ACE
Engineering Academy

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ESE- 2018 (Prelims) - Offline Test Series Test-24

ELECTRONICS & TELECOMMUNICATION ENGINEERING

FULL LENGTH MOCK TEST – 2 (PAPER - II)

01. Ans: (b)

Sol: Given $h(n) = \dfrac{\sin\left(\dfrac{n\pi}{4}\right)}{n\pi}$

$H(e^{j\omega}) = 1, \quad |\omega| \le \dfrac{\pi}{4}$

$= 0, \quad$ otherwise

Since, $\omega_0 = \dfrac{2\pi}{N_0} = \dfrac{2\pi}{5}$ and the filter passes only frequencies in the range $|\omega| \le \pi/4$, only dc term is passed.

So, $c_0 = \dfrac{1}{5}\sum_{n=0}^{4} x(n) = \dfrac{3}{5}$

The output $y(n) = \dfrac{3}{5}$;for all 'n'

02. Ans: (d)

Sol: $(n+1)a^n u(n) \longleftrightarrow \dfrac{1}{\left(1-ae^{-j\omega}\right)^2}$

$a = 1/4$

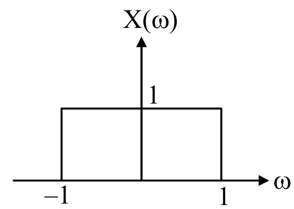
$x(n) = (n+1)(1/4)^n\, u(n)$

$x(-1) = 0$

03. Ans: (a)

04. Ans: (d)

Sol:



$X(\omega) = \text{rect}\left(\dfrac{\omega}{2}\right)$

We know that if $x(t) = \dfrac{\sin at}{\pi t}$

$\Rightarrow X(\omega) = \text{rect}\left(\dfrac{\omega}{2a}\right)$

Given $X(\omega) = \text{rect}\left(\dfrac{\omega}{2}\right) \Rightarrow x(t) = \dfrac{\sin t}{\pi t}$

05. Ans: (c)

Sol: From the given conditions the signal is finite duration both sided sequence. So, ROC is $0<|z|<\infty$

06. Ans: (b)

07. Ans: (b)

Sol: Given $x(t) = u(t) \Rightarrow y(t) = (1-e^{-t})\,u(t)$

$X(s) = 1/s \Rightarrow Y(s) = \dfrac{1}{s} - \dfrac{1}{s+1} = \dfrac{1}{s(s+1)}$

$H(s) = \dfrac{Y(s)}{X(s)} = \dfrac{1}{s+1}$

Given $y(t) = [2-3e^{-t}+e^{-3t}]\,u(t) \Rightarrow x(t) = ?$

$$Y(s) = \frac{2}{s} - \frac{3}{s+1} + \frac{1}{s+3}$$

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

$$Y(s) = \frac{2s^2+8s+6-3s^2-9s+s^2+s}{s(s+1)(s+3)}$$

$$= \frac{6}{s(s+1)(s+3)}$$

We know that $\frac{Y(s)}{X(s)} = \frac{1}{s+1}$

$X(s) = (s+1)\,Y(s) = \frac{6}{s(s+3)}$

$X(s) = \frac{A}{s} + \frac{B}{s+3} = \frac{2}{s} - \frac{2}{s+3}$

$x(t) = 2[1-e^{-3t}]\,u(t)$

08. Ans: (a)

Sol: No nonlinear operator is appearing in the given difference equation. So, it is a linear system

x(n) is multiplied with 'n', so it is a time variant.

For a bounded input system producing unbounded output. So, it is a unstable system.

09. Ans: (c)

Sol: Given $h(n) = (0.8)^n\,u(n)$

$$H(z) = \frac{1}{1-0.8z^{-1}}$$

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

$$y(\infty) = \underset{z\to 1}{Lt}(1-z^{-1})X(z)H(z)$$

$$= \underset{z\to 1}{Lt}\frac{4}{1-0.8z^{-1}} = \frac{4}{0.2} = 20$$

10. Ans: (b)

Sol: $X(f) = \frac{1-\cos 2\pi f}{2} = \frac{1}{2} - \frac{1}{4}e^{j2\pi f} - \frac{1}{4}e^{-j2\pi f}$

$$\delta(t-t_0) \xleftarrow{FT} e^{-j2\pi f(t_0)}$$

$$x(t) = \frac{1}{2}\delta(t) - \frac{1}{4}\delta(t+1) - \frac{1}{4}\delta(t-1)$$

$$x(t) = 0.5\delta(t) - 0.25[\delta(t+1)+\delta(t-1)]$$

11. Ans: (d)

Sol: (a) $a_0 = \frac{1}{2}\int_0^1 2\pi dt = \frac{2\pi}{2} = \pi$. So, option (a) is correct

(b) $T_0 = 2\,\text{sec}$. So, option (b) is correct

(c) $a_n = \frac{2}{2}\int_0^1 2\pi\cos(n\pi t)dt = \left.\frac{2\pi\sin(n\pi t)}{n\pi}\right|_0^1$

$$= \frac{2}{n}(\sin(n\pi)-\sin(0)) = 0$$

$$b_n = \frac{2}{2}\int_0^1 2\pi\sin(n\pi t)dt = 2\pi\left.\frac{-\cos(n\pi t)}{n\pi}\right|_0^1$$

$$= \frac{-2}{n}[(-1)^n-1] = \frac{2(1-(-1)^n)}{n}$$

$a_1 = 0$, $b_1 = 4$, so $d_1 = 4$.

So, option (c) is correct

(d) It contains odd harmonics.

So, option (d) is wrong

12. Ans: (c)

13. Ans: (b)

Sol: By apply KCL at inverting terminal

$$\frac{1}{10k} + \frac{2}{20k} + \frac{3}{30k} = \frac{-V_0}{30k}$$

$$\frac{6+6+6}{60k} = \frac{-V_0}{30k}$$

$V_0 = -9V$.

