PAPER-II
ELECTRONIC SCIENCE

Signature and Name of Invigilator

1. (Signature) _____

   (Name) _____

2. (Signature) _____

   (Name) _____

OMR Sheet No. : .....
(To be filled by the Candidate)

Roll No. | | | | | | | | |
(In figures as per admission card)

Roll No._____
(In words)

J 8 8 1 6

Time : **1 ¼** hours] [Maximum Marks : **100**

Number of Pages in this Booklet : **16**

Number of Questions in this Booklet : **50**

Instructions for the Candidates

1. Write your roll number in the space provided on the top of this page.
2. This paper consists of fifty multiple-choice type of questions.
3. At the commencement of examination, the question booklet will be given to you. In the first 5 minutes, you are requested to open the booklet and compulsorily examine it as below :
   (i) To have access to the Question Booklet, tear off the paper seal on the edge of this cover page. Do not accept a booklet without sticker-seal and do not accept an open booklet.
   (ii) **Tally the number of pages and number of questions in the booklet with the information printed on the cover page. Faulty booklets due to pages/questions missing or duplicate or not in serial order or any other discrepancy should be got replaced immediately by a correct booklet from the invigilator within the period of 5 minutes. Afterwards, neither the Question Booklet will be replaced nor any extra time will be given.**
   (iii) After this verification is over, the Test Booklet Number should be entered on the OMR Sheet and the OMR Sheet Number should be entered on this Test Booklet.
4. Each item has four alternative responses marked (1), (2), (3) and (4). You have to darken the circle as indicated below on the correct response against each item.
   Example : ① ② ● ④
   where (3) is the correct response.
5. Your responses to the items are to be indicated in the **OMR Sheet given inside the Booklet only.** If you mark your response at any place other than in the circle in the OMR Sheet, it will not be evaluated.
6. Read instructions given inside carefully.
7. Rough Work is to be done in the end of this booklet.
8. If you write your Name, Roll Number, Phone Number or put any mark on any part of the OMR Sheet, except for the space allotted for the relevant entries, which may disclose your identity, or use abusive language or employ any other unfair means, such as change of response by scratching or using white fluid, you will render yourself liable to disqualification.
9. You have to return the Original OMR Sheet to the invigilators at the end of the examination compulsorily and must not carry it with you outside the Examination Hall. You are, however, allowed to carry original question booklet and duplicate copy of OMR Sheet on conclusion of examination.
10. **Use only Black Ball point pen provided by C.B.S.E.**
11. **Use of any calculator or log table etc., is prohibited.**
12. **There is no negative marks for incorrect answers.**

