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ENTRANCE EXAMINATION 2022

Ph.D. (Electronics Science and Engineering)

Marks: 70

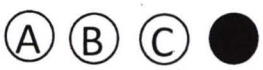
Time 2.00 hrs

Hall Ticket no.

Write your Hall ticket number in the OMR Answer Sheet given to you and the space provided above.

Read the following instructions carefully before answering the questions

1. This question paper has two parts "PART A" and "PART B"
2. PART A consists of 20 objective type questions of 1.75 marks each. There is no negative marking
3. PART B consists of 20 objective type questions of 1.75 marks each. There is no negative marking
4. All questions are to be answered. Answers for these questions are to be entered in the OMR sheet by filling the appropriate circle against each question. For example, if the answer to a question is D it should be marked as below



5. No additional sheets will be provided. Rough work can be done on the question paper itself.
6. Handover the OMR sheet to the invigilator at the end of the examination
7. Mobile phones, log tables and calculators of any kind are NOT permitted
8. Values of some physical constants: Planck's constant = 6.6×10^{-34} m^2kg/s ; speed of light in vacuum = 3×10^8 m/s; Boltzmann constant = 1.38×10^{-23} $m^2kgs^{-2}K^{-1}$; free space permittivity = 8.85×10^{-12} F/m; electronic charge = 1.6×10^{-19} C, mass of electron = 9.1×10^{-31} kg, Thermal voltage = 0.026 V
9. This paper contains 16 pages including this cover sheet.

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PART A

1. Two people appear in an interview for a vacancy in a post. The probability of the first and second person getting selected is 1/7 and 1/5 respectively. What is the probability that the post gets filled by one of them?

   A. 2/7
   B. 1/7
   C. 3/4
   D. 4/5

2. A man is walking from point A to point B and his displacement is 5.0 +/- 0.5 m during a time of 0.5 +/-0.1s. What is the average velocity and the error in the velocity?

   A. 10.00 +/-0.05 m/s
   B. 14.75 +/-2.75 m/s
   C. 10.00 +/-2.20 m/s
   D. 15.75 +/-2.75 m/s

3. The Maclaurin series for $ln((1+x)/(1-x))$ is

   A. $\Sigma_{n=1}^{\infty}(x^{2n-1}/(2n-1))$
   B. $2\Sigma_{n=1}^{\infty}(x^{2n-1}/(n-1))$
   C. $\Sigma_{n=1}^{\infty}(x^{n-1}/(n-1))$
   D. $2\Sigma_{n=1}^{\infty}(x^{2n-1}/(2n-1))$

4. The solution of the differential equation, $dy + 5xdx = 0$, given $y(0)=2$ is

   A. $y = \frac{5}{2}x^2 + 2$
   B. $y = -\frac{5}{2}x^2 + 2$
   C. $y = \frac{5}{2}x^2 - 2$
   D. $y = -\frac{5}{2}x^2$

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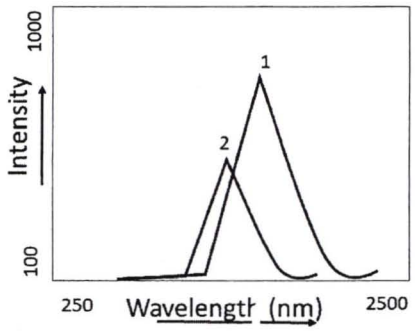
5. The interpretation of the graph below is that



A. There is decrease in intensity and a red-shift in the peak position of 2 with respect to 1
B. There is decrease in intensity and a red-shift in the peak position of 2 with respect to 1
C. There is decrease in intensity and a blue-shift in the peak position of 1 with respect to 2
D. There is decrease in intensity and a blue-shift in the peak position of 2 with respect to 1

6. Consider the following statement: the GaAs junction field effect transistor is a depletion mode device. Assuming that the source is grounded, this means that

A. the conductivity of the channel is independent of the voltage applied to the gate electrode.
B. the device conducts only when a voltage is applied to the gate electrode
C. the device conducts even when no voltage is applied to the gate electrode
D. the device becomes bipolar in nature

