EC : ELECTRONIC AND COMMUNICATION ENGINEERING

Duration : Three Hours **Maximum Marks : 100**

Read the following instructions carefully.

1. Do not open the seal of the Question Booklet unlit you are asked to do so by the invigilator.
2. Take out the Optical Response Sheet (**ORS**) from this Question Booklet **without breaking the seal** and read the instruments printed on the ORS carefully. If you find the Question Booklet Code printed at the right hand top corner of this page does not match with the Booklet Code on the ORS, exchange the booklet immediately with a new sealed Question Booklet.
3. On the right half of the **ORS**, using **ONLY a black ink ball point pen**, (i) darken the bubble corresponding to your test paper code and the appropriate bubble under each digit of your registration number and (ii) write your registration number, your name and name of the examination center and put your signature at the specified location.
4. This Question Booklet contain 16 pages including blank pages for rough work. After you are permitted to open the seal, please check all pages and report discrepancies, if any, to the invigilator.
5. There are a total of 65 Question carrying 100 marks. All these questions are of objective type. Each question has only on correct answer. Question must be answered on the left hand side of the **ORS** by darkening the appropriate bubble (marked A, B, C, D) using **ONLY a black ink ball point pen** against the question number. **For each question darken the bubble of the correct answer**. More than on answer bubbled against a question will be treated as an incorrect response.
6. Since bubbles darkened by the black ink ball point pen **cannot** be erased, candidates should darken the bubbles in the **ORS very carefully**.
7. Question Q. 1 Q. 25 carry 1 mark each. Questions Q. 26 - Q. 55 carry 2 marks each. The 2 marks question include two pairs of common data questions and two pairs of linked answer questions. The answer of the second question of the linked answer questions depends on the answer to the first question of the pair. If the first question in the linked pair is wrongly answered or is unattemped, then the answer to the second question in the pair will not be evaluated.
8. Question Q. 56 - Q. 65 belong to General Aptitude (GA) section and carry a total of 15 marks. Question Q. 56 - Q.60 carry 1 mark each, and questions Q. 61 -Q. 65 carry 2 marks each.
9. Unattempted questions will result in zero mark and wrong answer will result in **NEGATIVE** marks. For all 1 mark questions 1/3 mark will be deducted for each wrong answer. For all 2 marks questions, 2/3 mark will be deducted for each wrong answer. However, in the case of the linked answer question pair, there will be negative marks only for wrong answer to the first question and no negative marks for wrong answer to the second question.
10. Calculator is allowed whereas charts, graph sheets or tables are **NOT** allowed in the examination hall.
11. Rough work can be done on the question paper itself. Blank pages are provided at the end of the question paper for rough work.
12. Before the start of the examination, write your name and registration number in the space provided below using a blank ink ball point pen.

Names								
Registration Number	**EC**							

Q. 1- Q. 25 carry one mark each.

Q.1 If **A** is Hermitian, then $i\mathbf{A}$ is

(A) Symmetric (B) Skew-symmetric

(C) Hermitian (D) Skew-Hermitian

Q.2 If $u = \log\frac{x^2+y^2}{x+y}$, then $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y}$ is equal to

(A) 0 (B) 1

(C) u (D) eu

Q.3 The probability that a man who is x years old will die in a year is p. Then amongst n persons $A_1, A_2, ..., A_n$ each x years old now, the probability that, A_1 will die in one year is

(A) $\frac{1}{n^2}$ (B) $1-(1-p)^n$

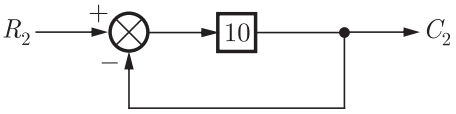
(C) $\frac{1}{n^2}[1-(1-p)^n]$ (D) $\frac{1}{n}[1-(1-p)^n]$

Q.4 If the closed-loop transfer function of a control system is $T(s) = \frac{s-5}{(s+2)(s+3)}$ then It is

(A) an unstable system (B) an uncontrollable system

(C) a minimum phase system (D) a non-minimum phase system

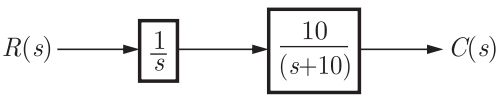
Q.5 Consider the systems shown below. If the forward path gain is reduced by 10% in each system then the variation in C_1 and C_2 will be respectively



