NG 23 (GROUP A)

No.

Time : 2 hours

Maximum marks : 100

Name of the
Candidate : ....

Signature of
the Candidate : ....

Regn.
Number :

Subject code for Part III

INSTRUCTIONS TO CANDIDATES

1. Write your Name and Registration Number (as found in the HALL TICKET) and sign in the space provided above.

2. Do not open the Question Book until the Hall Superintendent gives the signal for doing so.

3. The Question Book has **3 parts.** You have to answer Part I, Part II and the subject printed in the hall ticket for the Part III.

4. **Each correct answer carries 1 mark and for every wrong answer $\frac{1}{3}$ mark will be deducted.**

   The marks allotted to various parts are as follows :

   Part I : 20 marks and **Part II : 20 marks**

   Under Part II all correct answers upto a **maximum number of 20** will be given credit; but all wrong answers will be taken into account for negative marking.

5. The last few pages of the Question Book are blank, except for the words 'FOR ROUGH WORK'. You can make any relevant rough calculations there.

6. After commencement of the examination, open the Question Book and take out the **Answer Sheet.** If the Question Book or the Answer Sheet or both are not in good condition, ask for their immediate replacement. No replacement will be made 5 minutes after the commencement of the examination.

7. In the Answer Sheet

   (a) Use black ball point pen for all shading and writing.

   (b) In the space provided, write your Registration Number and shade.

   (c) In the space provided, write the subject code as printed in the hall ticket.

   (d) In the space provided, write the name of the examination centre.

   (e) Put your signature in the space provided.

8. Shade in the space provided against each question number in the Answer Sheet, one of the four alternatives a, b, c, d which according to you corresponds to the correct answer.

9. Use the Answer Sheet carefully. No spare Answer Sheet will be given.

10. At the end of the examination, when the Hall Superintendent announces 'Stop Writing', you must **stop writing immediately** and hand over the Answer Sheet to Hall Superintendent.

11. When you have completed answering, stand up and remain in your place. The Hall Superintendent will come to you and collect your Answer Sheet. Under no circumstances should be taken out of the Examination Hall. No candidate shall leave the Hall until the Answer Sheet is collected.

12. Calculator, tables or any other calculating devices and cell phone are strictly prohibited for this examination.

Code	Part III – Subjects	Page No.	Code	Part III – Subjects	Page No.
01	Civil Engineering	8-13	04	Electronics and Communication Engineering	26-31
02	Computer Science and Engg./Information Tech.	14-19	05	Mechanical Engineering	32-38
03	Electrical and Electronics Engineering	20-25			

NG 23 (GROUP A)

PART I — ENGINEERING MATHEMATICS

(Common to all Candidates)

(Answer ALL questions)

1. The rank of the matrix $\begin{pmatrix} 1 & 2 & 3 \\ 2 & 4 & 6 \\ 1 & 2 & 3 \end{pmatrix}$ is

    a.   0

    b.   1

    c.   2

    d.   3

2. The eigen values of the matrix $\begin{pmatrix} 0 & 2 \\ -2 & 0 \end{pmatrix}$ are

    a.   2, 2

    b.   2, –2

    c. $i, -i$

    d. $2i, -2i$

3. The eigen values of the matrix corresponding to the quadratic form $2x_1x_2 + 2x_1x_3 - 2x_2x_3$ are 1, 1, –2. Then, the canonical form of the given quadratic form is

    a. $2y_1^{\,2} + y_2^{\,2} - y_3^{\,2}$

    b. $y_1^{\,2} + 2y_2^{\,2} - y_3^{\,2}$

    c. $y_1^{\,2} + y_2^{\,2} - 2y_3^{\,2}$

    d. $y_1^{\,2} + y_2^{\,2} + 2y_3^{\,2}$

4. A flat circular plate is heated so that the temperature at any point (x, y) is $u(x, y) = x^2 + 2y^2 - x$. The coldest point on the plate is

    a. $\dfrac{1}{4}$

    b. $-\dfrac{1}{4}$

    c. $\dfrac{1}{2}$

    d. $-\dfrac{1}{2}$

5. The solution of the ordinary differential equation

$$(x + 2)^2 \frac{d^2 y}{dx^2} - (x + 2)\frac{dy}{dx} + y = 3x + 4$$

is

    a. $y = A\,e^x + B\,e^{-x} + \dfrac{2}{5}\log(x + 2) - 4$

    b. $y = A(x + 2) + B\,e^x + \dfrac{2}{5}[\log(x + 2)]^2 - 2$

    c. $y = A\log(x + 2) + B(x + 2) + \dfrac{2}{5}\log(x + 2) - 2$

    d. $y = [A\log(x + 2) + B](x + 2) + \dfrac{3}{2}[\log(x + 2)]^2 (x + 2) - 2$

6. The complete integral of the partial differential equation $q^2 = z^2 p^2 (1 - p^2)$ is

    a. $az = (y + ax + c)^2 + 1$

    b. $a^2 z^2 = ax + y + c$

    c. $a^2 - z^2 = (y + ax + c)^2$

    d. $a^2 z^2 = (y + ax + c)^2 + 1$

7. The value of the integral $\int_C [(2x - y)\,dx - yz^2\,dy - y^2\,z\,dz]$, where C is the circle $x^2 + y^2 = 1$, corresponding to the surface of the sphere of unit radius, is

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

    b. π

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

    d. 2π

8. The value of $\iint_S \vec{F} \cdot \hat{n}\,dS$, where $\vec{F} = (2x + 3z)\vec{i} - (xz + y)\vec{j} + (y^2 + 2z)\vec{k}$ and S is the surface of the sphere $x^2 + y^2 + z^2 = 9$ with volume V, is

    a. V

    b. $2V$

    c. $3V$

    d. $4V$

9. The volume of the solid bounded by planes $x = 0$, $y = 0$, $x + y + z = a$ and $z = 0$ is given by

    a. $\dfrac{a^3}{6}$

    b. $\dfrac{5a^2}{8}$

    c. $\dfrac{a^3}{8}$

    d. $\dfrac{5a^2}{6}$

10. The curve $u(x, y) = C$ and $v(x, y) = C'$ are orthogonal if

    a. $u + iv$ is an analytic function

    b. $u - iv$ is an analytic function

    c. $u - v$ is an analytic function

    d. $u + v$ is an analytic function

11. The function $f(z) = |z^2|$ is

    a. everywhere analytic

    b. nowhere analytic

    c. analytic only at $z = 0$

    d. analytic except at $z = 0$

12. The singularity of the function $\dfrac{z - \sin z}{z^2}$ is,

    a. $z = -2$

    b. $z = 2$

    c. $z = 0$

    d. $z = 4$

13. The inverse Z-transform of $X(z) = \dfrac{1}{1 - 1.5z^{-1} + 0.5z^{-2}}$, given the region of convergence as $|z| > 1$ is

    a. {1, 3/2, 7/4, 15/8, 31/16, ….}

    b. {1, 2/3, 4/7, 8/15, 16/31, ….}

    c. {1/2, 3/4, 7/8, 15/16, 31/32, ….}

    d. {0.25, 0.75, 0.125, 1.5, 0.0525, ….}

14. The inverse Laplace transform of $\dfrac{(s+2)}{s(s+3)(s+4)}$ is

    a. $\dfrac{1}{6} + \dfrac{1}{3}e^{-3t} + \dfrac{1}{2}e^{-4t}$

    b. $\dfrac{1}{6} - \dfrac{1}{3}e^{-3t} + \dfrac{1}{2}e^{-4t}$

    c. $1 - 3e^{-3t} + 2e^{-4t}$

    d. $\dfrac{1}{6} + \dfrac{1}{3}e^{-3t} - \dfrac{1}{2}e^{-4t}$

15. Which of the following functions is self-reciprocal with respect to Fourier cosine transform?

    a. $e^{-\frac{x^2}{2}}$

    b. $\dfrac{1}{\sqrt{x}}$

    c. $\sqrt{\dfrac{2}{\pi}}\cos x$

    d. $\sqrt{\dfrac{2}{\pi}}\sin x$

16. Which of the following methods is iterative for solving a system of linear algebraic equations?

    a. Gauss-Jordan method

    b. Gauss elimination method

    c. Fixed point iteration method

    d. Gauss-Jacobi method

17. The nature of the nth divided differences of a polynomial of nth degree is

    a. of degree n

    b. constant

    c. of degree $n+1$

    d. of degree $n-1$

18. The error in Simpson's $\dfrac{1}{3}$ rule is of order

    a. $O(h^3)$

    b. $O(h^4)$

    c. $O(h^2)$

    d. $O(h)$

19. Let X be a random variable such that $E(X) = 2$ and $E(X^2) = 7$, then $Var(X)$ is

    a. 5

    b. 4

    c. 3

    d. 2

20. If the moment generating function of a random variable X is given by $M_X(t) = \dfrac{2}{2-t}$, then the value of $E(X)$ is

    a. 1

    b. 2

    c. 1/2

    d. 1/3

PART II — BASIC ENGINEERING AND SCIENCES

(Common to all candidates)

(All correct answers upto a maximum number of 20 will be given credit, but all wrong answers will be taken into account for negative marking)

21. Which of the following deals with thermal equilibrium and provides a means for measuring temperatures?

    a. Zeroth law

    b. First law

    c. Second law

    d. Third law

22. An ideal fluid is

    a. a real fluid

    b. viscous

    c. compressive and gaseous

    d. incompressible and frictionless

23. $bh^3/6$ is the moment of inertia of

    a. Rectangle of width b and height h about the axis through its centroid

    b. Rectangle of width b and height h about the axis through its base

    c. Isosceles triangle of width b and height h about the axis through its centroid

    d. Isosceles triangle of width b and height h about the axis through its base

24. Biological oxygen demand (BOD) primarily measures

    a. Types of microbes

    b. Level of dissolved oxygen

    c. Quantity of organic matter

    d. Quantity of dissolved impurities

25. A DC series motor should not be run at no load, because it will

    a. draw excess current

    b. not start and damage the motor

    c. run at a dangerously high speed

    d. not develop starting torque

26. A given application runs for 15 seconds on a desk top processor. When the compiler used for the application is optimized, it requires only 0.6 as many instructions as the old compiler, but the CPI increases by 1.1. How much time will the application take to run with the new compiler?

    a. 9.9 seconds

    b. 8.2 seconds

    c. 25.5 seconds

    d. 0.044 seconds

27. Which of the following statements is false?

    a. SRAM is very fast

    b. SRAM is used for cache

    c. values stored in DRAM exist indefinitely as long as there is power

    d. DRAM is used in main memory

28. When does the Array Index Out Of Bounds Exception occur in JAVA?

    a. Compile-time

    b. Run-time

    c. When an array is declared

    d. When an array is printed

29. What does the following declaration mean?

    int (*ptr)[10];

    a. ptr is array of pointers to 10 integers

    b. ptr is a pointer to an array of 10 integers

    c. ptr is an array of 10 integers

    d. ptr is an pointer to array

30. Predict the output of the code

```
void m();
void n()
{
m();
}
void main()
{
void m()
{
printf("Welcome");
}
}
```

a. Welcome
b. Compile time error
c. Nothing
d. Varies

31. An Ideal heat engine operates between two temperatures 600 K and 900 K. What is the efficiency of the engine?

a. 50%
b. 80%
c. 10%
d. 33%

32.

