SUBJECT CODE	SUBJECT	PAPER
A-15-02	**MATHEMATICAL SCIENCES**	**II**

HALL TICKET NUMBER

QUESTION BOOKLET NUMBER

OMR SHEET NUMBER

DURATION	MAXIMUM MARKS	NUMBER OF PAGES	NUMBER OF QUESTIONS
1 HOUR 15 MINUTES	100	16	50

This is to certify that, the entries made in the above portion are correctly written and verified.

Candidate's Signature **Name and Signature of Invigilator**

Instructions for the Candidates

1. Write your Hall Ticket Number in the space provided on the top of this page.
2. This paper consists of fifty multiple-choice type of questions.
3. At the commencement of examination, the question booklet will be given to you. In the first 5 minutes, you are requested **<u>to open the booklet and compulsorily examine it as below</u>** :
   (i) To have access to the Question Booklet, tear off the paper seal on the edge of this cover page. Do not accept a booklet without sticker-seal and do not accept an open booklet.
   (ii) **Tally the number of pages and number of questions in the booklet with the information printed on the cover page. Faulty booklets due to pages/questions missing or duplicate or not in serial order or any other discrepancy should be got replaced immediately by a correct booklet from the invigilator within the period of 5 minutes. Afterwards, neither the Question Booklet will be replaced nor any extra time will be given.**
   (iii) After this verification is over, the Test Booklet Number should be entered in the OMR Sheet and the OMR Sheet Number should be entered on this Test Booklet.
4. Each item has four alternative responses marked (A), (B), (C) and (D). You have to darken the circle as indicated below on the correct response against each item.
   Example : (A) (B) ● (D)
   where (C) is the correct response.
5. Your responses to the items are to be indicated in the **OMR Answer Sheet given to you**. If you mark at any place other than in the circle in the Answer Sheet, it will not be evaluated.
6. Read instructions given inside carefully.
7. Rough Work is to be done in the end of this booklet.
8. If you write your name or put any mark on any part of the OMR Answer Sheet, except for the space allotted for the relevant entries, which may disclose your identity, you will render yourself liable to disqualification.
9. **The candidate must handover the OMR Answer Sheet to the invigilators at the end of the examination compulsorily** and must not carry it with you outside the Examination Hall. The candidate is allowed to take away the carbon copy of OMR Sheet and used Question paper booklet at the end of the examination.
10. **Use only Blue/Black Ball point pen.**
11. **Use of any calculator or log table etc., is prohibited.**
12. **There is no negative marks for incorrect answers.**

