

**Series SSJ/1**

**Set No. 4**

अनुक्रमांक  
Roll No.

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प्रश्न-पत्र कोड  
**Question Paper Code 465/1/4**

छात्र प्रश्न-पत्र कोड को OMR शीट में आबंटित जगह में लिखें।

Candidates must write the Question Paper Code in the space allotted in the OMR Sheet.

**नोट / NOTE :**

- (i) कृपया जाँच कर लें कि इस प्रश्न-पत्र में मुद्रित पृष्ठ 15 हैं।  
Please check that this question paper contains 15 printed pages.
- (ii) प्रश्न-पत्र में ऊपरी दाहिने हाथ की ओर दिए गए प्रश्न-पत्र कोड को छात्र OMR शीट में उपयुक्त स्थान पर लिखें।  
Question Paper Code given on the top right hand side of the question paper should be written in the appropriate place in the OMR Sheet by the candidate.
- (iii) कृपया जाँच कर लें कि इस प्रश्न-पत्र में 50 बहुविकल्पीय प्रश्न (MCQs) हैं।  
Please check that this question paper contains 50 Multiple Choice Questions (MCQs).
- (iv) परीक्षा शुरू होने के वास्तविक समय से पहले इस प्रश्न-पत्र को पढ़ने के लिए 20 मिनट का अतिरिक्त समय आबंटित किया गया है।  
20 minute additional time has been allotted to read this question paper prior to actual time of commencement of the examination.

**व्यवहारिक गणित**

**APPLIED MATHEMATICS**

**Term-I**

निर्धारित समय : 90 मिनट  
Time allowed : 90 minutes

अधिकतम अंक : 40  
Maximum Marks : 40

**General Instructions :**

- (i) This question paper contains **50** questions out of which **40** questions are to be attempted as per instructions. All questions carry equal marks.
- (ii) The question paper consists **three** Sections – Section A, B and C.
- (iii) Section A contains of **20** questions. Attempt any **16** questions from Q.No. **1** to **20**.
- (iv) Section B also consists of **20** questions. Attempt any **16** questions from Q.No. **21** to **40**.
- (v) Section C consists of a Case Studies containing **5** questions (Q.No. **46** – **50**). Attempt any **8** from Q.No. **41** to **50**.
- (vi) There is only **one** correct option for every multiple choice question (MCQ). Marks will **not** be awarded for answering more than one option.
- (vii) There is **no** negative marking.

**SECTION A**

In this section, attempt any **16** questions out of questions no. **1** – **20**. Each question is of **1** mark.

$16 \times 1 = 16$

1. If  $100 = x \pmod{7}$ , then the least positive value of  $x$  is :  
(a) 2                      (b) 3                      (c) 6                      (d) 4
2. If  $\tau(n)$  denotes the number of divisors of  $n$ , then the value of  $\tau(15)$  is :  
(a) 3                      (b) 4                      (c) 5                      (d) 7
3. If a man rows 32 km downstream and 14 km upstream in 6 hours each, then the speed of the stream is :  
(a) 2 km/h              (b) 1.5 km/h              (c) 2.5 km/h              (d) 2.25 km/h
4. In a 2 km race, P can give Q a start of 200 m and R a start of 560 m. Then, in the same race, Q can give R a start of :  
(a) 360 m              (b) 380 m              (c) 400 m              (d) 430 m
5. Pipe A and B can fill a tank in 5 hours and 6 hours respectively. Pipe C can empty it in 12 hours. If all the three pipes are opened together, then the time taken to fill the tank is :  
(a) 2 hours              (b)  $2\frac{3}{4}$  hours              (c) 3 hours              (d)  $3\frac{9}{17}$  hours
6. The solution of  $\frac{x-3}{x+5} > 0$ ,  $x \neq -5$ ,  $x \in \mathbf{R}$  is :  
(a)  $x > 3$                       (b)  $x < -5$   
(c)  $x < -5$  or  $x > 3$               (d) no solution

