AIKTC/KRRC/SoET/ACKN/QUES/2017-18/ **Date:** _____

School: SoET-CBSGS **Branch:** MECH. ENGG. **SEM:** VI

To,
Exam Controller,
AIKTC, New Panvel.

Dear Sir/Madam,

Received with thanks the following **Semester/Unit Test-I/Unit Test-II (Reg./ATKT)** question papers from your exam cell:

Sr. No.	Subject Name	Subject Code	Format		No. of Copies
			SC	HC	
1	Metrology & Quality Engg.	MEC601		✓	
2	Machine Design – I	MEC602		✓	
3	Mechanical Vibration	MEC603		✓	
4	Thermal & Fluid Power Engg.	MEC604		✓	
5	Mechatronics	MEC605		✓	
6	Finite Elements Analysis	MEC606		✓	

Note: SC – Softcopy, HC - Hardcopy

(Shaheen Ansari)
Librarian, AIKTC

150

TE-sem-VI - Mech-CBSGS-MAQE

14/5/18

Q.P. Code :09946

[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]	With help of suitable sketches explain plug gauges and snap gauges	5
B]	Write short note on-Planning for quality	5
C]	Explain advantages and limitations of pneumatic comparators.	5
D]	Explain importance of surface conditions in various applications.	5
Q.2 A]	Explain Taylors Principle of Gauge Design with suitable example,	10
B]	Explain Tomlinson's surface roughness measuring instrument in detail.	10
Q.3 A]	Explain following with respect to flatness testing:- 1. Principal of interference 2. Concept of flatness 3. Optical Flats 4. Application of Principle of interference in flatness testing	10
B]	Explain concept of quality of design and quality of conformance.	10
Q.4 A]	Explain following parameters with respect to surface roughness measurement:- 1) Waviness 2) Roughness 3) R_a Value 4) R_z Value	10
B]	Explain various modern SQC tools	10
Q.5 A]	Explain Principle, Construction and working of Parkinson's Gear tester.	10
B]	Explain following terms- 1) R chart 2) P chart 3) GANT chart 4) Pareto chart	10
Q.6 A]	Explain construction and working of Profile Projector. State various applications of Profile projector.	10
B]	Sketch OC curve and explain various elements of it. Also explain double sampling plans.	10

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160

TE-sem-VI- CBSGS- Mech- MD-I

18/5/1

Q.P.Code:13215

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

NB:

- Question No. 1 is compulsory.
- Attempt any three questions from the remaining.
- Assumption made should be clearly stated.
- Use of standard Design Data Book by PSG, Mahadevan is permitted.

Q.1 Answer any **four** of the following 20

(a) What is preferred Number? How to use it, explain with example.
(b) Draw and explain different fatigue stress cycle.
(c) Explain overhauling of screw and self-locking of screw.
(d) What is surge in spring? How it can be eliminated.
(e) What is the necessity of theories of failures? Discuss different theories of failures.

Q.2 (a) Why the cotter in the Cotter joint is kept as weakest part, explain. 4

(b) A knuckle joint is to be design to connect two Mild Steel bars under a tensile load of 150 KN. The allowable stresses are 75Mpa in tension, 50Mpa in shear and 150 Mpa in crushing. (Assume empirical relations as Diameter of knuckle pin $d_1 = d$, Outer diameter of eye $d_2 = 2d$, diameter of knuckle pin head and collar d3 =1.5d, thickness of single eye t = 1.25d, thickness of fork $t_1 = 0.75d$, thickness of pin head $t_2 = 0.5d$)

1. Draw neat sketch of knuckle joint. 3
2. Find the diameter of the rod (d). 2
3. Using empirical find all dimensions. 3
4. With neat sketches for failure cross section areas check all components under different failures. 8

Q.3 (a) Show the variation of the tangential stress and radial stress across the cylinder thickness and derive the Lame's equation for the thickness of thick cylinder subjected to an internal pressure only. 4

(b) A transmission shaft supporting a spur gear B and pulley D is shown in Fig. 1. The shaft is mounted on two bearings A and C. The diameter of pulley and the pitch circle diameter of the gear are 400 mm and 300 mm respectively. The pulley transmits 15 kW power at 550 rpm to the gear. P_1 and P_2 are belt tensions in tight and loose sides, while P_t and P_r are tangential and radial components of gear tooth force. Assume $P_1 = 3P_2$ and $P_r = P_t \tan(20^0)$ 16

Turn Over

The gear and pulley are keyed to the shaft. The material of the shaft is steel 50C4 (σ_{ut} =700 N/mm^2 and σ_{ut} = 460 N/mm^2). The factors k_b and k_t are 1.25 each. Determine the shaft diameter.