परीक्षार्थियों के लिए निर्देश

1. इस पृष्ठ के ऊपर नियत स्थान पर अपना रोल नम्बर लिखिए ।
2. इस प्रश्न-पत्र में पचास बहुविकल्पीय प्रश्न हैं ।
3. परीक्षा प्रारम्भ होने पर, प्रश्न-पुस्तिका आपको दे दी जायेगी । पहले पाँच मिनट आपको प्रश्न-पुस्तिका खोलने तथा उसकी निम्नलिखित जाँच के लिए दिये जायेंगे, जिसकी जाँच आपको अवश्य करनी है :
   (i) प्रश्न-पुस्तिका खोलने के लिए पुस्तिका पर लगी कागज की सील को फाड़ लें । खुली हुई या बिना स्टीकर-सील की पुस्तिका स्वीकार न करें ।
   (ii) **कवर पृष्ठ पर छपे निर्देशानुसार प्रश्न-पुस्तिका के पृष्ठ तथा प्रश्नों की संख्या को अच्छी तरह चैक कर लें कि ये पूरे हैं । दोषपूर्ण पुस्तिका जिनमें पृष्ठ/प्रश्न कम हों या दुबारा आ गये हों या सीरियल में न हों अर्थात् किसी भी प्रकार की त्रुटिपूर्ण पुस्तिका स्वीकार न करें तथा उसी समय उसे लौटाकर उसके स्थान पर दूसरी सही प्रश्न-पुस्तिका ले लें । इसके लिए आपको पाँच मिनट दिये जायेंगे । उसके बाद न तो आपकी प्रश्न-पुस्तिका वापस ली जायेगी और न ही आपको अतिरिक्त समय दिया जायेगा ।**
   (iii) इस जाँच के बाद प्रश्न-पुस्तिका का नंबर OMR पत्रक पर अंकित करें और OMR पत्रक का नंबर इस प्रश्न-पुस्तिका पर अंकित कर दें ।
4. प्रत्येक प्रश्न के लिए चार उत्तर विकल्प (1), (2), (3) तथा (4) दिये गये हैं । आपको सही उत्तर के वृत्त को पेन से भरकर काला करना है जैसा कि नीचे दिखाया गया है :
   उदाहरण : ① ② ● ④
   जबकि (3) सही उत्तर है ।
5. प्रश्नों के उत्तर **केवल प्रश्न पुस्तिका के अन्दर दिये गये OMR पत्रक पर ही** अंकित करने हैं । यदि आप OMR पत्रक पर दिये गये वृत्त के अलावा किसी अन्य स्थान पर उत्तर चिह्नांकित करते हैं, तो उसका मूल्यांकन नहीं होगा ।
6. अन्दर दिये गये निर्देशों को ध्यानपूर्वक पढ़ें ।
7. कच्चा काम (Rough Work) इस पुस्तिका के अन्तिम पृष्ठ पर करें ।
8. यदि आप OMR पत्रक पर नियत स्थान के अलावा अपना नाम, रोल नम्बर, फोन नम्बर या कोई भी ऐसा चिह्न जिससे आपकी पहचान हो सके, अंकित करते हैं अथवा अभद्र भाषा का प्रयोग करते हैं, या कोई अन्य अनुचित साधन का प्रयोग करते हैं, जैसे कि अंकित किये गये उत्तर को मिटाना या सफेद स्याही से बदलना तो परीक्षा के लिये अयोग्य घोषित किये जा सकते हैं ।
9. आपको परीक्षा समाप्त होने पर मूल OMR पत्रक निरीक्षक महोदय को लौटाना आवश्यक है और परीक्षा समाप्ति के बाद उसे अपने साथ परीक्षा भवन से बाहर न लेकर जायें । हालांकि आप परीक्षा समाप्ति पर मूल प्रश्न-पुस्तिका तथा OMR पत्रक की डुप्लीकेट प्रति अपने साथ ले जा सकते हैं ।
10. **केवल C.B.S.E. द्वारा प्रदान किये गये काले बाल प्वाईंट पेन का ही इस्तेमाल करें ।**
11. **किसी भी प्रकार का संगणक (कैलकुलेटर) या लाग टेबल आदि का प्रयोग वर्जित है ।**
12. **गलत उत्तरों के लिए कोई नकारात्मक अंक नहीं हैं ।**

ELECTRONIC SCIENCE
Paper – II

Note : This paper contains **fifty (50)** objective type questions of **two (2)** marks each. **All** questions are compulsory.

1. In JFET the transconductance can be expressed as

(1) $\frac{I_{dss}}{V_p}\left(1-\frac{V_{gs}}{V_p}\right)^2$

(2) $\frac{2I_{dss}}{V_p}\left(1-\frac{V_{gs}}{V_p}\right)$

(3) $\frac{2I_{dss}}{V_p}\left(1-\frac{V_{gs}}{V_p}\right)^2$

(4) $\frac{2I_{dss}}{V_p}\left(1+\frac{V_{gs}}{V_p}\right)$

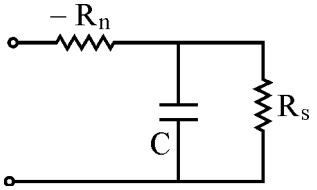
2. An electrodynamic generator is used to convert

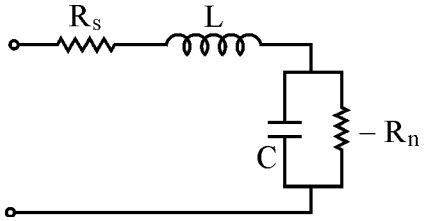
(1) Motion into voltage (2) Voltage into motion
(3) Temperature into pressure (4) Pressure into temperature

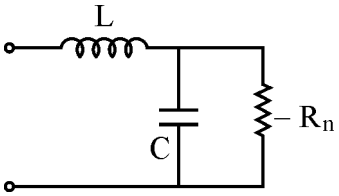
3. The effect of adding poles and zeros can be determined for determining phase and gain margin by

