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Bharatiya Vidya Bhavan's

Sardar Patel College of Engineering

(A Government Aided Autonomous Institute)
Munshi Nagar, Andheri (West), Mumbai – 400058

End Semester Examination
November 2016

Date: **21/11/2016**

Program: **M.Tech. (Mechanical) with Machine Design**

Duration: **4 Hrs**

Course Code: **MTMD103**

Max. Marks: **100**

Name of the Course: **Reliability Engg. and Design of Experiments**

Semester: **I**

Instructions: **Attempt any five questions. All questions carry equal marks.** Master file.

Question	Maximum Marks	Course Outcome Number	Module No.
Q.1.			
(a) Write a short note on: i) Statistical Estimation of Error ii) 95% confidence interval	**05**	**02**	**01**
(b) To examine the effects of projects and teams in stressful situations, researchers selected 45 people to participate in an experiment. Fifteen of the people (subjects) were randomly assigned to each of three groups to perform a stressful task alone (control group), with a good team present, or with their project present. Each subject's mean heart rate during the task was recorded. Test the appropriate hypotheses at the $\alpha = 0.05$ level to decide if the mean heart rate differs between the groups.	**05**	**02**	**02**
(c) Data collected randomly from 5 General Motors manufacturing plants for average annual sale in 2015 as given below,	**10**	**01**	**02**

	n	Mean	Std. Dev.
Control	15	82.52	9.24
Projects	15	73.48	9.97
Teams	15	91.33	8.34

Plant No.	Number of subunits	Number of car models	Annual Sale in Dollars
1	12	32	350,000
2	14	35	399,765
3	15	45	429,000
4	16	50	435,000
5	18	65	433,000

Compute the regression coefficients, intercept to formulate a generalized model for annual sale. Estimate the coefficient of

determination. Also predict the annual sales for a plant having 13 subunits and 49 numbers of car models

Q.2.

(a) What is the purpose of randomization of tests? What is the effect of blocking on analysis of results	**05**	**01**	**03**
(b) The following experiment is interested in comparing the effect four different materials (A, B, C and D) in producing water resistance (y) in car body. A strip, randomly selected from each of material, is cut into four pieces (samples). These pieces are randomly tested for corrosion test. This process is replicated three times producing a Randomized Block (RB) design as given below with corresponding measured moisture resistance of the samples. (Low readings indicate low moisture penetration).	**05**	**02**	**03**

9.9	C	13.4	D	12.7	B
10.1	A	12.9	B	12.9	D
11.4	B	12.2	A	11.4	C
12.1	D	12.3	C	11.9	A

Construct a ANOVA table for this randomly block design.

(c) Construct a one-half fraction of 2^{4-1} fractional factorial design. Illustrate the procedure of constructing fractional factorial design using this exercise.	**10**	**02**	**03**

Q.3.

(a) Illustrate the Least Square Method for estimation of parameters (β) used in Response Surface Methodology	**05**	**01**	**04**
(b) Define the term signal-to-noise (S/N) ratio. How do you set the objective function in robust design?	**05**	**01**	**04**
(c) Taguchi experimental design orthogonal array (L9) is designed for conducting three trials for each experiment, the data below was collected. Compute the S/N ratio for each experiment for the target value (nominal is best) case, create a response chart, main effect plot for S/N ratios and determine the parameters that have the highest and lowest effect on the casting yield.	**10**	**02**	**04**

Exp. Number	Preheat Temperature	Casting width	Cooling Rate	Flow Rate	Trial 1	Trial 2	Trial 3
1	100	2	4	0.1	87.3	82.3	70.7
2	100	5	6	0.2	74.8	70.7	63.2
3	100	8	8	0.3	56.5	54.9	45.7
4	150	2	6	0.3	79.8	78.2	62.3
5	150	5	8	0.1	77.3	76.5	54.9
6	150	8	4	0.2	89	87.3	83.2
7	200	2	8	0.2	64.8	62.3	55.7
8	200	5	4	0.3	99	93.2	87.3
9	200	8	6	0.1	75.7	74	63.2

