Paper / Subject Code: 36301 / AUTOMOTIVE SYSTEM

Auto) VI) CBSGS) AS) 16-11-18

(3 Hours) [Total Marks: 80]

N.B: (1) Question no 1 is compulsory.

(2) Attempt any three out of remaining five questions.

Q.1 a Explain the functional requirement of a clutch. Also explain the 10 working of a centrifugal clutch with a neat labelled diagram.

b Explain the need and working mechanism of a transfer case in 10 detail with a neat labelled diagram.

Q.2 a Explain epicyclic gear box in detail. Also explain how many 10 forward and reverse gears can be achieved by locking each component of a simple epicyclic gear train.

b What is the requirement of a steering system? Differentiate 10 between hydraulic steering and electrohydraulic steering.

Q.3 a Compare sliding mesh gear box with a synchromesh gearbox. 10 Also show power flow diagram.

b Explain the function and working of a final drive. Explain 10 different types of gearing used in a final drive.

Q.4 a Explain semi floating and three quarter floating type of rear axles 10 with neat labelled diagram and load acting on rear axle.

b Explain working of hydraulic brake system. 10

Q.5 a What do you understand by dependent and independent 10 suspension system? Explain one type of each with a neat labelled diagram.

b Explain radial ply and cross ply type of tire construction. 10

Q.6 Write short note on following with a neat labelled diagram:
  a) Electronic power steering 04
  b) Hotchkiss drive 04
  c) Transaxle 04
  d) Torque converter 04
  e) Propeller shaft construction and joints 04

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Paper / Subject Code: 36302 / MACHINE DESIGN - I

Q.P. Code: 25532

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 d_3 =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   8
     under different failures.

[PTO]

Q.P. Code: 25532

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

(b) A horizontal shaft transmitting 20KW at 120 rpm is supported at the bearing at 15
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 $F_r = F_t \tan(20^0)$

Q.4 (a) Design a bush pin type flexible coupling to connect an electric motor with the 12
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/mm². Select standard key and check it for shear
and crushing failure.

(b) Design a Helical valve spring for an operating load range of 600N to 1200N. 08
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/mm².

[PTO]

Q.P. Code: 25532

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

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 10 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.

Q.6 (a) Select suitable standard hook for the lifting load of 110KN of trapezoidal cross 10 section and find the stress induced at the most critical cross section of the hook.

(b) A bracket is supported by four rivet of equal diameter as shown in figure 1 is 10 use to support a load of 12KN. Determine the size of the rivet taking the permissible shear stress as 60MPa.
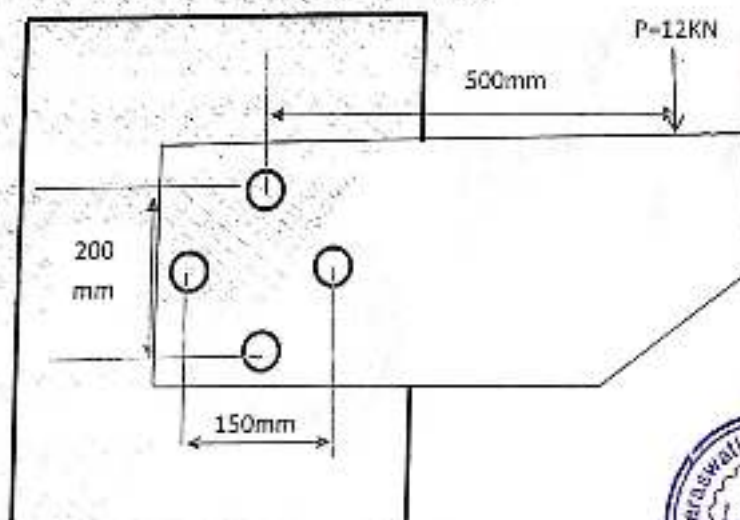

