For uploading on the website

Attender 20/01/17
Professor & Head, Department of Mathematics M.D. University, ROHTAK

(DO NOT OPEN THIS QUESTION BOOKLET BEFORE TIME OR UNTIL YOU ARE ASKED TO DO SO)

(MPH/PHD/URS–EE–2017)

Subject : MATHEMATICS

Sr. No. 10205

Code **A**

Time : 1¼ Hours	**Max. Marks : 100**	**Total Questions : 100**

Roll No. ____________ (in figure) ____________ (in words)

Name : ____________ Father's Name : ____________

Mother's Name : ____________ Date of Examination : ____________

(Signature of the candidate) (Signature of the Invigilator)

CANDIDATES MUST READ THE FOLLOWING INFORMATION/ INSTRUCTIONS BEFORE STARTING THE QUESTION PAPER.

1. **Candidates are required to attempt any 75 questions out of the given 100 multiple choice questions of 4/3 marks each. No credit will be given for more than 75 correct responses.**
2. The candidates must return the Question book-let as well as OMR answer-sheet to the Invigilator concerned before leaving the Examination Hall, failing which a case of use of unfair-means / mis-behaviour will be registered against him / her, in addition to lodging of an FIR with the police. Further the answer-sheet of such a candidate will not be evaluated.
3. In case there is any discrepancy in any question(s) in the Question Booklet, the same may be brought to the notice of the Controller of Examinations in writing **within two hours** after the test is over. No such complaint(s) will be entertained thereafter.
4. The candidate MUST NOT do any rough work or writing in the OMR Answer-Sheet. Rough work, if any, may be done in the question book-let itself. Answers **MUST NOT** be ticked in the Question book-let.
5. **There will be no negative marking. Each correct answer will be awarded 4/3 mark. Cutting, erasing, overwriting and more than one answer in OMR Answer-Sheet will be treated as incorrect answer.**
6. Use only Black or Blue BALL POINT PEN of good quality in the OMR Answer-Sheet.
7. BEFORE ANSWERING THE QUESTIONS, THE CANDIDATES SHOULD ENSURE THAT THEY HAVE BEEN SUPPLIED CORRECT AND COMPLETE BOOK-LET. COMPLAINTS, IF ANY, REGARDING MISPRINTING ETC. WILL NOT BE ENTERTAINED 30 MINUTES AFTER STARTING OF THE EXAMINATION.

Question No.	Questions
1.	If A and B are finite sets and the total number of subsets of A has 56 more elements than the total number of subsets of B, then the number of elements in A is : (1) 4 (2) 5 (3) 6 (4) 8
2.	If P (A) denotes the power set of the set A, then which of the following is correct ? (1) $A \cap P(A) = A$ (2) $A \cup P(A) = P(A)$ (3) $A - P(A) = A$ (4) $P(A) - \{A\} = P(A)$
3.	The order of a set A is 4 and that of a set B is 3. The number of relations from A to B is : (1) 12 (2) 144 (3) 2048 (4) 4096
4.	The set of real numbers in the closed interval {0, 1} is (1) finite set (2) uncountable set (3) countable set (4) None of these
5.	The nth term of the sequence $\left\{2, \frac{-3}{2}, \frac{4}{3}, \frac{-5}{4}, ...\right\}$ is : (1) $(-1)^{n-1}\left(1+\frac{1}{n}\right)$ (2) $(-1)^{n-1}\left(1-\frac{1}{n}\right)$ (3) $(-1)^{n-1}\left(1+\frac{2}{n}\right)$ (4) $(-1)^{n-1}\frac{2^n}{n-1}$

Question No.	Questions
6.	The series $x + \frac{2^2 x^2}{\lfloor 2} + \frac{3^3 x^3}{\lfloor 3} + \frac{4^4 x^4}{\lfloor 4} + \dots\dots$ is convergent if : (1) $x > \frac{1}{e}$ (2) $0 < x < \frac{1}{e}$ (3) $\frac{2}{e} < x < \frac{3}{e}$ (4) $\frac{e}{3} < x < \frac{e}{2}$
7.	The series $\sum\left(1+\frac{1}{n}\right)^{-n^2}$ is : (1) Convergent (2) Divergent (3) Oscillatory (4) None of these
8.	If $f(x) = x(x-1)(x-2)$; $x \in \left[0, \frac{1}{2}\right]$, then the value of 'C' of Lagrange's mean value theorem is : (1) $\frac{1}{3}$ (2) $\frac{1}{4}+\frac{1}{\sqrt{2}}$ (3) $\frac{6+\sqrt{21}}{18}$ (4) $\frac{6-\sqrt{21}}{6}$
9.	It is given that the function $f(x) = \begin{cases} \dfrac{a\cos x}{\frac{\pi}{2}-x}, & x \neq \pi/2 \\ 1, & x = \pi/2 \end{cases}$ is continuous at $x = \pi/2$, value of a is : (1) –1 (2) 1 (3) 2 (4) $\pi/2$

Question No.	Questions
10.	Which of the following functions is not uniformly continuous in $[2, \infty)$? (1) $\frac{1}{x}$ (2) $\frac{1}{x^2}$ (3) e^x (4) $\sin x$
11.	If $f_n(x) = \tan^{-1} nx$, $n \in [0, 1]$, whose point-wise limit is $f(x) = \begin{cases} 0, & x = 0 \\ \frac{\pi}{2}, & x \in (0, 1] \end{cases}$, then : (1) f (x) is differentiable (2) f (x) is not differentiable (3) f (x) is continuous (4) None of these
12.	The integral $\int_0^\infty \sin x \, dx$: (1) exists (2) exists and equals zero (3) exists and equals 1 (4) does not exist
13.	If f is Riemann integrable with respect to α on [a, b], then : (1) f and α are both increasing (2) f and α are both bounded (3) f is bounded and α is increasing function (4) f is increasing and α is bounded function
14.	If f (x) = sin x, then the total variation of f (x) on [0, 2] is (1) 3 (2) 1 (3) 2 (4) ∞

Question No.	Questions
15.	If f is a non-negative function, $< E_i >$ a disjoint sequence of measurable sets and $E = \bigcup E_i$, then (1) $\int_E f > \sum \int_{E_i} f$ (2) $\int_E f < \sum \int_{E_i} f$ (3) $\int_E f = \bigcup \int_{E_i} f$ (4) $\int_E f = \sum \int_{E_i} f$
16.	For the function $f(x, y) = \begin{cases} \dfrac{xy^2}{x^2+y^4}, & (x, y) \neq (0, 0) \\ 0, & (x, y) = (0, 0) \end{cases}$, the directional derivative along $\bar{u} = (\sqrt{2}, \sqrt{2})$ at (0, 0) is : (1) $\sqrt{2}$ (2) $\frac{1}{\sqrt{2}}$ (3) $2\sqrt{2}$ (4) $\sqrt{2}/3$
17.	If X is a complete metric space, E is non-empty open subset of X, then : (1) E is a null set (2) E is of first category (3) E is of second category (4) E is incomplete
18.	If $A = \begin{bmatrix} -5 & -8 & 0 \\ 3 & 5 & 0 \\ 1 & 2 & -1 \end{bmatrix}$, then A^2 is : (1) nilpotent (2) idempotent (3) involutory (4) periodic

Question No.	Questions
19.	If $A = \begin{bmatrix} 3 & -2 \\ 4 & -2 \end{bmatrix}$ satisfies the matrix equation $A^2 - \lambda A + 2I = 0$, then value of λ is : (1) 0 (2) 1 (3) 2 (4) -2
20.	If $X_1, X_2, ..., X_N$ are N non-zero orthogonal vectors, the dimension of the vector space spanned by the 2N vectors $X_1, X_2, ..., X_N, \quad -X_1, -X_2, ... -X_N$ is : (1) N (2) N + 1 (3) 2N (4) N^2
21.	The eigen values of a skew-symmetric matrix are : (1) always zero (2) always pure imaginary (3) always real (4) either zero or pure imaginary
22.	The dimension of the vector space of all 3 × 3 real symmetric matrices is : (1) 3 (2) 4 (3) 6 (4) 9
23.	The number of all non-singular linear transformations $T : R^4 \to R^3$ is : (1) 4 (2) 3 (3) 1 (4) 0

Question No.	Questions
24.	Let $T : R^3 \to R^3$ be a linear transformation given by $T(x, y, z) = \left(\frac{x}{2}, \frac{y}{2}, 0\right)$. Rank of T is : (1) 3 (2) 1 (3) 4 (4) 2
25.	A real quadratic form in three variables is equivalent to the diagonal form $-(x_1 - x_2)^2 - x_3^2$. Then, the quadratic form is : (1) negative definite (2) semi-negative definite (3) positive definite (4) semi-positive definite
26.	The positive integer n for which the equality $\left(\frac{\sqrt{3}}{2} + \frac{1}{2}i\right)^n = -1$ holds, is : (1) 2 (2) 4 (3) 5 (4) 6
27.	If $f(z) = 3x - y + 5 + i(ax + by - 3)$, then the values of a and b so that the function f (z) is entire, are : (1) $a = 1, b = 3$ (2) $a = 3, b = 1$ (3) $a = 1, b = -3$ (4) $a = -1, b = 3$
28.	The function $f(z) = e^{2\bar{z}+i}$ is : (1) differentiable at $z = 0$ (2) differentiable at $z = -1$ (3) differentiable at $z = i$ (4) no where differentiable

Question No.	Questions
29.	The principal value of $(-1)^{3i}$ is : (1) $e^{-\pi/2}$ (2) $e^{-\pi}$ (3) $e^{-3\pi}$ (4) $e^{-3\pi/2}$
30.	Solutions of the equation sinh z = cosh z are given by (1) $z = (-1 + 4n)\pi i$ (2) $z = e^{-3\pi i}$ (3) $z = e^{(2n+1)\pi i}$ (4) There are no solutions
31.	The value of the integral $\oint_C \frac{1}{z}dz$, where C is the circle $x = \cos t$, $y = \sin t$, $0 \le t \le 2\pi$, is : (1) $2\pi i$ (2) πi (3) 2π (4) $\frac{1}{2\pi}$
32.	If C is the circle $\lvert z - 3\rvert = 2$, then using Cauchy's integral formula, $\oint_C \frac{2z+5}{z^2-2z}dz =$ (1) $9\pi i$ (2) $\frac{9\pi i}{2}$ (3) $6\pi i$ (4) $3\pi i$
33.	For the function $f(z) = \frac{\cos z}{z^2(z-\pi)^3}$, the residue at the pole $z = \pi$ is : (1) $4\pi^3$ (2) $\frac{4\pi}{\pi^2-6}$ (3) $\frac{\pi^2-6}{2\pi^4}$ (4) $\frac{\pi^2-6}{2\pi^3}$

Question No.	Questions
34.	Using Cauchy's residue theorem, value of the integral $\oint_C \frac{\tan z}{z} dz$, $C : \lvert z-1 \rvert = 2$, is : (1) $4i$ (2) $-4i$ (3) $-2i$ (4) $2i$
35.	The only bounded entire functions are constants. This result is due to : (1) Cauchy (2) Liouville (3) Schwarz (4) Morera
36.	For the function $f(z) = \frac{1-e^z}{1+e^z}$, the singularity $z = \infty$ is : (1) a removable singularity (2) a pole (3) an isolated essential singularity (4) a non-isolated essential singularity
37.	If $z = x + iy$, $w = u + iv$, then by the transformation $w = z\,e^{i\pi/4}$, the line $x = 0$ is transformed into the line : (1) $u - v = 1$ (2) $u + v = 1$ (3) $v = -u$ (4) $v = u$
38.	Total number of 4 digit numbers with no two digits common, are : (1) 4096 (2) 5436 (3) 4896 (4) 4536

Question No.	Questions	
39.	The number of positive integers which are less than 108 and prime to 108, are :	
	(1) 24	(2) 36
	(3) 40	(4) 52
40.	The number of zeros at the end of $\lfloor 75$ is :	
	(1) 12	(2) 16
	(3) 18	(4) 75
41.	The number of elements of order 10 in Z_{30} is :	
	(1) 4	(2) 3
	(3) 2	(4) 1
42.	The generators of the group $G = \{a, a^2, a^3, a^4 = e\}$ are :	
	(1) a and a^2	(2) a and a^4
	(3) a and a^3	(4) a only
43.	If H and K are two subgroups of G of order 6 and 8 respectively, then order of HK is 16 if order of $H \cap K$ is :	
	(1) 2	(2) 3
	(3) 4	(4) 6
44.	Let G be a group of order 15, then the number of sylow subgroups of G of order 3 is :	
	(1) 4	(2) 3
	(3) 2	(4) 1
45.	The cardinality of a finite integral domain can not be :	
	(1) 6	(2) 5
	(3) 3	(4) 2

Question No.	Questions
46.	A ring of polynomials over a field is a : (1) group (2) unique factorization domain (3) prime field (4) irreducible
47.	Let R be a commutative ring with unity such that {0} is a prime ideal of R, then (1) {0} is a maximal ideal of R (2) R has zero divisors (3) R is a field (4) R is a integral domain
48.	A totally disconnected space is a : (1) T_0–space (2) T_1–space (3) T_2–space (4) T_3–space
49.	Every indiscrete space is : (1) compact and connected (2) not compact (3) disconnected (4) connected but not compact
50.	If Y is a subspace of X, A is closed in Y and Y is closed in X, then : (1) A is not closed in X (2) A is semi-closed in X (3) A is open in X (4) None of these
51.	Solution of $(xy^2 + x)\,dx + (yx^2 + y)\,dy = 0$ is : (1) $\tan^{-1}(x^2y^2 + 1) = c$ (2) $(x + 1)(y + 1) = c$ (3) $(x^2 + 1)(y^2 + 1) = c$ (4) $x^2 + y^2 + 1 = c$
52.	P.I. for $(D^2 - 4D + 4)\,y = x\,e^{2x}$, is : (1) $\frac{x^3 e^{2x}}{6}$ (2) $\frac{x^2 e^{2x}}{4}$ (3) $\frac{x^3 e^{2x}}{8}$ (4) $8\,e^{2x}$

Question No.	Questions
53.	The Green's function G (x, t) is : (1) one dimensional (2) two dimensional (3) three dimensional (4) n-dimensional
54.	Solving by variation of parameters the equation, $\frac{d^2y}{dx^2} + 4y = \tan 2x$, then value of Wornskion w, is (1) 4 (2) 3 (3) 1 (4) 0
55.	Which of the following is not true about the Strum-Liouville Problem (SLP) ? (1) All eigen values are real and non-negative. (2) SLP has always an eigen function. (3) Eigen functions corresponding to different eigen values are orthogonal w.r.t. weight function. (4) For each eigen value there exists only one linearly independent eigen function.
56.	Solution of $\frac{\partial^2 z}{\partial x^2} + z = 0$ with $x = 0$, $z = e^y$ and $\frac{\partial z}{\partial x} = 1$, is : (1) $z = \cos x - e^y \sin x$ (2) $z = \cos x + e^y \sin x$ (3) $z = \sin x - e^y \cos x$ (4) $z = \sin x + e^y \cos x$
57.	The differential equation $f_{xx} + 2f_{xy} + 4f_{yy} = 0$ is : (1) parabolic (2) elliptic (3) hyperbolic (4) linear

