

Paper Code : 2309

Ph. D. (Electronics and Comm. Engg.) Entrance Examination 2023-24

Time : 2 Hours

Do not open this Test Booklet until you are asked to do so.

Maximum Marks : 100

Immediately fill in the particulars on this page of the Question Booklet and the Answer Sheet with Blue/Black Ball Point Pen. Use of pencil is strictly prohibited.

Name of the candidate (In Capital Letters) : _____

Roll Number (In Figure) :

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(In Words) : _____

Name of Examination Centre (in Capital Letters) : _____

Candidate's Signature : _____ Invigilator's Signature _____

Important Instructions :

This booklet contains 100 objective type questions. First 50 questions of Research Methodology and Second 50 questions of Subject Specific. Each having four options a, b, c, d.

1. Candidates are not allowed to carry textual material printed or written, bits of papers, pages, mobile phone, electronic device or any other material except the Admit Card inside the Examination Hall/Room.
2. The candidates should fill in the required particulars on the Test Booklet and Answer Sheet with Blue/Black Ball Point Pen.
3. The candidate should not write their Roll Number anywhere else (except in the specified space) on the Test Booklet/Answer Sheet.
4. Out of the four options given for each question, the candidate must mark one correct option as an answer only.
5. There is no negative marking for any wrong answer.
6. Handle the Test Booklet and Answer Sheet with care, as under no circumstances (except for discrepancy in the Test Booklet Code and Answer Sheet Code), will another set be provided.
7. The candidates are not allowed to do any rough work or writing work on the Answer Sheet. All calculations/writing work are to be done in the space available in the Test Booklet itself.
8. Each candidate must show on demand her Admit Card to the Invigilator.
9. No candidate, without special permission of the Superintendent or Invigilator, should leave her seat.
10. The candidate should not leave the Examination Hall without handing over their Answer Sheet and Test Booklet to the invigilator on the duty and signing the Attendance Sheet.
11. No part of the Test Booklet and Answer Sheet shall be detached under circumstances.

NOTE : THIS BOOKLET SHALL BE RETAINED FOR SIX MONTH ONLY.

RESEARCH METHODOLOGY

1. What is the name of the conceptual framework in which the research is carried out ?
 - (a) Research hypothesis
 - (b) Synopsis of research
 - (c) Research paradigm
 - (d) Research design
2. What is the major attribute of Correlation Analysis ?
 - (a) Association among variables
 - (b) Difference among variables
 - (c) Regression among variables
 - (d) Variations among variables
3. Which of the following features are considered as critical in qualitative research ?
 - (a) Collecting data with the help of standardized research tools.
 - (b) Design sampling with probability sample techniques.
 - (c) Collecting data with bottom-up empirical evidence.
 - (d) Gathering data with top-down schematic evidence.
4. How is random sampling helpful ?
 - (a) Reasonably accurate
 - (b) An economical method of data collection
 - (c) Free from personal biases
 - (d) All of the above

5. A research intends to explore the result of possible factors for the organization of effective mid-day meal interventions. Which research method will be most appropriate for this study ?
- (a) Descriptive survey method
 - (b) Historical method
 - (c) Ex-post facto method
 - (d) Experimental method
6. In order to pursue the research, which of the following is priorly required?
- (a) Developing a research design
 - (b) Formulating a research question
 - (c) Deciding about the data analysis procedure
 - (d) Formulating a research hypothesis
7. The format of thesis writing is the same as in :
- (a) Writing of Seminar representation
 - (b) Preparation of research paper/article
 - (c) A research dissertation
 - (d) Presenting a workshop/conference paper
8. Which one among the following statements is false in the context of participatory research ?
- (a) It recognizes knowledge as power
 - (b) It is a collective process of inquiry
 - (c) It emphasizes people as experts
 - (d) Its sole purpose is the production of knowledge

9. Which one among the following statements is *true* in the context of the testing of hypotheses ?
- (a) It is only the alternative hypotheses that can be tested.
 - (b) It is only the null hypotheses that can be tested.
 - (c) Both the alternative and the null hypotheses can be tested.
 - (d) Both the alternative and the null hypotheses cannot be tested.
10. Research and Development become the index of development of the country. Which of the following reasons are true with regards to this statement?
- (a) R&D targets human development
 - (b) R&D can enhance people's standard of living in the country
 - (c) R&D reflects the actual economic and social conditions being prevailed in the country
 - (d) All of the above
11. What does the longitudinal research approach actually deal with ?
- (a) Long-term research
 - (b) Short-term research
 - (c) Horizontal research
 - (d) None of the above
12. What do you understand by the term "Anusandhan" ?
- (a) Goal-oriented
 - (b) Following an aim
 - (c) Attaining an aim
 - (d) Praying to achieve an aim

