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. $\dfrac{1}{12}$

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

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

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

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 $x\dfrac{d^2 y}{dx^2} + \dfrac{dy}{dx} = 0$ 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. $\dfrac{3\sqrt{2}}{16}$

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

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

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

8. The value of the integral $\displaystyle\int_0^a\int_0^b\int_0^c e^{x+y+z}\,dz\,dy\,dx$ 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 $\displaystyle\int_C \frac{1}{z}\,dz$, 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 $\dfrac{4s+1}{s^2+6s+3}$. 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 $\dfrac{a^2}{2\pi}\left[\dfrac{\sin\frac{ax}{2}}{\frac{ax}{2}}\right]^2$. The value of $\displaystyle\int_0^\infty \left[\dfrac{\sin x}{2}\right]^2 dx$ is

a. π

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

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

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

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. $\det(A) \ne 0$

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 $\dfrac{1}{3}$ 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

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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

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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 $°\rho$, the boiling and freezing points of water at one atmosphere are $100°$ ρ and $300°\rho$ respectively. Correlate this scale with the Centigrade scale. The reading of $0°\rho$ 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

20 — PRODUCTION AND INDUSTRIAL ENGINEERING

(Answer ALL questions)

41. A Linear Programming problem with a bounded feasible solution space will always have
    a. Some basic feasible solutions but no optimal solution
    b. Some basic feasible solutions and at least one optimal solution
    c. No basic feasible solutions and no optimal solution
    d. No basic feasible solutions but at least one optimal solution

42. Which one of the following is not a basic assumption of linear programming?
    a. Linearity
    b. Additivity
    c. Divisibility
    d. Feasibility

43. The dual problem statement is formulated with the help of the information available statement is called
    a. Primal problem
    b. Prime Problem
    c. Optimal problem
    d. Primal constants

44. Postman needs to visit all 5 geographically distributed post offices beginning and ending at the same post office and without visiting any other post office twice. We need to find the optimum path for the postman so that he covers the minimum possible distance. This is an example of
    a. Travelling Salesman problem
    b. Chinese Postman problem
    c. Travelling Postman problem
    d. Chinese Salesman problem

45. When the total allocations of a transportation problem are less than the sum of the number of supply point and demand point values, the solution is called ———— solution.
    a. Non-degenerate
    b. Degenerate
    c. Feasible
    d. Infeasible

46. Which of the following algorithms considers all pairs of shortest paths?
    a. A* search algorithm
    b. Dijkstra's algorithm
    c. Bellman-Ford algorithm
    d. Floyd-Warshall algorithm

47. Which of the following is not an inventory?
    a. Machines
    b. Raw materials
    c. Finished products
    d. Consumables

48. Productivity is
    a. Output/Input
    b. Input/Output
    c. (Input + Output)/Input
    d. (Input + Output)/Output

49. Which of the following is the correct sequence of steps used in the method study?
    a. SELECT-RECORD-EXAMINE-DEVELOP- INSTALL- MAINTAIN
    b. SELECT-RECORD-EXAMINE-INSTALL- MAINTAIN-DEVELOP
    c. SELECT-RECORD-INSTALL-EXAMINE- MAINTAIN-DEVELOP
    d. SELECT-EXAMINE-RECORD-DEVELOP- INSTALL- MAINTAIN

50. The most frequently used components are arranged in
    a. Left side
    b. Right side
    c. Central location
    d. Any of the above

51. The Design capacity is
    a. Rate of goods output under full operating conditions
    b. Rate of goods output under actual operating conditions
    c. Rate of goods output under reduced operating conditions
    d. Rate of goods output under half operating conditions

52. The amount of time by which the completion time of job j differs from the due date is called
    a. Flow Time
    b. Processing Time
    c. Lead Time
    d. Lateness

53. The value of the smoothing constant used in exponential smoothing will be
    a. Between –1 and 1
    b. Between 0 and 1
    c. Between –1 and 0
    d. Between 0 and infinity

54. A product passes through four machines A, B, C and D with cycle times 4 min, 4 min, 3 min and 2 min respectively. Then which are the bottleneck machines?
    a. Machine A and C
    b. Machine B and C
    c. Machine A and B
    d. Machine C and D