14. Ans: (b)

Sol: The pass band gain of this circuit is

$$A = \left|\frac{-R_f}{R}\right| = \frac{10000}{100} = 100$$

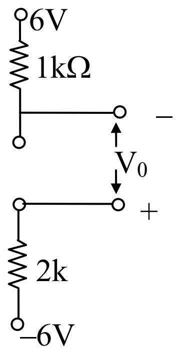
GBWP is constant,

$10^6 = 100 \times BW$

$\rightarrow BW = 10kHz$.

15. Ans: (d)

Sol: Both the diodes are in R.B



$V_0 = -6 - (6)$

$= -12V.$

16. Ans: (b)

Sol: As $\beta \to$ very large

$I_E \approx I_C = 1.3mA$

$V_{EC} = 10 - 1.3 - 13$

$= -4.3V$

$V_E = -1.3V, V_C = 3V, V_B = -2V$

As $V_C > V_B \Rightarrow J_C \Rightarrow$ FB

Saturation region.

17. Ans: (b)

Sol: **Case (i):** If output is taken at node 'C', the circuit becomes a CE amplifier with un bypassed emitter resistor. Under these conditions.

$R_i = h_{ie} + (1 + h_{fe}) R_E$

$$R_0 = \frac{1}{h_{0e}}$$

Case(ii): If output is taken at node 'E' instead of node 'C', the circuit becomes a CC amplifier (Emitter follower). Under these conditions,

$R_i = h_{ie} + (1 + h_{fe}) R_E$

$$R_0 = \frac{h_{ie}}{1 + h_{fe}}$$

$\therefore$ Input resistance remains same, but output resistance decreases.

18. Ans: (b)

19. Ans: (c)

Sol: 1. Current gain in Emitter Follower (CC) amplifier, $A_I = 1 + h_{fe}$

2. R_i is very high and R_0 is very low in CC amplifier, it is considered as a voltage amplifier

3. The phase shift between input and output signals in CC amplifier is zero

4. In CC Amplifier, the un bypassed 'R_E' (load), provides voltage series feedback

20. Ans: (b)

Sol: A = 60dB = 20logA

$A = 10^3$

$$Z_{of} = \frac{Z_0}{1 + \beta A}$$

$$1 + \beta A = \frac{12000}{500} = 24$$

$\beta A = 23$

$\beta = 2.3\%$

21. Ans: (d)

22. Ans: (d)

Sol: MM Bandwidth = 1 GB/s

10^9 Bytes $\Rightarrow$ 1 sec

2^7 Bytes $\Rightarrow$ 2^7 ns

Total time

= MM latency + Data transfer time

= 64 ns + 128 ns

= 192 ns

23. Ans: (b)

Sol: k bit comparator delay is $\frac{120}{k}$ ns

Size of tag field is 8 bit

So, tag comparator delay is $\frac{120}{8}$ ns

= 15 ns and 2-way set Associative map needs one 2×1 multiplexer.

So, total Hit latency time = 15 + 3

= 18 ns

24. **Ans: (c)**
Sol:

Tag	Set offset	Word offset
16	12	4

⟵ 32 ⟶

25. **Ans: (c)**
Sol: It doesn’t increase the I/O transfer rate.

26. **Ans: (c)**

27. **Ans: (d)**

28. **Ans: (b)**

29. **Ans: (d)**

30. **Ans: (d)**

31. **Ans: (a)**
Sol: Before compilation, some sort of processing is carried out known as pre-processing. In pre-processing stage, all macro calls are substituted with their corresponding macro body.
S = 5+1*5+1;
S = 11

32. **Ans: (a)**

33. **Ans: (d)**
Sol: Socket is a logical end point consists of port number and logical address

34. **Ans: (b)**
Sol:

- Digital signature provides message integrity, authentication and non-repudiation. Digital signature cannot provide confidentiality for the message.

If confidentiality is needed, a cryptosystem must be applied over the scheme. (Message confidentiality means that the sender and the receiver expect privacy; Message integrity means that the data must arrive at the receiver exactly as sent; Message authentication means that the receiver is ensured that the message is coming from the intended sender, not an imposter).

Digital Signatures (or) Non-repudiation Protocol

- Non-repudiation means that a sender must not be able to deny sending a message that he sent.

35. Ans: (b)

36. Ans: (c)

37. Ans: (b)

38. Ans: (a)

Sol: $$H(X)=\int_{-\infty}^{\infty} f_x(x)\log_2\left(\frac{1}{f_X(x)}\right)dx$$

$$f_X(x)=\begin{cases}\frac{1}{a}; & \frac{-a}{2}<x<\frac{a}{2}\\ 0; & \text{otherwise}\end{cases}$$

Entropy, H(X) =

$$\int_{-a/2}^{a/2}\frac{1}{a}\log_2\left(\frac{1}{\left(\frac{1}{a}\right)}\right)dx=\log_2^a$$

39. Ans: (c)

Sol: The phase deviation $\phi(t)$ produced by the modulated signal

$$= k_p\,x(t) = 4\times 3\sin 2\pi\times 2\times 10^3 t$$

$\therefore\ \phi(t) = 12\sin 4\pi\times 10^3 t$

If the modulated signal

$x_c(t) = A_c\cos(\omega_c t+\phi(t))$,

the instantaneous frequency f_i is given by

$$f_i=\frac{1}{2\pi}\frac{d}{dt}[\omega_c t+\phi(t)]$$

$$=\frac{1}{2\pi}\frac{d}{dt}[\phi(t)]+\frac{1}{2\pi}[\omega_c]$$

$$\therefore f_i = f_c+\frac{1}{2\pi}\frac{d}{dt}\left[12\sin 4\pi\times 10^3 t\right]$$

$$= f_c+\left(24\times 10^3\right)\cos\left(4\pi\times 10^3\right)t$$

$\therefore$ Peak frequency deviation of the carrier is $\Delta f = 24\times 10^3\text{Hz} = 24\text{kHz}$