- 13.** Which of the following does not correspond to characteristics of research?
- (a) Research is not passive
 - (b) Research is systematic
 - (c) Research is not problem-oriented
 - (d) Research is not a process
- 14.** Which of the following options are the main tasks of research in modern society ?
- (a) To learn new things
 - (b) To keep pace with the advancement in knowledge
 - (c) To systematically examine and critically analyze the investigations/ sources with the objective
 - (d) All of the above
- 15.** What is the main aim of interdisciplinary research ?
- (a) To oversimplify the problem of research
 - (b) To bring out the holistic approach to research
 - (c) To create a new trend in research methodology
 - (d) To reduce the emphasis on a single subject in the research domain
- 16.** The main aim of the scientific method in the research field is to :
- (a) Improve data interpretation
 - (b) Confirm triangulation
 - (c) Eliminate spurious research
 - (d) Introduce new variables

- P.T.O.**

21. Which of the following is *not* the method of Research ?

- (a) Survey
- (b) Historical
- (c) Observation
- (d) Philosophical

22. A research problem is feasible only when :

- (a) It has utility and relevance
- (b) It is new and adds something to knowledge
- (c) It is researchable
- (d) All of the above

23. Circle graphs are used to show :

- (a) How is one part related to other parts ?
- (b) How are various sections share in the whole ?
- (c) How is one whole related to another whole ?
- (d) How are various parts related to the whole ?

24. Authenticity of a research finding is its :

- (a) Validity
- (b) Objectivity
- (c) Originality
- (d) All of these

25. Which one is called non-probability sampling ?

- (a) Quota sampling
- (b) Cluster sampling
- (c) Systematic sampling
- (d) Stratified random sampling

26. What does a good thesis involve ?

- (A) Reducing punctuations as well as grammatical errors to minimalist
- (B) Correct reference citations
- (C) Consistency in the way of thesis writing
- (D) Well defined abstract

Select the answers from the codes given below :

- (a) (B), (C) and (D)
- (b) (A), (B), (C) and (D)
- (c) (A), (B) and (C)
- (d) (A), (B) and (D)

27. On what basis did Jean Piaget give his theory of cognitive development of humans ?

- (a) Evaluation Research (b) Fundamental Research
- (c) Applied Research (d) Action Research

28. What are the core elements of a dissertation ?

- (a) Introduction; Data Collection; Data Analysis; Conclusions and Recommendations
- (b) Executive Summary; Literature Review; Data Gathered; Conclusions; Bibliography
- (c) Research Plan; Research Data; Analysis; References
- (d) Introduction; Literature Review; Research Methodology; Results; Discussions and Conclusions

- 29.** "Sampling Cases" can be defined as :
- (a) Sampling using a sampling frame
 - (b) Identifying people who are suitable for research
 - (c) Literally the researcher's brief case
 - (d) A sampling of people, newspapers, television programs etc.
- 30.** Which technique is generally followed when the population is finite ?
- (a) Systematic Sampling Technique
 - (b) Purposive Sampling Technique
 - (c) Area Sampling Technique
 - (d) None of the above
- 31.** Research problem is selected from the standpoint of :
- (a) Social relevance
 - (b) Financial support
 - (c) Researcher's interest
 - (d) Availability of relevant literature
- 32.** Which one among the following is the most comprehensive source of population data ?
- (a) Census
 - (b) National Sample Surveys
 - (c) Demographic Health Surveys
 - (d) National Family Health Surveys

- 33.** The process not needed in experimental research is :
- (a) Controlling
 - (b) Observation
 - (c) Reference collection
 - (d) Manipulation and replication
- 34.** What are those conditions where a research problem is *not* viable ?
- (a) It is new and adds something to knowledge
 - (b) It can be researched
 - (c) It has utility and relevance
 - (d) It contains dependent and independent variables
- 35.** How can we enhance the research objective ?
- (a) By making it more valid
 - (b) By making it more reliable
 - (c) By making it more impartial
 - (d) All of the above
- 36.** Action-research can be understood as :
- (a) A longitudinal research
 - (b) An applied research
 - (c) A kind of research being carried out to solve a specific problem
 - (d) All of the above

