I-96

ENTRANCE EXAMINATION, 2015

M. Tech. Bioinformatics

Time: 2 hours **Maximum Marks: 75**

HALL TICKET NO. | |

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. Enter your hall ticket number on this sheet and the answer (OMR) sheet.
2. Answers are to be marked only on the OMR answer sheet with BLACK/BLUE ball point/Sketch pen following the instructions provided there upon.
3. Hand over OMR answer sheet at the end of examination.
4. All questions carry one mark each.
5. 0.33 mark will be deducted for every wrong answer.
6. There are total 13 pages (including this page) in this question paper. Check this before you start answering.
7. The question paper consists of **Part "A"** and **Part "B"**. The marks obtained in **Part "A"** will be taken into consideration in case of a tie, when more than one student gets equal marks, to prepare the merit list.
8. Non-programmable scientific calculators are permitted.
9. Cell/Mobile phones are strictly prohibited in the examination hall.

Part A

1. If α and β are the roots of $ax^2 + bx + c = 0$ then the equation whose roots are $a\alpha + b$ and $a\beta + b$ is
A) $x^2 - bx + ac = 0$
B) $x^2 - bx - ac = 0$
C) $x^2 - cx + ab = 0$
D) $x^2 - cx - ab = 0$

2. The decimal representation of an integer, whose ternary representation is 2120201, is
A) 1982
B) 1882
C) 1782
D) 1682

3. In a group of 520 persons each can speak at least one of Hindi and English languages. If 490 persons can speak Hindi and 260 persons can speak English then the number of persons who can speak both the languages is
A) 205
B) 210
C) 220
D) 230

4. Number of positive integers less than 1000 which are divisible either by 5 or by 7 is
A) 311
B) 312
C) 313
D) 314

5. For any positive integer k, let $f_k(x)$ be the function defined, for all real numbers x, by $f_k(x) = \frac{1}{k}(\sin^k x + \cos^k x)$; then the value of $f_4(x) - f_6(x)$ is:
A) $\frac{1}{12}$
B) $\frac{1}{10}$
C) $\frac{1}{8}$
D) $\frac{1}{6}$

6. A candidate is required to answer 6 out of 10 questions which divided into two parts each containing 5 questions. If the candidate is not permitted to attempt more than 4 questions from either part, then the number of different ways in which he/she can choose 6 questions is
A) 50
B) 100
C) 150
D) 200

7. Let X and Y be two sets, $f: X \rightarrow Y$ and $g: Y \rightarrow X$ be two functions such that the composition gof of g and f is the identity function on X. Then, which of the following statements is true
A) f is surjective
B) f is injective
C) g is surjective
D) g is injective

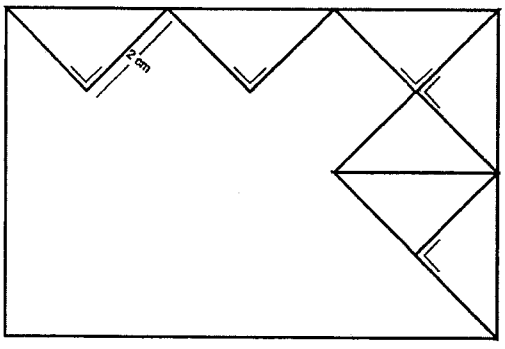
8. The value of $lim_{x \to 0}\, x\, cos\, \frac{1}{x}$ is
A) 0
B) 1
C) 2
D) -1

9. In the expansion of $(a - \frac{1}{\sqrt{a}})^7$ the coefficient of $\frac{1}{\sqrt{a}}$ is
A) 21
B) -21
C) 7
D) -7

10. The sum of the squared deviations of a set of numbers is minimum when deviations are from
A) median
B) geometric mean
C) arithmatic mean
D) origin

11) A drawer contains 50 bolts and 150 nuts. Half of the bolts and half of the nuts are rusted. If one item is chosen at random, the probability that it is rusted or is a bolt is
A) 5/12
B) 5/8
C) 5/16
D) 3/10

12) Consider the following image:



If the triangles are isosceles, what is the area of the quadrilateral?
A) 48

B) 8
C) 24
D) 12

13. Evaluate the equation

$(\sqrt{x^2} \div |x|) + 1$ where x is a non-zero real number. The answer should be:

