TEST ID: 110

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-19
ELECTRONICS & TELECOMMUNICATION ENGINEERING

SUBJECT: Electronic Measurements and Instrumentation + Computer Organization and Architecture + Analog and Digital Communication Systems
SOLUTIONS

01. Ans: (b)

Sol: In induction type energy meters, self-braking torque is proportional to the square of load current and it assumes increasing significance at higher loads. Hence at higher loads, registration tends to be lower than the actual value of reading.

02. Ans: (a)

Sol:

(i) Given $T_d = KI$

$T_C = K_1\theta$ for spring control

$T_C = K_2\text{Sin}\theta$ for gravity control

At balance position

For spring:

$T_d = T_C$

$\Rightarrow K_1\theta = KI$

$$\Rightarrow \theta = \left(\frac{K}{K_1}\right)I \Rightarrow \text{linear scale}$$

For gravity:

$T_d = T_C$

$\Rightarrow K_s\sin\theta = KI$

$$\sin\theta = \frac{KI}{K_2}$$

$$\Rightarrow \theta = \text{Sin}^{-1}\left(\frac{KI}{K_2}\right) \Rightarrow \text{non linear}$$

(ii) Gravity control can be used only in vertically mounted systems

03. Ans: (b)

Sol: Resolution= $\frac{V_{FS}}{2^N}$

$$14 \times 10^{-3} = \frac{3.5}{2^N}$$

$2^N = 250$

N=8

04. Ans: (d)

Sol: (i) Controlling torque is not required in both 1ϕ and 3ϕ electrodynamometer type power factor meters

(ii) Frequency changes will cause errors in 1ϕ pf meter but not in 3ϕ pf meters

05. Ans: (c)

06. Ans: (b)

Sol: In an energy meter the pressure coil current should lag voltage across pressure coil by 90° for accurate readings. Hence pressure coil circuit is designed in such a way that it is highly inductive and has low resistance.

07. Ans: (b)

Sol: In single phase induction type energy meters, the meter will register true energy only if the phase angle between applied voltage(v) and pressure coil current (I_P) is exactly equal to 90°[and also I_P should lag V]. Hence we use lag adjustment devices like shading bands so that I_P lags V by 90°.

08. Ans: (b)

Sol: In moving Iron (MI) voltmeters

$$\theta \propto I^2 \frac{dL}{d\theta} [\theta = \text{deflection}]$$

$$\theta \propto \frac{V^2}{Z^2} \frac{dL}{d\theta}$$

V = applied voltage

Z = impedance of moving coil of MI instrument.

$Z = R + j\omega L$

In D.C. $\omega = 0$, So

$$Z_{dc} < Z_{ac} \Rightarrow \frac{Z_{ac}}{Z_{dc}} > 1$$

$$\therefore \frac{\theta_{dc}}{\theta_{ac}} = \frac{Z_{ac}^2}{Z_{dc}^2}$$

$$\Rightarrow \frac{\theta_{dc}}{\theta_{ac}} = \left(\frac{Z_{ac}}{Z_{dc}}\right)^2$$

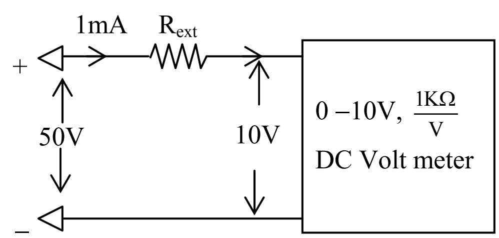
$$\Rightarrow \frac{\theta_{dc}}{\theta_{ac}} > (1)^2$$

$\theta_{dc} > \theta_{ac}$

Hence voltmeter indicates lower values for ac voltages than for corresponding dc voltages.

09. Ans: (b)

Sol:



$$R_{exr} = \frac{50V - 10V}{1mA} = \frac{40V}{1mA} = 40\ k\Omega$$

10. Ans: (c)

Sol: 1. Digital counter is used for measurement of frequency.