Question No.	Questions
58.	The surface satisfying $\frac{\partial^2 u}{\partial y^2} = x^3y$ containing two lines y = 0 = u and y = 1 = u is (1) $u = x^3y^3 + y(1 - x^3)$ (2) $u = x^3y^3 - y(1 + x^3)$ (3) $u = x^3y^2 + 1 - x^3$ (4) $u = x^2y^3 + 1 - x^3$
59.	The relation $2z = \frac{x^2}{a^2} + \frac{y^2}{b^2}$ represents the partial differential equation : (1) $2z = p + q$ (2) $2z = \frac{xp}{yq}$ (3) $2z = xq + yp$ (4) $2z = xp + yq$
60.	Using Newton's-Raphson method, an iterative formula to compute the reciprocal of a natural number N, is : (1) $x_{n+1} = x_n(2 - N \cdot x_n)$ (2) $x_{n+1} = x_n - N x_n^2$ (3) $x_{n+1} = 2x_n - N$ (4) $x_{n+1} = 2 - N \cdot x_n$
61.	$\Delta \tan^{-1}\left(\frac{n-1}{n}\right) =$ (1) $2\tan^{-1}\left(\frac{1}{n^2}\right)$ (2) $\tan^{-1}\left(\frac{1}{n^2}\right)$ (3) $\tan^{-1}\left(\frac{1}{2n^2}\right)$ (4) $\tan^{-1}\left(\frac{1}{2n}\right)$
62.	The first term of the series whose second and subsequent terms are 8, 3, 0, – 1, 0 is : (1) 10 (2) 12 (3) 15 (4) 20

Question No.	Questions
63.	In the Gauss elimination method for solving a system of linear algebraic equations, triangularization leads to : (1) diagonal matrix (2) lower triangular matrix (3) upper triangular matrix (4) singular matrix
64.	In Simpson's one-third rule the curve $y = f(x)$ is assumed to be : (1) circle (2) parabola (3) ellipse (4) hyperbola
65.	The second order Runge-kutta method is applied to the initial value problem $y' = -y$, $y(0) = y_0$ with step size h. Then $y(h) =$ (1) $y_0(h^2 - 2h - 2)$ (2) $\frac{y_0}{2}(h^2 - 2h + 2)$ (3) $\frac{y_0}{6}(h^2 - 2h + 2)$ (4) $\frac{y_0}{6}(h^2 - 2h - 2)$
66.	Using Picard's method upto third approximation, solution of $\frac{dy}{dx} = -xy$, $y(0) = 1$, is $y_3 =$ (1) $1 - \frac{x^2}{2} + \frac{x^4}{8} - \frac{x^6}{16}$ (2) $1 - \frac{x^2}{2} + \frac{x^4}{8} - \frac{x^6}{24}$ (3) $1 - \frac{x^2}{2} + \frac{x^4}{8} - \frac{x^6}{32}$ (4) $1 - \frac{x^2}{2} + \frac{x^4}{8} - \frac{x^6}{48}$
67.	The minimizing curve must satisfy a differential equation, called as : (1) Euler-Lagrange equation (2) Lagrange equation (3) Euler-Gauss equation (4) Cauchy-Euler equation

Question No.	Questions
68.	Given the functional $\int_{x_0}^{x_1}\left(\frac{y'^2}{x^3}\right)dx$, then the extremal is : (1) $y=\frac{cx^3}{3}+c_1$ (2) $y=\frac{cx^4}{4}+c_1$ (3) $y=cx^2+c_1$ (4) $y=\sin x$
69.	Solution of the integral equation $\int_0^x (x-t)^{-\frac{1}{2}} u(t)\,dt=1$ is : (1) $u(x)=\frac{1}{x\sqrt{\pi}}$ (2) $u(x)=\frac{\pi}{\sqrt{x}}$ (3) $u(x)=\frac{1}{\pi\sqrt{x}}$ (4) $u(x)=\frac{1}{\sqrt{\pi x}}$
70.	The resolvent third kernel of the Volterra's integral equation with kernel $k(x, t) = 1$, is (1) $(x-t)^2$ (2) $\frac{1}{2}(x-t)^2$ (3) $\frac{1}{3}(x-t)^3$ (4) $\frac{1}{\lfloor 3}(x-t)^3$
71.	The (n – 1)th derivative of the Green's function G (x, t) with regard to x at the point x = t, has : (1) Discontinuity of 1st kind (2) Discontinuity of 2nd kind (3) Removable discontinuity (4) No discontinuity

Question No.	Questions
72.	Which of the following is incorrect ? (1) The eigen values of a symmetric kernel are real. (2) All iterated kernels of a symmetric kernel are also symmetric. (3) Every symmetric kernel with norm $\neq 0$ has at least one eigen value (4) Fredholm integral equation of the second kind has always an eigen value.
73.	For a particle of mass m moving under a potential $v=\frac{k}{q}$, which one of the following relations is correct ? (1) $\ddot{q}=\frac{k}{m\,q^2}$ (2) $m\,\dot{q}^2+\frac{2k}{q}=\text{constant}$ (3) $m\,\dot{q}+\frac{2k}{q}=\text{constant}$ (4) $m\,\dot{q}^2+\frac{k}{q}=\text{constant}$
74.	A rigid body moving in space with one point fixed, has degrees of freedom : (1) 3 (2) 4 (3) 6 (4) 2
75.	For the Lagrangian $L=\frac{1}{2}\dot{q}^2-q\,\dot{q}+q^2$, the conjugate momentum p is : (1) $\dot{q}-q$ (2) $\dot{q}+q$ (3) $\frac{1}{2}\dot{q}\,q$ (4) $q-\dot{q}$

Question No.	Questions
76.	For n independent events $A_1, A_2, \ldots, A_n$, let $P(A_i) = \frac{1}{i+1}$, $i = 1, 2, \ldots, n$. Then the probability of happening at least one of the events is (1) $\frac{n}{n+1}$ (2) $\frac{1}{n+1}$ (3) $\frac{1}{n}$ (4) $1-\frac{1}{n}$
77.	The idea of posterior probabilities was introduced by (1) Pascal (2) Poisson (3) Fisher (4) Thomas Bayes
78.	In a perfectly symmetrical distribution, 50% of items are above 60 and 75% items are below 75. Then, the coefficient of quartile deviation is (1) 15 (2) 30 (3) $\frac{1}{4}$ (4) $\frac{1}{5}$
79.	In any discrete series (when all the values are not same) the relationship between M.D. about mean and S.D. is (1) M.D. = S.D. (2) M.D. < S.D. (3) M.D. > S.D. (4) M.D. = Mean + S.D.
80.	A random variable X can take all non-negative integral values, and the probability that X takes the value r is proportional to $(0.4)^r$. Then the value of $P(X = 0)$ is (1) 1 (2) 0.4 (3) 0.6 (4) $\frac{5}{3}$

Question No.	Questions
81.	Let X_1 and X_2 be two stochastic random variables having variances k and 2 respectively. If the variance of $Y = 3X_2 - X_1$ is 25, then the value of k is (1) 7 (2) 19 (3) –7 (4) –19
82.	Which of the following is incorrect statement ? (1) Both the central limit theorem and the Weak law of large numbers hold for a sequence of i.i.d. random variables with finite mean and variance. (2) For the sequence of independent r.v.'s, Weak law of large numbers may hold but the central limit theorem may not hold. (3) Under certain conditions, the central limit theorem holds for variables which are not independent. (4) Lindeberg-Levy theorem should not be inferred as a particular case of Liapounoff's theorem.
83.	Match List I and List II and select the correct answer using the codes given under the lists List I (Distribution) — List II (Moment Generating Function) for real t A. Poisson distribution — 1. $(q + p\,e^t)^n$, where p is probability of success B. Geometric distribution — 2. $p\,(1 - q\,e^t)^{-1}$, where p is probability of success C. Normal distribution — 3. $e^{\lambda(e^t - 1)}$, where λ is mean D. Binomial distribution — 4. $\exp\left(t^2/2\right)$ for standard variate Codes : A B C D (1) 1 2 3 4 (2) 3 1 4 2 (3) 2 3 1 4 (4) 3 2 4 1

Question No.	Questions
84.	Suppose that the probability of a dry day following a rainy day is $\frac{2}{3}$ and that the probability of a rainy day following a dry day is $\frac{1}{2}$. Given that January 19 is a dry day, what is the probability that January 21 will be a dry day ? (1) $\frac{5}{12}$ (2) $\frac{7}{12}$ (3) $\frac{7}{18}$ (4) $\frac{11}{18}$
85.	Let $X_1, X_2, \ldots, X_n$ be n in dependent and identically distributed variates, each with pdf $f(x) = \begin{cases} 1, & 0 < x < 1 \\ 0, & \text{otherwise} \end{cases}$. Then mean of smallest order statistic is (1) $\frac{n}{n+1}$ (2) $\frac{1}{n}$ (3) $\frac{1}{n+1}$ (4) 1
86.	If X_1, X_2 are i.i.d. N (0, 1), then the distribution of $X_1 - X_2$ is (1) N (0, 1) (2) N (0, 2) (3) $r\left(\frac{1}{2}\right)$ (4) r (1)

Question No.	Questions
87.	Mean square error of an estimator t of parameter θ is expressed as (1) Bias + Var (t) (2) [Bias + Var (t)]^2 (3) (Bias)^2 + [Var (t)]^2 (4) (Bias)^2 + Var (t)
88.	The degrees of freedom for t-statistic for paired t-test based on 20 pairs of observations is (1) 38 (2) 19 (3) 39 (4) 18
89.	If the sample size in Wald-Wolfowitz run test is large, the variate R (number of runs) is asymptotically normal with mean (1) $\frac{2n_1n_2}{n_1+n_2}+1$ (2) $\frac{2n_1}{n_1+n_2}+1$ (3) $\frac{2n_2}{n_1+n_2}+1$ (4) $\frac{2n_1n_2}{n_1+n_2}$ where n_1, n_2 are the sizes of the two samples.
90.	In the usual notations, $R^2_{1.23}$ can be expressed as : (1) $R^2_{1.23}=1-(1-r^2_{12})(1-r^2_{13.2})$ (2) $R^2_{1.23}=1-(1-r^2_{12})(1-r_{13.2})$ (3) $R^2_{1.23}=(1-r^2_{12})(1-r^2_{13.2})$ (4) $R^2_{1.23}=(1-r_{12})(1-r_{13.2})$
91.	Consider a multiple linear regression model with r regressors, $r \geq 1$ and the response variable Y. Suppose $\hat{Y}$ is the fitted value of Y. R^2 is the coefficient of determination and R^2_{adj} is the adjusted coefficient of determination. Then (1) R^2 always increases if an additional regressor is included in the model (2) R^2_{adj} always increases if an additional regressor is included in the model (3) $R^2 < R^2_{adj}$ for all r (4) Correlation coefficient between Y and $\hat{Y}$ is always non-negative.

Question No.	Questions
92.	Suppose X is a p-dimensional random vector with variance-covariance matrix Σ. If $P_1, P_2, \ldots, P_p$ represent p orthogonal eigenvectors of Σ corresponding to the eigen values $\lambda_1 > \lambda_2 > \ldots > \lambda_p \geq 0$ respectively, then which of the following is not correct ? (1) First principal component is $P_{-1}^{T} X$ (2) $P_{-1}^{T} X$ and $P_{-1}^{T} X$ ae correlated (3) $Var(P_{-1}^{T} X) = \lambda_1$ (4) $T_r(\Sigma) = \sum_{i=1}^{p} \lambda_i$
93.	For 2 strata $N_1 = 200$, $S_1^2 = 9$ and $N_2 = 300$, $S_2^2 = 4$; the variance of sample mean of sample size 100, under proportional allocation is (1) 0.048 (2) 0.056 (3) 0.240 (4) 0.084
94.	If the population consists of a linear trend, $Y_i = i$; i = 1, 2, 3, ..., k, then (1) $Var(\bar{y}_{st}) \leq Var(\bar{y}_{sys})$ (2) $Var(\bar{y}_{st}) \geq Var(\bar{y}_{sys})$ (3) $Var(\bar{y}_{st}) = Var(\bar{y}_{sys})$ (4) $Var(\bar{y}_{st}) > Var(\bar{y}_{sys})$
95.	The total number of main and interaction effects in a 2^4 factorial experiment is (1) 3 (2) 14 (3) 15 (4) 16
96.	While analysing the data of a k × k Latin square design, the error d.f. in analysis of variance is equal to : (1) $k^3 - 3k^2 + 2k$ (2) $k^2 - 1$ (3) $k^2 - k - 2$ (4) $k^2 - 3k + 2$

Question No.	Questions
97.	For a system with n elements connected in series with constant (but different for each element) hazard rates $\lambda_1, \lambda_2, \ldots, \lambda_n$ respectively, then mean time to failure of the system is (1) $1-\prod_{i=1}^{n}(1-e^{-\lambda_i t})$ (2) $\int_0^{\infty}\left[1-\prod_{i=1}^{n}(1-e^{-\lambda_i t})\right]dt$ (3) $e^{-\sum_{i=1}^{n}\lambda_i t}$ (4) $\int_0^{\infty} e^{-\sum_{i=1}^{n}\lambda_i t}\,dt$
98.	If primal in an LPP has alternative optimal solution, then the dual has (1) No feasible solution (2) Unbounded solution (3) Alternative optimal solution (4) Degenerate optimal solution
99.	A manufacturing company has determined from an analysis of its accounting and production data for a certain part that its demand is 9000 units per annum and is uniformly distributed over the year. Further, it is known that the lead time is uniform and equals 8 working days, and the total working days in an year are 300. Then the re-order level would be (1) 30 (2) 2400 (3) 240 (4) $\frac{300}{8}$
100.	Trains arrive at the yard every 15 minutes and the service time is 30 minutes. If the line capacity of the yard is limited to 4 trains, then the probability that the yard is empty (assuming the arrivals follows Poisson distribution and the service times follow the exponential distribution) is (1) $\frac{1}{31}$ (2) $\frac{1}{32}$ (3) $\frac{1}{2}$ (4) $\frac{1}{4}$

For uploading on the website

Attendes 23/01/17

Professor & Head, Department of Mathematics M.D. University, ROHTAK

(DO NOT OPEN THIS QUESTION BOOKLET BEFORE TIME OR UNTIL YOU ARE ASKED TO DO SO)

(MPH/PHD/URS–EE–2017)

Subject : MATHEMATICS

Code **B**

Sr. No. 10206

Time : 1¼ Hours	Max. Marks : 100	Total Questions : 100

Roll No. ________________ (in figure) ________________________ (in words)

Name : ________________________ Father's Name : ________________________

Mother's Name : ________________________ Date of Examination : ________________

(Signature of the candidate) (Signature of the Invigilator)

CANDIDATES MUST READ THE FOLLOWING INFORMATION/ INSTRUCTIONS BEFORE STARTING THE QUESTION PAPER.

