Q. No. 1 – 25 Carry One Mark Each

1.   A bulb in a staircase has two switches, one switch being at the ground floor and the other one at the first floor. The bulb can be turned ON and also can be turned OFF by any one of the switches irrespective of the state of the other switch. The logic of switching of the bulb resembles

   (A) an AND gate   (B) an OR gate   (C) an XOR gate   (D) a NAND gate

Answer: (C)

2.   Consider a vector field $A(r)$. The closed loop line integral $\oint A \cdot dl$ can be expressed as

   (A) $\iint (\nabla \times A) \cdot ds$ over the closed surface bounded by the loop

   (B) $\iiint (\nabla \cdot A) dv$ over the closed volume bounded by the loop

   (C) $\iiint (\nabla \cdot A) dv$ over the open volume bounded by the loop

   (D) $\iint (\nabla \times A) \cdot ds$ over the closed surface bounded by the loop

Answer: (D)

3.   Two systems with impulse responses $h_1(t)$ and $h_2(t)$ are connected in cascade.

Then the overall impulse response of the cascaded system is given by

(A) Product of $h_1(t)$ and $h_2(t)$

(B) Sum of $h_1(t)$ and $h_2(t)$

(C) Convolution of $h_1(t)$ and $h_2(t)$

(D) Subtraction of $h_2(t)$ from $h_1(t)$

Answer: (C)

4. In a forward biased pn junction diode, the sequence of events that best describes the mechanism of current flow is

(A) injection, and subsequent diffusion and recombination of minority carriers

(B) injection, and subsequent drift and generation of minority carriers

(C) extraction, and subsequent diffusion and generation of minority carriers

(D) extraction, and subsequent drift and recombination of minority carriers

Answer: (A)

5. In IC technology, dry oxidation (using dry oxygen) as compared to wet oxidation (using steam or water vapor) produces

(A) superior quality oxide with a higher growth rate

(B) inferior quality oxide with a higher growth rate

(C) inferior quality oxide with a lower growth rate

(D) superior quality oxide with a lower growth rate

Answer: (D)

|EC-GATE-2013 PAPER|

6. The maximum value of θ until which the approximation $\sin\theta \approx \theta$ holds to within 10% error is

(A) 10° (B) 18° (C) 50° (D) 90°

Answer: (C)

7. The divergence of the vector field $A = x\hat{a}_x + y\hat{a}_y + z\hat{a}_z$ is
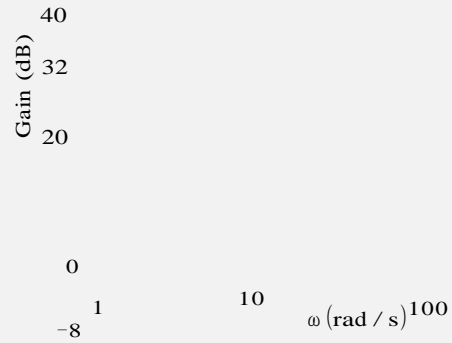
(A) 0 (B) 1/3 (C) 1 (D) 3

Answer: (D)

8. The impulse response of a system is $h(t) = t\,u(t)$. For an input $u(t-1)$, the output is

(A) $\dfrac{t^2}{2}u(t)$ (B) $\dfrac{t(t-1)}{2}u(t-1)$ (C) $\dfrac{(t-1)^2}{2}u(t-1)$ (D) $\dfrac{t^2-1}{2}u(t-1)$
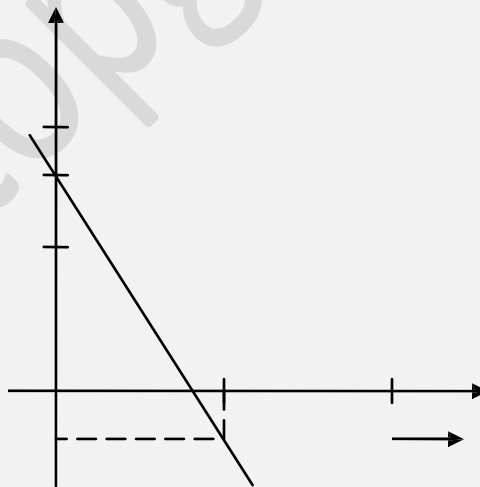
Answer: (C)

9. The Bode plot of a transfer function G (s) is shown in the figure below

Gain (dB)