2. As from Schearing bridge dissipation factor is obtained from that load angle can be obtained ($\tan\delta = \omega C4\ R4$).

11. Ans: (c)

12. Ans: (b)

Sol: $P = \frac{1}{2\pi}\int_0^{2\pi}(2+3\sin\omega t)(1+2\sin\omega t)$

$$= \frac{1}{2\pi}\int_0^{2\pi} 2+7\sin\omega t+6\sin^2\omega t$$

$$= \frac{1}{2\pi}[2t]_0^{2\pi}+7[-\cos\omega t]_0^{2\pi}+6\left[\frac{1-\cos\omega t}{2}\right]_0^{2\pi}$$

$$= \frac{1}{2\pi}[2(2\pi)+3(2\pi)] = 5$$

13. Ans: (c)

14. Ans: (c)

Sol: meter constant K = revkWh

$$= \frac{1380}{230\times 30\times 2\times 1\times 10^{-3}}$$

= 100 rev/kWh

15. Ans: (d)

16. Ans: (b)

Sol: In X-Y mode of operation only frequency, phase measurement is done.

CRO takes more time from measurement of amplitude comparing to other instruments as reading of quantity is not displayed/obtained readily.

17. Ans: (d)

Sol: In measurements system undesirable static characteristics are drift, static error, dead zone and non-linearity while the desired characteristics are accuracy, sensitivity, reproducibility.

18. Ans: (a)

Sol: $M = -8\cos(\theta+60^0)$mH

$\frac{dM}{d\theta} = 8\sin(\theta+60^0)$mH

$d = I^2 \frac{dM}{d\theta}$

$= [25 \times 10^{-3}]^2 \times [8\sin 90^0] \times 10^{-3}$

$= 5000 \times 10^{-9}$

$= 5\ \mu$N-m

19. Ans: (d)

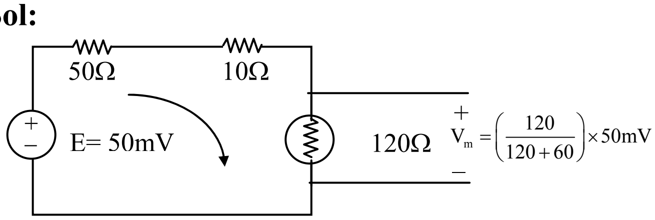
Sol: S = best resolution

= resolution in lowest voltage range

$= \frac{2V}{2\times10^4} = 0.1$ mV

20. Ans: (a)

Sol:



$V_m = 33.3$mV

21. Ans: (b)

Sol: $E_H = k_H.I.B/t$

$= \frac{-1\times10^{-6}\times3\times0.5}{2\times10^{-3}} = -0.75$mV

22. Ans: (c)

23. Ans: (a)

24. Ans: (c)

25. Ans: (d)

Sol: Database is an application software and not OS service

26. Ans: (d)

Sol: When a running process is moved out of RAM, then it is kept at specific space in harddisk known as swap space

27. Ans: (b)

Sol: Compaction is the solution for external fragmentation

28. Ans: (c)

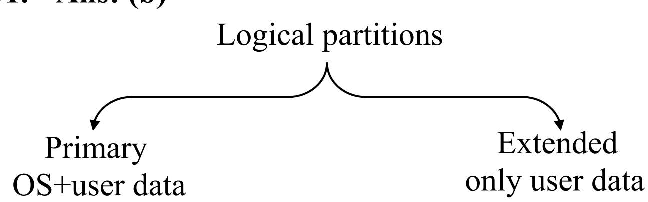
Sol: CPU can perform those operations which do not require buses, during DMA transfer, like: INCA.

29. Ans: (b)

Sol: Optimal page replacement policy gives minimum page faults

30. Ans: (c)

31. Ans: (b)



32. Ans: (b)

Sol: 'break' keyword is needed as last statement of the cases in switch

33. Ans: (d)

Sol: All are valid statements

34. Ans: (a)

Sol: Elements stored sequentially in memory.

