

PET-2017 (Electronics and Communication Engg – Faculty of Engineering)

Roll No:

Date: 25 JUN 2017

Signature of the Candidate:

1. In a Karnaugh's map for an eight variable boolean function, a certain group corresponds to a term having two literals it should be a group of

- A) 64 B) 32 C) 128 D) 16

2. An N-type silicon bar 0.1 cm long and $100 \mu\text{m}^2$ in cross-sectional area has a majority carrier concentration of $5 \times 10^{20} / \text{m}^3$ and the carrier mobility is $0.13 \text{ m}^2 / \text{V-s}$ 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

3. For a P-N junction, match the type of breakdown with the phenomenon

- 1. Avalanche breakdown
- 2. Zener breakdown
- 3. Punch through
- a) Collision of carriers with crystal ions
- b) Early effect
- c) Rupture of covalent bond due to strong electric field

- A) 1-b, 2-a, 3-c
B) 1-c, 2-a, 3-b
C) 1-a, 2-b, 3-c
 D) 1-a, 2-c, 3-b

4. A Boolean function f of two variables x and y is defined as $f(0,0) = f(0,1) = f(1,1) = 1$; $f(1,0) = 0$. Assuming that complements of x and y are not available, a minimum cost solution for realizing x using only two input NOR gates and two inputs OR gates (each having unit cost) would have total cost of

- A) 1 unit B) 4 unit C) 3 unit D) 2 unit

5. The output Y of a two bit comparator is logic 1 whenever the two bit input A is greater than the two bit input B , the number of combinations for which the output is logic 1 is

- A) 4 B) 6 C) 8 D) 10



6. The change in forward-bias voltage for doubling the forward current of a germanium semiconductor at 290 K is

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- A) 17.3 mV
- B) 1.73 mV
- C) 20.5 mV
- D) 205 mV

7. A mod-32 synchronous counter will require

- A) Six flip flops and three AND gates
- B) Five flip flops
- C) Five flip flops and three AND gates
- D) None of these

8. With reference to 2K bit ROM organized as 256×8 array of memory cells, which one of the following statements is true

- A) It uses 256 rows of 8 cells each
- B) It uses 2048 memory cells and 8 line to 256 line address decoder
- C) Both (a) and (b) are correct
- D) None of these

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

- I. LDA 3000H
 - II. LXI D, FOF 1H
- 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)

10. When the gate-to-source voltage (V_{GS}) of a MOSFET with the threshold voltage of 400 mV, working in saturation is 900 mV, the drain current is observed to be 1 mA. Neglecting, the channel width modulation effect and assuming that the MOSFET is operating at saturation, the drain current for an applied V_{GS} of 1400 mV is

- A) 0.5 mA
- B) 2.0 mA
- C) 3.5 mA
- D) 4.0 mA

11. The spectral density of white noise is

- A) Exponential
- B) Uniform
- C) Poisson
- D) Gaussian



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12. 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.

13. A planar graph has five nodes and nine branches. The number of meshes in the dual graph is

- A) 5
- B) 4
- C) 14
- D) none of these

14. The internal resistance of a battery which has an open circuit voltage of 12V and delivers a current of 100A to a load resistance of 0.1Ω is

- A) 2Ω
- B) $200 \text{ m}\Omega$
- C) $20 \text{ m}\Omega$
- D) $2 \text{ m}\Omega$

15. The Fourier transform of a voltage signal $x(t)$ is $X(jf)$. The unit of $|X(jf)|$ is

- A) Volt
- B) Volt-s
- C) Volt/s
- D) Volt^2

16. Given $A = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ the state transition matrix e^{At} is given by

- A) $\begin{bmatrix} 0 & e^{-t} \\ e^{-t} & 0 \end{bmatrix}$
- B) $\begin{bmatrix} e^t & 0 \\ 0 & e^t \end{bmatrix}$
- C) $\begin{bmatrix} e^{-t} & 0 \\ 0 & e^{-t} \end{bmatrix}$
- D) $\begin{bmatrix} 0 & e^t \\ e^t & 0 \end{bmatrix}$

17. Noise with the uniform power spectral density of $N_0 \text{ W/Hz}$ is passed through a filter $H(\omega) = 2 \exp(-j\omega t_d)$ followed by an ideal low pass filter of bandwidth $B \text{ Hz}$. The output noise power in watts is

- A) $2 N_0 B$
- B) $4 N_0 B$
- C) $8 N_0 B$
- D) $16 N_0 B$

18. An AM signal and a narrow band FM signal with identical carriers, modulating signals and modulation indices of 0.1 are added together the resultant signal can be closely approximated by

- A) Broadband FM
- B) SSB with carrier
- C) DSBSC
- D) SSB without carrier



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19. 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

20. A BPSK scheme operating over an AWGN channel with noise power spectral density of $N_0/2$ uses equiprobable signals

$s_1(t) = \sqrt{\frac{2E}{T}} \sin(\omega_c t)$ and $s_2(t) = -\sqrt{\frac{2E}{T}} \sin(\omega_c t)$ over the symbol interval $(0, T)$, if the local oscillator in a coherent receiver is ahead in phase by 45° with respect to the received signal the probability of error in the resulting system is

