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. $(e^a - 1)(e^b - 1)(e^c - 1)$

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

06 – AUTOMOBILE ENGINEERING

(Answer ALL questions)

41. The resultant of two forces P and Q (such that $P > Q$) acting along the same straight line, but in opposite direction, is given by
    a. $P + Q$
    b. $P - Q$
    c. P / Q
    d. Q / P

42. Mass moment of inertia of a tin rod about its one end is ———— the mass moment of inertia of the same rod about its mid-point.
    a. Same as
    b. Twice
    c. Thrice
    d. Four times

43. The ratio of static friction to dynamic friction is always
    a. Equal to one
    b. Less than one
    c. Greater than one
    d. Zero

44. Which one of the following is an open pair?
    a. Ball and socket joint
    b. Journal bearing
    c. Lead screw and nut
    d. Cam and follower

45. The train value of a gear trains is.
    a. Equal to velocity ratio of the gear train
    b. Reciprocal of velocity ratio of the gear train
    c. Always greater than unity
    d. Always less than unity

46. A porter governor is a ———— governor.
    a. Pendulum type
    b. Dead weight
    c. Spring loaded
    d. Inertia

47. Consider the following statements about theory of simple bending
    (i) Beam material is isotropic and homogenous
    (ii) Elastic modulus of beam material is more in tension than in compression
    (iii) Radius of curvature is large
    Of these statements,
    a. (i) and (ii) are true
    b. (i) and (iii) are true
    c. (ii) and (iii) are true
    d. (i), (ii), (iii) are true

48. If the diameter of a shaft is subjected to torque alone is doubled, then the horse power can be increased to
    a. 2P
    b. 4P
    c. 8P
    d. 16P

49. A higher value of flexural rigidity indicates
    a. Lower stiffness and lower deflection
    b. Lower stiffness and higher deflection
    c. Higher stiffness and lower deflection
    d. Higher stiffness and higher deflection

50. Match list I with list II and select the correct answer using the code given

List I	List II (Description)
1. Parallel shaft with slight offset	i. Universal joint
2. Parallel shaft at a reasonable distance	ii. Worm and worm wheel
3. Perpendicular shaft	iii. Oldham coupling
4. Intersecting shaft	iv. Belt and pulley

    a. 1 – iv, 2 – iii, 3 – ii, 4 – i
    b. 1 – iv, 2 – iii, 3 – i, 4 – ii
    c. 1 – iii, 2 – iv, 3 – i, 4 – ii
    d. 1 – iii, 2 – iv, 3 – ii, 4 – i

51. Match list I with list II and select the correct answer using the code given

List I		List II (Description)
1.	Spur gear	i. Helical tooth
2.	Bevel gear	ii. Two sets of helical tooth of opposite pair
3.	Herringbone gear	iii. Straight tooth on taper surface
4.	Helical gear	iv. Straight parallel teeth on cylinder surface

a. 1 – iv, 2 – iii, 3 – ii, 4 – i
b. 1 – iv, 2 – iii, 3 – i, 4 – ii
c. 1 – iii, 2 – iv, 3 – ii, 4 – i
d. 1 – iii, 2 – iv, 3 – i, 4 – ii

52. In the case of a flywheel, the maximum fluctuation of energy is the
a. Sum of the maximum and minimum energies
b. Difference between the maximum and minimum energies
c. Variations of energy above the mean resisting torque line
d. Variations of energy below the mean resisting torque line

53. Consider the following statements :
i. Volume, temperature and pressure are macroscopic quantities
ii. Intensive properties are independent of mass
iii. Extensive properties are related to mass
iv. Volume and temperature are intensive properties

Of these statements
a. i alone is true
b. ii and iii are true
c. ii, iii and iv are true
d. i, ii, iii and iv are true

54. The ideal vapour power cycle is
a. Diesel cycle
b. Otto cycle
c. Rankine cycle
d. Brayton cycle

55. For the same maximum pressure and temperature, what is the order of efficiency of Otto, Diesel and Dual cycle?
a. $\eta_{otto} > \eta_{diesel} > \eta_{dual}$
b. $\eta_{otto} > \eta_{dual} > \eta_{diesel}$
c. $\eta_{dual} > \eta_{otto} > \eta_{diesel}$
d. $\eta_{diesel} > \eta_{dual} > \eta_{otto}$

56. Consider the following statements :
i. Heat can flow of itself from lower temperature body to a higher temperature body
ii. A heat pump maintains a body at a temperature higher than the temperature of the surroundings
iii. The COP of a heat pump is greater than the COP of a refrigerator by unity
iv. The COP of a refrigerator using heat addition(Q1) and heat rejection(Q2) is expressed as

$$\frac{Q_1}{Q_1 - Q_2}$$

a. i and ii are true
b. i and iv are true
c. ii and iii are true
d. ii, iii and iv are true

