

288

QUESTION PAPER
SERIES CODE

A

Registration No. :

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Centre of Exam. :

Name of Candidate :

Signature of Invigilator

ENTRANCE EXAMINATION, 2017

Ph.D. in COMPUTATIONAL BIOLOGY AND BIOINFORMATICS (CBBH—903) and
Ph.D. in COMPUTATIONAL BIOLOGY AND BIOINFORMATICS (CBBJ—814)

[Field of Study Code : CBBH (903)/CBBJ (814)]

Time Allowed : 3 hours

Maximum Marks : 80

INSTRUCTIONS FOR CANDIDATES

Candidates must read carefully the following instructions before attempting the Question Paper :

- (i) Write your Name and Registration Number in the space provided for the purpose on the top of this Question Paper and in the Answer Sheet.
- (ii) **Please darken the appropriate Circle of Question Paper Series Code on the Answer Sheet.**
- (iii) The Question Paper consists of two Parts : **Part—I** and **Part—II**.
- (iv) **Part—I** contains twenty (20) questions. Answer **all** questions. Each correct answer carries **2** marks.
- (v) **Part—II** has **five** sections of twenty (20) questions each. Candidates may choose any **one** section and answer twenty (20) questions. Each question carries **2** marks.
- (vi) There is **NO** negative marking in any Part/Section.
- (vii) Answer all the questions in the Answer Sheet provided for the purpose by darkening the correct choice, i.e., (a) or (b) or (c) or (d) with BLUE/BLACK BALLPOINT PEN only against each question in the corresponding circle.
- (viii) In case you think none of the possible answers are correct, mark the correct answer which you think is closest to the correct one.
- (ix) Answer written by the candidates inside the Question Paper will not be evaluated.
- (x) Simple Calculators and Log Tables may be used.
- (xi) Pages at the end have been provided for Rough Work.
- (xii) Return the Question Paper and Answer Sheet to the Invigilator at the end of the Entrance Examination. **DO NOT FOLD THE ANSWER SHEET.**

INSTRUCTIONS FOR MARKING ANSWERS

- 1. Use only Blue/Black Ballpoint Pen (do not use pencil) to darken the appropriate Circle.
- 2. Please darken the whole Circle.
- 3. Darken **ONLY ONE CIRCLE** for each question as shown in example below :

Wrong	Wrong	Wrong	Wrong	Correct
<input type="radio"/> a <input type="radio"/> b <input type="radio"/> c <input type="radio"/> d	<input checked="" type="radio"/> a <input type="radio"/> b <input type="radio"/> c <input type="radio"/> d	<input checked="" type="radio"/> a <input type="radio"/> b <input type="radio"/> c <input checked="" type="radio"/> d	<input type="radio"/> a <input checked="" type="radio"/> b <input type="radio"/> c <input type="radio"/> d	<input checked="" type="radio"/> a <input type="radio"/> b <input type="radio"/> c <input type="radio"/> d

- 4. Once marked, no change in the answer is allowed.
- 5. Please do not make any stray marks on the Answer Sheet.
- 6. Please do not do any rough work on the Answer Sheet.
- 7. Mark your answer only in the appropriate space against the number corresponding to the question.
- 8. **Ensure that you have darkened the appropriate Circle of Question Paper Series Code on the Answer Sheet.**

PART—I
(Research Methodology)

1. Which of the following is NOT the property of a randomly sampled data from a population?
 - (a) Probability of selecting each member of the population is equal
 - (b) The sampled data contains items representative of the full population
 - (c) Models developed on sampled data can be extended to the whole population
 - (d) Sample size cannot be less than 10% of the population size

2. Which of the following is the most desired property of a sound experimental research?
 - (a) Literature survey and comparison with other results
 - (b) Reproducibility of the outcome
 - (c) Visual presentation of results
 - (d) Mathematical description of results

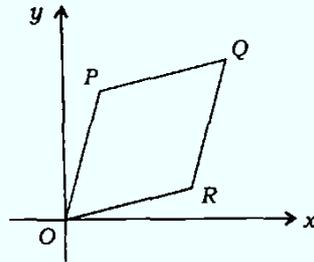
3. Which of the following improves the reliability of an experimental measurement?
 - (a) Use of replicates for making multiple observations
 - (b) Writing the results to higher places of decimal
 - (c) Use of a smoothing function
 - (d) Using costly equipment