(A) 10% and 1% (B) 2% and 10%

(C) 0% and 0% (D) 5% and 1%

Q.6 A system is shown in below. The rise time and settling time for this system is



(A) 0.22 s, 0.4 s (B) 0.4 s, 0.22 s

(C) 0.12 s, 0.4 s (D) 0.4 s, 0.12 s

Q.7 Two infinitely long parallel filaments each carry 100 A in the $\mathbf{u}_z$ direction. If the filaments lie in the plane $y = 0$ at $x = 0$ and $x = 5$ mm, the force on the filament passing through the origin is

(A) $0.4\mathbf{u}_x$ N/m (B) $-0.4\mathbf{u}_x$ N/m

(C) $4\mathbf{u}_x$ mN/m (D) $-4\mathbf{u}_x$ mN/m

Q.8 The phasor magnetic field intensity for a 400 MHz uniform plane wave propagating in a certain lossless material is $(6\mathbf{u}_y - j5\mathbf{u}_z)\, e^{-j18x}$ A/m. The phase velocity v_ρ is

(A) 6.43×10^6 m/s (B) 2.2×10^7 m/s

(C) 1.4×10^8 m/s (D) None of the above

Q.9 A mast antenna consisting of a 50 meter long vertical conductor operates over a perfectly conducting ground plane. It is base-fed at a frequency of 600 kHz. The radiation resistance of the antenna in Ohm is

(A) $\frac{2\pi^2}{5}$ (B) $\frac{\pi^2}{5}$

(C) $\frac{4\pi^2}{5}$ (D) $20\pi^2$

Q.10 A carrier is simultaneously modulated by two sine waves with modulation indices of 0.4 and 0.3. The resultant modulation index will be

(A) 1.0 (B) 0.7

(C) 0.5 (D) 0.35

Q.11 An FM wave use a 2-5 V, 500 Hz modulating frequency and has a modulation index of 50. The deviation is

(A) 500 Hz (B) 1000 Hz

(C) 1250 Hz (D) 25000 Hz

Q.12 A fast FH/MFSK system has the following parameters.
Number of bits per MFSK symbol = 4
Number of pops per MFSK symbol = 4
The processing gain of the system is

(A) 0 dB (B) 7 dB

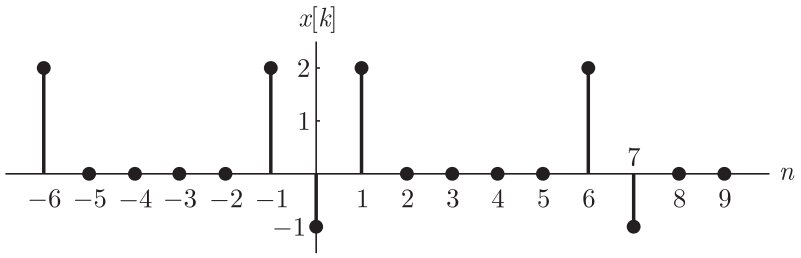
(C) 9 dB (D) 12 dB

Q.13 The Fourier transform of signal $sgn(t)$ is

(A) $\frac{-2}{j\omega}$ (B) $\frac{4}{j\omega}$

(C) $\frac{2}{j\omega}$ (D) $\frac{1}{j\omega}+1$

Q.14 The DTFS coefficient of a signal $x[n]$ is as show below



The signal $x[n]$ is

(A) $2\sin\left(\frac{\pi}{7}n\right)-1$ (B) $2\cos\left(\frac{\pi}{7}n\right)-1$

(C) $4\sin\left(\frac{2\pi}{7}n\right)-1$ (D) $4\cos\left(\frac{2\pi}{7}n\right)-1$

Q.15 The impulse response of a continuous-time LTI system is $h(t)=e^{-6t}u(3-t)$. The system is

(A) causal and stable (B) causal but not stable

(C) stable but not causal (D) neither causal nor stable

Q.16 A combinational circuit has input A, B, and C and its K-map is as shown below. The output of the circuit is given by

A \ CD	00	01	11	10
00		1		1
01	1		1	

(A) $(\overline{A}B+A\overline{B})\,\overline{C}$ (B) $(AB+\overline{A}\,\overline{B})\,\overline{C}$

(C) $\overline{A}\,\overline{B}\,\overline{C}$ (D) $A\oplus B\oplus C$

Q.17 A n bit A/D converter is required to convert an analog input in the range of $0-5$ V to an accuracy of 10 mV. The value of n should be

(A) 8 (B) 10

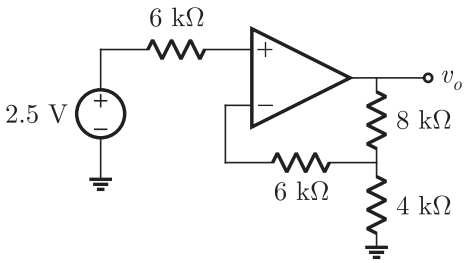
(C) 9 (D) 16

Q.18 What is addition of $(-64)_{10}$ and $(80)_{16}$?

