Paper / Subject Code: 37506 / FINITE ELEMENT ANALYSIS (CBSGS) 19/12/18

Sem VI mech, Dec 18 Q. P. Code: 39289

(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) Explain Global, Local & Natural Co-ordinate System 20

b) What is the significance of shape functions?

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

d) Draw lower order and higher order 1D, 2D and 3D elements.

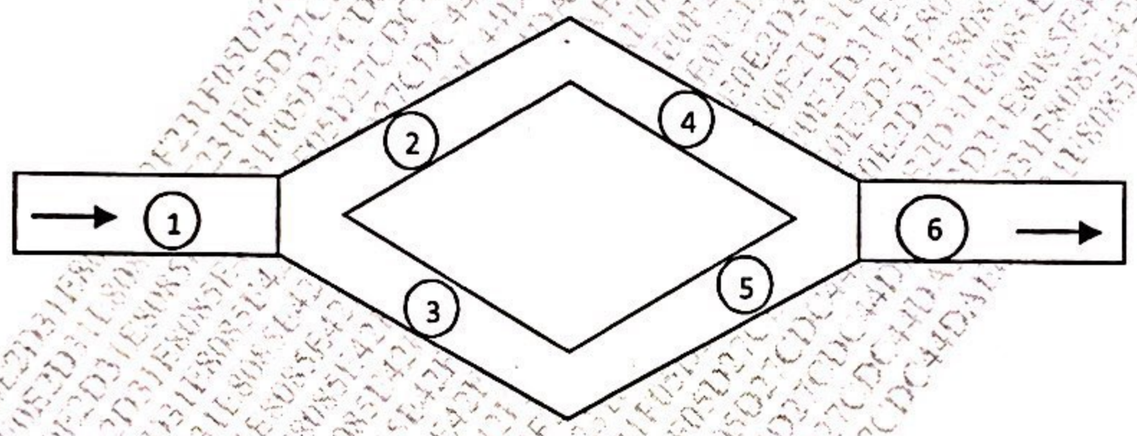
Q.2 a) Solve following differential equation by Galerkin method. 10

$$\frac{d^2\emptyset}{dx^2} = x + 1 \qquad 0 < x < 1$$

Boundary conditions: $\emptyset|_{x=0} = 0$ and $\emptyset|_{x=1} = 1$

Find values for $\phi(0.3)$ & $\phi(0.6)$

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) Solve using Rayleigh ritz method , the fin equation 10

$$\frac{d^2\theta}{dx^2} - m^2\theta = 0$$

where $\theta = T_x - T_\infty$ and $m^2 = h P / k A_c$ for $0 \le x \le L$

B.C.s are $\theta|_{x=0} = \theta_0$ and $\left.\frac{d\theta}{dx}\right|_{x=L} = 0$

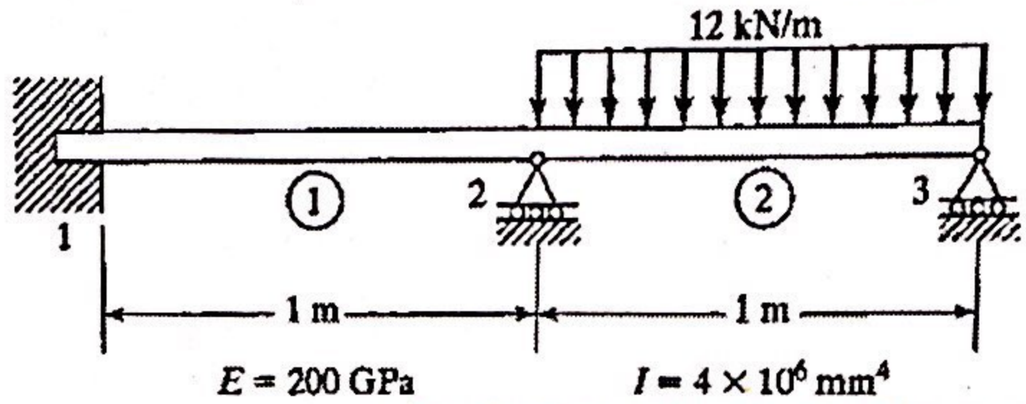
After getting EME substitute following data and solve:

L= 12 cm, no. of elements = 3, $\theta_0 = 500°C$, $T_\infty = 27°C$,

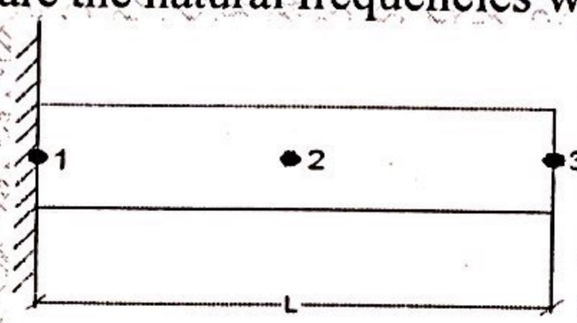
h= 100 W/ m^2 K, k = 60 W/ m K, D = 2.5 cm

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

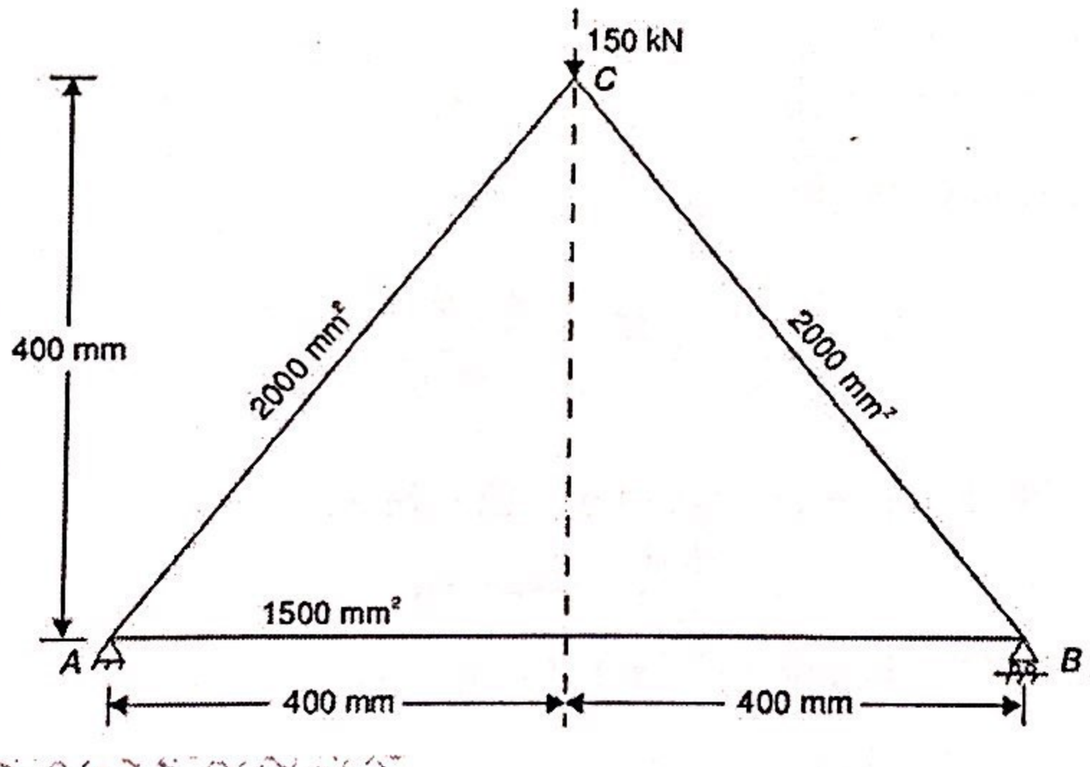
Q.4 a) For the beam shown with given loading determine the slopes at 2 & 3 and the vertical deflection at the midpoint of distributed load. 10