A) 1
B) 0
C) 2
D) -1

14. If $f(x) = |(x^2 - 50)|$, what is the value of f (-5)?
A) 25
B) 38
C) 50
D) 15

15. $1+x+x^2+x^3=60$, then average of x, x^2, x^3 and x^4 is equal to which of the following?
A) 12x
B) 15x
C) 20x
D) 60x

16. What is meant by a dedicated computer
A) Which is used by one person only
B) Which is assigned one and only one task
C) Which uses one kind of software
D) Which is meant for application software

17. A Program or set of programs that converts a source code written in high level language to the object code instruction by instruction is a
A) Compiler
B) Assemble
C) Program Manager
D) Interpreter

18. BIOS stands for
A) Basic Input Output Software
B) Basic Input Output Service
C) Basic Input Output Structure
D) Basic Input Output System

19. Programs stored in ROM are called
A) Firmware
B) Software

C) Hardware
D) Middleware

20. One of the following construct is used to select proper path out of two or more alternative paths in programming
A) If ..else
B) While..do
C) do..while
D) for

21. Which of the following is not a valid "C" Language expression
A) x=y++
B) x=x+1
C) x+=1
D) x=*1

22. What will be the output of the following "C" code segment

```
main()
{
        int x=5;
        printf("%d", sizeof(x));
}
```

A) 5
B) 1
C) 2
D) 3

23. The code below contains lines of stack operations, what will be the value at the top of the stack once the code is executed?

```
S.push(5)
S.push(6)
S.push(S.pop()+1)
S.push(S.pop()+1)
S.push(12)
S.push(13)
S.pop()
S.push(S.pop()+20)
S.push(S.pop()+20)
```

A) 52
B) 42
C) 32
D) 22

24. If BAGHAVAN is coded as BADEASAK, then GABBAR will be coded as:
A) DXYYXO
B) DAZZAO
C) DABBAO
D) DBZZBO

25. Which of the following computer languages is used in artificial intelligence?
A) FORTRAN
B) C
C) PASCAL
D) PROLOG

Part B

26) A machine-readable code consisting of an array of black and white squares for reading by the camera on a smartphone is called
A) Barcode
B) UPC Code
C) QR Code
D) Mobile tagging code

27) A form of distributed and parallel computing, whereby a 'super and virtual computer' is composed of a cluster of networked, loosely coupled computers acting in concert to perform very large computational assignments in a federated system:
A) Peer to peer system
B) Utility computing
C) Grid computing
D) Client-server model

28) Following is NOT the feature of MySQL
A) It is an open source code RDBMS
B) It is not limited by hard disk performance
C) MySQL can be run on cloud computing platforms
D) It is written in C and C++

29) What command is used to save the standard output in a file and to display it on the terminal?
A) tee
B) grep
C) cat
D) more

30) The binary internet address 11001100.10000100.00101000.10011011 will be written in dotted decimal notation as
A) 204.132.40.155
B) 19.120.10.6
C) 192.16.0.1
D) 55.55.55.1

31. The number of lead atoms in a lead block with the volume of 0.3 cm^3 is (atomic mass of lead = 207 u & density = 11.3 g/cm^3)
A) 3.68×10^{25}
B) 3.30×10^{24}
C) 1.10×10^{23}
D) 9.86×10^{21}

32. Two sky divers jump out from a fixed height with a time interval of 10 secs between them. What would be the vertical distance between them during the fall? Consider, their mass is same, air resistance is zero and acceleration due to gravity remains same.
A) Distance increases
B) Distance decreases
C) Distance remains the same
D) Distance increases and decreases

33. An elevator with users has a combined mass of 2000 kg. The amount of instantaneous power need to lift the elevator by 2 m/s against the frictional force of 500 N is (acceleration due to gravity = 9.8 m/s^2)
A) 19,600 W
B) 22,400 W
C) 40,200 W
D) 48,600 W

34. A simple pendulum with a bob mass of 70 g takes 3.5 sec to complete a period. Then, the length of the pendulum is (acceleration due to gravity = 9.8 m/s^2)
A) 0.5 m
B) 3 m
C) 20 m
D) 31.5 m