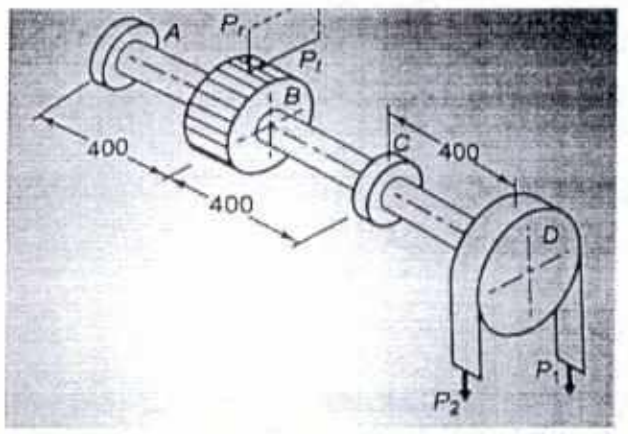

Fig.1

Q.4 (a) Design a cast iron protective type flange coupling to transmit 15 kW at 900 rpm from an electric motor to compressor. The service factor may be assumed as 1.35. The following permissible stresses may be taken. Allowable shear stress for shaft, bolt and key material is 40MPa, Allowable crushing stress for bolt and key is 80 N/mm^2 and Allowable shear stress for cast iron is 8 N/mm^2. 12

(b) Design a Helical valve spring for an operating load range of 600N to 1200N. The compression at the maximum load is 25mm. Take the spring index 6 and permissible endurance shear stress for the spring material as 480Mpa and yield stress in shear is 960MPa and G = 80KN/mm^2. 08

Q.5 (a) Draw neat sketch for the fatigue test set up. How the experimental data is generated and analyzed, explain. 10

(b) The circular rod is subjected to 700KN tensile to 300KN compressive varying axial load. Find the diameter of the rod using soderberg criteria and assuming following data. Endurance limit = 280Mpa, tensile yield strength =350Mpa, factor of safety =2, correction factor for loading = 0.7, surface factor = 0.8, size factor = 0.85, stress concentration factor = 1. 10

Q.6 (a) Select suitable standard hook for the lifting load of 100KN of trapezoidal cross section and find the stress induced at the most critical cross section of the hook. 10

(b) A bracket is supported by four rivet of equal diameter as shown in fig. 2. Determine the size of the rivet taking the permissible shear stress as 60MPa. 10

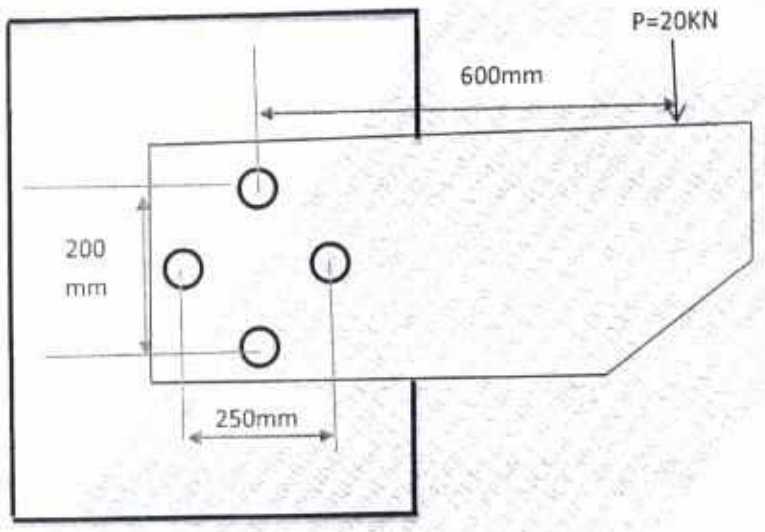

Fig: 2

Subject: Correction in Program Code : T0526 - T.E.(Automobile)(SEM VI) (CBSGS) (Rev-2012) / T0845 - MACHINE DESIGN - I and T3526 - T.E.(MECHANICAL)(SEM VI) (CBSGS) (Rev-2012) / T0845 - MACHINE DESIGN - I Q.P Code : 13215