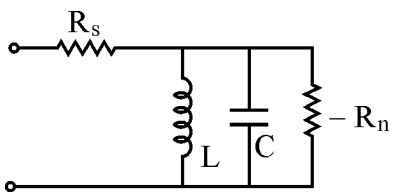
(1) Magnitude Vs phase plot (2) Nyquist plot
(3) Nicholas plot (4) Bode plot

4. The small signal model of a tunnel diode in negative resistance region is

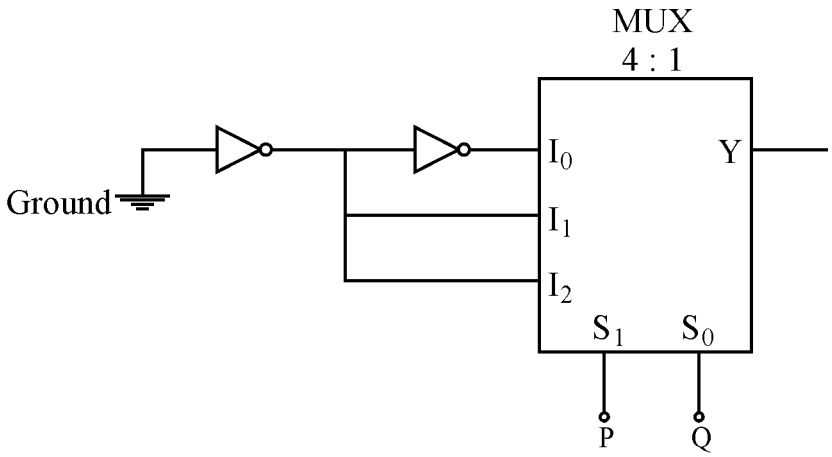
(1)


(2)


(3)


(4)


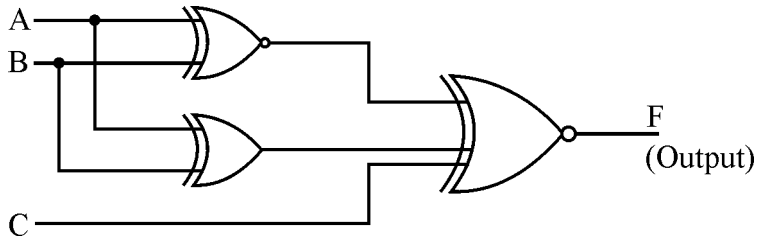
5. The logic function implemented by the circuit below is



(1) $Y = P.Q$ (2) $Y = \overline{P + Q}$

(3) $Y = P \oplus Q$ (4) $Y = \overline{P \oplus Q}$

6. For the following circuit, for making the output high (1), the input combination must be



(1) A = 0, B = 0 and C = 1

(2) A = 1, B = 1 and C = 0

(3) A = 1, B = 0, and C = 0

(4) A = 0, B = 1 and C = 1

7. Number of times the instruction sequence below will loop before coming out of loop is

```
MOV AL, 00H
A1 : INC AL
JNZ  A1
```

(1) 256 (2) 255

(3) 01 (4) 00

8. The number of wait states required to interface 8279 to 8086 with 8 MHz clock are

(1) One (2) Two

(3) Three (4) None

9. Which combination of the integer variables *x*, y and z makes the variable to get the value 4 in the following expression?

a = (*x* > y) ? ((*x* > z) ? *x* : z) : ((y > z) ? y : z)

(1) *x* = 6, y = 5, z = 3 (2) *x* = 6, y = 3, z = 5

(3) *x* = 5, y = 4, z = 5 (4) *x* = 3, y = 4, z = 2

10. Consider the following program

```
main( )
{
    float a = 0.3, b= 0.5 ;
    if (b < 0.6)
    if (a < 0.3) printf ("xyz" ) ;
    else printf ("ABC") ;
    else printf ("MLN") ;
}
```

The output is

(1) XYZ (2) MLN

(3) ABC (4) None of these

11. For a matched junction, scattering parameters are given values, which one of the following is true ?

(1) $S_{11} \neq 0$ (2) $|S_{21}| = 0$

(3) $S_{22} \neq 0$ (4) $S_{21} = 1$

12. The number of bits per sample in a PCM system is increased from 8 to 16. The bandwidth of the system would increase

(1) 8 times (2) 2 times

(3) ½ times (4) 2^4 times

13. An infrared LED is optically coupled to a photodiode. When LED is turned off, the reading on an ammeter in series with the reversed-biased photodiode will

