NG 24 (GROUP B)

PART I — ENGINEERING MATHEMATICS

(Common to all Candidates)

(Answer ALL questions)

1. If A is a 3×3 matrix and determinant of A is 6, then find the value of the determinant of the matrix $(2A)^{-1}$

   a. $\frac{1}{12}$

   b. $\frac{1}{24}$

   c. $\frac{1}{36}$

   d. $\frac{1}{48}$

2. If $3x+2y+z=0$, $x+4y+z=0$, $2x+y+4z=0$, be a system of equations, then

   a. it is inconsistent

   b. it has only the trivial solution $x=0,\ y=0,\ z=0$

   c. it can be reduced to a single equation and so a solution does not exist

   d. the determinant of the matrix of coefficients is zero

3. Let $M=\begin{pmatrix}1&1&1\\0&1&1\\0&0&1\end{pmatrix}$. The maximum number of linearly independent eigen vectors of M is

   a. 0

   b. 1

   c. 2

   d. 3

4. The shortest and longest distance from the point $(1,\ 2,\ -1)$ to the sphere $x^2+y^2+z^2=24$ is

   a. $\left(\sqrt{14},\ \sqrt{46}\right)$

   b. $(14,\ 46)$

   c. $\left(\sqrt{24},\ \sqrt{56}\right)$

   d. $(24,\ 56)$

5. The solution of the given ordinary differential equation $x\frac{d^2y}{dx^2}+\frac{dy}{dx}=0$ is

   a. $y=A\log x+B$

   b. $y=Ae^{\log x}+Bx+C$

   c. $y=Ae^{x}+B\log x+C$

   d. $y=Ae^{x}+Bx^2+C$

6. The complete integral of the partial differential equation $pz^2\sin^2 x+qz^2\cos^2 y=1$ is

   a. $z=3a\cot x+(1-a)\tan y+b$

   b. $z^2=3a^2\cot x+3(1+a)\tan y+b$

   c. $z^3=-3a\cot x+3(1-a)\tan y+b$

   d. $z^4=2a^2\cot x+(1+a)(1-a)\tan y+b$

7. The area between the parabolas $y^2 = 4 - x$ and $y^2 = x$ is given by

a. $\frac{3\sqrt{2}}{16}$

b. $\frac{16\sqrt{3}}{5}$

c. $\frac{5\sqrt{3}}{16}$

d. $\frac{16\sqrt{2}}{3}$

8. The value of the integral $\int_0^a \int_0^b \int_0^c e^{x+y+z}\, dz\, dy\, dx$ is

a. e^{a+b+c}

b. $e^a + e^b + e^c$

c. $\left(e^a - 1\right)\left(e^b - 1\right)\left(e^c - 1\right)$

d. e^{abc}

9. If $\nabla\phi = 2xyz^3\,\vec{i} + x^2z^3\,\vec{j} + 3x^2yz^2\,\vec{k}$, then $\phi(x, y, z) =$

a. $\phi = xyz^2 + c$

b. $\phi = x^3yz^2 + c$

c. $\phi = x^2yz^3 + c$

d. $\phi = x^3yz + c$

10. The only function from the following that is analytic is

a. $F(z) = \mathrm{Re}(z)$

b. $F(z) = \mathrm{Im}(z)$

c. $F(z) = z$

d. $F(z) = \sin z$

11. The value of m so that $2x - x^2 + my^2$ may be harmonic is

a. 0

b. 1

c. 2

d. 3

12. The value of $\int_C \frac{1}{z} dz$, where C is the circle $z = e^{i\theta}$, $0 \le \theta \le \pi$ is,

a. πi

b. $-\pi i$

c. $2\pi i$

d. 0

13. The Region of convergence of the signal $x(n) = \delta(n - k),\ k > 0$ is

a. $z = \infty$

b. $z = 0$

c. Entire z-plane, except at $z = 0$

d. Entire z-plane, except at $z = \infty$

14. The Laplace transform of a signal $X(t)$ is $\frac{4s+1}{s^2+6s+3}$. The initial value $X(0)$ is

a. 0

b. 4

c. 1/6

d. 4/3

15. Given the inverse Fourier transform of $f(s)=\begin{cases} a-|s|, & |s|\le a \\ 0, & |s|>a \end{cases}$ is $\frac{a^2}{2\pi}\left[\frac{\sin\frac{ax}{2}}{\frac{ax}{2}}\right]^2$. The value of $\int_0^\infty\left[\frac{\sin x}{2}\right]^2 dx$ is

