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ESE- 2019 (Prelims) - Offline Test Series Test-19

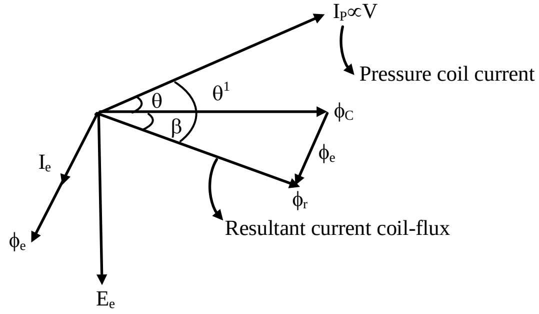
Electronics & Telecommunication Engineering

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

SOLUTIONS

01. Ans: (c)

Sol: In an electro-dynamo meter type instrument eddy currents are induced in the solid metal parts and within the thickness of conductors by alternating magnetic field of current coil. These eddy currents produce a flux of their own and alter the magnitude and phase of current coil field.



In the above phasor diagram it can be seen that due to eddy currents induced, the phase angle between pressure coil flux and resultant current coil flux is increased.

Hence for lagging power factors the meter will shows a low value and show a high value for leading power factors- error due to eddy current is opposite to that of error due to inductance in pressure coil.

02. Ans: (b)

Sol: Energy density in an electrostatic field is considerably smaller than that in electromagnetic field.

03. 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

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

$$\therefore \frac{\theta_{dc}}{\theta_{ac}} = \frac{Z_{ac}^2}{Z_{dc}^2} \Rightarrow \frac{\theta_{dc}}{\theta_{ac}} = \left(\frac{Z_{ac}}{Z_{dc}}\right)^2 \Rightarrow \frac{\theta_{dc}}{\theta_{ac}} > (1)^2 \Rightarrow \theta_{dc} > \theta_{ac}$$

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

04. Ans: (d)

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

05. Ans: (c)

Sol: Poynting vector wattmeter is works on the principle of Hall-effect. This wattmeter used for measuring the power loss density at the surface of a magnetic material.

06. Ans: (c)

Sol: The loss of charge method is more suitable for measurement of high resistance.

07. Ans: (c)

Sol: (i) The pressure coil of 1-ϕ inductance type energy meter has pure inductance.
(ii) The pressure coil of an electrodynamometer type wattmeter has pure resistance.

08. Ans: (b)

Sol: When the degree of damping is such that the pointer rises quickly to its deflected position without oscillations, the damping is said to be "critical" and the instrument is said to be "dead beat".

09. Ans: (c)

Sol: The working principle of the varley loop test which is used to detect the fault location of cables is based on Wheatstone bridge

10. Ans: (c)

Sol: **Heaviside bridge :** Measurement of mutual inductance interms of a known self-inductance.
Heydweiller bridge : Measurement of a mutual inductance interms of a standard capacitance.
Campbell's bridge : Measurement of a mutual inductance interms of a known standard mutual inductance.

11. Ans: (c)

Sol: Integrating type DVM uses the principle of dual slope A/D conversion. In dual slope A/D conversion, error in time constant gets cancelled out during charging and discharging. So any error in time constant is not reflected in the A/D conversion.

12. Ans: (b)

Sol: Distortion analyzer contains the rms values of all the harmonics present in the input signal. The individual harmonics cannot be separated out.

But incase of a wave analyzer or spectrum analyzer the individual harmonic content can be separated out.

13. Ans: (c)

Sol: The term "$\frac{1}{2}$ digit" refers to the fact that the most significant bit (MSB) can be only "0" or "1" while all other digits can be anything between "0" or "9".

14. Ans: (c)

Sol: A thin aluminum film is usually deposited on the non viewing side of the phosphor of a CRT because:

1. It does not allow the screen to be negatively charged
2. It acts as a heat sink and prevents phosphor burn
3. The light scatter from the phosphor is reduced

15. Ans: (c)

Sol:

Astigmatism: Additional focusing control.

Aquadag: Collection of secondary electrons.

Persistance: When the electron beam is switch off the phosphor crystals returns to their initial state and release a quantum of light energy.

Graticule: A grid of lines that serves as a scale when making time and amplitude measurement.