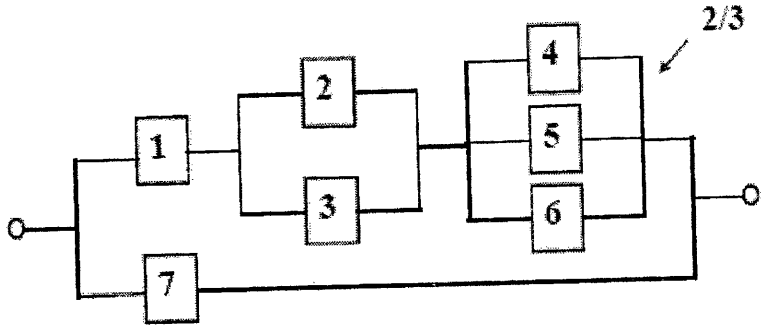
Q.4.

(a) With a suitable example describe the method of plotting: i) Frequency Distribution ii) Probability Density Function iii) Probability Distribution Function What type of information may they indicate?	**05**	**01**	**05**
(b) The foreman of a casting section in a factory finds that on the average 1 in every 5 casting made is defective. If the section makes 8 castings a day what is the probability that exactly 2 castings will be defective?	**05**	**01**	**05**
(c) A pumping station has two 20000 liters/hr pumps and is to have one 40000 liters/hr pump installed. Draw up a pumping capacity outage probability table for this system given that the unavailabilities (probability of failure) for the 20000 and 40000 liters/hr pumps are 0.2 and 0.1 respectively. If the system requires at least 50000 liters/hr for successful operation, what is the probability of system success?	**10**	**03**	**06**

Q.5.

(a) Write a short note on any two of the followings: i) Part/product life testing ii) Weibull distribution iii) Taguchi loss function	**05**	**01**	**05**
(b) A system consists of 5 components in parallel. System success requires that at least 3 of these components must function. What is the probability of system success if the component reliability in 0.9?	**05**	**03**	**05**

(c) Derive a general expression for the unreliability of the system whose reliability model is shown below. Calculate the system unreliability if the unreliability of component 3 and 5 are 0.01, and for the other components are 0.02.	**10**	**01**	**06**



Q.6.

(a) Illustrate the steps for evaluation of availability using Markov Modeling technique	**05**	**01**	**07**
(b) A system has 3 components in parallel with reliabilities designated as R_1, R_2 and R_3. A system requires at least 1 component to work for system success. Draw the reliability network diagram and find an expression for system reliability using the following methods: (i) conditional probability approach (ii) minimal cutsets (iii) event tree	**15**	**03**	**06**

Q.7.

(a) Compare the "fault tree analysis" and "failure mode and effect analysis" (FMEA)	**05**	**01**	**07**
(b) A telephone exchange contains 10 lines. A line can be busy or available for calls and all lines act independently. If the probability that a line will be busy during the noon period is 0.8, what is the probability of there being at least three free lines during this period? What is the expected number of free lines during this period?	**05**	**03**	**07**
(c) Compare the reliability and MTTF of a 2-component system each having a failure rate of 0.02 f/hr after a time of 10 hr if they are (i) parallel redundant (ii) standby redundant with 100% reliable sensing and changeover device.	**10**	**03**	**07**

Gb
18/11/16

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Munshi Nagar, Andheri (West), Mumbai – 400058

End Sem

Nov 2016

Program: M. Tech
Course code: MTMD102
Maximum Marks: 100
Name of the Course: Machine Dynamics and Advanced Vibration

Date: 18/11/ 2016
Duration: 4 hr
Semester: First

Instructions: Use of scientific calculator is allowed
Be specific in your answer
Attempt **any five** questions.

Master file.