	List – I		List – II
(A)	Heat to work	1.	Nozzle
(B)	Heat to Lift Weight	2.	Endothermic chemical reaction
(C)	Heat to strain energy	3.	Heat engine
(D)	Heat to electromagnetic energy	4.	Hot air balloon/evaporation
		5.	Thermal radiation
		6.	Bimetallic strips

Codes :

	(A)	(B)	(C)	(D)
a.	3	4	6	5
b.	3	4	5	6
c.	3	6	4	2
d.	1	2	3	4

33. A frictionless piston-cylinder device contains a gas initially at 0.8 MPa and 0.015 m^3. It expands quasi-statically at constant temperature to a final volume of 0.030 m^3. The work output (in kJ/kg) during this process will be

a. 8.32
b. 12
c. 554.67
d. 8320

34. Thermodynamic work is the product of

a. Two intensive properties
b. Two extensive properties
c. An intensive property and change in an extensive property
d. An extensive property and change in an intensive property

35. In the temperature-entropy diagram of a vapour shown in the given figure, the thermodynamic process shown by the dotted line AB represents
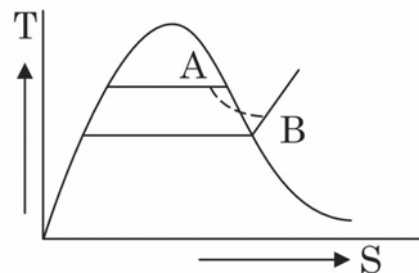
a. Hyperbolic expansion
b. Free expansion
c. Constant volume expansion
d. Polytropic expansion

36. The specific conductance of the electrolyte ————— on dilution.

a. Increases
b. Decreases
c. Slightly increases
d. Cannot be determined

37. The process of decomposition of an electrolyte by passing electric current through its solution is called as

a. Electrolyte
b. Electrode
c. Electrolysis
d. Electrochemical cell

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NG 23 (GROUP A)

38. The correct order of different types of energies is
    a. $E_{el} \gg E_{vib} \gg E_{rot} \gg E_{tr}$
    b. $E_{el} \gg E_{rot} \gg E_{vib} \gg E_{tr}$
    c. $E_{el} \gg E_{vib} \gg E_{tr} \gg E_{rot}$
    d. $E_{tr} \gg E_{vib} \gg E_{rot} \gg E_{el}$

39. The cuprous chloride used in Orsat apparatus can absorb
    a. Only carbon monoxide
    b. Both carbon monoxide and carbon dioxide
    c. Both carbon monoxide and oxygen
    d. All carbon monoxide, carbon dioxide and oxygen

40. Incomplete combustion of a fuel is characterised by the high ———— in the flue gas
    a. Smoke
    b. Temperature
    c. Oxygen
    d. Carbon monoxide

41. The rating of an electric lamp is 220 V and 100 W. If it is operated at 110 V, the power consumed by it will be:
    a. 50 W
    b. 75 W
    c. 90 W
    d. 25 W

42. An Ideal current source should have
    a. Zero internal resistance
    b. Infinite internal resistance
    c. Large value of EMF
    d. None of the above

43. A pony motor is basically a
    a. DC series motor
    b. DC shunt motor
    c. Double – winding AC/DC motor
    d. Small Induction motor

44. Two coils, connected in parallel across 100 V DC supply mains, takes 10 A from mains. The power dissipated in one coil is 600 W. The resistance of each coil is:
    a. $R_1 = 16.67\ \Omega$ and $R_2 = 25\ \Omega$
    b. $R_1 = 14.62\ \Omega$ and $R_2 = 10\ \Omega$
    c. $R_1 = 5.67\ \Omega$ and $R_2 = 9\ \Omega$
    d. $R_1 = 7\ \Omega$ and $R_2 = 3\ \Omega$

45. In electrostatic instrument for the linear motion, the force between plates is given by
    a. $F = \dfrac{1}{2}V^2 C^2$
    b. $F = \dfrac{1}{2}m^2 C^2$
    c. $F = \dfrac{1}{2}V^2 \dfrac{dc}{dx}$
    d. $F = V^2 C^2$

46. You have probably noticed that during a thunderstorm you see a lightning flash some time before you hear the thunder. That is because
    a. the thunder is generated only after the lightning has stopped
    b. lightning and thunder are unrelated events
    c. light travels a lot faster than sound
    d. sound travels a lot faster than light

47. In Young's double slit experiment, if one of the slits is covered with the blue and another one with red transparent papers,
    a. fringe width changes
    b. interference pattern is not observed
    c. multicolour fringes are observed
    d. circular fringes are formed

48. According to Plancks Quantum theory, the second energy level of a one second simple pendulum is

   a. 6.625×10^{-34} J

   b. 3.312×10^{-34} J

   c. 13.25×10^{-34} J

   d. 16.562×10^{-34} J

49. The principle behind fibre optic communication is

   a.   partial reflection

   b.   partial refraction

   c.   total internal refraction

   d.   total internal reflection

50. In which one of the following it is not possible to achieve laser action?

   a.   two level system

   b.   multi level system

   c.   four level system

   d.   seven level system

51. Dielectric loss is the phenomenon in which the electrical energy is converted into

   a.   dipole energy

   b.   light radiation

   c.   liquid plasma

   d.   heat

52. In Ferri magnetic materials in dual dipoles are

   a.   parallel to each other with unequal moments

   b.   antiparallel to each other with unequal moments

   c.   antiparallel to each other with equal moments

   d.   parallel to each other with equal moments

53. An electric bulb rated 200 V and 100 W is connected a 160 V power supply. What power will be consumed by the bulb?

   a.   64 W

   b.   80 W

   c.   100 W

   d.   160 W

54. Donar levels in an extrinsic n type semi conductors lie just

   a.   above the conduction band

   b.   below the conduction band

   c.   above the valence band

   d.   below the valence band

55. Which one of the following is false about super conductors?

   a.   super conductors have no resistance

   b.   electric current can destroy super conductivity

   c.   superconductors are diamagnetic

   d.   superconductors allow magnetic field to pass through only below the critical temperature

PART III

01— CIVIL ENGINEERING

(Answer ALL questions)

56. Calculate the flow of backwash pump (m³/h) required for the activated carbon filter for the following details.

    Process flow : 2500 m³/h

    Process flow velocity : 15m/h

    Backwash pump velocity : 24 m/h
    a. 2500
    b. 3500
    c. 4000
    d. 4500

57. Which of the following are formed in RSF due to insufficient washing of sand grains?
    a. Sand boils
    b. Mud balls
    c. Clogging
    d. Bubbles

58. Which of the following combines aeration basin and secondary clarifier into single unit?
    a. RBC
    b. MBBR
    c. SBR
    d. PBR

59. Which type of reactor is not subjected to back mixing?
    a. Plug flow
    b. Completely stirred reactor
    c. Batch reactors
    d. Venturi reactor

60. The sludge digestion process is independent of which of the following?
    a. Temperature of sludge
    b. pH of sludge
    c. Shape of tank
    d. Mixing of sludge

61. Out of the following given methods, in which of these organic matters is stabilized?
    a. Sludge lagoons
    b. Filter press
    c. Centrifuge
    d. Sludge drying bed

62. In which process, excess lime is converted into bicarbonate?
    a. Chlorination
    b. Liming
    c. Re-carbonation
    d. Super-chlorination

63. In DAF unit suspended solids are collected at the ————— of the unit.
    a. Top
    b. Bottom
    c. Middle
    d. Side

64. What is noise?
    a. Desirable sound
    b. Desirable and unwanted sound
    c. Undesirable and unwanted sound
    d. Undesirable and wanted sound

65. Which gas is mainly produced due to incomplete burning of wood?
    a. CO
    b. SO_2
    c. NO_2
    d. NO_3

66. If the relationship between the shear stress τ and rate of shear strain du/dy is expressed as $\tau = k\left[\dfrac{du}{dy}\right]^{n}$. The fluid with exponent $n < 1$ is known as
    a. Pseudoplastic fluid
    b. Bingham fluid
    c. Dilatant fluid
    d. Newtonian plastic

67. The predominant fluid property associated with cavitation phenomenon is
    a. Surface tension
    b. Vapour pressure
    c. Mass density
    d. Bulk modulus of elasticity

68. Local atmospheric pressure is measured by
    a. Hydrometer
    b. Barometer
    c. Hygrometer
    d. Altimeter

69. The minor loss due to sudden contraction is due to
    a. Flow contraction
    b. Expansion of flow after sudden contraction
    c. Boundary friction
    d. Cavitation

70. In a general sense, water turbines may be put in the following decreasing order of specific speeds as
    a. Propeller turbine, Francis turbine and Pelton wheel
    b. Pelton wheel, Francis turbine, Kaplan turbine
    c. Kaplan turbine, Impulse turbine and Francis turbine
    d. Francis turbine, Kaplan turbine and Pelton wheel

71. The double mass curve technique is adopted to
    a. check the consistency of rain gauge records
    b. find the average rainfall over a number of years
    c. find the number of rain gauge required
    d. estimate the missing rainfall data

72. An isohyet is a line joining points having equal
    a. evaporation value
    b. barometric pressure
    c. height above the MSL
    d. rainfall depth in a given duration

73. A hydrograph is a plot of
    a. Rainfall intensity against time
    b. Stream discharge against time
    c. Cumulative rainfall against time
    d. Cumulative runoff against time

74. Darcy's law is valid only for
    a. Laminar flow
    b. Turbulent flow
    c. Uniform flow
    d. Steady flow

75. Water surface in a well located in an unconfined aquifer is termed as
    a. Piezometric surface
    b. Line of influence
    c. Lineament
    d. Water table

76. Which of the following are a separate class of highways with superior facilities and design standards and are meant as through routes having very high volume of traffic?
    a. Expressways
    b. National Highways
    c. State Highways
    d. Major district Roads

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77. The coefficient of lateral friction as recommended by IRC is
   a. 0.15
   b. 0.20
   c. 0.25
   d. 0.30

78. If the CBR value obtained at 5 mm penetration is higher than that at 2.5 mm, then the test is repeated for checking; and if the check test reveals a similar trend, then the CBR value is to be reported as the
   a. mean of the values for 5 mm and 2.5 mm penetrations
   b. higher value minus the lower value
   c. lower value corresponding to 2.5 mm penetration
   d. higher value obtained at 5 mm penetration

79. In a bituminous pavement, alligator cracking is mainly due to
   a. Inadequate wearing course
   b. Inadequate thickness of sub-base course of pavement
   c. Use of excessive bituminous material
   d. Fatigue arising from repeated stress applications

80. Maximum permissible Cant deficiency in a B.G line
   a. 70 mm
   b. 75 mm
   c. 80 mm
   d. 85 mm

81. For coning of wheels, the slope maintained is
   a. 1 in 10
   b. 1 in 15
   c. 1 in 20
   d. 1 in 25

82. ICAO classifies airports based on
   a. Pavement Strength and Runway Length
   b. Number of Aircrafts and Pavement Strength
   c. Number of Runways and Runway Length
   d. Number of Aircrafts and Number of Runways

83. Which of the following is used for carrying out maintenance work of vessels?
   a. Wet Docks
   b. Dry Docks
   c. Pier
   d. Wharf

84. Peak Hour Factor (PHF) is used to represent the proportion of peak sub-hourly traffic flow within the peak hour. If 15-minute sub-hours are considered, the theoretically possible range of PHF will be
   a. 0 to 1.0
   b. 0.25 to 0.75
   c. 0.25 to 1.0
   d. 0.5 to 1.0

85. Traffic sign 'overtaking prohibited" is a
   a. Mandatory sign
   b. Cautionary sign
   c. Informatory sign
   d. Warning sign

86. The length of a line measured with a 20 m chain was found to be 250 m. Calculate the true length of the line if the chain was 10 cm too long.
   a. 252.25 m
   b. 251.25 m
   c. 225.25 m
   d. 221.25 m

87. Pick up the incorrect pair
   a. Plumbing fork : Accurate centering
   b. Trough compass : Orientation
   c. Telescopic Alidade : Horizontal inclined sights
   d. Tracing paper: Two-point problem

88. What will be the normal equation for z if the equations are given as $3x + 9y + 4z - 43 = 0$, $2x + 6y + z - 5 = 0$?
   Assume these equations have equal weights.
   a. $17x + 42y + 47z - 178 = 0$
   b. $14x + 17y + 42z - 178 = 0$
   c. $14x + 42y + 17z - 178 = 0$
   d. $42x + 14y + 17z - 178 = 0$

89. The magnetic bearing of a line AB is S 28°30′ E. Calculate the true bearing if the declination is 7°30′ West.
   a. N 36°00′ W
   b. S 21°00′ E
   c. S 36°00′ E
   d. N 21°00′ W

90. Coordinate length measured parallel to an assumed meridian direction may be defined as
   a. Latitude of a survey line
   b. Departure of survey line
   c. Length of survey line
   d. Slope of survey line

91. In plane Table surveying, the following diagram refers to
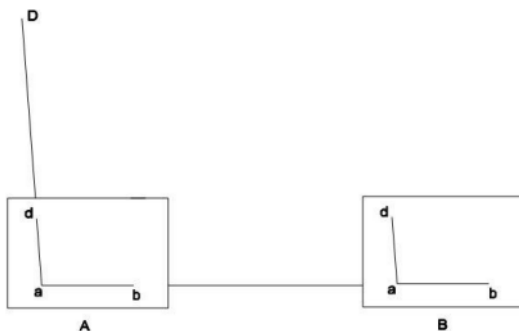
   a. Orientation of the plane table
   b. Orientation by fore sighting
   c. Orientation by back sighting
   d. Radiation method

92. The basic navigation message format consists of ———— bits.
   a. 6
   b. 30
   c. 300
   d. 1500

93. Overturning of vehicles on a curve can be avoided by using
   a. Compound curve
   b. Vertical curve
   c. Reverse curve
   d. Transition curve