(1) Not change (2) Decrease

(3) Increase (4) Fluctuate

14. After firing a SCR, the gating pulse is removed, the current in the SCR will

(1) remains the same (2) immediately falls to zero

(3) rise up (4) rise a little and then falls to zero

15. A signal f(t) is defined as $(1 - \alpha t)e^{-\alpha t}$. Its Laplace transform will be

(1) $\frac{1}{(s + \alpha)^2}$ (2) $\frac{s}{(s + \alpha)^2}$

(3) $\frac{(1 + s)}{(s - \alpha)}$ (4) $\frac{(s\alpha)}{(s + \alpha)^2}$

16. For intrinsic semiconductor the conductivity is

(a) $q(n\mu_n + p\mu_p)$ (b) $qn_i(\mu_n + \mu_p)$

(c) $q(n\mu_n - p\,\mu_p)$ (d) $q\,(\mu_n + \mu_p)$

Out of these the following is correct

(1) (a) and (b) are correct (2) (a) and (c) are correct

(3) (b) and (d) are correct (4) (c) and (d) are correct

17. Read the following statements :

(a) The gain crossover is a point on the L(jw) plot at which the magnitude of L(jw) is equal to 1.

(b) The gain crossover is a point on the L(jw) plot at which the magnitude of L(jw) is equal to 0.

(c) The gain crossover frequency, is the frequency of L(jw) where $|L(jw)| = 1$

(d) The gain crossover frequency is the frequency of L(jw) where $|L(jw)| = 0$

Which of the above statements are correct ?

(1) (a) and (b) (2) (a) and (c)

(3) (b) and (c) (4) (b) and (d)

18. In a p-n junction diode if A is the area of a junction then the transition capacitance is

(a) $q\,N_a\,W\,A$ (b) $q\,N_a\,A\left|\frac{dW}{dV}\right|$

(c) $\frac{q\,N_a\,W^2}{2\varepsilon_s}$ (d) $\frac{q\,N_a\,A}{\left|\frac{dW}{dV}\right|}$

Out of these which one is correct ?

(1) (a) and (b) are correct (2) (a) is correct but (b) is wrong

(3) (b) is correct, but (d) is wrong (4) (a) and (d) are correct

19. In a resistive ladder network used in n bit D to A converters, the following statements are given :

(a) LSB weight $= \frac{1}{(2^n - 1)}$

(b) LSB weight $= \frac{1}{(2^{n-1} - 1)}$

(c) The sum of all weights is equal to 1

(d) The sum of all the weight is greater than 1

Out of the above statements following is true :

(1) (b) and (c) (2) (a) and (c)

(3) (b) and (d) (4) (a) and (d)

20. The 8085 μp enters into bus idle machine cycle whenever

(a) INTR interrupt is recognized

(b) RST X.5 is recognized

(c) When content of register B is 00h

(d) DAD rp instruction is executed

Options :

(1) (a) and (c) are correct (2) (b) and (d) are correct

(3) (c) and (d) are correct (4) (b) and (c) are correct

21. If *x* is an one-dimensional array then

(a) & *x* [i] is same as *x* + i – 1

(b) * (*x* + i) is same as * *x* + i

(c) * (*x* + i) is same as * (& *x* [i])

(d) *(*x* + i) is same as *x*[i]

Options :

(1) (a) and (b) are correct (2) (b) and (c) are correct

(3) (c) and (d) are correct (4) (b) and (d) are correct

22. For transmission lines following statements are given :

(a) There is no cut-off frequency for TEM in coaxial cables.

(b) Coaxial cables are useful upto 100 MHz only.

(c) Waveguides do not support TEM waves.

(d) All the frequencies above cut-off flow through waveguides.

Out of the above statements following is true :

(1) (a), (b) and (c) (2) (a), (c) and (d)

(3) (b), (c) and (d) (4) (a) and (b)

23. Which of the following statements are true for Delta modulation ?

(a) The Modulation is digital in nature.

(b) The modulation is analogue in nature.

(c) Better signal to Noise-ratio than PCM.

(d) Slope overload occurs in Delta Modulation.

Options :

(1) (a) and (d) are correct (2) (b), (c) and (d) are correct

(3) (a), (c) and (d) are correct (4) (b) and (d) are correct

24. Which of the below mentioned statements are correct with respect of semiconductor LASER ?

(a) pn-junctions can be formed by using direct bandgap semiconductors.