35. Ans: (d)

Sol: Structure is derived data-type in C-Language

36. Ans: (c)

Sol: a & b is bitwise AND operation

a = 5 ⇒ 101

b = 6 ⇒ 110

a&b ⇒ 100 ⇒4

37. Ans: (c)

Sol: Addressing mode specifies that how and from where operands can be obtained for a specific instruction

38. Ans: (d)

Sol: Instruction fetch should be done in 2-steps as follows:

AR ←PC

IR ← M[AR]

39. Ans: (c)

Sol: $T_{avg} = H * t_{cm} + (1 - H)(t_{cm} + t_{mm})$

$10 = H * 8 + (1 - H)(8 + 60)$

H = 0.966 = 96.6%

40. Ans: (a)

Sol: Non-maskable interrupts are always accepted

41. Ans: (d)

Sol: 256MB = 256M ×1B

$= 2^{28} \times 1B$

Address = 28-bits

42. Ans: (c)

Sol: Cache & RAM ⇒ Volatile

ROM & HDD ⇒ Non-volatile

43. Ans: (c)

Sol: Average memory access time

= 0.8* 5 ns + 0.2 * 50 ns

= 4nsec + 10nsec

44. Ans: (c)

Sol: Based on locality of reference concept one block should be copied to cache when there is a miss.

45. Ans: (c)

Sol: $1 \text{ chip capacity} = \frac{\text{total capacity}}{\text{No. of chips}}$

$$= \frac{1GB}{32} = \frac{2^{30} B}{2^5} = 2^{25} B = 2^{23} \times 2^2 B$$

1 cell capacity = 2^2 B = 4B

46. Ans: (c)

Sol: According to definition of 3 NF option (c) is correct

47. Ans: (c)

Sol: For AM: Total Power $(P_T) = P_C\left(1+\frac{\mu^2}{2}\right)$

Modulation index (μ) = 1, for 100% modulation

Carrier power P_c = 20kW

$$P_T = 20kW\left(1+\frac{1^2}{2}\right)$$

$$= 20kW\left(1+\frac{1}{2}\right)$$

$$= 30kW$$

Useful power = 30kW – 20kW = 10kW

The DC input power $= \frac{10kW}{0.8} = 12.5kW$

48. Ans: (a)

Sol: $I_T = I_C\left(1+\frac{\mu^2}{2}\right)^{1/2}$

μ = Modulation index

$$20A = 18A\left(1+\frac{\mu^2}{2}\right)^{1/2}$$

$$\left(\frac{20}{18}\right)^2 = \left(1+\frac{\mu^2}{2}\right)$$

$$\mu = 0.68$$

49. Ans: (b)

sol: In a DSB-SC system carrier is suppressed and the total power contain in the intelligence part only

$$\%\text{Power saving} = \frac{\text{Power saved}}{\text{Total Power}} \times 100$$

$$= \frac{P_c}{P_c\left(1+\frac{\mu^2}{2}\right)} \times 100$$

$$= \frac{2}{(\mu^2+2)} \times 100$$

$$= \frac{2}{3} \times 100 = 66.6\% \cong 66\%$$

(OR)

For AM :

For 100% modulation, $\mu = 1$

$$P_t = P_c\left(1+\frac{\mu^2}{2}\right) = \frac{3}{2}P_c$$

$$P_c = \frac{2}{3}P_t$$

i.e., if carrier is suppressed, then $\frac{2}{3}P_c$

(or) 66% power will be saved.