16. Ans: (c)

Sol: I_{rms} = Hot-wire ammeter reading = 32 A

$$I_{avg} = \frac{\text{Rectifier meter reading}}{1.1}$$

$$= \frac{30}{1.1} = 27.027 \text{ A}$$

$$\text{Form-factor, } k_f = \frac{I_{rms}}{I_{avg}} = \frac{32}{27.027} = 1.184$$

17. Ans: (c)

Sol: Both the variable persistence and bistable storage oscilloscopes depend, for their operation, on the principle of secondary emission.

Bistable storage tube is slower than variable persistence storage tube.

18. Ans: (c)

Sol: The frequency range of the oscilloscopes can be increased by sub-dividing the deflecting plates in a number of sections in the path of the electron beam.

19. Ans: (c)

Sol: **Active transducers:** In a process of conversion of non electrical to electrical if a transducer does not require external power supply then it is called active transducers.

Ex: Thermocouple, piezoelectric transducer, photovoltaic cell, pH electrode.

Passive transducers: In external power supply then it is called passive transducers.

Ex: Reluctance pick-up, magnetostriction gauge.

20. Ans: (d)

Sol: Power consumed by Current coil = VI

$$= 6 \times 5 = 30\text{W}$$

Power consumed by pressure coil $= \dfrac{V^2}{R_{pc}}$

$$= \frac{200 \times 200}{8000} = 5\text{W}$$

Total power = 30 + 5 = 35W

21. Ans: (a)

Sol: measured value, A_m = 100W

Power loss in potential coil, $P_\ell = \dfrac{220 \times 220}{4840} = 10\text{W}$

Actual value, A_t = 100–10W = 90W

percentage error $\% E_r = \dfrac{A_m - A_t}{A_t} \times 100 = \dfrac{100-90}{90} \times 100 = 11\%$

22. Ans: (c)

Sol: All metal gauges have low gauge factor of the order 2.5 because the conductivity of the material is changes with applied strain in the elastic region

23. Ans: (b)

Sol: To reduce the effect of fringing in capacitive type transducer a guard ring is provided and it is kept at ground potential

24. Ans: (a)

Sol: For signal conditioning of a piezo-electric type transducer we require charge amplifier.

25. Ans: (c)

Sol: $r(t) = s(t)\cos(2\pi(f_c + 300)t)$

Taking only the low frequency components

$V_0(t) = m(t)\cos(2\pi(300t))$

$\therefore V_0(f) = \dfrac{M(f-300)}{2} + \dfrac{M(f+300)}{2}$

$\therefore$ Maximum frequency component will be 3400 + 300 = 3700 Hz

26. Ans: (d)

Sol: The frequency components that will be present after modulation are $f_c \pm f_m$

1000 kHz + 300 Hz → 1000.3 kHz

1000 kHz – 300 Hz → 999.7 kHz

1000 kHz + 2 kHz → 1002 kHz

1000 kHz – 2 kHz → 998 kHz

∴ The frequency component that is not present at the output is 700 kHz

27. Ans: (c)

Sol: $s(t) = 5\sin[2\pi \times 10^6 t]\sin[2\pi \times 10^3 t]$

Carrier Component   Message Component

The resulting components will have an amplitude of 5/2 = 2.5

28. Ans: (a)

Sol: $\mu_1 = 0.3,\ \mu_2 = 0.4$

$\mu_t^2 = \mu_1^2 + \mu_2^2 = 0.25$

$\therefore \mu_t = 0.5$

$$P_t = P_c\left[1 + \frac{\mu_t^2}{2}\right] = 10\left[1 + \frac{0.25}{2}\right]\text{kW} = 10 \times 1.125\,\text{kW} = 11.25\text{ kW}$$

29. Ans: (c)

Sol: $s(t)_{DSB-SC} = m(t)\cos(\omega_C t + \theta)$

$= m(t)\,[\cos(\omega_C t)\cos\theta - \sin(\omega_C t)\sin\theta]$

$s(t)_{DSB-SC} = m(t)\cos\theta[\cos\omega_c t] - m(t)\sin\theta[\sin\omega_c t]$

The envelope of the above signal is

$$\left|\sqrt{m^2(t)\cos^2\theta + m^2(t)\sin^2\theta}\right| = |m(t)|$$

30. Ans: (b)

Sol: The phenomenon of capturing stronger carrier and suppressing weaker one is called as capture effect. This is effectively present in angle [FM and PM] modulation schemes.