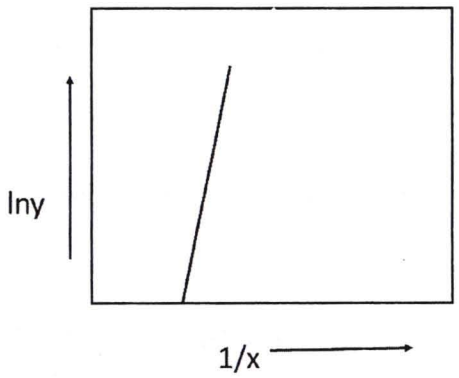
7. The x-ray diffraction pattern of a face centered cubic crystal can contain peaks from crystal planes with Miller indices that are
   A. either all odd or all even
   B. even only
   C. either odd or even
   D. such that their sum is a multiple of 2

8. The four probe and two probe methods of measuring conductivity are suitable respectively for
   A. insulators and metals
   B. both metals and insulators
   C. metals and insulators
   D. neither metals nor insulators

9. The electrons in a metal follow the Fermi-Dirac distribution. If E_F is the energy of the Fermi level, then the value of the probability distribution function just below and just above the Fermi level at T= 0K are, respectively

   A. 1 and 0
   B. 0 and 1
   C. 0.5 and 0.5
   D. 1 and 0.5

10. The equation that describes the graph below is (where M and A are constants and A is > 0)



   A. $y = M \exp(-Ax)$
   B. $y = M \exp(A/x)$
   C. $y = M/A \ln x$
   D. $y = M/x + A$

11. Read the passage and answer the question below: Bragg's law was introduced by Sir W.H. Bragg and his son Sir W.L. Bragg. The law states that when an x-ray is incident onto a crystal surface at an angle, θ, it will be reflected back with the same angle θ. In addition, when the path difference between the incident and reflected rays is equal to a whole number, n, times the wavelength, constructive interference will occur.
    Which statement can be inferred to be true from the passage given above?

   A. Braggs law describes the relation between Sir. W.H Bragg and Sir.W.L. Bragg
   B. When an x-ray is incident on a crystal surface, the angles of incidence and scattering are equal.
   C. Constructive interference occurs when path difference is equal to the wavelength.
   D. The path difference is equal to a whole number, n.

12. Read the passage and answer the question below: A MOSFET is a four terminal device having source(S), gate (G), drain (D) and body (B) terminals. In general, the body of MOSFET is assumed to be connected to the source terminal, thus forming a three-terminal device. MOSFET is a transconductance device employed in both the analog and digital circuits.
Which statement can be inferred to be true from the passage given above?

A. A MOSFET is a transistor in which the source and body terminal are always connected to each other.
B. A MOSFET is a four terminal device which can be converted into a three terminal device.
C. All field effect transistors have four terminals
D. A MOSFET can be employed in analog and digital circuits as it is a transconductance device

13. Consider the following electromagnetic phenomena and place them in the order of increasing frequency 1. Cosmic Rays, 2. X-rays, 3. Microwaves, 4. Radio waves

A. 2,1, 3, 4
B. 2, 3, 4, 1
C. 3, 1, 4, 2
D. 4, 3, 2, 1

14. If σ is the conductivity of a dielectric with ε as the dielectric constant, ε_r the relative permittivity ($\neq 1$), ε_0 the permittivity of free space, μ the permeability, μ_r the relative permeability and μ_0 the permeability of free space, then the conditions that describe a lossless dielectric (if $\sigma << \omega\varepsilon$, ω being the angular frequency) are

A. $\sigma = 0,\ \varepsilon = \varepsilon_r\ \varepsilon_0,\ \mu = \mu_r\ \mu_0$
B. $\sigma \neq 0,\ \varepsilon = \varepsilon_r\ \varepsilon_0,\ \mu = \mu_r\ \mu_0$
C. $\sigma = \infty,\ \varepsilon = \varepsilon_0,\ \mu = \mu_0$
D. $\sigma = 0,\ \varepsilon = \varepsilon_0,\ \mu = \mu_0$

15. The speed of light in a medium of relative dielectric permittivity ε_{r1} is c_1 and the speed of light in a medium of relative dielectric permittivity ε_{r2} is c_2. If $\varepsilon_{r1} = 2\varepsilon_{r2}$ then the relationship between c_1 and c_2 is