55. Match the following group 1 (charts) with group 2 (use) and select the correct option.
    (1) R chart   (A) study the number of defects per unit
    (2) C chart   (B) size of a variable is studied
    (3) P chart   (C) dispersion of measured data
    (4) X chart   (D) defective units produced per subgroup
    a. 1 – A, 2 – B, 3 – D, 4 - C
    b. 1 – C, 2 – D, 3 – B, 4 - A
    c. 1 – A, 2 – D, 3 – B, 4 - C
    d. 1 – C, 2 – A, 3 – D, 4 – B

56. When using the SPC methodology, a system is said to be stable when
    a. the system is efficient
    b. the mean and range of variation caused by the system are controllable
    c. the mean and range of variation caused by the system are predictable
    d. the performance of the system is improving

57. C-chart follows ———— distribution.
    a. Normal
    b. Poisson
    c. Binomial
    d. Weibull

58. An estimate of the measurement error is obtained through an index is known as
    a. Precision-to-tolerance Ratio
    b. Tolerance-to-precision Ratio
    c. Capability Ratio
    d. Taguchi Capability Ratio

59. Total productive maintenance strives to produce overall equipment effectiveness, through a combination of availability, performance efficiency and
    a. Rate of quantity of products
    b. Rate of quality products
    c. Rate of Quantity process
    d. Rate of Performance products

60. The term availability is used to indicate the probability of a system or equipment being in operating condition at any time t, given that it was in operating condition at

a. 1

b. 0

c. α

d. constant

61. Blanking and piercing operations can be performed simultaneously in one stroke of the ram is

a. Progressive die

b. Simple die

c. Combination die

d. Compound die

62. In metal cutting operations, continuous chips are produced while machining

a. Brittle material

b. Ductile material

c. Hard material

d. All of the above

63. Tool life is mostly affected by

a. Tool geometry

b. Cutting speed

c. Feed and depth

d. Microstructure of material

64. Steel wire is manufactured by ———— process.

a. Deep drawing

b. Forging

c. Drawing

d. Extrusion

65. Lewis equation in spur gear is applied

a. Only to the pinion

b. Only to the gear

c. To weaker of pinion or gear

d. To stronger of pinion or gear

66. The friction torque for square thread at mean radius while raising load is given by (ω = load, R_o = mean radius, ϕ = angle of friction, α = lead angle)

a. $\omega R_o \tan (\varphi - \alpha)$

b. $\omega R_o \tan (\varphi + \alpha)$

c. $\omega R_o \tan \alpha$

d. $\omega R_o \tan \varphi$

67. The size of a cam depends upon

a. Base circle

b. Pitch circle

c. Pitch curve

d. Prime circle

68. The equation $3 \dfrac{d^2 x}{dt^2} + 6 \dfrac{dx}{dt} + 15 x = 20 \cos 4t$ shows a vibrations system. The maximum amplitude of the system will be

a. 50 cm

b. 51 cm

c. 49 cm

d. 52 cm

69. In Opitz system, 2nd digit indicates

a. Type and shape

b. External shape and external shape elements

c. External plane surface finishing

d. Auxiliary hole and gear teeth

70. Which of the following is not a layout configuration used in FMS?

a. In-line

b. Loop

c. Ladder

d. Circle

71. The pattern used for mass production is

a. Match plate pattern

b. Skeleton pattern

c. Split pattern

d. Single plate pattern

72. In slush casting, ————— is used.

a. Metallic core

b. Sand core

c. Wooden core

d. No core

73. Thermit welding is a form of

a. Resistance welding

b. Gas welding

c. Fusion welding

d. Forge welding

74. Seam-welding is

a. Multi-spot welding process

b. Continuous spot welding process

c. Used to form mesh

d. Used for welding cylindrical objects

75. Last constituent to fail in fiber reinforced composites is

a. Matrix

b. Fiber

c. Both fails at same time

d. Can't define

76. Longitudinal strength of fiber reinforced composite is mainly influenced by

a. Fiber strength

b. Fiber orientation

c. Fiber volume fraction

d. Fiber length

77. The solidification of an alloy from one phase to another phase without changes in chemical composition is called

a. Eutectic reaction

b. Allotropy

c. Congruent transformation

d. Homogenization

78. A heat treatment process which will improve the machinability of hypereutectoid steel is

a. Austempering

b. Spheroidizing

c. Bainitic transformation

d. Process annealing

79. Which of the following elements strongly promote graphitization in Cast Iron?

a. Sulphur

b. Manganese

c. Silicon

d. Vanadium

80. Monel metal is an alloy of

a. Nickel- Copper

b. Chromium- Aluminum

c. Silicon - Beryllium

d. Tin - Lead

81. The energy per unit volume that can be absorbed by a material up to the point of fracture is known as

a. Resilience

b. Endurance limit

c. Toughness

d. Modulus of rigidity

82. The cost towards machining of special jigs or fixtures, pattern, tooling made for the job is
    a. Direct expense
    b. Administrative expense
    c. Indirect material cost
    d. Overhead cost

