ACE Engineering Academy

Hyderabad | Delhi | Bhopal |Pune | Bhubaneswar | Bengaluru |Lucknow | Patna | Chennai | Vijayawada | Visakhapatnam | Tirupati | Kukatpally| Kolkata

H.O: 204, II Floor, Rahman Plaza, Opp. Methodist School, Abids, Hyderabad-500001,
Ph: 040-23234418, 040-23234419, 040-23234420, 040 - 24750437

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

ELECTRICAL ENGINEERING

FULL LENGTH MOCK TEST – 2 (PAPER – II)

SOLUTIONS

01. Ans: (c)

02. Ans: (b)

Sol: By apply KCL at inverting terminal

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

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

$V_0 = –9V.$

03. Ans: (b)

Sol: The pass band gain of this circuit is

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

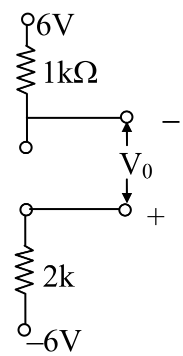
GBWP is constant,

$10^6=100\times BW$

$\rightarrow$ BW=10 kHz.

04. Ans: (d)

Sol: Both the diodes are R.B



$V_0= – 6 –(6)$

$= –12V.$

05. Ans: (b)

Sol: As $\beta \rightarrow$ 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 $V_C > V_B \Rightarrow J_C – FB$

Saturation region.

06. 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 remains same, but output resistance decreases.

07. 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 .

08. Ans: (b)

Sol: $A = 60\text{dB} = 20\log A$

$A = 10^3$

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

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

$\beta A = 23$

$\beta = 2.3\%$

09. Ans: (c)

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

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

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

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

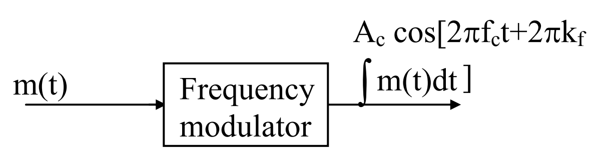
$$= \underset{z\to 1}{Lt}\frac{4}{1-0.8z^{-1}} = \frac{4}{0.2} = 20$$

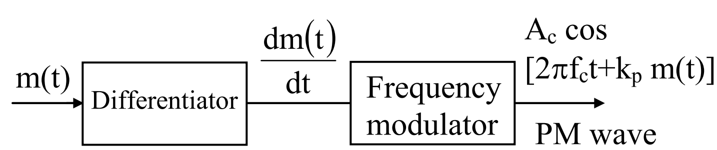
10. Ans: (d)

11. Ans: (b)

12. Ans: (b)

Sol: PM can be generated using FM signal:





13. Ans: (d)

14. Ans: (a)

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

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

15. Ans: (d)

Sol: Given ON state power loss $P_{av} = 150$ W

$\theta_{jc} = 0.01°C/W$, $\theta_{cs} = 0.08°C/W$,

$\theta_{SA} = 0.09°C/W$, and $T_A = 35°C$

$$P_{av} = \frac{T_j - T_A}{\theta_{jA}}$$

$$= \frac{T_j - 35}{\theta_{jc} + \theta_{cs} + \theta_{SA}}$$

$$150 = \frac{T_j - 35}{0.01 + 0.08 + 0.09}$$

$T_j - 35 = 150 \times 0.18$

$T_j = 62°C$

16. Ans: (a)

17. Ans: (d)

Sol: If $\alpha \le 60^0$, The conduction period of Thyristors and diode is 120^0 and conduction period of freewheeling diode is zero.

If $\alpha = 90^0$, the conduction period of Thyristors and diode is 90^0 and free wheeling diode conduction period is 30^0.

18. Ans: (c)

Sol: If induction motor frequency is increased, then slip becomes negative, now the induction motor is operated at 50 Hz frequency. If we suddenly decrease the inverter frequency the motor is operated in regenerative braking mode.

19. Ans: (b)

Sol: $\Delta V_0 = \dfrac{V_m}{\pi}[1 - \cos(\mu)] = 4fL_sI_0$

By increasing the peak magnitude of supply voltage, the change in overlap angle will be decreases.