Abbreviations: SDOF- Single degree of freedom
TDOF-Double degree of freedom
MDOF-Multi degree of freedom
DEOM-Differential equation of motion
MM-Maximum Marks
CN-Course Outcome Number.
MN-Module Number

QN		MM	CN	MN
Q 1				
A	Explain the rigid body kinematics, specifically derive the expression for velocity and acceleration in terms of the position vector.	6	1	1
B	Write short note Euler's equations of motions.	4		
C	The block is released from rest and slides to the right. (Refer fig 1) i. Find the acceleration of its centre of mass and location of the normal force. ii. Find the distance travelled by the mass centre in 4 sec. iii. What are the largest applied force and acceleration possible without tipping.	4 2 4		

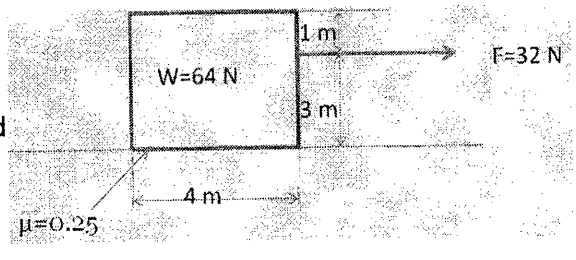
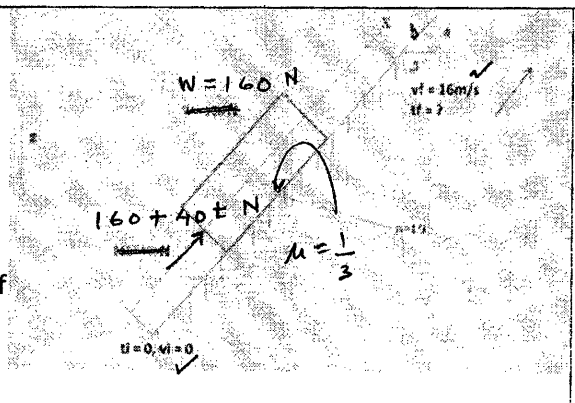
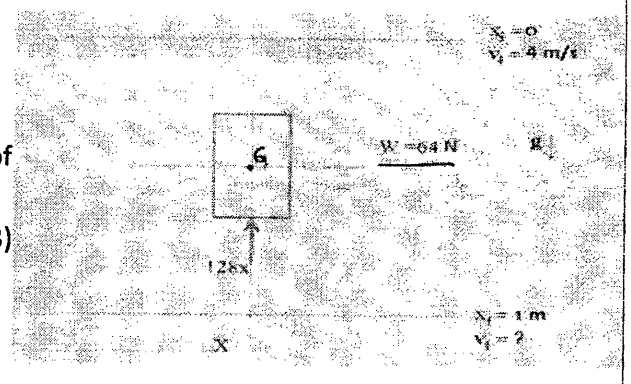
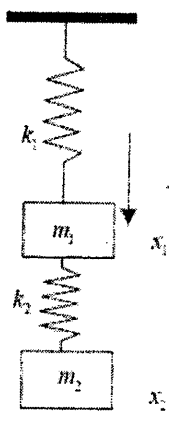
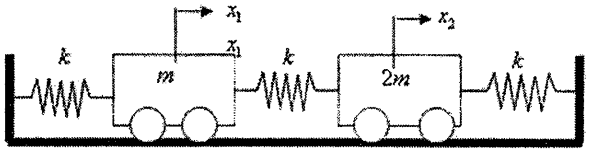
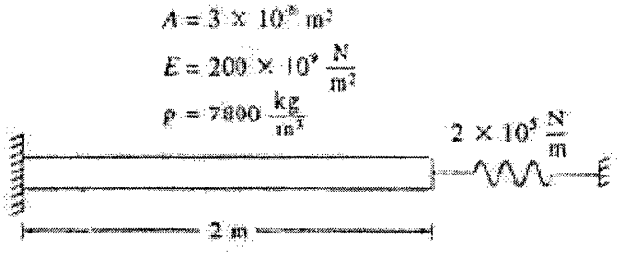
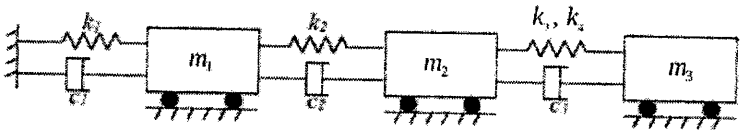
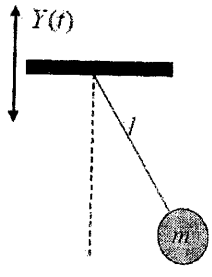


