TEST ID: 110

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ESE- 2020 (Prelims) - Offline Test Series Test- 19

ELECTRONICS & TELECOMMUNICATION ENGINEERING

SUBJECT: ELECTRONIC MEASUREMENTS & INSTRUMENTATION, COMPUTER ORGANIZATION & ARCHITECTURE AND ANALOG & DIGITAL COMMUNICATION SYSTEMS - SOLUTIONS

01. Ans: (b)

Sol: Comparing the modulated signal, with the AM equation $A_c[1+\mu\cos\omega_m t]\cos\omega_c t$, we get $4.5(1+2\cos\omega_m t)\cos\omega_c t$, thus $\mu = 2$.

For modulation index greater than 1, envelope detector fails to detect and synchronous detector is preferred.

02. Ans: (d)

Sol: Need for modulation

$\rightarrow$ Multiplexing

$\rightarrow$ Practicability of antennas

$\rightarrow$ Narrow banding

03. Ans: (b)

Sol: DSB-SC signal is generated using product modulator.

04. Ans: (d)

Sol: $$\underset{\substack{\text{B-PSK}\\ \text{with phase}\\ \text{mismatch}}}{p_e} = Q\left[\sqrt{\frac{A_c^2 T_b}{N_o}\cos^2\phi}\right]$$

Since $\phi = 45^o$

$$\cos^2\phi = \left(\frac{1}{\sqrt{2}}\right)^2 = \frac{1}{2}$$

$$\therefore \underset{\text{B-PSK}}{p_e} = Q\left[\sqrt{\frac{A_c^2 T_b}{2N_o}}\right]$$

05. Ans: (c)

Sol: Generally DPSK have more p_e than B-PSK scheme. Hence to maintain the same value of p_e DPSK has to the transmit with more power than B-PSK.

06. Ans: (a)

Sol: $DR = V_{max} - V_{min}$

$$N_q = \frac{\Delta^2}{12}$$

$$\Delta = \frac{V_{max} - V_{min}}{2^n} = \frac{DR}{2^n}$$

$\therefore$ DR$\downarrow$, $\Delta\downarrow$, $N_q\downarrow$

07. Ans: (a)

Sol: The frequency deviation $\Delta f = \beta f_m$. But in a mixer, modulation index 'β' and the message frequency are same. So the frequency deviation will not change. So Δf = 75kHz.

08. Ans: (a)

Sol: $s(t)_{max} = 12V$ $\quad$ $s(t)_{min} = 4V$

$m(t)_{max} = 2V$ $\quad$ $m(t)_{max} = -2V$

Modulation index depends on the amplitude variation of the AM signal only.

$$\mu = \frac{s(t)_{max} - s(t)_{min}}{s(t)_{max} + s(t)_{min}} = \frac{12-4}{12+4} = \frac{8}{16}$$

$\mu = 0.5$

For triangular wave,

$$\eta = \frac{\mu^2}{3+\mu^2} = \frac{0.25}{3.25} = 0.07$$

09. Ans: (c)

Sol: In telephone, the BW allotted to each signals is 4kHz and the number of voice signals multiplexed in a super group are 60. So, the BW is 60×4kHz = 240kHz.

10. Ans: (d)

Sol: For no slope overload distortion,

$$\frac{\Delta}{T_s} \geq \left|\frac{d}{dt}[m(t)]\right|$$

$$\frac{\Delta}{T_s} \geq 2\pi f_m A_m$$

$\Rightarrow 0.628 \times 4\times10^3 = 2\pi f_m \times 2$

$\therefore$ f_m = 200 Hz

11. Ans: (c)

Sol: The Basic principle of this method is to generate a NBFM indirectly by using phase-modulation technique and then converting this NBFM to WBFM.

12. Ans: (b)

Sol: In a typical broadcast system, each channel bandwidth in AM is 15kHz and for FM is 150kHz.

13. Ans: (d)

Sol: f_m = 400Hz

A_m = 2V

Δf = 60kHz = $k_f A_m$

$$k_f = \frac{\Delta f}{A_m} = \frac{60}{2} = 30\text{kHz}/\text{V}.$$

14. Ans: (a)

Sol: To find the frequency deviation Δf, we find the instantaneous frequency ω_i, given by

$$\omega_i = \frac{d}{dt}\theta(t)$$
$$= \omega_c + 15000\cos 3000t + 20{,}000\cos 2000t.$$

The carrier deviation is 15000cos3000t + 20000cos2000t.