- 37.** On what basis can one formulate the assumptions ?
- (a) The cultural background of the country
 - (b) Universities
 - (c) Some specific characteristics of castes
 - (d) All of the above
- 38.** Which one among the following falls under the category of research development ?
- (a) Descriptive Research
 - (b) Philosophical Research
 - (c) Action Research
 - (d) All of these
- 39.** What is the use of Factorial Analysis ?
- (a) For setting the hypotheses
 - (b) To understand the difference between two variables
 - (c) To understand the relationship between two variables
 - (d) To understand the difference between various variables
- 40.** What is the best-suited name for a process that doesn't necessitate experimental research ?
- (a) Manipulation
 - (b) Controlling
 - (c) Content analysis
 - (d) Observation
- 41.** Which one among the following variables cannot be expressed in quantitative terms ?
- (a) Numerical Aptitude
 - (b) Marital Status
 - (c) Socio-economic Status
 - (d) Professional Attitude

42. The "Sociogram" technique is used to study :
- (a) Vocational Interest
 - (b) Human Relations
 - (c) Professional Competence
 - (d) Achievement Motivation
43. Which one among the following phrases does not correspond to the meaning of research as a process ?
- (a) Problem Solving
 - (b) Trial and Error
 - (c) Objective Observation
 - (d) Systematic Activity
44. Research can be classified as :
- (a) Basic, Applied and Action Research
 - (b) Quantitative and Qualitative Research
 - (c) Philosophical, Historical, Survey and Experimental Research
 - (d) All of the above
45. The first step of research is :
- (a) Selecting a problem
 - (b) Searching a problem
 - (c) Finding a problem
 - (d) Identifying a problem
46. A research problem is feasible only when :
- (a) It has utility and relevance
 - (b) It is researchable
 - (c) It is new and adds something to knowledge
 - (d) All of the above

47. Bibliography given in a research report :

- (a) shows vast knowledge of the researcher
- (b) helps those interested in further research
- (c) has no relevance to research
- (d) All of the above

48. Fundamental research reflects the ability to :

- (a) Synthesize new ideals
- (b) Expound new principles
- (c) Evaluate the existing material concerning research
- (d) Study the existing literature regarding various topics

49. The experimental study is based on :

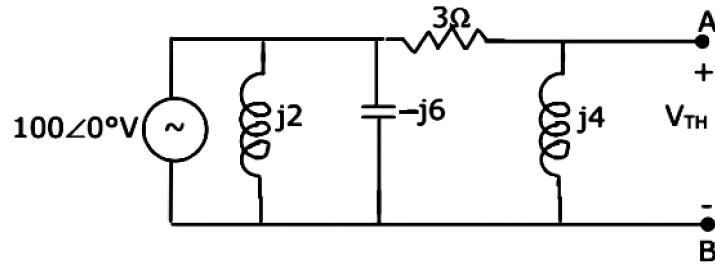
- (a) The manipulation of variables
- (b) Conceptual parameters
- (c) Replication of research
- (d) Survey of literature

50. The main characteristic of scientific research is :

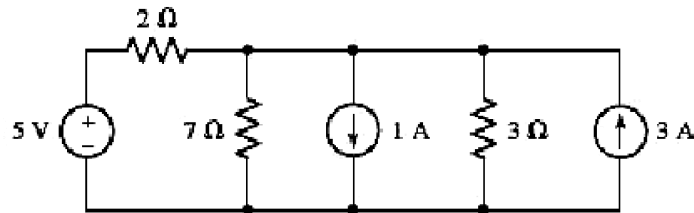
- (a) empirical
- (b) theoretical
- (c) experimental
- (d) All of these

Ph. D. (ECE) Entrance Test, 2023

51. The Thevenin's equivalent voltage V_{TH} appearing between the terminals A and B of the network shown below is given by :

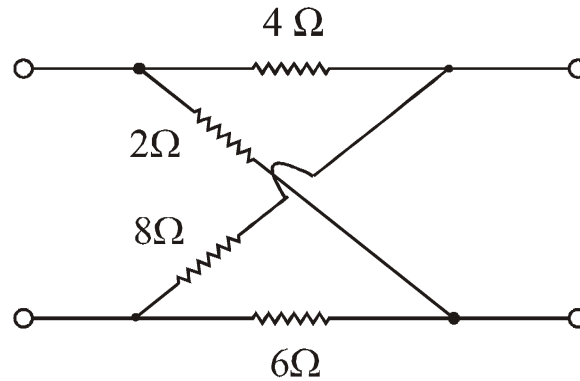


- (a) $j16(3+4j)$ (b) $16(3+4j)$
(c) $16(3-4j)$ (d) $j16(3-4j)$
52. What is the power dissipated in the 2Ω resistor in the circuit shown :