(A) $(-16)_{10}$ (B) $(16)_{10}$

(C) $(1100000)_2$ (D) $(01000000)_2$

Q.19 For the circuit shown below the value of v_o is



(A) -7.5 V (B) 7.5 V

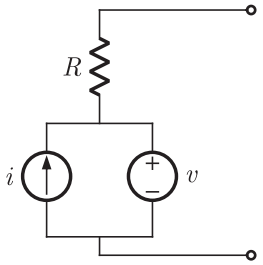
(C) 8 V (D) -8 V

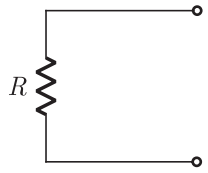
Q.20 In order to form a structure containing both pnp and npn transistors, monolithic IC requires

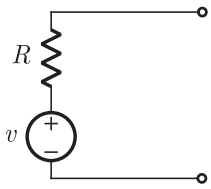
(A) 3 layers (B) 4 layers

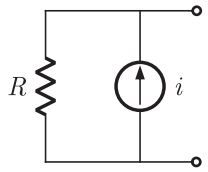
(C) 5 layers (D) 6 layers

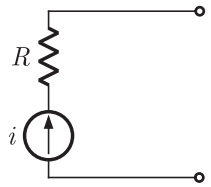
Q.21 A simple equivalent circuit of the 2 terminal network shown in figure is



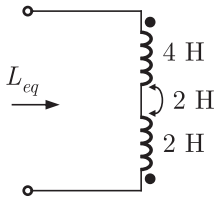
(A) 

(B) 

(C) 

(D) 

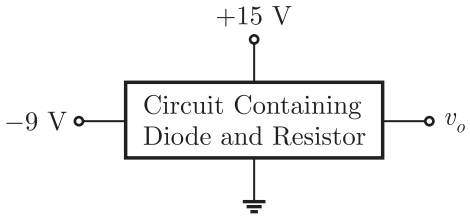
Q.22 The equivalent inductance L_{eq} is



(A) 2 H (B) 4 H

(C) 6 H (D) 8 H

Q.23 The circuit inside the box in figure shown below contains only resistor and diodes. The terminal voltage v_o is connected to some point in the circuit inside the box.



The largest and smallest possible value of v_o most nearly to is respectively

(A) 15 V, 6 V (B) 24 V, 0 V

(C) 24 V, 6 V (D) 15 V, −9 V

Q.24 Which of the following amplifier has high input resistance and high output resistance

(A) Common-source

(B) Common-drain

(C) Common-gate

(D) None of these

Q.25 A lag compensation network

(A) increases the gain of the original network without affecting stability.

(B) reduces the steady state error.

(C) reduces the speed of response

(D) permits the increase of gain of phase margin is acceptable.

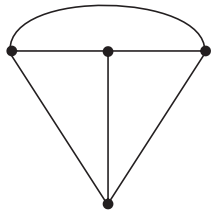
In the above statements, which are correct

(A) a and b (B) b and c

(C) b,c, and d (D) all

Q. 26- Q. 55 carry two mark each.

Q.26 The graph of a network is shown below. The number of possible tree are



(A) 8 (B) 12

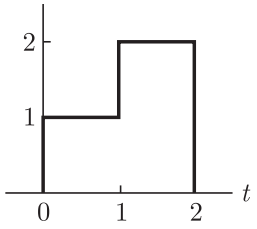
(C) 16 (D) 20

Q.27 For the signal $x(t)$ as below

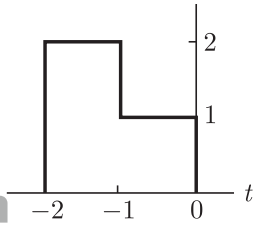
$x(t) = u(t) + u(t+1) - 2u(t+2)$

The correct waveform is

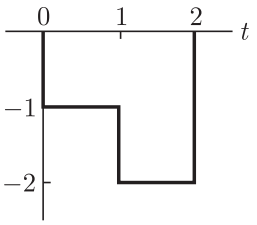
(A)



