M.Tech. Entrance Test – 2013 (AKU, Patna)

Subject: Electronics and Communication Engineering

Time: - 1½ Hrs. **Full marks: 50**

INSTRUCTIONS: -There are four options given for a question. You have choose the correct option/s. Candidates are required to submit this Question paper with answer book.

1. Identify which of the following is NOT a tree of the graph shown in Fig 1.

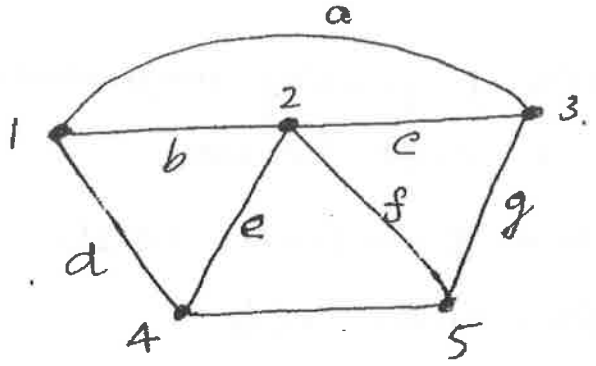


Fig 1

(a) begh (b) defg (c) adhg (d) aegh

2. The dependent current source shown in Fig 2

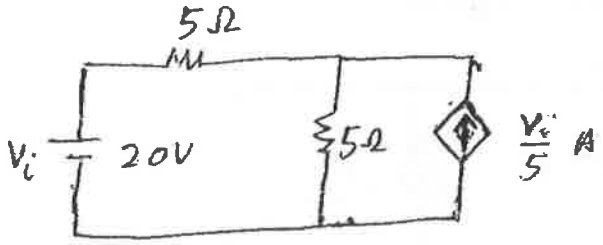


Fig 2

(a) delivers 80W (b) absorbs 80W (c) delivers 40W

(d) absorbs 40W

3. In circuit of Fig 3, the value of voltage E is

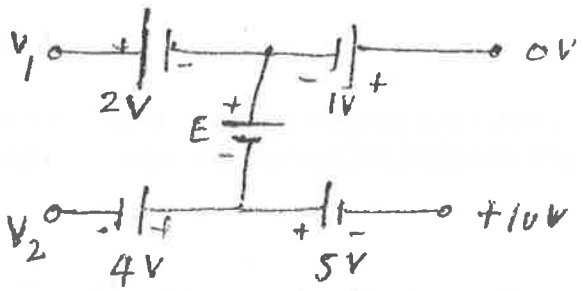


Fig 3

(a) −16V (b) 4V (c) −6V (d) 16V

4. The z-parameter of floating impedance $\hat{Z}$ shown in Fig 4 does not exist because

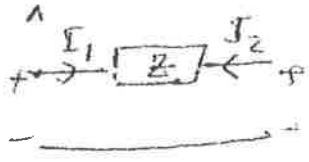


Fig 4

(a) Its transmission parameter exists

(b) ~~Yet~~ Its Y-parameter exists

(c) I_1 and I_2 are not independent

(d) None above

5. The Norton equivalent circuit of the circuit shown in Fig 6, with respect to terminals a and b, will be

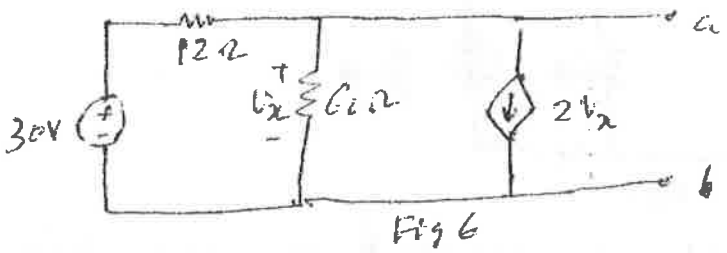


Fig 6

(a) 1.5 mH, 3 Ω (b) 2 mH, 40 Ω

(c) 2.5 A, 476.2 mΩ (c) none of the above

6. The current I_b in the circuit of Fig 7 will be

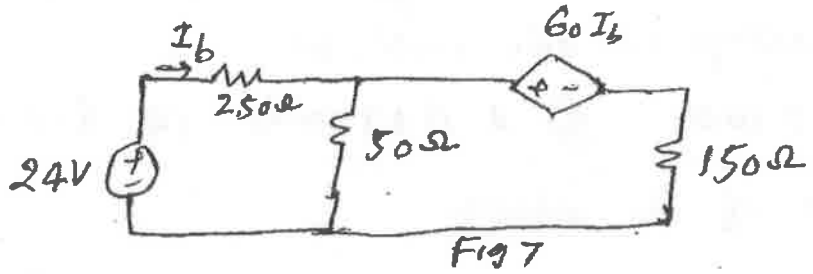


Fig 7

(a) 8.4 mA (b) 79.34 mA (c) 4 A (d) 3.5 mA

7. The switch in Fig 8 opens at $t=0$. v_o for $t>0$ will be

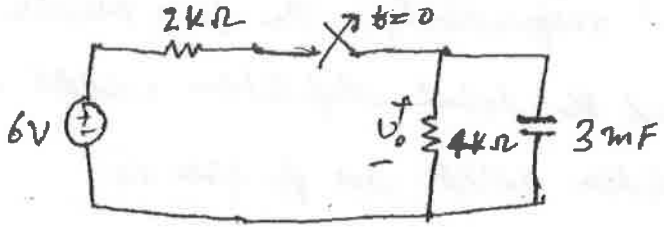


Fig 8

(a) $\frac{1}{2}e^{-t/12}$ volts (b) $4e^{-t/12}$ volts (c) 6 Volts (d) 20 volts

8. The two sided Laplace transform of $f(t)=1$ for all t will be