- (a) 67.2 mW (b) 52.5 mW
(c) 76.8 mW (d) 34.2 mW
53. A ramp voltage $v_i(t) = 100t \text{ V}$, is applied to an RC differentiating circuit with $R = 5 \text{ k}\Omega$ and $C = 4 \mu\text{F}$. The maximum output voltage is :
- (a) 0.2 V (b) 2.0 V
(c) 10.0 V (d) 50.0 V

54. For the two-port network shown in the figure below, the z-parameter matrix is :



- (a) $\begin{bmatrix} 4.8\Omega & -0.4\Omega \\ -0.4\Omega & 4.2\Omega \end{bmatrix}$ (b) $\begin{bmatrix} 4.8\Omega & -0.4\Omega \\ 0.4\Omega & 4.2\Omega \end{bmatrix}$
- (c) $\begin{bmatrix} 4.8\Omega & 0.4\Omega \\ 0.4\Omega & 4.2\Omega \end{bmatrix}$ (d) $\begin{bmatrix} 4.8\Omega & -0.4\Omega \\ -0.4\Omega & -4.2\Omega \end{bmatrix}$

55. Choose the function $f(t)$, $-\infty < t < \infty$, for which a Fourier series *cannot* be defined :

- (a) $3\sin(25t)$
- (b) $4\cos(20t+3)+2\sin(710t)$
- (c) $\exp(-|t|)\sin(25t)$
- (d) 1

56. The Fourier transform of the signal $u[n-3]-u[n-7]$ is :

- (a) $e^{-3j\omega} + e^{-4j\omega} + e^{-5j\omega} + e^{-6j\omega}$ (b) $e^{-3j\omega} - e^{-7j\omega}$
- (c) 0 (d) None of these

57. A linear discrete time system has the characteristic equation $z^3 - 0.64z = 0$.

The system :

- (a) is marginally stable
- (b) is unstable
- (c) cannot be determined from given data
- (d) is stable

58. According to Einstein relation, for any semiconductor the ratio of diffusion constant to mobility of carriers :

- (a) depends upon the temperature of the semiconductor
- (b) depends upon the type of the semiconductor
- (c) varies with life time of the semiconductor
- (d) is a universal constant

59. What is the probability that an electron in a semiconductor occupies the Fermi level at any temperature ($> 0K$) ?

- (a) 0
- (b) 1
- (c) 0.5
- (d) 1.0

60. A silicon P-N junction at a temperature of 20°C has a reverse saturation current of 10 pA. The reverse saturation current at 40°C for the same bias is approximately :

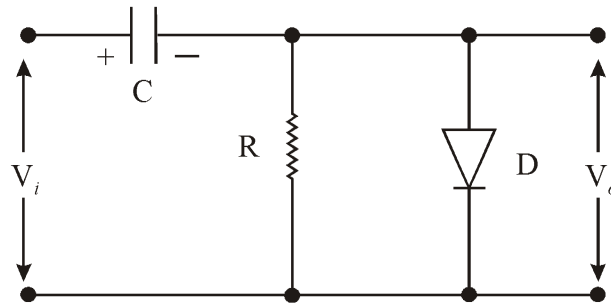
- (a) 30 pA
- (b) 40 pA
- (c) 50 pA
- (d) 60 pA

61. In a CE transistor amplifier with voltage gain A , the capacitance C_{bc} is amplified by :
- (a) A (b) $(1 + A)$
(c) $\sqrt{1 + A}$ (d) A^2
62. The drain of an N-channel MOSFET is shorted to the gate so that $V_{GS} = V_{DS}$. The threshold voltage (V_{TH}) of MOSFET is 1V. If the drain current (I_D) is 1 mA for $V_{GS} = 2V$, then for $V_{GS} = 3V$, I_D is :
- (a) 2 mA (b) 3 mA
(c) 9 mA (d) 4 mA
63. In a MOSFET operating in the saturation region, the channel length modulation effect causes :
- (a) an increase in the gate-source capacitance
(b) a decrease in the transconductance
(c) a decrease in the unity gain cut-off frequency
(d) a decrease in the output resistance
64. At room temperature, a possible value for the mobility of electrons in the inversion layer of a silicon N-channel MOSFET is :
- (a) 450 $\text{cm}^2/\text{V.s}$
(b) 1350 $\text{cm}^2/\text{V.s}$
(c) 1800 $\text{cm}^2/\text{V.s}$
(d) 3600 $\text{cm}^2/\text{V.s}$