From: support@muapps.in
To: controllerktc@yahoo.com
Date: Friday, 18 May, 2018, 4:02:46 PM IST

University of Mumbai

Correction in Program Code : T0526 - **T.E.(Automobile)(SEM VI)** (CBSGS) (Rev-2012) / T0845 - MACHINE DESIGN - I and T3526 - **T.E.(MECHANICAL)(SEM VI)** (CBSGS) (Rev-2012) / T0845 - MACHINE DESIGN - I **Q.P Code : 13215**

Question 3(b), please read Sigma ut = 460N/mm2 as Sigma yt = 460N/mm2

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Subject: Correction in Q.P code : 13215

From: support@muapps.in
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Date: Friday 18 May 2018, 5:11:17 PM IST

University of Mumbai

correction in Program Code : T0526 - T.E.(Automobile)(SEM VI) (CBSGS) (Rev-2012) / T0845 - MACHINE DESIGN - I and T3526 - T.E.(MECHANICAL)(SEM VI) (CBSGS) (Rev-2012) / T0845 - MACHINE DESIGN - I Q.P code : 13215

Q. 6b, read rivet as bolt

186 ⓑ TE-sem VI - CBSGS - Mechanical - M-V 24/5/18

Q.P.Code:38429

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.

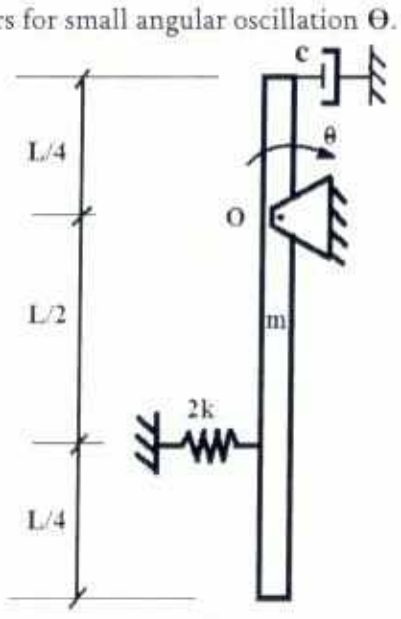
1. Attempt **any four** of the following. **All sub-questions carry equal marks.** 20
   (a) What are the goals of vibration engineering? Name any three causes of vibrations.
   (b) Represent harmonic motion in complex form using Euler's formula. Hence, derive the differential equation of motion from the complex form of the displacement equation.
   (c) A semi-definite system consists of 2 lumped masses 2 kg each and a helical spring of stiffness 100 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) For the case of $F(t) = F_0 \sin(\omega t)$ in a 1 d.o.f. system, write the force balance equation analytically, and represent the same graphically in terms of vector polygon of forces.
   (e) A vibration measuring device is used to find the displacement and acceleration of a machine running at 150 r.p.m. If the natural frequency of the instrument is 10 Hz and it shows 0.005 cm, what are the two readings? Assume no damping.
   (f) Three holes are drilled in a uniform circular disc at a radius of 100 mm and angles of 0°, 120° and 220°. The mass removed at hole 1 is 100 gm, and at holes 2 and 3 is 120 gm each. If the disc is to be balanced statically by drilling a fourth hole at a radius of 130 mm, find the mass to be removed and the angular location of the fourth hole.

2. (a) A connecting rod has a mass of 4 kg. The distance of centre of gravity (C.G.) from the smaller end (about which it is suspended) is 20 cm, and the natural frequency is found to be 50 cycles/minute. Estimate the moment of inertia of the connecting rod about its C.G. 10
   (b) Overshoot for an underdamped system is defined as the maximum displacement of the system at the end of its first half cycle. Find minimum damping ratio for the system such that it is subjected to no more than 10% overshoot. 10

3. (a) A 25 kg block is connected to a spring of stiffness 1.5×10^5 N/m. The coefficient of friction between the block and the surface on which it slides is 0.1. The block is displaced 15 mm from equilibrium and released. What is the amplitude of motion at the end of the first cycle? How many cycles of motion occur? 10
   (b) A spring-mass-damper system, having an undamped natural frequency of 20 Hz and a damping constant of 20 N-s/m, is used as a vibrometer to measure the vibration of a machine operating at a speed of 2500 rpm. If the actual velocity is 30 m/s and the recorded velocity is 29 m/s, find the mass and the spring constant of the vibrometer. 10