a. π

b. $\frac{2\pi}{3}$

c. $\frac{\pi}{2}$

d. $\frac{\pi}{4}$

16. If $A=[a_{ij}]$ is the coefficient matrix for a system of algebraic equations, then a sufficient condition for convergence of Gauss-Seidel iteration method is

a. A is strictly diagonally dominant

b. $|a_{ii}|=1$

c. $\det(A)\neq 0$

d. $\det(A)>0$

17. Which of the following formula is used to fit a polynomial for interpolation with equally spaced data?

a. Newton's divided difference interpolation formula

b. Lagrange's interpolation formula

c. Newton's forward interpolation formula

d. Least- square formula

18. For applying Simpson's $\frac{1}{3}$ rule, the given interval must be divided into how many number of sub-intervals?

a. odd

b. two

c. even

d. three

19. A discrete random variable X has the probability mass function given by $p(x)=cx,\ x=1,2,3,4,5$. The value of the constant 'c' is

a. 1/5

b. 1/10

c. 1/15

d. 1/20

20. For a Binomial distribution with mean 4 and variance 2, the value of 'n' is

a. 2

b. 4

c. 6

d. 8

PART II — BASIC ENGINEERING AND SCIENCES

(Common to all candidates)

(Answer ALL questions)

21. Speed of the processor chip is measured in
    a. Mbps
    b. GHz
    c. Bits per second
    d. Bytes per second

22. A program that converts Source Code into machine code is called
    a. Assembler
    b. Loader
    c. Compiler
    d. Converter

23. What is the full form of URL?
    a. Uniform Resource Locator
    b. Unicode Random Locator
    c. Unified Real Locator
    d. Uniform Read Locator

24. Which of the following can adsorb larger volume of hydrogen gas?
    a. Finely divided platinum
    b. Colloidal solution of palladium
    c. Small pieces of palladium
    d. A single metal surface of platinum

25. What are the factors that determine an effective collision?
    a. Collision frequency, threshold energy and proper orientation
    b. Translational collision and energy of activation
    c. Proper orientation and steric bulk of the molecule
    d. Threshold energy and proper orientation

26. Which one of the following flows in the internal circuit of a galvanic cell?
    a. atoms
    b. electrons
    c. electricity
    d. ions

27. Which one of the following is not a primary fuel?
    a. petroleum
    b. natural gas
    c. kerosene
    d. coal

28. Which of the following molecules will not display an infrared spectrum?
    a. CO_2
    b. N_2
    c. Benzene
    d. HCCH

29. Which one of the following behaves like an intrinsic semiconductor, at the absolute zero temperature?
    a. Superconductor
    b. Insulator
    c. n-type semiconductor
    d. p-type semiconductor

30. The energy gap (eV) at 300K of the material *GaAs* is
    a. 0.36
    b. 0.85
    c. 1.20
    d. 1.42

31. Which of the following ceramic materials will be used for spark plug insulator?

a. SnO_2

b. α-Al_2O_3

c. TiN

d. $YBaCuO_7$

32. In unconventional super-conductivity, the pairing interaction is

a. non-phononic

b. phononic

c. photonic

d. non-excitonic

33. What is the magnetic susceptibility of an ideal super conductor?

a. 1

b. –1

c. 0

d. infinite

34. The Rayleigh scattering loss, which varies as _____ in a silica fiber.

a. λ^0

b. λ^{-2}

c. λ^{-4}

d. λ^{-6}

35. What is the near field length *N* that can be calculated from the relation (if D is the diameter of the transducer and λ is the wavelength of sound in the material)?

