DU MCA – 2017

1. Let R be the region in R^2 described by $x^2 + y^2 \leq 1,\ y^2 \leq x^2$. Then the value of $\int\int_R \sin(x^2 + y^2)dA$ equals :
(a) $\frac{\pi}{4}(1 - \cos(1))$ (b) $\frac{\pi}{2}(1 - \cos(1))$
(c) $\pi(1 - \cos(1))$ (d) $\frac{\pi}{2}$

2. Let S be the union of the cylinder $x^2 + y^2 = 4, -1 \leq z \leq 1$ and the hemisphere $x^2 + y^2 + (z-1)^2 = 4, z \geq 1$ with unit normal pointing outwards. The value of the integral is $\int\int_S (z^2\hat{k} - 2xz\hat{\imath})dA$ equal to :
(a) -4π (b) -2π
(c) -8π (d) 2π

3. Let $\vec{a} = xyz\hat{\imath} - x^2z^2\hat{\jmath} - x^3\hat{k}$ and $\vec{b} = y^3\hat{\imath} - xyz\hat{\jmath} + z^2\hat{k}$. Then $\frac{\partial^2\vec{a}}{\partial x^2} \times \frac{\partial^2\vec{b}}{\partial y^2}$ at the point (1, 1, 1) is equal to :
(a) $2\hat{k} - 3\hat{\jmath}$ (b) $6(\hat{k} - 3\hat{\jmath})$
(c) $6(2\hat{k} - 3\hat{\jmath})$ (d) $12(\hat{k} - 3\hat{\jmath})$

4. Consider the sequence $< a_n >$ defined by $a_1 = 0, a_2 = 1, a_{n+1} - 2a_n + a_{n-1} = 2, n \geq 2$. Then, $< a_n >$ is :
(a) divergent
(b) bounded but not convergent
(c) convergent and converges to 0
(d) convergent and converges to 1

5. If $y_1(t) = 2e^{2t} + te^{2t}$ and $y_2(t) = -e^{5t} + te^{2t}$ are solutions of the differential equation $y'' + p(t)y' + q(t)y = f(t)$ then, which one of the following is also solution of the same equation ?
(a) $2e^{2t} - e^{5t} + 2te^{2t}$ (b) $-2e^{2t} - te^{2t}$
(c) $2e^{5t} + te^{2t}$ (d) $2e^{2t} + e^{5t}$

6. A tank originally contains 100 liter of water with 10 gram of salt contained in it. A salty water containing 1 gram of salt per liter is entering into this tank at the rate of 5 liter/hour. The well mixed salty water flows out of the tank at the same rate of 5 liter/hour. Then the amount of salt in tank after 10 hours is :
(a) $100\left(1 - \frac{1}{\sqrt{e}}\right)$ (b) $100 - \frac{90}{\sqrt{e}}$
(c) $100\left(1 - \frac{1}{e^{1/4}}\right)$ (d) $200 - \frac{190}{e^{1/4}}$

7. The volume of the solid generated by revolving the region bounded by the parabola $x = y^2 - 3$ and x = 0 about the y-axis is :
(a) $\frac{48}{5}\sqrt{3}\pi$ (b) $\frac{24}{5}\sqrt{3}\pi$
(c) $48\sqrt{3}\pi$ (d) $24\sqrt{3}\pi$

8. Let G be a simple undirected planar graph on 10 vertices with 15 edges. If G is a connected graph, then the number of bounded faces in any embedding of G on the plane is equal to :
(a) 8 (b) 7 (c) 6 (d) 5

9. The number of internal vertices and leaves in a full 3-ary tree (graph) with 100 vertices, respectively, are :
(a) 34. 67 (b) 33, 67
(c) 33, 66 (d) 34, 66

10. If A is a 3×3 matrix with two eigenvalue 2 and –1. And the respective eigenvectors $\begin{pmatrix}1\\2\\0\end{pmatrix}$ and $\begin{pmatrix}0\\0\\1\end{pmatrix}$, then the vector $A^3\begin{pmatrix}1\\2\\2\end{pmatrix}$ is equal to :
(a) $\begin{pmatrix}8\\16\\6\end{pmatrix}$ (b) $\begin{pmatrix}2\\4\\-2\end{pmatrix}$
(c) $\begin{pmatrix}8\\16\\-1\end{pmatrix}$ (d) $\begin{pmatrix}8\\16\\-2\end{pmatrix}$

11. If B is a countable subset of uncountable set A, then A – B is :
(a) countable finite (b) countable infinite
(c) uncountable (d) bounded