(b) Emitted radiations should be monochromatic and coherent.

(c) Emitted radiations be monochromatic and all are in same phase.

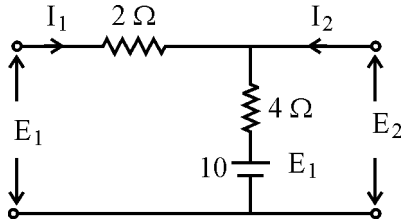
(d) Emitted radiations should be monochromatic and spontaneous.

Options :

(1) (a), (b) & (d) are correct (2) (a), (c) & (d) are correct

(3) (a), (b) & (c) are correct (4) (a) & (b) are correct

25. Consider a two port network shown in the following figure :



The z-parameters z_{11} and z_{21} for this network are given as

(a) $z_{11} = -\frac{6}{11}\Omega$

(b) $z_{21} = \frac{16}{11}\Omega$

(c) $z_{11} = \frac{6}{11}\Omega$

(d) $z_{21} = -\frac{16}{11}\Omega$

Which of the above are correct ?

(1) (a) and (b) (2) (a) and (d)

(3) (b) and (c) (4) (c) and (d)

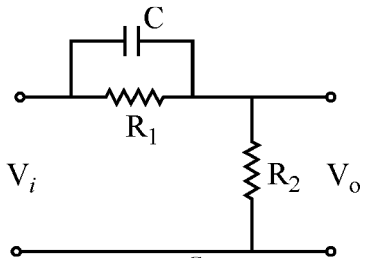
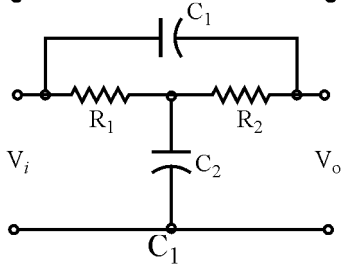
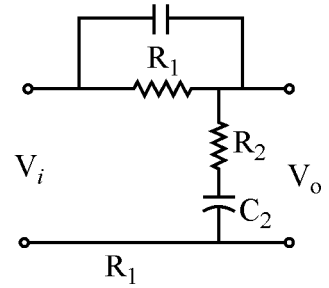
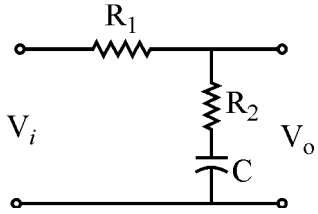
26. Match the following lists :

	List – I		**List – II**
a.	Darlington transistor	i.	$\beta + 1$
b.	Common base	ii.	β
c.	Common emitter	iii.	α
d.	Common collector	iv.	$\beta_1\beta_2$

Codes :

	a	b	c	d
(1)	iv	iii	ii	i
(2)	i	ii	iii	iv
(3)	iii	i	ii	iv
(4)	ii	iv	i	iii

27. Match the following lists :

	List – I		**List – II**
a.	A-bridge T filter	i.	
b.	A Lead Network	ii.	
c.	A Lag Network	iii.	
d.	A Lead-Lag Network	iv.	

Codes :

	a	b	c	d
(1)	ii	i	iv	iii
(2)	ii	i	iii	iv
(3)	i	iii	ii	iv
(4)	i	ii	iv	iii

28. Match the following lists :

	List – I		**List – II**
a.	h_{ie}	i.	i_c/i_b
b.	h_{re}	ii.	v_b/i_b
c.	h_{fe}	iii.	v_b/v_c
d.	h_{oe}	iv.	i_c/v_c

Codes :

	a	b	c	d
(1)	ii	iii	i	iv
(2)	iii	ii	i	iv
(3)	ii	iii	iv	i
(4)	i	ii	iii	iv

29. Match the following lists :

	List – I		**List – II**
a.	IC 7408	i.	BCD to decimal decoder
b.	IC 7442	ii.	BCD to seven segment decoder-drivers
c.	IC 7447	iii.	Quad 2-input NAND gate
d.	IC 7400	iv.	Quad 2-input AND gate

