

PART III

11 - BIO-MEDICAL ENGINEERING

(Answer ALL questions)

56. Longest Cell in human body

- Leg muscle cell
- Nerve cell
- Bone cell
- Heart muscle cell

57. Match the following and choose the correct option.

Type Synovial Joint

Bone Involved

A. Ball and socket

1. Carpal and metacarpal of thumb

B. Hinge

2. Atlas and axis

C. Pivot

3. Frontal and parietal

D. Saddle

4. Knee
5. Humerus and pectoral girdle

- A - 1, B - 3, C - 4, D - 5
- A - 1, B - 2, C - 5, D - 4
- A - 5, B - 4, C - 2, D - 1
- A - 5, B - 4, C - 3, D - 1

58. An action potential in the nerve fibre is produced when positive and negative charges on outside and the inside of the axon membrane are reversed because

- all potassium ions leave the axon
- more potassium ions enter the axon as compared to sodium ions leaving it
- all sodium ions enter the axon
- more sodium ions enter the axon as compared to potassium ions leaving it

59. The difference between systolic and diastolic pressure in human is

- 40 mm Hg
- 120 mm Hg
- 60 mm Hg
- 80 mm Hg

60. The polysaccharide found in the exoskeleton of insects is _____

- Hyaluronic acid
- Cellulose
- Chitin
- Chondrosamine

61. Which of the following vitamin is required for the synthesis of a cofactor required for the conversion of malate to OAA?

- Thiamine
- Pantothenic acid
- Niacin
- Riboflavin

62. Abundance of which of the following inhibits beta oxidation of fatty acids?

- ATP
- Malonyl coA
- Citrate
- Acetyl coA.

63. What is the outcome of the accumulation of acetyl-CoA in the mitochondria of the liver?

- It is used as an energy source
- It has broken down into free fatty acids
- It gets converted to oxaloacetate
- It forms ketone bodies

64. A load is connected to a network. At the terminals to which the load is connected, $R_{th} = 10 \Omega$ and $V_{th} = 40V$. The maximum possible power supplied to the load is

- 160 W
- 80 W
- 40 W
- 1 W

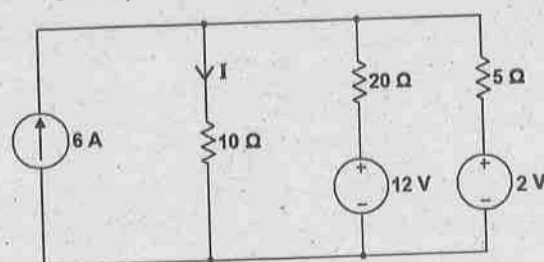
65. In the circuit given in Fig. Q. 1, the current I through the 10Ω resistor is,

Fig. Q.1

- 1.5 A
- 3.0 A
- 2.5 A
- 2.0 A

66. In a parallel RLC circuit with $R = 5k\ \Omega$, $L = 0.5\text{ mH}$ and $C = 5\ \mu\text{F}$, the Quality factor Q is

a. 1000
b. 200
c. 500
d. 2000

67. The switch in the circuit shown in Fig Q. 2 has been closed for a long time, and it is opened at $t=0$. The voltage across the capacitor $v_c(t)$ for $t \geq 0$ is given by

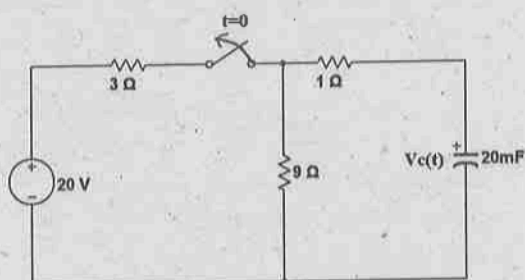


Fig. Q. 2

68. Find the drain current of a JFET with $I_{DSS} = 40\text{ mA}$, $V_p = -10\text{ V}$ and $V_{GS} = -5\text{ V}$

a. 10 mA
b. 80 mA
c. 1 mA
d. 8 mA

69. In the Colpitts oscillator $C_1 = 100\text{ pF}$ and $C_2 = 500\text{ pF}$, find the minimum gain to sustain oscillation.

a. 5
b. 0.5
c. 0.2
d. 2

70. For the amplifier shown in Fig. 3, Assume $V_{BE} = 0.7\text{ V}$ and the transistor parameter $\alpha = 1$, the voltages v_{c1} and v_{c2} in the circuit are