(a) $\frac{1}{s}$ (b) $-\frac{1}{s^2}$ (c) does not exist

(d) None of the above

9. The forward current through a silicon diode is 10 mA at room temperature (27°C). The corresponding forward voltage is 0.75 Volts. The reverse saturation current will be

(a) 5.236 mA (b) 0.5236 A (c) 5.446 nA

(d) none of the above

10. An 8.2 volt Zener diode (8.2V at 25°C) has a positive temperature coefficient of 0.01%. The Zener voltage at 60°C will be

(a) 8.2287 volts (b) 4.1143 volts (c) 6.2 volts

(d) none of the above

11. In an abrupt p-n junctions, the doping concentrations on the p-side and n-side are $N_A = 9 \times 10^{16}/cm^3$ and $N_D = 1 \times 10^{16}/cm^3$ respectively. The p-n junction is reverse biased and the total depletion width is 3 μm. The depletion width on p-side is

(a) 2.7 μm (b) 0.3 μm (c) 2.25 μm (d) 0.75 μm

12. The drain of an n-channel MOSFET is shorted to gate so that $V_{GS} = V_{DS}$. The threshold voltage (V_T) of MOSFET is 1V. If the drain current (I_D) is 1mA for $V_{GS} = 2V$, then for $V_{GS} = 3V$, I_D is

(a) 2mA (b) 3mA (c) 9mA (d) 4mA

13. Assuming that the β of the transistor in the circuit of Fig. 10 is extremely large and $V_{BE} = 0.7V$, I_C and V_{CE} are

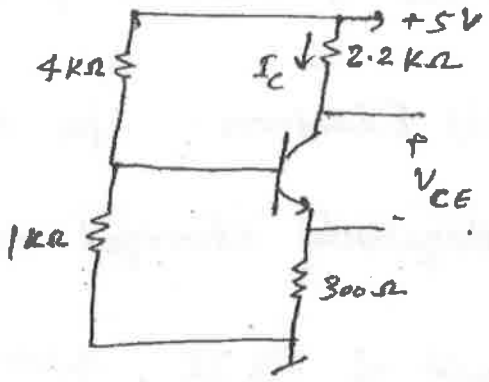


Fig 10

(a) $I_C = 1mA$, $V_{CE} = 4.7V$

(b) $I_C = 0.5mA$, $V_{CE} = 3.75V$

(c) $I_C = 1mA$, $V_{CE} = 2.5V$

(d) $I_C = 0.5mA$, $V_{CE} = 3.9V$

14. For the Zener diode shown in Fig 11, the Zener voltage at knee is 7V, the knee current is negligible and the Zener dynamic resistance is 10Ω. If the input voltage (V_i) range is from 10V to 16V, the output voltage (V_o) ranges from