65. The breakdown voltage of a transistor with its base open is BV_{CEO} and that with emitter open is BV_{CBO} , then :

- (a) $BV_{CEO} = BV_{CBO}$
- (b) $BV_{CEO} > BV_{CBO}$
- (c) $BV_{CEO} < BV_{CBO}$
- (d) BV_{CEO} is not related to BV_{CBO}

66. If the polarity of the diode in the circuit shown is reversed, the circuit would behave as a :



- (a) clipping circuit
 - (b) positive clamping circuit
 - (c) negative clamping circuit
 - (d) two level clipper
67. Introducing a resistor in the emitter of a common emitter amplifier stabilizes the DC operating point against variations in :
- (a) only the temperature
 - (b) only β of transistor
 - (c) both temperature and β
 - (d) None of these

68. For a transistor amplifier to be inherently stable against thermal runaway, the condition is :

(a) $V_{CE} < \left(\frac{V_{CC}}{2}\right)$

(b) $V_{CE} > \left(\frac{V_{CC}}{2}\right)$

(c) $V_{CE} = \left(\frac{V_{CC}}{2}\right)$

(d) None of these

69. Generally, the gain of a transistor amplifier falls at high frequencies due to the :

(a) internal capacitances of the device

(b) coupling capacitor at the input

(c) skin effect

(d) coupling capacitor at the output

70. What is the percentage reduction in gain of an amplifier due to introduction of 20 dB of negative feedback ?

(a) 100%

(b) 90%

(c) 75%

(d) 50%

71. The input impedance (Z_i) and the output impedance (Z_o) of an ideal transconductance (voltage controlled current source) amplifier are :

(a) $Z_i = 0, Z_o = 0$

(b) $Z_i = 0, Z_o = \infty$

(c) $Z_i = \infty, Z_o = 0$

(d) $Z_i = \infty, Z_o = \infty$

72. Three identical amplifiers with each one having a voltage gain of 50, input resistance of $1\text{ k}\Omega$ and output resistance of $250\ \Omega$ are cascaded. The open circuit voltage gain of the combined amplifier is :
- (a) 49 dB (b) 51 dB
(c) 98 dB (d) 102 dB
73. The Boolean function $Y = AB + CD$ is to be realized using only two-input NAND gates. The minimum number of gates required is :
- (a) 2 (b) 3
(c) 4 (d) 5
74. It is proposed to construct an eight input NAND gate using only two-input AND gates and two-input NAND gates. What is the least number of gates required to do it ?
- (a) 2 (b) 4
(c) 3 (d) 7
75. Number of half and full adders required to construct a 64-bit binary adder would be :
- (a) one half-adder and 63 full-adders
(b) 64 full-adders
(c) 64 half-adders
(d) one full adder and 63 half-adders

76. A four-bit presettable DOWN counter initially loaded with 0101 will divide the input clock frequency by :
- (a) 16 (b) 5
(c) 11 (d) 10
77. The percentage resolution in case of a D/A converter having a step size of 10 mV and full scale output of 5 V is :
- (a) 0.1% (b) 0.4%
(c) 0.2% (d) 0.3%
78. The average conversion time of an eight-bit counter-type A/D converter run by a 10 MHz clock would be :
- (a) 12.8 μ sec (b) 25.5 μ sec
(c) 80 nsec (d) 800 nsec
79. A type of memory device in which data is stored in the form of charge on a capacitor is :
- (a) Asynchronous SRAM (b) Synchronous SRAM
(c) DRAM (d) All of these
80. SRAM devices are made using :
- (a) Bipolar, MOS or BiMOS technologies
(b) MOS technology
(c) Bipolar technology
(d) BiMOS technology

81. The open-loop DC gain of a unity negative feedback system with closed loop transfer function $(s+4)/(s^2+7s+13)$ is :

(a) $\frac{4}{13}$

(b) $\frac{4}{9}$

(c) 4

(d) 13

82. The unit impulse response of a system is $h(t) = e^{-t}$, $t \geq 0$. For this system, the steady state value of the output for unit step input is equal to :

(a) -1

(b) 0

(c) 1

(d) ∞

83. Consider a unity feedback control system with open-loop transfer function

$G(s) = \frac{k}{s(s+1)}$. The steady state error of the system with unit parabolic

input is :