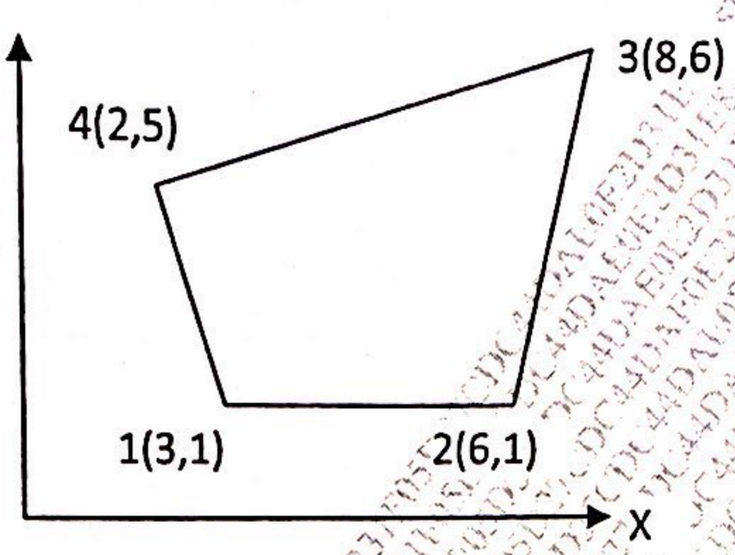
b) A uniform cross section bar as shown below has a length L=1 m ad made up of a material having $E=2x10^{11}$ N/m^2 & $\rho = 7800$kg/m^3. Estimate the natural frequencies of axial vibration of the bar using a two element mesh. $A= 30 x10^{-6}$ m^2. Compare the natural frequencies with exact frequencies.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



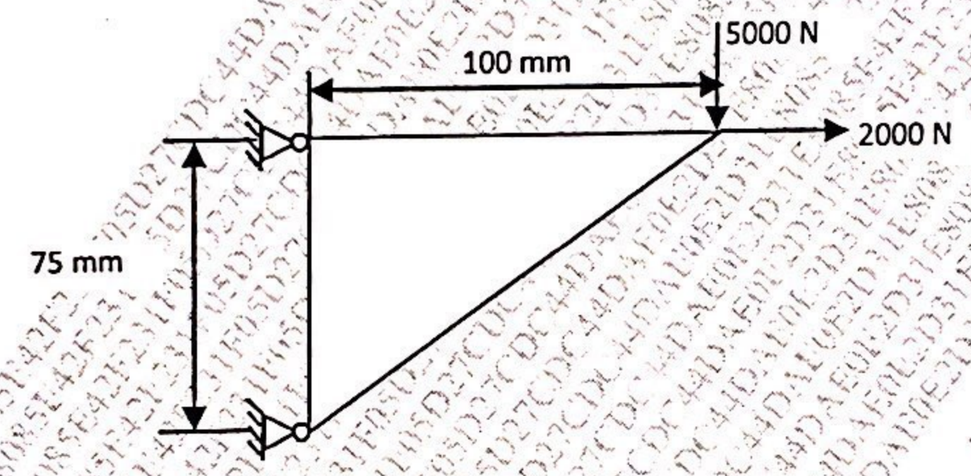
Q.5 a) For the three bar truss shown in fig, determine the nodal displacements and stress in each member. Also find the support reactions. Take E = 200GPa 10



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 of size 100 x 75 mm x 12.5mm is subjected to the load as shown in figure. The modulus of elasticity and Poisson's ratio for the plate material are 200GPa and 0.3 respectively. Model the plate with CST element and determine the element stiffness matrix and nodal displacements. 14



b) Obtain the strain-nodal displacement relationship for one dimensional linear element. 06

Q.P. Code: 25532

T.E.(MECHANICAL)(Sem VI) (CBSGS) / 37502 - MACHINE DESIGN - I

Time: 3 Hours **Marks: 80**

- 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) 'Ergonomic is compromise in order to achieve performance and aesthetic' explain this statement with example.

(b) Explain mechanism of fatigue failure in ductile and brittle material.

(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? Name 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**

[PTO]

Q.3 (a) Show the variation of the tangential stress and radial stress across the cylinder thickness and derive the Lames equation for the thickness of thick cylinder subjected to an internal pressure only. **5**

(b) A horizontal shaft transmitting 20KW at 120 rpm is supported at the bearing at A at the left end and B at the right end which are 2400mm apart. Gear C and gear D located at a distance of 250mm and 400mm from the Centre line of left and right bearing respectively. The PCD of gear C and D are 600mm and 200mm. The tangential force of the gear C and D are act vertically downward. The weight of gear C and D are 950N and 350N respectively. The combined shock and fatigue factors for bending and torsion are 1.5 and 1.2 respectively. Find the diameter of the shaft if the design stress is 100MPa in tension and 60MPa in shear. Take $F_r = F_t \tan(20^0)$ **15**