Figure 1

Q 2	A) Write a short note on Impulse moment formulation. B) Find the magnitude and direction of the acceleration of the center of the block (which slides up the plane).What is the t_f in depicted situation. (Refer fig 2)  Figure 2 C) Write a short note on Work energy principle. D) Find the magnitude and direction of the acceleration of block. What is the t_f in depicted situation. (Refer fig 3)  Figure 3	4 6 4 6	1	2
Q 3	A) Write short note on semi definite system. Give an example and do vibration analysis of it. B) Using matrix iteration method, Find out the natural frequencies and mode shapes for the system(Refer fig 4) (Assume $k_1=k_2=k$ and $m_1=m_2=m$) C) Derive the expression for maximum amplitude of spring mass damper system(for SDOF).A weight 55 N suspended by a spring of stiffness 1.1 KN/m is forced to vibrate by a harmonic force of 9 N. Assuming viscous damping co-efficient c=77 N sec/m, find i. The resonate frequency ii. The amplitude at resonance iii. The phase angle at resonance frequency corresponding to peak amplitude iv. peak amplitude v. The phase angle corresponding to peak amplitude  Figure 4	5 5 5	2	2

	OR The differential equation governing the motion of a TDOF system are $$\begin{bmatrix} m & 0 \\ 0 & m \end{bmatrix}\begin{bmatrix} \ddot{x}_1 \\ \ddot{x}_2 \end{bmatrix} + \begin{bmatrix} 2k & -k \\ -k & 3k \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$ Determine the system natural frequencies and mode shapes. D) Derive DEOM using Lagrange principle for the system (Refer fig 5)  Figure 5	5		
Q 4	A) What is the speed of torsional waves in a solid steel (G = 80 X 10 9 N/m$^{2'}$, p = 7800 kg/ m^3)shaft of 20 mm diameter? B) For longitudinal vibration of bar with free-free end boundary conditions i. Derive DEOM using newton's Method ii. Form the Eigen value formulation iii. Determine natural frequencies iv. Determine Mode shapes v. Draw first four mode shapes vi. Give expression for General vibrating response? **OR** Determine the lowest natural frequency of longitudinal motion for the system (Figure 6)  Figure 6	**2** **18** **20**	**4**	**2**

Q 5	A) Write short note on following Damping models i. Viscous Damping ii. Material Damping iii. Friction/Columb's Damping	5	3	5
	B) Short note on vibration isolator. What is the maximum stiffness of an undamped isolator to provide 81 percent isolation for a 200 kg fan operating at 1000 rpm. If the isolator had a damping ratio of 0.1, determine the stiffness value.	5		
	C) What is viscoelastic material and its significance in Vibration control.			
	D) Explain following i. Dynamic Vibration Absorber(DVA) ii. Basics concept of of DVA. iii. Design Considerations	2 8		
Q 6	A) Derive the equation motion of the system (Refer fig 7). Consider last spring to be nonlinear where the spring force is given by $F_s=k_3x+k_4x^2$ and other spring and damper behavior to be linear.  Figure 7	10	4	4
	B) Derive the equation of motion of a pendulum of length l and mass m which is attached to a mass less moving support (Refer fig 8) **OR** What is a singular or equilibrium point of non-linear vibration system? With derivation of necessary equilibrium explain the classification points. Draw neat sketches to illustrate of the equilibrium points.  Figure 8	10		
Q 7	A) Briefly describe two types of frequency measuring mechanical instruments?	**10**	**7**	**3**
	B) Explain signature analysis in the context of experiential study of vibrations?	**10**		