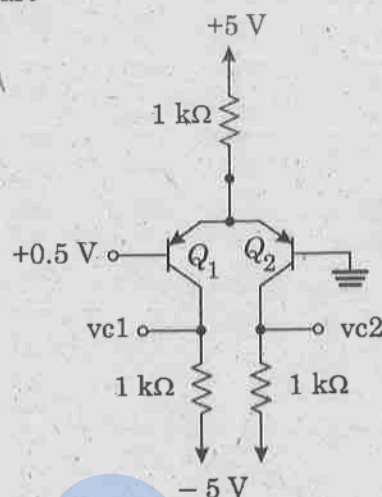


Fig. 3

a. $-5\text{ V}, -4.3\text{ V}$
b. $4.3\text{ V}, 0.7\text{ V}$
c. $-5\text{ V}, -0.7\text{ V}$
d. $-2.9\text{ V}, -2.9\text{ V}$

71. For the amplifier configuration shown in Fig Q. 4, the voltage gain is given by

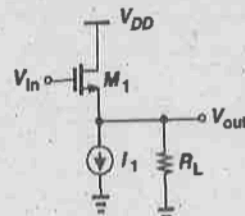


Fig. Q. 4

a. $g_{m1}R_L$
b. $g_{m1}(R_L \parallel r_{o1})$
c. $\frac{R_L}{R_L + \frac{1}{g_{m1}}}$
d. $\frac{R_L}{r_{o1}}$

72. The minterms in $F(A,B,C,D)$ realized by an 8-to-1 MUX with A,B,C as selection lines and inputs equal to $I_0=D$, $I_1=D'$, $I_2=D$, $I_3=1$, $I_4=D'$, $I_5=D'$, $I_6=1$, $I_7=D$ are

a. $F(A,B,C,D) = \Sigma(1,2,3,4,5,7,9,11,13,15)$
b. $F(A,B,C,D) = \Sigma(1,2,5,6,7,8,10,12,13,15)$
c. $F(A,B,C,D) = \Sigma(0,1,2,5,6,7,8,10,12,14)$
d. $F(A,B,C,D) = \Sigma(1,2,5,6,8,10,12,13,14,15)$

73. A synchronous counter consists of three D FFs namely, D_A , D_B , D_C with outputs Q_A , Q_B , Q_C respectively. The connections are as $D_A = Q_C'$, $D_B = Q_A$, $D_C = Q_B$. With the present state given as $[Q_A(t), Q_B(t), Q_C(t)] = [1, 0, 0]$, the next state $[Q_A(t+1), Q_B(t+1), Q_C(t+1)]$ is
- 0,1,1
 - 1,0,1
 - 0,1,0
 - 1,1,0
74. Given the gray code number as 10101111, the binary equivalent is
- 11001010
 - 10100101
 - 10110011
 - 10001111
75. The maxterms corresponding to $F(x, y, z) = xy + x'z$ are
- $\pi(1, 3, 5, 6)$
 - $\pi(1, 2, 5, 7)$
 - $\pi(0, 2, 4, 5)$
 - $\pi(0, 3, 4, 7)$
76. If the feedback/input resistor ratio of a feedback amplifier is 4.6 with 1.7 V applied to the non-inverting input, find the output voltage.
- 7.82 V
 - 9.52 V
 - 6.3 V
 - 6.12 V
77. An 8-bit successive approximation analog to digital converter has full scale reading of 2.55 V and its conversion time for an analog input of 1 V is 20 μ s. The conversion time for a 2 V input will be
- 10 μ s
 - 20 μ s
 - 40 μ s
 - 50 μ s
78. A 10-bit D/A converter given a maximum output of 10.23 V. The resolution is
- 10 mV
 - 20 mV
 - 15 mV
 - 25 mV
79. A voltage regulator has a no-load output of 18 V and a full-load output of 17.3 V. The percent load regulation is
- 0.25 %
 - 96.1 %
 - 4.05 %
 - 1.04 %
80. The _____ is a Programmable Interrupt Controller (IC) specifically designed for use with the interrupt signals (INTR /INT) of the 8085 microprocessor.
- 8255
 - 8237
 - 8251
 - 8259
81. The memory address of the last location of an 8K byte memory chip is FFFFH. Find the starting address.
- 9000H
 - D000H
 - E000H
 - A000H
82. The non maskable interrupt in 8085 microprocessor is
- RST 7.5
 - INTR
 - TRAP
 - RST 6.5
83. What is the maximum addressing capability of a processor if it has 20 bit address line?
- 20 KB
 - 1 MB
 - 64 KB
 - 160 KB
84. A 500 Hz sinusoidal signal is sampled at 600 samples/ second and a continuous time signal is derived by passing the samples through an ideal low pass filter with cut off frequency of 400 Hz. The signal at the output of the low pass filter will have the tone(s) of
- 500 Hz
 - 500 Hz and 400 Hz
 - 100 Hz
 - 400 Hz