4. Which one of the following is NOT the internet resource for obtaining the research article?
 - (a) Google scholar
 - (b) CiteSeer
 - (c) Google drive
 - (d) Scopus

5. If $y = 3x$ and $z = 2y$, what is the value of $x + y + z$ in terms of x ?

- (a) $10x$
- (b) $9x$
- (c) $8x$
- (d) $6x$

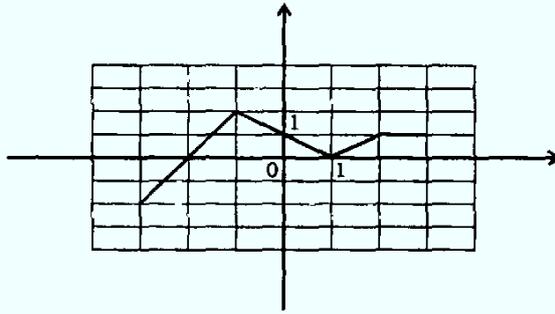
6. Parallelogram $OPQR$ lies in the x - y plane as shown in the figure given below :



Which of the following is correct?

- (a) Area of the parallelogram is constant if only O and Q are fixed
 - (b) OP and PR are always perpendicular
 - (c) Lines drawn between O and Q is always perpendicular to the one drawn between P and R
 - (d) All of the above
7. A manager is forming a 6-person team to work on a certain project. From the 11 candidates available for the team, the manager has already chosen three. In selecting the remaining team, how many different combinations are possible?
- (a) 6
 - (b) 8
 - (c) 56
 - (d) 120

8. The figure below shows the graph of a function f , in the $x-y$ plane.



What is the value of $f(f(-1))$?

- (a) -2
- (b) -1
- (c) 0
- (d) 1

9. Which of the following devices/techniques gives the highest precision?

- (a) Telescope
- (b) Microscope
- (c) X-ray
- (d) NMR

10. The alternating voltage that we use in household is sinusoidal in nature, which means the voltage signal is

- (a) cyclic
- (b) linear
- (c) non-linear
- (d) constant

11. Following table shows the average runs scored by four different cricket players in a series :

	<i>Average score</i>	<i>Standard deviation</i>	<i>Highest score</i>
<i>Player A</i>	85	25	100
<i>Player B</i>	75	5	100
<i>Player C</i>	40	15	100
<i>Player D</i>	45	10	100

Which of the following is true for the above data?

- (a) Every player is equally consistent
 - (b) Player B is most inconsistent
 - (c) Player A is most consistent
 - (d) None of the above
12. In a molecule an atom has a several stable conformations. The energy versus probability graph for such a molecule will be
- (a) Gaussian distribution
 - (b) sawtooth wave
 - (c) multimodal distribution
 - (d) binomial distribution
13. What is meant by *abstract* of a research paper?
- (a) Summary of the findings in the end of the text
 - (b) Randomly selected preview text for non-commercial users
 - (c) Final conclusion in the form of a hypothesis
 - (d) None of the above

14. If we find a new relationship between the properties under investigation through an experiment, the null hypothesis is most likely

- (a) accepted
- (b) rejected
- (c) modified
- (d) absent

15. The value of

$$\frac{(\log_{10} 4) \times (\log_{10} 2) \times (\log_{10} 3)}{(\log_{10} 7) \times (\log_{10} 2)}$$

is

- (a) $\log_{10} 2$
- (b) 0
- (c) 1
- (d) $\log_{10} \left(\frac{12}{7} \right)$

16. Goodness of a fitted model can be assessed by

- (a) chi-squared test
- (b) chi-cube test
- (c) test of normality
- (d) measuring kurtosis

17. A large number of observed nominal values of data can be summarized by
- (a) mean value
 - (b) median value
 - (c) frequency table
 - (d) All of the above
18. Resolution of a crystal structure was measured in distance units. A large reported value indicates
- (a) high resolution
 - (b) poor resolution
 - (c) multiple observations
 - (d) large molecule size
19. Primary data is NOT generated from
- (a) laboratory measurements
 - (b) sample survey
 - (c) simulation
 - (d) animal experiments
20. Which of the following softwares is NOT a data analysis platform/software?
- (a) SPSS
 - (b) R
 - (c) Excel
 - (d) SQL