20. Ans: (d)

21. Ans: (a)

22. Ans: (a)

Sol: $\phi = \tan^{-1}\left(\dfrac{X_C - X_L}{R}\right) = 45^o$

$\therefore$ Each thyristor conducts = 180 – 45

= 135°

23. Ans: (d)

Sol: $N = \dfrac{f_c}{2f} = \dfrac{15000}{2 \times 500}$

= 15

24. Ans: (b)

Sol: The given system can be written as

$$\begin{bmatrix} 1 & 1 & 1 \\ 0 & \lambda+1 & \lambda+1 \\ 0 & 0 & \lambda^2-1 \end{bmatrix}\begin{bmatrix} x \\ y \\ z \end{bmatrix}=\begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

If the system has 2 linearly independent solutions then ρ (A) = 1

$\Rightarrow \lambda = -1$

$\Rightarrow \rho$ (A) = 1

25. Ans: (a)

Sol: If $\left(-1+\sqrt{3}\right)$ is an eigen value of a matrix, then $\left(-1-\sqrt{3}\right)$ is also an eigen value of A.

Let λ be the third eigen value of A. Sum of the eigen values=Trace of A.

$\Rightarrow \left(-1+\sqrt{3}\right)+\left(-1-\sqrt{3}\right)+\lambda = 0$

$\Rightarrow \lambda = 2$

26. Ans: (a)

Sol: $f(x) = 3 + x$ when $x \geq 0$

$= 3 - x$ when $x < 0$

$\underset{x\to 0-}{\text{Lt}} f(x) = \underset{x\to 0}{\text{Lt}} (3-x) = 3$

$\underset{x\to 0+}{\text{Lt}} f(x) = \underset{x\to 0}{\text{Lt}} (3+x) = 3$

f(0) = 3

$\therefore$ f(x) is continuous at x = 0

$$f'(0+) = \underset{h\to 0+}{\text{Lt}} \frac{f(0+h)-f(0)}{h}$$

$$= \underset{h\to 0}{\text{Lt}} \frac{(3+h)-3}{h} = +1$$

$$f'(0-) = \underset{h\to 0-}{\text{Lt}} \frac{f(0+h)-f(0)}{h}$$

$$= \underset{h\to 0}{\text{Lt}} \frac{(3+h)-3}{-h} = -1$$

$\therefore$ f′(0) does not exist

$\Rightarrow$ f(x) is not differentiable at x = 0

27. Ans: (a)

Sol: $I_1 = \int_0^1 \frac{dx}{x^{\frac{1}{3}}} = \frac{2}{3}\left|x^{+2/3}\right|_0^1 = \frac{2}{3}$

$$I_3 = \int_0^1 x \log x \, dx$$

$$= \frac{-1}{4}$$

$$I_2 = \int_{-1}^1 \frac{dx}{x^2}$$

$$= 2\int_0^1 \frac{1}{x^2} = \infty \quad \text{given}$$

I_1 and I_3 are convergent.

28. Ans: (a)

Sol: To evaluate

$\int_C (yz\,dx + zx\,dy + xy\,dz)$, where C is the curve $x^2 + y^2 = 1$ and $z = y^2$ so that dz = 2y dy

$$\int_C yz\,dx + zx\,dy + xy\,dz = \int_C y^3dx + xy^2dy + 2xy^2dy$$

$$= \int_C \left(y^3dx + 3xy^2dy\right)$$

$$= \iint_R \left(3y^2 - 3y^2\right) dxdy$$

$[\text{By Green's Theorem}]$

$$= 0$$

29. Ans: (d)

Sol: For continuous random variable

$$\int_{-\infty}^{\infty} f(x)\,dx = 1$$

$$\Rightarrow \int_0^2 k\left(5x - 2x^2\right)dx = 1$$

$$\Rightarrow k\left[5\left(\frac{x^2}{2}\right)_0^2 - 2\left(\frac{x^3}{3}\right)_0^2\right] = 1$$