Q.4 (a) Design a bush pin type flexible coupling to connect an electric motor with the shaft of centrifugal pump. The motor delivers a power of 20KW at 960 rpm. The diameter of the motor and pump shaft 40mm. Allowable bearing pressure in the rubber bush is 0.45 N/mm^2. Select standard key and check it for shear and crushing failure. **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**

[PTO]

Q.5 (a) Explain the following terms related to the design of machine elements subjected to the variable loads. **10**

1. Notch sensitivity
2. Endurance limit
3. Surface finish factor
4. Size factor
5. Stress concentration factor

(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 110KN 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 figure 1 is use to support a load of 12KN. Determine the size of the rivet taking the permissible shear stress as 60MPa. **10**

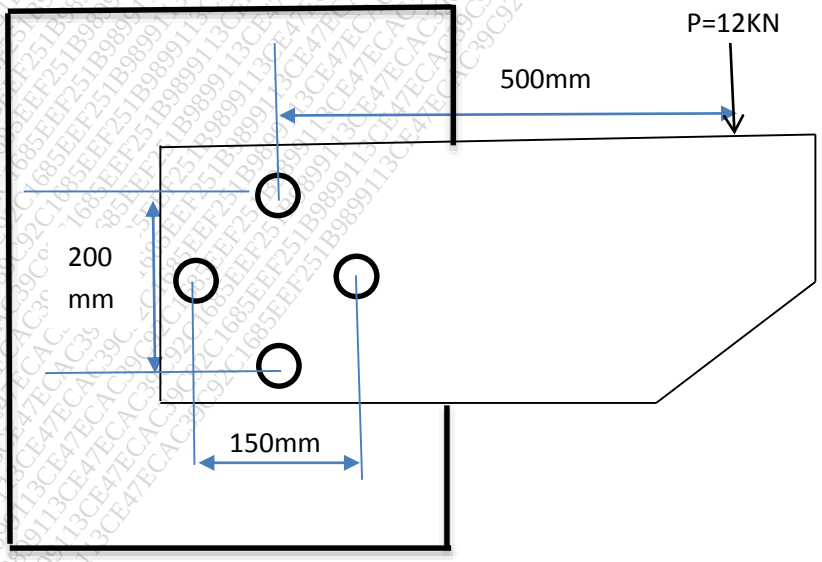


Figure:1

(3 Hours) Total Marks: 80

Instructions:

i. Question No.1 is compulsory
ii. Attempt any 3 out of the remaining questions
iii. Use your judgement for unspecified data, if any but justify the assumption.
iv. Numbers to the right indicate marks.

Q1. Attempt any four of the following sub questions: (20)

a. Explain Dunkerley's method and Rayleigh's Method to calculate the frequency of transverse vibration of shaft carrying number of point loads. (5)

b. Explain with suitable example how condition monitoring can be used to avoid catastrophic failures. (5)

c. Show that the inertia effect of a heavy spring under absolute deformation is accounted by transferring 1/3rd of its mass at the free end. (5)

d. What are the steps involved in vibration analysis? Explain with suitable example. (5)

e. The block of 10kg resting on an inclined plane, is attached on one of its end to a spring of 10KN/m as shown in Figure 1. The inclination of the plane with respect to the horizontal is 25 degrees. The mass is displaced 25 mm and released. It is observed that the amplitude decreases 1.2 mm in each cycle. What is the coefficient of friction between the block and surface? (5)

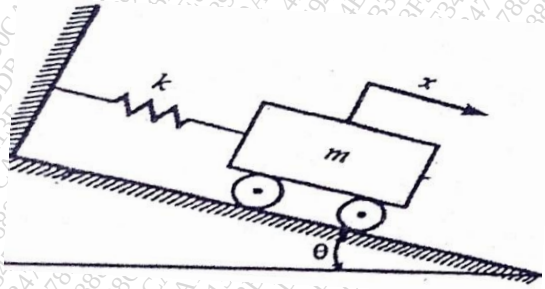


Figure 1

Q2.a A machine weighs 15 kg and is supported on springs and dashpot. The total stiffness of the spring is 10 N/mm and damping coefficient is 0.2 N-s/mm .The system is initially at rest, a velocity of 100 mm/sec is imparted to the mass. Determine : (15)

i) The displacement and velocity of mass as a function of time.

ii) the displacement and velocity of the mass after 0.5 sec

Now if an excitation force of 24sin15t is applied to the mass find the steady state response of the system.

