Question Booklet

S. No. 100050

C-31042(O)

Entrance Test, March 2010

Ph. D. Electronics & Communication (UIET)

(Objective Type Questions)

Maximum Marks : 50 Time : 60 Minutes

NOTE :

(i) This question booklet comprises of 50 questions.

(ii) Each question has four options (1), (2), (3) and (4) out of which one is correct. The candidate is required to darken completely the correct option in the OMR Answer Sheet supplied separately.

(iii) Each correct answer carries 1 marks.

(iv) No negative marking.

(v) Rough work may be done in this question booklet itself.

(vi) The question booklet along with the OMR answer sheet is to be handed over by the candidate to the Invigilator at the end of the examination.

Ph. D. Entrance Test, March 2010

ELECTRONICS AND COMMUNICATION (UIET)

Second Paper

(Objective Type Questions)

1. The intrinsic carrier density at 300 K is $1{\cdot}5 \times 10^{10}/cm^3$, in silicon. For n-type silicon doped to $2{\cdot}25 \times 10^{15}$ atoms/cm^3, the equilibrium electron and hole densities are :

   (1) $n = 1{\cdot}5 \times 10^{15}/cm^3$, $p = 1{\cdot}5 \times 10^{10}/cm^3$

   (2) $n = 1{\cdot}5 \times 10^{10}/cm^3$, $p = 2{\cdot}25 \times 10^{15}/cm^3$

   (3) $n = 2{\cdot}25 \times 10^{15}/cm^3$, $p = 1{\cdot}0 \times 10^{5}/cm^3$

   (4) $n = 1{\cdot}5 \times 10^{10}/cm^3$, $p = 1{\cdot}5 \times 10^{10}/cm^3$

2. The gate delay of an NMOS inverter is dominated by charge time rather than discharge time because :

   (1) the driver transistor has larger threshold voltage than the load transistor

   (2) the driver transistor has larger leakage currents compared to the load transistor

   (3) the load transistor has a smaller W/L ratio compared to the driver transistor

   (4) none of the above

3. The following instructions have been executed by an 8085 μP :

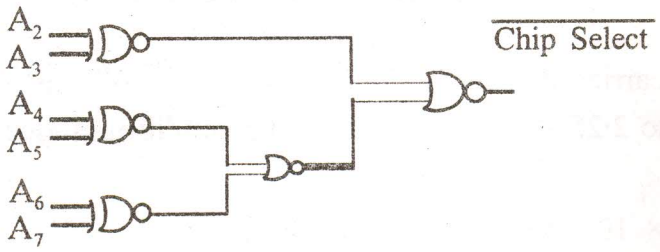
ADDRESS (HEX)	INSTRUCTION
6010	LX1 H, 8A 79H
6013	MOV A, L
6015	ADDH
6016	DAA
6017	MOV H, A
6018	PCHL

   From which address will the next instruction be fetched ?

   (1) 6019 (2) 6379

   (3) 6979 (4) None of these

4. The decoding circuit shown in the figure has been used to generate the active low chip select signal for a microprocessor peripheral. (The address lines are designated as AO to A7 for I/O addresses) :



The peripheral will correspond to I/O addresses in the range :

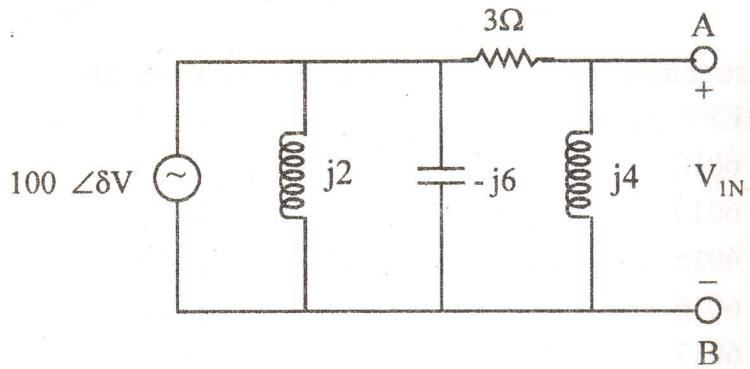
(1) 60 H to 63 H

(2) A4 to A7H

(3) 30 H to 33 H

(4) 70 H to 73 H

5. The Thevenin equivalent voltage V_{TH} appearing between the terminals A and B of the network shown in the given figure is given by :