40

32

20

0

−8

1

10

$\omega \, (\text{rad} / \text{s})$

100

The gain $\left(20 \log \left|G\left(s\right)\right|\right)$ is 32 dB and −8 dB at 1 rad/s and 10 rad/s respectively. The phase is negative for all ω. The G(s) is
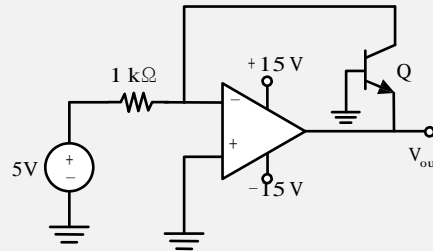
(A) $\dfrac{39.8}{s}$

(B) $\dfrac{39.8}{s^2}$

(C) $\dfrac{32}{s}$

(D) $\dfrac{32}{s^2}$

Answer: (B)

10. In the circuit shown below what is the output voltage (V_{out}) if a silicon transistor Q and an ideal op-amp are used?

(A) −15V   (B) −0.7V   (C) +0.7V   (D) +15V

Answer: (B)

11. Consider a delta connection of resistors and its equivalent star connection as shown below. If all elements of the delta connection are scaled by a factor k, k> 0, the elements of the corresponding star equivalent will be scaled by a factor of

(A) k^2 (B) k   (C) 1/k   (D) $\sqrt{k}$

Answer: (A)

12. For 8085 microprocessor, the following program is executed

        MVI A, 05H;

        MVIB, 05H;

PTR: ADD B;

        DCR B;

        JNZ PTR;

        ADI 03H;

        HLT;

At the end of program, accumulator contains

(A) 17 H   (B) 20 H   (C) 23 H   (D) 05 H

Answer: (A)

13. The bit rate of a digital communication system is R kbits/s. The modulation used is 32-QAM. The minimum bandwidth required for ISI free transmission is

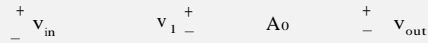(A) R/10 Hz (B) R/10 kHz (C) R/5 Hz (D) R/5 kHz
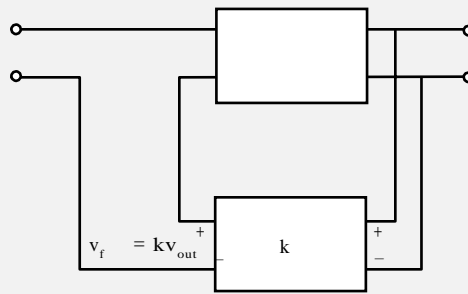
Answer: (B)

14. For a periodic signal $v(t) = 30\sin 100t + 10\cos 300t + 6\sin(500t + \pi/4)$, the fundamental frequency in rad/s

    (A) 100   (B) 300   (C) 500   (D) 1500

Answer: (A)

15. In a voltage-voltage feedback as shown below, which one of the following statements is TRUE if the gain k is increased?

$$\overset{+}{\underset{-}{}}\ v_{in} \qquad v_1 \overset{+}{\underset{-}{}} \qquad A_0 \qquad \overset{+}{\underset{-}{}}\ v_{out}$$

$v_f = kv_{out}$ k

(A) The input impedance increases and output impedance decreases

(B) The input impedance increases and output impedance also increases

(C) The input impedance decreases and output impedance also decreases

(D) The input impedance decreases and output impedance increases

Answer: (A)

16. A band-limited signal with a maximum frequency of 5 kHz is to be sampled. According to the sampling theorem, the sampling frequency which is not valid is

(A) 5 kHz   (B) 12 kHz   (C) 15 kHz   (D) 20 kHz

Answer: (A)

17. In a MOSFET operating in the saturation region, the channel length modulation effect causes

(A) an increase in the gate-source capacitance

(B) a decrease in the transconductance

(C) a decrease in the unity-gain cutoff frequency

(D) a decrease in the output resistance

Answer: (D)

18. Which one of the following statements is NOT TRUE for a continuous time causal and stable LTI system?

(A) All the poles of the system must lie on the left side of the $j\omega$ axis

(B) Zeros of the system can lie anywhere in the s-plane

(C) All the poles must lie within $|s| = 1$

(D) All the roots of the characteristic equation must be located on the left side of the $j\omega$ axis

Answer: (C)