40. Ans: (a)

Sol: We have,

$\underset{FM}{x(t)} = A_c\cos[\omega_c t+\beta_f\sin 2\pi f_m t]$

$\therefore$ Phase advance / retardation produced at any instant 't' is given by $\phi(t) = \beta_f\sin 2\pi f_m t$

Obviously, the maximum value of this is,

$$\beta_f=\left(\frac{\Delta f}{f_{m1}}\right)$$

$$\Rightarrow |\phi(t)|_{max}=\beta_f=\frac{50\times 10^3}{5\times 10^3}=10\text{ radians.}$$

In the second case, Δf remains the same as the amplitude of the new modulating signal is same as that of the previously used modulating signal

$$\therefore \beta_{f_2}=\frac{\Delta f}{f_{m_2}}=\frac{50\times 10^3}{1\times 10^3}=50$$

41. Ans: (b)

42. Ans: (b)

Sol: Band width of FM = $2(\beta+1)f_m$

For WBFM $\beta >> 1$ so Bandwidth $\approx 2\beta f_m$

$\beta=\frac{BW}{2f_m}$ f_m is constant.

As transmission bandwidth increases, β also increases proportionally. Thus if bandwidth is doubled β also gets doubled.

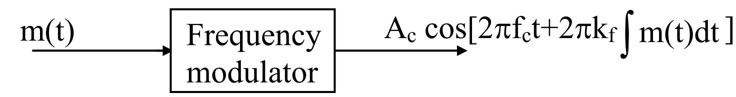
But figure of merit of FM

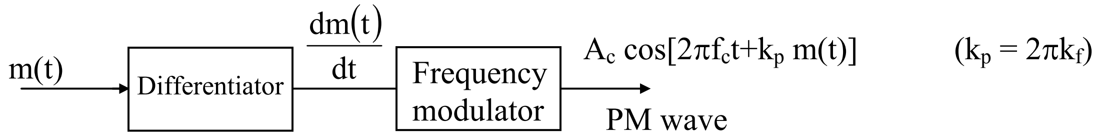
$$FOM=\frac{SNR_{O/P}}{SNR_{I/P}}=\frac{3}{2}\beta^2$$

Thus when β is doubled FOM increases four fold.

43. Ans: (b)

Sol: PM can be generated using FM signal:





44. Ans: (d)

Sol: Local oscillator frequency $(f_0) = f_s + IF$

Where,

f_s = AM receiver signal tuning range = 555 kHz to 1605kHz

IF = Intermediate frequency = 455kHz

$\therefore$ f_0 ranges from (555 + 455) kHz to (1605 + 455) kHz

i.e., from 1010kHz to 2060kHz

$\therefore (f_0)_{max} = 2060$kHz and

$(f_0)_{min} = 1010$kHz

Since the frequency of the oscillator is inversely proportional to the square-root of the tank circuit capacitance,

$$\left(\frac{C_{max}}{C_{min}}\right) = \left[\frac{(f_0)_{max}}{(f_0)_{min}}\right]^2$$

$$= \left(\frac{2060}{1010}\right)^2 = (2.04)^2 = 4.16$$

45. Ans: (d)

46. Ans: (a)

Sol: Since auto-correlation is an inverse Fourier transform of PSD

ACF, $R_n(\tau) = \frac{N_0}{2}\delta(\tau)$

47. Ans: (a)

Sol: Channel stopper implementation is done before growing the field oxide. Channel stopper implant increases the threshold voltages of channel under FOX.

48. Ans: (b)

Sol: Clock period $= \frac{1}{10} \times 10^{-9}$ =100 ps

Clock period

= delay of longest stage + buffer delay

buffer delay = 100 – 90

= 10 ps

49. Ans: (c)

Sol: No. of nodes (n) = 10

Total Single Stuck at Faults = 2n = 20

Number of detectable faults = 20 – 6 = 14

Fault coverage =

$$\frac{\text{Number of detectable faults}}{\text{total no. of faults}} = \frac{14}{20} = 70\%$$

50. Ans: (b)

Sol: IPC is called throughput, not CPI.

51. Ans: (b)

52. Ans: (b)

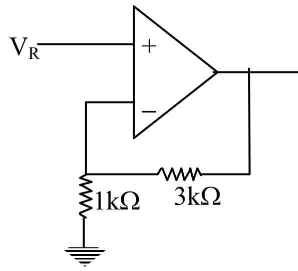
Sol: $f(A,B,C,D) = \prod M(6,7,8,9) + \prod d(10,11,12,13,14,15)$

AB \ CD	00	01	11	10
00				
01			0	0
11	X	X	X	X
10	0	0	X	X

$f(A,B,C,D) = \overline{A}(\overline{B} + \overline{C})$

53. Ans: (d)

Sol:



$V_0 = V_R\left(1+\frac{3}{1}\right)$

$V_0 = 4V_R$

54. Ans: (a)

Sol: The multiplexer inputs $I_0 = a$, $I_1 = \bar{a}_1$, $I_2 = \bar{a}$, $I_3 = a$, with selection lines $S_1 = b$, $S_0 = c$

$Y = I_0\bar{S}_0\bar{S}_1 + I_1\bar{S}_1S_0 + I_2S_1\bar{S}_0 + I_3S_1S_0$

$Y = a\bar{c}\bar{b} + \bar{a}\bar{b}c + \bar{a}b\bar{c} + abc$

$Y = \sum m\,(1, 2, 4, 7)$

Full Adder

a	b	c	Sum	Carry
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

$Sum = \sum m(1, 2, 4, 7)$

The multiplexer circuit equivalent to sum equation of full adder.