a. $D^2 / 2\lambda$

b. $D^2 / 4\lambda$

c. $2D^2 / \lambda$

d. $4D^2 / \lambda$

36. Which one of the following represents open thermodynamic system?

a. Manual ice cream freezer

b. Centrifugal pump

c. Pressure cooker

d. Bomb calorimeter

37. In a new temperature scale say $^\circ\rho$, the boiling and freezing points of water at one atmosphere are $100^\circ\ \rho$ and $300^\circ\rho$ respectively. Correlate this scale with the Centigrade scale. The reading of $0^\circ\rho$ on the Centigrade scale is:

a. 0°C

b. 50°C

c. 100°C

d. 150°C

38. Which of the cross-section of the beam subjected to bending moment is more economical?

a. Rectangular cross-section

b. I - cross-section

c. Circular cross-section

d. Triangular cross-section

39. The velocity of a particle is given by $V = 4t^3 - 5t^2$. When does the acceleration of the particle becomes zero?

a. 8.33 s

b. 0.833 s

c. 0.0833 s

d. 1 s

40. What will happen if the frequency of power supply in a pure capacitor is doubled?

a. The current will also be doubled

b. The current will reduce to half

c. The current will remain the same

d. The current will increase to four-fold

PART III

10 - BIO-TECHNOLOGY

(Answer ALL questions)

41. In scaling up agitators from lab model to Industrial scale, which one of the following is preferred as scale-up criterion?
    a. Mixing time
    b. Reynolds No.
    c. Power number
    d. Power / volume of fermenter

42. Which of the following cells are most shear sensitive?
    a. mammalian
    b. plant
    c. bacteria
    d. fungi

43. Majority of fermentation medium are pseudoplastic. Therefore, heat transfer and mass transfer rates are poor away from the impeller because
    a. density decreases
    b. viscosity decreases
    c. density increases
    d. viscosity increases

44. The term k_La during operation of bioreactors refers to
    a. Liquid-liquid mass transfer coefficient
    b. Distribution of gas bubble size as a function of mixing
    c. Volumetric oxygen mass transfer coefficient
    d. Dankwerts gas-liquid interfacial energy coefficient

45. Partition coefficient in two phase aqueous extraction is defined as concentration of solute in
    a. Extracte/raffinate
    b. Extract/feed
    c. Upper aqueous layer/ lower aqueous layer
    d. Amount of solute extracted / amount of solute in feed

46. Michaelis Menten reaction is
    a. first order reaction
    b. zero order reaction
    c. changing order reaction
    d. fractional order reaction

47. Arrhenius equation shows the variation of ———— with temperature
    a. reaction rate
    b. rate constant
    c. energy of activation
    d. frequency factor

48. While $DV\rho/\mu$ is the general expression for Reynolds number and for agitator it is
    a. $n^2D^2\rho/\mu$
    b. $n^2D\rho/\mu$
    c. $nD^2\rho/\mu$
    d. $nD\rho/\mu$

49. Which parameter gives performance of a centrifuge?
    a. g. number
    b. sigma factor
    c. separation ratio
    d. capacity factor

50. A batch reactor is characterized by
    a. constant residence time
    b. variation in extent of reaction and properties of the reaction mixture with time
    c. variation in reactor volume
    d. very low conversion

51. RNA primer at the 5' ends of Okazaki fragments in prokaryotes are removed by
    a. Ribonuclease Z
    b. S1 nuclease
    c. P1 nuclease
    d. DNA pol I

52. Phosphorylation of serine residue on the eIF2 bound to GDP results in
    a. Initiation of protein synthesis
    b. Inhibition of protein synthesis
    c. Inhibition of DNA synthesis
    d. Initiation of RNA synthesis

53. Premature or incomplete protein synthesis happens due to
    a. Nonsense mutation
    b. Mutation of promoter region
    c. Missense mutation
    d. Frameshift mutation

54. Which one of the following has the ability to inhibit transcription?
    a. Neomycin
    b. Kanamycin
    c. Rifampicin
    d. Quinolones

55. A double stranded DNA contains 42% of G and C. The percentage of 'T' is
    a. 58
    b. 23
    c. 29
    d. 21

56. Which enzyme is involved in the base excision repair of DNA?
    a. Purine glycosylase
    b. P1 nuclease
    c. Endonuclease II
    d. DNA glycosylase