Q2.b Determine the equivalent stiffness and equivalent inertia for the system shown in Figure 2. (5)

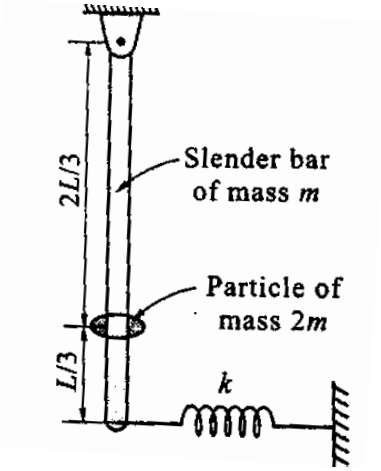


Figure.2

Q3.a Derive the equations of motion using Lagrange's method for the system shown in Figure 3 below. (8)

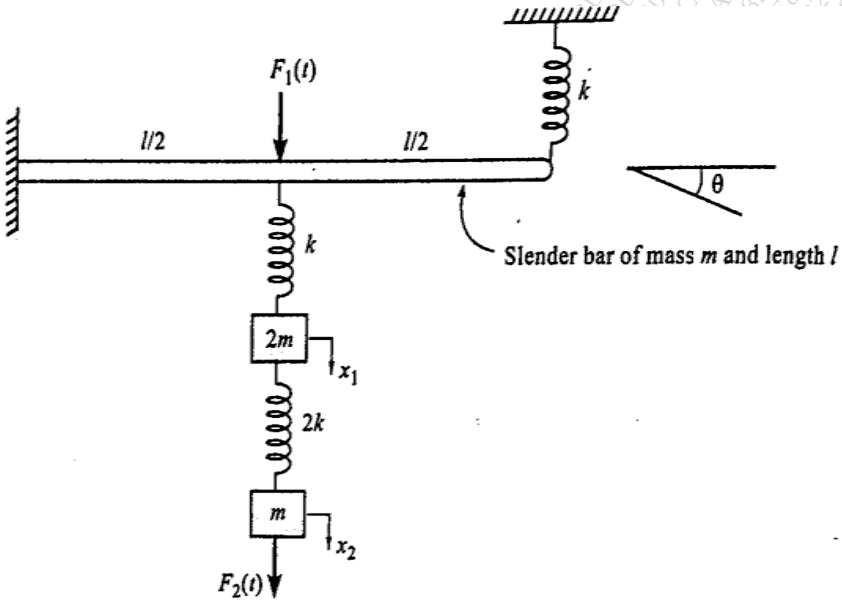


Figure 3

Q3.b A vertical steel shaft 15mm diameter is held in long bearings 1m apart and carries a disc of mass 15kg at its centre. The eccentricity of disc mass is 0.30mm .The modulus of elasticity of the disc material is 200GPa and permissible stress is 70Mpa. Neglect the mass of the shaft and determine the critical speed of the shaft. Also find the unsafe range of the speed of the shaft. (8)

Q3.c Explain the terms : Logarithmic decrement, Magnification factor. (4)

Q4.a 20N at 30Cm, 30N at 60cm and 10N at 100cm from fixed end are the loading on a cantilever. The deflection under 30N due to all loads is 2mm. What would be the natural frequency of transverse vibration if 20N is added at 80cm from fixed end? The deflection at a section i due to unit load at section j is given by (15)

$$u_{ij} = u_{ji} = \frac{s_i^2 \times \left(3s_j - s_i\right)}{\text{Constant of cantilever}} \quad \text{for } s_i < s_j$$

Q4.b A block of circular section having a diameter d and mass m floats vertically in a liquid of mass density ρ. A small displacement is given vertically to the mass in downward direction and released. Find the time period of oscillations of the mass. (5)

Q5.a. The piston of 45^0 Twin V-engine has strokes 125mm. The connecting rods driving a common crank has a length of 200mm. The mass of the reciprocating parts per cylinder is 1.2kg and the speed of the crank shaft is 2400 rpm. Determine the maximum and minimum magnitude of primary and secondary forces. (10)

Q5.b A spring mass damper system, having undamped natural frequency of 100Hz and a damping constant 20N-s/m, is used as an accelerometer to measure the vibration of a machine operating at a speed of 3000 rpm. If the actual acceleration is $10m/s^2$ and the recorded acceleration is $9m/s^2$. Determine the mass and spring constant of the accelerometer. (10)