Figure:1

Paper / Subject Code: 36303 / MECHANICAL VIBRATIONS

(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 (5)
      transverse vibration of shaft carrying number of point loads.
  b. Explain with suitable example how condition monitoring can be used to avoid   (5)
      catastrophic failures.
  c. Show that the inertia effect of a heavy spring under absolute deformation is accounted (5)
      by transferring $1/3^{rd}$ of its mass at the free end.
  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 (5)
      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
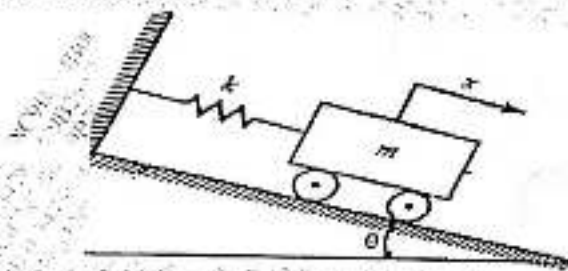   between the block and surface?

Figure 1

Q2.a   A machine weighs 15 kg and is supported on springs and dashpot. The total stiffness of   (15)
       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 :
       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   (5)
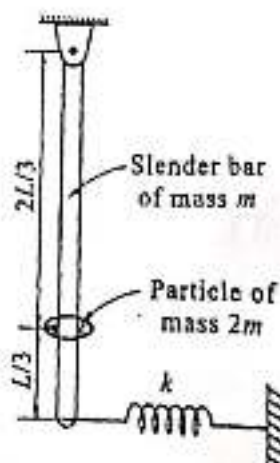   Figure 2.

Figure.2

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Q3.a Derive the equations of motion using Lagrange's method for the system shown in (6) Figure 3 below.
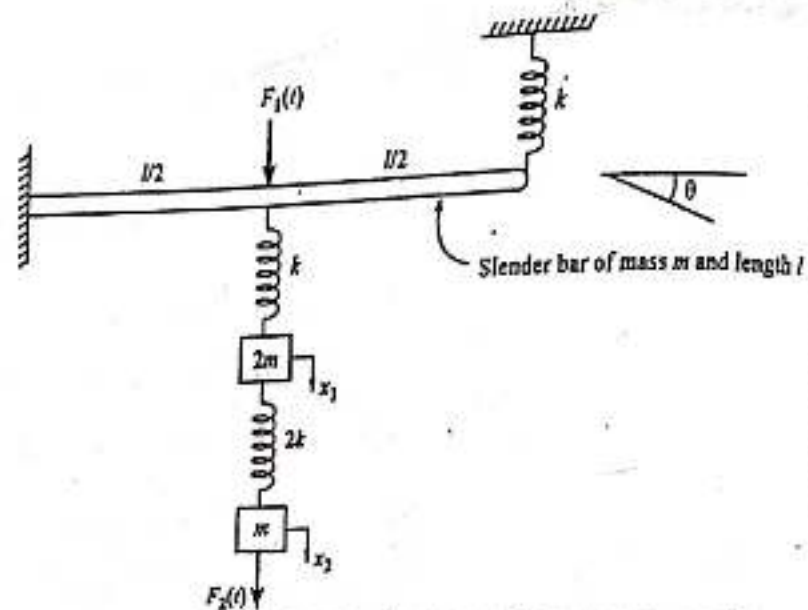

Figure 3

Q3.b A vertical steel shaft 15mm diameter is held in long bearings 1m apart and carries a (6) 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.

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 (15) 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

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

Q4.b A block of circular section having a diameter d and mass m floats vertically in a liquid (5) 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.

Q5.a. The piston of 45° Twin V-engine has strokes 125mm. The connecting rods driving a (10) 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.

Q5.b A spring mass damper system, having undamped natural frequency of 100Hz and a (10) 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/s² and the recorded acceleration is 9m/s². Determine the mass and spring constant of the accelerometer.