(1) $j\ 16\ (3 - j4)$

(2) $j\ 16\ (3 + j4)$

(3) $16\ (3 + j4)$

(4) $16\ (3 - j4)$

6. An amplifier has an open loop gain of 100, an input impedance of 1 kΩ, and an output impedance of 100Ω. A feedback network with a feedback factor of 0·99 is connected to the amplifier in a voltage series feedback mode. The new input and output impedances, respectively, are :

(1) 10Ω and 1Ω
(2) 10Ω and 10kΩ
(3) 100Ω and 1Ω
(4) 100 kΩ and 1kΩ

7. An amplifier is assumed to have a single-pole high-frequency transfer function. The rise time of its output response to a step function input is 35 n sec. The upper – 3 dB frequency (in MHz) for the amplifier to a sinusoidal input is approximately at :

(1) 4·55
(2) 10
(3) 20
(4) 28·6

8. For a binary half-subtractor having two inputs A and B, the correct set of logical expressions for the outputs D (= A minus B) and X (= borrow) are :

(1) $D = AB + \bar{A}B,\ X = \bar{A}B$
(2) $D = \bar{A}B + A\bar{B} + A\bar{B},\ X = A\bar{B}$
(3) $D = \bar{A}B + A\bar{B},\ X = \bar{A}B$
(4) $D = AB + \bar{A}\bar{B},\ X = A\bar{B}$

9. If $CS = A_{15}\ A_{14}\ A_{13}$ is used as the chip select logic of a 4 K RAM in an 8085 system, then its memory range will be :

(1) 3000 H – 3 FFF H
(2) 7000 H – 7 FFF H
(3) 5000 H – 5 FFF H and 6000 H – 6 FFF H
(4) 6000 H – 6 FFF H and 7000 H – 7 FFF H

10. If the closed-loop transfer function T(s) of a unity negative feedback system is given by :

$$T(s) = \frac{a_{n-1}s + a_n}{s^n + n_1 s^{n-1} + ... + a_{n-1}\, s + a_n}$$

then the steady state error for a unit ramp input is :

(1) $\frac{a_n}{a_{n-1}}$ (2) $\frac{a_n}{a_{n-2}}$

(3) $\frac{a_{n-2}}{a_{n-2}}$ (4) Zero

11. Consider the points $s_1 = -3 + j4$ *and* $s_2 = -3 - j2$ in the s-plane. Then, for a system with the open-loop transfer function :

$$G(s)\ H(s) = \frac{K}{(s+1)^4}$$

(1) s_1 is on the root locus, but not s_2

(2) s_2 is on the root locus, but not s_1

(3) both s_1 and s_2 are on the root locus

(4) neither s_1 and s_2 are on the root locus

12. For the system described by the state equation :

$$x = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0{\cdot}5 & 1 & 2 \end{bmatrix} x + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u$$

If the control signal u is given by $u = [-0{\cdot}5 \; -3 \; -5]\ x + v$, then the eigenvalues of the closed-loop system will be :

(1) 0, – 1, – 2 (2) 0, – 1, – 3

(3) – 1, – 1, – 2 (4) 0, – 1, – 1

13. The z-transform of a signal is given by :

$$C(z) = \frac{1z^{-1}(1-z^{-4})}{4(1-z^{-1})^2}$$

Its final value is :

(1) 1/4 (2) Zero

(3) 1·0 (4) Infinity

14. The Nyquist sampling frequency (in Hz) of a signal given by :

$$6 \times 10^4 \sin c^2 (400\ t) * 10^6 \sin c^3 (100\ t)$$

is :

(1) 200 (2) 300

(3) 500 (4) 1000

15. The peak-to-peak input to an 8-bit PCM coder is 2 volts. The signal power to quantization noise power ratio (in dB) for an input of 0·5 cos $(\omega_m t)$ is :

(1) 47·8 (2) 49·8

(3) 95·6 (4) 99·6

16. The input to a matched filter is given by :

$$s(t) = \begin{cases} 10 \sin (2\pi \times 10^6 t) & 0 < 1 < 10^{-4} \text{ sec} \\ 0 & \text{otherwise} \end{cases}$$

