# ENTRANCE TEST FOR Ph.D. PROGRAMME, 2023

## ELECTRONICS

Time : Three Hours                                                Maximum : 100 Marks

## Part A

*Answer all questions.*
*Each question carries 1 mark.*
*Choose the correct answer from the choices given.*

1. Which electronic device is used to generate a signal of a particular frequency ?

   (a) Resistor.                      (b) Capacitor.

   (c) Diode.                        (d) Oscillator.

2. The Fourier transform of a real and even function is :

   (a) Real and even.             (b) Real and odd.

   (c) Imaginary and even.        (d) Imaginary and odd.

3. Which of the following is NOT a combinational logic circuit ?

   (a) Multiplexer.                 (b) Decoder.

   (c) Flip-flop.                  (d) Encoder.

4. What is the function of a multiplexer ?

   (a) To convert a binary number into its decimal equivalent.

   (b) To convert a decimal number into its binary equivalent.

   (c) To select one of several input signals and pass it to the output.

   (d) None of the above.

5. Which of the following is a characteristic of a synchronous circuit ?

   (a) It uses feedback to create memory elements.

   (b) It is designed to operate with clock signals.

   (c) Its output is dependent on the input history.

   (d) None of the above.

**Turn over**

6. What is the purpose of a transistor in an analog circuit ?

    (a) To amplify a signal

    (b) To filter a signal

    (c) To convert a signal from analog to digital.

    (d) To generate a signal.

7. What is the unit of measurement for resistance ?

    (a) Ohms.                (b) Volts.

    (c) Amperes.          (d) Watts.

8. Which instrument is used to measure current ?

    (a) Voltmeter.         (b) Ammeter.

    (c) Ohmmeter.        (d) Multimeter.

9. What is the function of an oscilloscope ?

    (a) To measure voltage.      (b) To measure current.

    (c) To measure resistance.    (d) To display waveforms

10. Which of the following techniques is used to reduce the effects of noise in a digital signal ?

    (a) Filtering.         (b) Sampling.

    (c) Quantization.      (d) Encoding.

11. Which type of filter passes frequencies within a specified range and attenuates frequencies outside that range ?

    (a) Low-pass filter.      (b) High-pass filter.

    (c) Band-pass filter.     (d) Band-stop filter.

12. Which of the following is a common digital signal processing technique used for noise reduction in speech signals ?

    (a) Fourier transform.      (b) Wavelet transform.

    (c) Spectral subtraction.    (d) Short-time Fourier transform.

13. Which type of filter is commonly used in analog communication systems to limit the bandwidth of the transmitted signal ?

    (a) Low-pass filter.      (b) High-pass filter.

    (c) Band-pass filter.     (d) Band-stop filter.

14. Which type of communication system is more resistant to noise and interference ?

   (a) Analog.

   (b) Digital.

   (c) Hybrid.

   (d) All systems are equally noise resistant

15. Which digital modulation technique is commonly used in satellite communication ?

   (a) Amplitude modulation.

   (b) Frequency modulation.

   (c) Phase modulation.

   (d) Quadrature phase shift keying.

16. How is a microprocessor different from a microcontroller ?

   (a) A microprocessor is faster than a microcontroller.

   (b) A microcontroller has on-board memory and I/O peripherals, while a microprocessor does not have them.

   (c) A microprocessor is used for high-level computing tasks, while a microcontroller is used for low-level control tasks.

   (d) A microcontroller has a larger instruction set than a microprocessor.

17. Which of the following is used to synchronize the operation of the microprocessor with other components in a computer system ?

   (a) Instruction set.          (b) Clock signal.

   (c) Data bus.               (d) Control bus.

18. What is the purpose of speech coding in digital communication systems ?

   (a) To compress speech signals for efficient transmission and storage.

   (b) To remove noise from speech signals.

   (c) To amplify speech signals for better audibility.

   (d) To convert speech signals into digital signals for transmission.

19. What is the Nyquist-Shannon sampling theorem ?

    (a) The theorem that specifies the minimum sampling rate required to accurately represent a signal in the time domain.

    (b) The theorem that specifies the maximum sampling rate required to accurately represent a signal in the frequency domain.

    (c) The theorem that specifies the maximum bandwidth of a signal that can be transmitted over a communication channel.

    (d) The theorem that specifies the minimum number of bits required to represent a signal in digital form.