35. How many electrons have $l = 1$ on an atom of chromium ($^{52}_{24}Cr$)
A) 3
B) 6
C) 8
D) 12

36. Splitting of spectral lines due to static magnetic field is known as
A) Zeeman effect
B) Compton effect
C) Stark effect

D) Stokes Effect

37. For a reaction following second-order kinetics, if the initial concentrations of the reactant is doubled, the half-life time
A) does not change
B) becomes half
C) becomes double
D) increases by four-fold

38. An ideal gas reversibly expands to four times of its initial volume at isothermal conditions. If the initial pressure is 2 atm, then the final pressure will be
A) 0.5 atm
B) 1 atm
C) 4 atm
D) 8 atm

39. An inter planar distance between two layers in a crystal is 3Å. The angle of first order reflection for X-rays of wavelength 1.5 Å will be equal to
A) 14.5°
B) 45.0°
C) 59.5°
D) 75.5°

40. Which one of the following is the correct order of timescale for electronic transitions (from fastest to slowest)?
A) Phosphorescence > Fluorescence > Light Absorption
B) Phosphorescence > Light Absorption > Fluorescence
C) Light Absorption > Fluorescence > Phosphorescence
D) Light Absorption > Phosphorescence > Fluorescence

41. The molecular geometry of SF_4 is (based on VSEPR)
A) Square planar
B) Tetrahedral
C) Square pyramidal
D) Trigonal bipyramidal

42. Which of the following is not true about the Raman Effect?
A) It is used as a tool to detect high-frequency phonon and magnon excitations
B) It can be used to measure atmospheric extinction coefficient and water vapour vertical distribution
C) Raman amplification is used in optical amplifiers
D) Stimulated Raman scattering is a linear-optical effect

43. The following studies the ground state of individual atoms and molecules, the excited states, and the transition states during a process
A) Quantum chemistry
B) Magnetic resonance imaging
C) Non-linear dynamics

D) Quantum mechanics

44. The following system does not fulfill the superposition principle wherein the output of the system is not directly proportional to the given input
A) A non-linear system
B) A Hamiltonian system
C) A chaotic system
D) A polynomial system

45. The ω angle at the peptide bond in a protein structure is normally fixed at
A) 190°
B) 180°
C) 120°
D) 100°

46. Which of the molecules below would not form hydrogen bonds?
A) CH_3OH
B) CH_3OCH_3
C) CH_3COOH
D) NH_3

47. If a single bonds forms between N and F (N-F) which of the following statements is correct?
A) Nitrogen exerts a stronger attraction for the electrons in the bond than fluorine
B) Fluorine exerts a stronger attraction for the electrons in the bond than nitrogen
C) Nitrogen would have a partial positive charge and fluorine would have a partial negative charge
D) Both B and C are correct

48. The units of the molar extinction coefficient are
A) L. $mole^{-1}$. cm^{-1}
B) L. mole. cm^{-1}
C) $mole^{-1}$. cm^{-1}
D) mL. mg^{-1}. cm^{-1}

49. An element M with the valence electron configuration ns^2 forms a compound with an element X with the valence electron configuration ns^2np^4. The formula of the compound which is formed would be expected to be
A) M_2X
B) MX
C) MX_2
D) M_3X_2

50. Which of the following order is correct for the first ionization energies of their elements?
A) B < Be < N < O
B) Be < B < N < O

C) B < Be < O < N
D) B < O < Be < N

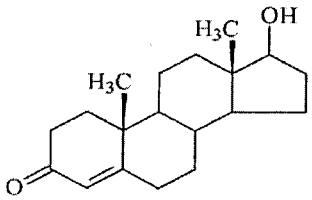
51. An atom of an isotope with a large neutron-to-proton ratio will probably emit a (an)
A) alpha particle
B) Beta particle
C) Gama particle
D) None of the above

52. The strongest of attractive forces is which type?
A) van der Waals
B) Dipole-dipole
C) Cation-anion
D) Hydrogen bonds

53. Which of these would you expect to have the lowest boiling point?
A) $CH_3CH_2CH_2OH$
B) $CH_3OCH_2CH_3$
C) $CH_3CH_2CH_2CH_2OH$
D) $CH_3CH_2OCH_2CH_3$