94. Match the following :
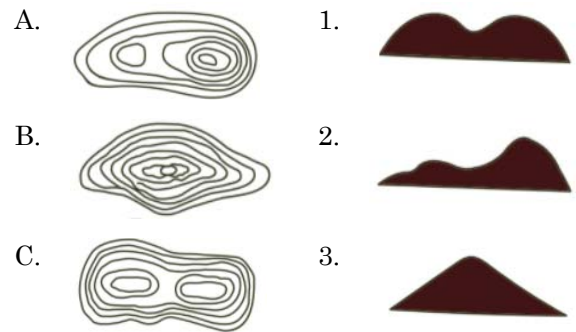
   Code :
	A	B	C
a.	1	2	3
b.	2	1	3
c.	2	3	1
d.	3	1	2

95. The method adopted for locating sounding in a narrow river is
   a. Location by cross rope
   b. Range and on angle
   c. Range and time interval
   d. By two angle method

96. The maximum permissible slenderness ratio of steel ties likely to be subjected to possible reversal of stress due to wind or seismic force is
   a. 180
   b. 250
   c. 350
   d. 450

97. A fixed beam AB is subjected to a triangular load varying from zero at end A to 'w' per unit length at end B. The ratio of fixed end moment at B to A will be

    a. $\dfrac{1}{2}$

    b. $\dfrac{1}{3}$

    c. $\dfrac{2}{3}$

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

98. The degree of static indeterminacy of the plane frame as shown in the figure is
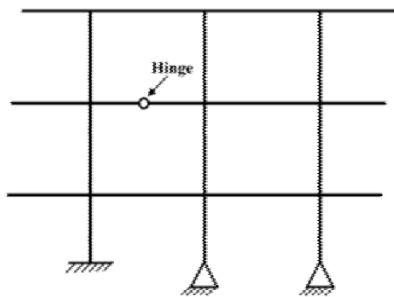
    a.   10
    b.   15
    c.   16
    d.   17

99. Weep holes are provided at the back of retaining walls to

    a.   reduce the active earth pressure on the walls
    b.   reduce the build-up of hydrostatic pressure
    c.   provide better compaction
    d.   increase the passive earth pressure

100. As per IS287-1993, the permissible moisture content of timber used as beam and rafter varies from

    a.   4 to 6%
    b.   6 to 8%
    c.   8 to 12%
    d.   12 to 20%

101. In a cantilever beam carrying gravity load, main reinforcement is provided

    a.   Above the neutral axis
    b.   As vertical stirrups
    c.   As helical reinforcement

    d.   Below the neutral axis

102. The Poisson's ratio for a perfectly incompressible linear elastic material is

    a.   1
    b.   0.5
    c.   0
    d.   −1

103. In limit state design of concrete structures the strain distribution is assumed to be

    a.   parabolic
    b.   exponential
    c.   cubic
    d.   linear

104. A 1st class brick immersed in water for 24 hours, should not absorb water (by weight) more than

    a.   10%
    b.   15%
    c.   20%
    d.   25%

105. Bending moment at any section in a conjugate beam gives ——————— in the actual beam.

    a.   Slope
    b.   Curvature
    c.   Deflection
    d.   Shear Force

106. A soil in the borrow pit is at a dry density of 17 kN/m^3 with a moisture content of 10%. The soil is excavated from this pit and compacted in an embankment to a dry density of 18 kN/m^3 with a moisture content of 15%. The quantity of soil to be excavated from the borrow pit for 100 m^3 of compacted soil in the embankment is,

    a.   105.9 m^3
    b.   115.9 m^3
    c.   95.9 m^3

d. 110.9 m³

107. A soil composed of 30% coarse grained particles and 70% fine grained particles. The liquid and plastic limit of the soil is 55% and 25% respectively, The IS soil classification group symbol is,
a. CH
b. MH
c. CI
d. MI

108. A sand stratum is 10m thick. The water table is 2 m below ground level. The unit weights of sand layer above and below water table are 17 kN/m³ and 21 kN/m³ respectively. The capillary rise above water table is 1 m. The effective stress at the level of capillary rise is,
a. 0 kN/m²
b. 17.00 kN/m²
c. 9.81 kN/m²
d. 26.81 kN/m²

109. The potential shear strength on a horizontal plane at a depth of 3 m below the surface in a formation of cohesionless soil with unit weight of 21.14 kN/m³, angle of internal friction 30° and water table at the ground surface is,
a. 24.6 kN/m²
b. 39.2 kN/m²
c. 19.6 kN/m²
d. 54.6 kN/m²

110. An embankment has a slope of 30° to the horizontal. The properties of the soil are : c = 15 kN/m², ϕ = 22°, γ = 18 kN/m³. The required factor of safety with respect to cohesion is 1.5. If Taylor's stability number is 0.046, The safe height of the embankment is,
a. 12.1 m
b. 6.05 m
c. 9.08 m
d. 15.13 m

111. A SPT is conducted in fine sand below water table and a value of 25 is obtained for N. What is the corrected value of N?
a. 25
b. 20
c. 30
d. 35

112. A raft of 6 m × 9 m is founded at a depth of 3 m in a cohesive soil having cohesion of 120 kN/m². The ultimate net bearing capacity of the soil in kN/m² using the Terzaghi's theory will be nearly
a. 920
b. 1036
c. 820
d. 1067

113. A square pile of section 30 cm × 30 cm and length 10 m penetrates a deposit of clay having c = 5 kN/m² and the adhesion factor is 0.8. What is the load carried by the pile by skin friction only?
a. 75 kN/m²
b. 60 kN/m²
c. 48 kN/m²
d. 192 kN/m²

114. In a plate load test on a soil, at a particular magnitudes of the settlement, it was observed that the bearing pressure beneath the footing is 100 kN/m² and the perimeter shear is 25 kN/m². Correspondingly, the load capacity of a 2 m square footing at the same settlement in kN will be
a. 300
b. 600
c. 200
d. 400

115. In a cohesionless soil deposit having unit weight of 15 kN/m³ and an angle of internal friction of 30˚, the active and passive lateral earth pressure intensities (kN/m²) at a depth of 10 m will respectively be
a. 45 and 5
b. 10 and 20
c. 20 and 10
d. 5 and 45

—————————

56. The optimization technique which is typically applied on loops is
    a. Removal of invariant computation
    b. Peephole optimization
    c. Constant folding
    d. All of the above

57. Dead-code elimination in machine code optimization refers to the removal of
    a. all tables
    b. values that never get used
    c. function which are not involved
    d. a module after its use

58. Which of the following is the advantage of declarative languages over imperative languages?
    a. Can use abstract data type
    b. Easy to verify the properties of the program
    c. Is more efficient
    d. Can be implemented by an interpreter or compiler

59. What formal system provides the semantic foundation for Prolog?
    a. Predicate calculus
    b. Lambda calculus
    c. Hoare logic
    d. Propositional logic

60. If the base register holds 256000 and the limit register holds 120900, the program can access the addresses from
    a. 256000 through 376900
    b. 120900 through 256000
    c. 120900 through 241800
    d. 241800 through 256000

61. Consider the page reference string 1,2,3,4,5,1,2,3,4,5 and assume the demand paging with four frames. How many page fault will occur if the system follows FIFO page replacement algorithms?
    a. 9
    b. 10
    c. 5
    d. 11

62. Which is not part of process?
    a. List
    b. Heap
    c. Stack
    d. Data section

63. Which of the following is used after fork() to replace process memory space with a new program.
    a. Exec()
    b. Wait()
    c. Exit()
    d. Replace()

64. Which one of the following are the characteristics of distributed file system?
    a. Service activity is not carried out across the network
    b. There are multiple dependent storage devices
    c. Its users, servers and storage devices are dispersed
    d. They have single centralized data repository

65. Process Fail - Stop in process omission faults can be detected in
    a. asynchronous system.
    b. synchronous system.
    c. synchronous and asynchronous system.
    d. stand alone system

66. Which of the following techniques is based on compile-time program transformation for accessing remote data in a distributed-memory parallel system?
    a. cache coherence scheme
    b. computation migration
    c. remote procedure call
    d. message passing

67. When data items in the same data block are being updated by multiple nodes at the same time is known as
    a. thrashing
    b. consistency
    c. granularity
    d. None of the above

68. A hash function defined as f(key) = key mod 7, with linear probing insert the keys 0, 2, 11, 12, 3, 6. Maximum number of comparisons needed in searching a key 4, that is not present is
    a. 1
    b. 2
    c. 5
    d. 6

69. Consider the following tree
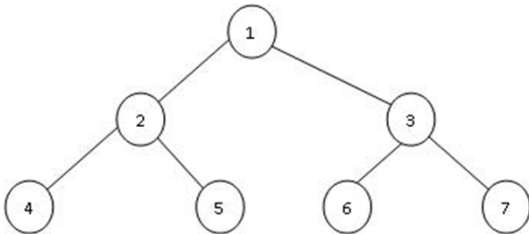
If the post order traversal gives AB+CD*- then the label of the nodes 1, 2, 3, ... will be
    a. *, +, −, A, B, C, D
    b. A, B, C, D, −, *, +
    c. −, +, *, A, B, C, D
    d. *, C, D, +, A, B, −

70. The height of AVL tree is atmost
    a. $1.6 \log n^2$
    b. $1.44 \log (n+1)$
    c. $\log n/2$
    d. $\log n+1$

71. A leftist tree with n nodes on the right path must have atleast
    a. n nodes
    b. n +1 nodes
    c. 2^n nodes
    d. $2^n − 1$ nodes

72. Which one of the following hash functions on integers will distribute keys most uniformly over 10 buckets numbered 0 to 9 for i ranging from 0 to 2020?
    a. $h(i) = i * i \mod 10$
    b. $h(i) = i * i * i \mod 10$
    c. $h(i) = (11 * i * i) \mod 10$
    d. $h(i) = (12 * i) \mod 10$

73. Let S be an NP-complete problem and Q and R be two other problems not known to be in NP. Q is polynomial time reducible to S and S is polynomial-time reducible to R. Which one of the following statements is true?
    a. R is NP – complete
    b. R is NP – hard
    c. Q is NP – complete
    d. Q is NP – hard

74. Dynamic Programming uses
    a. Divide-and-conquer strategy
    b. Memoization
    c. Categorization
    d. Approximation

75. For which of the following problems the greedy algorithm is not suitable?
    a. Largest sum of subset
    b. Traveling Salesman Problem
    c. Huffman Coding
    d. path finding in a graph

76. Assume that registers $s0 and $s1 hold the values 0 × 80000000 and 0 × D0000000, respectively, what is the value of $t0 for the following assembly code?
    Add $t0, $s0, $s1
    a. 0 × 150000000
    b. 0 × 160000000
    c. 0 × 140000000
    d. 0 × FFFFFFFFFF

NG 23 (GROUP A)

77. 8085 microprocessor executes "STA 1234H" with starting address location 1FFEH. While the instruction is fetched and executed, the sequence of values written at the address pins A15 − A8 is
   a. 1FH, 1FH, 12H, 12H
   b. 1FH, FEH, 1FH, FFH, 12H
   c. 1FH, 1FH, 20H, 12H
   d. 1FH, 1FH, 12H, 20H, 12H

78. What is the value of the register formed from D flip flop using Q0, Q1 and Q2 as output (Q0, Q1, Q2) after 14 cycles?
   a. 000
   b. 011
   c. 001
   d. 110

79. Which of the following does not interrupt a running process?
   a. Scheduler process
   b. Timer
   c. Power failure
   d. A device

80. Given $x(n) = \{0, 1, 2, 3\}$, find X(k) using DIT FFT algorithm
   a. $\{6, -2+2j, -2, -2-2j\}$
   b. $\{0, 0, 0, 0\}$
   c. $\{6, -2+2j, 2, -2+2j\}$
   d. $\{8, -2+2j, -8, -2-2j\}$

81. The total number of complex multiplications required to compute N point DFT by radix-2 FFT is given by
   a. $(N/2) \log N$
   b. $N \log_2 N$
   c. $(N/2) \log_2 N$
   d. $(N-1) \log_2 N$

82. In the Overlap save method in case of the long sequence filtering, then how many zeros do we need to append to the FIR filter's impulse response?
   a. L + 2
   b. L − 1
   c. L
   d. 2L

83. The number of complex additions required to compute DFT of any sequence with length N using the FFT algorithm would be
   a. $N \log_2 N$
   b. $2N \log_2 N$
   c. $2/N \log_2 N$
   d. $2 \log_2 N$

84. Which of the following protocols is used in Ethernet LAN for media access control?
   a. Sliding Window Protocol
   b. Stop and Wait Protocol
   c. Go Back N Protocol
   d. CSMA/CD Protocol

85. In the TCP/IP model, fragmentation of messages is carried out by
   a. The Application Layer
   b. Transport Layer
   c. Network Layer
   d. Data Link Layer

86. Which are the state-transitions possible on the server side during TCP's normal 3-way handshake?
   a. CLOSED - SYN_RCVD - ESTABLISHED
   b. CLOSED – LISTEN - ESTABLISHED
   c. LISTEN - SYN_RCVD - ESTABLISHED
   d. LISTEN – SYN_SENT – ESTABLISHED

87. If there are two routers between a source and a destination node, the number of layers traversed by an application packet is
   a. 20
   b. 16
   c. 12
   d. 14

88. Choose the correct option.
    A. When you access a bank website and retrieve your bank balance and transaction information, you are controlling the data stored.
    B. When you are accessing a online bookstore and browse a book or music collection, you are accessing the data stored.
    C. Databases are widely used for information about, employees, salary payroll taxes and benefits in department of Human Resources.
    a. Only A is incorrect
    b. Only B is incorrect
    c. Only C is correct
    d. Only A is correct

89. Suppose relation R(A, B, C, D, E) has the following functional dependencies:
    A -> B
    B -> C
    BC -> A
    A -> D
    E -> A
    D -> E
    Which of the following is not a key?
    a. A
    b. E
    c. B, C
    d. D

90. Which of the following is true about distributed database?
    a. A single logical database that is spread to multiple locations and is interconnected by a network.
    b. A loose collection of file that is spread to multiple locations and is interconnected by a network
    c. A single logical database that is limited to one location.
    d. A database that has multiple files located in different sites either on same or different networks.