Q6.a Explain why only a part of the unbalance force in reciprocating force is balanced by rotating mass. Derive resultant unbalance primary force if C% balancing is achieved. (6)

Q6.b A machine component of mass 2.5kg vibrates in a viscous medium. Determine the damping coefficient when the dynamic excitation force of 25N results in a resonant amplitude of 20mm with a period of 0.1sec. if excitation frequency is 8Hz and if damper is removed what will be the amplitude of forced vibration (6)

Q6.c A V-tube of constant cross sectional area is filled with a liquid of total column length L as shown in Figure 4 below. If both the arms are open to atmosphere, determine the natural frequency of oscillation of the liquid column. (8)

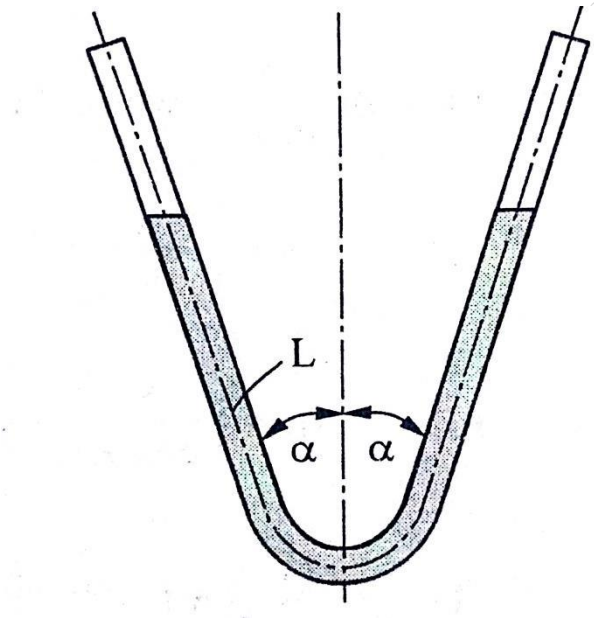


Figure.4

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(12)

Paper / Subject Code: 37505 / MECHATRONICS

13/12/18

Sem VI MECH, CBSGS, Dec 18

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(3 Hours) **[Total marks: 80]**

Instructions:
1. **Question 1 compulsory.**
2. Attempt any **three** questions from the remaining **five** questions.
3. Assume suitable data, **if necessary.**
4. **Figures/sketches** carry weightage.

Q1) Explain the following [Any four] 20
1) Concept of polling and interrupt
2) Harmonic Drive
3) Parameters to be considered for selection of an actuator
4) Working principle of DC Motor
5) Pick and place robot

Q2) a) Explain velocity profile in DC motor with suitable sketches. 06

b) Explain cantilever beam vibration control using piezo sensors. 08

c) Explain with a neat sketch office application of Mechatronics. 06

Q3) a) Two double acting pneumatic cylinders are selected for an industrial application ;The sequence of the movement is as given below:- 10
(AB)+ Delay, B-, A +Delay.
Draw electro pneumatic circuit using 5/2 DC valve which is single solenoid and spring operated and also sketch the displacement diagram

b) Explain with a neat block diagram Peripheral Interface Device. 10

Q4) a) Explain with a neat sketch the architecture of PLC. 10

b) Explain different sensors and actuators used in a car engine management system 10

Q5) a) Explain the difference between Internal and External Gear pumps with neat sketches. 08

b) Explain the selection process of PLC. 06

c) Explain with a neat sketch the components of Mechatronics. 06

Q6) Write short notes on: 20
1) Voice coil Actuator
2) Accumulators
3) FRL unit
4) Surveillance balloon