4. (a) A, B, C and D are four masses carried by a rotating shaft at radii 120 mm, 140 mm, 220 mm and 180 mm respectively. The planes in which the masses revolve are spaced 700 mm apart and the mass of B, C and D are 12 kg, 7 kg, and 5 kg respectively. Find the required mass A and the relative angular settings of the four masses so that the shaft shall be in complete balance. 8

(b) Figure below shows a pendulum connected to a spring and viscous damper. Derive the equivalent system parameters for small angular oscillation Θ. 8



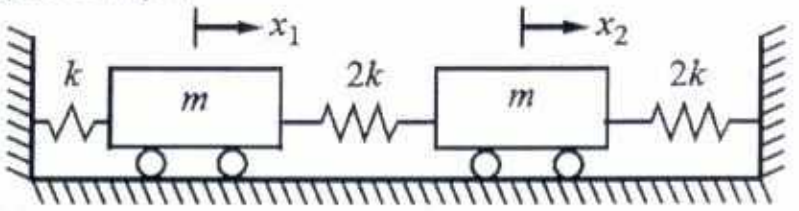
(c) Explain Influence Coefficients and Maxwell's Reciprocity Theorem for analyzing beam vibrations. 4

5. (a) A three cylinder internal combustion engine works on 2-stroke cycle. Investigate the unbalance effect graphically (for primary and secondary forces and couples) with respect to mid-axis of engine. Given—Mass of each piston is 3 kg, crank radius is 200 mm, angular frequency is 10 rad/s, linear pitch between cylinders is 200 mm, and ratio of crank length to radius is 4. 10

(b) An automobile is modeled as a single degree of freedom system vibrating in the vertical direction while travelling over a rough road. The vehicle has a mass of 1000 kg. The suspension system has a spring constant of 350 kN/m and a damping ratio of 0.4. If the vehicle speed is 25 km/hr, determine the displacement amplitude of the vehicle. The road surface varies sinusoidally with an amplitude of Y = 0.04 m and a wavelength of 5 m. 10

6. (a) Using simple pendulum as an example, explain the phenomenon causing oscillations once it is disturbed. 5

(b) Derive the differential equations of motion for the following two degree of freedom system using Newton's method. Also calculate the natural frequencies and draw the corresponding mode shapes. 10



(c) Write short note on Holzer's method. 5

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Q.P. Code: 25736

(3 Hours) [Total Marks: 80

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) Differentiate closed and open cycle gas turbine based on working fluid, efficiency, size of plant and control.
   (b) Differentiate between mounting and accessories with example.
   (c) Differentiate between fire tube and water tube boiler.
   (d) Explain working principle of any one mounting with sketch.
   (e) Define for turbojet engine: Propulsive power and propulsive efficiency.
   (f) State the factors on which nozzle efficiency depends.

2. (a) Write the difference between Francis and Kaplan turbine. 6
   (b) State impulse momentum principle. 2
   (c) A steam generator evaporates 18000 kg/hr of steam at 12.5 bar and a quality of 0.97 dry from feed water at 105°C, when coal is fired at 2040 kg/hr. If the high calorific value of coal is 27400 kJ/kg. Find: (i) amount of heat supplied in boiler (ii) Equivalent evaporation (iii) thermal efficiency. 12

3. (a) Explain performance characteristics of water turbines with sketch. 8
   (b) Following data refers to a stage in a reaction turbine: 12
   Mean blade ring diameter = 1 m, Turbine speed = 3000 rpm, degree of reaction = 50%, exit and inlet angles of blades = 30° & 50°, Steam flow rate = 10000 kg/hr, stage efficiency = 85%. Determine (i) power output of the stage (ii) specific enthalpy drop in kJ/kg (iii) percentage increase in relative velocity of steam over moving blades.