7. If matrix A is given by  $A = [a_{ij}]_{2 \times 2}$ , where  $a_{ij} = i + j$ , then A is equal to :
- (a)  $\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$       (b)  $\begin{bmatrix} 2 & 3 \\ 3 & 4 \end{bmatrix}$       (c)  $\begin{bmatrix} 1 & 1 \\ 2 & 2 \end{bmatrix}$       (d)  $\begin{bmatrix} 1 & 2 \\ 1 & 2 \end{bmatrix}$
8. If A is a square matrix such that  $A^2 = A$ , then  $(I + A)^2 - 3A$  is equal to :
- (a) I      (b) 2A      (c) 3I      (d) A
9. If A is a square matrix of order  $3 \times 3$  such that  $|A| = 4$ , then  $|3A|$  is equal to :
- (a) 27      (b) 81      (c) 108      (d) 256
10. The function  $f(x) = a^x$  is increasing on  $\mathbf{R}$ , if :
- (a)  $a > 0$       (b)  $a < 0$       (c)  $0 < a < 1$       (d)  $a > 1$
11. If  $C(x)$  and  $R(x)$  are respectively Cost function and Revenue function, then the Profit function  $P(x)$  is given by :
- (a)  $P(x) = R(x)$       (b)  $P(x) = C(x) + R(x)$   
(c)  $P(x) = R(x) - C(x)$       (d)  $P(x) = R(x) \cdot C(x)$
12. If 'm' is the mean of Poisson distribution, then its standard deviation is given by :
- (a)  $\sqrt{m}$       (b)  $m^2$       (c) m      (d)  $\frac{m}{2}$
13. The normal distribution curve is symmetrical about :
- (a)  $X = \mu$       (b)  $X = \sigma$       (c)  $X = \frac{\mu}{\sigma}$       (d)  $X = \frac{\sigma}{\mu}$
14. Let X be a discrete random variable whose probability distribution is given below :
- |                |   |    |    |    |       |        |        |    |
|----------------|---|----|----|----|-------|--------|--------|----|
| $X = x_i :$    | 0 | 1  | 2  | 3  | 4     | 5      | 6      | 7  |
| $P(X = x_i) :$ | 0 | 2K | 2K | 3K | $K^2$ | $2K^2$ | $7K^2$ | 2K |
- The value of K is :
- (a)  $\frac{1}{10}$       (b) -1      (c)  $-\frac{1}{10}$       (d)  $\frac{1}{5}$
15. In a box of 100 bulbs, 10 are defective. What is the probability that out of a sample of 5 bulbs, none is defective ?
- (a)  $\left(\frac{9}{10}\right)^5$       (b)  $\frac{9}{10}$       (c)  $10^{-5}$       (d)  $\left(\frac{1}{2}\right)^2$

16. If  $X$  is a normal variate with mean  $\mu$  and standard deviation  $\sigma > 0$ , then the new random variate  $Z = \frac{X - \mu}{\sigma}$  is a variate with :
- (a) Mean = 1, Standard deviation = 0.  
 (b) Mean = 1, Standard deviation = 1.  
 (c) Mean = 2, Standard deviation = 1.  
 (d) Mean = 0, Standard deviation = 1.
17. The mean  $E(x)$  of the numbers obtained on throwing a die having written 1 on three faces, 2 on two faces and 5 on one face is :
- (a) 1                      (b) 2                      (c) 5                      (d)  $\frac{8}{3}$
18. Which of the following index number satisfies the "time reversal test" ?
- (a) Fisher's ideal index number  
 (b) Laspeyres' index number  
 (c) Paasche's index number  
 (d) None of these
19. To calculate Paasche's price index, the weights are taken as :
- (a)  $p_0$                       (b)  $p_1$                       (c)  $q_0$                       (d)  $q_1$
20. Given that  $\sum p_1 q_1 = 860$ ,  $\sum p_0 q_0 = 520$ ,  $\sum p_1 q_0 = 630$  and  $\sum p_0 q_1 = 730$ , where subscript 0 and 1 are used for base year and current year respectively. The Laspeyres' index number is :
- (a) 117.81                      (b) 119.5                      (c) 121.15                      (d) 123.35

### SECTION B

*In this section, attempt any 16 questions out of questions no. 21 – 40. Each question is of 1 mark.* *16×1=16*

21. The remainder when  $5^{61}$  is divided by 7 is :
- (a) 1                      (b) 2                      (c) 4                      (d) 5
22. 20 litres of a mixture contains milk and water in the ratio 3 : 1. The amount of milk, in litres, to be added to the mixture so as to have milk and water in the ratio 4 : 1, is :
- (a) 7                      (b) 4                      (c) 5                      (d) 6