Codes :

	a	b	c	d
(1)	i	iii	iv	ii
(2)	ii	i	iv	iii
(3)	iv	i	iii	ii
(4)	iv	i	ii	iii

30. Match the following :

	List – I		**List – II**
a.	RST 7.5	i.	Non maskable interrupt
b.	RST 0-7	ii.	Level triggering interrupt
c.	TRAP	iii.	Hardware interrupt
d.	RST 5.5 and RST 6.5	iv.	Software interrupt

Codes :

	a	b	c	d
(1)	i	iii	ii	iv
(2)	ii	iii	i	iv
(3)	iii	i	ii	iv
(4)	iii	iv	i	ii

31. Match the following :

	List – I		**List – II**

a.	The program fragment
	int a = 4, b = 6;
	printf ("%d", b= =a);
		i.	Prints 4

b.	The program fragment
	int a = 4, b = 6;
	printf ("%d", a! = b);
		ii.	Prints 0

c.	The program fragment int a = 4, b = 6; printf("%d", a∧b);	iii.	Prints 1
d.	The program fragment int a = 4, b = 6; printf ("%d", a&b);	iv.	Prints 2

Codes :

	a	b	c	d
(1)	i	ii	iv	iii
(2)	ii	iii	i	iv
(3)	ii	iii	iv	i
(4)	iii	ii	i	iv

32. Match the following lists :

	List – I		**List – II**
a.	PIN diode	i.	Optical detector
b.	APD	ii.	Tuning
c.	Varacter diode	iii.	Microwave oscillator
d.	Tunnel diode	iv.	Microwave detector

Codes :

	a	b	c	d
(1)	iv	i	ii	iii
(2)	iii	i	ii	iv
(3)	i	iii	ii	iv
(4)	i	iv	ii	iii

33. Match the following lists :

	List – I		**List – II**
a.	Quantization noise in PCM	i.	Number of quantization levels
b.	Bandwidth in PCM	ii.	Lesser number of quantization levels needed
c.	Sampling rate	iii.	Highest frequency in the analog signal
d.	Differential PCM	iv.	Atleast twice the maximum frequency component present in the signal

Codes :

	a	b	c	d
(1)	i	iii	iv	ii
(2)	i	ii	iii	iv
(3)	i	iv	iii	ii
(4)	ii	iv	i	iii

34. Match the following lists :

	List – I		**List – II**
	Medium		**Index of refraction(η)**
a.	Glass Fibre	i.	1.0003
b.	Water	ii.	3.4
c.	Air	iii.	1.5 – 1.9
d.	Silicon	iv.	1.33

Codes :

	a	b	c	d
(1)	iv	iii	i	ii
(2)	ii	iv	i	iii
(3)	ii	i	iii	iv
(4)	iii	iv	i	ii

35. Match the following lists :

	List – I		**List – II**
a.	nU[n]	i.	$\frac{z^{-1}}{1 - z^{-1}}$; | z | < 1
b.	$\alpha^n U[n]$	ii.	$\frac{z}{z - \alpha}$; | z | > | a |
c.	$n\alpha^n U[n]$	iii.	$\frac{z}{(z - 1)^2}$; | z | > 1
d.	U[–n]	iv.	$\frac{\alpha z}{(z - \alpha)^2}$; | z | > | a |

Codes :

	a	b	c	d
(1)	iii	ii	iv	i
(2)	ii	iv	i	iii
(3)	i	ii	iii	iv
(4)	ii	iii	iv	i

Directions : Question No. **36** to **45 :**

The following items consist of two statements, one labelled as "Assertion (A)" and the other labelled as the "Reason (R)". You are to examine the two statements carefully and decide if the Assertion (A) and the Reason (R) are individually true and if so whether the reason is a correct explanation of the assertion. Select your answer to these items using the codes given below and mark your answer accordingly.

Codes :

(1) Both (A) and (R) are true and (R) is the correct explanation of (A).

(2) Both (A) and (R) are true, but (R) is not the correct explanation of (A).

(3) (A) is true, but (R) is false.

(4) (A) is false, but (R) is true.

36. **Assertion (A) :** GaAs shows very low reverse saturation current, excellent temperature sensitivities and high breakdown voltages.

Reason (R) : It operates at only low frequencies as compared to Ge and Si. It has a knee voltage of 2.0 Volts.

37. **Assertion (A) :** It is said that Kirchhoff's current law has never been found to be invalid.

Reason (R) : The current law is based on the principle of conservation of charge.

38. **Assertion (A) :** Networks that are quite stable and relatively insensitive to temperature variations have low stability factors.