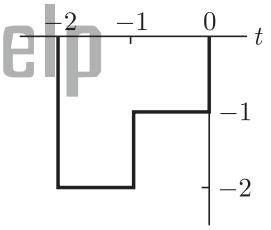
(B)



(C)



(D)



Q.28 An 8085 executes the following instructions

2710	LXI H,	30A0 H
2713	DAD	H
2714	PCHL	

All address and constants are in Hex. Let PC be the contents of program counter and HL be the contents of the HL register pair just after executing PCHL. Which of the following statements is correct ?

(A) PC = 2715 H
HL = 30A0H

(B) PC = 30A0H
HL = 2715H

(C) PC = 6140H
HL = 6140H

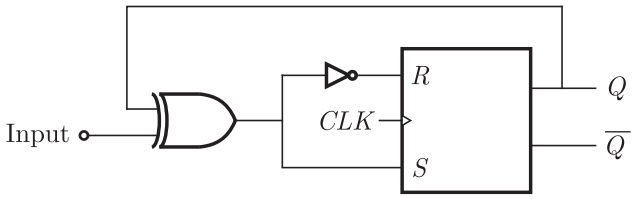
(D) PC = 6140H
HL = 2715H

Q.29 The minimum number of NOR gates required to implement $A(A+\overline{B})(A+\overline{B}+C)$ is equal to

(A) 0 (B) 3

(C) 4 (D) 7

Q.30 Consider a circuit shown in figure. The circuit functions as



(A) D-flip-flop (B) T-flip-flop

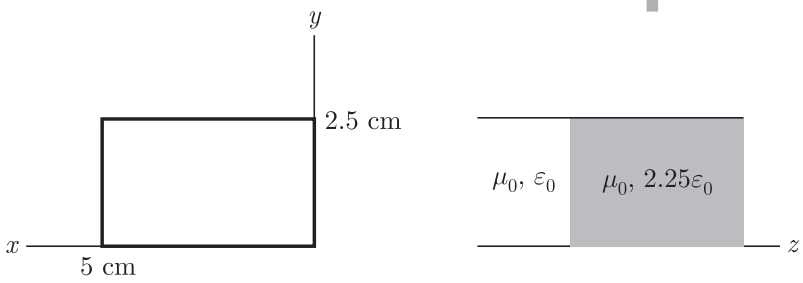
(C) Output remains stable at '1' (D) Output remains stable at '0'

Q.31 A 81 Ω lossless planer line was designed but did not meet a requirement. To get the characteristic impedance of 75 Ω the fraction of the width of the strip should be

(A) added by 4% (B) removed by 4%

(C) added by 8% (D) removed by 8%

Q.32 The cross section of a waveguide is shown in fig. It has dielectric discontinuity as shown in fig. If the guide operate at 8 GHz in the dominant mode, the standing wave ratio is



(A) -3.911 (B) 2.468

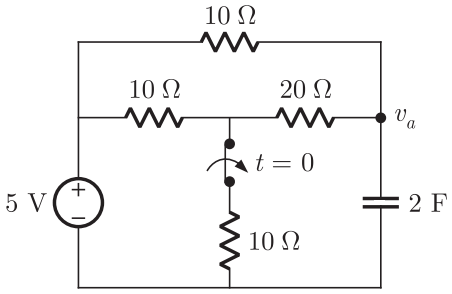
(C) 1.564 (D) 4.389

Q.33 A point charge of 2×10^{-16} C and 5×10^{-26} kg is moving in the combined fields $\mathbf{B}=-3\mathbf{u}_x+2\mathbf{u}_y-\mathbf{u}_z$ mT and $\mathbf{E}=100\mathbf{u}_x-200\mathbf{u}_y-300\mathbf{u}_z$ V/m. If the charge velocity at $t=0$ is $\mathbf{v}(0)=(2\mathbf{u}_x-3\mathbf{u}_y-4\mathbf{u}_z)10^5$ m/s, the acceleration of charge at $t=0$ is

(A) $600[3\mathbf{u}_x+2\mathbf{u}_y-3\mathbf{u}_z]10^9$ m/s^2 (B) $400[6\mathbf{u}_x+6\mathbf{u}_y-3\mathbf{u}_z]10^9$ m/s^2