The peak amplitude of the filter output is :

(1) 10 vots (2) 5 vots

(3) 10 millivolts (4) 5 millivolts

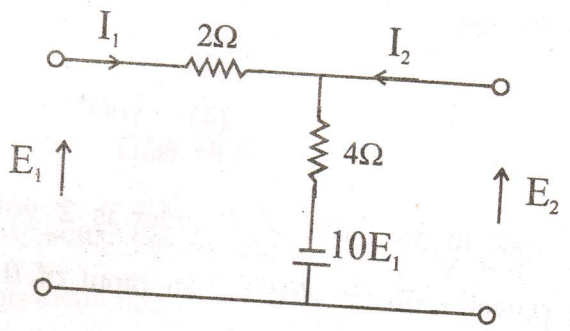
17. In air, a lossless transmission line of length 50 cm with L = 10 μH/m, C = 40 pF/m is operated at 25 MHz. Its electrical path length is :

(1) 0·5 metres
(2) λ metres
(3) π/2 radians
(4) 180 degrees

18. A plane wave propagating through a medium $\{\varepsilon_r = 8, \nu_r = 2 \text{ and } \sigma = 0\}$ has its electric field given by $\vec{E} = 0{\cdot}5\,\hat{X}\,e^{-(z/3)} \sin(10^8 t - \beta z)$ V/m. The wave impedance, in ohms is :

(1) 377
(2) $198{\cdot}5 \angle 180^\circ$
(3) $182{\cdot}9 \angle 14^\circ$
(4) 133·3

19. The Z-parameters Z_{11} and Z_{21} for the port network in the figure :

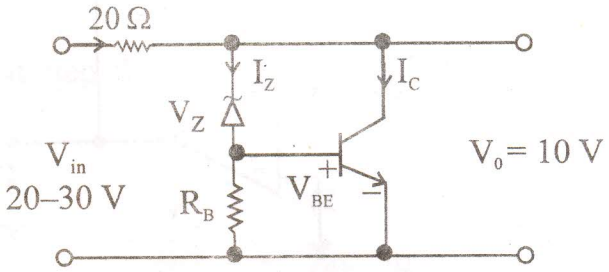


(1) $Z_{11} = -\frac{6}{11}\Omega;\ Z_{21} = \propto \frac{16}{11}\Omega$
(2) $Z_{11} = \frac{6}{11}\Omega;\ Z_{21} = \frac{4}{11}\Omega$
(3) $Z_{11} = \frac{6}{11}\Omega;\ Z_{21} = -\frac{6}{11}\Omega$
(4) $Z_{11} = \frac{4}{11}\Omega;\ Z_{21} = \frac{4}{11}\Omega$

20. An *npn* BJT has gm = 38 m A/V, $C_\mu = 10^{-14}$ F, $C_X = 4 \times 10^{-13}$ F, and DC current gain $\beta_0 = 90$. For this transistor f_T and f_β are :

(1) $f_T = 1{\cdot}64 \times 10^8$ Hz and $f_\beta = 1{\cdot}47 \times 10^{10}$ Hz
(2) $f_T = 1{\cdot}47 \times 10^{10}$ Hz and $f_\beta = 1{\cdot}64 \times 10^8$ Hz
(3) $f_T = 1{\cdot}33 \times 10^{12}$ Hz and $f_\beta = 1{\cdot}47 \times 10^{10}$ Hz
(4) $f_T = 1{\cdot}47 \times 10^{10}$ Hz and $f_\beta = 1{\cdot}33 \times 10^{12}$ Hz

21. The transistor shunt regulator shown in the figure has a regulated output voltage of 10 V, when the input varies from 20 V to 30 V. The relevant parameters for the zener diode and the transistor are $V_Z = 9{\cdot}5$, $V_{SE} = 0{\cdot}3$ V, $\beta = 99$. Neglect the current through R_B. Then the maximum power dissipated in the zener diode (Pz) and the transistor (P_T) are :