54. The solid alkane $CH_3(CH_2)_{18}CH_3$ is expected to exhibit the greatest solubility in which of the following solvents?
A) CCl_4
B) CH_3OH
C) H_2O
D) $CH_3\ NH_2$

55. The compound shown below is the male sex hormone, testosterone. In addition to the cycloalkane skeleton, testosterone also contains the following functional groups:



A) Alkene, ester, tertiary alcohol
B) Alkene, ether, secondary alcohol
C) Alkene, ketone, secondary alcohol
D) Alkene, ketone, tertiary alcohol

56. In order for a reagent to behave as a nucleophile it must have
A) an overall positive charge.
B) an overall negative charge
C) a non-bonding electron pair
D) a nitrogen or sulfur atom

57. Calculate the concentration of OH^- ions in a solution with pH = 12.1.
A) 79.4 mol dm^{-3}
B) 7.94×10^{-1} mol dm^{-3}
C) 7.94×10^{-6} mol dm^{-3}
D) 7.94×10^{-13} mol dm^{-3}

58. What will be the products of the reaction between chlorine and water?
A) H_2 and OCl_2
B) HCl and HOCl
C) H_2, O_2 and HCl
D) H_2, Cl_2 and HOCl

59. The following dye intercalates between the nitrogenous bases of the nucleic acids
A) Ethidium bromide
B) Trypan blue
C) Congo red
D) Methylene blue

60. Compounds having same structural formula but differing in spatial configuration are known as
A) Anomers
B) Epimers
C) Optical isomers
D) Stereoisomers

61. Proteins provide the following functions in an organism
A) Structural and matrix support
B) Serve as enzymes in biochemical reactions
C) Serve as regulatory elements and signaling molecules
D) All of the above

62. Which pathogens below can cause cancer?
A) *Chlamydia trachomatis*
B) Epstein-Barr Virus
C) *Helicobacter hepaticus*
D) All of the above

63. Much of the ultraviolet absorption of proteins above 240 nm is due to their content of
A) Alanine
B) Aspartate
C) Glutamate
D) Tryptophan

64. The new science of metagenomics aims at:
A. Generation of rapid genomic data from unculturable microorganisms
B. Decipher types of unculturable organisms inhabiting a given ecosystem, their functional acumen and interdependencies
C. To search for novel therapeutics and molecules through bioprospecting
D. All of the above

65. Physiologically active configuration of amino acids is in the form
A) D
B) L
C) Neither D nor L
D) For some amino acids it is either of two

66. The class of immunoglobulins that can get transported across epithelial cells is
A) IgG
B) IgE
C) IgA
D) IgM

67. Protein secondary structure is stabilized by
A) Vander waals forces
B) Electrostatic forces
C) Hydrogen bonds
D) Disulphide linkages

68. Topoisomerases are enzymes with
A) Both polymerization and unwinding activity
B) Both nuclease and ligase activity
C) Both transcription and ligase activity
D) Both polymerization and nuclease activity

69. A complex puzzle surrounding the extensive variation of nuclear genome size among eukaryotic species is called:
A) C- value paradox
B) Core genome disparity
C) Chargaff's rule
D) Enigmatic scaffolds

70. One of the following forms of DNA migrates fastest on gel electrophoresis:
A) covalently closed circular DNA
B) bacterial genomic DNA
C) restriction endonuclease digested DNA
D) nicked circular DNA

71. Nano-scale arbitrary folding of DNA in to different 2-D and 3-D shapes is called as:
A) DNA twisting and kinking
B) DNA origami
C) DNA kinking and bending
D) Atomic force scanning

72. One of the following is the most popular genome sequencing technology in terms of economy and output
A) Solexa/Illumina
B) 454
C) SoLiD
D) ABI/Sanger

73. The following species exhibit temperature dependent sex determination
A) Crocodilians
B) Turtles
C) Amphibians
D) Both A and B

74. One of the following dietary ingredients has been shown to harbor potential anti-inflammatory activities mediated through NfKB pathway
A) Cardamom
B) Linseed
C) Onion
D) Turmeric

75. One of the following is not a protozoan parasite
A) Chlamydia
B) Coccidia
C) Theileria
D) Giardia

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