అభ్యర్థులకు సూచనలు

1. ఈ పుట పై భాగంలో ఇవ్వబడిన స్థలంలో మీ హాల్ టికెట్ నంబరు రాయండి.
2. ఈ ప్రశ్న పత్రము యాభై బహుళైచ్ఛిక ప్రశ్నలను కలిగి ఉంది.
3. పరీక్ష ప్రారంభమున ఈ ప్రశ్నాపత్రము మీకు ఇవ్వబడుతుంది. మొదటి ఐదు నిమిషములలో **<u>ఈ ప్రశ్నాపత్రమును తెరిచి కింద తెలిపిన అంశాలను తప్పనిసరిగా సరిచూసుకోండి.</u>**
   (i) ఈ ప్రశ్న పత్రమును చూడడానికి కవర్‌పేజి అంచున ఉన్న కాగితపు సీలును చించండి. స్టిక్కర్ సీలులేని మరియు ఇదివరకే తెరిచి ఉన్న ప్రశ్నాపత్రమును మీరు అంగీకరించవద్దు.
   (ii) **కవరు పేజి పై ముద్రించిన సమాచారం ప్రకారం ఈ ప్రశ్నపత్రములోని పేజీల సంఖ్యను మరియు ప్రశ్నల సంఖ్యను సరిచూసుకోండి. పేజీల సంఖ్యకు సంబంధించి గానీ లేదా సూచించిన సంఖ్యలో ప్రశ్నలు లేకపోవుట లేదా నిజప్రతి కాకపోవుట లేదా ప్రశ్నలు క్రమపద్ధతిలో లేకపోవుట లేదా ఏవైనా తేడాలుండుట వంటి దోషపూరితమైన ప్రశ్న పత్రాన్ని వెంటనే మొదటి ఐదు నిమిషాల్లో పరీక్షా పర్యవేక్షకునికి తిరిగి ఇచ్చివేసి దానికి బదులుగా సరిగ్గా ఉన్న ప్రశ్నపత్రాన్ని తీసుకోండి. తదనంతరం ప్రశ్నపత్రము మార్చబడదు అదనపు సమయం ఇవ్వబడదు.**
   (iii) పై విధంగా సరిచూసుకొన్న తర్వాత ప్రశ్నాపత్రం సంఖ్యను OMR పత్రము పై అదేవిధంగా OMR పత్రము సంఖ్యను ఈ ప్రశ్నాపత్రము పై నిర్దిష్టస్థలంలో రాయవలెను.
4. ప్రతి ప్రశ్నకు నాలుగు ప్రత్యామ్నాయ ప్రతిస్పందనలు (A), (B), (C) మరియు (D) లుగా ఇవ్వబడ్డాయి. ప్రతిప్రశ్నకు సరైన ప్రతిస్పందనను ఎన్నుకొని కింద తెలిపిన విధంగా OMR పత్రములో ప్రతి ప్రశ్నా సంఖ్యకు ఇవ్వబడిన నాలుగు వృత్తాల్లో సరైన ప్రతిస్పందనను సూచించే వృత్తాన్ని బాల్ పాయింట్ పెన్‌తో కింద తెలిపిన విధంగా పూరించాలి.
   ఉదాహరణ : (A) (B) ● (D)
   (C) సరైన ప్రతిస్పందన అయితే
5. ప్రశ్నలకు ప్రతిస్పందనలను ఈ ప్రశ్నపత్రముతో ఇవ్వబడిన OMR పత్రము పైన ఇవ్వబడిన వృత్తాల్లోనే పూరించి గుర్తించాలి. అలాకాక సమాధాన పత్రంపై వేరొక చోట గుర్తిస్తే మీ ప్రతిస్పందన మూల్యాంకనం చేయబడదు.
6. ప్రశ్న పత్రము లోపల ఇచ్చిన సూచనలను జాగ్రత్తగా చదవండి.
7. చిత్తుపనిని ప్రశ్నపత్రము చివర ఇచ్చిన ఖాళీస్థలములో చేయాలి.
8. OMR పత్రము పై నిర్ణీత స్థలంలో సూచించవలసిన వివరాలు తప్పించి ఇతర స్థలంలో మీ గుర్తింపును తెలిపే విధంగా మీ పేరు రాయడం గానీ లేదా ఇతర చిహ్నాలను పెట్టడం గానీ చేసినట్లయితే మీ అనర్హతకు మీరే బాధ్యులవుతారు.
9. **పరీక్ష పూర్తయిన తర్వాత మీ OMR పత్రాన్ని తప్పనిసరిగా పరీక్ష పర్యవేక్షకుడికి ఇవ్వాలి.** వాటిని పరీక్ష గది బయటకు తీసుకువెళ్ళకూడదు. పరీక్ష పూర్తయిన తరువాత అభ్యర్థులు ప్రశ్న పత్రాన్ని, OMR పత్రం యొక్క కార్బన్ కాపీని తీసుకువెళ్ళవచ్చు.
10. **నీలి/నల్ల రంగు బాల్ పాయింట్ పెన్ మాత్రమే ఉపయోగించాలి.**
11. **లాగరిథమ్ టేబుల్స్, క్యాలిక్యులేటర్‌లు, ఎలక్ట్రానిక్ పరికరాలు మొదలగునవి పరీక్షగదిలో ఉపయోగించడం నిషేధం.**
12. **తప్పు సమాధానాలకు మార్కుల తగ్గింపు లేదు.**

MATHEMATICAL SCIENCE
Paper – II

1. Let $S = \left\{1 - \frac{(-1)^n}{n};\ n = 1, 2, 3, ...\right\}$; and α and β be the ifimum and supremum of S respectively. Then the ordered pair $(\alpha, \beta) =$

(A) $(0, 1)$ (B) $(0, 2)$

(C) $\left(\frac{1}{2}, 2\right)$ (D) $(1, 2)$

2. If $\{x_n\}_{n=1}^{\infty}$ is a sequence of real numbers such that $x_1 > 0$ and $x_{n+1} = \frac{1}{2}\left(x_n + \frac{a}{x_n}\right)$ for $n \geq 1$, where $a > 0$, then