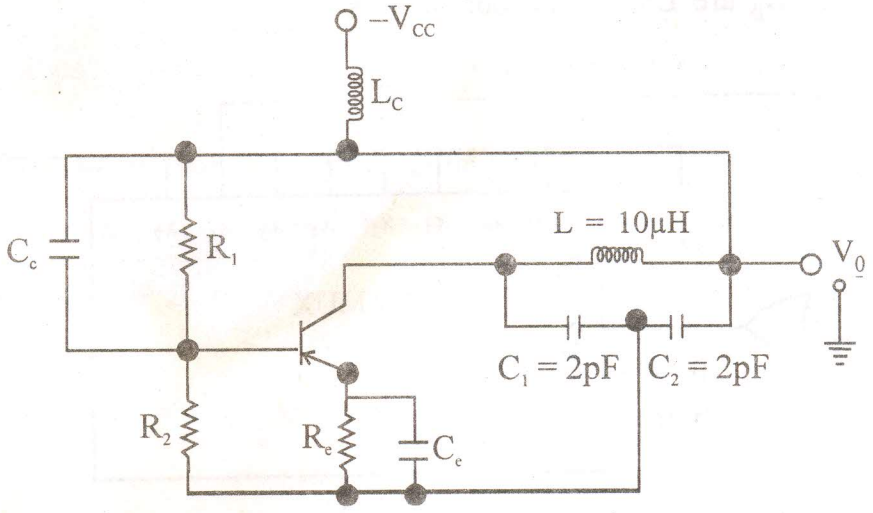
(1) $P_Z = 75$ mW, $P_T = 7{\cdot}9$ W

(2) $P_z = 85mw$, $P_T = 8{\cdot}9w$

(3) $P_z = 95mw$, $P_T = 9{\cdot}9w$

(4) $P_z = 115mw$, $P_T = 11{\cdot}9w$

22. The oscillator circuit shown in the figure :



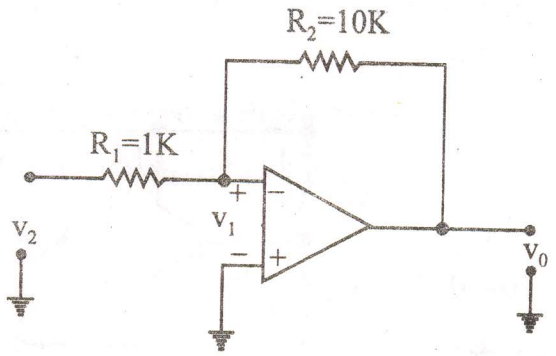
(1) Hartley oscillator with $f_{oscillation}$ = 79·6 MHz

(2) Colpitts oscillator with $f_{oscillation}$ = 79·6 MHz

(3) Hartley oscillator with $f_{oscillation}$ = 159·2 MHz

(4) Colpitts oscillator with $f_{oscillation}$ = 159·2 MHz

23. The inverting OP-AMP shown in the figure has an open-loop gain of 100. The closed-loop gain $\frac{v_0}{v_s}$ is :



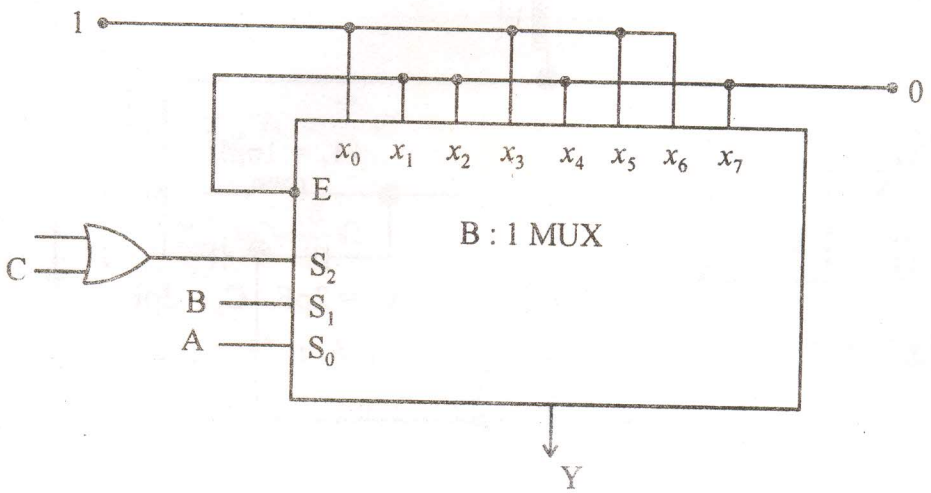
(1) – 8

(2) – 9

(3) – 10

(4) – 11

24. In the TTL circuit in the figure, S_2 to S_0 are select lines and X_7 to X_0 are input lines. S_0 and X_0 are LSBs. The output Y is :