57. Which of the following methods requires medium for heat transfer?
a. Conduction
b. Convection
c. Radiation
d. Conduction and convection

58. "The emissive power of a black body varies linearly to the fourth power of its absolute temperature" This statement is called
a. Fourier's law
b. Stefan-Boltzmann law
c. Kirchhoff's law
d. Wein's displacement law

59. Match list I with list II and select the correct answer using the code given

List I (Casting Process)		List II (Description)
1. Investment casting	(i)	Rotating method
2. Cold chamber die casting	(ii)	Low melting point metals
3. Centrifugal casting	(iii)	Wax pattern
4. Hot chamber die casting	(iv)	High melting point metals

a. 1 – iii, 2 – ii, 3 – i, 4 – iv
b. 1 – iii, 2 – iv, 3 – i, 4 – ii
c. 1 – i, 2 – iv, 3 – iii, 4 – ii
d. 1 – i, 2 – ii, 3 – iii, 4 – iv

60. Nose radius is expressed in
a. Degree
b. Radian
c. Millimetre
d. Meter

61. In which of the following welding methods Heat affected zone is minimum?
a. LASER welding
b. Gas welding
c. Arc welding
d. Thermit welding

62. Consider the following statements about non-conventional machining processes.
i. Hard materials can be easily machined without being damaged
ii. Complex shapes are easily produced
iii. They have low specific energy consumption
iv. Tools need not be harder than work piece

Of these statements
a. i, ii and iii only
b. i, ii and iv only
c. i, iii and iv only
d. ii, iii and iv only

63. Match list I with list II and select the correct answer using the code given

List I	List II (Description)
1. Quick return mechanism	i. Lathe
2. Apron mechanism	ii. Milling machine
3. Indexing mechanism	iii. Shaper
4. Regulating wheel	iv. Centerless grinding

a. 1 – iii, 2 – ii, 3 – i, 4 – iv
b. 1 – ii, 2 – iii, 3 – iv, 4 – i
c. 1 – iv, 2 – ii, 3 – iii, 4 – i
d. 1 – iii, 2 – i, 3 – ii, 4 – iv

64. Match list I with list II and select the correct answer using the code given

List I	List II (Description)
1. Interpolation	i. Tape preparation
2. Parity check	ii. Canned cycle
3. Preparatory function	iii. Drilling
4. Point to point control	iv. Contouring

a. 1 – iii, 2 – ii, 3 – i, 4 – iv
b. 1 – ii, 2 – iii, 3 – iv, 4 – i
c. 1 – iv, 2 – i, 3 – ii, 4 – iii
d. 1 – iii, 2 – i, 3 – ii, 4 – iv

65. What is the angle between the steering axis and the vertical when viewed from side of the vehicle?
a. Camber
b. Castor
c. Steering axis inclination
d. Kingpin inclination

66. The following diverts the power at right angles towards the driving wheels
a. Torque tube
b. Transfer case
c. Final drive
d. Gear box

67. Transfer case is used in a
    a. Front engine front wheel drive
    b. Rear engine rear wheel drive
    c. All wheel drive
    d. Front engine rear wheel drive

68. Wheel alignment servicing equipment is used to measure
    a. tire wear and tear
    b. brake pad and rotor angles wear
    c. steering and suspension alignment angles
    d. wear in the joints and bushings

69. Which type of rear axle is used in heavy vehicles?
    a. Semi- floating
    b. Three quarter - floating
    c. Full – floating
    d. Stub axle

70. In a modern final drive, the type of gearing used for the drive pinion and ring gear is
    a. Spur
    b. Spiral bevel
    c. Hypoid
    d. Helical

71. What is the maximum power transmitted by a single plate clutch at speed of 3600 rev/min if the coefficient of friction is 0.4 and the linings have a radius of 160mm inner and 190mm outer? The total spring force is 2.5 kN.
    a. 132Kw
    b. 139Kw
    c. 152Kw
    d. 160Kw

72. What is gear ratio of second year if Gear ratio of first and third gears are 4 and 1.55?
    a. 2.5
    b. 2.1
    c. 3
    d. 3.5

73. In a fluid coupling, power is transferred due to
    a. Change in pressure of the circulating fluid
    b. Change of mechanical energy to fluid energy
    c. Change in kinetic energy of the circulating fluid
    d. Conversion of fluid energy to mechanical energy