31. Ans: (a)

Sol: $\Delta f = \frac{1}{2\pi}\frac{d}{dt}4\sin(2000\pi t)$

$\Delta f = \frac{1}{2\pi} \times 4 \times 2000\pi\cos(2000\pi t)$

$\Delta f = 4000\cos(2000\pi t)$

$\therefore \Delta f_{max} = 4\,\text{kHz}$

32. Ans: (a)

Sol: Power content of FM signal is power of unmodulated carrier signal

$\therefore$ Power of s(t) = 200W

Power of $m_n(t)$ = 0.5W $\Rightarrow$ $m(t)_{max}$ = 1 volt

$$\beta = \frac{\Delta f_{max}}{f_{max}} = \frac{50000 \times 1}{10000} = 5 \text{ [WBFM]}$$

BW = 2(β + 1) f_m

$\therefore$ BW = 2×6×10 kHz

$\therefore$ BW = 120 kHz

33. Ans: (b)

Sol: $s(t)_{AM} = A_C[1 + k_a m(t)]\cos 2\pi f_c t$

$$s(t)_{WBFM} = A_C \sum_{n=-\infty}^{\infty} J_n(\beta)\cos[2\pi(f_c + nf_m)t$$

$f_c \pm nf_m = f_c \pm 1000$

$\therefore$ n = 1

$$\therefore \frac{\mu A_c}{4} = \frac{J_1(8)A_c}{2}$$

$\therefore \mu = 2J_1(8)$

34. Ans: (c)

Sol: Tuning takes place entirely in the front end (RF and mixer stage) so that the rest of the circuitary (IF stage, detector and final power amplifier stage) requires no adjustments to change in 'f_c' value.

35. Ans: (b)

Sol: The IF filter takes care of adjacent channel rejection. The BW of IF filter is strictly taken as 10 kHz centered at 455 kHz. Hence there will be no other channels that would be processed and demodulated.

36. Ans: (d)

Sol: 1. IF must not fall within the tuning range of the receiver.

2. The BW of IF filter is strictly taken as 10 kHz centered at 455 kHz. Hence there will be no other channels that would be processed and demodulated.

IF should not be too high a value resulting in poor selectivity.

3. IF should not be lowered too much which results in poor image frequency rejection.

37. Ans: (c)

Sol: Image station frequency is given by

$f_{IM} = f_s + 2f_{IF}$

f_{IM} = 600 + 2(450) kHz

= 1500 kHz

38. Ans: (a)

Sol: $f_Y(y) = f_X(x)\left|\frac{dx}{dy}\right|$

$f_Y(y) = f_X(x)\times\frac{1}{2}$ $\left[\because Y = -2X \Rightarrow X = \frac{-Y}{2}\right]$

$f_Y(y) = \frac{1}{2}\left[1+\frac{y}{4}\right]$

when x = 0, y = 0

x = 2, y = –4

$\therefore f_Y(y) = \frac{1}{2}\left[1+\frac{y}{4}\right], \quad -4 \le y \le 0$

$f_Y[y]_{\text{at } y=0} = \frac{1}{2} = 0.5$

39. Ans: (c)

Sol: Noise equivalent bandwidth of H(f) is given by

$$B_N = \frac{\int_0^\infty |H(f)|^2 df}{H^2(0)}$$

H(f) of RC-LPF is

$$H(f) = \frac{1}{1+j2\pi fRC} \text{ and } |H(f)|\big|_{f=0} = 1$$

$$\therefore B_N = \int_0^\infty \frac{1}{1+4\pi^2 f^2 R^2 C^2} df$$

Consider 2πfRC = x & 2πRC df = dx

$$\therefore B_N = \int_0^\infty \frac{1}{1+x^2}\frac{dx}{2\pi RC}$$

$$\therefore B_N = \frac{1}{2\pi RC}\times\frac{\pi}{2} = \frac{1}{4RC}$$

40. Ans: (a)

Sol: Impulse response of matched filter receiver $h(t) = s(T_b - t)$

$\therefore h(t) = s(3 - t)$

$y(t) = s(t)\, h(t) = s(t)\, s(3 - t)$

$y(t)_{\text{at } t=3(s)}$ = Energy of s(t)