91. Which of the following is the part of third generation DBMS?
    a. ORDBMS
    b. OODBMS
    c. ER Data Model
    d. NDBMS

92. Which of the following statements about Software Requirement Specification (SRS) is not true?
    a. SRS document is known as black-box specification
    b. SRS document concentrates on what needs to be done
    c. SRS document serves as a context between the developer and customer
    d. SRS document serves as system manual

93. In the context of modular software design, which one of the following combinations is desirable?
    a. High cohesion and high coupling
    b. Low cohesion and high coupling
    c. Low cohesion and low coupling
    d. High cohesion and low coupling

94. Which of the following is not a technique used in software maintenance?
    a. Re-engineering
    b. Technology change management
    c. Software configuration management
    d. Reverse engineering

95. Which of the following is not a valid goal of the requirement analysis and specification phase?
    a. Fully understand user requirements
    b. Remove inconsistencies from user requirements
    c. Produce system design based on user requirements
    d. Properly record user requirements in SRS document

96. Which of the following algorithms will require less memory?
    a. BFS
    b. DFS
    c. Linear Search
    d. Optimal Search

NG 23 (GROUP A)

97. Which of the following are used by an AI agent to perceive and act upon environment?
    a. Sensors and Perceivers
    b. Perceivers and Actuators
    c. Actuators and Sensors
    d. Sensors and decipher

98. Which is not a knowledge representation approach ?
    a. Semantic net
    b. Frames
    c. Conceptual dependency
    d. List

99. A. Knowledge base (KB) consists of set of statements.
    B. Inference is deriving a new sentence from the KB.
    Choose the correct option.
    a. A is true, B is false
    b. A is false, B is false
    c. A is true, B is true
    d. A is false, B is true

100. A wireless LAN is used for implementing security in which of the following layers.
    a. Data link layer
    b. Physical layer
    c. Network layer
    d. Transport layer

101. For digital communication systems, the bit rate is specified as M kbps and the modulation is 16 QAM. What is the bandwidth required for ideal data transmission?
    a. M/16 kHz
    b. M/8 kHz
    c. M/4 kHz
    d. M/2 kHz

102. The details of stolen and lost mobile devices are stored in
    a. Visitor location register
    b. Home location register
    c. Equipment identity register
    d. Authentication centre

103. The process of transferring an active call from one cell to another cell is called as
    a. Handoff
    b. Switching
    c. Routing
    d. Forwarding

104. Mr. X claims that he has discovered a prime number 'p' greater than the largest known prime number. Two of his colleagues A and B decide to test his claim.
    ● A chooses a random number 'a'. He applies the Miller Rabin test on 'p' using 'a' as the probe and finds that both the conditions are not satisfied. He claims that the number is composite.
    ● B also decides to use the Miller Rabin test but chooses a different random number 'b'. When he applies the Miller Rabin test on `p' using `b' as the probe, one of the two conditions is satisfied and he claims that the number is indeed prime.
    Who do you think is right?
    a. A is right and B is right.
    b. A is wrong and B is wrong.
    c. A is right and B is wrong.
    d. A is wrong and B is right.

105. Triple DES uses
    a. 168 bit keys on 64-bit blocks of plain text
    b. Working on 64-bit blocks of plain text and 56 bit keys by applying DES algorithm for three times.
    c. Works with 144 bit blocks of plain text and applies DES algorithm once
    d. Uses 128 bit blocks of plain text and 112 bit keys and apply DES algorithm thrice

106. Which one of the following has the highest preference in the environment of an Operating System?
    a. Device Drivers
    b. Application software
    c. Kernel
    d. Utility software.

107. Which of the following statements are correct?

    (i)   Physical separation – in which process use different physical objects like separate printers.

    (ii)   Physical separation – in which process having different security requirements at different times

    (iii) Logical separation – in which users operate under illusion that no other processes exist

    (iv) Logical separation – in which processes conceal their data and computations

    a.   (i)

    b.   (i) and (iii)

    c.   (ii) and (iii)

    d.   (iii) and (iv)

108. If the probability density function of a random variable X is given by

$$f(x) = \frac{1}{2} e^{\frac{-x}{2}}, x > 0, \text{ then } P(X > 1) =$$

    a. $- e^{\frac{-1}{2}}$

    b. $e^{\frac{-1}{2}}$

    c. $e^{\frac{-1}{2}} - 1$

    d. $1 - e^{\frac{-1}{2}}$

109. A random process for which the mean is constant and the autocorrelation is a function of time is called

    a.   Wide Sense Stationary Process

    b.   Strict Sense Stationary Process

    c.   First Order Stationary Process

    d.   Second Order Stationary Process

110. The probability of an empty system for an $(M / M / 1) : (FCFS / \infty / \infty)$ queueing model is

    a. $p_0 = \frac{\lambda}{\mu}$

    b. $p_0 = 1 - \frac{\lambda}{\mu}$

    c. $p_0 = \frac{\mu}{\lambda}$

    d. $p_0 = 1 - \frac{\mu}{\lambda}$

111. The value that separates the acceptance region and the rejection region of the null hypothesis is called
    a.   p value
    b.   acceptance value
    c.   critical value
    d.   F value

112. Which type of following languages does a finite automaton accept?
    a.   Type 0
    b.   Type 1
    c.   Type 2
    d.   Type 3

113. The regular expression for all strings starting with "01" and ending with "10" is
    a. $010 * 1 * 10$
    b. $01(0+1) * 10$
    c. $01(01) * 10$
    d. $(0+1)(01) * (0+1)$

114. The value of the Ackermann function $A(1, 2)$ is
    a.   3
    b.   2
    c.   5
    d.   4

115. Given a graph G with 21 edges, 3 vertices of degree 4 and other vertices each of degree 3, the number of vertices of G is
    a.   13
    b.   9
    c.   12
    d.   11

03 – ELECTRICAL AND ELECTRONICS ENGINEERING

(Answer ALL questions)

56. If A, B and C are three vectors, then
    a. $A \times (B \times C) = B \cdot (C \times A)$
    b. $A \times (B \times C) = C \cdot (B \cdot A)$
    c. $A \times (B \times C) \neq (A \times B) \times C$
    d. $A \times (B \times C) = (A \times B) \times C$

57. An electron and a proton separated by a distance of 10^{-11} meters are arranged symmetrically along the 'Z' axis with the $Z=0$, as its bisecting plane. The E field at P(3,4,12) is
    a. $4.69\overline{a}_x + 4.0a_y + 10.2\,a_z) \times 10^{-24}$ v/m
    b. $4.189\overline{a}_x + 5.58a_y^- + 10.2\,a_z^-) \times 10^{-24}$ v/m
    c. $2.29\overline{a}_x + 5.5a_y - 8.2a_z \times 10^{-12}$ v/m
    d. $1.98\overline{a}_x + 6.5a_y + 9.2a_z) \times 10^{-24}$ v/m

58. The equation for a Equipotential surface in a dipole is
    a. $\dfrac{\cos\theta}{r^2} = \text{constant}$
    b. $\dfrac{\sin\theta}{r^2} = \text{constant}$
    c. $\dfrac{\cos\theta}{2r} = \text{constant}$
    d. $\dfrac{2\cos\theta}{r^3} = \text{constant}$

59. The displacement current density J_d is
    a. $J_d = D$
    b. $J_d = \dfrac{\partial D}{\partial t}$
    c. $J_d = \nabla \times H$
    d. $J_d = \oint H \cdot dl$

60. When $\sigma \approx \alpha$, $\in = \in_0$, $\mu = \mu_r\,\mu_0$ or $\sigma >>> \omega\varepsilon$ then it is a
    a. Free space
    b. Lossless dielectric
    c. Lossy dielectric
    d. Good dielectric

61. A capacitor of 8μf capacitance is connected to a DC source through a resistance of 1M Ω
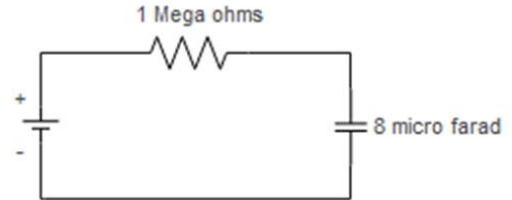
    Calculate the time taken by the capacitor to charge fully
    a. 40 seconds
    b. 20 seconds
    c. 6 seconds
    d. 8 seconds

62. Lagging power factor load
    a. Draws reactive power from supply, load current lags the voltage
    b. Supplies reactive power from supply, load current lags the voltage
    c. Draws reactive power from supply, load current leads the voltage
    d. Supplies reactive power from supply, load current leads the voltage

63. Stepper motors are widely used because of
    a. Wide speed range
    b. Large rating
    c. No need for field control
    d. Compatibility with digital systems

64. Motor which can produce uniform torque from standstill to synchronous speed is
    a. Universal motor
    b. Stepper motor
    c. Reluctance motor
    d. Hysteresis motor

65. If the applied voltage across a three phase induction motor is reduced to 'x' times, the starting current and starting torque will be reduced to ————— and ————— times respectively.
    a. x, x
    b. x, x^2
    c. x^2, x
    d. x^2, x^2

66. Skew of rotor bar eliminates
    a. The effect of harmonics
    b. The effect of crawling
    c. Magnetic noise
    d. Vibration due to unequal force developed on rotor

67. A salient pole synchronous generator connected to an infinite bus will deliver maximum power at a power angle of
    a. 0 degree
    b. 90 degree
    c. 45 degree
    d. 75 degree

68. Synchronous motor will behave like a resistor while operating with
    a. rated field current
    b. 1.5 times the rated field current
    c. 2 times the rated field current
    d. 0.5 times the rated field current

69. Which of the following connection of transformer will give the highest secondary voltage?
    a. Delta primary, Delta secondary
    b. Delta primary, Star secondary
    c. Star primary, Star secondary
    d. Star primary, Delta secondary

70. The purpose of Moderator in a Nuclear Power plant is to
    a. Control the flow of water inlet
    b. Control the amount of nuclear fuel into the reactor
    c. Control the steam flow to the turbine
    d. Control the nuclear fusion or fusion rate by slowing down the neutrons

71. Which type of insulator is used on 132kV transmission line?
    a. Pin type
    b. Disc type
    c. Shackle type
    d. Pin and Shackle type

72. The transmission line reactance is 100 ohms and base MVA is 90 MVA and the base kV is 145.2 kV. The per unit value of the line is
    a. 0.575 pu
    b. 0.265 pu
    c. 0.427 pu
    d. 0.726 pu

73. What is the type of fault for a boundary condition of a fault on phase 'a' of a power system are $I_b = -I_c$, $I_a = 0$, and $V_b - V_c = 0$?
    a. Single line to ground fault
    b. Line to line fault
    c. Double line to ground fault
    d. Three phase fault