(A) $\{x_n\}$ is monotonic increasing and $\lim_{n\to\infty} x_n = +\infty$

(B) $\{x_n\}$ is monotonic decreasing and $\lim_{n\to\infty} x_n = -\infty$

(C) $\{x_n\}$ is monotonic increasing and $\lim_{n\to\infty} x_n = \sqrt{a}$

(D) $\{x_n\}$ is monotonic decreasing and $\lim_{n\to\infty} x_n = \sqrt{a}$

3. If $f: \mathbb{R} \to \mathbb{R}$ is defined by $f(x) = \begin{cases} 1 \text{ for rational } x \\ 0 \text{ for irrational } x, \end{cases}$ then set of points of continuity for f is

(A) $\mathbb{Q}$, the set of all rational numbers

(B) I, the set of all irrational numbers

(C) $\mathbb{R}$, the set of all real numbers

(D) ϕ, the empty set

4. Suppose $f: \mathbb{R} \to \mathbb{R}$ is a monotonic decreasing continuous function with $f(0) = a$. Then the image, $f((0, \infty))$, of the interval $(0, \infty)$, under f is a sub set of

(A) $(-\infty, a)$

(B) $(-\infty, -a)$

(C) $(-a, +\infty)$

(D) $(a, +\infty)$

5. If $f:[a, b] \rightarrow \mathbb{R}$ is such that for some $\delta > 0$, $|f(x) - f(y)| < |x - y|^{1+\delta}$ for all $x, y \in [a, b]$ then

(A) $f(x) = e^x$ for all $x \in [a, b]$

(B) $f(x) = \cos x$ for all $x \in [a, b]$

(C) $f(x) = k$, a constant, for all $x \in [a, b]$

(D) $f(x) = \log x$ for all $x \in [a, b]$

6. In the vector space $\mathbb{R}^3$ over $\mathbb{R}$, if $(1, -2, 5) = \lambda_1(1, 1, 1) + \lambda_2(1, 2, 3) + \lambda_3(2, -1, 1)$ then $(\lambda_1, \lambda_2, \lambda_3) =$

(A) $(-6, 2, 3)$

(B) $(-6, 3, 2)$

(C) $(-6, -2, 3)$

(D) $(-6, 2, -3)$

7. If $B = \{\alpha_1, \alpha_2, ..., \alpha_n\}$ is a basis for a vector space V and $S = \{\beta_1, \beta_2, ..., \beta_m\}$ is a linearly independent set in V then

(A) $B \subseteq S$ (B) $S \subseteq B$

(C) $m \leq n$ (D) $n < m$

8. If $T: \mathbb{R}^3 \rightarrow \mathbb{R}^3$ is defined by $T(x, y, z) = (x + 2y, y - z, x + 2z)$ for $(x, y, z) \in \mathbb{R}^3$ then the rank of T is

(A) 3 (B) 2

(C) 1 (D) 0

9. If $T: \mathbb{R}^3 \rightarrow \mathbb{R}^3$ is given by $T(x, y, z) = (x + y + z, y + z, z)$ for $(x, y, z) \in \mathbb{R}^3$ then $T^{-1}(x, y, z) =$

(A) $(x - y, y - z, z - x)$

(B) $(x, y - z, z - x)$

(C) $(x - y, y - z, z)$

(D) $(x + y, y + z, z)$

10. Consider the vector space $p^2(□)$ of all polynomials of degree ≤ 2 over □ . If (a, b, c) represents the co-ordinates of the polynomial $3t^2 + 4t + 5$ with respect to the basis $\{1, 1 + t, 1 + t^2\}$ then $(a, b, c) =$