20. What is the purpose of spectral analysis in speech signal processing ?.

    (a) To identify the fundamental frequency and formants of the speech signal.

    (b) To remove noise from the speech signal.

    (c) To compress the speech signal for efficient transmission.

    (d) To convert the speech signal into digital form.

21. What is the purpose of speech enhancement in speech signal processing ?

    (a) To improve the quality and intelligibility of speech signals in noisy environments.

    (b) To compress speech signals for efficient transmission and storage.

    (c) To convert speech signals into digital signals for transmission.

    (d) To analyze the spectral characteristics of speech signals.

22. What is the steady-state error of a closed-loop control system ?

    (a) The difference between the desired output and the actual output of the system at steady state.

    (b) The difference between the reference input and the actual output of the system at steady state.

    (c) The difference between the feedback signal and the reference input at steady state.

    (d) The difference between the output of the system and the feedback signal at steady state.

23. What is the characteristic equation of a closed-loop control system ?.

    (a) The equation that relates the output of the system to the input.

    (b) The equation that describes the behavior of the system in the Laplace domain.

    (c) The equation that describes the stability of the system.

    (d) The equation that describes the transfer function of the system.

24. What is the Nyquist stability criterion ?

    (a) A graphical method for determining the stability of a closed-loop control system.

    (b) A method for determining the transfer function of a closed-loop control system.

    (c) A method for determining the steady-state error of a closed-loop control system.

    (d) A method for determining the open-loop gain of a control system.

25. What is the Bode plot ?

    (a) A graphical representation of the magnitude and phase response of a system as a function of frequency.

    (b) A graphical representation of the impulse response of a system.

    (c) A graphical representation of the step response of a system.

    (d) A graphical representation of the transfer function of a system.

26. What is the difference between a lead compensator and a lag compensator ?

    (a) A lead compensator increases the phase margin of a system, while a lag compensator decreases the phase margin.

    (b) A lead compensator increases the gain margin of a system, while a lag compensator decreases the gain margin.

    (c) A lead compensator introduces a phase lag in the system, while a lag compensator introduces a phase lead.

    (d) There is no difference between a lead compensator and a lag compensator.

27. What is the purpose of a state-space representation of a system ?

    (a) To describe the behavior of a system in terms of its state variables.

    (b) To describe the behavior of a system in the time domain.

    (c) To describe the behavior of a system in the frequency domain.

    (d) To describe the transfer function of a system.

28. Which of the following describes the relationship between electric and magnetic fields in an electromagnetic wave ?

    (a) Faraday's law of induction.    (b) Ampere's law.

    (c) Maxwell's equations.    (d) Coulomb's law.

**Turn over**

29. Which of the following is true about the speed of electromagnetic waves in a vacuum ?

    (a) It is infinite.

    (b) It depends on the wavelength of the wave.

    (c) It depends on the frequency of the wave.

    (d) It is constant and equal to the speed of light.

30. What is the relationship between the wavelength and frequency of an electromagnetic wave ?

    (a) They are directly proportional.

    (b) They are inversely proportional.

    (c) They are not related.

    (d) They are equal.

31. What is the electromagnetic spectrum ?

    (a) The range of frequencies of electromagnetic waves.

    (b) The range of wavelengths of electromagnetic waves.

    (c) The range of speeds of electromagnetic waves.

    (d) The range of amplitudes of electromagnetic waves.

32. What is skin effect ?

    (a) The tendency of electromagnetic waves to reflect off of conductive surfaces.

    (b) The tendency of electromagnetic waves to refract as they pass through a medium of varying refractive index.

    (c) The tendency of high-frequency currents to flow near the surface of a conductor.

    (d) The tendency of low-frequency currents to flow near the surface of a conductor.

33. What is the difference between a dipole and a monopole antenna ?

    (a) A dipole antenna has two conductive elements, while a monopole antenna has one conductive element.

    (b) A dipole antenna is used for transmitting signals, while a monopole antenna is used for receiving signals.

    (c) A dipole antenna is used for receiving signals, while a monopole antenna is used for transmitting signals.

    (d) There is no difference between a dipole and a monopole antenna.

34. Which is a measure of the amount of uncertainty in a random variable ?

    (a) Entropy.           (b) Mutual information.

    (c) Channel capacity.      (d) Information rate.

35. What is the purpose of a proximity sensor in a robotic system ?

    (a) To detect the robot's location.