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lib Sec 23/11/16

(1)

End Semester Examination
November 2016

Date: **23/11/2016**

Program: **M.Tech. (Mechanical) with Machine Design**

Duration: **4 Hrs**

Course Code: **MTMD104**

Max. Marks: **100**

Name of the Course: **Tribology**

Semester: **I**

Instructions: **Attempt any five questions. All questions carry equal marks.**

Use of approved PSG Design data book is permitted.

Assume suitable data, if necessary, giving reason. Master file.

Question	Maximum Marks	Course Outcome Number	Module No.
Q.1.			
(a) Write a note on Towers Experiment (test setup, observations and conclusions).	**10**	**02**	**01**
(b) Explain the following with neat sketches (i) Role of hydro-dynamic lubrication in Journal Bearings (ii) Cavitation zone in hydro-dynamic bearings (iii) Hydro-dynamic pressure profile in radial journal bearing (iv) Mechanism of pressure build-up in a hydrodynamic bearing	**10**	**01**	**01**
Q.2.			
(a) Distinguish between: (i) Shear thinning and shear thickening (ii) Full and partial journal bearing	**05**	**02**	**02**
(b) Describe following types of hydrostatic bearing with neat sketch (i) porous bearing (ii) multi-pocket hydrostatic bearing	**05**	**01**	**02**
(c) A journal bearing has the following specifications: Journal diameter = 100 mm Bearing diameter = 100.3 mm Bearing length = 105 mm Radial load = 15 kN Bearing is lubricated under pressure with inlet oil temperature of 44°C (Grove at lower point of bearing and oil viscosity = 30 mPa.s) Determine oil flow rate and inlet pressure to raise the journal 0.05 mm for operating under steady state condition.	**10**	**03**	**02**

Q3.			
(a) Explain schematically the effect of i) time, ii) load and iii) temperature on wear rate for dry, boundary lubricated and fluid film lubricated case	**05**	**01**	**03**
(b) Demonstrate the mechanism of elasto-hydrodynamic lubrication with a suitable example	**05**	**01**	**03**
(c) A lightly loaded journal bearing has following specifications: Radial load = 600 N Rotational speed = 2000 RPM Journal diameter = 40 mm Bearing length = 10 mm $\beta = 0.029$ Radial clearance = 20 μm Oil viscosity at room temperature = 15 mPa.s $\rho_{oil} = 860$ kg/m^3 Cp of oil = 1760 J/kg°C U = 4.19 m/s Determine the minimum film thickness, maximum pressure, coefficient of friction	**10**	**03**	**03**
Q.4.			
(a) Describe the situation where liquid lubricants are undesirable and ineffective over solid lubricants with an example	**05**	**01**	**04**
(b) Write a short note on Magnetorheological (MR) fluid	**05**	**01**	**04**
(c) A ball bearing is to operate on the following work cycle of 3 hours consisting of : Radial load 1400N at 200 rpm for 25% of the time Radial load 2000N at 500 rpm for 20% of the time Radial load 800N at 400 rpm for 55% of the time Expected life of bearing is 10000 hours. Calculate load carrying capacity of bearing	**10**	**02**	**05**
Q.5.			
(a) Suggest suitable roller element bearing for: (i) High speed (ii) High running accuracy (iii) Pure axial load (iv) Pure radial load (v) Combined radial and axial load	**05**	**03**	**05**
(b) What is preload? Explain it in terms of elastic deformation. State the significance of preloading on rolling element bearings.	**05**	**01**	**05**
(c) Select a suitable deep grove ball bearing among following bearings (SKF 6007 C = 12200N, C_o = 8500N and SKF 6207 C = 19600N, C_o = 13700N) for following operating conditions: Radial load = 1000N,	**10**	**02**	**05**