(A) $(-2, 4, 3)$

(B) $(2, 4, 3)$

(C) $(-3, 4, 3)$

(D) $(4, 4, 3)$

11. Let C be the circle $|z - 3| = 1$ positively oriented. Then $\int_C z \operatorname{cosec} z \, dz =$

(A) 0

(B) πi

(C) $-\pi i$

(D) $2\pi i$

12. Let C be the circle $|z-1| = \frac{1}{2}$ positively oriented. Then $\int_C \frac{1}{z(z-1)} dz =$

(A) $-2\pi i$

(B) $2\pi i$

(C) πi

(D) $-\pi i$

13. Suppose $f(z) = u + iv$ is an entire function with $u^2 \leq v^2 \ \forall z$. If $f(0) = 1$ then $f(2014) =$

(A) 0 (B) -1

(C) 1 (D) 2014

14. The number of zeroes of the polynomial $z^8 + 10z^3 + 14$ that lie in the domain $1 < |z| < 2$ is

(A) 5 (B) 6

(C) 7 (D) 8

15. If R is a Boolean ring, then the characteristic of R is

(A) 1 (B) 2

(C) 0 (D) ∞

16. The number of normal sub groups of order 13 in a group of order 143 is

(A) 1 (B) 2

(C) 3 (D) 4

17. The Galois group of the polynomial $x^{10}-1$ over □ is isomorphic to the group

(A) $(\{1, 3, 7, 9\}, \mathrm{X} \bmod 10)$

(B) $(\{0, 1, 2, 3, 4, 5, 6, 7, 8, 9\}, + \bmod 10)$

(C) $(\{1, 2, 3, 4\}, \mathrm{X} \bmod 5)$

(D) (10□, +)

18. A field among the following quotient rings is

(A) $\frac{\square[x]}{\langle 1+x+x^2 \rangle}$

(B) $\frac{\square[x]}{\langle x^4+4 \rangle}$

(C) $\frac{\square[x]}{\langle x^3-3 \rangle}$

(D) $\frac{\square[x]}{\langle x^2-1 \rangle}$

19. Let $X = \{a, b, c, d, e\}$. Consider the topology $T = \{\phi, X, \{a\}, \{a, b\}, \{a, b, e\}, \{(a, c, d\}, \{a, b, c, d\}\}$ on X. If $A = \{a, c, d, e\}$ then the interior of A is

(A) $\{a, b, e\}$

(B) $\{a, c, d\}$

(C) $\{a\}$

(D) $\{a, b\}$

20. Let S be an infinite subset of a discrete topological space X. Then S is

(A) Compact

(B) Not Compact

(C) Not a T_1 – space

(D) Not a T_2 – space

21. The general solution of the differential equation $\left(x^2 - y^2\right)dx + 2xy\,dy = 0$ is

(A) $x^2 - y^2 = cx$

(B) $x^2 + y^2 = cx$

(C) $x^2 - y^2 = cy$

(D) $x^2 + y^2 = cy$

22. If the solution of the differential equation

$\frac{dy}{dx} + y\cot x = \cos^3 x\left(1 + y^2 \sin^2 x\right)$

is $y\,f(x) = \tan\left(\frac{\pi}{4} - \frac{1}{4}\cos^4 x\right)$ when $y\left(\frac{\pi}{2}\right) = 1$, then $f\left(\frac{\pi}{2}\right) =$

(A) $\tan 1$ (B) $\frac{\pi}{2}$

(C) 1 (D) $\frac{\pi}{4}$

23. If $y(1) = \frac{1}{2}$ and if the solution of $y - x\frac{dy}{dx} = y^2 + \frac{dy}{dx}$ is $(1+x)(1-y) = ky$, then $k =$

(A) 1

(B) 2

(C) 4

(D) 3

24. If the solution of the partial differential equation $\frac{\partial^3 z}{\partial x^3} - 3\frac{\partial^3 z}{\partial x^2 \partial y} + 4\frac{\partial^3 z}{\partial y^2} = e^{x+2y}$ is