74. The abnormal voltage due to arching grounds is reduced by
    a. Ground wire
    b. Capacitor
    c. Arching horns
    d. Peterson coil

75. A Reactance relay is
    a. Voltage restrained directional relay
    b. Directional restrained over-current relay
    c. Voltage restrained over-current relay
    d. Current restrained voltage relay

76. A transmission line can generate VARs
    a. When loading is less than Surge Impedance loading
    b. When loading is equal to Surge Impedance loading
    c. When loading is more than Surge Impedance loading
    d. When Synchronous condenser is employed

77. For a Series RLC circuit, R = 10 Ω ; L = 1mH; C = 10µF, unit step input given to the circuit. The overshoot in the output would be
    a. 0%
    b. 16%
    c. 48%
    d. 56%

78. For a type 1 second order system if the input is given as unit ramp then what would be the steady state error?
    a. $e_{ss} = 1/1 + K_p$
    b. $e_{ss} = 1/K_v$
    c. $e_{ss} = 1/K_a$
    d. $e_{ss} = 0$

79. For the limitedly stable continuous system, poles must
    a. lie on the right half plane
    b. lie on the left half plane
    c. be on the imaginary axis
    d. be at infinity

NG 23 (GROUP A)

80. The Gain Margin for a marginally stable system would be
    a. infinity
    b. zero
    c. positive
    d. negative

81. The compensator Gc(s) = 5(1+0.3s)/1+0.1s is a
    a. Lead compensation
    b. Lag compensation
    c. Lead - lag compensation
    d. PI compensation

82. Loop transfer function of a feedback system is $G(s)H(s) = \dfrac{k}{s(s+1)(s+2)}$. The root locus branch crosses the imaginary axis at
    a. $\pm j\sqrt{2}$
    b. $\pm j\sqrt{3}$
    c. $\pm j\sqrt{5}$
    d. $\pm j\sqrt{7}$

83. A system is described by the following state and output equations

$$\frac{dx_1(t)}{dt} = -3x_1(t) + x_2(t) + 2u(t)$$

$$\frac{dx_2(t)}{dt} = -2x_2(t) + u(t)$$

$Y(t) = x_1(t)$ when $u(t)$ is the input and $y(t)$ is the output. The state-transition matrix of the above system is

a. $\begin{pmatrix} e^{-3t} & 0 \\ 3^{-3t} + e^{-2t} & e^{-2t} \end{pmatrix}$

b. $\begin{pmatrix} e^{-3t} & -e^{-3t} + e^{-2t} \\ 0 & e^{-2t} \end{pmatrix}$

c. $\begin{pmatrix} e^{-3t} & e^{-3t} + e^{-2t} \\ 0 & e^{-2t} \end{pmatrix}$

d. $\begin{pmatrix} e^{3t} & -e^{-3t} + e^{-2t} \\ 0 & e^{-2t} \end{pmatrix}$

84. The VI characteristics of ideal diode is

a.

b.

c.

d.
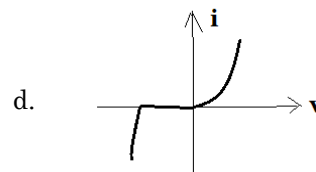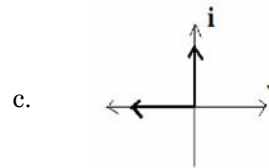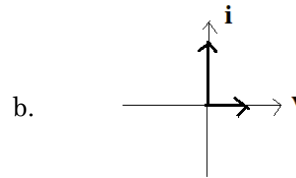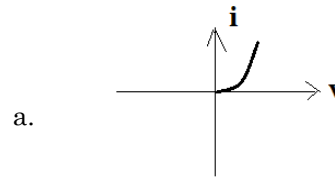
85. A buck converter with V_{in} = 25V, f_s = 50kHz and the power delivered to the load is 25W. The value of D for an average output current of 2A is
    a. 0.4
    b. 0.5
    c. 0.2
    d. 0.3

86. A single phase full wave uncontrolled bridge rectifier has a purely resistive load of R. The average output voltage for source voltage of Vs = 220 sinωt is
    a. 70V
    b. 140 V
    c. 99 V
    d. 220 V

87. In the given circuit diagram, V_{01}, V_{02} are the outputs of inverter 1 and inverter 2. The load voltage waveform V_o is

a.

b.

c.

d.
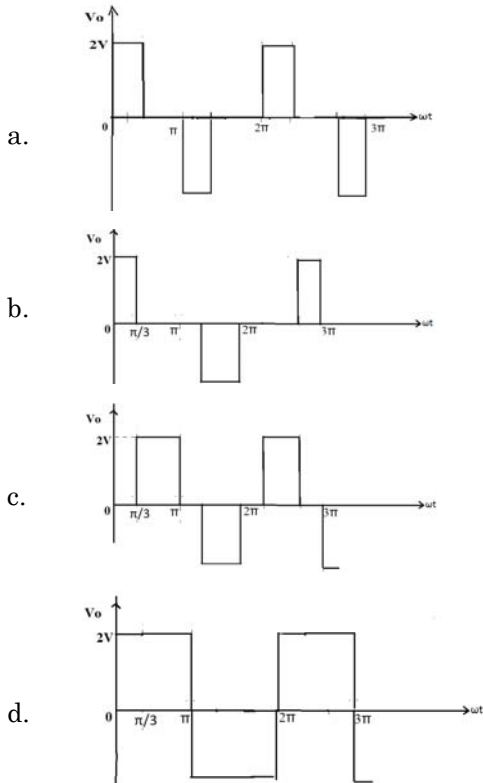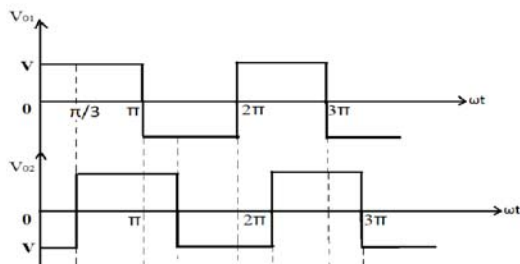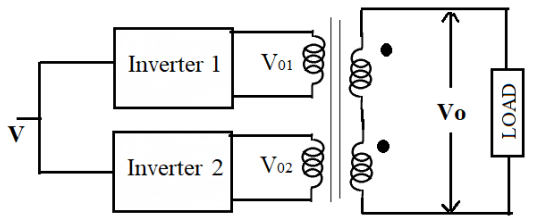
88. A full converter fed separately excited DC motor with field current remaining constant, is

   a. Constant torque drive
   b. Constant kW drive
   c. Constant speed drive
   d. Variable load speed drive

89. The conduction angle of the thyristor in the given circuit diagram if triggered continuously for $Vs = 100 \sin \omega t$ and $E = 50V$ is
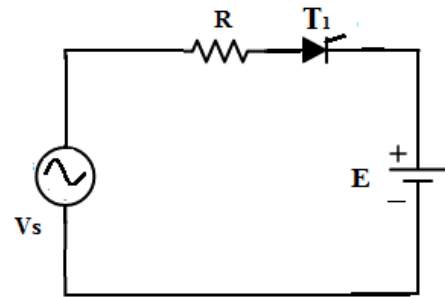
   a. 150°
   b. 120°
   c. 180°
   d. 100°

90. In a three phase inverter, harmonics existing in the line voltages are
   a. triplen harmonics
   b. Non - triplen harmonics
   c. Harmonics are absent
   d. Fifth order harmonics and third order harmonics

91. What can you comment about the data bus widths of microprocessors: 8085 and 8086?
   a. Both of these microprocessors have 8-bit data bus only
   b. Both of these microprocessors have 16-bit data bus only
   c. Whereas 8086 has a 8-bit long data bus, 8085 has 16-bit long data bus.
   d. Whereas the data bus width of microprocessor 8085 is of 8-bit size, that of 8086 is of 16-bit size.

92. What can you comment about the time taken for the machine cycles of the microprocessor 8085?
   a. Whereas 'opcode fetch' machine cycle takes 4 or 5 T-states, the ' memory read' machine cycle always takes 4 T-states only.
   b. Whereas 'opcode fetch' machine cycle takes 4 or 6 T-states, the 'memory read' machine cycle always takes 3 T-states only.
   c. Both 'opcode fetch' machine cycle and 'memory read' machine cycle uniformly take 5 T-states only.
   d. Both 'opcode fetch' machine cycle and 'memory read' machine cycle uniformly take 4 T-states only.

NG 23 (GROUP A)

93. The highest priority interrupt of microprocessor 8085, which is also non-maskable, is
    a. RST 6.5
    b. TRAP
    c. INTR
    d. INTA

94. The instruction at the physical location 21234h is to be pointed by the instruction pointer register. Assuming the contents of the code segment register to be 2111h, the contents of the instruction pointer is
    a. 0123h
    b. 0124h
    c. 1234h
    d. 0234h

95. When a 'PUSH' instruction is executed by the microprocessor 8085, what happens to the contents of the stack pointer?
    a. incremented by two
    b. incremented by one
    c. decremented by two
    d. decremented by three

96. The 8051 instruction required to switch to bank 2 from the default bank is,
    a. SETB 0D4h
    b. SETB 0D3h
    c. CLR 0D4h
    d. CLR 0D3h

97. Find the Nyquist rate and Nyquist interval for the signal $f(t) = \sin(500\pi t)$.
    a. 500 Hz, 2 sec
    b. 500 Hz, 2 msec
    c. 2 Hz, 500 sec
    d. 2 Hz, 500 msec

98. Zero-state response of the system is response of the system
    a. when initial state of the system is zero
    b. due to input alone
    c. due to input alone when initial state of the system is zero
    d. due to input alone when initial state is neglected

99. Which one of the following is the appropriate expression corresponding to $x(n) * \delta(n-k) =$
    a. $x(n)$
    b. $x(k)$
    c. $x(k) * \delta(n-k)$
    d. $x(k) * \delta(k)$

100. What is the inverse z-transform of $X(z) = 1/(1 - 1.5z^{-1} + 0.5z^{-2})$ if ROC is $0.5 < |z| < 1$?
    a. $-2u(-n-1) + (0.5)^n u(n)$
    b. $-2u(-n-1) - (0.5)^n u(n)$
    c. $-2u(-n-1) + (0.5)^n u(-n-1)$
    d. $2u(n) + (0.5)^n u(-n-1)$

101. Which of the following parameters are required to calculate the correlation between the signals $x(n)$ and $y(n)$?
    a. Time delay
    b. Attenuation factor
    c. Noise signal
    d. All of the above

102. What is the value of the coefficient $\alpha 2(1)$ in the case of FIR filter represented in direct form structure with $m = 2$ in terms of K_1 and K_2?
    a. $K_1 K_2$
    b. $K_1(1 - K_2)$
    c. $K_1(1 + K_2)$
    d. K_1 / K_2

103. Paschen's law states that
    a. breakdown voltage is a function of pd
    b. breakdown voltage is a function of electric field
    c. electronegative gases have high breakdown strength
    d. α and γ depends on E/p

104. The reflection coefficient for a travelling voltage wave at a junction of two impedances Z_1 and Z_2 is
    a. $(Z_1 + Z_2)/(Z_1 - Z_2)$
    b. $(Z_2 - Z_1)/(Z_2 + Z_1)$
    c. $2Z_1/(Z_1 + Z_2)$
    d. $2Z_2/(Z_1 + Z_2)$

105. For a 1 cm gap in air at 760 mm pressure and 20°C temperature, the breakdown voltage is
   a. 41kV
   b. 39.7kV
   c. 22.92kV
   d. 30.3kV

106. Voltage stabilizers used for regulating high dc voltages are
   a. series type
   b. shunt type
   c. both series and shunt type
   d. shunt or series or degenerative

107. Indirect strokes near overhead transmission lines induce over voltage's due to
   a. electrostatic induction
   b. both electrostatic and electromagnetic induction
   c. only electromagnetic induction
   d. conduction currents through line conductors

108. An impulse voltage generator has a generator capacitance of 0.01 μF, load capacitance of 1 nF, front resistance of R_1 = 110 Ω and tail resistance of R_2 = 400 Ω. The tail time is
   a. 60 μs
   b. 40 μs
   c. 28 μs
   d. 2 μs

109. For an RC divider to be compensated, the condition is
   a. $R_1 C_1 = R_2 C_2$
   b. $R_1 C_2 = R_2 C_1$
   c. $R_1 C_1 = R_2 C_1$
   d. $(R_1 + R_2)(C_1 + C_2) < 1\mu \sec$

110. Which of the following motor is preferred for electric traction?
   a. DC Shunt motor
   b. DC Series motor
   c. Synchronous motor
   d. Universal motor