The 2 sinusoids will add in phase at some point, and the maximum value of this expression is 15000 + 20,000 = 35000. This is the maximum carrier deviation $\Delta\omega$.

Hence, $\Delta f = \frac{\Delta\omega}{2\pi} = \frac{35000}{2\pi} = 5414\,\text{Hz}$

15. Ans: (a)

Sol: As f_m increased by two times, β becomes half.

$\Rightarrow \beta = 5$

Bandwidth = $2(\beta + 1)f_m = 2(5 + 1)2000$
$= 24$kHz.

16. Ans: (d)

Sol: Hilbert transform of f(t) = $f_h(t)$

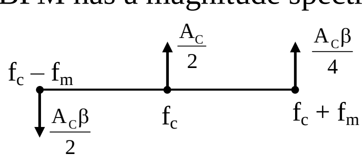
Hilbert transform of $f_h(t) = -f(t)$

17. Ans: (b)

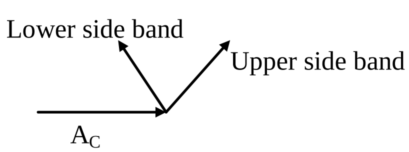
Sol: The selectivity of a super heterodyne receiver is decided mainly by Pre selector and RF stage only.

18. Ans: (b)

Sol: NBFM has a magnitude spectrum as below



which can be mapped to phasor diagram as



19. Ans: (a)

Sol: DSB-SC, $s_1(t) = m_1(t)\cos\omega_c t$

$s_2(t) = m_2(t)\cos\omega_c t$

let, $m_3(t) = m_1(t) + m_2(t)$;

$s_3(t) = s_1(t) + s_2(t)$

$= (m_1(t) + m_2(t))\cos\omega_c t$.

$s_3(t) = m_3(t)\cos\omega_c t$

20. Ans: (b)

Sol: Maximum transmission rate for NRZ transmission is,

$$r_b, \text{(bps)} = \frac{1}{2\Delta t \times L}$$
$$= \frac{1}{2\times 5\times 10^{-9}\times 10}$$
($\because$ Δt, L measured in kms)
$$= 10\text{Mbps}$$

21. Ans: (a)

Sol: f_s = 8kHz (nyquist rate)

$f_{i/p}$ = 5kHz

Alias frequency = $f_s - f_{i/p}$ = 8k – 5k = 3 kHz

22. Ans: (d)

Sol: $\theta = 8\pi t^3 + 6\pi t^2 + 4\pi t + 5$

$$\omega = \frac{d\theta}{dt} = 24\pi t^2 + 12\pi t + 4\pi$$
$$f = \frac{1}{2\pi}\omega = 12t^2 + 6t + 2$$
$$f\big|_{at\,t=1} = 12 + 6 + 2 = 20\text{Hz}$$

23. Ans: (b)

Sol: $I = -\log_2 p$ bits $= -\log_{10} p$ Hartleys

$= -\log_e p$ nats

24. Ans: (a)

Sol: Output SNR in DM system

$$= \frac{3f_s^3}{8\pi^2 f_m^2 f_M} = \frac{3\times(32\times 10^3)^3}{8\pi^2\times(10^3)^2\times 4\times 10^3}$$
$$= 311.25 = 24.93\text{dB}$$

25. Ans: (b)

Sol: Recursive functions are elegant and cleaner and all algorithms which uses recursive functions are easier to visualize.
Recursive functions make the program execution slow due to stack overlapping.
Recursive implicitly evaluates all stack operations.

26. Ans: (b)

27. Ans: (c)

Sol: We cannot copy anything using strcpy function to the character pointer pointing to NULL.

28. Ans: (c)

Sol: The collection of information stored in a database at a particular moment is called instance.

29. Ans: (a)

Sol: If two or more processes are sharing resources then it should be mandatory that only one process should access the resource at a time, this condition is called as mutual exclusion.

30. Ans: (c)

Sol: By Definition all statements in their content are TRUE.