1. **Candidates are required to attempt any 75 questions out of the given 100 multiple choice questions of 4/3 marks each. No credit will be given for more than 75 correct responses.**
2. The candidates must return the Question book-let as well as OMR answer-sheet to the Invigilator concerned before leaving the Examination Hall, failing which a case of use of unfair-means / mis-behaviour will be registered against him / her, in addition to lodging of an FIR with the police. Further the answer-sheet of such a candidate will not be evaluated.
3. In case there is any discrepancy in any question(s) in the Question Booklet, the same may be brought to the notice of the Controller of Examinations in writing **within two hours** after the test is over. No such complaint(s) will be entertained thereafter.
4. The candidate MUST NOT do any rough work or writing in the OMR Answer-Sheet. Rough work, if any, may be done in the question book-let itself. Answers **MUST NOT** be ticked in the Question book-let.
5. **There will be no negative marking. Each correct answer will be awarded 4/3 mark. Cutting, erasing, overwriting and more than one answer in OMR Answer-Sheet will be treated as incorrect answer.**
6. Use only Black or Blue **BALL POINT PEN** of good quality in the OMR Answer-Sheet.
7. BEFORE ANSWERING THE QUESTIONS, THE CANDIDATES SHOULD ENSURE THAT THEY HAVE BEEN SUPPLIED CORRECT AND COMPLETE BOOK-LET. COMPLAINTS, IF ANY, REGARDING MISPRINTING ETC. WILL NOT BE ENTERTAINED 30 MINUTES AFTER STARTING OF THE EXAMINATION.

Question No.	Questions
1.	If $f_n(x) = \tan^{-1} nx$, $n \in [0, 1]$, whose point-wise limit is $f(x) = \begin{cases} 0, & x=0 \\ \frac{\pi}{2}, & x \in (0,1] \end{cases}$, then : (1) f (x) is differentiable (2) f (x) is not differentiable (3) f (x) is continuous (4) None of these
2.	The integral $\int_0^\infty \sin x \, dx$: (1) exists (2) exists and equals zero (3) exists and equals 1 (4) does not exist
3.	If f is Riemann integrable with respect to α on [a, b], then : (1) f and α are both increasing (2) f and α are both bounded (3) f is bounded and α is increasing function (4) f is increasing and α is bounded function
4.	If f (x) = sin x, then the total variation of f (x) on [0, 2] is (1) 3 (2) 1 (3) 2 (4) ∞
5.	If f is a non-negative function, $< E_i >$ a disjoint sequence of measurable sets and $E = \bigcup E_i$, then (1) $\int_E f > \sum \int_{E_i} f$ (2) $\int_E f < \sum \int_{E_i} f$ (3) $\int_E f = \bigcup \int_{E_i} f$ (4) $\int_E f = \sum \int_{E_i} f$

Question No.	Questions
6.	For the function $f(x, y) = \begin{cases} \frac{xy^2}{x^2 + y^4}, & (x, y) \neq (0, 0) \\ 0, & (x, y) = (0, 0) \end{cases}$, the directional derivative along $\bar{u} = (\sqrt{2}, \sqrt{2})$ at (0, 0) is : (1) $\sqrt{2}$ (2) $\frac{1}{\sqrt{2}}$ (3) $2\sqrt{2}$ (4) $\sqrt{2}/3$
7.	If X is a complete metric space, E is non-empty open subset of X, then : (1) E is a null set (2) E is of first category (3) E is of second category (4) E is incomplete
8.	If $A = \begin{bmatrix} -5 & -8 & 0 \\ 3 & 5 & 0 \\ 1 & 2 & -1 \end{bmatrix}$, then A^2 is : (1) nilpotent (2) idempotent (3) involutory (4) periodic
9.	If $A = \begin{bmatrix} 3 & -2 \\ 4 & -2 \end{bmatrix}$ satisfies the matrix equation $A^2 - \lambda A + 2I = 0$, then value of λ is : (1) 0 (2) 1 (3) 2 (4) −2

Question No.	Questions
10.	If $X_1, X_2, \ldots\ldots, X_N$ are N non-zero orthogonal vectors, the dimension of the vector space spanned by the 2N vectors $X_1, X_2, \ldots\ldots, X_N, \quad -X_1, -X_2, \ldots\ldots -X_N$ is : (1) N (2) N + 1 (3) 2N (4) N^2
11.	Consider a multiple linear regression model with r regressors, $r \geq 1$ and the response variable Y. Suppose $\hat{Y}$ is the fitted value of Y. R^2 is the coefficient of determination and R^2_{adj} is the adjusted coefficient of determination. Then (1) R^2 always increases if an additional regressor is included in the model (2) R^2_{adj} always increases if an additional regressor is included in the model (3) $R^2 < R^2_{adj}$ for all r (4) Correlation coefficient between Y and $\hat{Y}$ is always non-negative.
12.	Suppose X is a p-dimensional random vector with variance-covariance matrix Σ. If $P_1, P_2, \ldots, P_p$ represent p orthogonal eigenvectors of Σ corresponding to the eigen values $\lambda_1 > \lambda_2 > \ldots > \lambda_p \geq 0$ respectively, then which of the following is not correct ? (1) First principal component is $P_{-1}^T X$ (2) $P_{-1}^T X$ and $P_{-1}^T X$ ae correlated (3) $Var(P_{-1}^T X) = \lambda_1$ (4) $T_r(\Sigma) = \sum_{i=1}^{p} \lambda_i$

Question No.	Questions
13.	For 2 strata $N_1 = 200$, $S_1^2 = 9$ and $N_2 = 300$, $S_2^2 = 4$; the variance of sample mean of sample size 100, under proportional allocation is (1) 0.048 (2) 0.056 (3) 0.240 (4) 0.084
14.	If the population consists of a linear trend, $Y_i = i$; $i = 1, 2, 3, ..., k$, then (1) $Var(\bar{y}_{st}) \le Var(\bar{y}_{sys})$ (2) $Var(\bar{y}_{st}) \ge Var(\bar{y}_{sys})$ (3) $Var(\bar{y}_{st}) = Var(\bar{y}_{sys})$ (4) $Var(\bar{y}_{st}) > Var(\bar{y}_{sys})$
15.	The total number of main and interaction effects in a 2^4 factorial experiment is (1) 3 (2) 14 (3) 15 (4) 16
16.	While analysing the data of a $k \times k$ Latin square design, the error d.f. in analysis of variance is equal to : (1) $k^3 - 3k^2 + 2k$ (2) $k^2 - 1$ (3) $k^2 - k - 2$ (4) $k^2 - 3k + 2$
17.	For a system with n elements connected in series with constant (but different for each element) hazard rates $\lambda_1, \lambda_2, ..., \lambda_n$ respectively, then mean time to failure of the system is (1) $1 - \prod_{i=1}^{n}(1 - e^{-\lambda_i t})$ (2) $\int_0^\infty \left[1 - \prod_{i=1}^{n}(1 - e^{-\lambda_i t})\right] dt$ (3) $e^{-\sum_{i=1}^{n}\lambda_i t}$ (4) $\int_0^\infty e^{-\sum_{i=1}^{n}\lambda_i t}\, dt$
18.	If primal in an LPP has alternative optimal solution, then the dual has (1) No feasible solution (2) Unbounded solution (3) Alternative optimal solution (4) Degenerate optimal solution

Question No.	Questions
19.	A manufacturing company has determined from an analysis of its accounting and production data for a certain part that its demand is 9000 units per annum and is uniformly distributed over the year. Further, it is known that the lead time is uniform and equals 8 working days, and the total working days in an year are 300. Then the re-order level would be (1) 30 (2) 2400 (3) 240 (4) $\frac{300}{8}$
20.	Trains arrive at the yard every 15 minutes and the service time is 30 minutes. If the line capacity of the yard is limited to 4 trains, then the probability that the yard is empty (assuming the arrivals follows Poisson distribution and the service times follow the exponential distribution) is (1) $\frac{1}{31}$ (2) $\frac{1}{32}$ (3) $\frac{1}{2}$ (4) $\frac{1}{4}$
21.	The (n – 1)th derivative of the Green's function G (x, t) with regard to x at the point x = t, has : (1) Discontinuity of 1st kind (2) Discontinuity of 2nd kind (3) Removable discontinuity (4) No discontinuity
22.	Which of the following is incorrect ? (1) The eigen values of a symmetric kernel are real. (2) All iterated kernels of a symmetric kernel are also symmetric. (3) Every symmetric kernel with norm ≠ 0 has at least one eigen value (4) Fredholm integral equation of the second kind has always an eigen value.

Question No.	Questions
23.	For a particle of mass m moving under a potential $v = \frac{k}{q}$, which one of the following relations is correct ? (1) $\ddot{q} = \frac{k}{m q^2}$ (2) $m \dot{q}^2 + \frac{2k}{q} = \text{constant}$ (3) $m \dot{q} + \frac{2k}{q} = \text{constant}$ (4) $m \dot{q}^2 + \frac{k}{q} = \text{constant}$
24.	A rigid body moving in space with one point fixed, has degrees of freedom : (1) 3 (2) 4 (3) 6 (4) 2
25.	For the Lagrangian $L = \frac{1}{2}\dot{q}^2 - q\dot{q} + q^2$, the conjugate momentum p is : (1) $\dot{q} - q$ (2) $\dot{q} + q$ (3) $\frac{1}{2}\dot{q}q$ (4) $q - \dot{q}$
26.	For n independent events $A_1, A_2, \ldots, A_n$, let $P(A_i) = \frac{1}{i+1}$, $i = 1, 2, \ldots, n$. Then the probability of happening at least one of the events is (1) $\frac{n}{n+1}$ (2) $\frac{1}{n+1}$ (3) $\frac{1}{n}$ (4) $1 - \frac{1}{n}$

Question No.	Questions
27.	The idea of posterior probabilities was introduced by (1) Pascal (2) Poisson (3) Fisher (4) Thomas Bayes
28.	In a perfectly symmetrical distribution, 50% of items are above 60 and 75% items are below 75. Then, the coefficient of quartile deviation is (1) 15 (2) 30 (3) $\frac{1}{4}$ (4) $\frac{1}{5}$
29.	In any discrete series (when all the values are not same) the relationship between M.D. about mean and S.D. is (1) M.D. = S.D. (2) M.D. < S.D. (3) M.D. > S.D. (4) M.D. = Mean + S.D.
30.	A random variable X can take all non-negative integral values, and the probability that X takes the value r is proportional to $(0.4)^r$. Then the value of P (X = 0) is (1) 1 (2) 0.4 (3) 0.6 (4) $\frac{5}{3}$
31.	Solution of $(xy^2 + x)\,dx + (yx^2 + y)\,dy = 0$ is : (1) $\tan^{-1}(x^2y^2 + 1) = c$ (2) $(x + 1)(y + 1) = c$ (3) $(x^2 + 1)(y^2 + 1) = c$ (4) $x^2 + y^2 + 1 = c$
32.	P.I. for $(D^2 - 4D + 4)\,y = x\,e^{2x}$, is : (1) $\frac{x^3 e^{2x}}{6}$ (2) $\frac{x^2 e^{2x}}{4}$ (3) $\frac{x^3 e^{2x}}{8}$ (4) $8\,e^{2x}$

Question No.	Questions
33.	The Green's function G (x, t) is : (1) one dimensional (2) two dimensional (3) three dimensional (4) n-dimensional
34.	Solving by variation of parameters the equation, $\frac{d^2y}{dx^2} + 4y = \tan 2x$, then value of Wornskion w, is (1) 4 (2) 3 (3) 1 (4) 0
35.	Which of the following is not true about the Strum-Liouville Problem (SLP) ? (1) All eigen values are real and non-negative. (2) SLP has always an eigen function. (3) Eigen functions corresponding to different eigen values are orthogonal w.r.t. weight function. (4) For each eigen value there exists only one linearly independent eigen function.
36.	Solution of $\frac{\partial^2 z}{\partial x^2} + z = 0$ with $x = 0, z = e^y$ and $\frac{\partial z}{\partial x} = 1$, is : (1) $z = \cos x - e^y \sin x$ (2) $z = \cos x + e^y \sin x$ (3) $z = \sin x - e^y \cos x$ (4) $z = \sin x + e^y \cos x$
37.	The differential equation $f_{xx} + 2f_{xy} + 4f_{yy} = 0$ is : (1) parabolic (2) elliptic (3) hyperbolic (4) linear

Question No.	Questions
38.	The surface satisfying $\frac{\partial^2 u}{\partial y^2} = x^3 y$ containing two lines $y = 0 = u$ and $y = 1 = u$ is (1) $u = x^3y^3 + y\,(1 - x^3)$ (2) $u = x^3y^3 - y\,(1 + x^3)$ (3) $u = x^3y^2 + 1 - x^3$ (4) $u = x^2y^3 + 1 - x^3$
39.	The relation $2z = \frac{x^2}{a^2} + \frac{y^2}{b^2}$ represents the partial differential equation : (1) $2z = p + q$ (2) $2z = \frac{xp}{yq}$ (3) $2z = xq + yp$ (4) $2z = xp + yq$
40.	Using Newton's-Raphson method, an iterative formula to compute the reciprocal of a natural number N, is : (1) $x_{n+1} = x_n\,(2 - N \,.\, x_n)$ (2) $x_{n+1} = x_n - N x_n^2$ (3) $x_{n+1} = 2\,x_n - N$ (4) $x_{n+1} = 2 - N \,.\, x_n$
41.	The value of the integral $\oint_C \frac{1}{z}\,dz$, where C is the circle $x = \cos t$, $y = \sin t$, $0 \le t \le 2\pi$, is : (1) $2\pi i$ (2) πi (3) 2π (4) $\frac{1}{2\pi}$
42.	If C is the circle $\|z - 3\| = 2$, then using Cauchy's integral formula, $\oint_C \frac{2z+5}{z^2 - 2z}\,dz =$ (1) $9\pi i$ (2) $\frac{9\pi i}{2}$ (3) $6\pi i$ (4) $3\pi i$

Question No.	Questions
43.	For the function $f(z) = \frac{\cos z}{z^2 (z-\pi)^3}$, the residue at the pole $z = \pi$ is : (1) $4\pi^3$ (2) $\frac{4\pi}{\pi^2 - 6}$ (3) $\frac{\pi^2 - 6}{2\pi^4}$ (4) $\frac{\pi^2 - 6}{2\pi^3}$
44.	Using Cauchy's residue theorem, value of the integral $\oint_C \frac{\tan z}{z} dz$, $C : \lvert z-1 \rvert = 2$, is : (1) $4i$ (2) $-4i$ (3) $-2i$ (4) $2i$
45.	The only bounded entire functions are constants. This result is due to : (1) Cauchy (2) Liouville (3) Schwarz (4) Morera
46.	For the function $f(z) = \frac{1-e^z}{1+e^z}$, the singularity $z = \infty$ is : (1) a removable singularity (2) a pole (3) an isolated essential singularity (4) a non-isolated essential singularity
47.	If $z = x + iy$, $w = u + iv$, then by the transformation $w = z\, e^{i\pi/4}$, the line $x = 0$ is transformed into the line : (1) $u - v = 1$ (2) $u + v = 1$ (3) $v = -u$ (4) $v = u$

Question No.	Questions	
48.	Total number of 4 digit numbers with no two digits common, are :	
	(1) 4096	(2) 5436
	(3) 4896	(4) 4536
49.	The number of positive integers which are less than 108 and prime to 108, are :	
	(1) 24	(2) 36
	(3) 40	(4) 52
50.	The number of zeros at the end of $\lfloor 75$ is :	
	(1) 12	(2) 16
	(3) 18	(4) 75
51.	The eigen values of a skew-symmetric matrix are :	
	(1) always zero	(2) always pure imaginary
	(3) always real	(4) either zero or pure imaginary
52.	The dimension of the vector space of all 3×3 real symmetric matrices is :	
	(1) 3	(2) 4
	(3) 6	(4) 9
53.	The number of all non-singular linear transformations $T : R^4 \rightarrow R^3$ is :	
	(1) 4	(2) 3
	(3) 1	(4) 0