111. A solid angle is expressed in terms of
   a. Radians / metre
   b. Radians
   c. Steradians
   d. Degrees

112. The efficiency of high pressure mercury vapour lamp is
   a. 30-40 watts/lumen
   b. 30-40 lumens/watt
   c. 40-50 watts/lumen
   d. 40-50 lumens/watt

113. A slab of insulating material 130 cm² in area and 1 cm thick is to be heated by dielectric heating. The power required is 400 W at 30 MHz. The material has a relative permittivity of 5 and power factor of 0.05. Determine the necessary voltage
   a. 960 V
   b. 960 kV
   c. 859 V
   d. 859 kV

114. In atomic hydrogen welding, the electrode is made of
   a. Carbon
   b. Graphite
   c. Tungsten
   d. Mild steel

115. The efficiency of solar cell panel is
   a. 90-95%
   b. 85-95%
   c. 45-50%
   d. 20-25%

04 - ELECTRONICS AND COMMUNICATION ENGINEERING

(Answer ALL questions)

56. Small signal model of MOSFET has a current source between —————— and ——————
    a. Gate, source
    b. Source, drain
    c. Gate, drain
   d. Gate, body

57. Depletion layer capacitance is also called
    a. Bypass capacitance
    b. Diffusion capacitance
    c. Transition capacitance
    d. Signal capacitance

58. Voltage series feedback reduces
    a. Input resistance
    b. Bandwidth
    c. Input capacitance
    d. Output resistance

59. Phase angle provided by the feedback network in the Wein bridge oscillator is —————— at resonant frequency.
    a. 180°
    b. 60°
    c. 0°
    d. 270°

60. A PN junction diode has a diffusion capacitance of 0.5 nF and forward current of 10 mA at 0.7 V. Find the transit time of carriers.
    a. 70 nS
    b. 50 nS
    c. 100 nS
    d. 35 nS

61. The transistor is specified to have $V_t = 0.5$ V, $kn' = 0.3$ mA/V², $W/L = 10$, and $\lambda = 0$. Also, let $V_{DD} = 1.8$ V, $R_D = 20$ kΩ, and $V_{GS} = 0.7$ V. Find the gain of the amplifier circuit given in the figure.
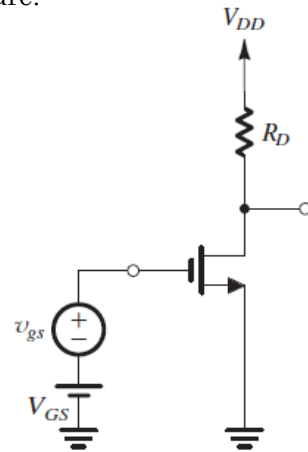
    a. – 24 V/V
    b. – 4 V/V
    c. – 12 V/V
    d. – 30 V/V

62. Negative feedback amplifier is designed with feedback factor of 20%. Open loop gain is 150V/V. What is the closed loop gain?
    a. 160V/V
    b. 14V/V
    c. 4.8V/V
    d. 9.4V/V

63. For a voltage series feedback amplifier, input of the feedback network is _____ and output of feedback network is _____.
    a. Voltage, voltage
    b. Voltage, current
    c. Current, current
    d. Current, voltage

64. A two input OR gate is designed for positive logic. Consider that this gate is operated with negative logic. Then the logic operation will be
    a. OR
    b. AND
    c. NOR
    d. Ex-OR

65. Which of these flip–flops cannot be used to construct a serial shift register?
   a. D Flip-flop
   b. T Flip-flop
   c. SR Flip-flop
   d. JK Flip-flop

66. Find the output offset voltage of an 741 op-amp, if the gain of the non-inverting amplifier is 8.5 and feedback resistor is 15 kΩ (I_B =200 nA for 741 op-amp)
   a. $1 \mu V$
   b. $2 \mu V$
   c. $3 \mu V$
   d. $4 \mu V$

67. Consider the following specifications: Voltage across the load is 5 V and Voltage across the internal resistor is 350 mV. Then, the difference between output current having a load of 100 Ω and 120 Ω for 7805 IC regulator is
   a. 3.4mA
   b. 7mA
   c. 8.4mA
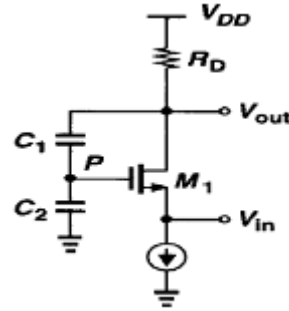   d. 9mA

68. The Q of a series RLC circuit is given by
   a. ωCR
   b. R/(ωL)
   c. 1/LC
   d. (ωL)/R

69. For the circuit and the respective characteristic of V_P versus $V_{in,CM}$ shown in the below Figure, the expression for Vx is given by
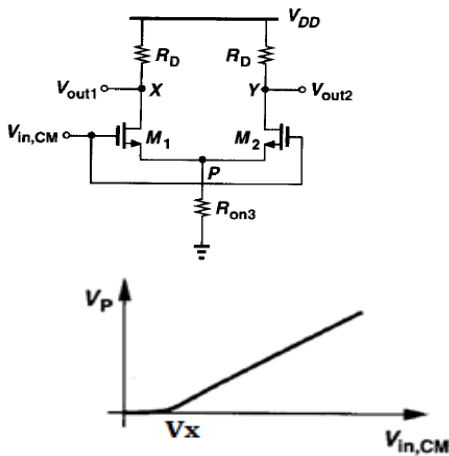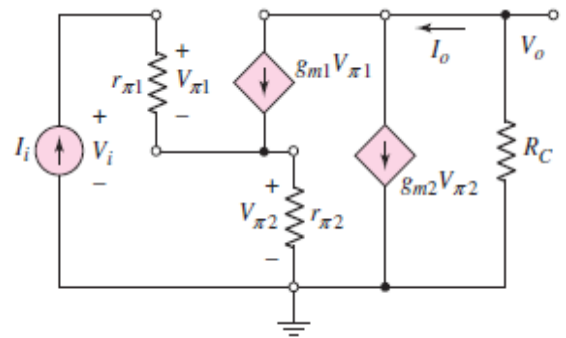

   a. $V_{DD} - 2V_{TN}$
   b. $V_{DD} - V_{TN}$
   c. $2V_{TN}$
   d. V_{TN}

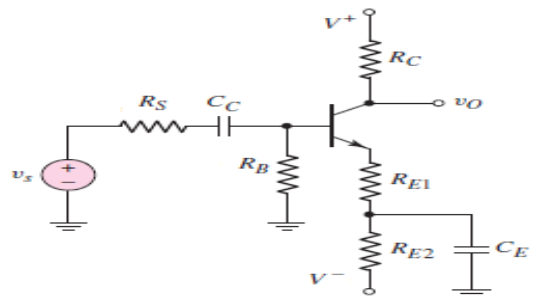70. The negative feedback topology of the circuit shown in the below Figure is

   a. Voltage Voltage Feedback
   b. Current Voltage Feedback
   c. Voltage Current Feedback
   d. Current Current Feedback

71. For the small signal equivalent circuit shown in the below Figure, small signal current gain Io/Ii is given by

   a. 1
   b. $\beta_1 + \beta_2(1+\beta_1)$
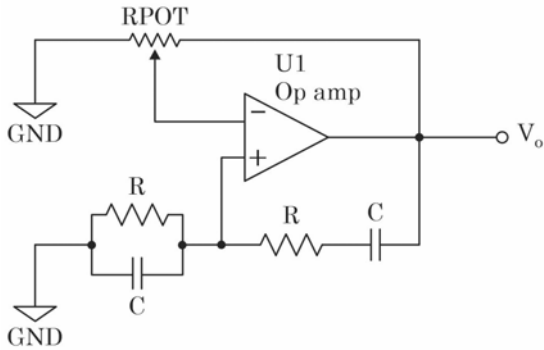   c. $\beta_1 + \beta_2$
   d. $\beta_1^2 + \beta_1(1+\beta_2)$

72. For the circuit shown in the Figure below, the slope of ac load line characteristic is given by

   a. $-1/(R_C + R_{E1})$
   b. $-1/\left(R_C + \left(\dfrac{\beta}{\beta+1}\right)R_{E1}\right)$
   c. $-1/\left(R_C + \left(\dfrac{\beta+1}{\beta}\right)R_{E1}\right)$
   d. $-1/(R_C + (\beta+1)R_{E1})$

NG 23 (GROUP A)

73. The value of LSB and MSB of a 12-bit DAC for 10 V is
   a. LSB = 2.4mV, MSB = 5V
   b. LSB = 4.2mV, MSB = 5V
   c. LSB = 4.8mV, MSB = 5V
   d. LSB = 8.4mV, MSB = 5V

74. The following Circuit is

   a. High pass filter
   b. RC Oscillator
   c. Wien Bridge Oscillator
   d. Low Pass filter

75. How many RC stages are used in an RC Phase shift oscillator and what is the Phase shift provided by the network?
   a. 2, 120°
   b. 3, 180°
   c. 3, 120°
   d. 2, 180°

76. A particular microcontroller has an in built 8-bit ADC. Controller operates at 10 V. What can be the resolution of the ADC?
   a. 19.608 mV
   b. 1.9608 mV
   c. 39.063 mV
   d. 3.9063 mV

77. Which among the following has best immunity to induced noise?
   a. Non-inverting amplifier
   b. Inverting amplifier
   c. Differential amplifier
   d. Voltage follower

78. Which IC is a fixed positive voltage regulator?
   a. LM78XX
   b. LM79XX
   c. LM2576
   d. LM2596

79. Which of the following is not a valid 8085 instruction?
   a. LDAX B
   b. LDAX D
   c. LDAX H
   d. MOV A, M

80. Consider the sequence of 8085 instruction given below
   LXI   H, 9258H
   MOV A, M
   CMA
   MOV M, A
   The contents of memory location after the execution of the above program, the contents of
   a. 9258 H are complemented
   b. 9258 H are compared with contents of the accumulator
   c. 8529 H are complemented and stored at location 8529 H
   d. 5829 H are complemented and stored at location 5892 H

81. In 8051, ————— in Program Status Word is used as the single bit accumulator for Boolean processor.
   a. Carry flag
   b. Auxiliary Carry flag
   c. Overflow flag
   d. User definable flag

82. The instruction INC source in 8086 microprocessor where
   a. Source cannot be memory location
   b. Source maybe immediate data
   c. Source maybe register
   d. The result is stored in Accumulator

83. Match the following : Jump instructions with its conditions of 8086 microprocessor
   A. JA   1. ZF = 1
   B. JC   2. OF = 0
   C. JO   3. CF = 0 and ZF = 0
   D. JE   4. CF = 1

   a. A – 2, B – 1, C – 3, D – 4
   b. A – 3, B – 4, C – 2, D – 1
   c. A – 2, B – 3, C – 1, D – 4
   d. A – 2, B – 3, C – 4, D – 1

84. What is the current density, for the corresponding drift velocity of 5.3×10^{-4} m/s in aluminum? Given, aluminum conductivity is $\sigma = 3.82 \times 10^7$ S/m and the mobility $\mu = 0.0014$ m²/V.s

   a. 1.45×10^7 A/m²

   b. 14.5×10^7 A/m²

   c. 145×10^7 A/m²

   d. 1450×10^7 A/m²

85. The curl of a gradient is

   a.   1

   b.   infinity

   c.   0

   d.   −1

86. Find the skin depth δ at a frequency of 1.6 MHz in aluminum, where, aluminum conductivity is $\sigma = 38.2$ MS/m and $\mu_r = 1$

   a.   64.4 μ m

   b.   78.4 μ m

   c.   46.4 μ m

   d.   39.4 μ m

87. By what factor is the magnitude of a phasor voltage wave reduced, if the wave experiences an attenuation of 1 neper?

   a.   1

   b.   infinity

   c.   0

   d.   0.368

88. The characteristic impedance of a transmission line was originally defined in terms of the lines distributed circuit constants and given by

   a. $z_0 = \dfrac{\sqrt{R + j\omega L}}{\sqrt{L + j\omega G}}$

   b. $z_0 = \dfrac{\sqrt{R + j\omega L}}{\sqrt{G + j\omega C}}$

   c. $z_0 = \dfrac{\sqrt{R + j\omega L}}{\sqrt{G + j\omega C}}$

   d. $z_0 = \dfrac{\sqrt{R + j\omega C}}{\sqrt{G + j\omega L}}$

89. The dominant mode for TM waves and TE waves in a circular waveguide are,

   a.   TM$_{01}$ and TE$_{11}$

   b.   TM$_{00}$ and TE$_{01}$

   c.   TM$_{11}$ and TE$_{10}$

   d.   TM$_{10}$ and TE$_{00}$

90. An antenna in free space receives $2\mu W$ of power when the incident electric field is 20 mV/m rms. The effective aperture of the antenna is

   a.   0.005 m²

   b.   1.885 m²

   c.   0.05 m²

   d.   3.77 m²

91. Which equations are regarded as wave equations in frequency domain for lossless media?

   a.   Maxwell's

   b.   Lorentz

   c.   Helmholtz

   d.   Poisson's

92. If the carrier in 100 % amplitude modulated wave is suppressed, the percentage power saving will be,

   a.   100

   b.   33.3

   c.   50

   d.   66.6

93. Identify the analog pulse modulation system from the following.

   a.   PCM

   b.   DPCM

   c.   PWM

   d.   DM

94. Let an error control scheme produces codewords with minimum distance of 7. If N_d and N_c denote the number of all possible error bits detectable and correctable respectively then, (N_d, N_c) will be equal to

   a.   (6,6)

   b.   (6,3)

   c.   (3,6)

   d.   (3,3)