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

Q6.b A machine component of mass 2.5kg vibrates in a viscous medium. Determine the (6) 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

2

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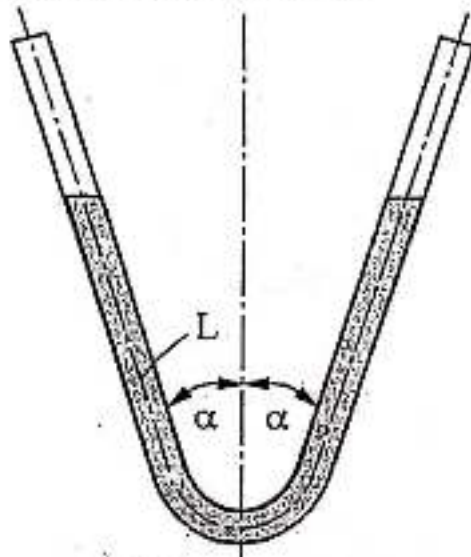natural frequency of oscillation of the liquid column.

L

α | α

Figure: 4

Paper / Subject Code: 36304 / THERMAL AND FLUID POWER ENGINEERING

Q.P.Code: 21486

(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   8
with a dryness fraction of 0.98. The feed water is supplied at 40 °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?
If the superheater is used with the boiler and temperature of the
superheated stream reaches 250°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   8
is 400 m/s. The blades operate close to the maximum blade efficiency.
The nozzle angle is 20⁰. Considering equiangular blades and neglecting
blade friction, calculate for a steam flow of 0.6 kg/s, the diagram power
and the diagram efficiency.

   (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 **8** 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 $C_p = 1.005$ kJ/kgK and $\gamma = 1$.

(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 **8** and velocity variations along the axis of the turbine.

(b) In a hydroelectric generation plant, there are four similar turbines of total **8** 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.

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

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

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

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

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_o=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**

Paper / Subject Code: 36305 / OPERATIONS RESEARCH

Q.P.Code: 018191

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

N.B.:

(1) Question number 1 is compulsory
(2) Solve any three questions from the remaining five questions
(3) Figures to right indicate full marks
(4) Assume suitable data if necessary.
(5) Notations carry usual meaning.

Q.1   Attempt any four

(A) Explain inventory model for manufacturing with non instantaneous   (05)
replenishment and without shortages.

(B) Food X contains 6 units of vitamin A per gram and 7 units of vitamin B per   (05)
gram and costs 12 paisa per gram. Food Y contains 8 units of vitamin A per
gram and 12 units of vitamin B per gram and costs 20 paisa per gram. The daily
minimum requirement of vitamin A and vitamin B is 100 units and 120 units
respectively. Formulate the problem as Linear programming model.

(C) A bank has only one typist. Since the typing work varies in length the typing rate is   (05)
randomly distributed approximating a Poisson distribution with mean service rate of 8
letters per hour. The letters arrive at a rate of 6 per hour during the entire 8 hour work
day. If the type writer is valued at Rs. 30 per hour, determine:

   i.   Equipment utilization.

   ii.   Average cost due to waiting on the part of typewriter.

(D) What are different decision criterion for decision making under uncertainty?   (05)
Explain in brief.

(E) Assign the four subjects to three faculty members. Students have to study One   (05)
subject on their own. The matrix given below indicates the marks score and the
objective is to score maximum marks.

Faculty	Subjects			
	S1	S2	S3	S4
P1	60	40	70	50
P2	45	55	65	60
P3	30	35	55	50

TURN OVER

Q.2 (A) Solve the following L.P. problem using Big-M method. (12)

Maximize $Z = 3X_1 - X_2$

Subject to $2X_1 + X_2 \geq 2$

$X_1 + 3X_2 \leq 3$

$X_2 \leq 4$

$X_1, X_2 \geq 0$

(B) A branch of PMK bank has only one typist. Since the typing work varies in length (no.of pages to be typed), the typing rate is randomly distributed approximating a Poisson distribution with mean service rate of 8 letters per hour. The letters arrive at a rate of 5 per hour during the entire 8 hour work day. If the typewriter is valued at Rs.150 per hour, determine (i) Equipment utilization (ii) The percent time that an arriving letter has to wait (iii) Average system time (iv) Average cost due to waiting on the part of typewriter. (08)