Reason (R) : The stability factors are defined as :

$$S(I_{CO}) = \frac{\Delta I_{CO}}{\Delta I_C}$$

$$S(V_{BE}) = \frac{\Delta V_{BE}}{\Delta I_C}$$

$$S(\beta) = \frac{\Delta \beta}{\Delta I_C}$$

Where Δ signifies the change in the quantity.

39. **Assertion (A) :** In Electromagnetics, materials are divided roughly into two classes, i.e. conductors and dielectrics or insulators.

Reason (R) : In Maxwell equation, $\sigma/\omega\in$ decides, whether the medium is a good conductor or a dielectric.

40. **Assertion (A) :** Ready pin of 8086 microprocessor is used to introduce wait states.

Reason (R) : Because the $\overline{WR}$ and ALE signals are not available directly from the processor in maximum mode.

41. **Assertion (A) :** When a static variable is defined inside a function in C, then it remains alive until end of the function.

Reason (R) : Because that variable is treated as local variable.

42. **Assertion (A) :** In tristate buffer, at the input of a digital system, there may be more than one input signal.

Reason (R) : The tristate buffer is controlled by gate signal, when G is high, the output follows the input. However, when the signal at G is low, the output is an open circuit (a third state).

43. **Assertion (A) :** The Fourier transform provides a unified solution for both periodic and non-periodic waveforms over the entire interval.

Reason (R) : The Fourier transform is a tool for generalized analysis of arbitrary waveforms over the entire interval.

44. **Assertion (A) :** Optical communications has certain inherent advantages over conventional communications systems such as copper cable and radio links etc.

Reason (R) : It is because optical fibres have light weight and smaller diameter.

45. **Assertion (A) :** Capacitive transducers are preferred over inductive transducers.

Reason (R) : Push-pull inductive transducers can be replaced with push-pull capacitive transducers.

Directions (46 – 50) : Read the passage and answer the following questions numbering from **46** to **50 :**

The metal oxide semiconductor field effect transistor is the most important device for very large scale integrated circuits such as microprocessor and semiconductor memories. MOSFET is also becoming a power device. The principle of field effect transistor was first proposed by Dillen Field in 1930. The current in a MOSFET is transported by carriers of one polarity and is usually referred as unipolar device. The MOSFET is a member of the family of field effect transistors. It is fabricated with various semiconductors such as Si, GaAs and SiC with various insulators. The most important system is Si – SiO_2 interface.

46. MOSFET is in equilibrium condition when

(1) $V_{gs} = 0, V_{ds} \neq 0$ (2) $V_{gs} \neq 0, V_{ds} = 0$

(3) $V_{gs} \neq 0, V_{ds} \neq 0$ (4) $V_{gs} = 0, V_{ds} = 0$

47. The cut off frequency of a MOSFET can be defined as

(1) $\frac{g_m}{2\pi}$ (2) $\frac{g_m}{2\pi C_{gs}}$

(3) $\frac{g_m}{g_d}$ (4) $\frac{g_d}{2\pi C_{gs}}$

48. The surface charge per unit area after strong inversion is given by

(1) $-\sqrt{2q N_A \varepsilon_s (V_D + 2\varphi_B)}$ (2) $-\sqrt{\frac{q\varepsilon_s}{N_A}(V_D + 2\psi_B)}$

(3) $-\sqrt{\frac{2qN_A}{\varepsilon_s}(V_D + 2\psi_B)}$ (4) $\sqrt{\frac{2qt_s}{N_A}(V_D + \psi_B)}$

49. The threshold voltage of a MOSFET is

(1) $2\psi_B$ (2) $2\varphi_B + \frac{\sqrt{2\varepsilon_s q N_A(2\psi_B)}}{C_i}$

(3) $2\varphi_B - \frac{\sqrt{2\varepsilon_s q N_A(2\psi_B)}}{C_i}$ (4) $2\varphi_B + \frac{\sqrt{2\varepsilon_s q N_A(2\psi_B)}}{C_i}$

50. The transconductance in linear region is

(1) $\frac{z}{L}\mu_n C_i V_D$ (2) $\frac{z}{L}\mu_n C_i (V_G - V_T)$

(3) $\frac{z}{L}\mu_n (V_G - V_T)$ (4) $\frac{z}{L}\mu_n C_i$

Space For Rough Work