$z = f_1(y + \alpha x) + f_2(y + \beta x) + x f_3(y + \gamma x)$

$+ \delta\, e^{x+2y}$, then $\frac{\alpha+\beta+\gamma}{\delta} =$

(A) 9 (B) 3

(C) 81 (D) 27

25. The solution of the Volterra integral equation,

$y(x)=\frac{1}{1+x^2}-\int_0^x \frac{1}{1+x^2}\,y(t)\,dt$ is

(A) $\frac{1}{(1+x^2)^{3/2}}$

(B) $\frac{1}{(1-x^2)^{3/2}}$

(C) $\frac{1}{(1+x^2)^2}$

(D) $\frac{1}{(1-x^2)^2}$

26. Using Newton-Raphson method, a root of the equation $x^3-2x-5=0$ is

(A) 2.5 (B) 2.7

(C) 2.1 (D) 2.3

27. When [1, 3] is divided in to 4 equal sub intervals, by Simpson's rule, $\int_1^3 \frac{1}{x}dx =$

(A) 1.5 (B) 1.1

(C) 1.7 (D) 1.4

28. The extremals of the functional

$$\int_0^{\pi/2}\left(\left(y^1\right)^2+2y\sin x\right)dx$$

under boundary conditions

$y(0)=0,\ y\left(\frac{\pi}{2}\right)=1$ is

(A) $y=\frac{4x}{\pi}+\cos x$

(B) $y=\frac{4x}{\pi}-\sin x$

(C) $y=\frac{2x}{\pi}-\cos x$

(D) $y=\frac{2x}{\pi}+\sin x$

29. If $y(0)=1,\ y'(0)=0,$ and $y''(x)=\psi(x)$ then the integral equation corresponding to $y''+2xy'+y=0$ is

(A) $\psi(x)+\int_0^x(3x-u)\psi(u)\,du+1=0$

(B) $\psi(x)+\int_0^x(3x-u)\psi(u)\,du-1=0$

(C) $\psi(x)+\int_0^x(2x-u)\psi(u)\,du+2=0$

(D) $\psi(x)+\int_0^x(2x-u)\psi(u)\,du-2=0$

30. The number of degrees of freedom of rigid body moving freely in space is

(A) 4 (B) 3

(C) 6 (D) 8

31. For any two events A and B which of the following is true ?

(A) $P(AB) \geq P(A) \geq P(A \cup B)$

(B) $P(AB) \leq P(A) \leq P(A \cup B)$

(C) $P(A) + P(B) \leq P(A \cup B)$

(D) $P(A) \cdot P(B) \geq P(A \cup B)$

32. Let A and B be two events such that $P(A) = 0.3$, $P(A \cup B) = 0.8$ and $P(B) = P$. Then for what values of P, A and B are independent.

(A) $\frac{1}{2}$ (B) $\frac{2}{7}$

(C) $\frac{5}{7}$ (D) $\frac{1}{5}$

33. The joint probability mass function (pmf) of (x, y) is given below:

x \ y	1	2	3
5	$\frac{3}{20}$	$\frac{1}{5}$	$\frac{6}{20}$
6	$\frac{2}{20}$	$\frac{1}{5}$	$\frac{1}{20}$

The marginal pmf of x is given by

(A)

x	1	2	3
P(x)	$\frac{5}{20}$	$\frac{2}{5}$	$\frac{7}{20}$

(B)

x	1	2	3
P(x)	$\frac{7}{20}$	$\frac{6}{20}$	$\frac{7}{20}$

(C)

x	5	6
P(x)	$\frac{13}{20}$	$\frac{7}{20}$

(D)

x	5	6
P(x)	$\frac{2}{5}$	$\frac{3}{5}$

34. The characteristic function of standard normal distribution is given by

(A) $\frac{\sin t}{t}$

(B) $e^{-|t|}$

(C) $\frac{1}{1+t^2}$

(D) $e^{-\frac{1}{2}t^2}$

35. Which of the following matrix is not a transition probability matrix ?

(A) $\begin{bmatrix} 1 & 0 & 0 \\ \frac{1}{2} & \frac{1}{3} & \frac{1}{6} \\ 0 & 0 & 1 \end{bmatrix}$

(B) $\begin{bmatrix} \frac{1}{2} & \frac{1}{4} & \frac{1}{4} \\ 0 & \frac{2}{3} & \frac{1}{3} \\ \frac{3}{4} & 0 & \frac{1}{4} \end{bmatrix}$

(C) $\begin{bmatrix} 0 & 2 & -1 \\ \frac{1}{2} & \frac{1}{2} & 0 \\ \frac{1}{3} & \frac{1}{3} & 0 \end{bmatrix}$

(D) $\begin{bmatrix} \frac{1}{2} & 0 & \frac{1}{2} \\ \frac{1}{3} & 0 & \frac{2}{3} \\ \frac{3}{4} & \frac{1}{4} & 0 \end{bmatrix}$

36. If X and Y are two i.i.d. random variables such that X+Y and X–Y are independently distributed, then the distribution of X is