Question No.	Questions
54.	Let $T : R^3 \rightarrow R^3$ be a linear transformation given by $T(x, y, z) = \left(\frac{x}{2}, \frac{y}{2}, 0\right)$. Rank of T is : (1) 3 (2) 1 (3) 4 (4) 2
55.	A real quadratic form in three variables is equivalent to the diagonal form $-(x_1 - x_2)^2 - x_3^2$. Then, the quadratic form is : (1) negative definite (2) semi-negative definite (3) positive definite (4) semi-positive definite
56.	The positive integer n for which the equality $\left(\frac{\sqrt{3}}{2} + \frac{1}{2}i\right)^n = -1$ holds, is : (1) 2 (2) 4 (3) 5 (4) 6
57.	If $f(z) = 3x - y + 5 + i(ax + by - 3)$, then the values of a and b so that the function f (z) is entire, are : (1) $a = 1, b = 3$ (2) $a = 3, b = 1$ (3) $a = 1, b = -3$ (4) $a = -1, b = 3$
58.	The function $f(z) = e^{2z+i}$ is : (1) differentiable at $z = 0$ (2) differentiable at $z = -1$ (3) differentiable at $z = i$ (4) no where differentiable

Question No.	Questions
59.	The principal value of $(-1)^{3i}$ is : (1) $e^{-\pi/2}$ (2) $e^{-\pi}$ (3) $e^{-3\pi}$ (4) $e^{-3\pi/2}$
60.	Solutions of the equation sinh z = cosh z are given by (1) $z = (-1 + 4n)\pi i$ (2) $z = e^{-3\pi i}$ (3) $z = e^{(2n+1)\pi i}$ (4) There are no solutions
61.	The number of elements of order 10 in Z_{30} is : (1) 4 (2) 3 (3) 2 (4) 1
62.	The generators of the group $G = \{a, a^2, a^3, a^4 = e\}$ are : (1) a and a^2 (2) a and a^4 (3) a and a^3 (4) a only
63.	If H and K are two subgroups of G of order 6 and 8 respectively, then order of HK is 16 if order of $H \cap K$ is : (1) 2 (2) 3 (3) 4 (4) 6
64.	Let G be a group of order 15, then the number of sylow subgroups of G of order 3 is : (1) 4 (2) 3 (3) 2 (4) 1
65.	The cardinality of a finite integral domain can not be : (1) 6 (2) 5 (3) 3 (4) 2

Question No.	Questions
66.	A ring of polynomials over a field is a : (1) group (2) unique factorization domain (3) prime field (4) irreducible
67.	Let R be a commutative ring with unity such that {0} is a prime ideal of R, then (1) {0} is a maximal ideal of R (2) R has zero divisors (3) R is a field (4) R is a integral domain
68.	A totally disconnected space is a : (1) T_0–space (2) T_1–space (3) T_2–space (4) T_3–space
69.	Every indiscrete space is : (1) compact and connected (2) not compact (3) disconnected (4) connected but not compact
70.	If Y is a subspace of X, A is closed in Y and Y is closed in X, then : (1) A is not closed in X (2) A is semi-closed in X (3) A is open in X (4) None of these
71.	$\Delta \tan^{-1}\left(\frac{n-1}{n}\right) =$ (1) $2\tan^{-1}\left(\frac{1}{n^2}\right)$ (2) $\tan^{-1}\left(\frac{1}{n^2}\right)$ (3) $\tan^{-1}\left(\frac{1}{2n^2}\right)$ (4) $\tan^{-1}\left(\frac{1}{2n}\right)$

Question No.	Questions
72.	The first term of the series whose second and subsequent terms are 8, 3, 0, – 1, 0 is : (1) 10 (2) 12 (3) 15 (4) 20
73.	In the Gauss elimination method for solving a system of linear algebraic equations, triangularization leads to : (1) diagonal matrix (2) lower triangular matrix (3) upper triangular matrix (4) singular matrix
74.	In Simpson's one-third rule the curve $y = f(x)$ is assumed to be : (1) circle (2) parabola (3) ellipse (4) hyperbola
75.	The second order Runge-kutta method is applied to the initial value problem $y' = -y$, $y(0) = y_0$ with step size h. Then $y(h) =$ (1) $y_0(h^2 - 2h - 2)$ (2) $\frac{y_0}{2}(h^2 - 2h + 2)$ (3) $\frac{y_0}{6}(h^2 - 2h + 2)$ (4) $\frac{y_0}{6}(h^2 - 2h - 2)$
76.	Using Picard's method upto third approximation, solution of $\frac{dy}{dx} = -xy$, $y(0) = 1$, is $y_3 =$ (1) $1-\frac{x^2}{2}+\frac{x^4}{8}-\frac{x^6}{16}$ (2) $1-\frac{x^2}{2}+\frac{x^4}{8}-\frac{x^6}{24}$ (3) $1-\frac{x^2}{2}+\frac{x^4}{8}-\frac{x^6}{32}$ (4) $1-\frac{x^2}{2}+\frac{x^4}{8}-\frac{x^6}{48}$

Question No.	Questions
77.	The minimizing curve must satisfy a differential equation, called as : (1) Euler-Lagrange equation (2) Lagrange equation (3) Euler-Gauss equation (4) Cauchy-Euler equation
78.	Given the functional $\int_{x_0}^{x_1}\left(\frac{y'^2}{x^3}\right)dx$, then the extremal is : (1) $y=\frac{cx^3}{3}+c_1$ (2) $y=\frac{cx^4}{4}+c_1$ (3) $y=cx^2+c_1$ (4) $y=\sin x$
79.	Solution of the integral equation $\int_0^x (x-t)^{-\frac{1}{2}}u(t)\,dt=1$ is : (1) $u(x)=\frac{1}{x\sqrt{\pi}}$ (2) $u(x)=\frac{\pi}{\sqrt{x}}$ (3) $u(x)=\frac{1}{\pi\sqrt{x}}$ (4) $u(x)=\frac{1}{\sqrt{\pi x}}$
80.	The resolvent third kernel of the Volterra's integral equation with kernel $k(x, t) = 1$, is (1) $(x-t)^2$ (2) $\frac{1}{2}(x-t)^2$ (3) $\frac{1}{3}(x-t)^3$ (4) $\frac{1}{\lfloor 3}(x-t)^3$
81.	If A and B are finite sets and the total number of subsets of A has 56 more elements than the total number of subsets of B, then the number of elements in A is : (1) 4 (2) 5 (3) 6 (4) 8

Question No.	Questions
82.	If P (A) denotes the power set of the set A, then which of the following is correct ? (1) $A \cap P(A) = A$ (2) $A \cup P(A) = P(A)$ (3) $A - P(A) = A$ (4) $P(A) - \{A\} = P(A)$
83.	The order of a set A is 4 and that of a set B is 3. The number of relations from A to B is : (1) 12 (2) 144 (3) 2048 (4) 4096
84.	The set of real numbers in the closed interval {0, 1} is (1) finite set (2) uncountable set (3) countable set (4) None of these
85.	The nth term of the sequence $\left\{2, \frac{-3}{2}, \frac{4}{3}, \frac{-5}{4}, \ldots\ldots\right\}$ is : (1) $(-1)^{n-1}\left(1+\frac{1}{n}\right)$ (2) $(-1)^{n-1}\left(1-\frac{1}{n}\right)$ (3) $(-1)^{n-1}\left(1+\frac{2}{n}\right)$ (4) $(-1)^{n-1}\frac{2^n}{n-1}$
86.	The series $x + \frac{2^2 x^2}{\lfloor 2} + \frac{3^3 x^3}{\lfloor 3} + \frac{4^4 x^4}{\lfloor 4} + \ldots\ldots$ is convergent if : (1) $x > \frac{1}{e}$ (2) $0 < x < \frac{1}{e}$ (3) $\frac{2}{e} < x < \frac{3}{e}$ (4) $\frac{e}{3} < x < \frac{e}{2}$

Question No.	Questions
87.	The series $\sum\left(1+\frac{1}{n}\right)^{-n^2}$ is : (1) Convergent (2) Divergent (3) Oscillatory (4) None of these
88.	If $f(x) = x(x-1)(x-2)$; $x \in \left[0, \frac{1}{2}\right]$, then the value of 'C' of Lagrange's mean value theorem is : (1) $\frac{1}{3}$ (2) $\frac{1}{4}+\frac{1}{\sqrt{2}}$ (3) $\frac{6+\sqrt{21}}{18}$ (4) $\frac{6-\sqrt{21}}{6}$
89.	It is given that the function $f(x) = \begin{cases} \dfrac{a\cos x}{\frac{\pi}{2}-x}, & x \neq \pi/2 \\ 1, & x = \pi/2 \end{cases}$ is continuous at $x = \pi/2$, value of a is : (1) –1 (2) 1 (3) 2 (4) $\pi/2$
90.	Which of the following functions is not uniformly continuous in $[2, \infty)$? (1) $\frac{1}{x}$ (2) $\frac{1}{x^2}$ (3) e^x (4) $\sin x$

Question No.	Questions
91.	Let X_1 and X_2 be two stochastic random variables having variances k and 2 respectively. If the variance of $Y = 3X_2 - X_1$ is 25, then the value of k is (1) 7 (2) 19 (3) −7 (4) −19
92.	Which of the following is incorrect statement ? (1) Both the central limit theorem and the Weak law of large numbers hold for a sequence of i.i.d. random variables with finite mean and variance. (2) For the sequence of independent r.v.'s, Weak law of large numbers may hold but the central limit theorem may not hold. (3) Under certain conditions, the central limit theorem holds for variables which are not independent. (4) Lindeberg-Levy theorem should not be inferred as a particular case of Liapounoff 's theorem.
93.	Match List I and List II and select the correct answer using the codes given under the lists **List I** (Distribution) — **List II** (Moment Generating Function) for real t A. Poisson distribution — 1. $(q + p\,e^t)^n$, where p is probability of success B. Geometric distribution — 2. $p\,(1 - q\,e^t)^{-1}$, where p is probability of success C. Normal distribution — 3. $e^{\lambda(e^t - 1)}$, where λ is mean D. Binomial distribution — 4. $\exp\left(t^2/2\right)$ for standard variate Codes : A B C D (1) 1 2 3 4 (2) 3 1 4 2 (3) 2 3 1 4 (4) 3 2 4 1

Question No.	Questions
94.	Suppose that the probability of a dry day following a rainy day is $\frac{2}{3}$ and that the probability of a rainy day following a dry day is $\frac{1}{2}$. Given that January 19 is a dry day, what is the probability that January 21 will be a dry day ? (1) $\frac{5}{12}$ (2) $\frac{7}{12}$ (3) $\frac{7}{18}$ (4) $\frac{11}{18}$
95.	Let $X_1, X_2, \ldots, X_n$ be n in dependent and identically distributed variates, each with pdf $f(x) = \begin{cases} 1, & 0 < x < 1 \\ 0, & \text{otherwise} \end{cases}$. Then mean of smallest order statistic is (1) $\frac{n}{n+1}$ (2) $\frac{1}{n}$ (3) $\frac{1}{n+1}$ (4) 1
96.	If X_1, X_2 are i.i.d. N (0, 1), then the distribution of $X_1 - X_2$ is (1) N (0, 1) (2) N (0, 2) (3) $r\left(\frac{1}{2}\right)$ (4) r (1)

Question No.	Questions
97.	Mean square error of an estimator t of parameter θ is expressed as (1) Bias + Var (t) (2) [Bias + Var (t)]^2 (3) (Bias)^2 + [Var (t)]^2 (4) (Bias)^2 + Var (t)
98.	The degrees of freedom for t-statistic for paired t-test based on 20 pairs of observations is (1) 38 (2) 19 (3) 39 (4) 18
99.	If the sample size in Wald-Wolfowitz run test is large, the variate R (number of runs) is asymptotically normal with mean (1) $\frac{2n_1n_2}{n_1+n_2}+1$ (2) $\frac{2n_1}{n_1+n_2}+1$ (3) $\frac{2n_2}{n_1+n_2}+1$ (4) $\frac{2n_1n_2}{n_1+n_2}$ where n_1, n_2 are the sizes of the two samples.
100.	In the usual notations, $R^2_{1.23}$ can be expressed as : (1) $R^2_{1.23}=1-(1-r^2_{12})(1-r^2_{13.2})$ (2) $R^2_{1.23}=1-(1-r^2_{12})(1-r_{13.2})$ (3) $R^2_{1.23}=(1-r^2_{12})(1-r^2_{13.2})$ (4) $R^2_{1.23}=(1-r_{12})(1-r_{13.2})$

For uploading on the website. Jitender 30/01/17

(DO NOT OPEN THIS QUESTION BOOKLET BEFORE TIME OR UNTIL YOU ARE ASKED TO DO SO)

(MPH/PHD/URS–EE–2017)

Subject : MATHEMATICS

Code **C**

Sr. No. 10227

Time : 1¼ Hours	Max. Marks : 100	Total Questions : 100

Roll No. ____________ (in figure) ____________ (in words)

Name : ____________ Father's Name : ____________

Mother's Name : ____________ Date of Examination : ____________

(Signature of the candidate) (Signature of the Invigilator)

CANDIDATES MUST READ THE FOLLOWING INFORMATION/ INSTRUCTIONS BEFORE STARTING THE QUESTION PAPER.

1. **Candidates are required to attempt any 75 questions out of the given 100 multiple choice questions of 4/3 marks each. No credit will be given for more than 75 correct responses.**
2. The candidates must return the Question book-let as well as OMR answer-sheet to the Invigilator concerned before leaving the Examination Hall, failing which a case of use of unfair-means / mis-behaviour will be registered against him / her, in addition to lodging of an FIR with the police. Further the answer-sheet of such a candidate will not be evaluated.
3. In case there is any discrepancy in any question(s) in the Question Booklet, the same may be brought to the notice of the Controller of Examinations in writing **within two hours** after the test is over. No such complaint(s) will be entertained thereafter.
4. The candidate MUST NOT do any rough work or writing in the OMR Answer-Sheet. Rough work, if any, may be done in the question book-let itself. Answers **MUST NOT** be ticked in the Question book-let.
5. **There will be no negative marking. Each correct answer will be awarded 4/3 mark. Cutting, erasing, overwriting and more than one answer in OMR Answer-Sheet will be treated as incorrect answer.**
6. Use only Black or Blue <u>**BALL POINT PEN**</u> of good quality in the OMR Answer-Sheet.
7. BEFORE ANSWERING THE QUESTIONS, THE CANDIDATES SHOULD ENSURE THAT THEY HAVE BEEN SUPPLIED CORRECT AND COMPLETE BOOK-LET. COMPLAINTS, IF ANY, REGARDING MISPRINTING ETC. WILL NOT BE ENTERTAINED 30 MINUTES AFTER STARTING OF THE EXAMINATION.