(1) Indeterminate

(2) A ⊕ B

(3) $\overline{A \oplus B}$

(4) $\bar{C} \cdot (\overline{A \oplus B}) + C \cdot (A \oplus B)$

25. The impulse response functions of four linear systems S_1, S_2, S_3, S_4 are given respectively by :

$$h_1(t) = 1 \qquad h_2(t) = U(t)$$

$$h_3(t) = \frac{U(t)}{t+1} \qquad h_4(t) = e^{3t}\, U(t)$$

Where $U(t)$ is the unit step funciton ? Which of these systems is time invariant, causal, and stable ?

(1) S_1 (2) S_2

(3) S_3 (4) S_4

26. A video transmission system transmits 625 picture frames per second. Each frame consists of a 400 × 400 pixel grid with 64 intensity levels per pixel. The data rate of the system is :

(1) 16 Mbps (2) 100 Mbps

(3) 600 Mbps (4) 6·4 Gbps

27. During transmission over a communication channel, bit errors occur independently with probability p. If a block of n bits is transmitted the probability of at most one bit error is equal to :

(1) $1 - (1 - p)^n$ (2) $p + (n - 1)(1 - p)$

(3) $np\,(1 - p)^{n-1}$ (4) $(1 - p)^n + np\,(1 - p)^{n-1}$

28. The PSD and the power of a signal $g(t)$ are, respectively, $S_g(\omega)$ and P_g. The PSD and the power of the signal $ag(t)$ are, respectively :

(1) $a^2S_g(\omega)$ and a^2P_g (2) $a^2S_g(\omega)$ and aP_g

(3) $aS_g(\omega)$ and a^2P_g (4) $aS_g(\omega)$ and aP_g

29. A material has conductivity of 10^{-2} mho/m and a relative permittivity of 4. The frequency at which the conduction current in the medium is equal to the displacement current is :

(1) 45 MHz (2) 90 MHz

(3) 450 MHz (4) 900 MHz

30. A uniform plane electromagnetic wave incident normally on a plane surface of a dielectric material is reflected with a VSWR of 3. What is the percentage of incident power that is reflected ?

(1) 10% (2) 25%

(3) 50% (4) 75%

31. A medium wave radio transmitter operating at a wavelength of 492 m has a lower antenna of height 124 m. What is the radiation resistance of the antenna ?

(1) 25 Ω (2) 36·5 Ω

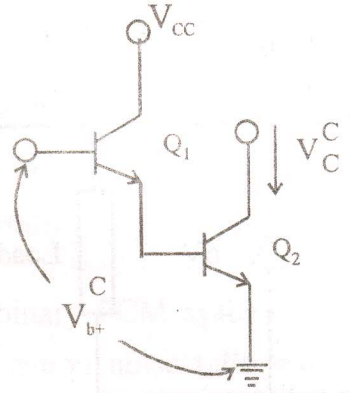
(3) 50 Ω (4) 73 Ω

32. In a uniform linear array, four isotropic radiating elements are spaced $\frac{\lambda}{4}$ apart. The progressive phase shift between the elements required for forming the main beam at 60° off the end-fire is :