Axial load = 400 N,
Shaft speed = 1500 RPM,
Operating life = 15000 hours,
Bore diameter = 35mm
Conversion factor for equivalent load = 1.3

F_a/C_0	$F_a/VF_r > e$		e
	X	Y	
.014	0.56	2.30	.19
.028		1.99	.22
.056		1.71	.26
.084		1.55	.28
.11		1.45	.3
.17		1.31	.34
.28		1.15	.38
.42		1.04	.42
.56		1.00	.44

Q.6.

(a) Write a note on friction induced instability	**05**	**01**	**06**
(b) What is surface roughness? Explain the relevant terminologies. Distinguish Average roughness and Root Mean Square roughness. Which one quantifies the exact behavior of surface roughness and Why? Illustrate the role of surface roughness in dry and lubricated surfaces	**05**	**02**	**06**
(c) Explain the friction due to deformation by considering conical and spherical asperities	**10**	**01**	**06**

Q.7.

(a) Explain schematically surface contamination layers on metal surface	**05**	**02**	**07**
(b) Illustrate rolling and sliding in gears	**05**	**02**	**07**
(c) Explain the role of tribology in following machine elements: (i) Cams (ii) Brakes (iii) Seals (iv) cylinder liner and ring of IC engine	**10**	**03**	**07**

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END SEMESTER RE-EXAMINATION

DECEMBER 2016

Q. P. Code:

Max. Marks: 100 Duration: 4 Hour

Class: M.Tech(Mechanical) with Machine Design Semester: I Program:

Name of the Course: Elective I -Computer Aided design Course Code :MTMD111

Master file.

Instructions:

1. Answer any five questions.
2. Assume suitable additional data if necessary and state the same.

Question No		Maximum Marks	Course Outcome	Module No
Q 1	A) Consider the Fig.1.Calculate and sketch what will appear on the screen for each of the following Window and View Port settings. a) SET VIEWPORT (0,1,0,1) SET WINDOW (0,2,0,2) b) SET VIEWPORT (0.5,1,0.5,1) SET WINDOW (0,1,0,1)	10	01&03	03
	B) Explain the two methods, namely, vector cross product and vector dot product, to find the vector normal to the plane of the polygon to decide back face removal.	10	01,02 &03	03
Q2	A)Given B_0 [1 1], B_1 [2 3], B_2 [4 3] and B_3 [3 1] the vertices of a Bezier polygon determine the co-ordinates at points, P1(0.2), P2(0.4), P3(0.6) and P4 (0.8).	12	04	04
	B) Vectorize a line to be drawn from (10, 20) to (150, 125) mm on a display which is mapped to approximately (300 * 250 mm). The resolution of the screen is 640 * 480 pixels. Apply DDA Algorithm.	08	01, 03 & 04	03

Q3	A)Generate the parabolic segment for parametric representation in the first quadrant for $1 \leq x \leq 4$ for the parabola given by : $X = a\,\theta^2$, $y = 2a\,\theta$ for a=1. B)Consider the triangle ABC with position vectors as shown below: $\begin{vmatrix} 4 & 1 \\ 5 & 2 \\ 4 & 3 \end{vmatrix}$ First reflect the triangle about the X-axis and then reflect about the line Y = - X	10 10	01,03 &04 01,03 &05	02&04 04
Q4	A)Explain in detail Boundary Representation (B-rep) and Constructive solid Geometry (CSG) schemes to create solid models of physical objects in CAD system. B) The various design- related tasks which are performed by a modern computer applied design system can be grouped into four functional areas: • Geometric Modeling • Engineering Analysis • Design Review and Evaluation • Automated Drafting. Briefly explain each of these four areas.	10 10	01,03&04 01&04	02 01
Q5	Explain the following(any four):- a) Data Exchange Format (DXF) b) Constraint Driven Modeling c) Artificial Intelligence in Design d) Virtual Prototyping e) Object Oriented Programming f) Data Capture Techniques like Contact Inspection Methods and Scanning Methods.	(5 each)	 02 01 04 04 03&04 04	 02&05 02 05 06 07 06
Q6	A)List the various hardware components that make up a modern CAD system and briefly explain each. B)Discuss the application of Concurrent Engineering approach in limited design changes .How does IT(Information Technology) facilitate Concurrent Engineering.	10 10	01&04 01,03&04	01 01&02