PART—II

Answer all questions from any ONE of the Sections

Section—A

(Biology)

- 21.** Which of the following is true about prokaryotic cells?
- (a) Translation begins even before transcription is complete
 - (b) Translation initiates only after transcription is complete
 - (c) Translation occurs in the nucleus
 - (d) Transcription occurs in the nucleus
- 22.** Which of the following technologies does Roche 454 platform use for DNA sequencing?
- (a) Sequencing by synthesis
 - (b) Sequencing by ligation
 - (c) Chemical termination
 - (d) Pyrosequencing
- 23.** In *E. coli*, inactivation of cellular DNA methylase enzyme causes severe mutation in the genomic DNA. Which of the following DNA repair mechanisms would be most probably inhibited?
- (a) Double-strand break repair
 - (b) Mismatch repair
 - (c) Base excision repair
 - (d) Nucleotide excision repair
- 24.** Major plant hormone regulating plant's response to abiotic stresses is
- (a) auxin
 - (b) gibberellin
 - (c) abscisic acid
 - (d) cytokinin

25. Which of the following reagents/steps is NOT routinely used in polymerase chain reaction?
- (a) DNA ligase
 - (b) Oligonucleotide primers
 - (c) Taq DNA polymerase
 - (d) Denaturation using heating
26. In *E. coli*, the 70S ribosome dissociates into 30S and 50S subunits, when Mg^{2+} concentration is
- (a) low
 - (b) high
 - (c) Both (a) and (b)
 - (d) None of the above
27. Active chromatin is characterized by which of the following histone modifications?
- (a) H3K9 trimethylation
 - (b) H3K9 acetylation
 - (c) H4S1 phosphorylation
 - (d) H4K5 acetylation
28. A gene sequence consists of 1000 nucleotides of 5'UTR, 720 nucleotides of open reading frame and 500 nucleotides of 3'UTR. The protein coded by this gene would consist of
- (a) 240 amino acids
 - (b) 239 amino acids
 - (c) 238 amino acids
 - (d) 720 amino acids

- 29.** The approximate length of the ORF coding for a 55 kDa protein will be
- (a) 5000 nucleotides
 - (b) 2400 nucleotides
 - (c) 1500 nucleotides
 - (d) 3000 nucleotides
- 30.** Small nucleolar RNA (snoRNA) is involved in
- (a) inhibition of translation from mRNA
 - (b) processing of mRNA
 - (c) processing of pre-rRNA to mature rRNA species
 - (d) site-specific base modification in rRNA
- 31.** After sequencing 5000 genomes from a population of *Arabidopsis thaliana*, a researcher found a single nucleotide change from A to G in one of the genes on chromosome 2 in only one plant. What is the term used for this alteration?
- (a) Single nucleotide polymorphism
 - (b) Single nucleotide variant
 - (c) Single nucleotide shift
 - (d) Recombination
- 32.** Which of the following is responsible for induction of lytic cycle in response to UV irradiation in lysogenic bacteria?
- (a) RecA protein cleaves the repressor
 - (b) The repressor loses affinity for binding to promoter of cro gene due to formation of heterodimers
 - (c) The cro gene cannot transcribe anymore
 - (d) Phage DNA undergoes mutation in the region responsible for its replication

33. Which of the following statements is true about microRNAs?
- (a) microRNAs are highly specific and need 100% complementarity to the target gene
 - (b) microRNAs can target more than one gene
 - (c) microRNAs genes encode multiple primary transcripts that undergo extensive recombination to produce mature miRNA
 - (d) microRNAs, under extreme stress condition, can target pathogen proteins for degradation
34. Which of the following is the most abundant aromatic polymer on earth?
- (a) Cellulose
 - (b) Lignin
 - (c) Methane
 - (d) Limonene
35. The arrangement of leaves on the stem axis exhibits distinct patterns, termed as
- (a) phyllon
 - (b) phyllotaxy
 - (c) phyllous
 - (d) phyllobranchia
36. Plasmodesmata are microscopic channels that enable transport and communication between cells. Which of the following cannot pass through plasmodesmata in plants?
- (a) Transcription factors
 - (b) Viruses
 - (c) Fungal pathogens
 - (d) Chloroplasts