74. Janney transmission is working as per _____ principle
    a. Hydrodynamic
    b. Hydrostatic
    c. Centrifugal
    d. None of the above

75. The vehicle having a passenger cabin with two rows of seats and integrated cargo space, accessed from behind by a single tail gate is
    a. Saloon
    b. Limousine
    c. Estate car
    d. Coupe

76. As per AIS 052, School Bus are come under the TYPE
    a. I
    b. II
    c. III
    d. IV

77. Solar radiation is increased inside the passenger compartment by increasing _____ of a car.
    a. Roof camber
    b. Wind screen angle
    c. Bonnet angle
    d. Diffuser angle

78. In a wind tunnel, the honeycomb has a longer length that reduces the ———— velocity components of the flow with minimal pressure drop in the stream wise direction.
a. longitudinal
b. axial
c. traverse
d. lengthwise

79. When there is a reduction in amplitude over every cycle of vibration, then the body is said to have
a. free vibration
b. forced vibration
c. damped vibration
d. logarithmic decrement

80. Outer part of the tyre that extends from the bead to the tread is
a. Plies
b. Chords
c. Sidewall
d. Liner

81. The rolling resistance does not depend upon
a. Velocity of the vehicle
b. Density of air
c. Construction of tyre
d. Mass of the vehicle

82. Which of the following is the longitudinal framing of the roof at the joining?
a. Cant panel
b. Cant rail
c. Cowl panel
d. Drip rail

83. The negative plates of a lead acid battery have
a. Lead peroxide (PbO_2)
b. Spongy lead (Pb)
c. Lead sulphate $(PbSO_4)$
d. Lead Hydrate (PbH)

84. Why slip rings in an alternator are necessary?
a. They permit the stator to rotate
b. They provide a high resistance connection to the stator windings
c. They prevent a delta from forming.
d. They permit current to flow through a rotating component called the rotor

85. Which of the following is not a component of a starter motor?
a. Armature
b. Battery
c. Commuter
d. Field windings

86. Which of the following sensors is usually installed in the exhaust manifold?
a. Crank position
b. LAMDA
c. Wheel speed
d. Cam position

87. Increasing a proportional gain will :
a. increase the overshoot, decrease the steady state error
b. decrease the overshoot, increase the steady state error
c. increase the overshoot, increase the steady state error
d. decrease the overshoot, decrease the steady state error

88. Which of the following is measured by Linear Variable Differential Transformer (LVDT)?
a. Crank angle
b. Engine speed
c. Displacement
d. Gas Temperature

89. Adblue is
a. 32.5 % Urea and water
b. 37.5 % Urea and water
c. 40 % Urea and water
d. 88 % Urea and water

90. The unit of emission for heavy vehicles are measured in
    a. Mg/ms
    b. g/km-s
    c. g/km
    d. g/kW-h

91. Piston crevice volume is one of the reasons for ———— emission
    a. Unburned hydrocarbon
    b. Carbon mono oxide
    c. Oxides of nitrogen
    d. Particulate matter

92. Which of the following is not a stage of combustion in SI engine
    a. Ignition lag
    b. Flame propagation
    c. After burning
    d. Stratified combustion

93. Which of the following materials is used in Engine noise control?
    a. Aluminum
    b. Austempered ductile iron
    c. Magnesium
    d. Lead oxide

94. Blue smoke is caused by
    a. Lubricant oil
    b. High load conditions
    c. Lean mixture
    d. Worn out piston rings

95. The self-ignition Temperature of Methanol is
    a. Lower than Gasoline
    b. Higher than Gasoline
    c. Lower than diesel
    d. Lower than Ethanol

96. The presence of oxygen in vegetable oils
    a. Increases the energy content of the fuel
    b. Forms Gum in engine components
    c. Increases the cetane rating of the fuel
    d. Reduces the viscosity of the fuel

97. Micro explosion occurs at the temperature of about
    a. 100°C
    b. 200°C
    c. 300°C
    d. 400°C

98. Hydrogen Induction in diesel engine will
    a. Decrease the Thermal Efficiency
    b. Reduce the Power output
    c. Increase the ignition Delay
    d. Increase the combustion Duration

99. Hydrogen combustion with air at stochiometric condition results in
    a. Reduced HC, CO and NOx emissions
    b. Reduced HC and CO with increased NOx emissions
    c. Reduced HC with increased CO and NOx emissions
    d. Reduced CO with increased HC and NOx emissions

100. Biogas is
    a. Heavier than Air
    b. Lighter than Air
    c. Equal in weight of Air
    d. Lighter than Hydrogen