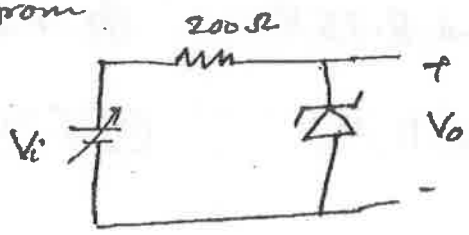


Fig. 11

(a) 7.00 V to 7.29 V (b) 7.14 V to 7.29 V

(c) 7.14 V to 7.43 V (d) 7.29 V to 7.43 V

15. A MOS Capacitor is made using p type substrate in the accumulation mode. The domain charge in the channel is due to presence of

(a) Holes (b) Electrons (c) Positively charged ions (d) Negatively charged ions

16. In the circuit of Fig 12, given $I_{DSS} = 10\,mA$, $V_p = -8V$. I_D and V_{DS} under DC conditions are respectively

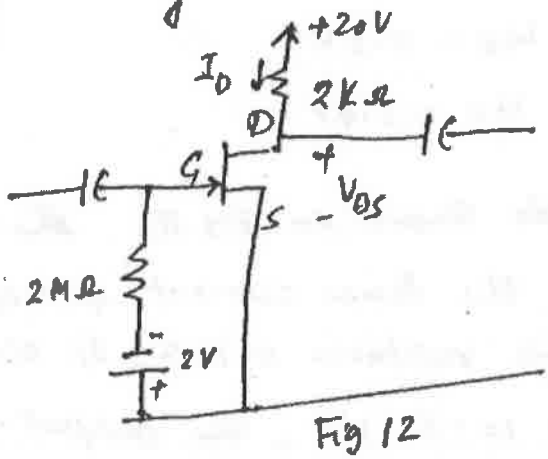


Fig 12

(a) 5.625 mA and 8.75 V (b) 7.50 A and 5.0 V

(c) 4.50 mA and 11.00 V (d) 6.250 mA and 7.50 V

17. At 300K, a silicon diode has a saturation current of 10nA. If the current through diode is 5mA, then voltage across the diode is:

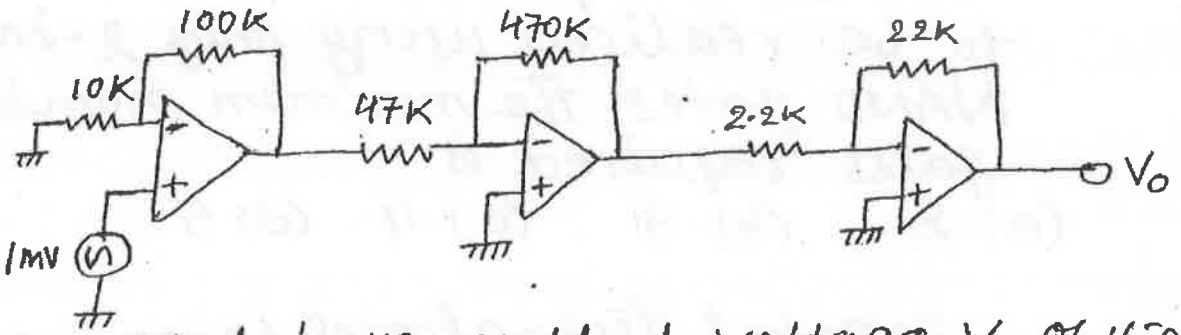
(a) 0.28 V (b) 0.96 V (c) 0.68 V (d) 0.79 V

