Entrance Examinations – 2023

(Ph.D. Admissions – January 2024 session)

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

$$\text{(A)} \quad \text{(B)} \quad \text{(C)} \quad \bullet$$

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^{2}kg/s ; speed of light in vacuum = 3×10^8 m/s; Boltzmann constant = 1.38×10^{-23} m^{2}kgs^{-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 9 pages including this cover sheet.

1

PART A

1. The value of $e^{i\theta} - e^{-i\theta}$ is
   A. $2\ isin\theta$
   B. $2\ sin\theta$
   C. $2\ icos\theta$
   D. $2\ cos\theta$

2. Which of the following Boolean expressions is correct?

   A. $X + 0 = 0$
   B. $X.(X' + Y) = X.Y$
   C. $X + (X'.Y) = X + 1$
   D. $X + X = 1$

3. In a digital circuit, M number of n-bit positive numbers are added. The number of bits required to represent the sum are

   A. $2n + log_2 M$
   B. $(2n + 1) + log_2 M$
   C. $n + log_2 M$
   D. $2n + log_{10} M$

4. The simplified form of the Boolean expression

   $X(X' + Z)\ (X'Y + Z)(X'YZ + Z')$ is

   A. XY
   B. YZ
   C. 0
   D. XZ

5. In a set of 4 numbers, the third number is six times the fourth number. The second number is one fourth the third number and the first number is three times the second number. If the average of the numbers is 39, then the largest and smallest numbers are respectively

   A. 72, 12
   B. 54, 18
   C. 18, 12
   D. 72, 18

2

The variation in intrinsic carrier density is plotted as a function of inverse of the temperature for four semiconductors S1, S2, S3 and S4 in the graph below. Based on this, answer the questions 6, 7 and 8
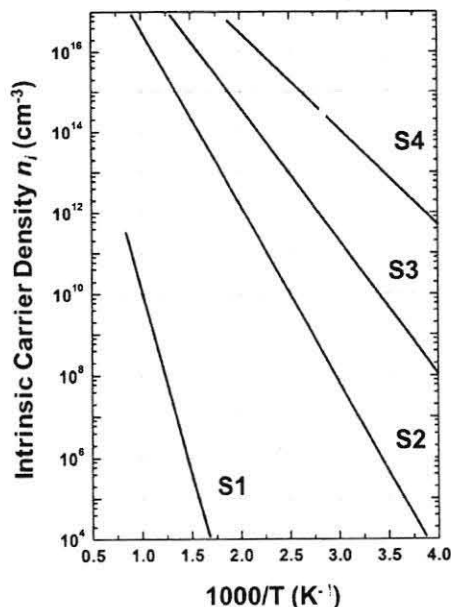
6. It can be inferred from the graph that the intrinsic carrier density

    A. decreases exponentially with temperature for S1, S2, S3 and S4.
    B. increases linearly with temperature for S3 and S4 only.
    C. increases exponentially with temperature for S1 and S4 only.
    D. increases exponentially with temperature for S1, S2, S3 and S4.

7. The slope at any point of the curves S1, S2, S3 and S4 has

    A. units of $cm^{-3}K^{-1}$
    B. units of $cm^{3}K$
    C. units of $cm^{-3}K$
    D. no units

8. The intrinsic carrier density of S2 and S3, at a temperature of 400 K are, respectively, of the order of

    A. 10^{6} and 10^{10} cm^{-3}
    B. 10^{10} and 10^{13} cm^{-3}
    C. 10^{13} and 10^{17} cm^{-3}
    D. 10^{17} and 10^{6} cm^{-3}

9. The publication that is not considered as a research output of a scientific study is

    A. Refereed article in conference proceedings.
    B. Refereed journal article.
    C. Patent.
    D. Preface of a book.

10. A patent is a form of

    A. Journal Article.
    B. Intellectual property.
    C. Newspaper article.
    D. Book.

Consider the data given in the table and answer the questions 11, 12 below

Year	Product Sales
2018	50000
2019	48000
2020	52000
2021	46000
2022	42000
2023	46000

11. The percentage rate of change of product sales from 2019 to 2020 is

    A. 4.00%
    B. 7.77%
    C. 8.33%
    D. 91.67%

12. The percentage rate of change of product sales between which two years is the highest ?

    A. 2019 to 2020
    B. 2020 to 2021
    C. 2021 to 2022
    D. 2018 to 2019

13. The statement that is incorrect about the comparison of properties of ice and water is

    A. Electrical conductivity of ice is lower than water.
    B. Electrical Conductivity of ice is higher than water.
    C. Dielectric constant ice is greater than water.
    D. Velocity of light in ice is greater than velocity of light in water.