37. A researcher mapped the reads obtained after RNA sequencing on transcriptome file available for all protein coding genes. Which of the following **cannot** be done?
- (a) Identification of miRNA coding genes
 - (b) Determination of gene expression
 - (c) Identification of single nucleotide polymorphisms
 - (d) Identification of splicing isoforms
38. Which of the following is used as model systems for understanding symbiosis for nitrogen fixation?
- (a) *Arabidopsis thaliana*
 - (b) *Selaginella moellendorffii*
 - (c) *Lemna gibba*
 - (d) *Lotus japonicus*
39. Which of the following defines genome?
- (a) Total DNA contained in a single chromosome of an organism
 - (b) Total DNA present in a single cell of an organism
 - (c) Total DNA contained in somatic cells of an organism
 - (d) Total DNA contained in all cells of an organism
40. Which of the following is NOT true about metagenomics?
- (a) It may involve sequencing of thousands of species in one sample
 - (b) It is culture-independent
 - (c) It does not require isolation of individual microbes
 - (d) It focuses on microbial communities and wild plant races

Section—B

(Chemistry)

41. If 60% of a first-order reaction was completed in 60 minutes, 50% of the same reaction would be completed in approximately

- (a) 45 minutes
- (b) 60 minutes
- (c) 40 minutes
- (d) 50 minutes

42. Rate of a reaction can be expressed by Arrhenius equation as

$$k = Ae^{-E/RT}$$

In this equation, E represents

- (a) the energy below which colliding molecules will not react
 - (b) the total energy of the reacting molecules at a temperature T
 - (c) the fraction of molecules with energy greater than the activation energy
 - (d) the energy above which all the colliding molecules will react
43. Which of the following statements for order of reaction is NOT correct?
- (a) Order can be determine experimentally
 - (b) Order of a reaction is equal to the sum of the power of concentration terms in differential rate law
 - (c) It is not affected with the stoichiometric coefficients of the reactants
 - (d) Order cannot be fractional

44. A follows first-order reaction, $(A) \rightarrow \text{product}$

Concentration of A changes from $0.1M$ to $0.025M$ in 40 minutes. Find the rate of reaction of A when concentration of A is $0.01M$.

- (a) $1.73 \times 10^{-4} M \text{ min}^{-1}$
- (b) $3.47 \times 10^{-5} M \text{ min}^{-1}$
- (c) $3.47 \times 10^{-4} M \text{ min}^{-1}$
- (d) $1.73 \times 10^{-5} M \text{ min}^{-1}$

45. In a first-order reaction, the concentration of the reactant decreases from $0.8M$ to $0.4M$ in 15 minutes. The time taken for the concentration to change from $0.1M$ to $0.025M$ is
- (a) 7.5 minutes
 - (b) 15 minutes
 - (c) 30 minutes
 - (d) 60 minutes
46. Given $\Delta H_{\text{vap}} = 30 \text{ kJ/mole}$ and $\Delta S_{\text{vap}} = 75 \text{ J mol}^{-1} \text{ K}^{-1}$. Find the temperature of vapour at one atmosphere.
- (a) 400 K
 - (b) 350 K
 - (c) 298 K
 - (d) 250 K
47. For a particular reversible reaction at temperature T , ΔH and ΔS were found to be both +ve. If T_e is the temperature at equilibrium, the reaction would be spontaneous, when
- (a) $T = T_e$
 - (b) $T_e > T$
 - (c) $T > T_e$
 - (d) T_e is 5 times of T
48. The activation energy of a reaction at a given temperature is found to be $2.303 RT \text{ J mol}^{-1}$. The ratio of rate constant to the Arrhenius factor is
- (a) 0.1
 - (b) 0.01
 - (c) 0.001
 - (d) 0.02
49. Which among the following is NOT an antibiotic?
- (a) Erythromycin
 - (b) Oxytocin
 - (c) Penicillin
 - (d) Tetracycline