    (b) To detect the presence of obstacles.

    (c) To provide feedback on the robot's movement.

    (d) To control the robot's gripper.

36. Which of the following is not a type of input/output device commonly used in embedded systems ?

    (a) Keyboard.           (b) Display.

    (c) Motor.            (d) Microphone.

37. What is the purpose of a Real-Time Operating System (RTOS) in an embedded system ?

    (a) To provide power to the system.

    (b) To monitor the system's temperature.

    (c) To control the system's clock.

    (d) To manage the system's resources and scheduling.

38. Which of the following is not a type of sensor commonly used in embedded systems ?

    (a) Temperature sensor.      (b) Pressure sensor.

    (c) Keyboard sensor.      (d) Light sensor.

39. Which of the following is not a type of cellular network topology ?

    (a) Point-to-point.      (b) Point-to-multipoint.

    (c) Mesh.            (d) Star.

40. Which of the following is not a type of mobile communication network ?

    (a) GSM.            (b) CDMA.

    (c) Wi - Fi.          (d) LTE.

41. What is the purpose of a base station in a cellular network ?

   (a) To provide power to the network.

   (b) To act as a gateway between the mobile devices and the core network.

   (c) To store data for the network.

   (d) To control the network's clock.

42. Which of the following is not a type of orbit commonly used by satellites ?

   (a) Low Earth Orbit (LEO).

   (b) Medium Earth Orbit (MEO).

   (c) Geosynchronous Orbit (GEO).

   (d) Hyperbolic Orbit (HO).

43. What is the purpose of a satellite in a communication system ?

   (a) To generate power for the system.

   (b) To transmit signals between ground stations.

   (c) To provide internet access to the system.

   (d) To store data for the system.

44. Which the following is a commonly used power source for wireless sensor nodes ?

   (a) AC power.         (b) Solar power.

   (c) Battery power.     (d) Wind power.

45. Which of the following is not a subfield of artificial intelligence ?

   (a) Machine learning.

   (b) Natural language processing.

   (c) Computer vision.

   (d) Block chain technology.

46. What is the purpose of a neural network in artificial intelligence ?

   (a) To model the structure and function of the human brain

   (b) To store data for the system.

   (c) To control the system's clock.

   (d) To provide power to the system.

47. Which of the following is a commonly used algorithm in artificial intelligence ?

    (a) Bubble sort.               (b) Quicksort.

    (c) Back propagation.        (d) Merge sort.

48. What is the Internet of Things (IoT) ?

    (a) A network of connected human beings.

    (b) A network of connected computers.

    (c) A n etwork of co n nected devices.

    (d) A network of connected animals.

49. Which of the following is a commonly used bioinformatics database ?

    (a) Microsoft Excel.          (b) Google Drive.

    (c) GenBank.              (d) Facebook

50. Which of the following is a commonly used bioinformatics software package ?

    (a) Microsoft Office.        (b) Adobe Creative Suite.

    (c) R.                  (d) QuickBooks.

(50 × 1 = 50 marks)

## Part B

*Answer any* **ten** *questions.*
*Each question carries 5 marks.*

51. Describe the steps involved in conducting a literature review for a research project. What are the key sources of information, and how do you evaluate the quality of the literature ?

52. What is the importance of data visualization in scientific research ? What are some common techniques for presenting data, and how do you choose the appropriate visualization for your data ?

53. Describe the process of developing a research question or hypothesis. How do you refine your research question to ensure it is both feasible and meaningful ?

54. What do you mean by dependent variable and independent variable ?

55. What is linear programming ? What are its applications ?

56. Describe the differences between TTL and CMOS logic families. How do you choose between them, for a given application ?

Turn over

57. Discuss the concept of Digital Signal Processing and its applications.

58. Explain the concept of Power Electronics. Give examples of Power Electronic devices and their applications in various industries.

59. What is a Voltage Controlled Oscillator ? What are its applications ?

60. How do you design a power amplifier for a wireless communication system ? What are some of the key design challenges ?

61. What is a Digital to Analog Converter ? Give some common types of DACs and their applications.

62. Distinguish between analog and digital circuits. When will you use one over the other ?

63. Explain the concept of feedback in electronic circuits. How can it be used to improve circuit performance ?

64. Discuss any *four* modulation techniques.

(10 × 5 = 50 marks)