14. The physical process or phenomenon that is not associated with generating a magnetic field is

    A. Mutual inductance.
    B. Current carrying coil.
    C. Current carrying solenoid.
    D. Flow of charge in a capacitor.

15. The transition metal oxide in the list below is

    A. CuO
    B. Yb_2O_3
    C. Nd_2O_3
    D. CaO

16. Consider three physical quantities p, E and E_F. It is given that

    $p(E) = gE^{1/2}$ for $E < E_F$ and $p(E) = 0$ for $E > E_F$
    where g is a constant, then

    A. $p(E)$ is constant independent of the value of E.
    B. $p(E)$ is constant for all values of $E > E_F$ and varies linearly with E for $E < E_F$.
    C. $p(E)$ is constant for all values of $E < E_F$ and varies linearly with E for $E > E_F$.
    D. $p(E)$ is constant for all values of $E > E_F$ and varies linearly with $E^{1/2}$ for $E < E_F$.

17. A quantity that represents the reproducibility of a measurement is

    A. Mean.
    B. Median.
    C. Mode.
    D. Standard deviation.

18. The reverse breakdown voltage of a p^+n diode is V_1. If the donor concentration is doubled then the resultant reverse breakdown voltage (V_2) is

    A. $V_1/\sqrt{2}$
    B. $\sqrt{2}V_1$
    C. $2V_1$
    D. $V_1/2$

19. In a MOSFET, when the depletion regions of the source and drain contact each other due to short channel effect, then, the leakage current

    A. increases and is called gate induced drain leakage.
    B. increases and is called punch through effect.
    C. decreases and is called hot carrier effect.
    D. decreases and oxide tunnelling leakage.

20. If the common emitter (CE) gain of a transistor is β, then the DC input resistance in this configuration

    A. decreases linearly with β.
    B. increases exponentially with β.
    C. increases linearly with β.
    D. decreases as square of β.

PART B

21. The general solution of the differential equation,
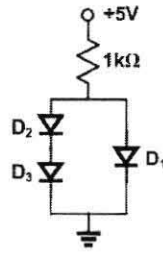 $y' - t^3 y = 0$ is (where K is a constant)

    A. $K \exp(t^4/4)$
    B. $K \exp(-t^4)/4$
    C. $K \exp(t^3)/3$
    D. $K \exp(-t^3)/3$

22. The Taylor series expansion for $f(x) = ln(x)$ is, where $n = 1, 2, 3 \ldots$

    A. $(1)^{n+1} (n-1)!/ x^n$
    B. $(-1)^{n+1} (n-1)!/ x^n$
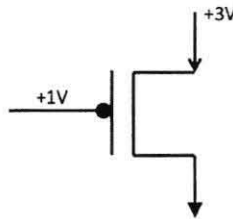   C. $(-1)^{n+1} (n+1)!/ x^n$
    D. $(-1)^{n-1} (n-1)!/ x^n$

23 Identify the diode(s) that is/ are conducting in the given circuit (all are Si diodes)

    A. D1, D2, D3.
    B. D1, D2 only.
    C. D1 only.
    D. D2, D3 only.

24. The gate to source voltage in the given MOSFET configuration is

    A. +1 V
    B. -1 V
    C. +2 V
    D. -2 V

25. The gate-source voltage of an n-channel MOSFET is decreased from +2V to +1V. If the threshold voltage is 0.3 V, then the percentage change in the drain current is

    A. 17%
   B. 33%
    C. 50%
    D. 83%

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26. In the given circuit, if the internal resistance and transconductance of the MOSFET are r_0 and g_m respectively and channel length modulation is non-zero, the output impedance is ?

A. $\dfrac{1}{g_m}\|r_0$

B. $\dfrac{1}{g_m}$

C. r_0

D. $\dfrac{1}{g_m}+r_0$
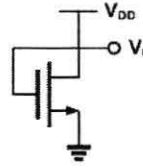
27. In the given circuit, all the transistors are in the active region and their current gain (β) is high. If the emitter area of Q_2 is 3 times of Q_1 and emitter area of Q_4 is 5 times of Q_3, then the ratio of output current I_0 and the reference current I_{ref} is (given that saturation current $I_{sat} \propto$ Area)