NG 23 (GROUP A)

95. In a rate 1/2 convolutional encoder with 4 flip flops, the constraint length is equal to
    a. 2
    b. 3
    c. 4
    d. 5

96. If the spread spectrum communication system uses chip rate of 2048 for the bit rate of 1 μs, the processing gain offered by the system is
    a. 33 dB
    b. 3.3 dB
    c. 33
    d. 3.3

97. A 15 kHz band limited signal is frequency modulated with modulation index of 5. In the spectrum of modulated signal, the energy will be distributed over the band by considering 1% unmodulated carrier level as reference will be
    a. within 180 kHz bandwidth
    b. equal to 180 kHz bandwidth
    c. greater than 180 kHz bandwidth
    d. 15 kHz bandwidth

98. A single tone signal with 50 Hz is sampled at a rate 75 samples/s and samples are passed through an ideal low pass filter with cut off frequency of 60 Hz. The reconstructed signal will have
    a. 50 Hz component
    b. 60 Hz component
    c. 75 Hz component
    d. 25 and 50 Hz component

99. In a Pulse Code Modulation (PCM) system, 6 bit encoder is replaced by 12 bit encoder. The SQNR improvement offered at the output of PCM system will be
    a. 36 dB
    b. 72 dB
    c. 6 dB
    d. 12 dB

100. A 20 kbps baseband signaling requires minimum bandwidth of
    a. 5 kHz
    b. 10 kHz
    c. 15 kHz
    d. 20 kHz

101. In a frequency hopping spread spectrum system, message symbols are emitted at a rate 20 kSps and carrier hops every milli second. This system is a
    a. slow FHSS
    b. fast FHSS
    c. slow fading system
    d. fast fading system

102. Twiddle factor $W_N^{k+(N/2)} =$
    a. -1
    b. $-W_N^k$
    c. W_N^k
    d. 1

103. Which one of the following is not present in TCP/IP model?
    a. Application
    b. Session
    c. Network
    d. Physical

104. Which of the following statements could be valid with respect to the ICMP (Internet Control Message Protocol)?
    a. A redirect message is used when a router notices that a packet seems to have been routed wrongly.
    b. It reports all errors which occur during transmission.
    c. It informs routers when an incorrect path has been taken
    d. The "destination unreachable" type message is used when a router cannot locate the destination.

105. How many 4 bit parallel binary adders will be required to construct a 4 bit parallel multiplier?
    a. 8
    b. 4
    c. 2
    d. 1

106. In a step-index fiber in the ray approximation, the ray propagating along the axis of the fiber has the shortest route, while the ray incident at the critical angle has the longest route. Determine the difference in travel time (in ns/km) for the modes defined by those two rays for a fiber with ncore = 1.5 and ncladding = 1.485.
   a. 50.51 ns/km
   b. 50.51 μs/km
   c. 50.51 ms/km
   d. 50.51 s/km

107. The type of coding that is based on blocks of data is known as
   a. Entropy Coding
   b. Huffman Coding
   c. Runlength Coding
   d. Vector Quantization

108. The poles of analog Chebyshev filter magnitude squared function lie on
   a. ellipse
   b. circle
   c. jw-axis
   d. real axis

109. The condition to be satisfied for linear phase in an M-tap FIR filter is
   a. $h(n) = h(M-1)n = 0, 1, 2...M-1$
   b. $h(n) = -h(M-1)n = 0, 1, 2...M-1$
   c. $h(n) = \pm h(M-1-n)n = 0, 1, 2...M-1$
   d. $h(-n) = \pm h(M-n)n = 0, 1, 2...M-1$

110. In bilinear transformation, the left-half s-plane is mapped to which of the following in the z-domain?
   a. Outside the unit circle
   b. Re(z)
   c. Im(z)
   d. Inside the unit circle

111. The first three values of the DFT coefficients of $x(n)$={0,1,2,3} are $X(0) = 6$, $X(1) = -2+2j$, $X(2) = -2$. The value of $X(3)$ is
   a. -6
   b. $2-2j$
   c. $-2-2j$
   d. 2

112. The number of real multiplications required in the direct computation of N-point DFT is
   a. $4N(N-1)$
   b. $N(N-1)$
   c. $2N^2$
   d. $4N^2$

113. Peak sidelobe level for a Rectangular window is
   a. -13 dB
   b. -32 dB
   c. -43 dB
   d. -58 dB

114. The following is a valid denominator polynomial of a normalized Butterworth transfer function.
   a. $s-1$
   b. $(s^2+s+0.5)(s+1)$
   c. $(s^2+0.77s+1)(s^2+1.18s+1)$
   d. $s^2+1.4s+0.3$

115. The equation describing the relation between s and z variables in bilinear transformation is
   a. $s = (2/T)[(1+z^{-1})/(1-z^{-1})]$
   b. $z = [(2/T)+s]/[(2/T)-s]$
   c. $s = (2/T)[(1-z)/(1+z)]$
   d. $z = [(2/T)-s]/[(2/T)+s]$

PART III

05 - MECHANICAL ENGINEERING

(Answer ALL questions)

56. The manufacturing area of a plate is divided into four quadrants. Four machines have to be located, one in each quadrant. What is the total number of possible layouts?

    a. 4
    b. 8
    c. 16
    d. 24

57. The shaft of a motor starts from rest and attains its full speed of 1800 rpm in 10 seconds. What is the angular acceleration of the shaft?

    a. $\pi \, \text{rad/s}^2$
    b. $6 \, \pi \, \text{rad/s}^2$
    c. $12 \, \pi \, \text{rad/s}^2$
    d. $24 \, \pi \, \text{rad/s}^2$

58. The Reynolds number for a flow of a certain fluid in a circular tube is specified as 2500. What would be the Reynolds number for the same fluid when the tube diameter is increased by 20% and the fluid velocity is decreased by 40%?

    a. 900
    b. 1800
    c. 2700
    d. 3600

59. A steel (Specific heat of steel = 0.4 kJ/kg-K) ball of mass 1 kg and at a temperature of 60°C is dropped into 1 kg of water that is at 20°C. What would be final steady state temperature of water?

    a. 23.5 °C
    b. 40°C
    c. 35°C
    d. 30°C

60. In a steam power plant, the power output of the turbine is 4200 kW when the enthalpy of steam at the entry and exit of the turbine is measured as 3400 kJ/kg and 2600 kJ/kg, respectively. Considering the power consumed by the feed pump as 200 kW, what is the steam flow rate through the turbine?

    a. 5.0 kg/s
    b. 1.3 kg/s
    c. 1.6 kg/s
    d. 0.7 kg/s

61. A cylindrical shaped vessel of internal diameter of 100 cm and height of 80 cm contains a gas. The mercury manometer that is connected to the vessel shows 640 mm of Hg above the atmosphere when the barometer reads 760 mm of Hg. What is the absolute pressure of gas inside the vessel? Take: 1 mm of Hg = 133.4 N/m^2

    a. 186.8 kPa
    b. 101.4 kPa
    c. 085.4 kPa
    d. 016.1 kPa

62. One reversible heat engine operates between the temperature limits of 1000 K and T_x K and another heat engine operates between the temperature limits of T_x and 360 K. If both the heat input and the output of the first engine is twice that of the second engine, what is the value of T_x?

    a. 720 K
    b. 680 K
    c. 600 K
    d. 640 K

63. In Morse test on a 4-cylinder, 4-stroke, spark ignition engine, the brake power was 24 kW whereas the brake powers of individual cylinders with spark cut off were 17.2 kW, 16.6 kW, 16.8 kW, and 16.0 kW. What is the mechanical efficiency of the engine?

    a. 77.6 %
   b. 81.6 %
    c. 85.6 %
    d. 89.6 %

64. What is the function of flash chamber in vapour compression refrigeration system?
   a. The flash chamber is used for doing subcooling of refrigerant, thereby refrigerating effect would be increased.
   b. The flash chamber is used for removing the dry vapour after the throttling process.
   c. The flash chamber is used for removing the liquid particles after the evaporator, thereby entrance of liquid particles would be avoided.
   d. The flash chamber is used for heating the refrigerant vapour after the evaporator, thereby entrance of liquid particles would be avoided.

65. The latent heat of evaporation at critical point is
   a. Sensible heat
   b. Equal to zero
   c. Twice that of sensible heat
   d. Indeterminate

66. The gravimetric analysis of a fuel is given as 80 % of carbon, 8 % of Hydrogen and 8 % of oxygen and the remaining is incombustible. What is the stoichiometric air/fuel ratio of the fuel?
   a. 9.3
   b. 11.7
   c. 12.1
   d. 14.5

67. A hot-fluid flows at a velocity of 1.2 m/s through a pipe having a diameter of 100 mm and 1000 m long. If the heat loss across the wall of the pipe is estimated as 1000 W/m², density of the fluid is 780 kg/m³ and C_p = 2.3 kJ/kg-K, what is the difference in temperature of fluid between the inlet and exit of the pipe?
   a. 09.3 K
   b. 18.6 K
   c. 27.9 K
   d. 37.2 K

68. A hollow sphere of internal diameter of 100 mm and an external diameter of 150 mm is to be insulated by an insulation material having a thermal conductivity of 1.2 W/m-K. If the convective heat transfer coefficient for the system is 20 W/m²K, what is the critical thickness of insulation?
   a. 120 mm
   b. 50 mm
   c. 75 mm
   d. 45 mm

69. Fin efficiency defined as
   a. the ratio between the actual amount of heat transfer with fins and the amount of heat transfer without fin
   b. the ratio between the actual amount of heat transfer with fins and the amount of heat transfer when the entire surface of the fin is maintained at base temperature
   c. the ratio between the ideal amount of heat transfer with fins and the amount of heat transfer when the entire surface of the fin is maintained at base temperature
   d. the ratio between the actual amount of heat transfer with fins and the amount of heat transfer when the entire surface of the fin is maintained at tip temperature

70. A 5 kW water heater with 30 litres of water is switched on for 20 minutes. What is the rise in temperature of water? Assume zero loss in electrical energy and specific heat of water as 4 kJ/kg-K.
   a. 40 °C
   b. 50 °C
   c. 45 °C
   d. 55 °C

71. A composite wall consists of three different materials (slabs) with the thermal conductivities of k, k/2, k/4, respectively. The temperature drop across the individual will be in the ratio of
   a. 1 : 1 : 1
   b. 1 : 2 : 4
   c. 4 : 2 : 1
   d. 16 : 4 : 1

72. An enclosure consists of four surfaces 1, 2, 3, and 4. The view factors for radiative heat transfer are $F_{11} = 0.1$, $F_{12} = 0.4$, $F_{13} = 0.25$. If the surface area of A_1 and A_4 are $4m^2$ and $2m^2$, respectively, what is the value of view factor, F_{41}?

a. 0.50

b. 0.25

c. 0.75

d. 0.40

73. A refrigerator is working on a reversed Carnot cycle has a COP of 4. If the same system is employed as a heat pump for supplying heat of 10 kW, what is the required work input?

a. 3.0 kW

b. 2.5 kW

c. 2.0 kW

d. 3.3 kW

74. What is the process in which the addition of moisture to air at constant dry bulb temperature called as?

a. Sensible cooling

b. Humidification

c. Dehumidification

d. Sensible heating

75. A room is to be maintained at 50% relative humidity and 25°C dry bulb temperature when the outside condition is 75% relative humidity and 45°C. Which of the following processes is (are) to be applied?

a. Sensible heating only

b. Humidification and cooling

c. Dehumidification and cooling

d. Sensible cooling only

76. In case of sensible cooling of air, the bypass factor is given by (where t_{d1} = Dry bulb temperature of air entering the cooling coil, t_{d2} = Dry bulb temperature of air leaving the cooling coil, and t_{d3} = Dry bulb temperature of the cooling coil)

a. $\dfrac{(t_{d1} - t_{d3})}{(t_{d2} - t_{d3})}$

b. $\dfrac{(t_{d3} - t_{d1})}{(t_{d2} - t_{d3})}$

c. $\dfrac{(t_{d3} - t_{d1})}{(t_{d3} - t_{d2})}$

d. $\dfrac{(t_{d2} - t_{d1})}{(t_{d1} - t_{d3})}$

77. What is the meaning of regeneration in a steam power plant?

a. It means doing some useful work by the steam after its complete expansion in the turbine.

b. Bypassing a fixed quantity of steam during the expansion in the turbine to control the speed.

c. Extraction of some useful steam during the expansion in the turbine stage and heating the feed water by the extracted steam.

d. Heating of steam after the expansion in high pressure turbine.