50. The sp^3d^2 hybridization of central atom of a molecule would lead to
- (a) square planar geometry
 - (b) tetrahedral geometry
 - (c) trigonal bipyramidal geometry
 - (d) octahedral geometry
51. The metal that is used as a catalyst in the hydrogenation of oils is
- (a) Pb
 - (b) Ni
 - (c) Cu
 - (d) Pt
52. Bleaching action of chlorine is by
- (a) decomposition
 - (b) hydrolysis
 - (c) reduction
 - (d) oxidation
53. How many chiral carbon atoms are present in 2, 3, 4-trichloropentane?
- (a) 3
 - (b) 2
 - (c) 1
 - (d) 4
54. IUPAC name of $(CH_3)_3CCl$ is
- (a) 2-chloro-2-methyl propane
 - (b) *t*-butyl chloride
 - (c) *n*-butyl chloride
 - (d) 3-chlorobutane
55. There are 20 naturally occurring amino acids. The maximum number of tripeptides that can be obtained is
- (a) 7465
 - (b) 5360
 - (c) 8000
 - (d) 6410

56. Which one of the following conformations of cyclohexane is the least stable?

- (a) Boat
- (b) Half-chair
- (c) Chair
- (d) Twisted boat

57. Paracetamol is

- (a) methyl salicylate
- (b) phenyl salicylate
- (c) *n*-acetyl *p*-amino phenol
- (d) acetyl salicylic acid

58. The correct decreasing order of dipole moment in CH_3Cl , CH_3Br and CH_3F is

- (a) $\text{CH}_3\text{F} > \text{CH}_3\text{Cl} > \text{CH}_3\text{Br}$
- (b) $\text{CH}_3\text{F} > \text{CH}_3\text{Br} > \text{CH}_3\text{Cl}$
- (c) $\text{CH}_3\text{Cl} > \text{CH}_3\text{F} > \text{CH}_3\text{Br}$
- (d) $\text{CH}_3\text{Cl} > \text{CH}_3\text{Br} > \text{CH}_3\text{F}$

59. What among the following is used to produce artificial rain?

- (a) Copper oxide
- (b) Carbon monoxide
- (c) Silver iodide
- (d) Silver nitrate

60. The term PVC used in the plastic industry stands for

- (a) polyvinyl chloride
- (b) polyvinyl carbonate
- (c) phosphor vanadium chloride
- (d) phosphavinyl chloride

Section—C

(Physics)

61. A vector \vec{A} is solenoidal, if its
- (a) gradient is zero
 - (b) divergence is zero
 - (c) divergence is non-zero
 - (d) gradient is non-zero
62. The eigenvalues of a matrix $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 1 \\ 0 & 1 & 1 \end{bmatrix}$ are
- (a) 1, 1, 2
 - (b) 0, 1, 2
 - (c) 2, 2, 0
 - (d) 2, 2, 1
63. If the dot product of two vectors is the same as the magnitude of the cross product, then angle between two vectors \vec{a} and \vec{b} is
- (a) $\pi/2$
 - (b) $\pi/4$
 - (c) $\pi/8$
 - (d) 0
64. Lagrange's equations of motion are second-order equations. The degrees of freedoms for these are
- (a) $2n$
 - (b) $2n - 1$
 - (c) $2n + 1$
 - (d) $2n + 2$
65. In the famous Rutherford scattering cross-section, differential scattering cross-section is proportional to [Hint : $e \rightarrow$ charge]
- (a) e
 - (b) e^2
 - (c) e^3
 - (d) e^4

66. What is the nature of the orbit if the value of eccentricity is 1?
- Hyperbola
 - Ellipse
 - Parabola
 - Circle
67. Electric field near an infinitely long sheet of charge with surface charge density σ is given as
- $\frac{\sigma}{\epsilon_0}$
 - $\frac{\sigma}{2\epsilon_0}$
 - $\frac{2\sigma}{\epsilon_0}$
 - $\frac{\sigma}{6\epsilon_0}$
68. Let $\delta(t)$ denote the delta function. The value of the integral $\int_{-\infty}^{\infty} \delta(t) \cos\left(\frac{3t}{2}\right) dt$ is
- 1
 - 1
 - 0
 - $\pi/2$
69. The Fourier transform of a signal $h(t)$ is $H(j\omega) = (2 \cos \omega)(\sin 2\omega) / \omega$. The value of $h(0)$ is
- 1/4
 - 1/2
 - 1
 - 2
70. A cylindrical cavity operating in TE_{111} mode has a 3 dB bandwidth of 2.4 MHz and its quality factor is 4000. Its resonant frequency would be
- 9.6 GHz
 - 6.78 GHz
 - 5.54 GHz
 - 3.67 GHz