(A) Exponential

(B) Normal

(C) Cauchy

(D) Laplace

37. State which of the following is correct ?

(A) Unbiased estimator is always the best estimator

(B) Unbiased estimator is also a consistent estimator

(C) Unbiased estimator is unique

(D) Unbiased estimator need not be consistent

38. Consider the following statements on the maximum likelihood estimator (MLE) of θ involved in the uniform $U(\theta, \theta+1)$ distribution:

P : MLE of θ is unique; Q : MLE of θ is always unbiased

(A) Both P and Q are true

(B) P is true but not Q

(C) Both P and Q are not true

(D) Q is true but not P

39. For a fixed confidence coefficient $(1-\alpha)$, the most preferred confidence interval for the parameter θ is the one with

(A) Shortest length

(B) Largest length

(C) Average length

(D) None of these

40. The nonparametric alternative to the two sample t – test is

(A) Sign test

(B) Mann-Whitney U test

(C) Wilcoxon signed rank test

(D) Runs test for randomness

41. The Gauss Markov theorem establishes that the OLS estimator of β, $\hat{\beta} = \left(X^1X\right)^{-1} X^1Y$ is

(A) BLUE

(B) Error free estimator

(C) uve only

(D) Not a BLUE

42. A quadratic form in p-variables $x_1, x_2, ..., x_p$ is a homogeneous function consisting of all possible second order terms namely

(A) $\sum_{ij}^{p} a_{ij}x_i x_j$

(B) $\sum_{ij}^{p} a_{ij}x_i$

(C) $\sum_{ij}^{p} a_{ij}x_j$

(D) $\sum_{ij}^{p} a_{ji}x_{ij}$

43. The standard procedure for maximising a function of several variables, subject to one or more constraints, is the method of

(A) Lagrange Multipliers

(B) First Principal Component

(C) Principal of Least Squares

(D) Data Reduction Method

44. In Cluster Analysis the dissimilarity measure equation $d_{AB} = \underset{\substack{i \in A \\ j \in B}}{\text{Min}}\left(d_{ij}\right)$ is known as

(A) Dendrogram

(B) Complete linkage clustering

(C) Single linkage clustering

(D) Both (B) and (C)

45. Let $r_{12.3}$ be the partial correlation coefficient between X_1 and X_2 after linear effect of X_3 has been eliminated, then the relationship between total correlation, partial correlation and multiple correlation can be expressed as

(A) $R^2_{1.23} = (1 - r_{12})(1 - r_{13.2})$

(B) $R^2_{1.23} = \left(1 - r^2_{12}\right)\left(1 - r^2_{13.2}\right)$

(C) $R^2_{1.23} = 1 - \left(1 - r^2_{12}\left(1 - r_{13.2}\right)\right)$

(D) $R^2_{1.23} = 1 - \left(1 - r^2_{12}\right)\left(1 - r^2_{13.2}\right)$

46. Let $f(x, y) = \begin{cases} 2, & 0 < x < y;\ 0 < y < 1 \\ 0, & \text{Otherwise} \end{cases}$

be the joint probability density function of x and y, then x and y

(A) are uncorrelated

(B) are correlated with coefficient of correlation equal to 1

(C) are correlated with coefficient of correlation equal to 0.5

(D) are correlated with coefficient of correlation equal to 0.2

47. The estimator of reliability function for exponential failure distribution with parameter 'λ' is given by

(A) $1-\exp(-\lambda t)$

(B) λ

(C) $\exp(-\lambda t)$

(D) $1/\lambda$

48. The structure function $\phi(x)$ of K out of n system is

(A) $\sum_{i=1}^{n} x_i \geq K$

(B) $\sum_{i=1}^{n} x_i \leq K$

(C) $\sum_{i=1}^{n} x_i = K$

(D) $\sum_{i=1}^{n} x_i \neq K$

49. Any solution to a general linear programming problem which also satisfies the non negative restrictions is called a

(A) Optimum solution

(B) Non basic solution

(C) Feasible solution

(D) Basic solution

50. Single item inventory models occur when an item is ordered only once to satisfy the

(A) Supply for the period

(B) Demand for the period

(C) EOQ problem with shortages

(D) Supply and Demand for the period

Space for Rough Work

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