A. $c_1 = \sqrt{2}c_2$
B. $c_1 = 2c_2$
C. $c_1 = (1/2)c_2$
D. $c_1 = (1/\sqrt{2})c_2$

16. A BJT is connected in common emitter mode and operated in active region. Its base current is 30μA and collector base junction reverse bias saturation current is 0.3 μA. The emitter current for this mode of operation is (given common base current gain α = 0.987)

A. 0.987 mA
B. 2.27 mA
C. 2.30 mA
D. 2.33 mA

17. An 8-bit successive approximation analog to digital converter (ADC) has full scale voltage of 5.0 V and the conversion t.me for an analog input of 1V is 10μs. If the analog input to the same ADC is changed to 3V, then the conversion time is

A. 5 μs
B. 10 μs
C. 20 μs
D. 30 μs

18. The depletion capacitance of an ideal p-n diode is measured to be C_1 and C_2 at the reverse voltages V_1 and V_2 respectively. Which one of the following relations is correct.

A. $C_1 = C_2$
B. $V_1C_1 = V_2C_2$
C. $\frac{V_1}{V_2} = \frac{C_2^2}{C_1^2}$
D. $\frac{V_1}{V_2} = \frac{C_1^2}{C_2^2}$

19. If the doping concentration of a semiconductor is doubled by adding additional impurities, the Hall coefficient of the semiconductor will

A. remain the same
B. increase by a factor of 2
C. decrease by a factor of 2
D. decrease by a factor of $\frac{1}{\sqrt{2}}$

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20. If the feedback resistance of an ideal op-amp inverting amplifier is increased by a factor of 4, then the current through the feedback loop will

A. remain the same
B. increase by a factor of 2
C. decrease by a factor of 4
D. increase by a factor of 4

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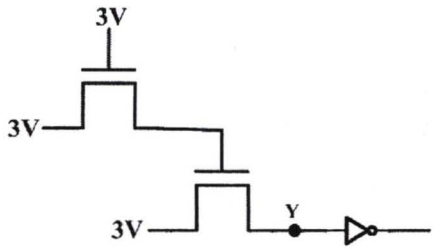
PART B

21. The gate threshold voltage of the NMOSFET shown below is 0.8V. The voltage at the terminal Y is



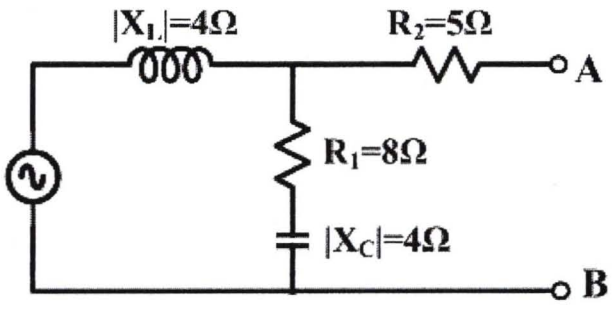
A. 3 V

B. 6 V

C. 2.2 V

D. 1.4 V

22. The Thevenin's impedance across the terminals "A" and "B" for the circuit below is



A. 8

B. 7+4j

C. 7-4j

D. $\frac{56+j32}{13-j4}$

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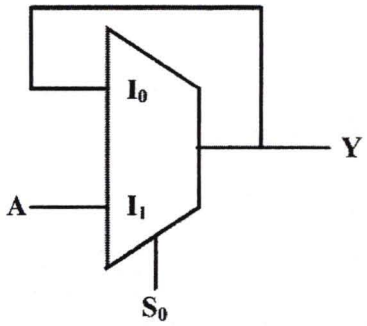
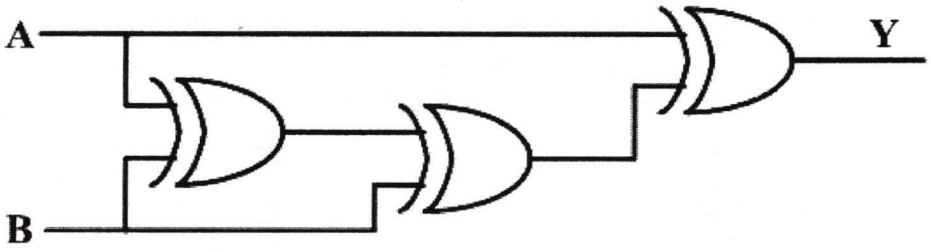
23. The configuration of the MUX circuit shown below represents a