$$\Rightarrow k\left(10 - \frac{16}{3}\right) = 1$$

$$\Rightarrow k = \frac{3}{14}$$

$$P(x > 1) = \int_1^{\infty} f(x)\,dx$$

$$= \int_1^2 \frac{3}{14}\left(5(x) - 2x^2\right)dx$$

$$= \frac{3}{14}\left(5\left(\frac{x^2}{2}\right)_1^2 - 2\left(\frac{x^3}{3}\right)_1^2\right)$$

$$= \frac{3}{14}\left(5\left(\frac{3}{2}\right) - \frac{14}{3}\right)$$

$$= \frac{3}{14}\left(\frac{45-28}{2\times 3}\right)$$

$$= \frac{17}{28}$$

30. Ans: (a)

Sol: Variance of uniform distribution $= \dfrac{(b-a)^2}{12}$

$$= \frac{(10-2)^2}{12} = \frac{16}{3}$$

31. Ans: (c)

Sol: Given $x\dfrac{dy}{dx} + y = 0$, $y(2) = -2$

$$x\frac{dy}{dx} = -y$$

$$\Rightarrow \frac{dy}{y} = -\frac{dx}{x}$$

$$\Rightarrow \frac{dy}{y} + \frac{dx}{x} = 0$$

Integrating both sides

$$\int \frac{dy}{dx} + \int \frac{dx}{x} = \int 0$$

$$\Rightarrow \log y + \log x = c$$

$$\Rightarrow xy = c$$

at $x = 2$ and $y = -2 \Rightarrow c = -4$

$\therefore$ The solution is $xy = -4$

32. Ans: (d)

Sol: Given $(D^3 - D)\,y = e^x + e^{-x}$

$$P.I = \frac{1}{(D^3 - D)}\left(e^x + e^{-x}\right)$$

$$= \frac{1}{(D^3 - D)}e^x + \frac{1}{(D^3 - D)}e^{-x}$$

$$= \frac{1}{(1^3 - 1)}e^x + \frac{1}{[(-1)^3 - (-1)]} \text{ [fails]}$$

$$= x\left[\frac{1}{3D^2-1}e^x\right] + x\left[\frac{1}{3D^2-1}e^{-x}\right]$$

$$= x\left[\frac{1}{3(1^2)-1}e^x\right] + x\left[\frac{1}{3(-1)^2}e^{-x}\right]$$

$$= \frac{x}{2}e^x + \frac{x}{2}e^{-x}$$

$$= \frac{x}{2}\left(e^x + e^{-x}\right)$$

33. Ans: (d)

Sol: $\frac{1-\cos z}{z} = \frac{1}{z}\left\{1-\left(1-\frac{z^2}{2!}+\frac{z^4}{4!}-\frac{z^6}{6!}+.....\right)\right\}$

$$= \frac{1}{z}\left\{\frac{z^2}{2!}-\frac{z^4}{4!}+\frac{z^6}{6!}-.....\right\}$$

$$= \frac{z}{2!}-\frac{z^3}{4!}+\frac{z^5}{6!}.......$$

This series has no negative powers of $(z-z_0)$

$\therefore$ z = 0 is removable singularity.

34. Ans: (c)

Sol: Let $f(x) = x^2 - 2 = 0$ and $x_0 = -1$

$f^1(x) = 2x$

$$x_1 = x_0 - \frac{f(x_0)}{f^1(x_0)}$$

$$= x_0 - \frac{(x_0^2-2)}{2x_0}$$

$$= -1.5$$

$x_2 = -1.44$

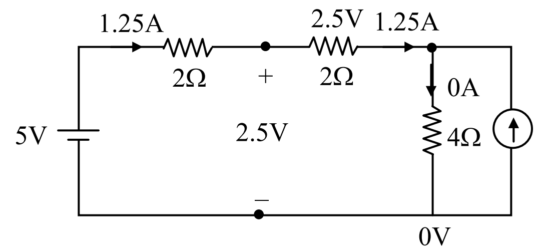
$\therefore$ The iteration convergence to the root $-\sqrt{2}$

35. Ans: (a)

36. Ans: (b)

37. Ans: (a)

Sol: Above circuit can be drawn as below



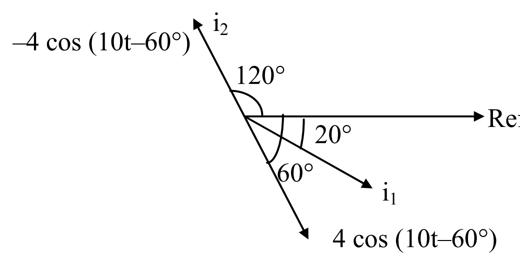
The value of current for which maximum power transfer to load will be I = –1.25A

38. 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°

39. 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.