31. Ans: (d)

Sol: All four are benefits of using multithreading

32. Ans: (a)

Sol: Number of pages $= \dfrac{2^{32}\,B}{64KB} = 2^{16}$

Size of page table
$= \text{Number of pages} * 1 \text{ entry size}$
$= 2^{16} * 4B$
$= 2^{18}$ B

Number of pages required

$$= \frac{2^{18}B}{\text{page size}} = \frac{2^{18}B}{2^{16}B} = 2^2$$

But because, all the entries cannot be stored in single page, hence 2-level paging will be required. So 1 extra page is required to store the external page table.
Hence total 4 + 1 = 5 pages are needed.

33. Ans: (c)

Sol:

- Number of processes in memory is known as degree of multiprogramming
- Interrupts are not allowed in non-preemptive multiprogramming because once a process is given to run of CPU, process can leave CPU by its own wish (either completed or going for I/O).

34. Ans: (d)

Sol: In paging $\Rightarrow$ Page table
In segmentation $\Rightarrow$ Segment table
For particular implementation either of these two is used.

35. Ans: (d)

Sol: In direct mapping at each index only one block is stored in cache. Hence if new block comes in cache then existing block should be replaced from that index. Hence no any choice of selecting one victim among multiple which mean no any replacement policy is required.

36. Ans: (b)

Sol: All 1: M and 1:1 relationships should be converted into two tables but not separate tables

37. Ans: (a)

Sol: EAT = H(T + M) + (1 – H) (T + 2M)
$= 0.8\,(20 + 100) + (0.2)\,(20 + 200)$
$= \dfrac{8}{10}\times 120 + \dfrac{2}{10}\times 220$
$= 96 + 44 = 140$ ns

38. Ans: (a)

Sol: Only EC+ contains all attributes of the relation, then EC is key for R.

39. Ans: (a)

Sol: Option (b) is true only for linear pipelines
Option (c) is true only for synchronized pipeline with no hazard.

40. Ans: (b)

Sol: If Y is deleted, then X is also deleted

41. Ans: (a)

Sol:

- O.S. stops executing a process (i.e. process crashes) when exception is caught such as divide by zero exception & null pointer exception.
- Stack & Heap overflow are not considered as crashing errors.

42. Ans: (b)

Sol: In linked allocation, there is no accommodation of the principle of locality.

43. Ans: (a)

Sol: Reading the clock of system is done in user mode and accessing the I/O devices needs privileged instruction.

44. Ans: (c)

Sol: Every attribute of select must appear in the group by class.

45. Ans: (a)

Sol: The blocks / chunks of same size of logical memory are called as pages
The blocks / chunks of same size of physical memory are called as frames
Page Table contains the base address of the frame location for each page in the process
Page offset is combined with the base address to define the physical memory address.

46. Ans: (d)

Sol: For standard coil with impedance $Z_s = R_s + j\omega_1 L_s$, Q meter resonates with a capacitor of capacitance C_1 and corresponding Q factor is Q_1.

$$\Rightarrow Q_1 = \frac{1}{\omega_1 C_1 R_s}$$

$$\Rightarrow R_s = \frac{1}{2\pi f_1 C_1 Q_1} \text{ --------- (1)}$$

When an unknown impedance of $Z_x = R_x + j\omega_1 L_x$ is connected in series with standard coil then resonant capacitance C_2 and corresponding Q factor is Q_2

$$\Rightarrow Q_2 = \frac{1}{\omega_1 C_2 (R_s + R_x)}$$

$$\Rightarrow R_s + R_x = \frac{1}{2\pi f_1 C_2 Q_2}$$

$$R_x = \frac{1}{2\pi f_1 C_2 Q_2} - R_s$$

$$= \frac{1}{2\pi f_1 C_2 Q_2} - \frac{1}{2\pi f_1 C_1 Q_1} \quad \text{[From (1)]}$$

$$R_x = \frac{1}{2\pi f_1}\left[\frac{1}{C_2 Q_2} - \frac{1}{C_1 Q_1}\right]$$

47. Ans: (d)

Sol: Given time period T = 10ms
Count (C) = 025 = 25

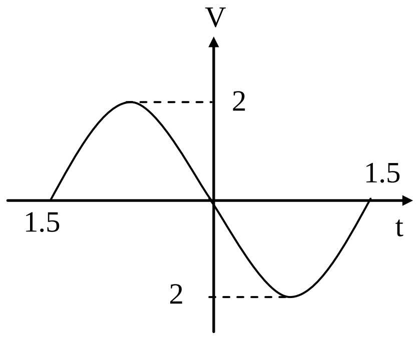
$$\therefore \text{Frequency (f)} = \frac{C}{T}$$

$$= \frac{25}{10 \times 10^{-3}}$$

= 2500 Hz

48. Ans: (c)

Sol:



$$\frac{\text{time}}{\text{disvision}} = 10\mu s$$

$$\frac{\text{volt}}{\text{division}} = 100 \text{ mV}$$

Here the wave repeats for every 3 divisions.