- A) $Q\sqrt{\frac{2E}{N_0}}$
- B) $Q\sqrt{\frac{E}{N_0}}$
- C) $Q\sqrt{\frac{E}{2N_0}}$
- D) $Q\sqrt{\frac{E}{4N_0}}$

21. 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

22. In which of the following transistor configurations, is the input impedance least dependant on the load resistance?

- A) Common-emitter configuration
- B) Common-base configuration
- C) Common-collector configuration
- D) Common-emitter with unbypassed emitter resistance

23. The controller represented by transfer function $(s^2 + 11s + 30) / (s^2 + 17s + 30)$ is possibly a

- A) Lag controller
- B) Lead controller
- C) Lag-lead controller
- D) Derivative controller



24. The maximum peak-to-peak amplitude of the input signal of frequency 100 kHz for undistorted output is
- A) 15.9V B) 3.18V C) 2.12V D) Not possible
25. 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 μ s B) 45.5 μ s C) 55.5 μ s D) 49.5 μ s
26. The residues of $f(z) = \frac{1}{(z+5)(z+2)}$ at the poles are
- A) 1/3, -1/3
 B) 2/3, -2/3
 C) 3, -3
 D) 1/2, 1/5
27. The volume under the surface $z(x, y) = x + y$ and above the triangle in the x-y plane defined by $\{0 \leq y \leq x \text{ and } 0 \leq x \leq 12\}$ is
- A) 468 B) 860 C) 864 D) 884
28. An unbiased coin is tossed an infinite number of times. The probability that the fourth head appears at the tenth toss is
- A) 0.082 B) 0.067 C) 0.073 D) 0.091
29. Given $dy/dx = x^2 + y^2$, $y(1) = 1.2$
 The value of $y(1.05)$ obtained after applying fourth order Runge-kutta method is _____
- A) 1.3325 B) 13.325 C) 0.3325 D) 0.00325
30. If A is a matrix of order $n \times n$ then which of the following is false?
- A) $(A^T)^T = A$
 B) $\text{adj}(\text{adj } A) = A$ (when A is unimodular)
 C) $\det(KA) = K^{n-1} \det A$
 D) $|\text{adj}(\text{adj } A)| = (\det A)^{(n-1)^2}$
31. A system has fourteen poles and two zeros. Its high-frequency asymptote in its magnitude plot will have a slope of
- A) -40 dB / decade
 B) -240 dB / decade
 C) -280 dB / decade
 D) -320 dB / decade



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

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- A) Only the temperature
- B) Only the β of the transistor
- C) Both temperature and β
- D) None of these

33. Which of the following is not a $\frac{\lambda}{2}$ dipole antenna?

- A) Yagi-Uda antenna
- B) Rhombic antenna
- C) Parabolic antenna
- D) Horn antenna

34. The electric field component of a time harmonic plane EM wave travelling in a non magnetic lossless dielectric medium has amplitude of 1V/m. If the relative permittivity of the medium is 4, the magnitude of the time-average power density vector (in W/m^2) is

- A) $\frac{1}{30\pi}$
- B) $\frac{1}{60\pi}$
- C) $\frac{1}{120\pi}$
- D) $\frac{1}{240\pi}$

35. An experimental setup using a JFET gave the following readings:

- With $V_{GS} = 0$ V and $V_{DS} = 15$ V, $I_D = 15$ mA
- With $V_{GS} = 0$ V and $V_{DS} = 10$ V, $I_D = 14$ mA
- With $V_{GS} = -1$ V and $V_{DS} = 15$ V, $I_D = 13$ mA

Which of the following statements is true?

- A) Drain resistance = $5k\Omega$ and Trans-conductance = 2mA/volt
- B) Amplification factor = 10 and the JFET is an N-channel JFET
- C) Both A and B
- D) None of these

36. Consider a closed surface S surrounding a volume V, if \vec{r} is a position vector of a point inside S, with \hat{n} the unit normal on S, the value of the integral $\oint_S \vec{r} \cdot \hat{n} dS$ is

- A) 3 volts
- B) 5 volts
- C) 10 Volts
- D) 15 volts



37. A uniform plane wave in the free space is normally incident on an infinitely thick dielectric slab (dielectric constant $\epsilon_r = 9$) the magnitude of the reflection coefficient is

A) 0

B) 0.3

C) 0.5

D) 0.8

38. The unit impulse response of a system is $h(t) = e^{-t}$, $t \geq 0$. For this system, the steady-state value of the output for the unit step input is equal to

A) -1

B) 0

C) 1

D) Infinity

39. The Nyquist plot of $G(j\omega)H(j\omega)$ for a closed-loop control system, passed through $(-1, j0)$ point in GH plane. The gain margin of the system in dB is equal to

A) infinite

B) greater than zero

C) less than zero

D) zero

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

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

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

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

D) $20\pi^2$