Question No.	Questions	
1.	The number of elements of order 10 in Z_{30} is :	
	(1) 4	(2) 3
	(3) 2	(4) 1
2.	The generators of the group $G = \{a, a^2, a^3, a^4 = e\}$ are :	
	(1) a and a^2	(2) a and a^4
	(3) a and a^3	(4) a only
3.	If H and K are two subgroups of G of order 6 and 8 respectively, then order of HK is 16 if order of $H \cap K$ is :	
	(1) 2	(2) 3
	(3) 4	(4) 6
4.	Let G be a group of order 15, then the number of sylow subgroups of G of order 3 is :	
	(1) 4	(2) 3
	(3) 2	(4) 1
5.	The cardinality of a finite integral domain can not be :	
	(1) 6	(2) 5
	(3) 3	(4) 2
6.	A ring of polynomials over a field is a :	
	(1) group	(2) unique factorization domain
	(3) prime field	(4) irreducible
7.	Let R be a commutative ring with unity such that {0} is a prime ideal of R, then	
	(1) {0} is a maximal ideal of R	(2) R has zero divisors
	(3) R is a field	(4) R is a integral domain

Question No.	Questions
8.	A totally disconnected space is a : (1) T_0–space (2) T_1–space (3) T_2–space (4) T_3–space
9.	Every indiscrete space is : (1) compact and connected (2) not compact (3) disconnected (4) connected but not compact
10.	If Y is a subspace of X, A is closed in Y and Y is closed in X, then : (1) A is not closed in X (2) A is semi-closed in X (3) A is open in X (4) None of these
11.	The eigen values of a skew-symmetric matrix are : (1) always zero (2) always pure imaginary (3) always real (4) either zero or pure imaginary
12.	The dimension of the vector space of all 3×3 real symmetric matrices is : (1) 3 (2) 4 (3) 6 (4) 9
13.	The number of all non-singular linear transformations $T : R^4 \rightarrow R^3$ is : (1) 4 (2) 3 (3) 1 (4) 0
14.	Let $T : R^3 \rightarrow R^3$ be a linear transformation given by $T(x, y, z) = \left(\frac{x}{2}, \frac{y}{2}, 0\right)$. Rank of T is : (1) 3 (2) 1 (3) 4 (4) 2

Question No.	Questions
15.	A real quadratic form in three variables is equivalent to the diagonal form $-(x_1-x_2)^2-x_3^2$. Then, the quadratic form is : (1) negative definite (2) semi-negative definite (3) positive definite (4) semi-positive definite
16.	The positive integer n for which the equality $\left(\frac{\sqrt{3}}{2}+\frac{1}{2}i\right)^n=-1$ holds, is : (1) 2 (2) 4 (3) 5 (4) 6
17.	If $f(z)=3x-y+5+i(ax+by-3)$, then the values of a and b so that the function f (z) is entire, are : (1) $a=1, b=3$ (2) $a=3, b=1$ (3) $a=1, b=-3$ (4) $a=-1, b=3$
18.	The function $f(z)=e^{2\bar{z}+i}$ is : (1) differentiable at $z=0$ (2) differentiable at $z=-1$ (3) differentiable at $z=i$ (4) no where differentiable
19.	The principal value of $(-1)^{3i}$ is : (1) $e^{-\pi/2}$ (2) $e^{-\pi}$ (3) $e^{-3\pi}$ (4) $e^{-3\pi/2}$
20.	Solutions of the equation sinh z = cosh z are given by (1) $z=(-1+4n)\pi i$ (2) $z=e^{-3\pi i}$ (3) $z=e^{(2n+1)\pi i}$ (4) There are no solutions

Question No.	Questions
21.	If A and B are finite sets and the total number of subsets of A has 56 more elements than the total number of subsets of B, then the number of elements in A is : (1) 4 (2) 5 (3) 6 (4) 8
22.	If P (A) denotes the power set of the set A, then which of the following is correct ? (1) $A \cap P(A) = A$ (2) $A \cup P(A) = P(A)$ (3) $A - P(A) = A$ (4) $P(A) - \{A\} = P(A)$
23.	The order of a set A is 4 and that of a set B is 3. The number of relations from A to B is : (1) 12 (2) 144 (3) 2048 (4) 4096
24.	The set of real numbers in the closed interval {0, 1} is (1) finite set (2) uncountable set (3) countable set (4) None of these
25.	The nth term of the sequence $\left\{2, \frac{-3}{2}, \frac{4}{3}, \frac{-5}{4}, \ldots\ldots\right\}$ is : (1) $(-1)^{n-1}\left(1+\frac{1}{n}\right)$ (2) $(-1)^{n-1}\left(1-\frac{1}{n}\right)$ (3) $(-1)^{n-1}\left(1+\frac{2}{n}\right)$ (4) $(-1)^{n-1}\frac{2^n}{n-1}$

Question No.	Questions
26.	The series $x + \frac{2^2 x^2}{\lfloor 2} + \frac{3^3 x^3}{\lfloor 3} + \frac{4^4 x^4}{\lfloor 4} + ...$ is convergent if : (1) $x > \frac{1}{e}$ (2) $0 < x < \frac{1}{e}$ (3) $\frac{2}{e} < x < \frac{3}{e}$ (4) $\frac{e}{3} < x < \frac{e}{2}$
27.	The series $\sum \left(1+\frac{1}{n}\right)^{-n^2}$ is : (1) Convergent (2) Divergent (3) Oscillatory (4) None of these
28.	If $f(x) = x(x-1)(x-2)$; $x \in \left[0, \frac{1}{2}\right]$, then the value of 'C' of Lagrange's mean value theorem is : (1) $\frac{1}{3}$ (2) $\frac{1}{4}+\frac{1}{\sqrt{2}}$ (3) $\frac{6+\sqrt{21}}{18}$ (4) $\frac{6-\sqrt{21}}{6}$
29.	It is given that the function $f(x) = \begin{cases} \frac{a \cos x}{\frac{\pi}{2} - x}, & x \neq \pi/2 \\ 1, & x = \pi/2 \end{cases}$ is continuous at $x = \pi/2$, value of a is : (1) –1 (2) 1 (3) 2 (4) $\pi/2$

Question No.	Questions
30.	Which of the following functions is not uniformly continuous in $[2, \infty)$? (1) $\frac{1}{x}$ (2) $\frac{1}{x^2}$ (3) e^x (4) $\sin x$
31.	Consider a multiple linear regression model with r regressors, $r \geq 1$ and the response variable Y. Suppose $\hat{Y}$ is the fitted value of Y. R^2 is the coefficient of determination and R^2_{adj} is the adjusted coefficient of determination. Then (1) R^2 always increases if an additional regressor is included in the model (2) R^2_{adj} always increases if an additional regressor is included in the model (3) $R^2 < R^2_{adj}$ for all r (4) Correlation coefficient between Y and $\hat{Y}$ is always non-negative.
32.	Suppose X is a p-dimensional random vector with variance-covariance matrix Σ. If $P_1, P_2, ..., P_p$ represent p orthogonal eigenvectors of Σ corresponding to the eigen values $\lambda_1 > \lambda_2 > ... > \lambda_p \geq 0$ respectively, then which of the following is not correct ? (1) First principal component is $P_{-1}^T X$ (2) $P_{-1}^T X$ and $P_{-1}^T X$ ae correlated (3) $Var(P_{-1}^T X) = \lambda_1$ (4) $T_r(\Sigma) = \sum_{i=1}^{p} \lambda_i$
33.	For 2 strata $N_1 = 200$, $S_1^2 = 9$ and $N_2 = 300$, $S_2^2 = 4$; the variance of sample mean of sample size 100, under proportional allocation is (1) 0.048 (2) 0.056 (3) 0.240 (4) 0.084

Question No.	Questions
34.	If the population consists of a linear trend, $Y_i = i$; $i = 1, 2, 3, \ldots, k$, then (1) $Var(\bar{y}_{st}) \leq Var(\bar{y}_{sys})$ (2) $Var(\bar{y}_{st}) \geq Var(\bar{y}_{sys})$ (3) $Var(\bar{y}_{st}) = Var(\bar{y}_{sys})$ (4) $Var(\bar{y}_{st}) > Var(\bar{y}_{sys})$
35.	The total number of main and interaction effects in a 2^4 factorial experiment is (1) 3 (2) 14 (3) 15 (4) 16
36.	While analysing the data of a $k \times k$ Latin square design, the error d.f. in analysis of variance is equal to : (1) $k^3 - 3k^2 + 2k$ (2) $k^2 - 1$ (3) $k^2 - k - 2$ (4) $k^2 - 3k + 2$
37.	For a system with n elements connected in series with constant (but different for each element) hazard rates $\lambda_1, \lambda_2, \ldots, \lambda_n$ respectively, then mean time to failure of the system is (1) $1 - \prod_{i=1}^{n} (1 - e^{-\lambda_i t})$ (2) $\int_0^\infty \left[1 - \prod_{i=1}^{n} (1 - e^{-\lambda_i t})\right] dt$ (3) $e^{-\sum_{i=1}^{n} \lambda_i t}$ (4) $\int_0^\infty e^{-\sum_{i=1}^{n} \lambda_i t} dt$
38.	If primal in an LPP has alternative optimal solution, then the dual has (1) No feasible solution (2) Unbounded solution (3) Alternative optimal solution (4) Degenerate optimal solution

Question No.	Questions
39.	A manufacturing company has determined from an analysis of its accounting and production data for a certain part that its demand is 9000 units per annum and is uniformly distributed over the year. Further, it is known that the lead time is uniform and equals 8 working days, and the total working days in an year are 300. Then the re-order level would be (1) 30 (2) 2400 (3) 240 (4) $\frac{300}{8}$
40.	Trains arrive at the yard every 15 minutes and the service time is 30 minutes. If the line capacity of the yard is limited to 4 trains, then the probability that the yard is empty (assuming the arrivals follows Poisson distribution and the service times follow the exponential distribution) is (1) $\frac{1}{31}$ (2) $\frac{1}{32}$ (3) $\frac{1}{2}$ (4) $\frac{1}{4}$
41.	$\Delta \tan^{-1}\left(\frac{n-1}{n}\right) =$ (1) $2\tan^{-1}\left(\frac{1}{n^2}\right)$ (2) $\tan^{-1}\left(\frac{1}{n^2}\right)$ (3) $\tan^{-1}\left(\frac{1}{2n^2}\right)$ (4) $\tan^{-1}\left(\frac{1}{2n}\right)$
42.	The first term of the series whose second and subsequent terms are 8, 3, 0, – 1, 0 is : (1) 10 (2) 12 (3) 15 (4) 20

Question No.	Questions
43.	In the Gauss elimination method for solving a system of linear algebraic equations, triangularization leads to : (1) diagonal matrix (2) lower triangular matrix (3) upper triangular matrix (4) singular matrix
44.	In Simpson's one-third rule the curve $y = f(x)$ is assumed to be : (1) circle (2) parabola (3) ellipse (4) hyperbola
45.	The second order Runge-kutta method is applied to the initial value problem $y' = -y$, $y(0) = y_0$ with step size h. Then $y(h) =$ (1) $y_0(h^2 - 2h - 2)$ (2) $\frac{y_0}{2}(h^2 - 2h + 2)$ (3) $\frac{y_0}{6}(h^2 - 2h + 2)$ (4) $\frac{y_0}{6}(h^2 - 2h - 2)$
46.	Using Picard's method upto third approximation, solution of $\frac{dy}{dx} = -xy$, $y(0) = 1$, is $y_3 =$ (1) $1 - \frac{x^2}{2} + \frac{x^4}{8} - \frac{x^6}{16}$ (2) $1 - \frac{x^2}{2} + \frac{x^4}{8} - \frac{x^6}{24}$ (3) $1 - \frac{x^2}{2} + \frac{x^4}{8} - \frac{x^6}{32}$ (4) $1 - \frac{x^2}{2} + \frac{x^4}{8} - \frac{x^6}{48}$
47.	The minimizing curve must satisfy a differential equation, called as : (1) Euler-Lagrange equation (2) Lagrange equation (3) Euler-Gauss equation (4) Cauchy-Euler equation

Question No.	Questions
48.	Given the functional $\int_{x_0}^{x_1}\left(\frac{y'^2}{x^3}\right)dx$, then the extremal is : (1) $y=\frac{cx^3}{3}+c_1$ (2) $y=\frac{cx^4}{4}+c_1$ (3) $y = cx^2 + c_1$ (4) $y = \sin x$
49.	Solution of the integral equation $\int_0^x (x-t)^{-\frac{1}{2}} u(t)\,dt = 1$ is : (1) $u(x) = \frac{1}{x\sqrt{\pi}}$ (2) $u(x) = \frac{\pi}{\sqrt{x}}$ (3) $u(x) = \frac{1}{\pi\sqrt{x}}$ (4) $u(x) = \frac{1}{\sqrt{\pi x}}$
50.	The resolvent third kernel of the Volterra's integral equation with kernel $k(x, t) = 1$, is (1) $(x-t)^2$ (2) $\frac{1}{2}(x-t)^2$ (3) $\frac{1}{3}(x-t)^3$ (4) $\frac{1}{\lfloor 3}(x-t)^3$
51.	The value of the integral $\oint_C \frac{1}{z}dz$, where C is the circle $x = \cos t$, $y = \sin t$, $0 \le t \le 2\pi$, is : (1) $2\pi i$ (2) πi (3) 2π (4) $\frac{1}{2\pi}$

Question No.	Questions
52.	If C is the circle $\lvert z-3\rvert = 2$, then using Cauchy's integral formula, $\oint_C \frac{2z+5}{z^2-2z}\,dz =$ (1) $9\pi i$ (2) $\frac{9\pi i}{2}$ (3) $6\pi i$ (4) $3\pi i$
53.	For the function $f(z) = \frac{\cos z}{z^2(z-\pi)^3}$, the residue at the pole $z=\pi$ is : (1) $4\pi^3$ (2) $\frac{4\pi}{\pi^2-6}$ (3) $\frac{\pi^2-6}{2\pi^4}$ (4) $\frac{\pi^2-6}{2\pi^3}$
54.	Using Cauchy's residue theorem, value of the integral $\oint_C \frac{\tan z}{z}\,dz$, $C: \lvert z-1\rvert = 2$, is : (1) $4i$ (2) $-4i$ (3) $-2i$ (4) $2i$
55.	The only bounded entire functions are constants. This result is due to : (1) Cauchy (2) Liouville (3) Schwarz (4) Morera
56.	For the function $f(z) = \frac{1-e^z}{1+e^z}$, the singularity $z=\infty$ is : (1) a removable singularity (2) a pole (3) an isolated essential singularity (4) a non-isolated essential singularity

Question No.	Questions
57.	If $z = x + iy$, $w = u + iv$, then by the transformation $w = z\, e^{i\pi/4}$, the line $x = 0$ is transformed into the line : (1) $u - v = 1$ (2) $u + v = 1$ (3) $v = -u$ (4) $v = u$
58.	Total number of 4 digit numbers with no two digits common, are : (1) 4096 (2) 5436 (3) 4896 (4) 4536
59.	The number of positive integers which are less than 108 and prime to 108, are : (1) 24 (2) 36 (3) 40 (4) 52
60.	The number of zeros at the end of $\lfloor 75$ is : (1) 12 (2) 16 (3) 18 (4) 75
61.	The $(n-1)$th derivative of the Green's function $G(x, t)$ with regard to x at the point $x = t$, has : (1) Discontinuity of 1st kind (2) Discontinuity of 2nd kind (3) Removable discontinuity (4) No discontinuity
62.	Which of the following is incorrect ? (1) The eigen values of a symmetric kernel are real. (2) All iterated kernels of a symmetric kernel are also symmetric. (3) Every symmetric kernel with norm $\neq 0$ has at least one eigen value (4) Fredholm integral equation of the second kind has always an eigen value.

