1. A square matrix which is equal to its transpose multiplied by -1 is called a
   a. Adjoint of a matrix
   b. Skew-symmetric matrix
   c. Row-Echelon matrix
   d. Sub-matrix

2. The line integral of a tangential component of a vector field $\vec{F}$ taken around a simple closed curve C is equal to the
   a. Surface integral of the normal component of the curl of $\vec{F}$ taken over any open surface S having C as its boundary.
   b. Surface integral of the normal component of the curl of $\vec{F}$ taken over any open surface S.
   c. Surface integral of the normal component of a vector point function $\vec{F}$ over a closed surface S enclosed by surface S.
   d. Surface integral of the normal component of a vector point function $\vec{F}$ over a closed surface S.

3. What is the laplace transform of the first derivative of a function y(t) with respect to t : y'(t)?
   a. $sy(0) - Y(s)$
   b. $sY(s) - y(0)$
   c. $s^2 Y(s) - sy(0) - y'(0)$
   d. $s^2 Y(s) - sy'(0) - y(0)$

4. An urn A contains 2 white and 5 black balls, and an urn B contains 5 black and 6 white balls. Find the probability that at least one ball is white when one ball each is drawn at random from the urn A and B.
   a. 10/77
   b. 5/11
   c. 5/7
   d. 52/77

5. The number of telephone calls arriving on an internal switch board of an office is 90 per hour. Find the probability that at the most 1 to 3 calls arrive in the board in a minute.
   a. 0.711
   b. 0.722
   c. 0.705
   d. 0.745

6. Let x(t) be the input to a LTI system. The required output is 4x(t-2). The transfer function of the system should be
   a. $4e^{j4\pi f}$
   b. $2e^{-j8\pi f}$
   c. $4e^{-j4\pi f}$
   d. $2e^{j8\pi f}$

7. The z transform of a system is $H(z) = \frac{z}{z-0.2}$. If the ROC is $|z| < 0.2$, then the impulse response of the system is
   a. $(0.2)^n u[n]$
   b. $(0.2)^n u[-n-1]$
   c. $-(0.2)^n u[n]$
   d. $-(0.2)^n u[-n-1]$

8. If a system does not have a bounded output for bounded input, then the system is said to be:
   a. Causal
   b. Non-causal
   c. Stable
   d. Non-stable

9. The lack of precise control of cutoff frequencies is a disadvantage of which of the following designs?

    a. Window design

    b. Chebyshev approximation

    c. Frequency sampling

    d. None of the mentioned

10. The four-point discrete Fourier transform (DFT) of a discrete-time sequence {1, 0, 2, 3} is

    a. [0, -2+ 2j, 2, -2]

    b. [2, 2+2j, 6, 2-2j]

    c. [6, 1-3j, 2, 1+3j]

    d. [6, -1+3j, 0, -1-3j]

11. Which of the following is the fastest light sensor?

    a. PIN photodiode

    b. Photovoltaic diode

    c. Photodiode

    d. Avalanche photodiode

12. Which factor/s play/s a crucial role in determining the speed of CMOS logic gate?

    a. Load capacitance

    b. Supply voltage

    c. Gain factor of MOS

    d. All the above

13. The h-parameter equivalent circuit of a BJT is valid for

    a. Large signal operation at low frequency

    b. Large signal operation at high frequency

    c. Small signal operation at high frequency

    d. Small signal operation at low frequency

14. Introducing a resistor in the emitter of a common emitter amplifier stabilizes the DC operating point against variations in

    a. Only the temperature

    b. Only the β of the transistor

    c. Both temperature and β

    d. None of these

15. An N–type silicon bar 0.1 cm long and 100 μm^2 in cross-sectional area has a majority carrier concentration of $5 \times 10^{20}/ m^3$ and the carrier mobility is 0.13 $m^2/$ V-s at 300 K. If the charge of an electron is 1.6×10^{-19} coulomb, then the resistance of the bar is

    a. 10^6 ohm

    b. 10^4 ohm

    c. 10^{-1} ohm

    d. 10^{-4} ohm

16. A three-stage amplifier with identical stages has overall lower and upper 3-dB cut-off frequencies of 10 Hz and 10 KHz, respectively. What is the band-width of the individual stages assuming that the stages are non-interactive stages?
   a. 19605 Hz
   b. 9990 Hz
   c. 21564 Hz
   d. 19500 Hz