A. 5
B. 3
C. 8
D. 15
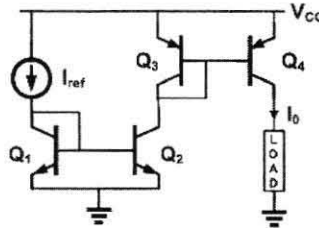
28. The drain current of an n channel JFET is I_{D1} when the gate-source voltage (V_{GS}) is $V_P/2$, and I_{D2} when V_{GS} is $V_P/4$, (where V_P is the pinch-off voltage), then the ratio of the drain current I_{D2} to I_{D1} is

A. 1/2
B. 1/4
C. 9/4
D. 4/9

29. The gain of the operational amplifier in the circuit below is A_1; the transconductance and internal resistance of the MOSFET are g_m and r_0 respectively. The overall voltage gain is

A. A1
B. $g_m r_0$
C. $A_1 g_m r_0$
D. ∞
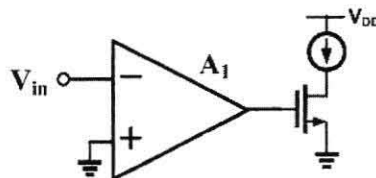
30. As the CMOS technology scales down from the 45 nm to 32 nm and 28 nm nodes, one of the reasons for the polysilicon gate to be replaced by metal gates is

A. polysilicon forms a depletion region which acts like an additional gate oxide.
B. metal has a higher dielectric constant than polysilicon.
C. metal has a lower electrical conductivity than polysilicon.
D. dopant penetration in polysilicon gates is very low.

7

31. The physical phenomenon that exhibits hysteresis, is the variation in

    A. polarization of a ferroelectric as a function of applied magnetic field.
    B. polarization of a ferroelectric as a function of applied electric field.
    C. capacitance of a dielectric as a function of applied electric field.
    D. dielectric constant as a function of applied magnetic field.

32. In Verilog, the syntax reg [0:7] A, B means

    A. Both A and B are 8 bit, A[7] and B[7] is MSB.
    B. Both A and B are 8 bit, A[0] and B[0] are MSBs.
    C. A is 8 bit with A[0] as MSB, whereas B is a single bit.
    D. A is a 8 bit register and B is a single bit wire.

33. For the following Verilog code,

```
always @ (x,y)
a <= x;
always @ (x,y)
a <= y;
```

the correct inference is

    A. A given variable 'a' should not be assigned different value in more than one always block.
    B. A given variable 'a' should be assigned different value in more than one always block.
    C. Always blocks are not concurrent with respect to each other.
    D. Always block is used in data flow modeling style.

34. A 2-input CMOS NOR gate is designed such that its output resistance is same as that of a unit CMOS inverter. If the width of each NMOS transistor is 1, then the width of the PMOS transistor is

    A. 0.25
    B. 1
    C. 2
    D. 4

35. A 50 Ohm radio transmitter is connected to a lossless antenna having an impedance of 150 Ohms, with a coaxial cable of 30 Ohm impedance. If the transmitter can deliver 50 W power to a 50 Ohm load, then the power delivered to the antenna is

    A. 50 W
    B. 30 W
    C. 16.66 W
    D. 5.55 W

36. Identify the correct statement

    A. Linear time invariant systems have a memory of past states but do not have the ability to predict the future.
    B. Time-invariant systems are systems where the output depends on when an input was applied.
    C. Continuous linear time invariant systems are stable if the impulse response is absolutely integrable.
    D. Linear time invariant systems do not have a memory of past states but have the ability to predict the future.

37. The statement that is not true for a unit impulse function $\delta(t)$ is

    A. it is zero at every point except t_o, where it is unbounded.
    B. it is zero at every point except t_o, where it is bounded.
    C. it is also called a Dirac delta function.
    D. the area under a unit impulse function is equal to unity.

38. The statement that is not true for a microprocessor system is

    A. the stack is a special area in memory used by the CPU to store register information.
    B. the contents of the stack memory are retrieved on a FIFO basis.
    C. the contents of the stack memory are retrieved on a LIFO basis.
    D. the stack is implemented using a dedicated block of memory addressed by the stack pointer.

39. It is reported from different countries of the world that roads generate electricity as vehicles travel over them. The likely physical phenomenon on which this may be based is

    A. Piezoelectricity
    B. Ferroelectricity.
    C. Superconductivity.
    D. Photoconductivity.

40. The number of Bravais lattices possible in the orthorhombic crystal system are

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

University of Hyderabad
Entrance Examinations – 2023
(Ph.D. Admissions - January 2024 Session)

PhD (Electronics Science and Engineering)- January 2024

Key

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

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19/1/2024