A. half adder
B. flip flop
C. latch
D. decoder

24. The output (Y) of the logic circuit given below is



A. $Y = A \oplus B$
B. $Y = A$
C. $Y = 1$
D. $Y = 0$

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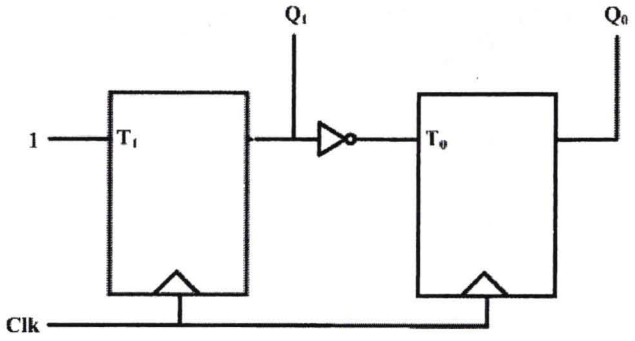
25. The correct counting sequence of the synchronous counter shown below is



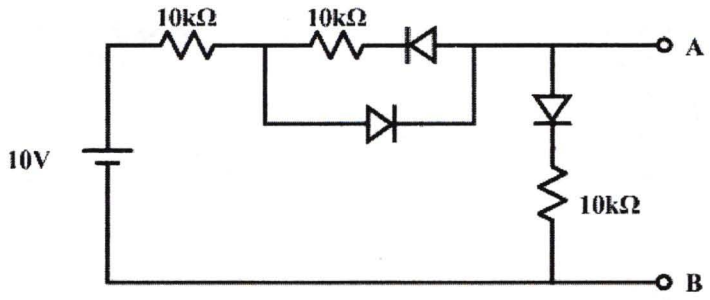
A. Q_1Q_0 : 00,11,01,10,00

B. Q_1Q_0 : 00,01,10,11,00

C. Q_1Q_0 : 00,11,10,01,00

D. Q_1Q_0 : 00,10,01,11,00

26. The forward voltage drop and the reverse breakdown voltages of the diodes shown below are 0.7 V and 6V respectively. The voltage across terminals A & B is



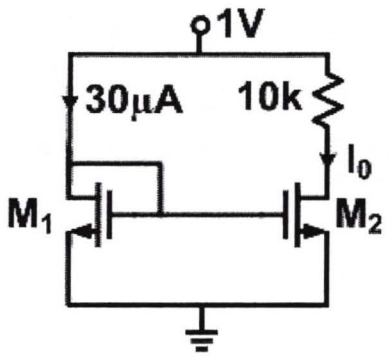
A. 4V

B. 5V

C. 0.7V

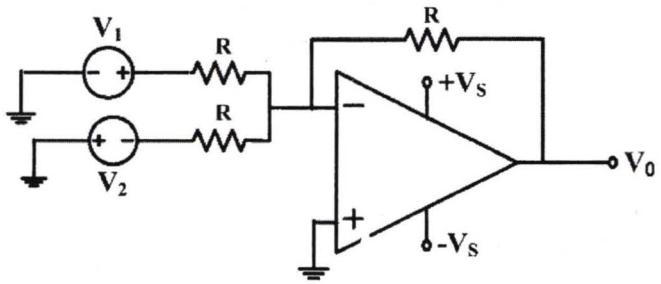
D. 0V

27. In the circuit below, the transistor width of M1 is W1, the transistor width of M2 is W2, and the gate lengths are equal. If the drain to source voltage for transistor M_2 is 0.4 V, then the relation between the transistor widths is



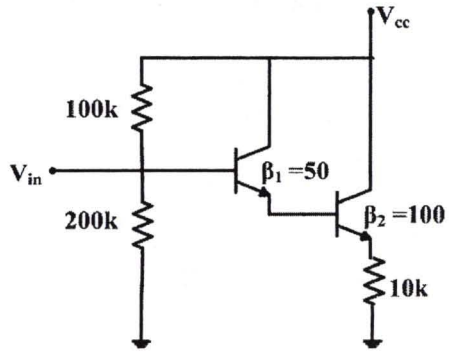
A. $W_2 = W_1$
B. $W_2 = W_1/2$
C. $W_2 = 2W_1$
D. $W_2 = W_1/3$