12. The partial differential equation :
$A\frac{\partial^2 u}{\partial x^2} + 2B\frac{\partial^2 u}{\partial x \partial y} + C\frac{\partial^2 u}{\partial y^2} + D\frac{\partial u}{\partial x} + E\frac{\partial u}{\partial y} + Fu + G = 0$
(A, B, C, D, E, F, G are functions of x, y) is elliptic if :
(a) $B^2 - 4AC > 0$ (b) $B^2 - 4AC < 0$
(c) $B^2 - AC < 0$ (d) $B^2 - 8AC = 0$

13. Let A and B be cyclic groups of order m and n, respectively. Then the group $A \times B$ is cyclic if
(a) m and n are even
(b) m and n are odd
(c) m is seven and n are odd
(d) m and n are relatively prime

14. The function f is defined on R as :
$f(x) = \begin{cases} x - [x] - \frac{1}{2}, & when\ x\ is\ not\ an\ integer \\ 0, & x\ is\ an\ integer \end{cases}$
Then the function f(x) is continuous at all points of :
(a) R (b) Z
(c) Q (d) R – Z

15. Let f be defined and derivable on [a, b]. If f'(a). f'(b) < 0, then there exists a real number c between a and b such that :
(a) $f'(c) < 0$ (b) $f'(c) > 0$
(c) $f'(c).f'(a) < 0$ (d) $f'(c) = 0$

16. The characteristics roots of an idempotent matrix are :
(a) 0, –1 (b) –1, 0
(c) 1, –1 (d) 0, 1

17. If y = sin ax + cos ax then the nth derivate of y is $a^n\{1+(-1)^n.k\}^{1/2}$ where k is equal to :
(a) cos 2 ax (b) sin 2 ax
(c) cos ax (d) sin ax

18. The equation of the pair of lines through the origin perpendicular to the pair of lines $ax^2+2hxy+by^2=0$ is :
(a) $bx^2-2hxy+ay^2=0$
(b) $x^2-2hxy+y^2=0$
(c) $ax^2-2hxy+by^2=0$
(d) $bx^2+2hxy+ay^2=0$

19. The length of the common chord of two circles $(x-a)^2+y^2=a^2$ and $x^2+(y-b)^2=b^2$ is :
(a) $\frac{ab}{\sqrt{a^2+b^2}}$ (b) $\frac{2ab}{\sqrt{a^2+b^2}}$
(c) $\frac{3ab}{\sqrt{a^2+b^2}}$ (d) $\frac{4ab}{\sqrt{a^2+b^2}}$

20. The eccentricity and latusreclum of the ellipse :
$4x^2+9y^2-8x-36y+4=0$
Is …… respectively.
(a) $\frac{\sqrt{5}}{8}$ and $\frac{8}{5}$ (b) $\frac{\sqrt{5}}{6}$ and $\frac{8}{7}$
(c) $\frac{\sqrt{5}}{3}$ and $\frac{8}{3}$ (d) $\frac{\sqrt{5}}{2}$ and $\frac{8}{9}$

Read the following passages and answer the Question Nos. 21 – 30.

Passage 1

In a scientific feat, the Indian Space Research Organisation (ISRO) successfully launched a record 104 satellites into orbit at one go, shattering the previous Russian record of 37. ISRO's cost-effective and reliable satellite launch model is certainly reason to conclude. The problem though, is that such technological excellence is rarely visible in other sectors. From consumer goods to defence, the presence of successful Indian products and innovation is minimal. Even in the premier IT sector, Indian companies mostly excel at providing services to foreign clients rather than creating cutting-edge IT products. This lack of inventive spirit bodes ill for a country that wants to emerge as a global knowledge and technology hub.

China has powered far ahead of India-even in areas such as design, technology, innovation and scientific patents. This is the result of an Indian system that prefers bureaucratic red tape to merit or innovation. While private sector companies may have a better work culture than public sector organizations in India, they invest very little in R & D.

Heavy-handed regulation of India's educational institutions has also stifled creativity and innovation. It's being said that America doesn't produce enough STEM (science, technology, engineering, math) graduates of its own and will need to rely on Indian talent. But why does Indian talent need to be married to American institutions to succeed ? If we have the talent, why can't we have the institutions, thereby benefiting India rather than America ? ISRO may be one such institution but India needs many, many others like it. In that sense, as an industrialist has suggested, President of USA, Trump, may be a blessing in disguise if he prompts India to rethink its fundamentals, and start producing and innovating instead of just feeding talent to foreign shores.