Q.3(A) Solve the following game using dominance property and find the game value. (10)

	I	II	III	IV	V	VI
1	4	2	0	2	1	1
2	4	3	1	3	2	2
3	4	3	7	-5	1	2
4	4	3	4	-1	2	2
5	4	3	3	-2	2	2

(B) Find the basic feasible solution of the following transportation problem by VAM method. Also find the optimal transportation plan. (10)

	D1	D2	D3	D4	Available
O1	21	16	25	13	11
O2	17	18	14	23	13
O3	32	27	18	41	19
Requirement	6	10	12	15	

Q.4(A) Explain the following (08)
(i) Resource leveling
(ii) Decision tree

(B) The time and cost estimates of different activities of a project and their (12) precedence relationship are given below

Activity	Preceding activity	Time (in weeks)		Cost (RS.)	
		Normal	Crash	Normal	Crash
A	-	6	4	10,000	14,000
B	-	4	3	5,000	8,000
C	A	3	2	4,000	5,000
D	B	8	3	1,000	6,000
E	B	14	6	9,000	13,000
F	C,D	8	4	7,000	8,000

Overhead costs amounts to Rs.1, 000 /- per week. Crash the project to optimum extent.

Q.5(A) Solve the following LPP by Simplex method (10)

$$Max \ Z = 6X_1 + 4X_2$$
$$Sub \ to \ 4X_1 + 5X_2 \leq 10$$
$$3X_1 + 2X_2 \leq 9$$
$$8X_1 + 3X_2 \leq 12 \ \ and \ \ X_1, X_2 \geq$$

(B) A newspaper boy has the following probabilities of selling a magazine: (10)

No. of copies sold	10	11	12	13	14
Probability	0.10	0.15	0.20	0.25	0.30

Cost of copy is 30 paise and sale price is 50 paise. He cannot return unsold copies. How many copies should he order?

Q.6 (A) Customers arrive at random. Probability of inter arrival time and service time are given as under (10)

Inter Arrival Time (Minutes)	Probability	Service Time (Minutes)	Probability
1	0.1	1.0	15
2	0.2	1.5	20
3	0.3	2.0	25
4	0.3	2.5	30
5	0.1	3.0	10

TURN OVER

4

Estimate the average waiting time and queue length of customer by using seven simulations

Random Number: 5887, 4739, 2328, 6997, 3569, 5587, 6952

(B) A particular item has a demand of 10,000 units/year. The cost of procurement is (10) Rs.100 and the holding cost per unit is Rs2.50 per year. The replacement is instantaneous and no shortages are allowed. Determine :
i) The economic lot size
ii) The number of orders per year
iii) The time between orders
iv) The total cost per year if the cost of one unit is Rs.2

AUTU) VI) (BSGS) FEA)19-12-18   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.
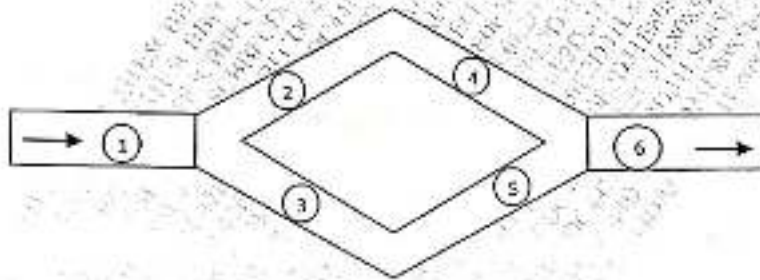   d) Draw lower order and higher order 1D, 2D and 3D elements.