40. Ans: (b)

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

41. Ans: (c)

Sol: By Applying KVL,

V = 5(i – 10) + 40

= 5i – 10

42. Ans: (a)

43: Ans: (c)

44. Ans: (a)

Sol: Number of nodes (n) = 500

Number of branches (b) = 800

Number of tiesets = Number links (or) loops

= b – n+1

= 800 – 500 + 1 = 301

Number of cutsets = Number of tree branches.

= n – 1

= 500 – 1

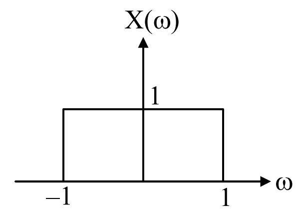
= 499

45. Ans: (a)

46. Ans: (a)

47. Ans: (d)

Sol:



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

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

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

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

48. Ans: (c)

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

49. Ans: (b)

50. 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.

51. Ans: (b)

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

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

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

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

52. Ans: (d)

Sol: $D_1 \rightarrow RB \Rightarrow$ open, $D_2 \rightarrow FB \Rightarrow$ short hence $R_{EQ} = 10k$

53. 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 extrinsic silicon which has more charge carrier in it.

54. 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.

55. Ans: (c)

Sol: Polarization $P = \in_0 E(\in_r - 1)$

$$P = N\alpha E$$

$$N\alpha E = \in_0 E(\in_r - 1)$$

$$\varepsilon_r - 1 = \frac{N\alpha}{\varepsilon_0}$$

$$\chi_e = \frac{N\alpha}{\varepsilon_0}$$

56. Ans: (c)

Sol: Since eddy current losses are also called i^2R losses, they are inversely proportional to resistivity.

57. Ans: (c)

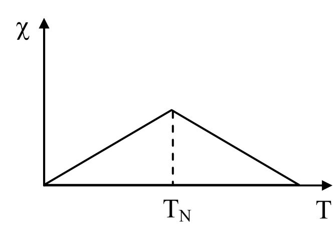
58. Ans: (b)

Sol: The atomic packing factor of BCC is 0.68.

59. Ans: (c)

Sol: Antiferromagnetic material follows Neel's law

$$\chi_e = \frac{C}{T+\theta}$$



60. Ans: (c)

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

61. 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.

62. Ans: (c)

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

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

63. Ans: (b)

Sol: Inter planar distance (d)

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

64. Ans: (b)

65. Ans: (c)

Sol: $P_{max} = \frac{|V_s||V_r|}{|B|} = \frac{(400)^2}{51.97}$

$= 3078.7$ MW

$$\text{SIL} = \frac{V^2}{Z_c} = \frac{(400)^2}{250}$$

$$= 640 \text{ MW}$$

$$\frac{P_{max}}{\text{SIL}} = 4.81046$$

66. Ans: (d)

Sol: (i) $\text{Slope} = \frac{1}{\text{Reach}} = \frac{1}{50} = 0.02 \text{ mho}$

(ii) Radius = Reach = 50 Ω

67. Ans: (d)

Sol: In p.u., the reactance as the same value whether calculated refer lv or refer hv. So the given pu value can be taken to be on a base of 250 MVA (3-ph) and line to line voltage 400 kV.

$$X\text{ (pu)} = \frac{X\ (\Omega)}{X_{base}} = \frac{X(\Omega)}{\left(\frac{kV^2}{MVA}\right)}$$

$$X_\Omega = 0.05 \times \frac{400^2}{250}$$

$$= 32\ \Omega$$

68. Ans: (b)

Sol: In multi machine interconnected system, transient stability can be studied by knowing the solution of swing equation where as Equal area criteria is used study the transient stability of two machine inter connected system but not for multi machine system.

69. Ans: (b)

70. Ans: (d)

71. Ans: (b)

Sol: In a double line-to ground fault Z_1, Z_2, Z_0 all come into the picture.