21. How does the writer first react to ISRO's launch of 104 satellites ?
(a) It shows India's scientific talent and expertise
(b) Such achievements are very rare
(c) It will pave the way to future successes in the field
(d) We are still far behind China in this field

22. The writer is not entirely satisfied with this achievement because :
(a) Such achievements are exceptions rather than the rule
(b) Such skill and competence are confined to just a few sectors
(c) Unlike ISRO, other sectors have little to show by way of creativity and innovation
(d) All of the above

23. We lag behind China in matters of technology and scientific patents because :
(a) There is little encouragement to originality and innovation in our system
(b) Even private sector is unwilling to spend on research
(c) Both public sector and educational institutions discourage creativity
(d) All of the above

24. What change is required to make India a global knowledge and technology hub ?
(a) We need to have a better work culture
(b) Our educational institutions should not be focused merely on producing STEM graduates for America
(c) We should have many more ISROs in our country
(d) We should start producing and innovating rather than supplying talent to foreign countries

25. …… has also stifled creativity and innovation.
(a) Heavy-handed regulation of India's educational institutions.
(b) America produces enough STEM graduates.
(c) China invests little in R & D.
(d) Indian companies are poor in providing services.

Passage 2

According to the Global Tiger Initiative, tigers are indicators of the ecological wellness of planet earth. Being the dominant predators of the ecosystem, they ensure that the numbers of herbivores like deer are kept balanced. A steep fall in tiger population could lead to a rise in herbivore population, which could potentially destroy forests by consuming the trees and plants. At a time when the phenomena of climate change have increased concerns about environmental hazards, it is being sought to be addressed by using forests as carbon sinks. Conservation of tigers offers immense ecological services in terms of carbon storage value. So forests have to be saved to ensure that carbon storage is achieved. Poaching or killing of animals such as tigers results in increase of herbivore population, which in turn results in forests getting decimated.

A study conducted in Ranthambore tiger reserve has estimated that carbon stock in Ranthambhore Tiger Reserve fell progressively between 1975 to 2012 due to agricultural expansion and resultant deforestation. Tigers feed on mammalian herbivores such as chinkara, chital and sambar in this reserve area, thus keeping their population in check and helping to preserve the forests. Tiger habitats also provide critical ecosystem services such as flood control and hydrological services/securing watersheds.

India is home to 70 per cent of global tiger population. The Government of India has set up nine core buffer areas for maintaining tiger population. Now, this has expanded to 48 tiger reserves. Other measures being taken to save the tiger include : curbing wildlife trade through international agreements.

Apart from the ecological services provided by the animal, the tiger also offers direct use such as attracting tourists, which provide incomes for local communities. The aesthetic, ethical and cultural value of tigers have also proved to be critical factors for saving tigers, which has also ensured the success of tiger conservation in India.

26. Tiger are indicators of the ecological wellness of planet earth. How ?

(a) Poaching or killing of animals such as tigers eventually results in forests getting decimated.

(b) Tiger habitats provide critical ecosystem services such as flood control

(c) Tigers attract tourists and thus help the local economy

(d) They ensure that the numbers of herbivores like deer are kept balanced and thus help in conservation of forests

27. Tigers have a positive role to play in tackling the problem of climate. How ?

(a) Tigers help preserve forests – which act as carbon sinks – by keeping the herbivore population in check

(b) They render ecological services in terms of carbon storage

(c) Climate change is sought to be addressed by using forests as carbon sinks

(d) All of the above

28. How is tiger population sought to be maintained ?

(a) Setting up of tiger reserves is the most important step in this direction

(b) Conservation of tigers offers immense ecological services in terms of carbon storage value

(c) Agricultural expansion and resultant deforestation are being tackled

(d) Steps against poaching or killing of tigers are being taken

29. Mark the statement that is not true :

(a) A steep fall in tiger population could lead to a rise in herbivore population

(b) The number of tigers has fallen in Ranthambore Tiger Reserve

(c) By attracting tourists, the tiger has become a source of income for local communities

(d) Nine core buffer areas have been set up for maintaining tiger

30. India is home to ……. per cent of global tiger population.

(a) 50 (b) 60 (c) 70 (d) 80

31. The hexadecimal equivalent of the decimal number 2555, is :

(a) B9F (b) F9B (c) 9F8 (d) BF9

32. If the size of integer data type is four byte then the range of the values is :

(a) 0 to $2^{31} - 1$

(b) -2^{31} to $2^{31} - 1$

(c) -2^{31} to $2^{31} + 1$

(d) 0 to $2^{31} + 1$

33. For m = 4, n = 3 the value of expression m + + + – – n is, in C language.

(a) 5 (b) 6 (c) 7 (d) 8

34. Which of the following statement is correct in C language ?

(a) 'for loop' in C language can not be nested

(b) in 'pass by value' in functions in C the formal argument is not a copy of the actual parameter

(c) In 'pass by reference' in functions in C the actual and formal parameters refer to same memory area

(d) There is no associatively of operators in C language

35. The next term in the series is :
5, 20, 51 , 104, 185, ……..
(a) 300 (b) 285
(c) 265 (d) 250

36. The next element of the series :
ABZYCDXWEFVUGHTSIJ ……..
(a) QR (b) RQ (c) KL (d) LK

37. If A * B means age of B is less then age of A. A/B means age of A is less than age of B. A + B means A and B are of same age. Read the following expression in pairs from left :
P * Q * R + R/S/T
Then expression given that …… is youngest, without caring for other relationship of ages.
(a) S (b) R (c) Q (d) R