18. MOSFET can be used as a

(a) current controlled capacitor
(b) voltage controlled capacitor
(c) current controlled inductor
(d) voltage controlled inductor

19. Bandwidth of a RC amplifier which has a mid frequency gain of 200 and frequency response of 100 Hz to 20KHz and feedback $\beta = 0.02$

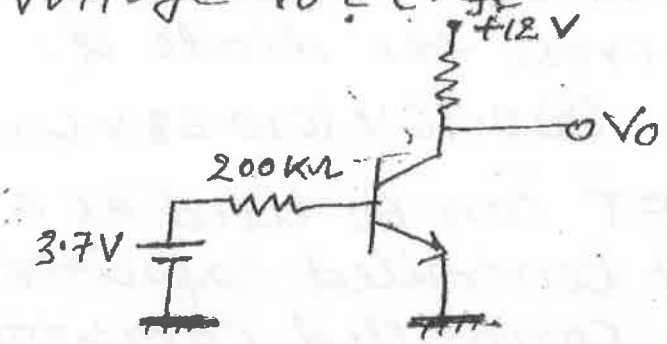
(a) 50KHz (b) 100 KHz (c) 150KHz (d) 200KHz

20. 

What is the output voltage V_o of the circuit?

(a) −1.1 V (b) 1.1 V (c) 1.0 V (d) 10 V

21. Consider the npn transistor circuit shown below, what is the output voltage V_o? ($h_{fe} = 100$)



(a) 0 V (b) 12 V (c) 7 V (d) 5 V

22. The counter which requires maximum number of flips flops for a given mod number is
(a) ripple counter (b) BCD counter
(c) ring counter (d) Johnson counter

23. The Boolean function $Y = AB + CD$ is to be realised using only 2-input NAND gates. The minimum number of gates required is
(a) 2 (b) 3 (c) 4 (d) 5

24. Digital technologies being used now-a-days are
(a) DTL and CMOS
(b) TTL, ECL and CMOS
(c) EMOS, TTL, ECL, [redacted] and DTL
(d) TTL, ECL, CMOS and RTL

25. [redacted] shifting digits from left to right and vice versa is needed in
(a) storing numbers (b) arithmetic operations
(c) counting (d) storing and counting

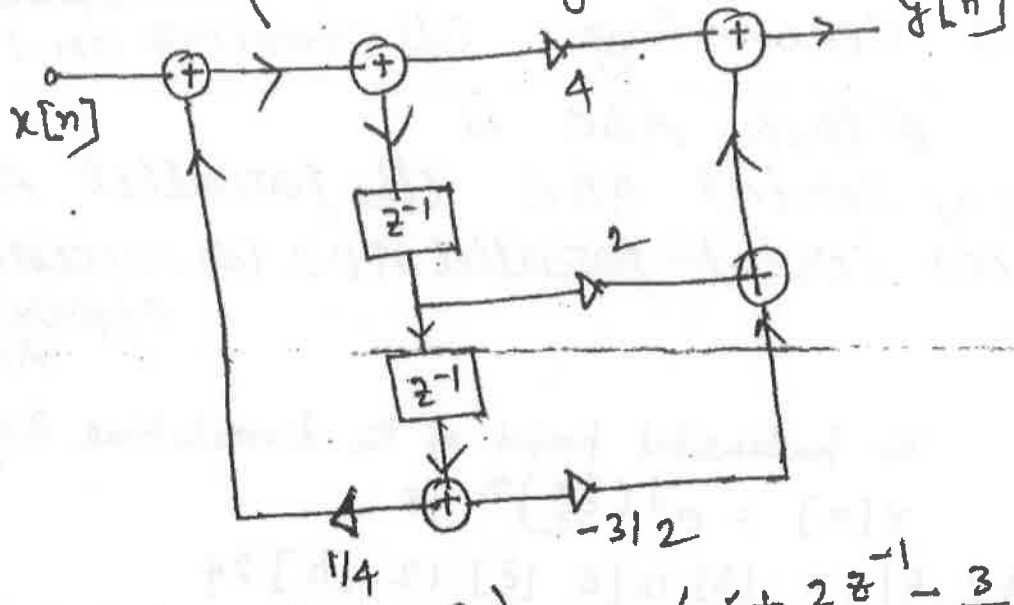
26. Flash ADC is
(a) serial ADC (b) parallel ADC
(c) serial-parallel ADC (d) successive approximation ADC