$$= \int_0^1 4dt + \int_2^3 4dt$$

$$\therefore y(t)_{\text{at } t=3\text{sec}} = 8$$

41. Ans: (c)

Sol: Power of random process is given by

$$R_{XX}(0) = \frac{1}{2\pi}\int S_{XX}(\omega)d\omega$$

$$R_{XX}(0) = \frac{1}{2\pi}\left[\int_{-4\pi}^{4\pi} 1.d\omega - \frac{1}{4\pi}\int_{-4\pi}^{4\pi}\omega.d\omega\right]$$

$$R_{XX}(0) = \frac{1}{2\pi}\left[8\pi - \frac{1}{8\pi}(\omega^2)_{-4\pi}^{4\pi}\right]$$

$$R_{XX}(0) = \frac{8\pi}{2\pi} = 4W$$

42. Ans: (d)

Sol: Noise power = KTB

B → Bandwidth

T → Temperature

K → Boltzmann's constant

43. Ans: (c)

Sol: As 1 bit encoder used in delta modulator, channel capacity is less compared to PCM.

44. Ans: (b)

Sol:

Parameters	**Binary scheme**	**M-ary scheme**
Bandwidth	r_b Hz	$r_s = (r_b/k)$ Hz
Transmitted power for a given probability of error	Less	More
Equipment complexity	Less	More

Where Bit rate = r_b bits/sec

M-ary symbol rate = $r_s = r_b/k$ symbols/sec

∴ Binary transmission has lower power requirements and the M-ary signalling schemes require less bandwidth.

45. Ans: (c)

Sol: Pre - emphasis used in FM transmitter.

Armstrong method is used to generate FM signals.

Envelope detector is used to detect AM signals.

De - emphasis is used in FM receivers.

46. Ans: (c)

Sol: BW = $2(\beta + 1) f_m$

$\beta = k_p A_m$

Modulation index does not depend on the message frequency.

47. Ans: (c)

Sol: $(6.25)_{10} = (110.01)_2$

$1.1001 * 2^{+2}$

0	10000001	100100 …….00
Sign bit	Exponent (Excess 127 code)	Fraction

40C80000

48. Ans: (c)

Sol: Gantt chart

P_1	P_2	P_1	P_3	P_2	P_1	P_1

0 5 10 15 20* 23* 28 33*

Turnaround Time = Finish time – Arrival time

$P_1 \Rightarrow 33 - 0 = 33$, $P_2 \Rightarrow 23 - 4 = 19$, $P_3 \Rightarrow 20 - 7 = 13$

Waiting time = Turn around time – burst time

$P_1 \Rightarrow 33 - 20 = 13$, $P_2 \Rightarrow 19 - 8 = 11$, $P_3 \Rightarrow 13 - 5 = 8$

Average Waiting Time = $\frac{13+11+8}{3} = \frac{32}{3} = 10.66$

Ready Queue	P_1	P_2	P_1	P_3	P_2	P_1	P_1
In Time	0	4	5	7	10	15	28
Remaining Burst	20	8	15	5	3	10	5

49. Ans: (a)

Sol: $t_m = 20$ ns, s = 200 ns, P = 0.3

EAT = $(1 - P) \times t_m + P \times s$

$= 0.7 \times 20$ ns $+ 0.3 \times 200$ ns

= 74 ns

50. Ans: (b)

51. Ans: (a)

Sol: $t_c = 3$ns , $t_m = 15$ns, $h_c = 0.8$

$T_m = h_c \times t_c + (1 - h_c) \times t_m$ (Read through, cache read policy)

$T_m = 0.8 \times 3\text{ns} + 0.2 \times 15\text{ns}$

= 5.4 ns

52. Ans: (a)

Sol: $t_n = 2 + 1 + 3 + 2 + 1 = 9$

$t_p = \max(2+1, 1+1, 3+1, 2+1, 1+1) = 4$

Speed up = $\frac{t_n}{t_p} = \frac{9}{4} = 2.25$

(For large number of instructions)

53. Ans: (b)

Sol: Operand forwarding

*****It handle RAW hazards.

54. Ans: (a)

55. Ans: (c)

Sol: $(3F000000)_{16}$

0	011111110	00………00
Sign	Exponent	Mantissa

$+(1.00) \times 2^{(126-127)}$

$+(0.1)_2 = +(0.5)_{10}$

56. Ans: (b)

Sol: It's a special representation of +0 as a float.

57. Ans: (a)

Sol: Convoy's effect may appear in first come first served process scheduling policy.