Time period T = 10 μs × 3 = 30 μs.

Frequency$=1/T = \dfrac{1}{30\times10^{-6}} = 33.33\text{kHz}$ and

Number of division for peak to peak is 4.

$\therefore$ Peak to peak voltage = $4 \times \dfrac{\text{voltage}}{\text{division}}$

= 4 × 100

= 400mV

49. Ans: (b)

Sol: A multimeter can measure voltage, current and resistance.

50. Ans: (b)

Sol: During the retrace time or flyback time, the beam returns quickly to the left side of the screen.

51. Ans: (b)

Sol: **Given** $R_1 = R_2 = 100 \pm 1\%\Omega$

$\Rightarrow \sigma_{x1} = \sigma_{x2} = 1\Omega$

For parallel combination

$$R = \frac{R_1R_2}{R_1 + R_2}$$

$$\frac{\partial R}{\partial R_1} = \frac{R_2^2}{(R_1+R_2)^2} = \frac{(100)^2}{(100+100)^2} = \frac{1}{4}$$

$$\frac{\partial R}{\partial R_2} = \frac{R_1^2}{(R_1+R_2)^2} = \frac{100^2}{(100+100)^2} = \frac{1}{4}$$

$$\sigma_R = \sqrt{\left(\frac{\partial R}{\partial R_1}\right)^2 \sigma_{R_1}^2 + \left(\frac{\partial R}{\partial R_2}\right)^2 \sigma_{R_2}^2}$$

$$= \sqrt{\left(\frac{1}{4}\right)^2 (1)^2 + \left(\frac{1}{4}\right)^2 (1)^2} = \frac{1}{2\sqrt{2}}\Omega$$

$$R = \frac{100\times100}{100+100} = 50\Omega$$

$$\therefore \%\sigma_R = \frac{\sigma_R}{R}\times100$$

$$= \frac{\frac{1}{2\sqrt{2}}}{50}\times100$$

$$= \frac{1}{100\sqrt{2}}\times100$$

$$\%\sigma_R = \frac{1}{\sqrt{2}}$$

52. Ans: (d)

Sol: Application of measurement systems

1. Control of processes & operations
2. Experimental Engineering analysis
3. Monitoring of processes and operations

53. Ans: (d)

Sol: For converting galvanometer into ammeter, we put a low value of resistance in parallel with the galvanometer.

54. Ans: (d)

Sol: Given i = 5 +10sin (100πt) + 20sin (200πt) is flowing through PMMC and M.I instrument.

PMMC reads average value = 5A

M.I reads rms value

$= \sqrt{(5)^2 + \left(\frac{10}{\sqrt{2}}\right)^2 + \left(\frac{20}{\sqrt{2}}\right)^2}$

$= \sqrt{25+50+200} = 16.58$ Amp

Ratio of M.I to PMMC reading

$= \frac{16.58}{5} = 3.31$

55. Ans: (d)

Sol: CC current settings: 15A, 30A
PC voltage settings : 300V, 600V
Full scale reading = 4500 Watts
When the meter is connected for 30A, 600V
VA rating = 30 × 600 = 18,000
Which is 4 times the full scale watt meter reading
Therefore, Multiplying factor = 4

Actual power = 4 × Wattmeter reading

= 4 × 2000

= 8000 watts

56. Ans: (d)

Sol: First 6 hrs energy consumption is
$E_1 = VI\cos\theta \times t$
$= 250 \times 10 \times 1 \times 6$
= 15 kWh
for next 10 hours
$E_2 = VI\cos\theta \times t$
$= 250 \times 10 \times 0.8 \times 10 \times 0.5$
= 20 kWh × 0.5 = 10 kWh
For last 8 hours
$E_3 = VI\cos\theta \times t$
$= 250 \times 7.5 \times 0.6 \times 8$
= 9 kWh
$\therefore E = E_1 + E_2 + E_3$
= 15 + 10 + 9
= 34 kWh
∴ Number of revolutions = meter constant × total energy
= 34 kWh × 1600 revolutions/kWh
= 54,400 revolutions