38. The persons A, B, C, D, E, F, G, H, I, J, K and L are watching a football match seated in two rows, one person sitting exactly behind the other person and six persons in each row. A, B, C, G, H and I are sitting in row 1 and remaining persons are sitting row 2 :
B, C, G, H, I are to the right of A, D, E, F, J, K are to the left of L, H is to the left of I, B is to the left of H and right of G, C is to the left of G, K is to the left of L and right of J. F is to the right of D and left of J. Others are sitting in the remaining positions.
Who is sitting exactly in front or behind the person D ?
(a) C (b) G (c) B (d) H

39. If the code of CAT is NLE and the code of ROSE is CZDP. The code of BOAT is :
(a) MZNE (b) LZME
(c) MZLE (d) NZME

40. In a group of cows and men the number of legs is 32 more than the twice the number of heads. The number of cows is :
(a) 8 (b) 12 (c) 14 (d) 16

41. Let $f(x) = \frac{1}{1+|x|} + \frac{1}{1+|x-1|}, x \in R$. Then :
(a) f is an increasing function for x > 0
(b) local minimum value of f is 4/3
(c) minimum value of f is 0
(d) f is decreasing function in (–1, 1)

42. If the set $S = \left\{\begin{pmatrix} 1 & 0 \\ -2 & 1 \end{pmatrix}, \begin{pmatrix} 0 & -1 \\ 1 & 1 \end{pmatrix}, \begin{pmatrix} 0 & 2 \\ 1 & 0 \end{pmatrix}\begin{pmatrix} \lambda & 0 \\ 1 & -\lambda \end{pmatrix}\right\}$ is linearly dependnt is the space $M_{2\times2}(R)$ of real matrices, then λ is equal to :
(a) –1/10 (b) 1/10
(c) –1/4 (d) 1/4

43. Let $W_1 = \{(a_1, a_2, a_3, a_4, a_5) \in R^5 | a_1 - a_3 - a_4 = 0\}$ and
$W_2 = \{(a_1, a_2, a_3, a_4, a_5) \in R^5 | a_2 = a_3 = a_4, a_1 + a_5 = 0\}$ be two subspaces of vector space R^5. Then
(a) $\dim(W_1 \cap W_2) \geq 2$
(b) $\dim(W_1 + W_2) = 5$
(c) $W_1 \cap W_2 = \phi$
(d) $\dim(W_1 + W_2) = 4$

44. Let $T : R^2 \to R^2$ be a linear transformation such that T(2, 3) = (3, 2) and T(0, 1) = (1, 4). Then :
(a) T(5, 6) = (6, 1) (b) T(5, 6) = (–6, 1)
(c) T(–5, –6) = (–6, 1) (d) T(–5, –6) = (6, –1)

45. Let G be a group of 2×2 matrics $\begin{pmatrix} a & b \\ c & d \end{pmatrix}$ such that ad – bc ≠ 0, and a, b, c, d ∈ Z_3 (integer modulo 3). The order of G is :
(a) 24 (b) 48
(c) 32 (d) 64

46. The number of automorphisms on a group Z_{12} (integer modulo 12) equals :
(a) 1 (b) 2
(c) 4 (d) 6

47. The order of the subgroup <12> + 26 in the quotient group $Z_{60}/< 12 >$ is :
(a) 3 (b) 4 (c) 6 (d) 8

48. Let the probability density function of a discrete random variable X be :
$$f(x) = \begin{cases} kx & x = 2, 4, 6 \\ k(x-2) & x = 8 \\ 0 & otherwise \end{cases}$$
Then, the expectation $E(X^2)$ is equal to :
(a) 20 (b) 18 (c) 24 (d) 22

49. Let $X_1, \ldots\ldots\ldots\ldots X_{100}$ be independent and identically distributed random variables with probability density function $f(x) = \frac{x^2}{9}, 0 \leq x \leq 3$. If $\bar{X}$ is the mean of these random variables, then the variance of $\bar{X}$ is equal to :
(a) $\left(\frac{3}{20}\right)^3$ (b) $\left(\frac{3}{10}\right)^3$
(c) $\frac{1}{10}\left(\frac{3}{2}\right)^3$ (d) $\frac{7}{5}\left(\frac{3}{2}\right)^3$

50. Let C be the curve $x = 1 - y^2$ from (0, –1) to (0, 1). Then the value of the line integral $\int_C y^3dx + x^2dy$ equals :
(a) $-\frac{26}{15}$ (b) $\frac{4}{15}$
(c) $-\frac{11}{15}$ (d) $\frac{16}{15}$