83. Tong hold loss is a
    a. Welding loss
    b. Forging loss
    c. Machining loss
    d. Casting loss

84. The time wasted by the operator due to breakdown, non-availability or supply of tool and material is
    a. Down time
    b. Setup time
    c. Unit operation time
    d. Allowance

85. An instrument which is designed to eliminate the personal element of feel when setting a measuring equipment for measurement is known as:
    a. Fiducial indicator
    b. Standard
    c. Scale
    d. Device

86. Which type of tolerance does a slip gauge have?
    a. Unilateral tolerance
    b. Bilateral tolerance
    c. Universal tolerance
    d. Zero tolerance

87. In surface photography of measuring surface finish of machined surfaces using vertical illumination, which portion appears as bright area?
    a. Hills
    b. Scratch
    c. Valleys
    d. Flat portion

88. Which of the following is a reason for pitch errors observed in threads?
    a. Lack of inspection
    b. Incorrect ratio of tool work velocity
    c. Interference between mating parts
    d. Less skilled operator

89. Which of the following is used for rolling tests?
    a. Tooth caliper
    b. Parkinson gear tester
    c. Base pitch measuring instrument
    d. Involute profile testing machine

90. Which of the following is an application of machine vision system?
    a. Assembly verification
    b. Image processing
    c. Reliability testing
    d. Cause and effect analysis

91. Which of the following the techniques that is not suitable to measure large diameter parts or large gaps?
    a. Diffraction pattern technique
    b. Scanning laser technique
    c. Photodiode array imaging
    d. Laser triangulation sensor

92. In Ultrasonic Machining, the material is removed by
    a. Anodic dissolution
    b. Thermal melting
    c. Abrasive action
    d. Electrochemical oxidation

93. Which of the following statements are true for Electro-Chemical Machining (ECM)?
    1. ECM is capable of machining metals and alloys irrespective of their strength and hardness
    2. No cutting forces are involved in ECM process
    3. Erosion of metal takes place as a reverse process of electroplating
    4. Dielectric is used in Electro-Chemical Machining
    a. (1), (2) and (3)
    b. (2), (3) and (4)
    c. (1), (3) and (4)
    d. (1), (2) and (4)

94. What is the value of gap maintained in between the electrodes while machining with Electro Discharge Machining?
    a. 10 – 100 μm
    b. 100 – 200 μm
    c. 200 – 500 μm
    d. 500 – 1000 μm

95. The range of diameters obtained using Laser drilling process is
    a. 0.0001 – 0.001 mm
    b. 0.001 – 0.01 mm
    c. 0.005 – 1.25 mm
    d. 1.5 – 10.5 mm

96. Which of the following codes is used to rotate the spindle of the CNC machine tool in clockwise direction?
    a. M04
    b. G03
    c. G04
    d. M03

97. How many number of degrees of freedom is exhibited by the robot wrist?
    a. 1
    b. 3
    c. 2
    d. 4

98. The positioning accuracy of robotic arm is the highest in the following type configuration of a robot
    a. Cartesian Robot
    b. Cylindrical Robot
    c. Articulated jointed arm robot
    d. Spherical co-ordinate robot

99. Which one of the following rapid prototyping processes uses a photosensitive liquid polymer as the starting material?
    a. Fused deposition modeling
    b. Laminated-object manufacturing
    c. Selective laser melting
    d. Stereolithography

100. Direct Energy Deposition is
    a. A process in which a droplet of build material are selectively deposited
    b. A process in which a thermal energy selectively fuses regions of a powder bed
    c. A process in which focused thermal energy is used to fuse materials by melting as the material is being deposited
    d. A process in which a material is selectively dispensed through an orifice

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