71. Which one of the following is the characteristic impedance of lossless transmission line?
- (a) $\sqrt{\frac{R}{G}}$
 - (b) $\sqrt{\frac{L}{G}}$
 - (c) $\sqrt{\frac{L}{C}}$
 - (d) $\sqrt{\frac{R}{C}}$
72. Quantum statistics reduces to classical statistics under which of the following conditions?
- (a) $\rho\lambda^3 = 1$
 - (b) $\rho\lambda^3 \gg 1$
 - (c) $\rho\lambda^3 \ll 1$
 - (d) $\rho = 0$
73. A classical ideal gas follows
- (a) Maxwell-Boltzmann statistics
 - (b) Bose-Einstein statistics
 - (c) Fermi-Dirac statistics
 - (d) Gibbs' statistics
74. Which of the following is NOT true about the quantum numbers of electrons in an atom?
- (a) No two electrons can have all the four quantum numbers identical
 - (b) Electrons with higher principle quantum numbers have higher energy
 - (c) More electrons can have higher principal quantum numbers than the lower principal quantum numbers
 - (d) Electrons can swap their quantum numbers without energy implications
75. For a non-relativistic free particle, the phase velocity is
- (a) half of the group velocity
 - (b) equal to the group velocity
 - (c) greater than the group velocity
 - (d) independent of group velocity

- 76.** For Hermitian operators
- (a) every eigenvalue is complex
 - (b) Hermitian operator is a self-conjugate like real numbers
 - (c) the sum of two Hermitian operators is not Hermitian
 - (d) the product of two non-commuting Hermitian operators is also Hermitian
- 77.** Nuclear forces are
- (a) short range attractive forces
 - (b) short range repulsive forces
 - (c) long range attractive forces
 - (d) long range repulsive forces
- 78.** Superconducting materials are
- (a) paramagnetic
 - (b) ferromagnetic
 - (c) diamagnetic
 - (d) ferrimagnetic
- 79.** Suppose that a neutron at rest in free space decays into a proton and an electron. This process would violate
- (a) conservation of angular momentum
 - (b) conservation of charge
 - (c) conservation of energy
 - (d) conservation of linear momentum
- 80.** Which one of the following is true for a sinusoidal alternative current in a purely inductive circuit?
- (a) Current and voltage are in the same phase
 - (b) Voltage always lags behind the current
 - (c) Phase difference between current and voltage is sinusoidal
 - (d) Current always lags behind the voltage

Section—D

(Mathematics and Statistics)

- 81.** Fluid motion may be studied by which two/three different methods?
- (a) Lagrangian and Newtonian methods
 - (b) Lagrangian and Eulerian methods
 - (c) Newtonian and Eulerian methods
 - (d) Newtonian, Lagrangian and Eulerian methods
- 82.** How many sinks are there if the complex potential is given by $w = \log \left\{ z - \left(\frac{a^2}{z} \right) \right\}$?
- (a) 1
 - (b) 2
 - (c) 3
 - (d) 0
- 83.** Cauchy-Riemann equations in polar form are
- (a) $\frac{\partial \phi}{\partial r} = r \frac{\partial \psi}{\partial \theta}, \quad \frac{\partial \phi}{\partial \theta} = -\frac{1}{r} \frac{\partial \psi}{\partial r}$
 - (b) $\frac{\partial \phi}{\partial r} = \frac{1}{r} \frac{\partial \psi}{\partial \theta}, \quad \frac{1}{r} \frac{\partial \phi}{\partial \theta} = -\frac{\partial \psi}{\partial r}$
 - (c) $\frac{\partial \phi}{\partial r} = \frac{1}{r} \frac{\partial \psi}{\partial \theta}, \quad r \frac{\partial \phi}{\partial \theta} = -\frac{\partial \psi}{\partial r}$
 - (d) $\frac{\partial \phi}{\partial r} = -r \frac{\partial \psi}{\partial \theta}, \quad \frac{\partial \phi}{\partial \theta} = \frac{1}{r} \frac{\partial \psi}{\partial r}$
- 84.** In a conformal transformation, a source is transformed into an
- (a) equal source
 - (b) equal sink
 - (c) equal doublet
 - (d) equal source and doublet