4. (a) Derive an equation for discharge though an isentropic nozzle. 8

   (b) Air enters the compressor of a gas turbine plant operating on air standard cycle at 100 kPa & 300 K with volumetric flow rate 5 m^3/s. The compressor pressure ratio is 10. The turbine inlet temperature is 1400 K. The turbine and compressor each has an isentropic efficiency of 80%. Calculate (a) thermal efficiency of cycle. (b) Back work ratio (c) net power developed in kW. 12

   ρ_{air} (density) $= 1.2\ kg/m^3$

5. (a) An inward flow turbine (reaction type with radial discharge) with an overall efficiency of 80% is required to develop 150 kW. The head is 8 m, peripheral velocity of the wheel is $0.96\sqrt{2gH}$. The radial velocity of flow is $0.36\sqrt{2gH}$. The wheel is to make 150 rpm. The hydraulic losses in the turbine are 22% of the available energy. Determine: (a) angle of the guide blade at inlet (b) wheel vane angle at inlet (c) diameter of the wheel (d) width of the wheel at inlet. 12

   (b) Define unit speed, unit discharge, unit power & specific speed. Write their equations also. 8

6. (a) Write the detailed classification of jet propulsion engine. 4

   (b) Explain construction and working of Velox boiler. 7

   (c) Why are the steam turbines compounded? Explain. 4

   (d) 2.5 cm diameter jet of water strikes a symmetrical vane tangentially at one end and leaves at the other end. After impingement, the jet gets deflected through 160° by the vane. Calculate the thrust exerted by the jet on the vane if the discharge is 0.0736 m^3/s. Assume vane to be smooth. 5

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TE - Sem - VI - CBSGS - Mechanical - Mechatronics 5/6/18

Q.P. Code: 50535

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

Q.1. (A) With a neat sketch explain the architecture of a mechatronic system. (05)
(B) What are different hydraulic pumps used in hydraulic systems? Explain any one in detail (05)
(C) Explain the working principle of Voice coil actuator (05)
(D) Explain the working principle of Comb drives with applications. (05)

Q.2. (A) Explain the central theme of velocity profile optimization of DC motor. (06)
(B) With neat diagrams illustrate the working of Filter-Regulator-Lubricator (FRL) unit in a pneumatic system. (08)
(C) Write constructional features of piezoelectric drives with applications. (06)

Q.3. (A) Write a short note on servo amplifier for DC Motors. (06)
(B)What are the different elements of a CNC machine? Explain in detail. (08)
(C) Explain the concept of "Handshaking". (06)

Q.4. (A) Two double acting pneumatic cylinders A, B are selected for an industrial application. The sequence of movement for piston of the cylinder is as below- A +Delay B+ Delay (AB)- Draw the electro-pneumatic circuit using 5/2 double solenoid as final directional control valves. (12)

(B) Differentiate between serial and parallel data transfer method. (08)

Q.5 (A) Explain the working principle of stepper motor and describe its various type along with its applications. (08)
(B)What is "Polling and Interrupt"? (06)
(C) Differentiate between DAQs and Data Loggers. (06)

Q.6 (A) Design and develop a closed loop mechatronic system to control the vibration of a cantilever beam using active vibration control technique.Also write the features of sensor, actuator, amplifier and controller used. (10)

(B) Describe the possible speed control strategies of A.C. Induction Motors. (05)

(C) Write selection and applications of PLCs. (05)

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TF - Sem. VI - Mechanical - CBSGS - FEA 14/6/1

Q. P. Code: 39287

(Time: 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

Q.1 a) Discuss the different types of coordinate systems used in finite element method of analysis. 20

b) What is the significance of shape functions?

c) Prove that the strain far a three node triangular element is constant.

d) Explain Weak & Non Weak form method used in FEA.

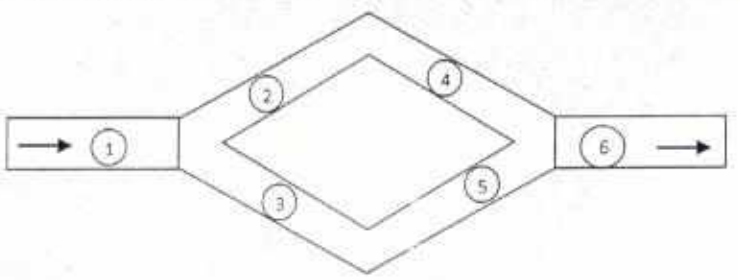
Q.2 a) Solve following differential equation by Galerkin method. 10

$$-\frac{d^2y}{dx^2} - 9y + 2x^2 = 0;\ 0 \le x \le 1$$

Given Boundary Conditions are: y = 0 at x = 0, $\frac{dy}{dx} = 1$ at x = 1

Find values for y (0.5) & y (0.7)

b) For the fluid network shown in figure write the global matrix equation. 10



Element No.	1	2	3	4	5	6
L cm	70	50	50	70	60	55
d cm	10	7.5	7.5	5	8	5

Pipe resistance is given by R^e.