78. The reheat factor of multi-stage steam turbine is normally in the range of

a. 0.5 to 0.80

b. 0.8 to 0.98

c. 1.03 to 1.07

d. 1.20 to 1.50

79. Work ratio of a gas turbine unit is defined as

a. Ratio between the work required for the compressor and the heat supplied

b. Ratio between the net-work output and heat supplied

c. Ratio between the net-work output and the compressor work

d. Ratio between the net-work output and the turbine work

80. Air enters into the combustor of a gas turbine unit at a velocity of 112 m/s and a temperature of 223°C. What is the Mach number at the entry?
   a. 0.125
   b. 0.250
   c. 0.375
   d. 0.325

81. The velocity of steam at the exit of nozzle vanes of a simple axial flow impulse turbine is 500 m/s and the tangential velocity of rotor blades is 250 m/s. The nozzle vanes are set at angle of 30° (with reference to direction of rotation of rotor) and the steam leaves rotor exactly parallel to the axis of the rotor. By neglecting the effects of friction, what is diagram power and blade efficiency for a mass flow rate of 1 kg/s?
   a. 108.3 kW and 86.6 %, respectively.
   b. 108.3 kW and 43.3 %, respectively.
   c. 125.0 kW and 86.6 %, respectively.
   d. 125.0 kW and 43.3 %, respectively.

82. What is the purpose(s) of providing lacing wires in a steam turbine? Lacing wires is used to
   a. control the disturbance of water particles
   b. keep the blades alignment and to control the effects of vibration in longer blades in low pressure stages
   c. increase mechanical strength of blades
   d. control the disturbance due to impurities

83. A mechanism has 7 links with all binary pairs except one, which is a ternary pair. The number of instantaneous centres of this mechanism is
   a. 21
   b. 42
   c. 14
   d. 28

84. Governor power is defined as the product of
   a. Mean force exerted on the governor sleeve due to change in speed and mean radius of the governor balls.
   b. Mean force exerted on the governor sleeve due to change in speed and the sleeve lift.
   c. Force required to stop the movement of sleeve while there is 1% change in rated speed and radius of fly balls.
   d. Force required to stop the movement of sleeve while there is 2% change in rated speed and the radius of fly balls.

85. If the unbalanced force developed by an eccentric mass that is rotating at 3000 rpm is X times more than the 50% of the unbalanced force that is developed by the same mass rotates at 300 rpm, what is the value of X?
   a. X = 10
   b. X = 100
   c. X = 50
   d. X = 200

86. The Whitworth quick return mechanism is formed in a slider-crank chain when the
   a. Coupler link is fixed
   b. Longest link is a fixed link
   c. Slider is a fixed link
   d. Smallest link is a fixed link

87. The rotor of a turbine is generally rotated at
   a. a speed much below the critical speed
   b. a speed slightly less than the critical speed
   c. a speed much above the critical speed
   d. The operating speed does not have any relation with the critical speed

88. Consider the given two sets and select the correct answer using codes.

	Set I		Set II
1.	Flywheel	5.	Speed control on par with load
2.	Governor	6.	Turning moment diagram
3.	Critical speed	7.	D'Alembert's principle
4.	Inertia force	8.	Dunkerley's method

    a.   1-5, 2-6, 3-7, 4-8
    b.   1-6, 2-5, 3-8, 4-7
    c.   1-7, 2-8, 3-5, 4-6
    d.   1-8, 2-7, 3-6, 4-5

89. In a slider-crank mechanism, what is the position of the crank at which the velocity of the slider is maximum?
    a.   Crank and connecting rod are in-line with each other
    b.   Crank and connecting rod are mutually perpendicular.
    c.   Crank is perpendicular with the line of motion of slider.
    d.   Crank is 120° with the line of stroke

90. Consider the following follower motions with respect of given lift, speed of rotation of cam and angle of stroke of cam; X. Cycloidal motion, Y. Simple harmonic motion, Z. Uniform velocity motion. What is the correct sequence of the above stated motions in the descending order of maximum velocity?
    a.   X – Y – Z
    b.   Z – Y – X
    c.   Z – X – Y
    d.   X – Z – Y

91. In a simple epicyclic gear train, the number of teeth in sun gear, and planetary gear is 18 and 24, respectively. If the internal gear is kept as stationery and the sun gear rotates at 100 RPM, what is the speed and direction of rotation of the arm that is connected to planetary gear?
    a.   78.6 RPM, direction of rotation is same as sun gear
    b.   21.4 RPM, direction of rotation is same as sun gear
    c.   78.6 RPM, direction of rotation is opposite to the direction of rotation of sun gear
    d.   21.4 RPM, direction of rotation is opposite to the direction of rotation of sun gear

92. Which one of the following statements is correct in terms of direction of linear velocity of any point on a kinematic link relative to any other point on the same link?
    a.   Dependent on the angular velocity of the link.
    b.   At 45° to the line joining the points.
    c.   Parallel to the line joining the points.
    d.   Perpendicular to the line joining the points

93. Two shafts; P and Q are made up of same material. If the diameter of the shaft P is 1.5 times of that of Q, the torque transmitting capacity of shaft P is
    a.   50% more than the capacity of shaft Q
    b.   100% more than the capacity of shaft Q
    c.   125% more than the capacity of shaft Q
    d.   337.5% more than the capacity of shaft Q

94. A boiler shell having an internal diameter of 2 m and plate thickness of 15 mm is subjected by an internal pressure of 1.5 MPa. What is the hoop stress and longitudinal stress induced in the shell wall?
    a.   150 MPa and 75 MPa, respectively
    b.   75 MPa and 150 MPa, respectively
    c.   100 MPa and 50 MPa, respectively
    d.   50 MPa and 100 MPa, respectively

95. A solid shaft is subjected to a bending moment and a twisting moment of 3 kN-m and 4 kN-m. If the allowable shear stress for the shaft material is 50 MPa, what is the minimum diameter of the shaft based on equivalent twisting moment?
    a.   75 mm
    b.   80 mm
    c.   90 mm
    d.   85 mm

96. The deflection of a spring with 24 active turns under a load of 2400 N is 24 mm. The spring is cut into two springs in such a way that one spring has 16 turns and another with 8 turns. If the two springs are arranged in parallel and subjected under the same load; 2400 N, what would be deflection of the system?
    a.   9.33 mm
    b.   8.33 mm
    c.   7.33 mm
    d.   5.33 mm

97. In a simple quick return mechanism shown in the figure, AC (Continuously rotating link) = 100 mm, AB (Fixed link) = 200 mm. What is the ratio of time for forward motion to that for return motion?
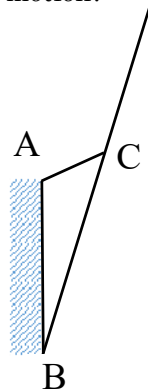
    a.   4.0
    b.   3.0
    c.   2.0
    d.   0.5

98. What is the purpose of cages in deep grove ball bearings?
    a.   To separate the internal and external races
    b.   To separate the balls from the inner race
    c.   To separate the balls from the outer race
    d.   To ensure that the balls do not cluster at one point and maintain the proper angular position of balls

99. To ensure the self-locking in screw jack, it is essential that the helix angle is
    a.   1.5 times of the angle of friction between the nut and screw
    b.   twice the angle of friction between the nut and screw
    c.   less than the angle of friction between the nut and screw
    d.   No mandatory relation between them

100. In a power transmission, the maximum shear stress induced in a solid shaft is 50MPa. If the solid shaft is replaced by a hollow shaft, whose outer diameter is same as solid shaft diameter, inner diameter is 0.6 times of outer diameter and made up of same material, what would be maximum induced shear stress in the hollow shaft?
    a.   57.45MPa
    b.   50.45MPa
    c.   83.45MPa
    d.   30.45MPa

101. What is the composition of Germen Silver?
    a.   60% Silver, 20% Nickel and 20% Zinc
    b.   60% Copper, 20% Nickel and 20% Zinc
    c.   60% Copper, 20% Zinc, 20% Silver
    d.   60% Silver, 40% Copper

102. Which of the following materials has better shock absorbing capacity?
    a.   Stainless steel
    b.   Mild steel
    c.   Cast iron
    d.   White iron

103. What is the tensile strength of a structural steel that is represented as St50?
    a.   45 to 55 MPa
    b.   500 to 600 Pa
    c.   450 to 550 MPa
    d.   500 to 600 kgf/cm^2

104. Impact strength is the combination of
    a.   Hardness and strength
    b.   Toughness and strength
    c.   Malleability and ductility
    d.   Yield strength and compression strength

105. Creep can be defined as
    a.   the formation of cracks by stress or strain
    b.   elongation of materials in the elastic region at high temperature
    c.   time dependent strain occurs under stress at high temperature
    d.   failure of material due to cyclic loading

106. Thermit welding process involve
    a.   heating of base metals by using thermit mixture and d.c.
    b.   local heating of base metals by means of ignition powder followed by exothermic reactions produced by thermit
    c.   heating of base metals by using thermit, flux and electric arc
    d.   heating of base metals by using thermit with ignition powder

NG 23 (GROUP A)

107. Whether coolant is needed for Gray cast iron tool during machining? Why?
    a. Yes needed, because it is brittle
    b. Yes needed, because it contains hot inclusions
    c. Not needed, because of the presence of graphite
    d. Not needed, because it is soft

108. The mechanism of material removal in EDM process is
    a. Melting and Evaporation
    b. Melting and Corrosion
    c. Erosion and Cavitation
    d. Cavitation and Evaporation

109. In unilateral system of tolerance, the tolerance is allowed on
    a. both sides of actual size
    b. both sides of nominal size
    c. one side of the actual size
    d. one side of the nominal size.

110. The force required for metal cutting operation
    a. increases with increase in the feed of the tool and decreases with increase in the depth of cut
    b. increases with increase in both the feed of the tool and the depth of cut
    c. decrease with increase in both the feed of the tool and the depth of cut
    d. decreases with increase in the feed of the tool and increases with increase in the depth of cut

111. In connection with network analysis, dummy activity
    a. does not require both time and utilization of resources
    b. does not require time but requires utilization of resources
    c. requires both time and resources
    d. requires time but does not require any resources

112. The cost of a machine is Rs.24,000 and the estimated scrap value after an average life of 30,000 hours is Rs. 1,200. What will be the depreciation charge at the end of the first year if the machine is operated for a total duration of 1,500 hours?
    a. Rs.1,260
    b. Rs.1,200
    c. Rs.1,140
    d. Rs.1,080

113. Which one of the following metals is unsuitable for testing with Ultrasonics?
    a. Copper
    b. Aluminum
    c. Cast Iron
    d. Stainless Steel

114. A compound gear train consists of six gears, namely A, B, C, D, E and F and the number of teeth on the gears is 60, 40, 50, 25, 30, and 24, respectively. The gears B and C are on one shaft while the gears D and E are on another shaft. The gear A drives gear B, gear C drives gear D and gear E drives gear F. If the gear A transmits 1.5 kW at 100 rpm. and the gear train has an efficiency of 80 per cent, find the torque on gear F.
    a. 68.62 Nm
    b. 47.75 Nm
    c. 30.56 Nm
    d. 38.23 Nm

115. It takes 10 minutes to empty the contents of a prismatic tank through an orifice at the bottom of the tank. The time taken to empty top half of the tank will be
    a. 2 min
    b. 2.93 min
    c. 3 min
    d. 3.93 min

NG 23 (GROUP A)