23. Pipe A can fill a tank 6 times faster than a pipe B. If B can fill a tank in 21 minutes, then the time taken by both the pipes together to fill the tank is :
- (a) 3 minutes      (b)  $4\frac{1}{2}$  minutes      (c) 7 minutes      (d) 9 minutes
24. The ratio of investments of two partners A and B is 11 : 12 and the ratio of their profits is 2 : 3. If A invested the money for 8 months, then for how much time did B invest his money ?
- (a) 11 months      (b) 10 months      (c) 9 months      (d) 5 months
25. The solution set of the inequation  $|x + 2| \leq 5$  is :
- (a) (-7, 5)      (b) [-7, 3]      (c) [-5, 5]      (d) (-7, 3)
26. If  $A = \begin{bmatrix} 1 & 2 & x \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$  and  $B = \begin{bmatrix} 1 & -2 & y \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$  and  $AB = I_3$ , then  $(x + y)$  equals :
- (a) 0      (b) -1      (c) 2      (d) -2
27. If  $A = \begin{bmatrix} 1 & 0 & 1 \\ 0 & 0 & 1 \\ a & b & 2 \end{bmatrix}$ , then  $aI + bA + 2A^2$  equals :
- (a) A      (b) -A  
(c) abA      (d) None of these
28. If  $A^2 - A + I = O$ , then the inverse of matrix A is :
- (a)  $A^2$       (b)  $A + I$       (c)  $I - A$       (d)  $A - I$
29. If the points (1, 3), (x, 5) and (2, 7) are collinear, then the value of x is :
- (a) 2      (b)  $\frac{3}{2}$       (c) 1      (d)  $\frac{3}{4}$
30. If  $y = Ae^{5x} + Be^{-5x}$ , then  $\frac{d^2y}{dx^2}$  is :
- (a) 25 y      (b) 5 y      (c) -25 y      (d) 15 y
31. The point on the curve  $x^2 = 2y$  which is nearest to the point (0, 5) is :
- (a)  $(2\sqrt{2}, 4)$       (b)  $(2\sqrt{2}, 0)$       (c) (0, 0)      (d) (2, 2)

32. If the total revenue (₹) received from the sale of  $x$  units of a product is given by :

$$R(x) = 3x^2 + 36x + 5,$$

then the marginal revenue, when  $x = 15$ , is

- (a) 116                      (b) 96                      (c) 90                      (d) 126
33. The equation of normal at the point  $(1, 1)$  to the curve  $2y + x^2 = 3$  is :
- (a)  $x + y = 0$               (b)  $x - y = 0$               (c)  $x + y = 1$               (d)  $x - y = 1$
34. Let  $X$  represent the difference between the number of heads and the number of tails obtained when a coin is tossed 6 times. Then the possible values of  $X$  are :
- (a) 0, 1, 3, 5              (b) 0, 2, 4, 6              (c) 0, 2, 5, 6              (d) 1, 3, 4, 5
35. If the mean of a binomial distribution is 81, then the standard deviation lies in the interval :
- (a)  $[0, 9)$                       (b)  $(0, 9]$                       (c)  $[0, 3]$                       (d)  $(0, 3]$
36. If a random variable  $X$  has the Poisson distribution with mean 2. Then,  $P(X > 1.5)$  is :
- (a)  $2e^{-2}$                       (b)  $3e^{-2}$                       (c)  $1 - 2e^{-2}$                       (d)  $1 - 3e^{-2}$
37. There are 50 telephone lines in an exchange. The probability that any one of them will be busy is 0.1. The probability that all the lines are busy is :
- (a)  $\frac{5^0 e^{-5}}{0!}$                               (b)  $1 - \frac{5^0 e^{-5}}{0!}$   
(c)  $\frac{5^{50} e^{-5}}{50!}$                               (d)  $1 - \frac{5^{50} e^{-5}}{50!}$
38. Price relative of sugar is 135 in the year 2020 compared to the year 2019. If the sugar cost ₹ 30 per kg in 2019, then its cost in 2020 is :
- (a) ₹ 15 per kg                      (b) ₹ 40.50 per kg  
(c) ₹ 45.20 per kg                      (d) ₹ 65 per kg
39. If  $\sum W \log p = 199.50$  and  $\sum W = 100$ , then the weighted index number is :
- (a) 120.86                      (b) 88.86                      (c) 98.86                      (d) 78.86
40. The condition for the time reversal test to hold good with usual notation is :
- (a)  $P_{bc} \times P_{cb} = 1$                       (b)  $P_{bc} \times P_{cb} = 0$   
(c)  $P_{bc} + P_{cb} = 1$                       (d)  $\frac{P_{cb}}{P_{bc}} = 1$

