 10



Q.5 a) The nodal coordinate of the triangular element for ground water simulation is as shown in figure. The nodal values of hydraulic heads (ϕ) at the nodes are (3.5, 2.2, 4.4) respectively. Find the value of the hydraulic head at pint P. 10



Q.P. Code:18542

10

b) A constant strain triangle element has the nodal coordinates (1, 2), (4, 0.5) and (3, 4) for i, j & k nodes respectively. The element is 2 mm thick and is of material with properties E=70GPa and Poisson's ratio 0.3. Upon loading of the model, the nodal deflections were found to be:

$u_i = 100\mu m$	$u_j = 75\mu m$	$u_k = 80\mu m$
$v_i = -50\mu m$	$v_j = -40\mu m$	$v_k = -45\mu m$

Determine-

i) The Jacobian for (x,y)-(ξ,η) transformation
ii) The strain-displacement relation matrix
iii) The strains
iv) The element stresses.

Q.6 a) Derive the shape functions for a linear quadrilateral element and show it's variation over the element. 10

b) Find the natural frequency of axial vibrations of a bar of uniform cross section of $30mm^2$ and length 1m. Take $E = 2 \times 10^5$ N/mm^2 and $\rho = 8000$ kg/m^3. Take two linear elements. Compare the natural frequencies with exact frequencies. 10