Question No.	Questions
63.	For a particle of mass m moving under a potential $v = \frac{k}{q}$, which one of the following relations is correct ? (1) $\ddot{q} = \frac{k}{m q^2}$ (2) $m\dot{q}^2 + \frac{2k}{q} = \text{constant}$ (3) $m\dot{q} + \frac{2k}{q} = \text{constant}$ (4) $m\dot{q}^2 + \frac{k}{q} = \text{constant}$
64.	A rigid body moving in space with one point fixed, has degrees of freedom : (1) 3 (2) 4 (3) 6 (4) 2
65.	For the Lagrangian $L = \frac{1}{2}\dot{q}^2 - q\dot{q} + q^2$, the conjugate momentum p is : (1) $\dot{q} - q$ (2) $\dot{q} + q$ (3) $\frac{1}{2}\dot{q}q$ (4) $q - \dot{q}$
66.	For n independent events $A_1, A_2, ..., A_n$, let $P(A_i) = \frac{1}{i+1}$, i = 1, 2, ..., n. Then the probability of happening at least one of the events is (1) $\frac{n}{n+1}$ (2) $\frac{1}{n+1}$ (3) $\frac{1}{n}$ (4) $1 - \frac{1}{n}$

Question No.	Questions	
67.	The idea of posterior probabilities was introduced by	
	(1) Pascal	(2) Poisson
	(3) Fisher	(4) Thomas Bayes
68.	In a perfectly symmetrical distribution, 50% of items are above 60 and 75% items are below 75. Then, the coefficient of quartile deviation is	
	(1) 15	(2) 30
	(3) $\frac{1}{4}$	(4) $\frac{1}{5}$
69.	In any discrete series (when all the values are not same) the relationship between M.D. about mean and S.D. is	
	(1) M.D. = S.D.	(2) M.D. < S.D.
	(3) M.D. > S.D.	(4) M.D. = Mean + S.D.
70.	A random variable X can take all non-negative integral values, and the probability that X takes the value r is proportional to $(0.4)^r$. Then the value of P (X = 0) is	
	(1) 1	(2) 0.4
	(3) 0.6	(4) $\frac{5}{3}$
71.	Let X_1 and X_2 be two stochastic random variables having variances k and 2 respectively. If the variance of $Y = 3X_2 - X_1$ is 25, then the value of k is	
	(1) 7	(2) 19
	(3) −7	(4) −19

Question No.	Questions
72.	Which of the following is incorrect statement ? (1) Both the central limit theorem and the Weak law of large numbers hold for a sequence of i.i.d. random variables with finite mean and variance. (2) For the sequence of independent r.v.'s, Weak law of large numbers may hold but the central limit theorem may not hold. (3) Under certain conditions, the central limit theorem holds for variables which are not independent. (4) Lindeberg-Levy theorem should not be inferred as a particular case of Liapounoff 's theorem.
73.	Match List I and List II and select the correct answer using the codes given under the lists List I (Distribution) — List II (Moment Generating Function) for real t A. Poisson distribution — 1. $(q + p\,e^t)^n$, where p is probability of success B. Geometric distribution — 2. $p\,(1 - q\,e^t)^{-1}$, where p is probability of success C. Normal distribution — 3. $e^{\lambda(e^t - 1)}$, where λ is mean D. Binomial distribution — 4. $\exp\left(t^2/2\right)$ for standard variate Codes : A B C D (1) 1 2 3 4 (2) 3 1 4 2 (3) 2 3 1 4 (4) 3 2 4 1

Question No.	Questions
74.	Suppose that the probability of a dry day following a rainy day is $\frac{2}{3}$ and that the probability of a rainy day following a dry day is $\frac{1}{2}$. Given that January 19 is a dry day, what is the probability that January 21 will be a dry day ? (1) $\frac{5}{12}$ (2) $\frac{7}{12}$ (3) $\frac{7}{18}$ (4) $\frac{11}{18}$
75.	Let $X_1, X_2, \ldots, X_n$ be n in dependent and identically distributed variates, each with pdf $f(x) = \begin{cases} 1, & 0 < x < 1 \\ 0, & \text{otherwise} \end{cases}$. Then mean of smallest order statistic is (1) $\frac{n}{n+1}$ (2) $\frac{1}{n}$ (3) $\frac{1}{n+1}$ (4) 1
76.	If X_1, X_2 are i.i.d. N (0, 1), then the distribution of $X_1 - X_2$ is (1) N (0, 1) (2) N (0, 2) (3) $r\left(\frac{1}{2}\right)$ (4) r (1)

Question No.	Questions
77.	Mean square error of an estimator t of parameter θ is expressed as (1) Bias + Var (t) (2) [Bias + Var (t)]^2 (3) (Bias)^2 + [Var (t)]^2 (4) (Bias)^2 + Var (t)
78.	The degrees of freedom for t-statistic for paired t-test based on 20 pairs of observations is (1) 38 (2) 19 (3) 39 (4) 18
79.	If the sample size in Wald-Wolfowitz run test is large, the variate R (number of runs) is asymptotically normal with mean (1) $\frac{2n_1n_2}{n_1+n_2}+1$ (2) $\frac{2n_1}{n_1+n_2}+1$ (3) $\frac{2n_2}{n_1+n_2}+1$ (4) $\frac{2n_1n_2}{n_1+n_2}$ where n_1, n_2 are the sizes of the two samples.
80.	In the usual notations, $R^2_{1.23}$ can be expressed as : (1) $R^2_{1.23}=1-(1-r^2_{12})(1-r^2_{13.2})$ (2) $R^2_{1.23}=1-(1-r^2_{12})(1-r_{13.2})$ (3) $R^2_{1.23}=(1-r^2_{12})(1-r^2_{13.2})$ (4) $R^2_{1.23}=(1-r_{12})(1-r_{13.2})$
81.	If $f_n(x)=\tan^{-1} nx$, $n \in [0, 1]$, whose point-wise limit is $f(x)=\begin{cases}0, & x=0\\ \frac{\pi}{2}, & x\in(0,1]\end{cases}$, then : (1) f (x) is differentiable (2) f (x) is not differentiable (3) f (x) is continuous (4) None of these

Question No.	Questions
82.	The integral $\int_0^\infty \sin x \, dx$: (1) exists (2) exists and equals zero (3) exists and equals 1 (4) does not exist
83.	If f is Riemann integrable with respect to α on [a, b], then : (1) f and α are both increasing (2) f and α are both bounded (3) f is bounded and α is increasing function (4) f is increasing and α is bounded function
84.	If f (x) = sin x, then the total variation of f (x) on [0, 2] is (1) 3 (2) 1 (3) 2 (4) ∞
85.	If f is a non-negative function, $< E_i >$ a disjoint sequence of measurable sets and $E = \bigcup E_i$, then (1) $\int_E f > \sum \int_{E_i} f$ (2) $\int_E f < \sum \int_{E_i} f$ (3) $\int_E f = \bigcup \int_{E_i} f$ (4) $\int_E f = \sum \int_{E_i} f$
86.	For the function $f(x, y) = \begin{cases} \frac{xy^2}{x^2 + y^4}, & (x, y) \neq (0, 0) \\ 0 & , (x, y) = (0, 0) \end{cases}$, the directional derivative along $\vec{u} = (\sqrt{2}, \sqrt{2})$ at (0, 0) is : (1) $\sqrt{2}$ (2) $\frac{1}{\sqrt{2}}$ (3) $2\sqrt{2}$ (4) $\sqrt{2}/3$

Question No.	Questions
87.	If X is a complete metric space, E is non-empty open subset of X, then : (1) E is a null set (2) E is of first category (3) E is of second category (4) E is incomplete
88.	If $A = \begin{bmatrix} -5 & -8 & 0 \\ 3 & 5 & 0 \\ 1 & 2 & -1 \end{bmatrix}$, then A^2 is : (1) nilpotent (2) idempotent (3) involutory (4) periodic
89.	If $A = \begin{bmatrix} 3 & -2 \\ 4 & -2 \end{bmatrix}$ satisfies the matrix equation $A^2 - \lambda A + 2I = 0$, then value of λ is : (1) 0 (2) 1 (3) 2 (4) −2
90.	If $X_1, X_2, \ldots\ldots, X_N$ are N non-zero orthogonal vectors, the dimension of the vector space spanned by the 2N vectors $X_1, X_2, \ldots\ldots, X_N, \quad -X_1, -X_2, \ldots\ldots -X_N$ is : (1) N (2) N + 1 (3) 2N (4) N^2
91.	Solution of $(xy^2 + x)\,dx + (yx^2 + y)\,dy = 0$ is : (1) $\tan^{-1}(x^2y^2 + 1) = c$ (2) $(x + 1)(y + 1) = c$ (3) $(x^2 + 1)(y^2 + 1) = c$ (4) $x^2 + y^2 + 1 = c$

Question No.	Questions
92.	P.I. for $(D^2 - 4D + 4)\, y = x\, e^{2x}$, is : (1) $\frac{x^3 e^{2x}}{6}$ (2) $\frac{x^2 e^{2x}}{4}$ (3) $\frac{x^3 e^{2x}}{8}$ (4) $8\, e^{2x}$
93.	The Green's function G (x, t) is : (1) one dimensional (2) two dimensional (3) three dimensional (4) n-dimensional
94.	Solving by variation of parameters the equation, $\frac{d^2y}{dx^2} + 4y = \tan 2x$, then value of Wornskion w, is (1) 4 (2) 3 (3) 1 (4) 0
95.	Which of the following is not true about the Strum-Liouville Problem (SLP) ? (1) All eigen values are real and non-negative. (2) SLP has always an eigen function. (3) Eigen functions corresponding to different eigen values are orthogonal w.r.t. weight function. (4) For each eigen value there exists only one linearly independent eigen function.

Question No.	Questions
96.	Solution of $\frac{\partial^2 z}{\partial x^2} + z = 0$ with $x = 0$, $z = e^y$ and $\frac{\partial z}{\partial x} = 1$, is : (1) $z = \cos x - e^y \sin x$ (2) $z = \cos x + e^y \sin x$ (3) $z = \sin x - e^y \cos x$ (4) $z = \sin x + e^y \cos x$
97.	The differential equation $f_{xx} + 2f_{xy} + 4f_{yy} = 0$ is : (1) parabolic (2) elliptic (3) hyperbolic (4) linear
98.	The surface satisfying $\frac{\partial^2 u}{\partial y^2} = x^3 y$ containing two lines $y = 0 = u$ and $y = 1 = u$ is (1) $u = x^3y^3 + y(1 - x^3)$ (2) $u = x^3y^3 - y(1 + x^3)$ (3) $u = x^3y^2 + 1 - x^3$ (4) $u = x^2y^3 + 1 - x^3$
99.	The relation $2z = \frac{x^2}{a^2} + \frac{y^2}{b^2}$ represents the partial differential equation : (1) $2z = p + q$ (2) $2z = \frac{xp}{yq}$ (3) $2z = xq + yp$ (4) $2z = xp + yq$
100.	Using Newton's-Raphson method, an iterative formula to compute the reciprocal of a natural number N, is : (1) $x_{n+1} = x_n(2 - N.x_n)$ (2) $x_{n+1} = x_n - N x_n^2$ (3) $x_{n+1} = 2x_n - N$ (4) $x_{n+1} = 2 - N.x_n$

For uploading on the website

Jitender 20/01/17
Professor & Head, Department of Mathematics, M.D. University, ROHTAK

(DO NOT OPEN THIS QUESTION BOOKLET BEFORE TIME OR UNTIL YOU ARE ASKED TO DO SO)

(MPH/PHD/URS–EE–2017)

Subject : MATHEMATICS

Sr. No. 10212

Code **D**

Time : 1¼ Hours **Max. Marks : 100** **Total Questions : 100**

Roll No. ____________ (in figure) ____________ (in words)

Name : ____________ Father's Name : ____________

Mother's Name : ____________ Date of Examination : ____________

(Signature of the candidate) (Signature of the Invigilator)

CANDIDATES MUST READ THE FOLLOWING INFORMATION/ INSTRUCTIONS BEFORE STARTING THE QUESTION PAPER.

1. **Candidates are required to attempt any 75 questions out of the given 100 multiple choice questions of 4/3 marks each. No credit will be given for more than 75 correct responses.**
2. The candidates must return the Question book-let as well as OMR answer-sheet to the Invigilator concerned before leaving the Examination Hall, failing which a case of use of unfair-means / mis-behaviour will be registered against him / her, in addition to lodging of an FIR with the police. Further the answer-sheet of such a candidate will not be evaluated.
3. In case there is any discrepancy in any question(s) in the Question Booklet, the same may be brought to the notice of the Controller of Examinations in writing **within two hours** after the test is over. No such complaint(s) will be entertained thereafter.
4. The candidate MUST NOT do any rough work or writing in the OMR Answer-Sheet. Rough work, if any, may be done in the question book-let itself. Answers **MUST NOT** be ticked in the Question book-let.
5. **There will be no negative marking. Each correct answer will be awarded 4/3 mark. Cutting, erasing, overwriting and more than one answer in OMR Answer-Sheet will be treated as incorrect answer.**
6. Use only Black or Blue **BALL POINT PEN** of good quality in the OMR Answer-Sheet.
7. BEFORE ANSWERING THE QUESTIONS, THE CANDIDATES SHOULD ENSURE THAT THEY HAVE BEEN SUPPLIED CORRECT AND COMPLETE BOOK-LET. COMPLAINTS, IF ANY, REGARDING MISPRINTING ETC. WILL NOT BE ENTERTAINED 30 MINUTES AFTER STARTING OF THE EXAMINATION.

Question No.	Questions
1.	The (n – 1)th derivative of the Green's function G (x, t) with regard to x at the point x = t, has : (1) Discontinuity of 1st kind (2) Discontinuity of 2nd kind (3) Removable discontinuity (4) No discontinuity
2.	Which of the following is incorrect ? (1) The eigen values of a symmetric kernel are real. (2) All iterated kernels of a symmetric kernel are also symmetric. (3) Every symmetric kernel with norm ≠ 0 has at least one eigen value (4) Fredholm integral equation of the second kind has always an eigen value.
3.	For a particle of mass m moving under a potential $v = \frac{k}{q}$, which one of the following relations is correct ? (1) $\ddot{q} = \frac{k}{m q^2}$ (2) $m \dot{q}^2 + \frac{2k}{q} = \text{constant}$ (3) $m \dot{q} + \frac{2k}{q} = \text{constant}$ (4) $m \dot{q}^2 + \frac{k}{q} = \text{constant}$
4.	A rigid body moving in space with one point fixed, has degrees of freedom : (1) 3 (2) 4 (3) 6 (4) 2

Question No.	Questions
5.	For the Lagrangian $L = \frac{1}{2}\dot{q}^2 - q\dot{q} + q^2$, the conjugate momentum p is : (1) $\dot{q} - q$ (2) $\dot{q} + q$ (3) $\frac{1}{2}\dot{q}q$ (4) $q - \dot{q}$
6.	For n independent events $A_1, A_2, ..., A_n$, let $P(A_i) = \frac{1}{i+1}$, i = 1, 2, ..., n. Then the probability of happening at least one of the events is (1) $\frac{n}{n+1}$ (2) $\frac{1}{n+1}$ (3) $\frac{1}{n}$ (4) $1 - \frac{1}{n}$
7.	The idea of posterior probabilities was introduced by (1) Pascal (2) Poisson (3) Fisher (4) Thomas Bayes
8.	In a perfectly symmetrical distribution, 50% of items are above 60 and 75% items are below 75. Then, the coefficient of quartile deviation is (1) 15 (2) 30 (3) $\frac{1}{4}$ (4) $\frac{1}{5}$
9.	In any discrete series (when all the values are not same) the relationship between M.D. about mean and S.D. is (1) M.D. = S.D. (2) M.D. < S.D. (3) M.D. > S.D. (4) M.D. = Mean + S.D.