(a) 0

(b) k

(c) $1/k$

(d) ∞

84. A lead compensator is defined by transfer function $\frac{s+5}{s+10}$. The phase

difference introduced by the compensator at $\omega = 10$ rad/s is :

(a) 45°

(b) 90°

(c) 22.5°

(d) 18.4°

85. If the open-loop transfer function is a ratio of a numerator polynomial of degree m and a denominator polynomial of degree n , then the integer $n - m$ represents number of :

- (a) breakaway points
- (b) unstable poles
- (c) separate root loci
- (d) asymptotes

86. The transfer function $Y(s)/U(s)$ of a system described by the below mentioned state equations is given by :

$$\dot{x}(t) = -2x(t) + 2u(t)$$

$$y(t) = 0.5x(t).$$

(a) $\frac{1}{s+2}$

(b) $\frac{0.5}{(s-2)}$

(c) $\frac{1}{(s-2)}$

(d) $\frac{0.5}{(s+2)}$

87. White Gaussian noise is passed through a linear narrow band filter. The PDF of the envelope of the noise at the filter output is :

(a) Rayleigh

(b) Uniform

(c) Poisson

(d) Gaussian

88. The autocorrelation of the sequence $\{1, 1, 2, 3\}$ is :

(a) $\{1, 1, 2, 3\}$

(b) $\{3, 5, 9, 15, 9, 5, 3\}$

(c) $[3, 2, 1, 1]$

(d) $\{15, 9, 3, 9, 15\}$

89. The maximum phase deviation for an angle modulated signal given by :

$$s(t) = \cos \left[2\pi (2 \times 10^6 t + 30 \sin 150t + 40 \cos 150t) \right]$$

is :

- (a) 100
- (b) 50
- (c) 100π
- (d) 50π

90. A band limited signal is sampled at the Nyquist rate. The signal can be recovered by passing the samples through :

- (a) RC filter
- (b) ideal low pass filter with the appropriate bandwidth
- (c) PLL
- (d) envelope detector

91. For an 8-PSK signal having a bandwidth of 5 kHz, the baud rate and the bit rate, respectively are :

- (a) 5000 bauds, 5000 bps
- (b) 5000 bauds, 15000 bps
- (c) 5000 bauds, 40000 bps
- (d) None of the above

92. In a PCM system with uniform quantization, increasing the number of bits from 8 to 9 will reduce the quantization noise power by a factor of :

- (a) 9
- (b) 8
- (c) 4
- (d) 2

93. The Nyquist rate for message signal represented by :

$$m(t) = 10 \cos(1000\pi t) \cos(4000\pi t)$$

is :

- (a) 10 kHz
- (b) 2.5 kHz
- (c) 5 kHz
- (d) 2 kHz

94. The bit rate of digital communication system is R kbps. The modulation used is 32 QAM. The minimum bandwidth required for ISI free transmission is :

- (a) $\frac{R}{10}$ Hz
- (b) $\frac{R}{10}$ kHz
- (c) $\frac{R}{5}$ Hz
- (d) $\frac{R}{5}$ kHz

95. Source encoding in a data communication system is done in order to :

- (a) enhance the information transmission rate
- (b) conserve the transmitted power
- (c) decrease probability of error
- (d) None of the above

96. One of the following laws is *not* represented by Maxwell's equations :

- (a) Ampere's law
- (b) Faraday's laws
- (c) Ohm's law
- (d) Gauss's law

97. Given that $\sigma = 38 \text{ mS/m}$ and $\mu_r = 1$ for aluminium, skin depth at a frequency of 2 MHz would be equal to :

- (a) 64.5 nm (b) 57.8 nm
(c) 64.5 μm (d) 57.8 μm

98. The intrinsic impedance of a lossy dielectric medium is given by :

- (a) $\frac{j\omega\mu}{\sigma}$

(b) $\frac{j\omega \epsilon}{\mu}$
- (c) $\sqrt{\frac{j\omega\mu}{\sigma + j\omega \epsilon}}$

(d) $\sqrt{\frac{\mu}{\epsilon}}$

99. When a plane wave travelling in free space is incident normally on a medium having $\epsilon_r = 4.0$, then fraction of power transmitted into the medium is given by :

- (a) $\frac{8}{9}$ (b) $\frac{1}{2}$
- (c) $\frac{1}{3}$ (d) $\frac{5}{6}$

100. A quarter wave transmission line section is used to reject an interfering frequency of 100 MHz. Its approximate length is :

- (a) 3 m (b) 75 cm
- (c) 1.5 m (d) 6 m