57. Ans: (b)

Sol: The given bridge is Desauty's bridge
Given $R_3 = 40\ \Omega$, $R_4 = 80\ \Omega$, $C_2 = 20\ \mu F$

∴ Unknown capacitance $C_x = \frac{R_4}{R_3} \times C_2$

$= \frac{80}{40} \times 20$

$= 40\ \mu F$.

58. Ans: (b)

Sol: For normal frequency of supply, the voltage drop across non inductive resistor and across inductor are equal. So needle takes up a position to 45° to show pointer reading as normal.

59. Ans: (d)

Sol: (i) Controlling torque is not required in both $1-\phi$ and $3-\phi$ electrodynamometer type power factor meters
(ii) Frequency changes will cause errors in $1-\phi$ pf meter but not in $3-\phi$ pf meters

60. Ans: (b)

Sol: load current $I_1 = 50$ A (primary current)
Wattmeter CC current $I_2 = 5$ A (secondary current)

CT ratio $= \frac{I_1}{I_2} = \frac{50}{5} = \frac{10}{1}$

61. Ans: (c)

Sol: $\theta = \frac{180}{\pi} \times \frac{I_m}{nI_s}$

$= \frac{180}{\pi} \times \frac{80}{200 \times 5}$

$= 4.58°$

62. Ans: (d)

Sol: In the measurement of strain by wheat stone bridge, the maximum sensitivity is obtained by a combination of four active strain gauges.

GSLV MK III
ISRO
INDIA
INDIA

63. Ans: (b)

Sol: Acceleration (a) $=\dfrac{Kx}{M}$

$K = 3\times10^3$ N/m
M = 0.05 kg
x = ± 1mm

$$a=\frac{3\times10^3\times1\times10^{-3}}{0.05}=60\text{ m/s}^2$$

64. Ans: (c)

Sol: Hall effect converts magnetic energy to electric energy. Hall effect pick-up can be used for the measurement of magnetic flux.

65. Ans: (a)

Sol: The coefficient of discharge (d) of orifice opening. The Cd value of orifice meter is much smaller than Cd value of a venturi-meter. The orifice normal value of Cd is 0.6 and the % loss of work out at 65% of the differential pressure.

66. Ans: (b)

Sol: For the Piezo electric transducer,
No load output voltage, E_0 = 3V
Crystal capacitance, C_P = 250 pF
Load capacitance, C_L = 125 pF
At high frequencies, the voltage across the load is $E_L \approx E_0\dfrac{C_P}{C_P+C_L}$

$$\Rightarrow E_L = 3\times\frac{250}{375}=2V$$

67. Ans: (a)

68. 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.

69. Ans: (a)

70. Ans: (b)

Sol: Statement (I) and Statement (II) both are true but Statement (II) is not the correct reason for Statement (I) because increasing the number of page frames allocated to a process sometimes increases the page fault rate is "Belady's anamoly" and it is not related with locality of reference.

71. Ans: (d)

Sol: For recursive function calls, a stack is required. Since the variables are declared at each function call and the instants of all the local variables at each function call are needed to be stored. For this, a stack data structure is used.

72. 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.

73. Ans: (a)

Sol: Shunts used with measuring instruments should have the following properties:
(i) The resistance temperature coefficient of shunt should be low and as nearly as possible to that of the instrument.
(ii) Resistance of shunts should be time invariant
(iii) They should have low thermal emfs with copper.
(iv) They should carry current without excessive temperature rise.

Manganin has a low temperature coefficient of resistance which is $40\times10^{-6}1°C$. Hence it is a preferred shunt material in DC instruments.

Constantan's thermal emf with copper, eventhough high, is unidirectional and hence it is used as a shunt in AC instruments.

74. Ans: (d)

Sol: Air cored electrodynamometer type instruments are protected against external magnetic fields by enclosing them in a casing of high permeability alloy.

75. Ans: (c)

Sol: Both are not related

Statement (II) is wrong.