Question No.	Questions
10.	A random variable X can take all non-negative integral values, and the probability that X takes the value r is proportional to $(0.4)^r$. Then the value of P (X = 0) is (1) 1 (2) 0.4 (3) 0.6 (4) $\frac{5}{3}$
11.	Solution of $(xy^2 + x)\, dx + (yx^2 + y)\, dy = 0$ is : (1) $\tan^{-1}(x^2y^2 + 1) = c$ (2) $(x + 1)(y + 1) = c$ (3) $(x^2 + 1)(y^2 + 1) = c$ (4) $x^2 + y^2 + 1 = c$
12.	P.I. for $(D^2 - 4D + 4)\, y = x\, e^{2x}$, is : (1) $\frac{x^3 e^{2x}}{6}$ (2) $\frac{x^2 e^{2x}}{4}$ (3) $\frac{x^3 e^{2x}}{8}$ (4) $8\, e^{2x}$
13.	The Green's function G (x, t) is : (1) one dimensional (2) two dimensional (3) three dimensional (4) n-dimensional
14.	Solving by variation of parameters the equation, $\frac{d^2y}{dx^2} + 4y = \tan 2x$, then value of Wornskion w, is (1) 4 (2) 3 (3) 1 (4) 0

Question No.	Questions
15.	Which of the following is not true about the Strum-Liouville Problem (SLP) ? (1) All eigen values are real and non-negative. (2) SLP has always an eigen function. (3) Eigen functions corresponding to different eigen values are orthogonal w.r.t. weight function. (4) For each eigen value there exists only one linearly independent eigen function.
16.	Solution of $\frac{\partial^2 z}{\partial x^2} + z = 0$ with $x = 0$, $z = e^y$ and $\frac{\partial z}{\partial x} = 1$, is : (1) $z = \cos x - e^y \sin x$ (2) $z = \cos x + e^y \sin x$ (3) $z = \sin x - e^y \cos x$ (4) $z = \sin x + e^y \cos x$
17.	The differential equation $f_{xx} + 2f_{xy} + 4f_{yy} = 0$ is : (1) parabolic (2) elliptic (3) hyperbolic (4) linear
18.	The surface satisfying $\frac{\partial^2 u}{\partial y^2} = x^3 y$ containing two lines $y = 0 = u$ and $y = 1 = u$ is (1) $u = x^3y^3 + y(1 - x^3)$ (2) $u = x^3y^3 - y(1 + x^3)$ (3) $u = x^3y^2 + 1 - x^3$ (4) $u = x^2y^3 + 1 - x^3$
19.	The relation $2z = \frac{x^2}{a^2} + \frac{y^2}{b^2}$ represents the partial differential equation : (1) $2z = p + q$ (2) $2z = \frac{xp}{yq}$ (3) $2z = xq + yp$ (4) $2z = xp + yq$

Question No.	Questions
20.	Using Newton's-Raphson method, an iterative formula to compute the reciprocal of a natural number N, is : (1) $x_{n+1} = x_n (2 - N . x_n)$ (2) $x_{n+1} = x_n - N x_n^2$ (3) $x_{n+1} = 2 x_n - N$ (4) $x_{n+1} = 2 - N . x_n$
21.	The value of the integral $\oint_C \frac{1}{z} dz$, where C is the circle $x = \cos t$, $y = \sin t$, $0 \le t \le 2\pi$, is : (1) $2\pi i$ (2) πi (3) 2π (4) $\frac{1}{2\pi}$
22.	If C is the circle $\lvert z - 3 \rvert = 2$, then using Cauchy's integral formula, $\oint_C \frac{2z+5}{z^2 - 2z} dz =$ (1) $9\pi i$ (2) $\frac{9\pi i}{2}$ (3) $6\pi i$ (4) $3\pi i$
23.	For the function $f(z) = \frac{\cos z}{z^2 (z-\pi)^3}$, the residue at the pole $z = \pi$ is : (1) $4\pi^3$ (2) $\frac{4\pi}{\pi^2 - 6}$ (3) $\frac{\pi^2 - 6}{2\pi^4}$ (4) $\frac{\pi^2 - 6}{2\pi^3}$
24.	Using Cauchy's residue theorem, value of the integral $\oint_C \frac{\tan z}{z} dz$, $C : \lvert z - 1 \rvert = 2$, is : (1) $4i$ (2) $-4i$ (3) $-2i$ (4) $2i$

Question No.	Questions
25.	The only bounded entire functions are constants. This result is due to : (1) Cauchy (2) Liouville (3) Schwarz (4) Morera
26.	For the function $f(z) = \frac{1-e^z}{1+e^z}$, the singularity $z = \infty$ is : (1) a removable singularity (2) a pole (3) an isolated essential singularity (4) a non-isolated essential singularity
27.	If $z = x + iy$, $w = u + iv$, then by the transformation $w = z\, e^{i\pi/4}$, the line $x = 0$ is transformed into the line : (1) $u - v = 1$ (2) $u + v = 1$ (3) $v = -u$ (4) $v = u$
28.	Total number of 4 digit numbers with no two digits common, are : (1) 4096 (2) 5436 (3) 4896 (4) 4536
29.	The number of positive integers which are less than 108 and prime to 108, are : (1) 24 (2) 36 (3) 40 (4) 52
30.	The number of zeros at the end of $\underline{|75}$ is : (1) 12 (2) 16 (3) 18 (4) 75

Question No.	Questions
31.	If $f_n(x) = \tan^{-1} nx$, $n \in [0, 1]$, whose point-wise limit is $f(x) = \begin{cases} 0, & x=0 \\ \frac{\pi}{2}, & x \in (0,1] \end{cases}$, then : (1) f (x) is differentiable (2) f (x) is not differentiable (3) f (x) is continuous (4) None of these
32.	The integral $\int_0^\infty \sin x \, dx$: (1) exists (2) exists and equals zero (3) exists and equals 1 (4) does not exist
33.	If f is Riemann integrable with respect to α on [a, b], then : (1) f and α are both increasing (2) f and α are both bounded (3) f is bounded and α is increasing function (4) f is increasing and α is bounded function
34.	If f (x) = sin x, then the total variation of f (x) on [0, 2] is (1) 3 (2) 1 (3) 2 (4) ∞
35.	If f is a non-negative function, $< E_i >$ a disjoint sequence of measurable sets and $E = \bigcup E_i$, then (1) $\int_E f > \sum \int_{E_i} f$ (2) $\int_E f < \sum \int_{E_i} f$ (3) $\int_E f = \bigcup \int_{E_i} f$ (4) $\int_E f = \sum \int_{E_i} f$

Question No.	Questions
36.	For the function $f(x, y) = \begin{cases} \dfrac{xy^2}{x^2 + y^4}, & (x, y) \neq (0, 0) \\ 0, & (x, y) = (0, 0) \end{cases}$, the directional derivative along $\bar{u} = (\sqrt{2}, \sqrt{2})$ at (0, 0) is : (1) $\sqrt{2}$ (2) $\frac{1}{\sqrt{2}}$ (3) $2\sqrt{2}$ (4) $\sqrt{2}/3$
37.	If X is a complete metric space, E is non-empty open subset of X, then : (1) E is a null set (2) E is of first category (3) E is of second category (4) E is incomplete
38.	If $A = \begin{bmatrix} -5 & -8 & 0 \\ 3 & 5 & 0 \\ 1 & 2 & -1 \end{bmatrix}$, then A^2 is : (1) nilpotent (2) idempotent (3) involutory (4) periodic
39.	If $A = \begin{bmatrix} 3 & -2 \\ 4 & -2 \end{bmatrix}$ satisfies the matrix equation $A^2 - \lambda A + 2I = 0$, then value of λ is : (1) 0 (2) 1 (3) 2 (4) −2

Question No.	Questions
40.	If $X_1, X_2, \ldots\ldots, X_N$ are N non-zero orthogonal vectors, the dimension of the vector space spanned by the 2N vectors $X_1, X_2, \ldots\ldots, X_N, \quad -X_1, -X_2, \ldots\ldots -X_N$ is : (1) N (2) N + 1 (3) 2N (4) N^2
41.	Consider a multiple linear regression model with r regressors, $r \geq 1$ and the response variable Y. Suppose $\hat{Y}$ is the fitted value of Y. R^2 is the coefficient of determination and R^2_{adj} is the adjusted coefficient of determination. Then (1) R^2 always increases if an additional regressor is included in the model (2) R^2_{adj} always increases if an additional regressor is included in the model (3) $R^2 < R^2_{adj}$ for all r (4) Correlation coefficient between Y and $\hat{Y}$ is always non-negative.
42.	Suppose X is a p-dimensional random vector with variance-covariance matrix Σ. If $P_1, P_2, \ldots, P_p$ represent p orthogonal eigenvectors of Σ corresponding to the eigen values $\lambda_1 > \lambda_2 > \ldots > \lambda_p \geq 0$ respectively, then which of the following is not correct ? (1) First principal component is $P_{-1}^T X$ (2) P_{-1}^T X and P_{-1}^T X ae correlated (3) Var $(P_{-1}^T X) = \lambda_1$ (4) $T_r(\Sigma) = \sum_{i=1}^{p} \lambda_i$

Question No.	Questions
43.	For 2 strata $N_1 = 200$, $S_1^2 = 9$ and $N_2 = 300$, $S_2^2 = 4$; the variance of sample mean of sample size 100, under proportional allocation is (1) 0.048 (2) 0.056 (3) 0.240 (4) 0.084
44.	If the population consists of a linear trend, $Y_i = i$; $i = 1, 2, 3, ..., k$, then (1) $Var(\bar{y}_{st}) \le Var(\bar{y}_{sys})$ (2) $Var(\bar{y}_{st}) \ge Var(\bar{y}_{sys})$ (3) $Var(\bar{y}_{st}) = Var(\bar{y}_{sys})$ (4) $Var(\bar{y}_{st}) > Var(\bar{y}_{sys})$
45.	The total number of main and interaction effects in a 2^4 factorial experiment is (1) 3 (2) 14 (3) 15 (4) 16
46.	While analysing the data of a k × k Latin square design, the error d.f. in analysis of variance is equal to : (1) $k^3 - 3k^2 + 2k$ (2) $k^2 - 1$ (3) $k^2 - k - 2$ (4) $k^2 - 3k + 2$
47.	For a system with n elements connected in series with constant (but different for each element) hazard rates $\lambda_1, \lambda_2, ..., \lambda_n$ respectively, then mean time to failure of the system is (1) $1 - \prod_{i=1}^{n} (1 - e^{-\lambda_i t})$ (2) $\int_0^\infty \left[1 - \prod_{i=1}^{n} (1 - e^{-\lambda_i t})\right] dt$ (3) $e^{-\sum_{i=1}^{n} \lambda_i t}$ (4) $\int_0^\infty e^{-\sum_{i=1}^{n} \lambda_i t} dt$
48.	If primal in an LPP has alternative optimal solution, then the dual has (1) No feasible solution (2) Unbounded solution (3) Alternative optimal solution (4) Degenerate optimal solution

Question No.	Questions
49.	A manufacturing company has determined from an analysis of its accounting and production data for a certain part that its demand is 9000 units per annum and is uniformly distributed over the year. Further, it is known that the lead time is uniform and equals 8 working days, and the total working days in an year are 300. Then the re-order level would be (1) 30 (2) 2400 (3) 240 (4) $\frac{300}{8}$
50.	Trains arrive at the yard every 15 minutes and the service time is 30 minutes. If the line capacity of the yard is limited to 4 trains, then the probability that the yard is empty (assuming the arrivals follows Poisson distribution and the service times follow the exponential distribution) is (1) $\frac{1}{31}$ (2) $\frac{1}{32}$ (3) $\frac{1}{2}$ (4) $\frac{1}{4}$
51.	$\Delta \tan^{-1}\left(\frac{n-1}{n}\right) =$ (1) $2\tan^{-1}\left(\frac{1}{n^2}\right)$ (2) $\tan^{-1}\left(\frac{1}{n^2}\right)$ (3) $\tan^{-1}\left(\frac{1}{2n^2}\right)$ (4) $\tan^{-1}\left(\frac{1}{2n}\right)$
52.	The first term of the series whose second and subsequent terms are 8, 3, 0, – 1, 0 is : (1) 10 (2) 12 (3) 15 (4) 20

Question No.	Questions
53.	In the Gauss elimination method for solving a system of linear algebraic equations, triangularization leads to : (1) diagonal matrix (2) lower triangular matrix (3) upper triangular matrix (4) singular matrix
54.	In Simpson's one-third rule the curve $y = f(x)$ is assumed to be : (1) circle (2) parabola (3) ellipse (4) hyperbola
55.	The second order Runge-kutta method is applied to the initial value problem $y' = -y$, $y(0) = y_0$ with step size h. Then $y(h) =$ (1) $y_0(h^2 - 2h - 2)$ (2) $\frac{y_0}{2}(h^2 - 2h + 2)$ (3) $\frac{y_0}{6}(h^2 - 2h + 2)$ (4) $\frac{y_0}{6}(h^2 - 2h - 2)$
56.	Using Picard's method upto third approximation, solution of $\frac{dy}{dx} = -xy$, $y(0) = 1$, is $y_3 =$ (1) $1 - \frac{x^2}{2} + \frac{x^4}{8} - \frac{x^6}{16}$ (2) $1 - \frac{x^2}{2} + \frac{x^4}{8} - \frac{x^6}{24}$ (3) $1 - \frac{x^2}{2} + \frac{x^4}{8} - \frac{x^6}{32}$ (4) $1 - \frac{x^2}{2} + \frac{x^4}{8} - \frac{x^6}{48}$
57.	The minimizing curve must satisfy a differential equation, called as : (1) Euler-Lagrange equation (2) Lagrange equation (3) Euler-Gauss equation (4) Cauchy-Euler equation

Question No.	Questions
58.	Given the functional $\int_{x_0}^{x_1}\left(\frac{y'^2}{x^3}\right)dx$, then the extremal is : (1) $y=\frac{cx^3}{3}+c_1$ (2) $y=\frac{cx^4}{4}+c_1$ (3) $y=cx^2+c_1$ (4) $y=\sin x$
59.	Solution of the integral equation $\int_0^x (x-t)^{-\frac{1}{2}}\, u(t)\, dt = 1$ is : (1) $u(x)=\frac{1}{x\sqrt{\pi}}$ (2) $u(x)=\frac{\pi}{\sqrt{x}}$ (3) $u(x)=\frac{1}{\pi\sqrt{x}}$ (4) $u(x)=\frac{1}{\sqrt{\pi x}}$
60.	The resolvent third kernel of the Volterra's integral equation with kernel k (x, t) = 1, is (1) $(x-t)^2$ (2) $\frac{1}{2}(x-t)^2$ (3) $\frac{1}{3}(x-t)^3$ (4) $\frac{1}{\lfloor 3}(x-t)^3$
61.	Let X_1 and X_2 be two stochastic random variables having variances k and 2 respectively. If the variance of $Y = 3X_2 - X_1$ is 25, then the value of k is (1) 7 (2) 19 (3) −7 (4) −19