(1) $-\pi$ radians (2) $-\frac{\pi}{2}$ radians

(3) $-\frac{\pi}{4}$ radians (4) $-\frac{\pi}{8}$ radians

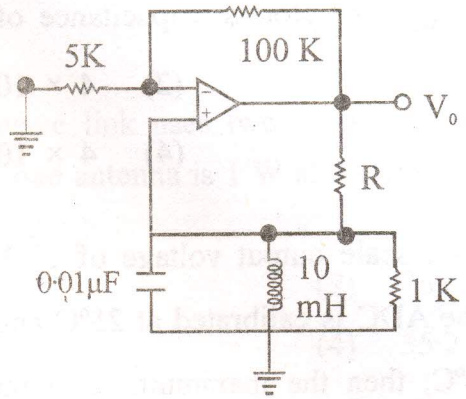
33. A Darlington stage is shown in the figure. If the transconductance of Q_1 is g_{m1} and Q_2 is g_{m2}, then the overall transconductance g_{mx} $\left[\triangleq \frac{i_e^r}{v_{br}^r}\right]$ is given by :



(1) g_{m1} (2) $0{\cdot}5g_{m1}$

(3) g_{m2} (4) $0{\cdot}5g_{m2}$

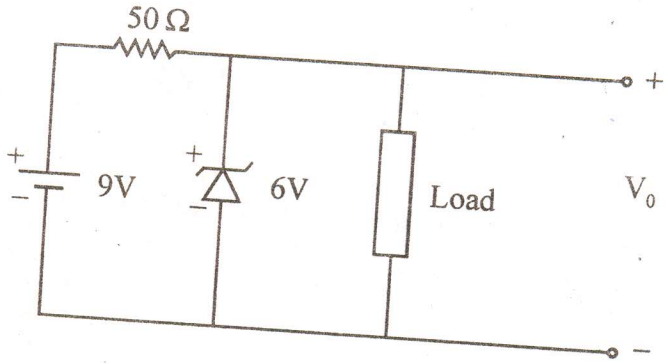
34. Value of R in the oscillator circuit shown in the given figure, so chosen that it just oscillates at an angular frequency of ω. The value of ω and the required value of R will respectively be :



(1) 10^5 rad/sec, 2×10^4 Ω (2) 2×10^4 rad/sec, 2×10^4 Ω

(3) 2×10^4 rad/sec, 10^5 Ω (4) 10^5 rad/sec, 10^5 Ω

35. A zener diode in the circuit shown in the figure has a knee current of 5 mA, and a maximum allowed power dissipation of 300 mW. What are the minimum and maximum load currents that can be drawn safely from the circuit, keeping the output voltage V_0 constant at 6V ?



(1) 0 mA, 180 mA

(2) 5 mA, 110 mA

(3) 10 mA, 55 mA

(4) 60 mA, 180 mA

36. A dynamic RAM cell which hold 5 V has to be refreshed every 20 m secs, so that the stored voltage does not fall by more than 0·5 V. If the cell has a constant discharge current of 0·1 pA, the storage capacitance of the cell is :

(1) 4×10^{-6} F

(2) 4×10^{-9} F

(3) 4×10^{-12} F

(4) 4×10^{-15} F

37. A 10 bit ADC with a full scale output voltage of 10·24 V is designed to have a ± LSB/2 accuracy. If the ADC is calibrated at 25°C and the operating temperature ranges from 0°C to 50°C, then the maximum net temperature coefficient of the ADC should not exceed :

(1) ± 200 μV/°C

(2) ± 400 μV/°C

(3) ± 600 μV/°C

(4) ± 800 μV/°C

38. The following sequence of instructions are executed by an 8085 microprocessor :

1000	LXI	SP,	27 FF
1000	CALL		1006
1006	POP H		

The contents of the stack pointer (SP) and the HL, register pair on completion of execution of these instructions are :

(1) SP = 27 FF, HL = 1003 (2) SP = 27 FD, HL = 1003

(3) SP = 27 FF, HL = 1006 (4) SP = 27 FD, HL = 1006

39. The number of bits in a binary PCM system is increased from n to $n + 1$. As a result, the signal to quantization noise ratio will improve by a factor :

(1) $\frac{n+1}{n}$ (2) $2^{(n+1)/n}$

(3) $2^{2(n+1)/n}$ (4) Which is independent of n

40. The critical frequency of an ionospheric layer is 10 MHz. What is the maximum launching angle from the horizon for which 20 MHz wave will be reflected by the layer ?