72. Ans: (a)

73. Ans: (d)

Sol: From the given data, the figure can be drawn as shown below

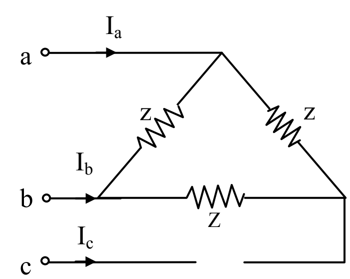
$I_a = 10\angle 0°\text{ A}$

$I_b = 10\angle 180°\text{ A}$

$I_c = 0\text{ A}$

$I_{c_1} = a\,I_{a_1}$

$I_{c_2} = a^2\,I_{a_2}$



$$I_{a_1} = \frac{1}{3}(I_a + aI_b + a^2I_c)$$

$$= \frac{1}{3}(10\angle 0° + 10\angle(180° + 120°) + 0)$$

$$= \frac{1}{3}(10\angle 0 + 10\angle 300)$$

= non-zero

$I_{c_1} = a\,I_{a_1} \rightarrow$ non – zero value

$$I_{a_2} = \frac{1}{3}(I_a + a^2\,I_b + a\,I_c)$$

$$= \frac{1}{3}(10\angle 0° + 10\angle 180° + 240° + 0)$$

$= \frac{1}{3}(10\angle 0° + 10 + \angle 420°)$

= non-zero

$I_{c_2} = a^2 I_{a_2} = \text{non} - \text{zero value}$

'so' option 'd' is correct

74. Ans: (b)

Sol: In Y-bus matrix of a n bus system, if a bus (k) has shunt elements then sum of either k^{th} column elements or k^{th} row elements in Y-Bus matrix is non zero.

Sum of row elements in

Row 1 = j [– 9 + 2.5 +2.5 + 4] = 0

Row 2 = j [2 – 10 + 2.5 + 4] = – 1.5j

Row 3 = j [2.5 + 2–5] = –0.5j

Row 4 = j [0 + 4 + 4 – 8]=0

Hence non zero sum rows are 2 and 3. So bus 2 and bus 3 contains shunt elements.

75. Ans: (d)

76. Ans: (b)

Sol: In impedance relay, the relay operates when impedance seen by it is less than a set value $Z < Z_C$. By universal torque equation,

$K_1 I^2 > K_2 V^2$ ……… (1)

$\frac{I^2}{V^2} > \frac{K_2}{K_1}$

$\frac{V^2}{I^2} < \frac{K_2}{K_1}$

$Z^2 < \frac{K_1}{K_1}$

$Z < Z_C$

∴ From (1) operating torque is produced by current; restraining torque is produced by voltages.

77. Ans: (b)

Sol: F(A,B,C,D) = ∏M(6,7,8,9)

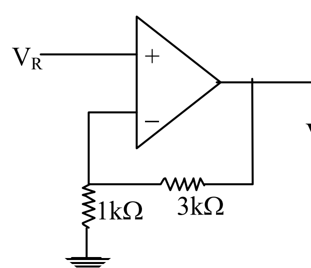
∏d(10,11,12,13,14,15)

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

$F(A,B,C,D) = \overline{A}\left(\overline{B} + \overline{C}\right)$

78. Ans: (d)

Sol:



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

$V_0 = 4V_R$

79. Ans: (b)

Sol: We have the boolean expression as

Z = x ⊕ y ⊕ xy

One minimizing the expression we have

Z= x⊕y⊕xy

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

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

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

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

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

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

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

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

$Z = x + y$

80. Ans: (c)

81. Ans (b)

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

RLC ---- 10101001 cy=1

RRC ---- 11010100 cy=1

RAL----- 10101001(-86_{10}) cy=1.