85. A continuous system has transfer function $H(s) = (1+s)/(1-s)$ and it has right sided RoC. Then, the system is
- causal and stable
 - causal and unstable
 - non-causal and stable
 - non-causal and unstable
86. A discrete time signal $x(n]$ has its Z-transform $X(z) = 1/(1-2z^{-1})$, $|z| > 2$. Let $X(e^{j\omega})$ represents the discrete time Fourier transform of $x(t)$. Then,
- $X(e^{j\omega}) = 1/(1-2e^{-j\omega})$
 - $X(e^{j\omega}) = 1/(1-2e^{j\omega})$
 - $X(e^{j\omega}) = (1-2e^{-j\omega})$
 - $X(e^{j\omega})$ does not exist
87. Let N -point of $X(k)$, $k = 0, 1, 2, \dots, (N-1)$ represents discrete Fourier transform of a discrete time signal $x(n) = 5 \cos(\pi n/8)$. If N equals 32, $X(k)$ will get non-zero components for the value of k equal(s),
- 8
 - 4 and 28
 - 2 and 30
 - 32
88. An analog filter with system function $H(s) = \frac{s+1}{s^2+5s+1}$ is transformed into a digital filter $H(z)$ using impulse invariance technique with $T = 0.1$. The transfer function of corresponding digital filter $H(z)$ is given as
- $\frac{2}{1-e^{-3T}z^{-1}} - \frac{1}{1-e^{-2T}z^{-1}}$
 - $\frac{2}{1-e^{-2T}z^{-1}} - \frac{1}{1-e^{-3T}z^{-1}}$
 - $\frac{2}{1-e^{+2T}z^{-1}} - \frac{1}{1-e^{+3T}z^{-1}}$
 - $\frac{2}{1-e^{+3T}z^{-1}} - \frac{1}{1-e^{+2T}z^{-1}}$
89. Blackman window can eliminate ripple in FIR filters with a trade-off
- smaller transition bandwidth
 - larger transition bandwidth
 - non-linear phase response
 - less pass-band ripple
90. For the same specifications, the order of a Chebyshev filter is _____ that of a Butterworth filter
- more than
 - equal to
 - less than
 - less than or equal to
91. The filter coefficients of a 5-tap linear phase FIR band reject filter are $h(0) = 0.9$, $h(1) = 0.008$ and $h(2) = 0.007$. The corresponding transfer function is given by
- $H(z) = 0.9 + 0.008z^{-1} + 0.007z^{-2} + 0.007z^{-3} + 0.008z^{-4} + 0.9z^{-5}$
 - $H(z) = 0.9 + 0.008z^{-1} + 0.007z^{-2} + 0.007z^{-3} + 0.008z^{-4}$
 - $H(z) = 0.007 + 0.008z^{-1} + 0.9z^{-2} + 0.9z^{-3} + 0.008z^{-4} + 0.007z^{-5}$
 - $H(z) = 0.007 + 0.008z^{-1} + 0.9z^{-2} + 0.008z^{-3} + 0.007z^{-4}$
92. Consider a system represented by the block diagram in Fig Q.5

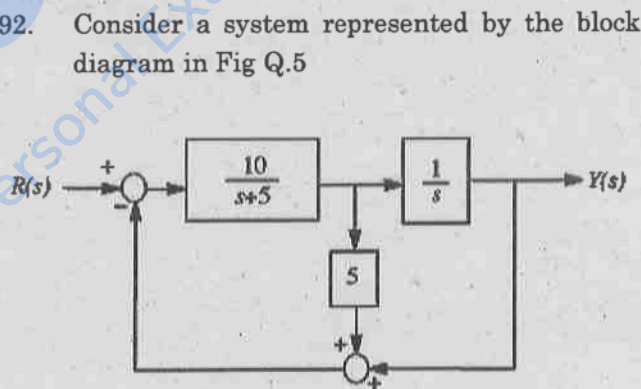


Fig. Q.5

The closed-loop transfer function

$T(s) = Y(s)/R(s)$ is

- $T(s) = \frac{10}{s^2 + 50s + 55}$
- $T(s) = \frac{10}{s^2 + 55s + 55}$
- $T(s) = \frac{10}{s^2 + 50s + 50}$
- $T(s) = \frac{10}{s^2 + 10s + 55}$

93. The first two rows in the Routh table for the characteristic equation of a certain closed-loop control system are given as

$$\begin{array}{r} s^3 \quad 1 \quad (2k+3) \\ s^2 \quad 2K \quad 4 \end{array}$$

The range of 'K' for which the system is stable is

- $-2.0 < K < 0.5$
- $0 < K < 0.5$
- $0 < K < \infty$
- $0.5 < K < \infty$

94. Which of the following is the best method for determining the stability and transient response?

- Root locus
- Bode plot
- Nyquist plot
- None of the above

95. The open loop transfer function for unity feedback system is given by $\frac{5(1+0.1s)}{s(1+5s)(1+20s)}$

Find the steady state error for a ramp input of magnitude 10.