85. The Mach number M for supersonic flow is

- (a) $1 < M < 6$
- (b) $M = 1$
- (c) $M > 1$
- (d) $M > 6$

86. The solution of initial value problem $y'' + 2y' + 10y = 6\delta(t)$, $y(0) = 0$, $y'(0) = 0$, where $\delta(t)$ denotes the Dirac delta function, is

- (a) $2e^t \sin 3t$
- (b) $6e^t \sin 3t$
- (c) $2e^{-t} \sin 3t$
- (d) $6e^{-t} \sin 3t$

87. $F(t) = G(t) + \lambda \int_a^t K(t, u)F(u)du$, where a is constant, is known as

- (a) Abel's integral equation
- (b) integrodifferential equation
- (c) Volterra integral equation
- (d) Fredholm integral equation

88. Under the usual meanings of the notations, the relation between the Fourier and Laplace transform is

- (a) $F\{F(t)\} = L\{F(t)\}$
- (b) $F\{F(t)\} = L\{G(t)\}$
- (c) $F\{F(t)\} = L[F\{G(t)\}]$
- (d) $F\{F(t)\} = L[G\{F(t)\}]$

89. Extremals $y = y(x)$ for the variational problem $I[y(x)] = \int_0^1 (y + y')^2 dx$ satisfies the differential equation

(a) $y'' + y = 0$

(b) $y'' - y = 0$

(c) $y'' + y' = 0$

(d) $y' + y = 0$

90. A Mobius transformation takes circle onto

(a) circle

(b) rectangle

(c) sphere

(d) any closed region

91. Every compact metric space M is

(a) complete

(b) not complete

(c) Can't be said

(d) Every Cauchy sequence is not convergent in M

92. The value of $\int_0^1 \frac{dx}{(1-x^n)^{\frac{1}{n}}}$ is

(a) $\frac{\pi}{n \sin \frac{\pi}{n}}$

(b) $\frac{\pi}{\sin \frac{\pi}{n}}$

(c) $\frac{2\pi}{n \sin \frac{\pi}{n}}$

(d) $\frac{1}{n \sin \frac{\pi}{n}}$

93. The function $f(z) = |z|^2$ is
- continuous everywhere
 - differential everywhere
 - not differential at origin
 - not continuous at origin
94. The convergence of which of the following methods is sensitive to starting value?
- False position method
 - Gauss-Seidel method
 - Newton-Raphson method
 - Bisection method
95. In general the ratio of truncation error to that of round-off error is
- 2 : 1
 - 1 : 1
 - 1 : 2
 - 1 : 3
96. What is the determinant value of the matrix
- $$\begin{bmatrix} (a+b)^2 & a^2 & a^2 \\ b^2 & (c+a)^2 & b^2 \\ c^2 & c^2 & (a+b)^2 \end{bmatrix} ?$$
- $2abc(a+b+c)$
 - $2abc(a-b-c)^3$
 - $2abc(a+b+c)^2$
 - $2abc(a+b+c)^3$

97. Find the equation of plane which passes through the point (3, -3, 1) and is normal to the line joining the points (3, 2, -1) and (2, -1, 5).

- (a) $x + 5y - 8z - 12 = 0$
- (b) $x + y - z + 12 = 0$
- (c) $x - 3y - 6z - 12 = 0$
- (d) $x + 3y - 6z + 12 = 0$

98. Find the equation of the spheres passing through the circle

$$x^2 + y^2 + z^2 - 6x - 2z + 5 = 0, \quad y = 0$$

and touching the plane $3y + 4z + 5 = 0$.

- (a) $x^2 + y^2 + z^2 + 6x + 4y + 2z - 5 = 0$
- (b) $x^2 + y^2 + z^2 - 6x - 4y - 2z + 5 = 0$
- (c) $x^2 + y^2 + z^2 - x - y - z + 5 = 0$
- (d) $x^2 + y^2 + z^2 - 3x - 7y - 9z + 5 = 0$

99. Find the angle of intersection of the curves $x^2 = 4y$ and $y^2 = 4x$.

- (a) $\tan^{-1} \frac{3}{4}$
- (b) $\tan^{-1} \frac{3\pi}{4}$
- (c) $\tan^{-1} \frac{\pi}{4}$
- (d) $\tan^{-1} \frac{\pi}{2}$

100. A five-figure number is formed by the digits 0, 1, 2, 3, 4 without repetition. Find the probability that the number formed is divisible by 4.