27. The fundamental period of the discrete time signal $x[n] = e^{j\left(\frac{5\pi}{12}\right)n}$ is
[A] 6/5π [B] 12/5 [C] 12 [D] 24

28. If the fourier transform of $x(n)$ is $X(e^{jw})$.
Then the fourier transform of $(-1)^n x[n]$ is
[A] $(-j)^w X(e^{jw})$ [B] $(-1)^w X(e^{jw})$
[C] $X\left(e^{j(w-\pi)}\right)$ [D] $\frac{d}{dw}\left(X(e^{jw})\right)$

29. Four point DFT of a real discrete time signal $x[n]$ of Length 4 is given by $X[k]$. $n = 0, 1, 2, 3$ and $k = 0, 1, 2, 3$
It is given that $X[0] = 6$, $X[1] = -2 + j2$ $X[2] = -2$
$X[3]$ and $X[0]$ respectively are
[A] $-2, 6$ [B] $-2 - j2, 6$ [C] $-j2, 0$ [D] $-2 - j2, 0$

30. A discrete - time System is shown in the following figure. The System function $H(z)$ of the network is given by



[A] $\dfrac{\left(-4-2z^{-1}-\frac{3}{2}z^{-2}\right)}{\left(1+\frac{1}{4}z^{-2}\right)}$ [B] $\dfrac{\left(4+2z^{-1}-\frac{3}{2}z^{-1}\right)}{\left(1-\frac{1}{4}z^{-2}\right)}$

[C] $\dfrac{1}{1-\frac{1}{4}z^{-2}}$ [D] $\dfrac{\left(1-\frac{1}{4}z^{-2}\right)}{\left(4+2z^{-1}-\frac{3}{2}z^{-2}\right)}$

31. $u(t)$ represents the unit step function
The Laplace transform of $x(t) = -e^{-at}u(-t)$ is

(A) $(S-a)$ $Re(S) > 0$ (B) $\dfrac{1}{s+a}$ $Re(S) < -a$

(C) $\dfrac{1}{s-a}$ $Re(S) > -a$ [D] $\dfrac{1}{s}$ $Re(S) < -a$

32. The Impulse response of a discrete time LTI System is given by $h[n] = \left(\frac{1}{2}\right)^n u[n]$ Let $y[n]$ be the output of the System with the input $x[n] = 2\delta[n] + \delta[n-3]$, $y[1]$ and $y[4]$ respectively are

[A] 5, 1 [B] 5/8, 1 [C] $\frac{1}{8}$, 1 [D] 1, 5/8

33. Fourier transform of the signal $x(t) = e^{-a|t|}$ is

[A] $\frac{2a}{a^2+\omega^2}$ [B] $\frac{a}{a^2+\omega^2}$ [C] $\frac{1}{a^2+\omega^2}$

[D] $\frac{4a}{2^2+\omega^2}$

34. In a pulse code modulated (PCM) signal sampled at f_s and encoded into an n bit code, the minimum bandwidth required for faithful reconstruction is

[A] $2nf_s$ [B] $nf_s/2$ [C] nf_s [D] f_s

35. A signal with frequency components 50 Hz, 100 Hz and 200 Hz only is sampled at 150 samples/sec. The ideally reconstructed signal will have frequency components of

[A] 50 Hz only [B] 75 Hz only [C] 50 Hz and 75 Hz

[D] 50 Hz, 75 Hz and 100 Hz.