50. Ans: (d)

Sol: For PSK: $P_e = Q\left[\sqrt{\frac{A_C^2 T_b}{N_0}}\right] = Q\left[\sqrt{\frac{A_C^2}{N_0 r_P}}\right]$

For ASK: $P_e = Q\left[\sqrt{\frac{A_C^2 T_b}{4N_0}}\right] = Q\left[\sqrt{\frac{A_C^2}{4N_0 r_A}}\right]$

Given, $P_{e,PSK} = P_{e,ASK}$

$$\Rightarrow \frac{A_C^2}{4N_0 r_A} = \frac{A_C^2}{N_0 r_P}$$

$$\Rightarrow \frac{r_A}{r_P} = \frac{1}{4} = 0.25$$

51. Ans: (b)

Sol: Highest frequency component

i.e., $(f_c+f_m) = 705$ kHz

AM signal band width (BW) = $2f_m$ = 10 kHz

$\Rightarrow f_m = 5$kHz

Carrier frequency (f_c) = 705kHz – 5kHz

= 700 kHz

52. Ans: (d)

Sol: $H(x) = \sum_{i=1}^{n} p_i \log_2\left(\frac{1}{p_i}\right)$

Since symbols are equiprobable.

Thus P= 1/4.

$H(x) = (4)\left(\frac{1}{4}\right)\log_2(4) = 2$ bits/symbol

For 100% efficiency, the average length of code must be equal to entropy.

$$\left[\because \text{Average length}(L) = \frac{H(x)}{\eta}\right]$$

53. Ans: (d)

Sol: Using carson's rule, the effective bandwidth of the FM modulated signal is

$$B_c = 2(1+\beta)f_m = 2\left[\frac{k_f \max|m(t)|}{f_m} + 1\right]f_m$$

$$= 2\left[\frac{60\text{kHz}\times 1}{10\text{kHz}} + 1\right]\times 10\text{kHz}$$

$$= 140 \text{ kHz}$$

54. Ans: (b)

Sol: $V_i(t) = \cos\omega_c t + 0.5 \cos\omega_m t$

$i = 10 + 2 (\cos\omega_c t + 0.5 \cos\omega_m t) +$

$0.2 [\cos\omega_c t + 0.5 \cos\omega_m t]^2$

$= 10 + 2\cos\omega_c t + \cos\omega_m t + 0.2 [\cos^2\omega_c t$

$+(0.5)^2\cos^2\omega_m t + (2\times0.5) \cos\omega_c t \cos\omega_m t)]$

$= 10 + 2\cos\omega_c t + \cos\omega_m t + 0.2\cos^2\omega_c t +$

$(0.25)(0.2)\cos^2\omega_m t + 0.2\cos\omega_c t.\cos\omega_m t$

If we consider AM components in output

$S(t) = 2\cos\omega_c t + 0.2 \cos\omega_c t \cos\omega_m t$

$$= 2\cos\omega_c t\left[1+\frac{0.2}{2}\cos\omega_m t\right]$$

Depth of modulation (μ)

$$= \frac{0.2}{2} = \frac{1}{10}\text{(or) } 10\%$$

55. Ans: (a)

Sol: For superheterodyne AM receiver, Tuning range $\rightarrow$ 550 kHz – 1650kHz

Intermediate frequency (IF) $\rightarrow$ 455 kHz

Then range of variation of local oscillator frequency (f_ℓ)

$$(f_\ell)_{min} = (f_s)_{min} + IF = 550\text{kHz} + 455\text{kHz}$$
$$= 1005\text{kHz}$$

$$(f_\ell)_{max} = (f_s)_{max} + IF = 1650\text{kHz} + 455\text{kHz}$$
$$= 2105\text{kHz}$$

56. Ans: (c)

Sol: Sampling rage $(f_s) \geq 2f_m = 6400 = 6.4$ kHz

(To avoiding aliasing effect)

$nf_s \leq$ Bit rate (r) = 36000 bps

$$n \leq \frac{r}{f_s} \leq \frac{36000}{6400} = 5.6$$

$n \approx 5$

$L = 2^n = 2^5 = 32$

$$f_s = \frac{36000}{5} = 7200\text{Hz} = 7.2\text{kHz}$$

57. Ans: (d)

Sol: In quadrature multiplexing, two different base band signals can be transmitted using two carriers of same frequency, but in phase quadrature.