(C) $400[6\mathbf{u}_x-6\mathbf{u}_y+3\mathbf{u}_z]10^9$ m/s^2 (D) $800[6\mathbf{u}_x+6\mathbf{u}_y-\mathbf{u}_z]10^9$ m/s^2

Q.34 In the circuit shown below a steady state is reached with switch open. At $t = 0$ the switch is closed. The value of $v_a(\infty)$ is



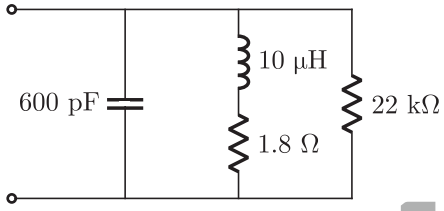
(A) $\frac{30}{7}$ V

(B) $-\frac{30}{7}$ V

(C) $\frac{40}{7}$ V

(D) $-\frac{40}{7}$ V

Q.35 For the circuit shown below the resonant frequency f_0 is



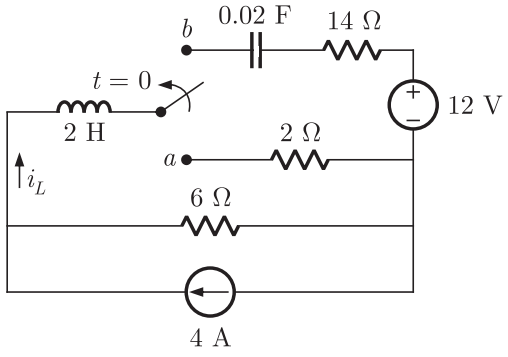
(A) 12.9 kHz

(B) 12.9 MHz

(C) 2.05 MHz

(D) 2.05 kHz

Q.36 In the circuit shown below switch is moved from position a to b at $t = 0$.



The $i_L(t)$ for $t > 0$ is

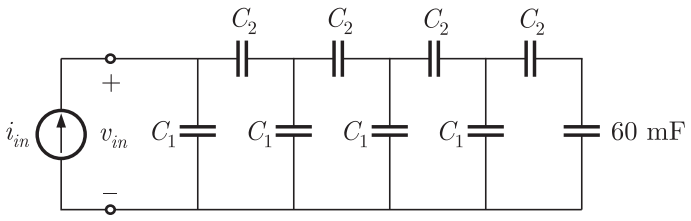
(A) $(4 - 6t)\, e^{4t}$ A

(B) $(3 - 6t)\, e^{-4t}$ A

(C) $(3 - 9t)\, e^{-5t}$ A

(D) $(3 - 8t)\, e^{-5t}$

Q.37 In the circuit shown in figure $i_{in}(t) = 300\sin 20t$ mA, for $t \geq 0$.



Let $C_1 = 40$ μF and $C_2 = 30$ μF. All capacitors are initially uncharged. The $v_{in}(t)$ would be

(A) $-0.25\cos 20t$ V

(B) $0.25\cos 20t$ V

(C) $-36\cos 20t$ mV

(D) $36\cos 20t$ mV

Q.38 The thermal-equilibrium concentration of hole p_0 in silicon at $T = 300$ K is 10^{15} cm^{-3} . The value of n_0 is

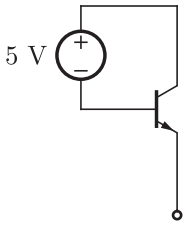
(A) 3.8×10^8 cm^{-3}

(B) 4.4×10^4 cm^{-3}

(C) 2.6×10^4 cm^{-3}

(D) 4.3×10^8 cm^{-3}

Q.39 For the transistor in circuit shown below, $I_s = 10^{-15}$ A, $\beta_F = 100$, $\beta_R = 1$. The current I_{CBO} is