57. Mitochondrial DNA replication is carried out by
    a. DNA polymerase gamma
    b. DNA polymerase I
    c. Pfu DNA polymerase
    d. DNA polymerase alpha

58. Which one of the following is not true about promoter?
    a. They are sequence of DNA
    b. Binds to RNA polymerase II during transcription
    c. Located between operator and coding region
    d. Mutation of promoter region affects transcription rate

59. Telomerase functions as
    a. DNA dependent RNA polymerase
    b. DNA dependent DNA polymerase
    c. RNA dependent DNA polymerase
    d. RNA dependent RNA polymerase

60. The sequence of the structural genes in the lac operon is in the order of
    a. lacZ-lacA-lacY
    b. lacZ-lacY-lacA
    c. lacA-lacY-lacZ
    d. lacA-lacZ-lacY

61. Which separation technique uses ligand to purify its receptor protein?
    a. Ion exchange chromatography
    b. Expanded Bed Adsorption chromatography
    c. Affinity chromatography
    d. Size-exclusion chromatography

62. Lipogenesis is enhanced by
    a. Insulin
    b. Epinephrine
    c. Glucagon
    d. Thyroxine

63. The cell organelle primarily responsible for the source of reactive oxygen species is
    a. Nucleus
    b. Endoplasmic reticulum
    c. Golgi apparatus
    d. Mitochondria

64. Which one of the following cells depends primarily on glucose for energy?
    a. Lymphocyte
    b. Differentiated adipocytes
    c. Matured RBC
    d. Muscle cells

65. Which of the tests is used to differentiates that the oil is rich in saturated or unsaturated fatty acids?
    a. Iodine number
    b. Acid value
    c. Saponification value
    d. Acrolein test

66. Which is not a selective medium but is a differential medium?
    a. Blood agar
    b. Mannitol salt agar
    c. Mac Conkey agar
    d. Eosin methylene blue agar

67. The time taken to kill 90% of the organisms or spores in a sample under specified condition is
    a. Thermal death time (TDT)
    b. Decimal reduction time (D value)
    c. Generation time
    d. Doubling time

68. Phenolics control microorganisms by
    a. Denaturing proteins
    b. Oxidising cellular components
    c. Preventing cell wall formation
    d. Inhibiting DNA replication

69. Which of the following binds to the small ribosomal subunit (30S) and interfere with protein synthesis by causing misreading of the mRNA?
    a. Macrolides
    b. Aminoglycosides
    c. Lincosamines
    d. Quinolones

70. Which is an example of a biopolymer?
    a. Scleroglucan
    b. Aconitase
    c. Lyase
    d. Phenyl acetic acid

71. Which is true regarding a cosmid vector?
    a. Plaques are not produced
    b. Use lac selection system
    c. Can carry small DNA fragments
    d. Uses lambda origin of replication

72. The most important use of BAC vector is for
    a. Stable transfection
    b. Human genomic library construction
    c. E. coli protein expression
    d. E. coli genomic library construction

73. Creating mutant protein with novel characteristics and properties is called
    a. Cloning
    b. Mutagenesis
    c. Sequencing
    d. Protein engineering

74. The mismatch repair system of *E. coli* is
    a. Prenyl directed repair system
    b. Cysteine directed system
    c. Mutated system
    d. Methyl directed system

75. Which is not true for karyotyping?
    a. used to determine chromosome number
    b. used to determine chromosome size
    c. used in DNA amplification
    d. used to detect diseases

76. Pyrolysis mass spectroscopy is used to differentiate organisms to ———— level
    a. Phyla and kingdom
    b. Genus and species
    c. Kingdom and species
    d. Kingdom and Genus

77. Which of the following methods can be used to detect single nucleotide change in DNA?
    a. ELISA
    b. WESTERN Blotting
    c. SDS-PAGE
    d. PCR

78. Why is enhancer region included in many vectors based on alphaviruses?
    a. Expression of protein in N terminus
    b. Expression of protein on P terminus
    c. Expression as fusion protein
    d. To decrease the expression

79. All these statements are true regarding RFLP and RAPD except
    a. RAPD is quicker when compared to RFLP
    b. RFLP is more reliable than RAPD
    c. Species specific primers are required for RAPD
    d. Radioactive probes are not used in RAPD