58. Ans: (a)

Sol: $E(-2 X_1X_2 -3 X_1X_3 +4 X_2X_3)$

$= -2\overline{X_1X_2} - 3\overline{X_1X_3} + 4\overline{X_2X_3}$

$= -2\overline{X}_1\overline{X}_2 - 3\overline{X}_1\overline{X}_3 + 4\overline{X}_2\overline{X}_3$

$= -2(3)(6) -3(3)(-2)+4(6)(-2)$

$= -36 + 18 - 48$

$= -66$

59. Ans: (b)

Sol: $$T_e = T_{e_1} + \frac{T_{e_2}}{G_1} + \frac{T_{e_3}}{G_2}$$

$$430 = 200 + \frac{450}{G_1} + \frac{1000}{5}$$

$\Rightarrow G_1 = 15$

60. Ans: (d)

Sol: We know that for Ergodic with no periodic component $\underset{|\tau|\to\infty}{\text{Lim}} R_{XX}(\tau) = (\overline{X})^2$

$\Rightarrow (\overline{X})^2 = 20$

$\Rightarrow \overline{X} = \sqrt{20}$

$R_{XX}(0) = E[x^2(t)] = 50 = \left(\overline{X^2}\right)$

$\therefore \text{Variance}(\sigma_x{}^2) = \overline{X^2} - (\overline{X})^2$

$= 50 - 20$

$= 30$

61. Ans: (b)

Sol: $\text{FOM}_{PM} = \dfrac{\beta_p^2}{2}$

$\text{FOM}_{FM} = \dfrac{3}{2}\beta_f^2$

Given that, both PM and FM systems have same FOM. Then

$\dfrac{\beta_p^2}{2} = \dfrac{3}{2}\beta_f^2 \Rightarrow \beta_p = \sqrt{3}\beta_f \to (1)$

$\therefore \dfrac{BW_{PM}}{BW_{FM}} = \dfrac{2f_m(1+\beta_p)}{2f_m(1+\beta_f)} [\because \text{From Carson's rule}]$

$= \dfrac{1+\beta_p}{1+\beta_f} \Rightarrow \dfrac{1+\sqrt{3}\beta_f}{1+\beta_f} [\because \text{From}(1)]$

$\therefore \dfrac{BW_{PM}}{BW_{FM}} = \dfrac{\sqrt{3}\beta_f + 1}{\beta_f + 1}$

62. Ans: (c)

Sol: If L = 2, then 2 = 2^n (or) n = 1 and L = 8, Then 8 = 2^n (or) n = 3 so relative bandwidth will be tripled

63. Ans: (a)

Sol: let us take n symbols with same probability 'P'

$$\text{Entropy } H(m) = \sum_{i=1}^{n} P_i \log_2 1/P_i$$

$$= P\log_2 1/P + P\log_2 1/P + \ldots.$$

$$= nP \log_2 1/P$$

$$= \log_2 1/P$$

$$H(m) = -\log_2 P$$

NOTE: Total probability =1

P+P+P+……=1

nP=1

64. Ans: (c)

Sol: $f_Y(y)dy = f_x(x)dx$

$$\Rightarrow f_Y(y) = f_x(x)\frac{dx}{dy}, y = ax + b$$

$$\frac{dy}{dx} = a (or) \frac{dx}{dy} = \frac{1}{a}$$

$$x = \frac{y-b}{a}, f_Y(y) = \frac{1}{a} f_x\left(\frac{y-b}{a}\right)$$

65. Ans: (a)

Sol: Phase shift (ϕ) in the local oscillator results in,

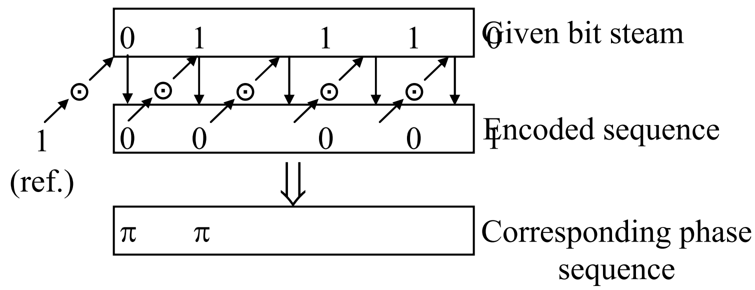
(i) Signal strength is multiplied by $\cos\phi$, there by reduces the signal strength.