55. Ans: (a)

Sol: $f(X + Y, Y) = X + Y + Y = X + Y$

$f(f(X + Y, Y), Z) = X + Y + Z$

56. Ans: (b)

Sol: We have the boolean expression as

$Z = x\oplus y\oplus xy$

On minimizing the expression we have

$Z = x\oplus y\oplus xy$

$= x\oplus\left[y\left(\overline{xy}\right)+\bar{y}xy\right]$

$= x\oplus\left[y\left(\bar{x}+\bar{y}\right)+0\right]$

$= x\oplus\left[y\bar{x}+0\right]$

$= x\,\overline{y\bar{x}} + \bar{x}\;y\bar{x}$

$= x\left(\bar{y}+x\right)+\bar{x}\,y$

$= x + x\bar{y}+\bar{x}\,y$

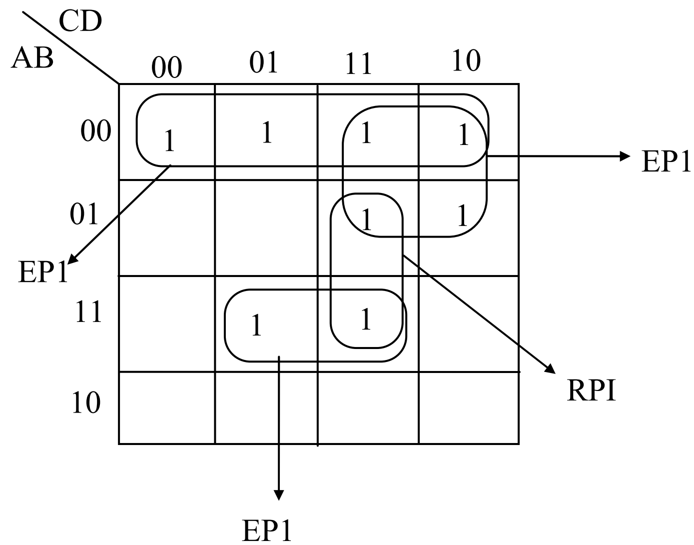
$= x\left(1+\bar{y}\right)+\bar{x}\,y$

$= x + \bar{x}\,y$

$Z = x+y$

57. Ans: (a)

Sol: For the given function, we have the k-map representation as shown below



$\therefore$ No. of redundant prime implicant is '1'

58. Ans: (c)

59. Ans: (b)

Sol: Accumulator = 11010100 (-43_{10})

RLC ----	10101001	cy = 1
RRC ----	11010100	cy = 1
RAL ----	10101001(-86_{10})	cy = 1

60. Ans: (a)

Sol: The operations for the given instruction set are explained below

MVI A, 07H	;	A = 00000 111
RLC	;	A = 0000 111 0
MOV B,A	;	A→ B = 0000 1110
RLC	;	A = 000 111 00

RLC ; A = 00 111 000
ADD B ; A+B → A = 01000
110 = 46H

61. Ans: (d)

Sol: For 8255 chip to get selected, $\overline{CS} = 0$

$\Rightarrow A_7\ A_6\ A_5\ A_4\ A_3 = 1\ 0\ 0\ 1\ 1$ and A_2 , A_1 & A_0 can be any value. Thus the range is as shown below

A_7	A_6	A_5	A_4	A_3	A_2	A_1	A_0	
1	0	0	1	1	0	0	0	→ 98H
1	0	0	1	1	1	1	1	→ 9FH

Hence, the range of address is 98H to 9FH.

62. Ans: (c)

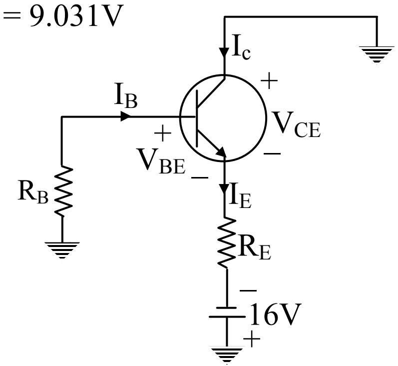
Sol: Assume active region

$I_C = \beta I_B \to I_B = 46\mu A$

$16 = V_{CE} + I_E R_E$

$\quad = V_{CE} + (1+\beta) I_B R_E$

$\to V_{CE} = 9.031V$



So that the emitter-Collector junction is in reverse bias

$16 = I_B R_B + V_{BE} + (1+\beta)\ I_B\ R_E$

$\to V_{BE} = 0.751V$

63. Ans: (d)

Sol: $D_1 \to RB \Rightarrow$ open, $D_2 \to FB$

$\Rightarrow$ short hence $R_{EQ} = 10k\Omega$

64. Ans: (d)

Sol: $R = \frac{L}{\sigma_n A} \rightarrow \sigma_n = 2551 ℧/m$

$\sigma_n \approx N_D q\mu_n \rightarrow N_D = 4.2 \times 10^{22}$ donors/m^3

Doping rate $= \frac{4.2\times10^{28}}{4.2\times10^{22}} = 1\times10^6$

$\Rightarrow$ 1 donor atom added for every 10^6 Ge atoms

65. Ans: (c)

Sol: It is due to diffusion of carriers, but not drift.

66. Ans: (b)

Sol: Since, doping efficiency = $\frac{n}{N_D}$

Given % $\frac{n}{N_D} = 90\% \Rightarrow n = 0.9N_D$ ----(1)

Since $\sigma_n = nq\mu_n$ and

$R_n = \frac{\rho_n L_n}{A_n} = \frac{L_n}{\sigma_n A_n} = \frac{L_n}{nq\mu_n A_n}$

$n = \frac{L_n}{q\mu_n R_n A_n}$ ------(2)

Given $R_n = 2k\Omega$, $A_n = 10^{-8}cm^2$,

$\ell_n = 200\mu cm$, $\mu_n = 8000cm^2/sec$

So by substituting all these values in equation (2) & solving from (1) & (2) we get $N_D \cong 8.7\times10^{15}/cm^3$

