

**PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)**

**BVoc DEGREE EXAMINATION DECEMBER 2024
(Fourth Semester)**

Branch – **NETWORKING AND MOBILE APPLICATION**

MATHEMATICAL STRUCTURES

Time: Three Hours

Maximum: 50 Marks

SECTION-A (5 Marks)

Answer ALL questions

ALL questions carry **EQUAL** marks (5 x 1 = 5)

- 1 In a rectangular matrix, how are the number of columns and the number of rows defined?
(i) Equal (ii) Either equal or not equal
(iii) Not equal (iv) None of these
- 2 What term is used to denote the process of finding the values outside this interval?
(i) Extrapolation (ii) Interpolation
(iii) Differentiation (iv) Integration
- 3 If $a=0$, $b=1$, and the number of equal parts is 10, what is the value of h ?
(i) 0.1 (ii) 0.2
(iii) 0.3 (iv) 0.4
- 4 In CPM, what is the term used to refer to the shortest possible time to complete the project?
(i) Optimistic (ii) Pessimistic
(iii) Most likely (iv) Normal
- 5 What is the utilization factor ρ is?
(i) $\frac{\lambda}{\mu}$ (ii) $-\frac{\lambda}{\mu}$
(iii) $\frac{1}{\mu}$ (iv) $\frac{\mu}{\lambda}$

SECTION - B (15 Marks)

Answer ALL Questions

ALL Questions Carry **EQUAL** Marks (5 x 3 = 15)

- 6 a How can you show that the matrix $A = \begin{bmatrix} 1 & 0 & -2 \\ 2 & 2 & 4 \\ 0 & 0 & 4 \end{bmatrix}$ satisfies the equation $A^2 - 3A + 2I = 0$.

OR

- b How can you check whether the matrix $A = \begin{bmatrix} \frac{1}{3} & \frac{2}{3} & \frac{2}{3} \\ \frac{2}{3} & \frac{1}{3} & -\frac{2}{3} \\ -\frac{2}{3} & \frac{1}{3} & -\frac{1}{3} \end{bmatrix}$ is orthogonal or not?

- 7 a Using Newton's formula, how can you find the pressure of the steam at a temperature of 142°C based on the following data from the steam table?

Temperature in	140	150	160	170	180
Pressure $kg f/cm^2$	3.685	4.854	6.302	8.076	10.225

OR

- b Using Newton's formula, how can you find the melting point of the alloy containing 84 percent lead based on the following data?

p	40	50	60	70	80	90
t	184	204	226	250	276	304

- 8 a Given the following table of values for x and y , find first two derivatives $\frac{dy}{dx}$, $\frac{d^2y}{dx^2}$ for $x=1.05$.

x	1.00	1.05	1.10	1.15	1.20	1.25	1.30
y	1.00000	1.02470	1.04881	1.07238	1.09544	1.11803	1.14017

OR

Cont...

- b From the following table of values of x and y , find first two derivatives $\frac{dy}{dx}$, $\frac{d^2y}{dx^2}$ for $x=1.25$

x	1.00	1.05	1.10	1.15	1.20	1.25	1.30
y	1.00000	1.02470	1.04881	1.07238	1.09544	1.11803	1.14017

- 9 a Draw a network diagram for the following data:

Activity	A	B	C	D	E	F	G	H	I	J
Pre-activity	-	A	A	B	A	B,E	C	D, F	G	H, I

OR

- b Draw a network diagram for the following data:

$B < E, F; C < G, L; E, G < H; L, H < I; L < M; H < N; H < J; I, J < P; P < Q.$

- 10 a A TV repairman finds that the time spent on his job has an exponential distribution with mean 30 minutes. If the repairs sets in the order in which they come in, and if the arrival of the sets is approximately Poisson with an average rate of 10-per 8 hour a day, what is repairman's expected idle time each day? How many jobs are ahead of the average set just brought-in?

OR

- b Assume that the goods trains are coming in a yard at the rate of 30 trains per day and suppose that the inter-arrival times follow an exponential distribution. The service time for each train is assumed to be exponential with an average of 36 minutes. If the yard can admit 9 trains at a time (there being 10 lines, one of which is reserved for shunting purposes), calculate the probability than the yard is empty and find the average queue length.