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

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

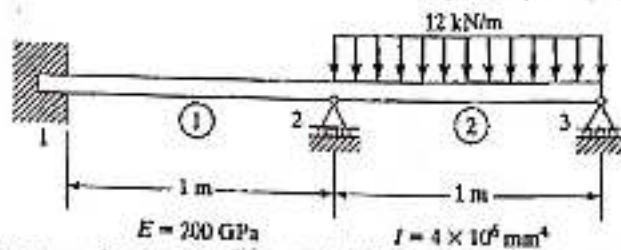where $\theta = T_x - T_\infty$ and $m^2 = h P / k A_c$ for $0 \le x \le L$

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

After getting EME substitute following data and solve:
L= 12 cm, no. of elements = 3, $\theta_0 = 500°C$, $T_\infty = 27°C$,
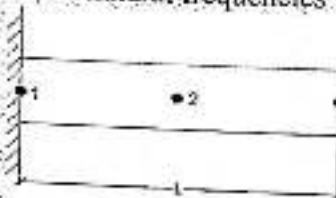h= 100 W/ m² K, k = 60 W/ m K, D = 2.5 cm

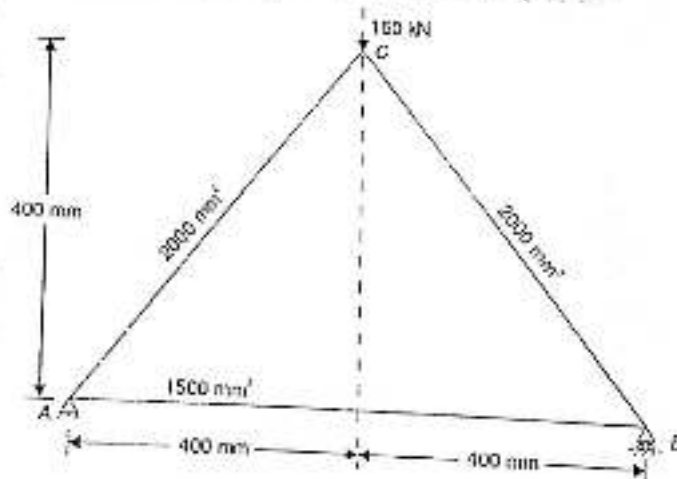b) Derive the shape function for a rectangular element in local coordinate system.   10

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
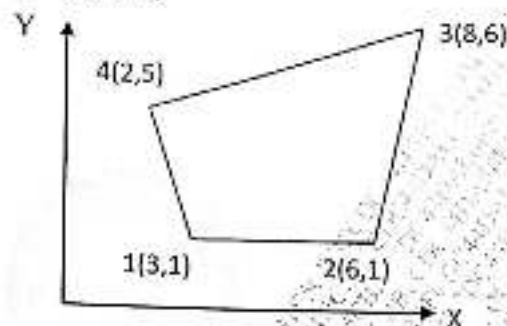

$E = 200$ GPa $I = 4 \times 10^6$ mm^4

b) A uniform cross section bar as shown below has a length L=1 m ad made up of a material having $E=2\times10^{11}$ N/m^2 & $\rho = 7800$ kg/m^3. Estimate the natural frequencies of axial vibration of the bar using a two element mesh. $A= 30 \times10^{-6}$ m^2. Compare the natural frequencies with exact frequencies.   10
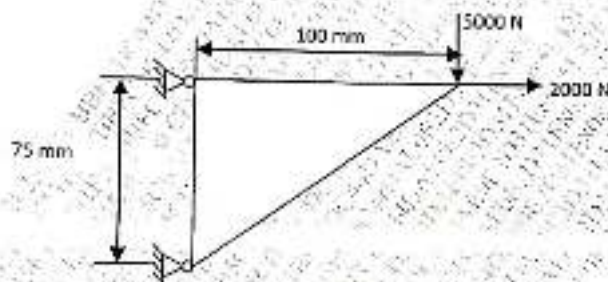

Q.5

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   10
cartesian coordinates of the point P which has local coordinates ($\xi =$
0.9125 and $\eta = 0.2106$)

Q.6   a) A triangular plate of size 100 x 75 mm x 12.5mm is subjected to the load   14
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.

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