67. Ans: (a)

Sol: Given number of photons incident = 8×10^6

Quantum efficiency of PIN = 86%

$\therefore \eta_e = Q_e = 0.86$

$\therefore Q_e = \frac{\text{no.of EHPs generated}}{\text{no.of photons incident}}$

No. of EHPs generated = $0.86\times8\times10^6$

$= 6.88\times10^6$

Given $E_{G_{GaAS}} = 1.47eV$

Since, $E_G = \frac{12400}{\lambda(A^0)}$

$\Rightarrow \lambda_{[A^0]} = \frac{12400}{1.47} = 8435.37A^0 = 0.843\mu m$

68. Ans: (c)

Sol: Given $\phi_m = 4.1eV$, $\phi_s = 5.1eV$

Voltage acting across the MOS capacitance is 1V (5.1 – 4.1 = 1eV)

Inversion charge (Q) = $C_g (V - V_T)$

Q = 1fF (1 – 0.5) = 0.5 fC

69. Ans: (a)

Sol: BJT in CB mode having lowest input impedance and highest output impedance CE mode having moderate input impedance and moderate output impedance FET having high input impedance compare to BJT.

MOSFET having high input impedance compare to JFET

70. Ans: (b)

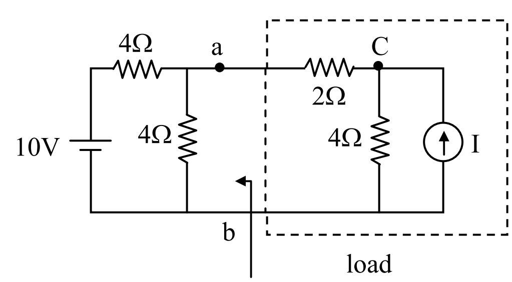
71. Ans: (d)

Sol: We can use MOSFET as LOAD RESISTOR, but not BJT

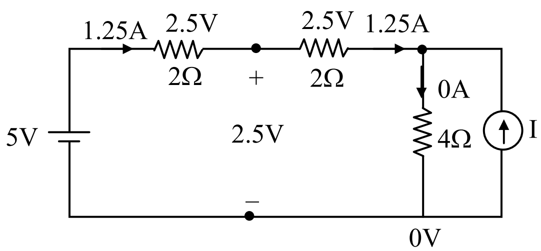
72. Ans: (b)

73. Ans: (a)

Sol:



Above circuit can be drawn as below



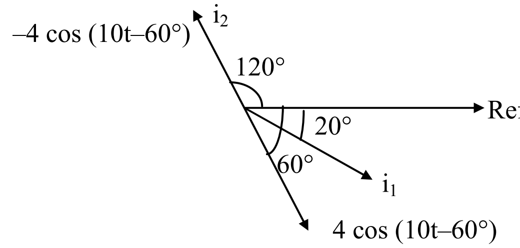
The value of current for which maximum power transfer to load will be I = –1.25A

74. Ans: (a)

Sol: $i_1 = 5\cos(10t - 20°)$

$i_2 = -4\sin(10t+30°)$

$= -4\cos(10t - 60°)$



i_2 lags i_1 by $= 360° - 140° = 220°$

75. Ans: (b)

Sol: Since flux linkages remain constant, there is no induced voltage in the coil. Hence power received by the coil = 2×0 = 0

76. Ans: (b)

Sol: The dual of resistance (R) is conductance (G) will remain the same value.

77. Ans: (c)

Sol: By Applying KVL,

$V = 5(i - 10) + 40$

$= 5i - 10$

78. Ans: (a)

79. Ans: (c)

80. Ans: (a)

Sol: Number of nodes (n) = 500

Number of branches (b) = 800

Number of tie-sets

= Number links (or) loops

$= b - n + 1$

$= 800 - 500 + 1$

$= 301$

Number of cut-sets

= Number of tree branches.

$= n - 1$

$= 500 - 1$

$= 499$

81. Ans: (a)

Sol: We have $R/L = \omega_r / Q_r$ and $1/2\pi = f_r / \omega_r$.

$$BW = \frac{R}{2\pi L} = \frac{f_r}{\omega_r}\frac{\omega_r}{Q_s} = \frac{f_r}{Q_s}$$

82. Ans: (b)

Sol: **Series Motor:** At no load, the speed of the motor is dangerously high. So series motor is not used in those applications where there is a possibility of no load.

Shunt Motor: The speed of shunt motor is almost constant (5-10% speed regulation) w.r.t. load.

Cumulative compound Motor: Definite no-load speed because of the presence of shunt field winding.

83. Ans: (b)

Sol: As the induction motor is self starting machine, the starting torque is not zero and it is very low value.

84. Ans: (a)

Sol: **V-curve:** (Armature current (I_a)) Vs (Field current (I_f) or Excitation)

Inverted V-curve: (Power factor (pf)) Vs (Field current (I_f) or Excitation)

85. Ans: (c)

Sol:

(i) Damper bars are used to increasing synchroning stability limit in alternators and also starting purpose in synchronous motors.

(ii) Rotor bars are present in induction motors.

(iii) Commutator converts the A.C voltage [induced in armature] to D.C and vice verse in dc machines

86. Ans: (b)

Sol: Connected Load = 2kW

Maximum demand = 1.5 kW

Demand factor

$$= \frac{\text{Maximum demand of station}}{\text{Connected load of the station}}$$

$$= \frac{1.5}{2} = 0.75$$

87. Ans: (d)

Sol Diversity factor

$$= \frac{\text{Max. demand of all generating stations}}{\text{Max. demand of system}}$$

$$= \frac{15000 + 12000 + 8500 + 6000 + 450}{22000}$$

$= 1.91$

88. Ans: (b)

Sol: $B_{max} \propto \frac{V_1}{f}$, as f is reduced the B_{max} demand increases. Hence the magnetizing component current demand increases, which may damage the Transformer due to increased resultant current.