- (a) $\frac{3}{10}$
- (b) $\frac{5}{7}$
- (c) $\frac{5}{6}$
- (d) $\frac{5}{16}$

Section—E
(Bioinformatics)

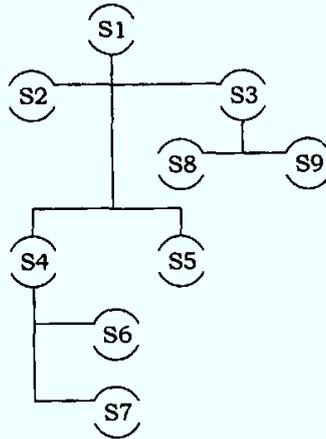
101. Which one of the following software tools is NOT used for multiple sequence alignment?
- (a) MAFFT
 - (b) T-coffee
 - (c) MUSCLE
 - (d) BLAST
102. If we consider a multiple sequence alignment and compute the columnwise shannon entropy, the value will be maximum if
- (a) the occurrences of all the bases have equal probability
 - (b) the occurrences of all the bases have different probability
 - (c) the occurrences of purines have zero probability
 - (d) the occurrences of pyrimidines have zero probability
103. What is the hamming distance between two DNA sequences S1 and S2 if S1 = {AACGTAAC} and S2 = {CGTAA}?
- (a) 0
 - (b) 1
 - (c) 2
 - (d) 3
104. The usual axioms of a distance measure do not include ____ property.
- (a) symmetry
 - (b) the triangle
 - (c) non-negativity
 - (d) the Boolean
105. Riboswitch is related to
- (a) DNA
 - (b) RNA
 - (c) lambda-bacterial switch
 - (d) ribosome protein

106. The degree distribution in a scale-free network is approximated by _____ law behaviour.
- (a) Gaussian
 - (b) power
 - (c) exponential
 - (d) gamma
107. Which of the following databases is useful for identifying geneal protein functional motifs?
- (a) SNPdB
 - (b) PROSITE
 - (c) KEGG
 - (d) MEME
108. Which one of the following do NOT belong to non-coding RNA family?
- (a) snRNA
 - (b) sdRNA
 - (c) snoRNA
 - (d) rRNA
109. Which of the following softwares/resources is used for RNA secondary structure prediction?
- (a) picTAR
 - (b) MFOLD
 - (c) miRNAmap
 - (d) MirScan
110. Which of the following is NOT included in protein data bank?
- (a) Structures of proteins solved by NMR
 - (b) Structures of proteins solved by homology modelling
 - (c) Structures of DNA
 - (d) Structures of large proteins such as ribosomal assembly

111. Which of the following is NOT a protein secondary structure?
- (a) 3-10 helix
 - (b) pi-helix
 - (c) alpha helix
 - (d) double helix
112. The matching of a protein sequence to a set of structural models is termed as
- (a) docking
 - (b) screening
 - (c) threading
 - (d) cliquing
113. Parameter estimation in HMM framework does not include _____ probabilities.
- (a) emission
 - (b) state transition
 - (c) begin and end
 - (d) state cumulative
114. Bowtie is a software used for
- (a) converting between BAM and SAM formatted files
 - (b) mapping raw NGS data to reference genomes
 - (c) NGS data compression
 - (d) NGS gene expression analysis
115. Which one of the following is NOT a proper genomic sequence data type?
- (a) BAC
 - (b) WGS
 - (c) RF
 - (d) MF
116. Which one of the following terms is NOT a part of RNA secondary structure?
- (a) Bulge loop
 - (b) Pseudoknot
 - (c) Hairpin loop
 - (d) Double knot

117. In BLAST search the E -value is computed by an expression $E = Kmn e^{-\lambda s}$; the term mn stands for
- magnitude
 - two-dimensional array
 - search space
 - substitution scoring matrices

118. In the following species tree



the relation between S7 and S9 is

- orthologous
 - paralogous
 - progeny
 - orphan
119. Which of the following is the ideal data structure for quick identification of substring of a fixed target string?
- Suffix tree
 - Hash tree
 - Prefix tree
 - Rootless tree
120. Which one of the following is NOT used in modelling and analyzing gene networks?
- Griffiths
 - Gillespie
 - Langevin
 - Fokker-Planck

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/288-A

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[P.T.O.]

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E7-225x2