58. Ans: (b)

Sol: Starvation may occur in unfair process scheduling policy.

59. Ans: (a)

Sol: Gantt chart:

P_1	P_2	P_3	P_2	P_1

0 2 4 9* 17* 30*

TAT = FT – AT	WT = TAT – BT
$P_1 \rightarrow 30 - 0 = 30$	$P_1 \rightarrow 30 - 15 = 15$
$P_2 \rightarrow 17 - 2 = 15$	$P_2 \rightarrow 15 - 10 = 5$
$P_3 \rightarrow 9 - 4 = 5$	$P_3 \rightarrow 5 - 5 = 0$

$$\text{Average Waiting Time} = \frac{15+5+0}{3} = \frac{20}{3} = 6.66$$

60. Ans: (c)

Sol: Number of processes = P

Number of instances of R needed by each process = r

Minimum number of instances of R = P× (r – 1) + 1 = 3×(4 – 1) + 1 = 10

(So that system must be deadlock free)

61. Ans: (a)

Sol: Optimal page replacement policy

2	7	9	4	2	9	7	4	2
2	2	2	2			2		
	7	7	4			4		
		9	9			7		
✓	✓	✓	✓			✓		

62. Ans: (b)

63. Ans: (d)

Sol: $t_n = 2 + 1 + 3 + 2 = 8$

t_p = maximum stage delay including pipeline overhead

= maximum (2+1,1+1,3+1,2+1) = 4

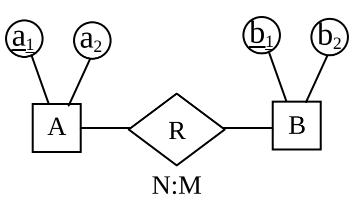
K = 4(number of stages), N = 100 (number of instructions)

$$\text{Speedup} = \frac{N \times t_n}{(K + N - 1) \times t_p} = \frac{100 \times 8}{(4 + 100 - 1) \times 4} = 1.94$$

64. Ans: (c)

65. Ans: (c)

Sol:



The above ER model is represented as the following relations

A($\underline{a_1}$, a_2)

B ($\underline{b_1}$, b_2)

R($\underline{a_1 b_1}$) where a_1, b_1 are foreign keys of A and B.

66. Ans: (c)

Sol: Statement (I) is correct but statement (II) is false because sensitivity of *LVDT* is in V/mm.

67. Ans: (a)

Sol: Statement (I) and Statement (II) are true and Statement (I) is correct explanation for Statement (II).

68. Ans: (b)

Sol: Both the statements are correct. But the reason for taking two readings with direction of current reversed is to eliminate errors due to thermoelectric emfs.

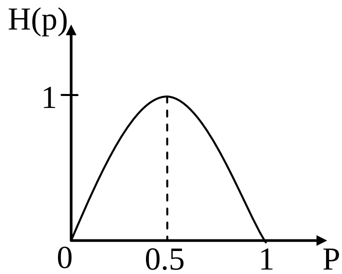
69. Ans: (a)

Sol: They have a very weak operating magnetic field and introduction of a permanent magnet required for eddy current damping would distort the operating magnetic field.

$\therefore$ Statement (II) is correct explanation for statement (I).

70. Ans: (b)

Sol:



Entropy of a binary source is given by

$H(x) = -p\log_2 P - (1-p)\log_2(1-P)$

At $P = \frac{1}{2} \Rightarrow (1-P) = \frac{1}{2}$ we get maximum entropy. Hence entropy of a binary source maximum if all the symbols are equiprobable.

Average amount of information per source symbol is called "entropy"

So, both the statements are individually true. But statement (II) is not correct explanation of statement (I)

71. Ans: (d)

Sol: VSB modulation is used for picture signals in TV broadcasting.

So, statement (I) is true

Video signals ranges from 0 to 4.5 MHz. So, statement (II) is false.

72. Ans: (a)

Sol: In Delta Modulation bit rate is equal to the sampling rate because one bit A/D converter is used in delta modulator. So, both the statements are true and statement (II) is correct explanation of statement (I).

73. Ans: (a)

Sol: Both statements are true and statement (II) is the correct explanation of statement (I).

74. Ans: (a)

Sol: Both statements are individually true and statement (II) is correct explanation of statement (I).

75. Ans: (a)

Sol: Both statements are individually true and statement (II) is correct explanation of statement (I).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