17. The basic low-pass RC circuit has a 3-dB cut-off frequency of 3.5 kHz. If this circuit were fed at the input with a 20V step, in what time will the output rise to 12.6 V starting from the time of receiving the step?
   a. 43.7 µs
   b. 45.5 µs
   c. 55.5 µs
   d. 49.5 µs

18. An ideal sawtooth voltage waveform of frequency 500 Hz and amplitude 3 V is generated by charging a capacitor of 2 µF in every cycle. The charging requires
   a. Constant voltage source of 3 V for 1 ms
   b. Constant voltage source of 3 V for 2 ms
   c. Constant current source of 3 mA for 1 ms
   d. Constant current source of 3 mA for 2 ms

19. Given that the PSRR of an op-amp is 120dB. The supply lies between 12V to 15V. Calculate the change in the input offset voltage.
   a. 3µV
   b. ±3µV
   c. ±3×10-12V
   d. -3V

20. In the Zener controlled series regulator shown below, find the current through the Zener diode.
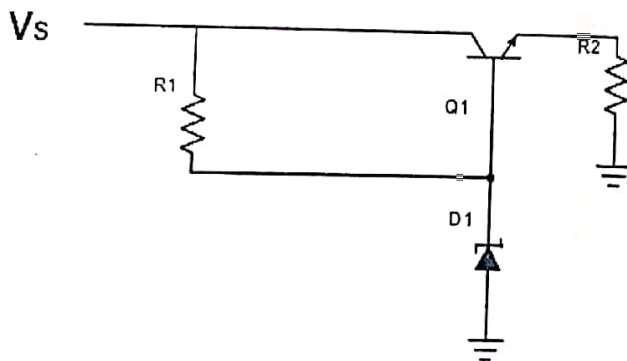
   Given that the Zener diode breakdown voltage is 5V, the source voltage is 15V, the output voltage is 10V, R4 = 2kΩ, β=99, R1=2kΩ.
   a. 5.05 mA
   b. 4.95 mA
   c. 3.33 mA
   d. 0

21. Product-of-Sums expressions can be implemented using
   a. 2-level OR-AND logic circuits
   b. 2-level NOR logic circuits
   c. 2-level XOR logic circuits
   d. Both 2-level OR-AND and NOR logic circuits

22. Which IC is used for the implementation of 1-to-16 DEMUX?

    a.   IC 74154
    b.   IC 74155
    c.   IC 74139
    d.   IC 74138

23. 11001, 1001 and 111001 correspond to the 2's complement representation of which one of the following sets of number?
    a.   25, 9 and 57, respectively
    b.   -7, -7 and -7, respectively
    c.   -6, -6 and -6, respectively
    d.   -25, -9 and -57, respectively

24. A four-bit ripple counter and a four-bit synchronous counter are made using flip-flops having a propagation delay of 10 ns each. If the worst-case delay in the ripple counter and the synchronous counter be R and S, respectively, then
    a.   R= 10 ns, S = 40 ns
    b.   R= 40 ns, S = 10 ns
    c.   R = 10 ns, S = 30 ns
    d.   R= 30 ns, S = 40ns

25. The simplified expression of full adder carry is
    a. $c = xy + xz + yz$
    b. $c = xy + xz$
    c. $c = xy + yz$
    d. $c = x + y + z$

26. In bilinear transformation, the left-half s-plane is mapped to which of the following in the z-domain?
    a.   Entirely outside the unit circle $|z|=1$
    b.   Partially outside the unit circle $|z|=1$
    c.   Partially inside the unit circle $|z|=1$
    d.   Entirely inside the unit circle $|z|=1$

27. What is the peak side lobe (in dB) for a rectangular window?
    a.   -13
    b.   -27
    c.   -32
    d.   -58

28. If a Nyquist plot of G (jω) H (jω) for a closed loop system passes through (-2, j0) point in GH plane, what would be the value of gain margin of the system in dB?
    a.   0 dB
    b.   2.0201 dB
    c.   4 dB
    d.   6.0205 dB

29. The closed loop transfer function of a unity negative feedback system is $100/(s2+8s+100)$. Its open loop transfer function is:
    a. $100/s+8$
    b. $1/s^2+8s$
    c. $100/s^2-8s$
    d. $100/s^2+8s$