### SECTION C

In this section, attempt any 8 questions out of questions no. 41 – 50. Each question is of 1 mark.  
(Questions no. 46 – 50 are based on a Case-Study)

8×1=8

41. The least value of 'a' such that the function  $f(x) = x^2 + ax + 1$  is increasing on (1, 2) is :  
(a) 0 (b) -1 (c) -2 (d) -4
42. The demand function of a commodity is given by :  
 $x = 82 - p$   
and its total cost function is given by :  
 $TC = 100 + 60x$   
For maximum profit, the value of x is :  
(a) 15 (b) 14 (c) 13 (d) 11
43. The mean of the probability distribution of the number of doublets in 4 throws of a pair of dice, is :  
(a) 1 (b)  $\frac{2}{3}$  (c)  $1\frac{3}{5}$  (d)  $2\frac{2}{3}$
44. It is known from the past experience that the number of telephone calls made daily in a certain community between 3 p.m. and 4 p.m. has a mean of 352 and a standard deviation of 31. What percentage of the time will there be more than 400 telephone calls made in the community between 3 p.m. to 4 p.m. ? [Use :  $P(0 \leq Z \leq 1.5) = 0.4394$ ]  
(a) 11.4% (b) 9.6% (c) 7.08% (d) 6.06%
45. The index number of the following data :
- |                  |     |     |     |     |
|------------------|-----|-----|-----|-----|
| Relative Index : | 181 | 116 | 110 | 157 |
| Weight :         | 4   | 12  | 3   | 7   |
- is :  
(a) 118.74 (b) 136.34 (c) 142.04 (d) 146.14

#### Case-Study :

Two products P and Q are produced such that 0.4 tonne of P and 0.7 tonne of Q are required to produce one tonne of P. Similarly, 0.1 tonne of P and 0.6 tonne of Q are required to produce one tonne of Q. The economy needs 68 tonnes of P and 102 tonnes of Q.

Based on the above information, answer the following questions :

46. The technology matrix A is :  
(a)  $\begin{bmatrix} 0.4 & 0.1 \\ 0.7 & 0.6 \end{bmatrix}$  (b)  $\begin{bmatrix} 0.4 & 0.6 \\ 0.7 & 0.1 \end{bmatrix}$  (c)  $\begin{bmatrix} 0.6 & 0.1 \\ 0.7 & 0.4 \end{bmatrix}$  (d)  $\begin{bmatrix} 0.4 & 0.7 \\ 0.1 & 0.6 \end{bmatrix}$

47. The demand matrix is :

(a)  $\begin{bmatrix} 68 \\ 102 \end{bmatrix}$

(b)  $\begin{bmatrix} 68 \\ 34 \end{bmatrix}$

(c)  $\begin{bmatrix} 102 \\ 68 \end{bmatrix}$

(d)  $\begin{bmatrix} 34 \\ 68 \end{bmatrix}$

48.  $(I - A)$  is :

(a)  $\begin{bmatrix} 0.6 & -0.6 \\ -0.7 & 0.9 \end{bmatrix}$

(b)  $\begin{bmatrix} 0.4 & -0.1 \\ -0.7 & 0.6 \end{bmatrix}$

(c)  $\begin{bmatrix} 0.6 & -0.7 \\ -0.1 & 0.4 \end{bmatrix}$

(d)  $\begin{bmatrix} 0.6 & -0.1 \\ -0.7 & 0.4 \end{bmatrix}$

49.  $(I - A)^{-1}$  is :

(a)  $\frac{1}{0.17} \begin{bmatrix} 0.6 & 0.1 \\ 0.7 & 0.4 \end{bmatrix}$

(b)  $\frac{1}{0.17} \begin{bmatrix} 0.4 & 0.1 \\ 0.7 & 0.6 \end{bmatrix}$

(c)  $\frac{1}{0.17} \begin{bmatrix} 0.4 & 0.7 \\ 0.1 & 0.6 \end{bmatrix}$

(d)  $\frac{1}{0.17} \begin{bmatrix} 0.9 & 0.6 \\ 0.7 & 0.6 \end{bmatrix}$

50. The gross outputs of P and Q are :

(a) P = 260; Q = 360

(b) P = 220; Q = 640

(c) P = 520; Q = 300

(d) P = 420; Q = 433