36. A message signal given by $m(t) = \left(\frac{1}{2}\right)\cos w_1 t - \left(\frac{1}{2}\right)\sin w_2 t$ is amplitude modulated with a carrier of frequency w_c to generate $s(t) = [1 + m(t)]\cos w_c t$ what is the power efficiency achieved by this modulation scheme?

[A] 8.33 %. [B] 11.11 %. [C] 20 %. [D] 25 %.

37. Which of the following modulation schemes requires the minimum transmitted power and minimum channel bandwidth?

[A] SSB [B] VSB [C] DSB-SC [D] AM

38. The auto correlation function of the white noise is

[A] step function [B] Impulse function [C] constant

[D] None of the above.

39. A scheme in which several channels are interleaved and then transmitted together is known as

[A] A group [B] A super group [C] TDM [D] frequency division multiplexing.

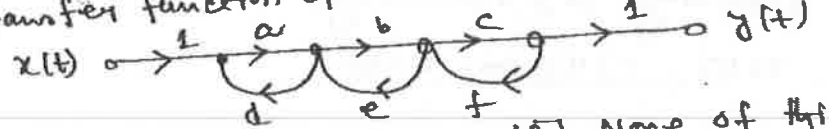
40. In high power AM transmission modulation is done at [A] IF stage [B] Buffer stage [C] RF power stage [D] oscillator stage.

41. Thermal noise power is

[A] proportional to B [B] proportional to $\sqrt{B}$

[C] proportional to $1/B^2$ [D] proportional to B^2

42. The signal flow graph of a system shown in the following figure. The input is $x(t)$ and output is $y(t)$. The transfer function of the system is



[A] $\frac{abc}{1-(ad+be+cf)+(adcf)}$ [B] None of this

[C] $\frac{abc}{1-adcf+(ad+cf)}$ [D] $\frac{abc}{1-(ad+be+cf)}$

43. Consider a unity feed back control system whose forward path transfer function is $G(s) = K/s^2$. The steady-state error for a step input is

[A] 1 [B] ∞ [C] 0 [D] Does not exist.

44. The open loop transfer function of a unity gain feedback system is given by : $G(s) = \dfrac{Ks(3s+1)}{(s^2+2s+3)}$

The range of value of K for which the closed loop system will remain stable is

[A] $K > -\frac{1}{3}$ [B] $0 < K < \infty$ [C] $K > 2$ [D] $K < 2$

45. Consider a unity feed back system with loop transfer function $G(s) = \dfrac{1+6s}{s^2(1+s)(1+2s)}$

The gain margin of the system is

[A] 0.25 [B] 0.125 [C] 0.5 [D] 1

46. A state space representation for the transfer function $\dfrac{y(s)}{u(s)} = \dfrac{s+6}{s^2+5s+6}$ is $\dot{x} = Ax + Bu$ and $y = Cx$ where $A = \begin{bmatrix} 0 & 1 \\ -6 & -5 \end{bmatrix}$ $B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$ and the value of C is

[A] $\begin{bmatrix} 1 \\ 2 \end{bmatrix}$ [B] $[6\ \ 1]$ [C] $\begin{bmatrix} 1 & 2 \\ -1 & 0 \end{bmatrix}$ [D] $[1\ \ -5]$

47. For a closed-loop system to be stable, the Nyquist plot of $G(s)H(s)$ must encircle the point ——

[A] $-1 + j0$ [B] $-j$ [C] $-1+2j$ [D] $-1-j$

as many times as the number of poles of $G(s)H(s)$ that are in the right hand of s plane.

48. Settling time(t_s) is the time required for the response to reach and finally remain within a specified tolerance band of the _____ of its final value.

[A] 10% to 20% [B] 30% to 70% [C] 2% to 5%

[D] 90% - 95%.

49. Addition of zeros in transfer function causes which of the following?

[A] Lead-Compensation [B] Lag-Compensation

[C] Lead-Lag Compensation [D] None of the above

50. The Bode plot is used to analyse which of the following

[A] Minimum phase network

[B] Lag Lead network

[C] Maximum phase network

[D] None of the above