Q7	A)Write the steps in detail for creating a Spur Gear with the following specifications:- Module ---------- 4 Number of Teeth----------40 Pressure Angle----------20 deg Gear Face Width----------30mm Bore Diameter----------35 H_8 Material---------- EN 8 Steel. (Use the guidelines in the CAD packages UG NX, Solid works, CATIA or ProE for modeling technique)	12	01&03	07
	B) Develop a C ++ program to carry out following transformations on a 2D object like a line.Insert necessary comments wherever it is necessary. a) Translation b) Rotation	08	05	03&04

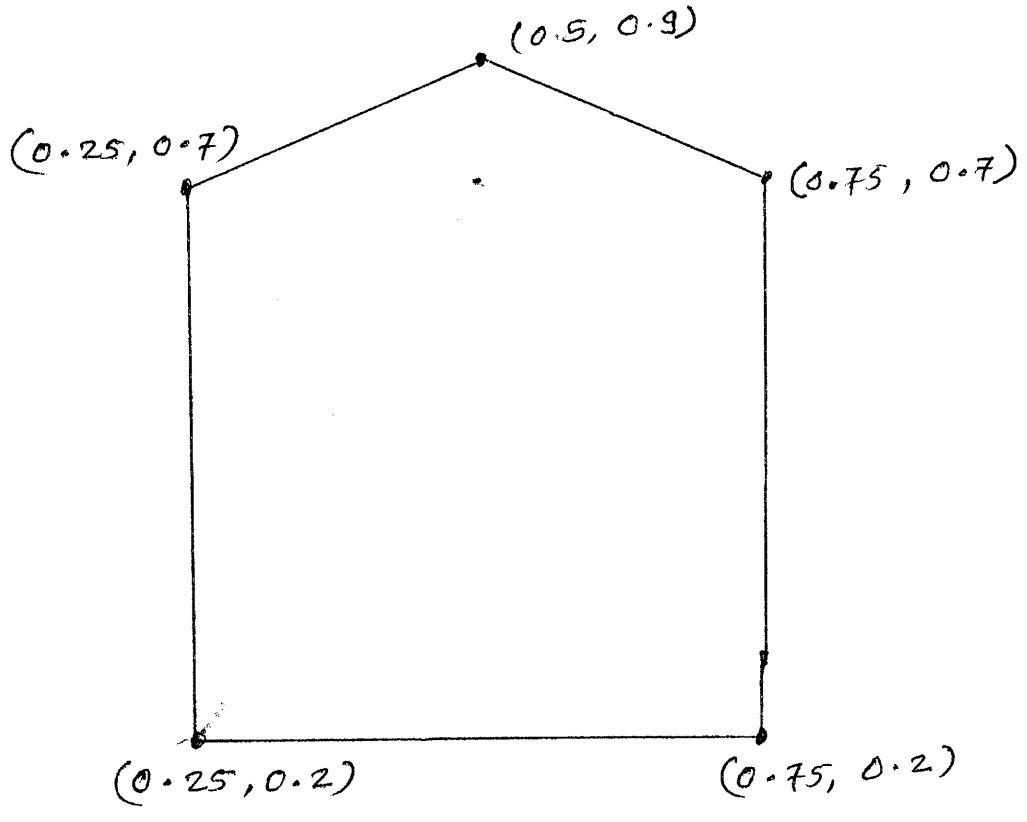

Fig. 1
Q. No. 1(A)