Hence $\frac{V_1}{f}$ must be maintained constant.

$$\frac{V_{11}}{f_1} = \frac{V_{12}}{f_2} \Rightarrow V_2 = \frac{230}{50} \times 100 = 460V$$

89. Ans: (c)

Sol: Efficiency $\eta = \frac{kVA_{out} \times P.f}{kVA_{out} \times P.f + W_i + W_{cu}}$

Let P.f = unity,

$$\eta_{full\ load} = \frac{100 kVA \times 1}{100 kVA \times 1 + W_i + W_{cu}} \text{ …….. (i)}$$

$$\eta_{half\ load} = \frac{50 kVA \times 1}{50 kVA \times 1 + W_i + \frac{1}{4} W_{cu}} \text{ ….. (ii)}$$

Solving (1) & (2) $W_{cu} = 2\ W_i$

90. Ans: (d)

Sol: The slip of induction motor depends on speed of rotor; synchronous speed of RMF and shaft torque and it is independent of Iron loss component.

91. Ans: (d)

Sol: Power input to rotor of main induction motor = P_{GM}

Gross mechanical o/p power (P_0) = (1 − s) P_{GM}

$\therefore P_{GM} = [P_0/(1-s)]$

Slip power recovered = s P_{GM}

$$= s\frac{P_o}{1-s}$$

$$= P_o \frac{s}{(1-s)}$$

92. Ans: (c)

Sol: Nuclear is base plant since it is uncontrollable.

Power plants for which output power depends on environmental aspects are to be chosen as base plants like wind forms and run off river plant

93. Ans: (c)

Sol: Iron is a metal, its resistivity is the lowest, where as mica is an insulator with highest resistivity. As pure silicon is an intrinsic semiconductor whose resistivity is slightly higher than the doped silicon which has more charge carrier in it.

94. Ans: (a)

Sol: Stripped metal nanowires of alternative metal like Au & Ag can be used as barcode. Au as '0' and Ag as '1', so 0001010, 01011101, 11010001 there are all different barcodes.

95. Ans: (c)

Sol: Polarization $P = \epsilon_0 E(\epsilon_r - 1)$

$$P = N\ \alpha\ E$$

$$N\ \alpha\ E = \epsilon_0 E\ (\epsilon_r - 1)$$

$$\epsilon_r - 1 = \frac{N\alpha}{\epsilon_0}$$

$$\chi_e = \frac{N\alpha}{\epsilon_0}$$

96. Ans: (c)

Sol: Since eddy current losses are inversely proportional to resistivity, so eddy current losses decreases by a factor of four.

97. Ans: (c)

Sol: The dielectric strength of ferroelectric material depends to a large extent on intensity of electric field applied.

98. Ans: (a)

Sol: Iron gets magnetized faster but loses its magnetism as soon as the inducing magnet is removed. Hence soft iron is said to have high susceptibility but low retentivity.

99. Ans: (c)

Sol: Shortest distance between two atoms in face centered cubic structure =

$$2R = \frac{\sqrt{2}a}{2} = \frac{a}{\sqrt{2}}$$

100. Ans: (b)

Sol: Inter planar distance (d)

$$= \frac{1}{\sqrt{\left(\frac{h}{a}\right)^2 + \left(\frac{k}{b}\right)^2 + \left(\frac{\ell}{c}\right)^2}}$$

101. Ans: (a)

102. Ans: (d)

103. Ans: (b)

Sol: $TF = \frac{2}{s^2+3s+2}$

$= \frac{2}{(s+1)(s+2)}$

$\frac{C(s)}{R(s)} = \frac{2}{(s+1)(s+2)}$

Real and unequal roots, then system is over damped.

For step input, $R(s) = \frac{1}{s}$

$C(s) = \frac{2}{s(s+1)(s+2)}$

Initial value = c(0) = $\underset{s\to\infty}{Lt}\, sC(s) = 0$

Final value = c(∞) = $\underset{s\to 0}{Lt}\, \frac{2s}{s(s+1)(s+2)} = 1$

104. Ans: (a)

Sol: We can use routh Hurwitz criteria for system stability studies

C E = $s^2 + (K-1)s + 3K = 0$

s^2	1	3 K
s^1	K–1	0
s^0	3K	

$K - 1 > 0$

$3K > 0$

$K > 1$

105. Ans: (a)

Sol: Given circuit is lag network

$TF = \frac{1+\tau s}{1+\beta\tau s}$

$\omega_1 = \frac{1}{\beta\tau} \quad \omega_2 = \frac{1}{\tau} \quad \left[\tau = R_1C, \beta = \frac{R_1+R_2}{R_1}\right]$

$\omega_1 = \frac{\omega_2}{\beta} = \omega_2\left(\frac{R_1}{R_1+R_2}\right)$

$\omega_2 = \frac{1}{R_1C}$

106. Ans: (b)

Sol: If X is open

$G(s) = \frac{K}{s(s+a)}$

$K_V = \underset{s\to 0}{Lt}\, sG(s) = \frac{K}{a}$

$e_{ss} = \frac{1}{\frac{K}{a}} = \frac{a}{K}$ for unit ramp input

Characteristic equation $s^2 + as + K = 0$

$\omega_n = \sqrt{K}$ rad/sec

$2\xi\omega_n = a$

$\xi = \frac{a}{2\sqrt{K}}$

If X is closed

$$G(s)=\frac{K}{s^2+s(a+K_tK)}$$

$$=\frac{K}{s(s+a+KK_t)}$$

$$e_{ss}=\frac{1}{\frac{K}{(a+KK_t)}}=\left(\frac{a+KK_t}{K}\right)$$

Characteristic equation

$s^2 + s(a+KK_t) + K = 0$

$\omega_n=\sqrt{K}\,r/sec$

$2\xi\omega_n = a + KK_t$

$$\xi=\left(\frac{a+KK_t}{2\sqrt{K}}\right)$$

Both e_{ss} and ξ increases

107. Ans: (b)

108. Ans: (c)

Sol: To find the transfer function, all the initial conditions of the system is zero