82. 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
```

83. 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.

84. Ans: (a)

85. Ans: (d)

86. Ans: (b)

Sol: $TF = \dfrac{2}{s^2+3s+2} = \dfrac{2}{(s+1)(s+2)}$

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

Real and unequal roots, then system is over damped.

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

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

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

Final value = $C(\infty) = \underset{s\to 0}{\text{Lt}}\dfrac{2s}{s(s+1)(s+2)}$

$= 1$

87. Ans: (a)

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

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

$$\begin{array}{c|cc} s^2 & 1 & 3K \\ s^1 & K-1 & 0 \\ s^0 & 3K & \end{array}$$

$K - 1 > 0$

$3K > 0$

$K > 1$

88. Ans: (a)

Sol: Given circuit is lag network

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

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

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

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

89. Ans: (b)

Sol: If X is open

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

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

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

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

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

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

$2\xi\omega_n = a + KK_t$

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

Both e_{ss} and ξ increases

90. Ans: (b)

91. Ans: (c)

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

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

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

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

92. Ans: (c)

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

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

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

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

93. Ans: (b)

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

$$=\frac{12}{13}$$

94. 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

95. Ans: (a)

96. Ans: (a)

Sol: Q_c = [B AB]

$$AB=\begin{bmatrix}1 & 1\\ -2 & -1\end{bmatrix}\begin{bmatrix}0\\1\end{bmatrix}=\begin{bmatrix}1\\-1\end{bmatrix}$$

$$Q_c=\begin{bmatrix}0 & 1\\ 1 & -1\end{bmatrix}\Rightarrow|Q_c|=-1$$

The system is said to be controllable if $|Q_c| \neq 0$ where Q_c = [B AB]

$|Q_c| \neq 0 \rightarrow$ so, controllable

$$Q_0=\begin{bmatrix}C\\CA\end{bmatrix}$$

$$CA=\begin{bmatrix}1 & 0\end{bmatrix}\begin{bmatrix}1 & 1\\ -2 & -1\end{bmatrix}$$

$$=[1\quad 1]$$

$$Q_0=\begin{bmatrix}1 & 0\\ 1 & 1\end{bmatrix}\Rightarrow|Q|_0=1$$

The system is said to be observable if $|Q_0| \neq 0$ where $Q_0=\begin{bmatrix}C\\CA\end{bmatrix}$.

Det $|Q_0| \neq 0 \rightarrow$ so, observable

97. 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

98. 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

99. Ans: (c)

100. Ans: (a)

101. 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

102. Ans: (a)

Sol: TCP is transport layer;

IP,ICMP and IGMP are network layers

Where as DNS is application layer

103. Ans: (b)

104. Ans: (d)

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

105. Ans: (a)

106. Ans: (a)

107. Ans: (b)

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

Voltmeter range = (0 – 200 V)

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

$\Rightarrow R_v = 400\ k\Omega$

R_v is connected parallel to 200 kΩ resistance

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

$$\text{voltmeter reading (V)} = \frac{R_{eq}}{100+R_{eq}} \times 150$$

$$\Rightarrow V = \frac{133.3}{133.3+100} \times 150$$

V = 85.7 V

108. Ans: (d)

Sol: From the figure