(A) 1.01×10^{-14} A

(B) 2×10^{-14} A

(C) 1.01×10^{-15} A

(D) 2×10^{-15} A

Q.40 Consider the three LTI systems with impulse response

$h_1(t) = u(t)$, $h_2(t) = -2\delta(t) + 5e^{-2t}u(t)$, $h_3(t) = 2te^{-t}u(t)$

The response to $x(t) = \cos t$ of above systems are

$y_1(t) = x(t) * h_1(t)$, $y_2(t) = x(t) * h_2(t)$, $y_3(t) = x(t) * h_3(t)$

The same response are

(A) All $y_1(t), y_2(t)$, and $y_3(t)$

(B) $y_2(t)$ and $y_2(t)$

(C) $y_2(t)$ and $y_3(t)$

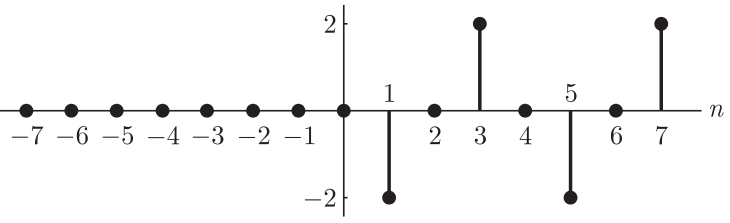
(D) $y_3(t)$ and $y_2(t)$

Q.41 For a discrete periodic signal $x[n]$ with period $N = 8$ and Fourier coefficients a_k it is given that

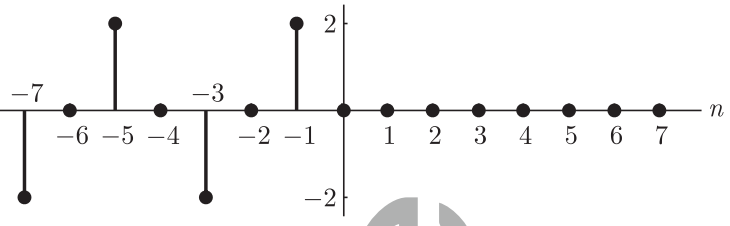
1. $a_k = -a_{k-4}$
2. $x[2n+1] = (-1)^n$

The signal $x[n]$ is

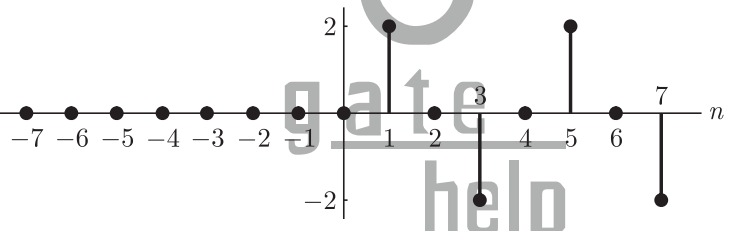
(A)



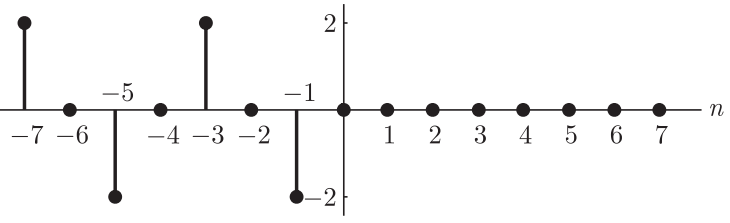
(B)



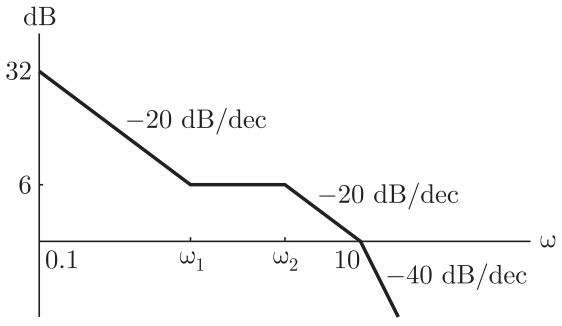
(C)



(D)



Q.42 Consider the asymptotic Bode plot of a minimum phase linear system in fig. The transfer function is



(A) $\dfrac{8s(s+2)}{(s+5)(s+10)}$ (B) $\dfrac{4(s+5)}{(s+2)(s+10)}$

(C) $\dfrac{4(s+2)}{s(s+5)(s+10)}$ (D) $\dfrac{8s(s+5)}{(s+2)(s+10)}$

Q.43 A DSB-SC signal is to be generated with a carrier frequency $f_c = 1$ MHz using a non-linear device with the input-output characteristic $v_o = a_0 v_i + a_1 v_i^3$ where a_0 and a_1 are constants. The output of the non-linear device can be filtered by an appropriate band-pass filter. Let $v_i = A_c^{'}\cos(2\pi f_c^{'} t) + m(t)$ where $m(t)$ is the message signal. Then the value of $f_c^{'}$ (in MHz) is