Q.P. Code: 39028

1T01416 - T.E.(MECHANICAL)(Sem VI) (CBSGS) METROLOGY AND QUALITY ENGINEERING

Total Marks: 80 **Duration: 3 Hours**

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

Q1	A]	Explain surface roughness symbols in brief.	**5**
	B]	Explain concept of flatness with suitable example.	**5**
	C]	Differentiate between precision and accuracy.	**5**
	D]	Write short note on-Planning for quality	**5**
Q2	A]	Explain Taylors Principle of Gauge design with suitable examples	**10**
	B]	Explain construction and working of laser interferometer in detail	**10**
Q3	A]	Explain following parameters with respect to surface roughness measurement:- 1) R_a Value 2) R_zValue 3) R_y Value 4) RMS value	**10**
	B]	Explain different types of quality costs in detail. How will you maintain compromise between quality and cost?	**10**
Q4	A]	Explain following:- 1) GANT charts 2) Pareto Chart	**10**
	B]	Explain three wire method used in screw thread measurements	**10**
Q5	A]	Explain construction, working and applications of 3D coordinate measuring machine	**10**
	B]	"Statistically Controlled Process is always a capable process". Do you agree with above statement? Justify your agreement or disagreement in detail.	**10**
Q6	A]	Explain construction, working Parkinson's tester used in gear measurement.	**10**
	B]	Explain Single sampling and double sampling plans in detail	**10**

(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.

Q.1 Attempt any **FIVE** of the following: **20**

a) Differentiate between the high pressure & low pressure boilers with examples.
b) Write the classification of the water turbines with example.
c) Explain the principle of working of an impulse turbine.
d) Write the classification of the rockets.
e) Write applications of the gas turbine.
f) Define specific speed and unit speed.

Q. 2 (a) A boiler generates steam at the rate of 6000 kg/hr at a pressure of 800 kPa with a dryness fraction of 0.98. The feed water is supplied at 40 ^{0}C. If the efficiency of the boiler is 75%, Calculate the rate of coal consumption, which has a calorific value of 31000 kJ/kg. What is equivalent evaporation from this boiler? **8**

If the superheater is used with the boiler and temperature of the superheated stream reaches 250^{0}C, then (i) what is the equivalent evaporation from the boiler & (ii) What is the thermal efficiency of the boiler? Take Cp of superheated steam as 2.27 kJ/kg K.

(b) The velocity of steam exiting the nozzle of the impulse stage of a turbine is 400 m/s. The blades operate close to the maximum blade efficiency. The nozzle angle is 20^0. Considering equiangular blades and neglecting blade friction, calculate for a steam flow of 0.6 kg/s, the diagram power and the diagram efficiency. **8**

(c) Differentiate between jet engine and rocket engine. **4**

TURN OVER

Q. 3 (a) Air enters the compressor of a gas turbine 1 bar and 300 K and compressed to 10 bar. The temperature at the inlet to the first turbine is 1400 K. The expansion takes place isentropically in two stages with reheat to 1400 K between the two stages at a constant pressure of 300 kPa. A regenerator having an effectiveness of 100% is also incorporated in the cycle. Determine the thermal efficiency of the cycle. Take for air Cp =1.005 kJ/kgK and γ =1. **8**

(b) Explain with the help of neat diagram – Benson Boiler. **8**

(c) Prove that net efficiency of a simple impulse turbine is given by **4**

$\eta_{net} = \eta_{stage} \times \eta_{Nozzle} \times \eta_{mech}$

Q. 4 (a) Explain velocity compounded impulse steam turbine showing pressure and velocity variations along the axis of the turbine. **8**

(b) In a hydroelectric generation plant, there are four similar turbines of total output 220 MW. Each turbine is 90% efficient and runs at 100 rpm under a head of 65m. It is proposed to test the model of the above turbines in a flume where discharge is 400 litres /s under a head of 4m. Work out the size (scale ratio) of the model. Also calculate the model speed and power results expected from the model. **8**

(c) Explain the working principle of turbo jet engine. Write its applications also. **4**

Q. 5 (a) Write the merits and demerits of closed cycle gas turbine over open cycle gas turbine. **4**

(b) What are the different methods for improving thermal efficiency of open cycle gas turbine plant? Explain one method with the help of schematic and TS diagram. **8**

(c) What is meant by cavitation? On what factors does the cavitation in water turbine depend? **8**

Q. 6 (a) The following data pertain to an inward flow reaction turbine: **12**
Net head=60m, speed = 650 rpm, Brake power = 275 kW, Ratio of wheel width to wheel diameter at inlet = 0.10, ratio of inner diameter to outer diameter = 0.5, flow ratio K_f = 0.17, η_h=0.95 and η_0=0.85. The flow velocity remains constant and the discharge is radial. Neglecting area blockage by blades, work out the main dimensions and blade angles of the turbine.

(b) What is draft tube and what are its functions? **4**

(c) Define boiler mounting and accessories. **4**