30. An increase in gain, in most systems, leads to:
    a.   Smaller damping ratio
    b.   Larger damping ratio
    c.   Constant damping ratio
    d.   Zero damping ratio

31. A band-limited signal $x(t)$ is sampled using impulse train with period T such that there is no aliasing. The sampled signal is represented as $x_s(t)$, which is then converted to a sequence $x[n]$ such that $x[n] = x(nT)$. If E is the energy of the signal $x(t)$ and E_P is the energy of sequence $x[n]$, then the relation between E and E_P is

a. $E = E_P$

b. $E = \dfrac{E_P}{T}$

c. $E = \dfrac{E_P}{2}$

d. $E = T\, E_P$

32. The bandwidth of an FM signal in kilohertz, produced in a commercial FM broadcast with modulating signal frequency being in the range of 50 Hz to 15 kHz and the maximum allowable frequency deviation being 75 kHz, is

a. 200

b. 210

c. 450

d. 460

33. If the number of bits per sample in a PCM system is increased from n to n+1, the improvement in signal-to-quantization-noise ratio will be

a. 3 dB

b. 6 dB

c. 2n dB

d. n dB

34. A signal sampled at 8 KHz and is quantized using an 8-bit uniform quantizer. Assuming SNR_q for a sinusoidal signal, the correct statement for a PCM signal with a bit rate of R is

a. R is 32 kbps and $SNR_q = 25.8$ dB

b. R is 64 kbps and $SNR_q = 49.8$ dB

c. R is 64 kbps and $SNR_q = 55.8$ dB

d. R is 32 kbps and $SNR_q = 49.8$ dB

35. A BPSK scheme operating over an AWGN channel with noise power spectral density of $N_0/2$ uses equiprobable signals $s_1(t) = \sqrt{\dfrac{2E}{T}} \sin(\omega_c t)$ and $s_2(t) = -\sqrt{\dfrac{2E}{T}} \sin(\omega_c t)$ over the symbol interval (0,T), if the local oscillator in a coherent receiver is ahead in phase by 45^0 with respect to the received signal the probability of error in the resulting system is

a. $Q\sqrt{\dfrac{2E}{N_0}}$

b. $Q\sqrt{\dfrac{E}{N_0}}$

c. $Q\sqrt{\dfrac{E}{2N_0}}$

d. $Q\sqrt{\dfrac{E}{4N_0}}$

36. The number of memory cycles required to execute the following 8085 instructions

I. LDA 3000H

II. LXI D, FOF IH

Would be

a. 2 for (I) and 2 for (II)

b. 4 for (I) and 3 for (II)

c. 3 for (I) and 3 for (II)

d. 3 for (I) and 4 for (II)

37. Consider a transmission line of characteristic impedance 50Ω. Let it be terminated at one end by $(+j\ 50)\Omega$. The VSWR produced by it in the transmission line will be
    a. $+1$
    b. ∞
    c. 0
    d. $+j$

38. A rectangular waveguide of internal dimensions ($a = 4$ cm, $b = 3$cm) is to be operated in TE_{11} mode. The minimum operating frequency is
    a. 6.25 GHz
    b. 6 GHz
    c. 5 GHz
    d. 3.75 GHz

39. A tracking radar antenna with operational wavelength of 3 cm produces a pencil-like beam with both azimuth and elevation beam width equal to $0.5°$ each. Determine the approximate gain of antenna in decibel.
    a.   52 dB
    b.   48 dB
    c.   42 dB
    d.   40 dB

40. Does a TM_{01} mode exist in a rectangular waveguide?
    a. Yes, it exists.
    b. No, it does not.
    c. Yes, it exists only for very high values of cut-off wavelength.
    d. Yes, it exists only if the waveguide had a dielectric inserted in it.

Answer Key to PhD entrance ECE

Q.No.	Answer
1.	b
2.	a
3.	b
4.	d
5.	a
6.	c
7.	d
8.	d
9.	a
10.	d
11.	d
12.	d
13.	d
14.	c
15.	a
16.	a
17.	b
18.	d
19.	b
20.	b

Q.No.	Answer
21.	d
22.	a
23.	b
24.	b
25.	a
26.	d
27.	a
28.	d
29.	d
30.	a
31.	d
32.	b
33.	b
34.	b
35.	b
36.	b
37.	b
38.	a
39.	a
40.	b