28. In the circuit below if $V_1 \ll V_s$ and $V_2 \ll V_s$, the condition to be satisfied by the magnitudes of V_1, V_2 at which $V_o = 0$ is



A. $V_1 = 2V_2$
B. $V_1 = 0.5V_2$
C. $V_1 = V_2 + 2$
D. $V_1 = V_2$

29. The small signal input resistance of the circuit shown below is (β is the common emitter current gain)



A. 67 kΩ
B. 50 MΩ
C. 55 MΩ
D. 70 kΩ

30. A communication channel of 1MHz bandwidth is perturbed with additive white Gaussian noise of unit spectral power. If a continuous signal with average transmitted power of 1,000 Watt is transmitted over this channel and the Signal to Noise Ratio of the channel is increased by two times, then the channel capacity approximately.

A. Increases by 5%
B. Increases by 10%
C. Increases by 50%
D. Increases by 100%

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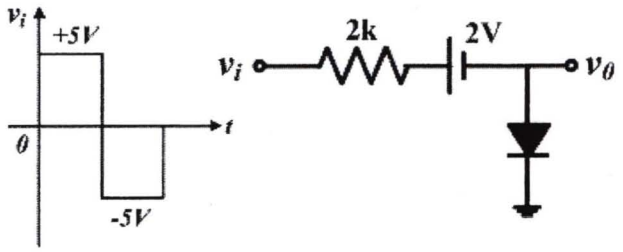
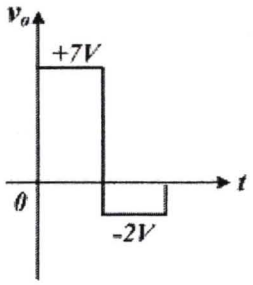
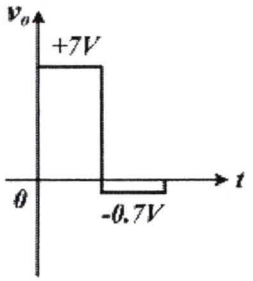
31. The output voltage waveform of the circuit below is



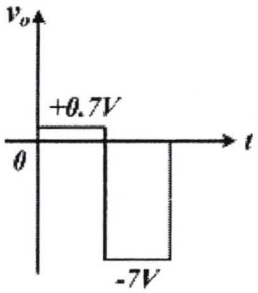
A.



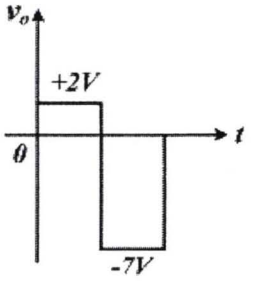
B.



C.



D.



32. If a bar of Gallium Arsenide (GaAs) is doped with silicon (Si) such that silicon atoms occupy Ga and As sites in the GaAs crystal, then Si atoms act as

A. n-type dopants in both As and Ga sites
B. p-type dopants in both As and Ga sites
C. n-type dopants in As sites and p-type dopants in Ga sites
D. p-type dopants in As sites and n-type dopant in Ga sites

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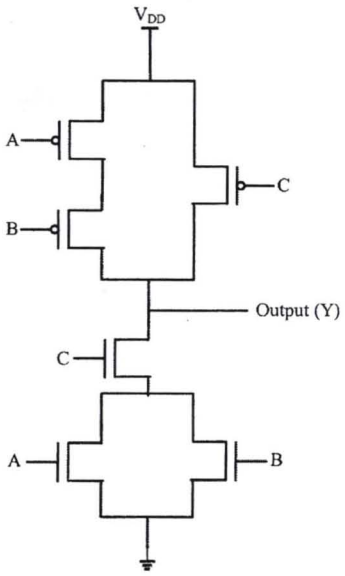
33. The equivalent output Y of the circuit given below is



A. $\overline{A}\overline{B} + \overline{C}$

B. (A+B).C

C. $(A + B) + \overline{C}$

D. $\overline{(A + B)} + C$

34. An integral $\int_x^y a^2 da$ with $y > x > 0$ is calculated both analytically and numerically using Simpson's 1/3rd rule. If 'K' is the exact value of the integral obtained analytically and 'M' is the approximate value obtained using Simpson's 1/3rd rule, then which of the following is correct?