(A) 1.0 (B) 0.333

(C) 0.5 (D) 3.0

Q.44 If $z = z(u,v), u = x^2 - 2xy - y^2, v = a$, then

(A) $(x+y)\dfrac{\partial z}{\partial x} = (x-y)\dfrac{\partial z}{\partial y}$ (B) $(x-y)\dfrac{\partial z}{\partial x} = (x+y)\dfrac{\partial z}{\partial y}$

(C) $(x+y)\dfrac{\partial z}{\partial x} = (y-x)\dfrac{\partial z}{\partial y}$ (D) $(y-x)\dfrac{\partial z}{\partial x} = (x+y)\dfrac{\partial z}{\partial y}$

Q.45 The solution of the differential equation $xdy - ydx = \sqrt{x^2+y^2}\,dx$ is given by

(A) $y = \dfrac{c_1}{x} + \sqrt{x^2 - y^2}$ (B) $y = c_2 x^2 - \sqrt{x^2+y^2}$

(C) $y = \dfrac{c_3}{x^2} + \dfrac{1}{\sqrt{x^2+y^2}}$ (D) $y = \dfrac{c_4}{x} - \dfrac{1}{\sqrt{x^2-y^2}}$

Q.46 $\displaystyle\int_c \frac{1-2z}{z(z-1)(z-2)}\,dz = ?$ where c is the circle $|z| = 15$

(A) $2 + i6\pi$ (B) $4 + i3\pi$

(C) $1 + i\pi$ (D) $i3\pi$

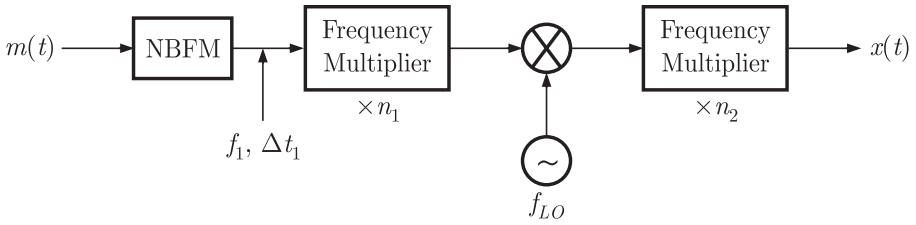
Q.47 If the sum of mean and variance of a binomial distribution is 4.8 for five trials, the distribution is

(A) $\left(\dfrac{1}{5} + \dfrac{4}{5}\right)^5$ (B) $\left(\dfrac{1}{3} + \dfrac{2}{3}\right)^5$

(C) $\left(\dfrac{2}{5} + \dfrac{3}{5}\right)^5$ (D) None of these

Common Data for 48-49 :

A block diagram of an Armstrong FM transmitter is shown in fig. The parameter are as follows : $f_1 = 200$ kHz, $f_{LO} = 10.8$ MHz. $\triangle f_1 = 25$ Hz, $n_1 = 64$, $n_2 = 48$



Q.48 The maximum frequency deviation at the output of the FM transmitter is

(A) 100.6 kHz (B) 76.8 kHz

(C) 43.2 kHz (D) None of the above

Q.49 At output of the transmitter the carrier frequency is 5

(A) 96 MHz (B) 12.8 MHz

(C) 48 MHz (D) 132.4 MHz

Common Data for Q. 50-51

A 50 Ω, 8.4 m long lossless line operates at 150 MHz. The input impedance at the middle of the line is $80 - j60\,\Omega$. The phase velocity is $0.8c$.

Q.50 The input impedance at the generator is

(A) $40.3 + j38.4\,\Omega$ (B) $21.6 - j20.3\,\Omega$

(C) $43.2 - j40.3\,\Omega$ (D) $80.3 + j76.8\,\Omega$

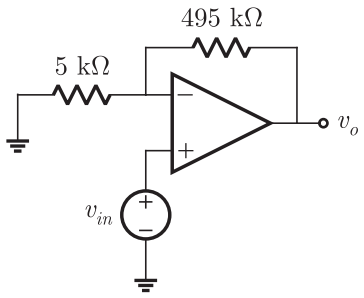
Q.51 The voltage reflection coefficient at the load is

(A) $0.468\angle -6.34^\circ$ (B) $0.468\angle 6.34^\circ$

(C) $0.468\angle -38.66^\circ$ (D) $0.468\angle 51.34^\circ$

Common Data Q. 52-53 :

Consider an op-amp circuit shown in figure below



Q.52 If open loop gain of op-amp is $A_{ol} = 10^5$, then closed loop gain A_{CL} is