- 0
- 2
- 5
- Infinite

96. The percentage of the total power carried by the sidebands of the AM when the modulation index is 0.5 is

- 22
- 11
- 33
- 44

97. The maximum entropy of a discrete memoryless source which generates 8 symbols

- 2 bits/symbol
- 1 bit/symbol
- 3 bits/symbol
- 4 bits/symbol

98. A signal bandlimited to 3 kHz is sampled at a rate 33.33% higher than the Nyquist rate and is quantized by 256 level quantizer; the data rate of the encoded information in bits/sec

- 32000
- 64000
- 16000
- 128000

99. Message signal $m(t) = \cos 4000 \pi t$ modulates the carrier $c(t) = \cos 2\pi ft$ where $f = 1$ MHz to produce an AM signal. For demodulating the generated AM signal using an envelope detector, the time constant RC of the detector circuit should satisfy

- $0.5 \text{ ms} < RC < 1 \text{ ms}$
- $1 \mu\text{s} \ll RC < 0.5 \text{ ms}$
- $RC \ll \mu\text{s}$
- $RC \gg 0.5$

100. In an ECG amplifier, the right leg driven circuit is used to increase

- CMRR
- Gain
- Input impedance
- Isolation

101. A transducer has a sensitivity of $10 \mu\text{V/V/g}$. Find the output voltage for an applied force of 15 g if the excitation potential is 5 V d.c.

- 300 μV
- 750 μV
- 30 μV
- 75 μV

102. The mean velocity of the blood flow in the aorta which is about 10.5 mm is 40 cm/sec. The ultrasonic velocity in the blood is 1550 m/sec. What is the Doppler shift in frequency for an ultrasound of frequency of 3 MHz?

- 1550 Hz
- 1000 Hz
- 500 Hz
- 2000 Hz

103. Among the following electrodes, which has high input impedance?

- Surface electrode
- Micro electrode
- Needle electrode
- Disc electrode

104. The output energy level of an external pacemaker is
- 10 μJ
 - 100 μJ
 - 400 μJ
 - 200 μJ
105. The volume of blood within the dialyzer is known as _____
- secondary volume
 - quarterly volume
 - priming volume
 - residual volume
106. The let go current range is
- 1-5 mA
 - 10-50 mA
 - 100-300 mA
 - 0-1 mA
107. What is the normal operating frequency of surgical diathermy?
- 10 KHz – 20 KHz
 - 1-3 MHz
 - 500 Hz
 - 50 Hz
108. Young's modulus for bone is $1.0 \times 10^{10} \text{ N/m}^2$, find the compression experienced by a leg bone 50 cm long subjected to a load of half the weight of a 70 kg person. The cross-sectional area of a leg bone is about 5 cm^2 .
- $3.4 \times 10^{-8} \text{ m}$
 - $3.4 \times 10^{-5} \text{ m}$
 - $1.4 \times 10^{-5} \text{ m}$
 - $1.4 \times 10^{-8} \text{ m}$
109. A small artery has a length of $1.1 \times 10^{-3} \text{ m}$ and a radius of $2.5 \times 10^{-5} \text{ m}$. If the pressure drop across the artery is 1.3 kPa, what is the flow rate through the artery? (Assume that the viscosity is $3 \text{ Pa}\cdot\text{sec}$).
- $6.04 \times 10^{-14} \text{ m}^3/\text{sec}$
 - $9 \times 10^{-11} \text{ m}^3/\text{sec}$
 - $1.59 \times 10^{-15} \text{ m}^3/\text{sec}$
 - $2.64 \times 10^{-10} \text{ m}^3/\text{sec}$
110. Bone is strongest along long axis because
- Bone is stronger in resisting both compression and tension
 - Bone is stronger in resisting tension than in resisting compression
 - Bone is stronger in resisting compression than in resisting tension
 - Bone is stronger in resisting tension only
111. Joints that have bones with articulating surfaces that are flat or slightly curved faces and allow for gliding movements
- Saddle joints
 - Condylod joints
 - Hinge joints
 - Planar joints
112. A Radon transformed image $g(l, \theta)$ with l and θ as rectilinear co-ordinates is called
- Spectrogram
 - Sinogram
 - Scalogram
 - Sonogram
113. A sample has a T1 of 1.0 seconds. If the net magnetization is set equal to zero, how long will it take for the net magnetization to recover to 98% of its equilibrium value?
- 2.8 s
 - 3.9 s
 - 8.2 s
 - 9.3 s
114. The use of Al filter in the X-ray imaging system is
- To remove the scattered radiation
 - To reduce the other radiation
 - To remove the soft X-rays
 - To reduce the noises
115. The Technetium-99m has a half-life of _____ and gamma ray energy of _____
- 8 hours and 120 KeV
 - 6 hours and 140 KeV
 - 6 hours and 120 KeV
 - 8 hours and 140 KeV