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

$\theta = 30°$

Phase displacement (ϕ) = 180–θ or 180 + θ

($\because$ the pattern is in 2^{nd} and 4^{th} 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.

109. Ans: (c)

110. 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 $\rightarrow$1 (Half digit)

Y, A, B, C – 0 $\rightarrow$ 9 (Full digits)

111. Ans: (c)

Sol: In a 1-ϕ 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

112. Ans: (c)

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

113. 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

∴ 2 represents greater precision while (1) and (3) represents same precision

114. Ans: (a)

115. Ans: (d)

116. Ans: (d)

117. Ans: (c)

118. Ans: (d)

Sol: Total copper loss in the machine=copper loss in armature circuit + copper loss in field circuit

$W_{cu} = W_{cu\,(arm)} + W_{cu\,(field)}$

$= I_a^2.R_a + I_f^2.R_f \rightarrow$ (1)

$I_f = \frac{200}{100} = 2A$

$I_{L\,(N.L)}$ = 6A (from the given data)

∴ For motor, $I_{a(NL)} = I_{L\,(NL)} - I_{f\,(NL)}$

$= 6A - 2A = 4A$

From equation (1),

$W_{cu} = (4^2)(1) + (2^2)(100) = 416$ W

119. Ans: (a)

Sol: Synchronizing power coefficient P_{sy} gives the change in power delivered or received by the machine per unit change in the torque angle or load angle. A large P_{sy} means more power for a given change in the angle. The coupling between the stator and rotor magnetic fields is called stiffer if a small change in the angle between the axes of these fields leads to a large change in power delivered or received. Thus, synchronizing power coefficient and the stiffness of coupling are the same.

120. Ans: (c)

121. Ans: (b)

Sol: Capacity of open delta bank is 57.7% of capacity of closed delta bank without over loading of the winding

$\therefore$% Reduction in load

$$= \frac{1-0.57}{1} = 0.43 \times 100 = 43\%$$

122. Ans: (b)

Sol: %R = 6%, % x = 8 %

% Z = 10%

$$I_{pu} = \frac{1}{0.1} = 10 \text{ p.u}$$

123. Ans: (c)

Sol: $$I_a^1 = \frac{\text{No.of parallel paths available}}{\text{Total No.of parallel paths}} \times I$$

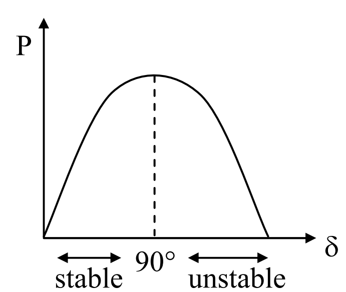
$$I_c^1 = \frac{4}{6} \times I_c$$

$P \propto I_a$ since E is constant

$$P' = \frac{2}{3} P$$

124. Ans: (c)

Sol:



Alternator is stable if δ <90°

Critically stable if δ = 90°

125. Ans: (a)

Sol: (i) In 1-ϕ, shaded pole induction motor shaded rings are used.

(ii) In 3-ϕ, Induction motors, slip rings are present.

(iii) In dc machines, compoles are used to compensate the armature reaction effect.

(iv) In synchronous machines, damper bars are used to improve the stability of machine.

126. Ans: (a)

Sol: As skewed rotor slot is not parallel to stator in an induction motor there is more leakage reactance. As a result, induction motor has lower starting and maximum torques.

With skewing the rotor resistance increase and noise reduces.

127. Ans: (a)

Sol: **Detent torque:**

It is the maximum load torque that can be applied to the shaft of an unexcited motor without causing continuous rotation.

Holding torque:

It is the maximum load torque that can be applied to the shaft of an excited motor with causing continuous rotation.

128. Ans: (c)

Sol: As terminal voltage is reduced to half, flux and back emf reduces to half and speed remains constant as $E_b \propto \phi N$. And load torque $T_L \propto N^2$. As speed remains constant load torque also constant and $T_L \propto \phi I_a$ so for constant load torque current doubles.

129. 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 FET

130. Ans: (a)

Sol: By an application of Ampere's law

$$\overline{H} = -\frac{a_x}{2\pi(1)}\ AT/m$$

Magnitude is $\frac{1}{2\pi}$ AT/m.

131. Ans: (c)

Sol: Capacitance of spherical capacitor

$$C = \frac{4\pi\varepsilon_0\varepsilon_r}{\left(\frac{1}{a}-\frac{1}{b}\right)}$$

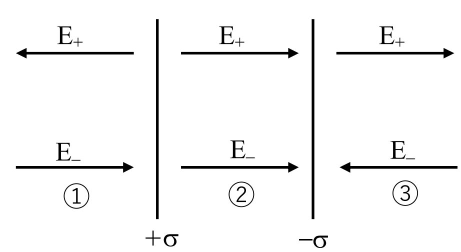