(A) 100 (B) 99.90

(C) 98.90 (D) 99

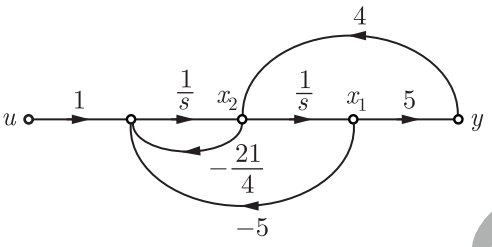
Q.53 If open loop gain decreases by 100%, then change in closed loop gain will be

(A) 0.99% (B) 0.01%

(C) 1.01% (D) 10%

Common Data Q. 54-55:

A state flow graph is shown below



Q.54 The state and output equation for this system is

(A) $\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix} = \begin{bmatrix}0 & -1\\ 5 & \frac{21}{4}\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix} + \begin{bmatrix}0\\ 1\end{bmatrix}u,\ y = \begin{bmatrix}5 & 4\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}$

(B) $\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix} = \begin{bmatrix}0 & 1\\ -5 & -\frac{21}{4}\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix} + \begin{bmatrix}0\\ 1\end{bmatrix}u,\ y = \begin{bmatrix}5 & 4\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}$

(C) $\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix} = \begin{bmatrix}0 & 1\\ -5 & -\frac{21}{4}\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix} + \begin{bmatrix}1\\ 1\end{bmatrix}u,\ y = \begin{bmatrix}4 & 5\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}$

(D) $\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix} = \begin{bmatrix}0 & 1\\ -5 & -\frac{21}{4}\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix} + \begin{bmatrix}1\\ 1\end{bmatrix}u,\ y = \begin{bmatrix}4 & 5\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}$

Q.55 The system is

(A) Observable and controllable (B) Controllable only

(C) Observable only (D) None of the above

General Aptitude(GA)Questions

Q.56- Q 60 carry one mark each

Q.56 Which of the following options is the closet in meaning to the word given below
Ruse

(A) trick (B) pause

(C) fault (D) pattern

Q.57 In the following series, what number should come next ?
3, 4, 7, 8, 11, 12, ...

(A) 7 (B) 10

(C) 14 (D) 15

Q.58 Which word does NOT belong withe the others ?

(A) branch (B) dirt

(C) leaf (D) root

Q.59 Let p, q and r be distinct integers that are odd and positive. Which of the following statements can be true ?

(A) pqr is even (B) pq+qr+rp is even

(C) pq+qr+p+q is odd (D) none of these

Q.60 The sum of series $-1+1^2-2+2^2-3+3^2+\ldots\ldots-n+n^2$ is

(A) $\frac{-n(n+1)}{3}$ (B) $\frac{n(n+1)(n-1)}{3}$

(C) $\frac{n(n-1)}{3}$ (D) none of these

Q. 61-65 carry two marks each

Q.61 The increasing scarcity of available rental housing, particularly apartment with two or more bedrooms, is attributable to two recent trends : the increasing number of new office buildings as compared to new apartment buildings and the increasing number of rental apartments being sold as condominiums rather than rented.
The passage above best supports which of the following conclusions ?

A. The rate at which new apartment building are being built is decreasing.

B. The current demand for reasonably priced rental housing is greater than the current supply.

C. Most rental apartments being sold as condominiums have at least two bedrooms.

D. More new office buildings than rental apartment buildings are currently being built.

Q.62 A person can complete a work in 12 days. After he works for some days, one more person of equal capacity joins him and they completed the work together in 3 days earlier. After how many days the other person did join him?

(A) 2 (B) 4

(C) 6 (D) 8

Q.63 An amount was to be divided between P and Q in the ratio 3 : 2. Somehow it was found that P got one fifth of the total amount more than his expected share. In what ratio was the amount divided between P and Q ?

(A) 5 : 2 (B) 2 : 1

(C) 2 : 5 (D) 4 : 1

Q.64 Here are some words translated from an artificial language.
moolokarn means blue sky
wilkospadi means bicycle race
moolowilko means blue bicycle
Which word could means " racecar"

(A) wilkozwet (B) spadiwilko

(C) moolobreil (D) spadivolo

Q.65 Blueberries cost more than strawberries.
Blue berries cost lest than raspberries.
Raspberries cost more than both strawberries and blueberries.
If the first two statements are true, the third statement is

(A) true (B) false

(C) uncertain. (D) can not be determined

END OF THE QUESTION PAPER

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