$$L\left[\frac{d^3y}{dt^3}+6\frac{d^2y}{dt^2}-5\frac{dy}{dt}+10y\right]=2\frac{dx}{dt}$$

$$(s^3+6s^2-5s+10)Y(s)=2sX(s)$$

$$\frac{Y(s)}{X(s)}=\frac{2s}{s^3+6s^2-5s+10}$$

109. Ans: (c)

Sol:
$$\frac{C(s)}{R(s)}=\frac{G_1G_2}{1-G_1G_2}(G_3-x)$$

$$=\frac{G_1G_2G_3}{1-G_1G_2}-\frac{xG_1G_2}{1-G_1G_2}$$

$$=\frac{G_1G_2G_3}{1-G_1G_2}-1$$

$$\frac{C(s)}{R(s)}=\frac{G_1G_2G_3-1+G_1G_2}{1-G_1G_2}$$

110. Ans: (b)

Sol:
$$\frac{N_5}{N_3}=\frac{2\times3\times4\times\{1+5\}}{2\times\{1+12+5+60\}}=\frac{12}{13}$$

111. Ans: (c)

Sol:
$$\frac{4s+5}{s}=4+\frac{5}{s}=4\left[1+\frac{5}{4s}\right]$$

$$=4\left[1+\frac{1}{\frac{4}{5}s}\right]$$

$$=4\left[1+\frac{1}{0.8s}\right]$$

$$=4\left[1+\frac{1}{T_Is}\right]$$

$\therefore T_I =$ reset time = 0.8 sec

112. Ans: (a)

113. Ans: (a)

114. Ans: (a)

115. Ans: (b)

Sol: Sensitivity of voltmeter (S) = 2kΩ/V

Voltmeter range = (0 – 200 V)

$\therefore$ R of voltmeter = R_v = 200 V × 2kΩ/V

$\Rightarrow R_v$ = 400 kΩ

R_v is connected parallel to 200 kΩ resistance

$$\therefore R_{eq}=\frac{200k\Omega\times400k\Omega}{(200+400)k\Omega}=133.33k\Omega$$

$$\text{voltmeter reading (V)}=\frac{R_{eq}}{100+R_{eq}}\times150$$

$$\Rightarrow V=\frac{133.3}{133.3+100}\times150$$

V = 85.7 V

116. Ans: (d)

Sol: From the figure

$\theta = \sin^{-1}\left(\frac{2.5}{5}\right)$

$\theta = 30°$

Phase displacement (ϕ)

$= 180-\theta$ or $180+\theta$

($\because$ the pattern is in 2nd and 4th quadrates)

$\Rightarrow \phi = 180 - 30$ or $180 + 30°$

$= 150°$ or $210°$

$\phi = 150$ if the pattern moves in clockwise direction

$\phi = 210°$ if the pattern moves in anti clockwise direction.

117. Ans: (c)

118. Ans: (b)

Sol: A 4½ DVM has 4 full digits and one half digit. Resolution on a 10V scale is

$=10\left[\frac{1}{10^4}\right] = \frac{10}{10^4} = \frac{1}{10^3} = 0.001\text{V}$

Display on such a $4^{\frac{1}{2}}$ DVM on a 10V scale will be of the form

XY.ABC

Range of

X – 0 →1 (Half digit)

Y, A, B, C – 0 → 9 (Full digits)

119. Ans: (c)

Sol: In a 1ϕ energy meter, the speed of rotation of disc is given by

$N\alpha\phi_1\phi_2$ [ϕ_1 = Flux due to voltage coil]

[ϕ_2 = Flux due to current coil]

So when flux of either coil is reversed then the disc of energy meter rotates in opposite direction.

But when the fluxes of both the coils are reversed then the direction of rotation remains the same

120. Ans: (c)

Sol: Flash type ADC has highest speed, uses maximum number of comparators as compared to other ADCs.

121. Ans: (b)

Sol: (1) 110 Ω is in between 109 Ω and 111 Ω

(2) 110.0 is in between 109.9 Ω and 110.1 Ω

(3) 0.000110 M Ω is in between 0.000109 M Ω and 0.000111M Ω

$\therefore$ (2) represents greater precision while (1) and (3) represents same precision

122. Ans: (a)

Sol: A linear variable differential transform LVDT is a displacement transducer

123. Ans: (d)

Sol: **Passive transducers:**

Photo emissive cell

Photo diode

Photo transistor

Active transducers:

Photo-voltaic cell

124. Ans: (b)

Sol: As dielectric interface is perpendicular to the metal plates and hence this configuration is equivalent to parallel combination of two capacitors.

$C_{equ} = C_1 + C_2$

$$= \frac{\varepsilon_0 (A/2)}{d} + \frac{\varepsilon_0\varepsilon_r (A/2))}{d}$$

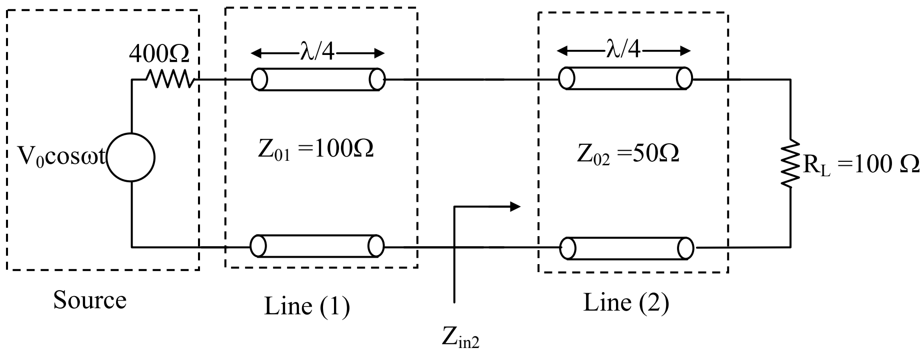
$$= \frac{\varepsilon_0 A}{2d}(1+\varepsilon_r)$$

$$= \frac{C_0}{2}(1+\varepsilon_r)$$

$$\therefore C_{equ} = \frac{C_0}{2}(1+\varepsilon_r)$$

125. Ans: (b)

Sol:



When switch was open

$$Z_{L_1} = Z_{in_2} = \frac{Z_{0_2}^2}{Z_L} = \frac{50^2}{100} = 25\Omega$$

$\therefore$ For line 1 , $VSWR_1 = \dfrac{Z_{01}}{Z_{in_2}} = \dfrac{100}{25} = 4$

$\therefore$ For line 2 , $VSWR_2 = \dfrac{R_L}{Z_{02}} = \dfrac{100}{50} = 2$

(Note: If both Z_0 and Z_L are real then we can find out VSWR just by taking ratio of either $\dfrac{Z_0}{Z_L}$ or $\dfrac{Z_L}{Z_0}$ whichever is greater than 1)

126. Ans: (a)

Sol: Volume charge density, $\rho_V = \nabla.\overline{D}$

$$\nabla.\overline{D} = \frac{\partial}{\partial x}\left(2y^2 + z\right) + \frac{\partial}{\partial y}\left(4xy\right) + \frac{\partial}{\partial z}\left(x\right)$$

$$= 0 + 4x + 0 = 4x$$

So, $\rho_{V\,at(-1,0,3)} = \left(\nabla.\overline{D}\right)_{at\,(-1,0,3)}$

$$= 4 \times -1 = -4C/m^3$$

127. Ans: (b)

Sol: A material is said to be linear if $\overline{D}$ varies linearly with $\overline{E}$ Materials for which ε (or σ) does not vary in a region being considered and is therefore the same at all points (i.e. independent of x, y, z) are said to be homogeneous.

128. Ans: (a)

Sol: An air line can be regarded as a lossless line. So, R=0=G and α=0

$$R_0 = \sqrt{\frac{L}{C}} \text{ and } \beta = \omega\sqrt{LC}$$

$$\frac{R_0}{\beta} = \frac{1}{\omega C}$$

$$\Rightarrow C = \frac{\beta}{\omega R_0}$$

$$= \frac{3}{2\pi \times 10 \times 10^6 \times 100}$$

$$= \frac{1.5}{\pi} \text{nF/m}$$

129. Ans: (c)

Sol: a = 2cm

$$f_c = \frac{c}{2a} = \frac{3\times10^{10}}{2\times2} = 7.5\,\text{GHz}$$

130. Ans: (a)

Sol: In perfect dielectric medium

$$\frac{E}{H} = \sqrt{\frac{\mu}{\in}}\angle 0°(\Omega)$$

In medium with finite conductivity

$\frac{E}{H} = \sqrt{\frac{j\omega\mu}{\sigma + j\omega\in}}(\Omega)$ is complex hence has both magnitude and phase

If the medium is good conducting medium.

$$\frac{E}{H} = \sqrt{\frac{j\omega\mu}{\sigma}} = \sqrt{\frac{\omega\mu}{\sigma}}\angle 45°$$

$$E = H\sqrt{\frac{\omega\mu}{\sigma}}\angle 45°$$

$\therefore$ E-fields leads H-field by 45°

131. Ans: (c)

132. Ans: (d)

Sol: loss tangent $= \frac{\sigma}{\omega\varepsilon}$

$$= \frac{3\times10^{-4}}{2\pi\times6\times10^6\times\frac{10^{-9}}{36\pi}\times3}$$

$$= 0.3$$

133. Ans: (a)

Sol: $T_r = \frac{\varepsilon}{\sigma}$

$$= \frac{6\times8.854\times10^{-12}}{10^{-15}}$$

$$= 6\times8.854\times10^3 \text{ sec}$$

$$= 15\text{hrs}$$

134. Ans: (b)

135. Ans: (a)

136. Ans: (c)

137. Ans: (d)

Sol: Composite materials are formed by physical mixing at two or more chemically unlike materials. Specific properties of composites are different from their individual material properties.

138. Ans: (b)

Sol: Since conductivity in an intrinsic semiconductors is both due to electrons and holes and is given as $\sigma_2 = ne\mu_n + pe\mu_p$, where n and p are electron and hole concentration which are equal but μ_n & μ_p the mobility of e^- and holes are different ($\mu_n > \mu_p$).

139. Ans: (d)

Sol: Power available from wind turbine $\propto V^3$

This will be derived from basics of mechanics it self. This may be true for all types of turbines.

Drag type turbine: It's an example for this type of turbine is savonius turbine.

It is a vertical axis type wind turbine.

It will be used for lower wind speeds with high torque capabilities. This turbine (VAWT) will have low efficiency than HAWT.

140. Ans: (c)

Sol: Propagation delay time is less in schottky transistor because it is not entering in to saturation region. Schottky transistors operate in active region whenever it is ON.

141. Ans: (b)

142. Ans: (b)

143. Ans: (a)

144. Ans: (c)

145. Ans: (d)

146. Ans: (a)

147. Ans: (d)

Sol: ARP is not at transport layer and statement 2 is the definition of ARP

148. Ans:(a)

Sol: In class-B push-pull power amplifier, the Q-pt is established in cutoff region with co-ordinates (V_{CC}, 0), so that both the transistors remains OFF till the input signal amplitude rises upto the cut-in voltage of the transistors. Hence the internal power loss of transistors is minimized.

149. Ans: (a)

Sol: $a^n u(n) \leftrightarrow \frac{z}{z-a}, |z| > |a|$

$-a^n u(-n-1) \leftrightarrow \frac{z}{z-a}, |z| < |a|$

150. Ans: (d)

Sol: $Y(z) = 2X(z) + 4z^{-1}X(z)$

$H(z) = 2 + 4z^{-1}$

$h(n) = \{2, 4\}$

It is a stable system

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