(ii) Probability of error

$$(P_e) = Q\left[\sqrt{\frac{d_{min}^2 \cos^2\phi}{2N_0}}\right]$$

66. Ans: (b)

Sol: Given bit steam is differentially encoded using "Delay and EXNOR"



Note: ⊙ = EX-NOR operation

$A \odot A = 1$

$A \odot \overline{A} = 0$

67. Ans: (a)

Sol: Probability of getting head in a single toss, $P(X) = \frac{1}{2}$

No. of tosses (n) → probability of getting head

$$1 \rightarrow \frac{1}{2}$$

$$2 \rightarrow \left(\frac{1}{2}\right)\left(\frac{1}{2}\right)$$

$$3 \rightarrow \left(\frac{1}{2}\right)^3$$

Entropy,

$$H(x) = \sum_{n=0}^{\infty} P_i \log_2 \frac{1}{P_i} = \sum_{n=0}^{\infty}\left(\frac{1}{2}\right)^n \log_2 2^n$$

$$\text{Entropy, } H(x) = \sum_{n=0}^{\infty} n\left(\frac{1}{2}\right)^n = \frac{\frac{1}{2}}{\left(1-\frac{1}{2}\right)^2} = 2$$

68. Ans: (b)

Sol: Number of quantization levels (L) = 2^n = 256

$\Rightarrow$ n = number of bits/sample = 8

Step size $(\Delta) = \frac{A_{max} - A_{min}}{L} = \frac{2A_{max}}{L} = \frac{10}{256}$

Then range of quantizing error

$(Q_e) = -\frac{\Delta}{2} \le Q_e \le \frac{\Delta}{2}$

$\Rightarrow Q_e = \frac{-10}{2\times 256} \le Q_e \le \frac{10}{2\times 256}$

$= -0.0195 \le Q_e \le +0.0195$

$\approx -0.02 \le Q_e \le +0.02$

69. Ans: (b)

Sol: Let 'C' be the capacity of a discrete memory less channel and 'H' be the entropy of a discrete information source emitting 'r' symbols per second.

"The capacity theorem states that if $rH \le C$, then there exists a coding scheme such that the output of the source can be transmitted over the channel with an arbitrarily small probability of error"

70. Ans: (a)

Sol: Dual scope A/D converter is most preferred A/D conversion approach in digital multimeters since it provides highest accuracy and also highest noise rejection.

71. Ans: (a)

72. Ans: (a)

Sol: Associative memories are content addressable memories, in those searching is performed with content not with addresses. The content matching in each cell is performed parallely with the help of the matching logic in each cell.

73. Ans: (a)

Sol: Non-preemptive system cannot take away CPU from any process if it is not either terminated or it is not going to block state (for any I/O execution).

Hence process can make two transitions from running state to block/wait state or to terminate state.

74. Ans: (a)

Sol: In M-ary signalling

Efficiency $(\eta) = \frac{\text{Bit rate}(R_b)}{\text{Bandwidth}}$

Where, bandwidth = $\frac{2R_b}{\log_2 M}$

75. Ans: (a)

Sol: FM demodulation is a frequency to voltage converter. Frequency variation converted back into voltage if the envelope of FM signal is constant. But amplitude distortion occurs due to noise Amplitude limiter is used to maintain a constant envelope. In AM superheterodyne receiver, limiter is not used, as the information is in the form of amplitude.