Question No.	Questions
62.	Which of the following is incorrect statement ? (1) Both the central limit theorem and the Weak law of large numbers hold for a sequence of i.i.d. random variables with finite mean and variance. (2) For the sequence of independent r.v.'s, Weak law of large numbers may hold but the central limit theorem may not hold. (3) Under certain conditions, the central limit theorem holds for variables which are not independent. (4) Lindeberg-Levy theorem should not be inferred as a particular case of Liapounoff 's theorem.
63.	Match List I and List II and select the correct answer using the codes given under the lists **List I** (Distribution) — **List II** (Moment Generating Function) for real t A. Poisson distribution — 1. $(q + p\,e^t)^n$, where p is probability of success B. Geometric distribution — 2. $p\,(1 - q\,e^t)^{-1}$, where p is probability of success C. Normal distribution — 3. $e^{\lambda(e^t - 1)}$, where λ is mean D. Binomial distribution — 4. $\exp\left(t^2/2\right)$ for standard variate Codes : A B C D (1) 1 2 3 4 (2) 3 1 4 2 (3) 2 3 1 4 (4) 3 2 4 1

Question No.	Questions
64.	Suppose that the probability of a dry day following a rainy day is $\frac{2}{3}$ and that the probability of a rainy day following a dry day is $\frac{1}{2}$. Given that January 19 is a dry day, what is the probability that January 21 will be a dry day ? (1) $\frac{5}{12}$ (2) $\frac{7}{12}$ (3) $\frac{7}{18}$ (4) $\frac{11}{18}$
65.	Let $X_1, X_2, ..., X_n$ be n in dependent and identically distributed variates, each with pdf $f(x) = \begin{cases} 1, & 0<x<1 \\ 0, & \text{otherwise} \end{cases}$. Then mean of smallest order statistic is (1) $\frac{n}{n+1}$ (2) $\frac{1}{n}$ (3) $\frac{1}{n+1}$ (4) 1
66.	If X_1, X_2 are i.i.d. N (0, 1), then the distribution of $X_1 - X_2$ is (1) N (0, 1) (2) N (0, 2) (3) $r\left(\frac{1}{2}\right)$ (4) r (1)
67.	Mean square error of an estimator t of parameter θ is expressed as (1) Bias + Var (t) (2) [Bias + Var (t)]² (3) (Bias)² + [Var (t)]² (4) (Bias)² + Var (t)

Question No.	Questions
68.	The degrees of freedom for t-statistic for paired t-test based on 20 pairs of observations is (1) 38 (2) 19 (3) 39 (4) 18
69.	If the sample size in Wald-Wolfowitz run test is large, the variate R (number of runs) is asymptotically normal with mean (1) $\frac{2n_1n_2}{n_1+n_2}+1$ (2) $\frac{2n_1}{n_1+n_2}+1$ (3) $\frac{2n_2}{n_1+n_2}+1$ (4) $\frac{2n_1n_2}{n_1+n_2}$ where n_1, n_2 are the sizes of the two samples.
70.	In the usual notations, $R^2_{1.23}$ can be expressed as : (1) $R^2_{1.23}=1-(1-r^2_{12})(1-r^2_{13.2})$ (2) $R^2_{1.23}=1-(1-r^2_{12})(1-r_{13.2})$ (3) $R^2_{1.23}=(1-r^2_{12})(1-r^2_{13.2})$ (4) $R^2_{1.23}=(1-r_{12})(1-r_{13.2})$
71.	The number of elements of order 10 in Z_{30} is : (1) 4 (2) 3 (3) 2 (4) 1
72.	The generators of the group $G = \{a, a^2, a^3, a^4 = e\}$ are : (1) a and a^2 (2) a and a^4 (3) a and a^3 (4) a only
73.	If H and K are two subgroups of G of order 6 and 8 respectively, then order of HK is 16 if order of $H \cap K$ is : (1) 2 (2) 3 (3) 4 (4) 6

Question No.	Questions
74.	Let G be a group of order 15, then the number of sylow subgroups of G of order 3 is : (1) 4 (2) 3 (3) 2 (4) 1
75.	The cardinality of a finite integral domain can not be : (1) 6 (2) 5 (3) 3 (4) 2
76.	A ring of polynomials over a field is a : (1) group (2) unique factorization domain (3) prime field (4) irreducible
77.	Let R be a commutative ring with unity such that {0} is a prime ideal of R, then (1) {0} is a maximal ideal of R (2) R has zero divisors (3) R is a field (4) R is a integral domain
78.	A totally disconnected space is a : (1) T_0–space (2) T_1–space (3) T_2–space (4) T_3–space
79.	Every indiscrete space is : (1) compact and connected (2) not compact (3) disconnected (4) connected but not compact

Question No.	Questions
80.	If Y is a subspace of X, A is closed in Y and Y is closed in X, then : (1) A is not closed in X (2) A is semi-closed in X (3) A is open in X (4) None of these
81.	The eigen values of a skew-symmetric matrix are : (1) always zero (2) always pure imaginary (3) always real (4) either zero or pure imaginary
82.	The dimension of the vector space of all 3×3 real symmetric matrices is : (1) 3 (2) 4 (3) 6 (4) 9
83.	The number of all non-singular linear transformations $T : R^4 \to R^3$ is : (1) 4 (2) 3 (3) 1 (4) 0
84.	Let $T : R^3 \to R^3$ be a linear transformation given by $T(x, y, z) = \left(\frac{x}{2}, \frac{y}{2}, 0\right)$. Rank of T is : (1) 3 (2) 1 (3) 4 (4) 2
85.	A real quadratic form in three variables is equivalent to the diagonal form $-(x_1 - x_2)^2 - x_3^2$. Then, the quadratic form is : (1) negative definite (2) semi-negative definite (3) positive definite (4) semi-positive definite

Question No.	Questions
86.	The positive integer n for which the equality $\left(\frac{\sqrt{3}}{2}+\frac{1}{2}i\right)^n = -1$ holds, is : (1) 2 (2) 4 (3) 5 (4) 6
87.	If f (z) = 3x – y + 5 + i (ax + by – 3), then the values of a and b so that the function f (z) is entire, are : (1) a = 1, b = 3 (2) a = 3, b = 1 (3) a = 1, b = – 3 (4) a = – 1, b = 3
88.	The function $f(z) = e^{2z+i}$ is : (1) differentiable at z = 0 (2) differentiable at z = – 1 (3) differentiable at z = i (4) no where differentiable
89.	The principal value of $(-1)^{3i}$ is : (1) $e^{-\pi/2}$ (2) $e^{-\pi}$ (3) $e^{-3\pi}$ (4) $e^{-3\pi/2}$
90.	Solutions of the equation sinh z = cosh z are given by (1) $z = (-1 + 4n)\pi i$ (2) $z = e^{-3\pi i}$ (3) $z = e^{(2n+1)\pi i}$ (4) There are no solutions
91.	If A and B are finite sets and the total number of subsets of A has 56 more elements than the total number of subsets of B, then the number of elements in A is : (1) 4 (2) 5 (3) 6 (4) 8

Question No.	Questions
92.	If P (A) denotes the power set of the set A, then which of the following is correct ? (1) $A \cap P(A) = A$ (2) $A \cup P(A) = P(A)$ (3) $A - P(A) = A$ (4) $P(A) - \{A\} = P(A)$
93.	The order of a set A is 4 and that of a set B is 3. The number of relations from A to B is : (1) 12 (2) 144 (3) 2048 (4) 4096
94.	The set of real numbers in the closed interval {0, 1} is (1) finite set (2) uncountable set (3) countable set (4) None of these
95.	The nth term of the sequence $\left\{2, \frac{-3}{2}, \frac{4}{3}, \frac{-5}{4}, \ldots\ldots\right\}$ is : (1) $(-1)^{n-1}\left(1+\frac{1}{n}\right)$ (2) $(-1)^{n-1}\left(1-\frac{1}{n}\right)$ (3) $(-1)^{n-1}\left(1+\frac{2}{n}\right)$ (4) $(-1)^{n-1}\frac{2^n}{n-1}$
96.	The series $x + \frac{2^2 x^2}{\lfloor 2} + \frac{3^3 x^3}{\lfloor 3} + \frac{4^4 x^4}{\lfloor 4} + \ldots\ldots$ is convergent if : (1) $x > \frac{1}{e}$ (2) $0 < x < \frac{1}{e}$ (3) $\frac{2}{e} < x < \frac{3}{e}$ (4) $\frac{e}{3} < x < \frac{e}{2}$

Question No.	Questions
97.	The series $\sum \left(1+\frac{1}{n}\right)^{-n^2}$ is : (1) Convergent (2) Divergent (3) Oscillatory (4) None of these
98.	If $f(x) = x(x-1)(x-2)$; $x \in \left[0, \frac{1}{2}\right]$, then the value of 'C' of Lagrange's mean value theorem is : (1) $\frac{1}{3}$ (2) $\frac{1}{4}+\frac{1}{\sqrt{2}}$ (3) $\frac{6+\sqrt{21}}{18}$ (4) $\frac{6-\sqrt{21}}{6}$
99.	It is given that the function $f(x) = \begin{cases} \frac{a\cos x}{\frac{\pi}{2}-x}, & x \neq \pi/2 \\ 1, & x = \pi/2 \end{cases}$ is continuous at $x = \pi/2$, value of a is : (1) –1 (2) 1 (3) 2 (4) $\pi/2$
100.	Which of the following functions is not uniformly continuous in $[2, \infty)$? (1) $\frac{1}{x}$ (2) $\frac{1}{x^2}$ (3) e^x (4) $\sin x$

1. 3	16. 1	31. 1	46. 2	61. 3	76. 1	91. 2
2. 3	17. 2	32. 1	47. 4	62. 3	77. 4	92. 3
3. 4	18. 3	33. 3	48. 3	63. 3	78. 3	93. 1
4. 2	19. 2	34. 2	49. 1	64. 2	79. 2	94. 1
5. 1	20. 1	35. 2	50. 2	65. 2	80. 3	95. 3
6. 2	21. 4	36. 4	51. 3	66. 4	81. 1	96. 4
7. 1	22. 3	37. 3	52. 1	67. 1	82. 2	97. 4
8. 4	23. 4	38. 4	53. 1	68. 2	83. 4	98. 4
9. 2	24. 4	39. 2	54. 3	69. 3	84. 2	99. 3
10. 3	25. 2	40. 3	55. 2	70. 2	85. 3	100. 1
11. 2	26. 4	41. 1	56. 4	71. 1	86. 2	
12. 4	27. 1	42. 3	57. 2	72. 4	87. 4	
13. 3	28. 4	43. 2	58. 1	73. 2	88. 2	
14. 1	29. 3	44. 4	59. 4	74. 1	89. 1	
15. 4	30. 4	45. 1	60. 1	75. 1	90. 1	

Jitander
Professor & Head,
Department of Mathematics
M.D. University. ROHTAK

1. 2	16. 4	31. 3	46. 4	61. 1	76. 4	91. 1
2. 4	17. 4	32. 1	47. 3	62. 3	77. 1	92. 2
3. 3	18. 4	33. 1	48. 4	63. 2	78. 2	93. 4
4. 1	19. 3	34. 3	49. 2	64. 4	79. 3	94. 2
5. 4	20. 1	35. 2	50. 3	65. 1	80. 2	95. 3
6. 1	21. 1	36. 4	51. 4	66. 2	81. 3	96. 2
7. 2	22. 4	37. 2	52. 3	67. 4	82. 3	97. 4
8. 3	23. 2	38. 1	53. 4	68. 3	83. 4	98. 2
9. 2	24. 1	39. 4	54. 4	69. 1	84. 2	99. 1
10. 1	25. 1	40. 1	55. 2	70. 2	85. 1	100. 1
11. 2	26. 1	41. 1	56. 4	71. 3	86. 2	
12. 3	27. 4	42. 1	57. 1	72. 3	87. 1	
13. 1	28. 3	43. 3	58. 4	73. 3	88. 4	
14. 1	29. 2	44. 2	59. 3	74. 2	89. 2	
15. 3	30. 3	45. 2	60. 4	75. 2	90. 3	

Jitender
Professor & Head,
Department of Mathematics
M.D. University, ROHTAK

1. 1	16. 4	31. 2	46. 4	61. 1	76. 2	91. 3
2. 3	17. 1	32. 3	47. 1	62. 4	77. 4	92. 1
3. 2	18. 4	33. 1	48. 2	63. 2	78. 2	93. 1
4. 4	19. 3	34. 1	49. 3	64. 1	79. 1	94. 3
5. 1	20. 4	35. 3	50. 2	65. 1	80. 1	95. 2
6. 2	21. 3	36. 4	51. 1	66. 1	81. 2	96. 4
7. 4	22. 3	37. 4	52. 1	67. 4	82. 4	97. 2
8. 3	23. 4	38. 4	53. 3	68. 3	83. 3	98. 1
9. 1	24. 2	39. 3	54. 2	69. 2	84. 1	99. 4
10. 2	25. 1	40. 1	55. 2	70. 3	85. 4	100. 1
11. 4	26. 2	41. 3	56. 4	71. 1	86. 1	
12. 3	27. 1	42. 3	57. 3	72. 2	87. 2	
13. 4	28. 4	43. 3	58. 4	73. 4	88. 3	
14. 4	29. 2	44. 2	59. 2	74. 2	89. 2	
15. 2	30. 3	45. 2	60. 3	75. 3	90. 1	

Jitender
Professor & Head,
Department of Mathematics
M.D. University, ROHTAK

1. 1	16. 4	31. 2	46. 4	61. 1	76. 2	91. 3
2. 4	17. 2	32. 4	47. 4	62. 2	77. 4	92. 3
3. 2	18. 1	33. 3	48. 4	63. 4	78. 3	93. 4
4. 1	19. 4	34. 1	49. 3	64. 2	79. 1	94. 2
5. 1	20. 1	35. 4	50. 1	65. 3	80. 2	95. 1
6. 1	21. 1	36. 1	51. 3	66. 2	81. 4	96. 2
7. 4	22. 1	37. 2	52. 3	67. 4	82. 3	97. 1
8. 3	23. 3	38. 3	53. 3	68. 2	83. 4	98. 4
9. 2	24. 2	39. 2	54. 2	69. 1	84. 4	99. 2
10. 3	25. 2	40. 1	55. 2	70. 1	85. 2	100. 3
11. 3	26. 4	41. 2	56. 4	71. 1	86. 4	
12. 1	27. 3	42. 3	57. 1	72. 3	87. 1	
13. 1	28. 4	43. 1	58. 2	73. 2	88. 4	
14. 3	29. 2	44. 1	59. 3	74. 4	89. 3	
15. 2	30. 3	45. 3	60. 2	75. 1	90. 4	

Jitander