80. The variation in the number of tandem repeats between two or more individuals is called
    a. Variable number of tandem repeats (VNTRs)
    b. Restriction fragment length polymorphism (RFLP)
    c. Simple sequence repeats (SSRs)
    d. Amplified fragment length polymorphism (AFLP)

81. Which of the following transcription factor is said to be a master switch of immune system, that promotes the cytokine expression during inflammation?
    a. Nuclear factor kappa B
    b. Transcription factor II
    c. DNA transcriptase
    d. RNA transcriptase

82. Which of the following is the opsonin?
    a. C5b
    b. C1q
    c. C3a
    d. C3b

83. Which of the following is the suppressive cytokine?
    a. IL-1
    b. IL-2
    c. IL-10
    d. IL-12

84. Which of the following is NOT a mechanism of action of cyclosporine leading to immunosuppression
    a. Inhibition of transcription of IL-2 gene
    b. Inhibition of Calcineurin pathway
    c. Inhibition of Cytochrome P450 3A4
    d. Inhibition of dephosphorylation of NF-AT

85. Which of the following drug is used to prevent graft rejection?
    a. Azathioprine
    b. Methotrexate
    c. Rapamycin
    d. Tacrolimus

86. BCG vaccine contain non virulent strain of
    a. *Bacillus subtilis*
    b. *Bacillus Pumilus*
    c. *Mycobacteriumleprae*
    d. *Mycobacterium bovis*

87. Which of the following methods is correct for producing vector vaccines?
    a. By inserting genes for antigens of a pathogen into a nonpathogenic viral vector
    b. By inserting attenuated antigen to the pathogenic virus
    c. By inserting whole antigen to the pathogenic virus
    d. By inserting the antigenic component to host

88. Which of the following enzymes plays a vital role in the pathogenesis of HIV infection?
    a. RNA polymerase
    b. RNA polymerase II
    c. Tag polymerase
    d. Reverse Transcriptase

89. When in skin allograft, second set of rejection occurs?
    a. 10-14 days
    b. 5-7 days
    c. After a month
    d. After a week

90. What are passenger cells in transplantation?
    a. Donor leukocytes in graft tissue
    b. Recipient leukocytes around graft tissue
    c. Recipient dendric cells
    d. Recipient T cells

91. A data mining method especially for studying biological networks based on pairwise correlations between variables is:
    a. Hidden markov model
    b. Convoluted network analysis
    c. Artificial neural networks
    d. Weighted correlation network analysis

92. The preference for the 20 standard amino acid residue types at each position in a given multiple sequence alignment refers to the:
    a. Pattern
    b. Profile
    c. Motif
    d. Feature

93. What is the approximate time taken in dynamic programming for the alignment of 3 sequences of length n?
    a. $5n^3$
    b. $6n^3$
    c. $7n^3$
    d. $8n^3$

94. Which of the following models assumes constant rates of evolution with two substitution types?
    a. Jukes cantor model
    b. Kimura Model
    c. BLOSUM model
    d. PAM model

95. The machine learning model associated with supervised learning is:
    a. Support vector machine
    b. K-mean clustering
    c. Principle Component analysis
    d. Independent Component analysis

96. The concept of DNA computing was kick-started by the famous scientist
    a. Craig Venter
    b. Margarette Dayhoff
    c. Saul Needleman
    d. Len Adleman

97. The phylogenetic tree following the principles of occam's razor is
    a. Maximum likelihood tree
    b. Ultrametric tree
    c. Additive tree
    d. Maximum parsimony tree

98. In a microarray experiment, the typical *p* value for a reliable analysis of differentially gene expression is
    a. 0.05
    b. 0.1
    c. 1.0
    d. 1.5

99. The term T2T-CHM13 refers to
    a. Recently sequenced Human genome
    b. A new docking algorithm
    c. A structure prediction method
    d. A phylogenetic software

100. Similarity due to parallel evolution, convergent evolution or secondary loss is called
    a. Homoplasy
    b. Homology
    c. Heteroplasy
    d. Heterogenecy