$$C = \frac{4\pi\varepsilon_0 \times 5}{\left(\frac{1}{0.01}-\frac{1}{0.02}\right)} = 0.4\ \pi\varepsilon_0\ F$$

132. Ans: (c)

Sol: The left plate produces a field $\frac{\sigma}{2\varepsilon_0}$, which points away from it-to the left in region ① and to the right in regions ② and ③

The right plate being negatively charged produces a field $\frac{\sigma}{2\varepsilon_0}$, which points towards it-to the right in regions ① and ② and to the left in region ③. The two fields cancel in regions ① and ③ and they add in region ②.

$\therefore$ in region ② the field will be $\frac{\sigma}{\varepsilon_0}$



133. Ans: (b)

Sol: If $\oint \vec{E}.d\vec{\ell} = 0$ and

$\nabla \times \vec{E} = 0$, then $\vec{E} = -\nabla V$

Means that the curl of gradient of scalar electric potential is zero

$\nabla\times(-\nabla V) = 0$

The expression $\vec{E} = -\nabla V$ is valid for static electric field only.

Therefore both Statement (I) & Statement (II) are true, but Statement (II) is not the correct explanation of Statement (I)

134. Ans: (b)

Sol: High frequency transformers are designed with thin laminations.

$\therefore$ Stacking factor is low.

135. Ans: (c)

Sol: DC series motor develops high torque at low speeds i.e at starting. Hence DC series motors are used to drive electric locomotives.

$T \propto (\phi.\ I_a) \Rightarrow T \propto I_a^2 \rightarrow (1)$

$[\because$ for series motor, $\phi \propto I_f = I_a]$

$$N \propto \frac{E_b}{\phi} \quad \Rightarrow N \propto \frac{1}{I_a} \quad \rightarrow (2)$$

From (1) & (2)

$$\Rightarrow N \propto \frac{1}{\sqrt{T}} = \text{Rectangular hyperbola.}$$

$\therefore$ N (v_s) T characteristics of series motor is "Rectangular hyperbola", which shows as speed of the motor increases, the magnitude of torque produced by the motor reduces.

136. Ans: (c)

Sol: Because, memory indirect type addressing mode instructions require two memory visits in its execution cycle.

137. Ans: (c)

138. Ans: (b)

139. Ans: (b)

140. Ans: (a)

Sol: Lighting arresters are connected between the line and ground at the substation to divert or discharge the surge to the ground and always act in shunt with the equipment to be protected. Shunt capacitors are used in conjunction with lighting arresters for the protection of equipment to be protected against surges. These shunt capacitors will absorb some part of the over voltages. (i.e. reduce the crest of the surges).

141. Ans: (a)

142. Ans: (c)

Sol: In a power system

If active power supply > active power demand and then frequency increases

If active power supply < active power demand then the frequency decreases.

So whenever system frequency decreases it implies that active power demand is more than active power supply and in a perfect competitive market, price increases whenever demand > supply. So unit price of power increases.

143. 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.

144. Ans: (b)

Sol: Since conductivity in an intrinsic semiconductors is both due to electrons and holes and is given as $\sigma_2 = ne\mu_h + Pe\mu_P$, where h and P are electron and hole concentration which are equal but μ_h & μ_P the mobility of e^- and holes are different ($\mu_h > \mu_P$).

145. 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.

146. Ans: (a)

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

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

147. 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

148. Ans: (c)

Sol: For R – L Load

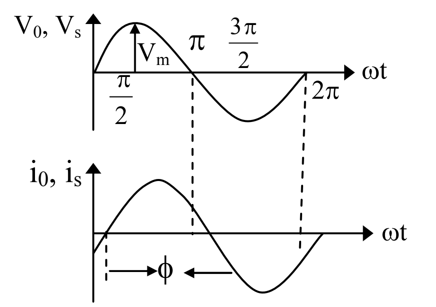


Fig. (a) $\alpha \le \phi$
In this controlling is not possible

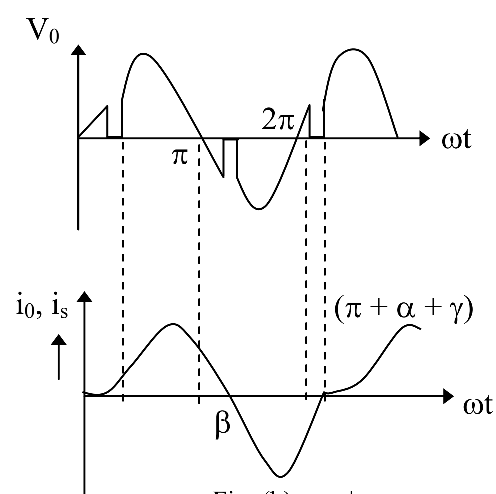


Fig. (b) $\alpha > \phi$
In this output is controlled by appropriate firing angle

149. Ans: (d)

Sol: Only statement (I) is true

150. 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.