(1) 0° (2) 30°

(3) 45° (4) 90°

41. A 1 km long microwave link uses two antennas each having 30 dB gain. If the power transmitted by one antenna is 1 W at 3 GHz, the power received by the other antenna is approximately :

(1) 98·6 μW (2) 76·8 μW

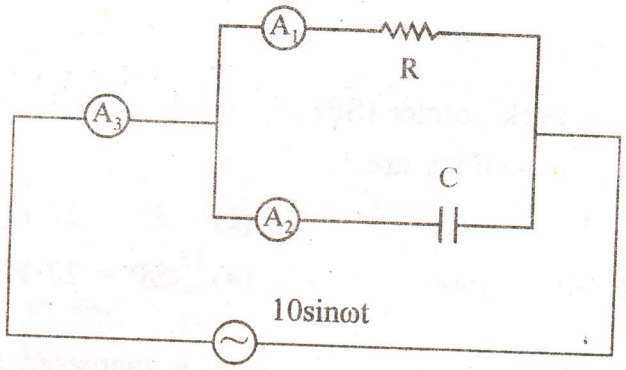
(3) 63·4 μW (4) 55·2 μW

42. Some unknown material has a conductivity of 10^6 mho/m and a permeability of $4\pi \times 10^{-7}$ H/m. The skin depth for the material at 1 GHz is :

(1) 15·9 μm (2) 20·9 μm

(3) 25·9 μm (4) 30·9 μm

43. In the figure A^1A^2 and A^3 are ideal ammeters. If A^1 reads 5A, A^2 reads12 A, then A^3 should read :



(1) 7A

(2) 12A

(3) 13A

(4) 17A

44. If $\tau F(s) = [f(t)] = \dfrac{K}{(s+1)(s^2+4)}$ then $\lim_{t\to\infty} f(t)$ is given by :

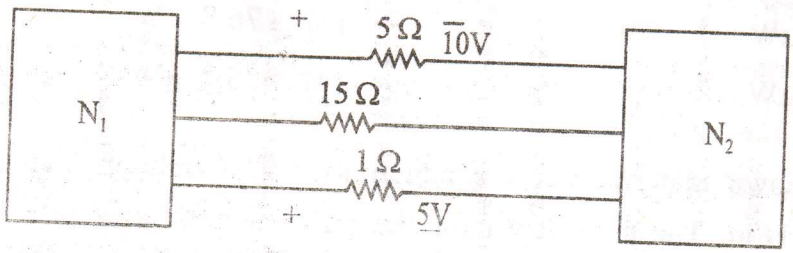
(1) K/4

(2) Zero

(3) Infinite

(4) Underfined

45. The two electrical sub network N^1 and N^2 are connected through three resistors as shown in the figure. The voltage across 5 ohm resistor and 1 ohm resistor are given to be 10 V and 5V, respectively. Then voltage across 15 ohm resistor is :



(1) – 105 V

(2) + 105 V

(3) – 15 V

(4) + 15 V

46. 2's complement representation of a 16-bit number (one sign bit and 15 magnitude bits) is FFFI. Its magnitude in decimal representation is :

(1) 0 (2) 1

(3) 32,767 (4) 65,535

47. Consider a transmission line of characteristic impedance of 50 ohm. Let it be terminated at one end by $+j$ 50 ohm. The VSWR produced by it in the transmission line will be :

(1) + 1 (2) 0

(3) ∞ (4) $+j$

48. A material is described by the following electrical parameters as a frequency of 10 GHz, $\sigma = 10^6$ mho/m, $\mu = \mu^0$ and $\sigma/\sigma^0 = 10$. The material at this frequency is considered to be $\left(\sigma_0 = \frac{1}{36\pi} \times 10^{-9} \text{ F/m}\right)$.

(1) a good conductor

(2) a good dielectric

(3) neither a good conductor, nor a good dielectric

(4) a good magnetic material

49. The transfer function of a system is $G(s) = \frac{100}{(s+1)(s+100)}$. For a unit step input to the system the approximate settling time for 2% criterion is :

(1) 100 sec (2) 4 sec

(3) 1 sec (4) 0·01 sec

50. The characteristic polynomial of a system is $q(s) = 2s^5 + s^4 + 4s^3 + 2s^2 + 2s + 1$. The system is :

(1) Stable (2) Marginally stable

(3) Unstable (4) Oscillatory