A. $K=M^{1/3}$

B. K=M

C. K>M

D. K<M

35. If a semiconductor in thermal equilibrium is doped with donor concentration $N_d(x) = 10^{15}e^{-7x}$ cm^{-3} at a depth of x cm, then the electric field is

A. 26 mV/cm

B. 130 mV/cm

C. 156 mV/cm

D. 182 mV/cm

36. If the electron mobility in Si is 1400 $cm^2V^{-1}s^{-1}$, the mean free time in scattering of electrons is (Assume effective mass is 0.33)

A. 12.6×10^{-13} s

B. 4.2×10^{-13} s

C. 1.4×10^{-13} s

D. 2.6×10^{-13} s

37. A signal has two frequency components, 6KHz and 6.05 KHz. If it is sampled using a sampling frequency of 48K samples/sec, then the minimum length of Fast Fourier Transform required to resolve these two frequency components is

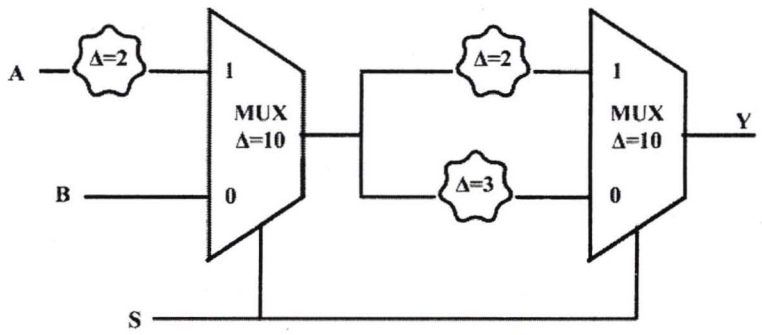
A. 256

B. 512

C. 1024

D. 2048

38. In the circuit given below, A and B are inputs, S is select line of the multiplexer (MUX), Y is output and Δ is the propagation delay. The longest true path between the input and output of the circuit is



A. 25 ns

B. 24 ns

C. 23 ns

D. 22 ns

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39. Which of the following is a Skew Symmetric matrix?

A. $\begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}$

B. $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$

C. $\begin{bmatrix} 0 & 3 \\ -1 & 9 \end{bmatrix}$

D. $\begin{bmatrix} 8 & -2 \\ -1 & 3 \end{bmatrix}$

40. A Linear Time Invariant system is described by the following differential equation relating its input *x(t)* and output *y(t)*.

$$\frac{d^2y(t)}{dt^2} + \frac{dy(t)}{dt} - 2y(t) = x(t)$$

What is the impulse response *h(t)* of the system if it is given that the system is non-causal and stable.

A. $h(t) = -\frac{1}{3}[e^{-t}u(t) + e^{2t}u(-t)]$

B. $h(t) = \frac{1}{3}[e^{t}u(-t) + e^{-2t}u(-t)]$

C. $h(t) = -\frac{1}{3}[e^{t}u(-t) + e^{-2t}u(t)]$

D. $h(t) = -\frac{1}{3}[e^{t}u(t) + e^{2t}u(t)]$

University of Hyderabad
Ph.D. Entrance Examinations - 2022

School/Department/Centre : Centre for Advanced Studies in Electronics Science and Technology

Course : Ph.D. **Subject : Electronics Science and Engineering**

1.	A	21.	D
2.	C	22.	B
3.	D	23.	C
4.	B	24.	D
5.	D	25.	A
6.	C	26.	B
7.	A	27.	C
8.	C	28.	D
9.	A	29.	A
10.	B	30.	B
11.	C	31.	C
12.	B	32.	D
13.	D	33.	A
14.	A	34.	B
15.	D	35.	D
16.	D	36.	D
17.	B	37.	C
18.	C	38.	B
19.	C	39.	A
20.	A	40.	C

M. Ramashyam
Head, CASEST 19/9/2022.

HEAD, CASEST
(Centre for Advanced Studies
Electronics Science & Tech
School of Physics
University of Hyderabad-500