$$R^e = \frac{128\mu h_e}{\pi {d_e}^4}$$

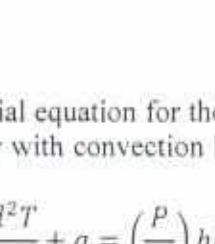
Q.3 a) Derive the shape function for a rectangular element in local coordinate system. 10

b) The governing differential equation for the steady state one dimensional conduction heat transfer with convection heat loss from lateral surfaces is given by 10

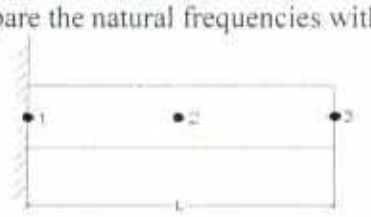
$$k\frac{d^2T}{dx^2} + q = \left(\frac{P}{A_c}\right)h(T - T_\infty)$$

where
K= coefficient of thermal conductivity of the material,
T = Temperature
q= internal heat source per unit volume
P = Perimeter
A_c=the cross-sectional area,
h = convective heat transfer coefficient, and
T_∞= Ambient Temperature
Develop the finite element formulation for linear element. Use Rayleigh Ritz method, mapped over general element. Derive relevant element level matrix equation.

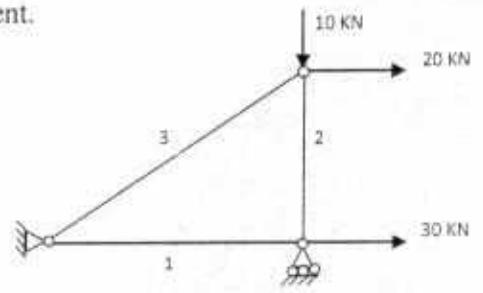
Q.4 a) A tapered thin plate made of steel (E = 200 GPa, ρ = 7800 kg/m^3) has a length of 500 mm and a thickness of 20mm. Its width is 180 mm at the fixed end and 80mm at the free end. In addition to its self-weight, it is subjected to a point load P of 50KN at a distance of 300mm from the fixed end. Model the plate with two spar elements and determine the nodal displacements and stresses in each element. 10



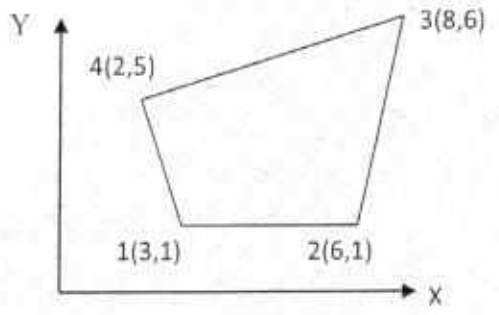
b) A uniform cross section bar as shown below has a length L=1 m and made up of a material having E=2x10^{11} N/m^2 & ρ = 7800kg/m^3. Estimate the natural frequencies of axial vibration of the bar using a two element mesh. A= 30 x10^{-6} m^2. Compare the natural frequencies with exact frequencies. 10



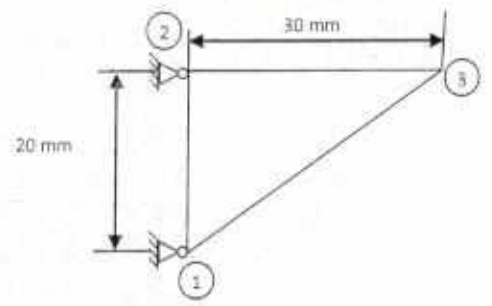
Q.5 a) A three bar truss is subjected to loading as shown. The modulus of elasticity for the bar material is 300 GPa. The cross sectional area of each bar used for truss is 300 mm^2. The length of the elements are l_1=800mm, l_2=600mm and l_3=1000mm. Determine the nodal displacements and stresses in each element. 10



b) For the iso-parametric quadrilateral elements shown in figure determine cartesian coordinates of the point P which has local coordinates (ξ=0.9125 and η = 0.2106) 10



Q.6 a) A triangular plate (E = 210 GPa, γ = 0.3) of thickness 10 mm is as shown in figure. Node 1 and 2 are fixed and the displacements at node 3 are 1.95 x 10^{-4} mm and -1.114 10^{-3} mm in x and y direction respectively. Determine the element stresses. 12



b) Obtain the strain-nodal displacement relationship for one dimensional linear element. 08