EC-GATE-2013 PAPER|

19. The minimum eigen value of the following matrix is

$$\begin{bmatrix} 3 & 5 & 2 \\ 5 & 12 & 7 \\ 2 & 7 & 5 \end{bmatrix}$$

(A) 0   (B) 1   (C) 2   (D) 3

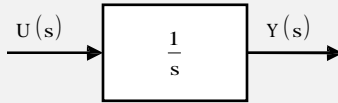Answer: (A)

20. A polynomial $f(x) = a_4 x^4 + a_3 x^3 + a_2 x^2 + a_1 x + a_0$ with all coefficients positive has

(A) no real roots

(B) no negative real root

(C) odd number of real roots

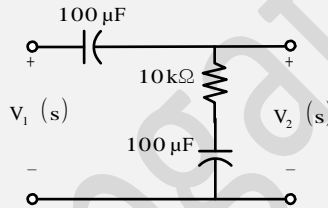(D) at least one positive and one negative real root

Answer: (D)

21. Assuming zero initial condition, the response y(t) of the system given below to a unit step input u(t) is

(A) $u(t)$ (B) $tu(t)$ (C) $\dfrac{t^2}{2}u(t)$ (D) $e^{-t}u(t)$

Answer: (B)

22. The transfer function $\dfrac{V_2(s)}{V_1(s)}$ of the circuit shown below is

(A) $\dfrac{0.5s+1}{s+1}$ (B) $\dfrac{3s+6}{s+2}$ (C) $\dfrac{s+2}{s+1}$ (D) $\dfrac{s+1}{s+2}$

Answer: (D)

23. A source $v_s(t) = V\cos 100\pi t$ has an internal impedance of $(4+j3)\Omega$. If a purely resistive load connected to this source has to extract the maximum power out of the source, its value in Ω should be

(A) 3   (B) 4   (C) 5   (D) 7

Answer: (C)

24. The return loss of a device is found to be 20 dB. The voltage standing wave ratio (VSWR) and magnitude of reflection coefficient are respectively

(A) 1.22 and 0.1   (B) 0.81 and 0.1   (C) −1.22 and 0.1   (D) 2.44 and 0.2

Answer: (A)

25. Let $g(t) = e^{-\pi t^2}$, and h(t) is a filter matched to g(t). If g(t) is applied as input to h(t), then the Fourier transform of the output is

(A) $e^{-\pi f^2}$ (B) $e^{-\pi f^2/2}$ (C) $e^{-\pi|f|}$ (D) $e^{-2\pi f^2}$

Answer: (D)

Q. No. 26 − 55 Carry Two Marks Each

26. Let U and V be two independent zero mean Gaussian random variables of variances $\frac{1}{4}$ and $\frac{1}{9}$ respectively,. The probability $P(3V \geq 2U)$ is

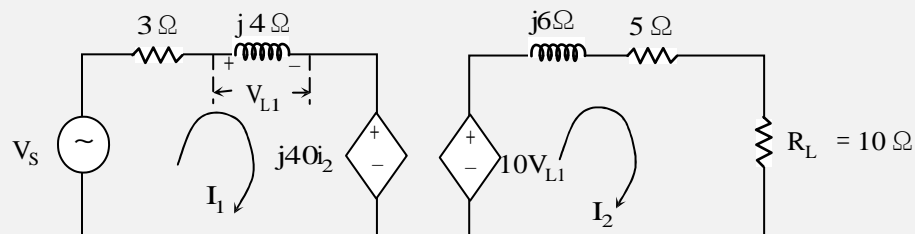(A) 4/9   (B) 1/2   (C) 2/3   (D) 5/9

Answer: (B)

27. Let A be an m x n matrix and B an n x m matrix. It is given that determinant $(I_m + AB) = $ determinant $(I_n + BA)$, where I_k is the $k \times k$ identity matrix. Using the above property, the determinant of the matrix given below is

$$\begin{bmatrix} 2 & 1 & 1 & 1 \\ 1 & 2 & 1 & 1 \\ 1 & 1 & 2 & 1 \\ 1 & 1 & 1 & 2 \end{bmatrix}$$

(A) 2   (B) 5   (C) 8   (D) 16

Answer: (B)

28. In the circuit shown below, if the source voltage $V_S = 100 \angle 53.13^O V$ then the Thevenin's equivalent voltage in Volts as seen by the load resistance R_L is

(A) $100 \angle 90^O$ (B) $800 \angle 0^O$ (C) $800 \angle 90^O$ (D) $100 \angle 60^O$

Answer: (C)