SECTION -C (30 Marks)

Answer ALL questions

ALL questions carry EQUAL Marks (5 x 6 = 30)

- 11 a Find the rank $A = \begin{bmatrix} 3 & 1 & -5 & -1 \\ 1 & -2 & 1 & -5 \\ 1 & 5 & -7 & 2 \end{bmatrix}$ by using row and column operation.

OR

- b Show that the following matrix A can be written as a sum of a symmetric and a skew-symmetric matrix.

$$A = \begin{pmatrix} -2 & 1 & 4 \\ 8 & -1 & 3 \\ 3 & -5 & 0 \end{pmatrix}$$

- 12 a How can you construct Newton's polynomial for the following data, and how can you use it to find the value of y for a specific $x=5$?

x	4	6	8	10
y	1	3	8	16

OR

- b Construct Newton's polynomial for the following data. Use it to find the value of y for $x = 9$.

x	4	6	8	10
y	1	3	8	16

- 13 a Dividing the range into 10 equal parts, find the approximate value of $\int_0^\pi \sin x \, dx$ by
(i) Trapezoidal rule (ii) Simpson's rule.

OR

- b Dividing the range into 10 equal parts, find the approximate value of $\int_0^\pi \cos x \, dx$ by
(i) Trapezoidal rule (ii) Simpson's rule.

Cont...

- 14 a A small project is composed of seven activities whose time estimates are listed in the table as follows:

Activity		Estimated duration (in weeks)		
<i>i</i>	<i>j</i>	Optimistic	Most likely	Pessimistic
1	2	1	1	7
1	3	1	4	7
1	4	2	2	8
2	5	1	1	1
3	5	2	5	14
4	6	2	5	8
5	6	3	6	15

- (i) Draw the project network. (ii) Find the float values (iii) Find the expected duration, variance and standard deviation of project? (iv) If the project due date is 19 weeks, what is the probability of meeting the due date?

Z	0.5	0.67	1	1.33	2
P	0.3805	0.2514	0.1587	0.0918	0.0228

OR

- b A project consists of eight activities with the following relevant information:

Activity	Immediate predecessor	Estimated duration (in weeks)		
		Optimistic	Most likely	Pessimistic
A	-	1	1	7
B	-	1	4	7
C	-	2	2	8
D	A	1	1	1
E	B	2	5	14
F	C	2	5	8
G	D, E	3	6	15
H	F, G	1	2	3

- (i) Draw the project network.(ii) Find the float values. (iii) Find the expected duration, standard deviation and variance of the project? (iv)What duration will have 95% confidence for project completion? (For standard normal $Z=1.645$, area under the standard normal curve from 0 to Z is 0.45)

- 15 a The rate of arrival of customers at a public telephone booth follows Poisson distribution, with an average time of 10 minutes between one customer and the next. The duration of a phone call is assumed to follow exponential distribution, with mean time of 3 minutes.
- (i) What is the probability that a person arriving at the booth will have to wait?
- (ii) What is the average length of the non-empty queues that from from time to time?
- (iii) The Mahanagar Telephone Nigam Ltd. will install a second booth, when it is convinced that the customers would expect waiting for at least 3 minutes for their turn to make a call. By how much time should the flow of customers increase in order to justify a second booth?
- (iv) Estimate the fraction of a day that the phone will be in use.
- (v) What is the probability that it will take him more than 10 minutes altogether to wait for phone and complete his call?

OR

- b. On an average 96 minutes per 24-hour day require the service of an emergency clinic. Also, on an average, a patient requires 10 minutes of active attention. Assume that the facility can handle only one emergency at a time. Suppose that it costs the clinic Rs. 100 per patient treated to obtain an average servicing time of 10 minutes, and that each minute of decrease in this average time would cost Rs. 10 per patient treated. How much would have to be budgeted by the clinic to decrease the average size of the queue from $1\frac{1}{3}$ patients to $\frac{1}{2}$ a patient.