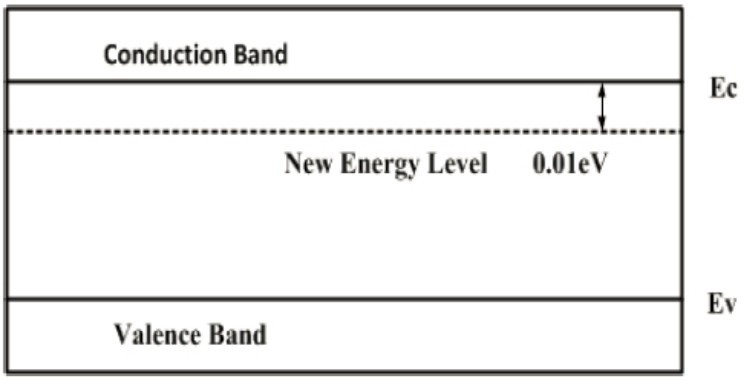
PAPER – III

ELECTRONICS

Note : Attempt all the questions. Each question carries *two* (2) marks.

1. A small percentage of impurity is added to an intrinsic semiconductor at 300 K. Which one of the following statements is TRUE for the energy band diagram shown in the following figure?



1) Intrinsic semiconductor doped with pentavalent atoms to form n-type semiconductor
2) Intrinsic semiconductor doped with trivalent atoms to form n-type semiconductor
3) Intrinsic semiconductor doped with pentavalent atoms to form p-type semiconductor
4) Intrinsic semiconductor doped with trivalent atoms to form p-type semiconductor

2. Diffusion of free electrons across the junction of an unbiased diode produces

1) Forward bias
2) Reverse bias
3) Breakdown
4) The depletion layer

3. The phenomenon known as "Early Effect" in a bipolar transistor refers to a reduction of the effective base-width caused by

1) Electron - hole recombination at the base
2) The reverse biasing of the base - collector junction
3) The forward biasing of emitter-base junction
4) The early removal of stored base charge during saturation-to-cut off switching

4. The DC current gain (β) of a BJT is 50. Assuming that the emitter injection efficiency is 0.995, the base transport factor is

1) 0.980
2) 0.985
3) 0.990
4) 0.995

5. Under low level injection assumption, the injected minority carrier current for an extrinsic semiconductor is essentially the

1) Diffusion current
2) Drift current
3) Recombination current
4) Induced current

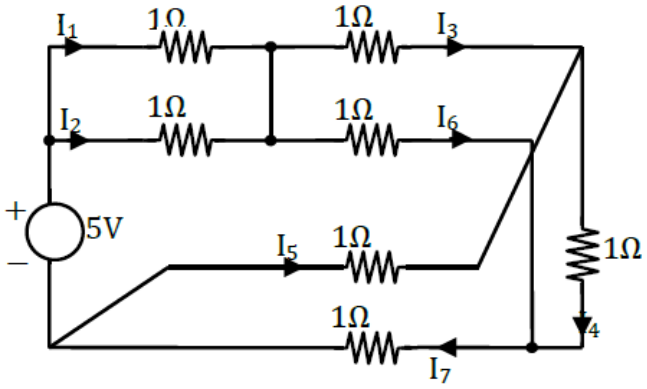
6. The values of voltage (V_D) across a tunnel-diode corresponding to peak and valley currents are V_p, V_D respectively. The range of tunnel-diode voltage for V_D which the slope of its I-V_D characteristics is negative would be,

1) $V_D < 0$ 2) $0 \le V_D < V_p$
3) $V_p \le V_D < V_V$ 4) $V_D \ge V_V$

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

1) 2 mA 2) 3 mA
3) 9 mA 4) 4 mA

8. Which one of the following equations is valid for the circuit shown below?



1) $I_3 + I_5 - I_6 + I_7 = 0$ 2) $I_3 - I_5 + I_6 + I_7 = 0$
3) $I_3 + I_5 + I_6 + I_7 = 0$ 4) $I_3 + I_5 + I_6 - I_7 = 0$

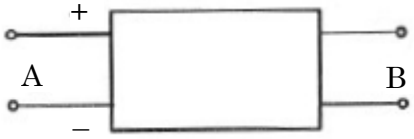
9. A discrete time signal $x[n] = \delta[n-3] + 2\delta[n-5]$ has z-transform $X(z)$. If $Y(z) = X(-z)$ is the z-transform of another signal $y[n]$, then

1) $y[n] = x[n]$ 2) $y[n] = x[-n]$
3) $y[n] = -x[n]$ 4) $y[n] = -x[-n]$

10. With 10 V dc connected at port A in the linear non reciprocal two port network shown below, the following were observed :

(i) 1 Ω connected at port B draws a current of 3 A

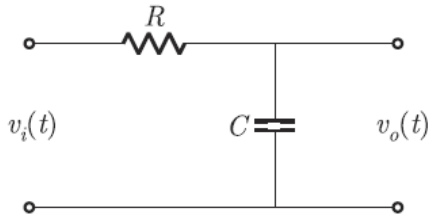
(ii) 2.5 Ω connected at port B draws a current of 2 A



For the above network, with 6 V dc connected at port A, 1 Ω connected at port B draws 7/3 A. If 8 V dc is connected to port A, the open circuit voltage at port B is,

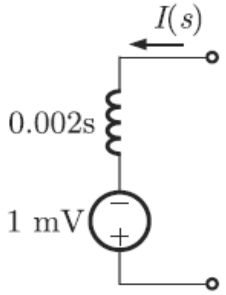
1) 6 V 2) 7 V
3) 8 V 4) 9 V

11. For the circuit shown in the figure, the time constant RC = 1 ms. The input voltage is $v_i(t) = \sqrt{2}\sin 10^3 t$. The output voltage $v_0(t)$ is equal to,



1) $\sin(10^3 t - 45^\circ)$
2) $\sin(10^3 t + 45^\circ)$
3) $\sin(10^3 t - 53^\circ)$
4) $\sin(10^3 t + 53^\circ)$

12. A 2 mH inductor with some initial current can be represented as shown below, where s is the Laplace Transform variable. The value of initial current is



1) 0.5 A
2) 2.0 A
3) 1.0 A
4) 0.0 A

13. To get the Norton current, you have to

1) short the load resistor
2) open the load resistor
3) short the voltage source
4) open the current source

14. The Dirac delta function $\delta(t)$ is defined as

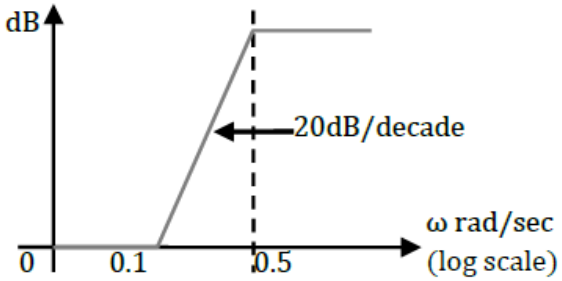
1) $\delta(t) = \begin{cases} 1 & t = 0 \\ 0 & otherwise \end{cases}$

2) $\delta(t) = \begin{cases} \infty & t = 0 \\ 0 & otherwise \end{cases}$

3) $\delta(t) = \begin{cases} 1 & t = 0 \\ 0 & otherwise \end{cases}$ and $\int_{-\infty}^{\infty} \delta(t)dt = 1$

4) $\delta(t) = \begin{cases} \infty & t = 0 \\ 0 & otherwise \end{cases}$ and $\int_{-\infty}^{\infty} \delta(t)dt = 1$

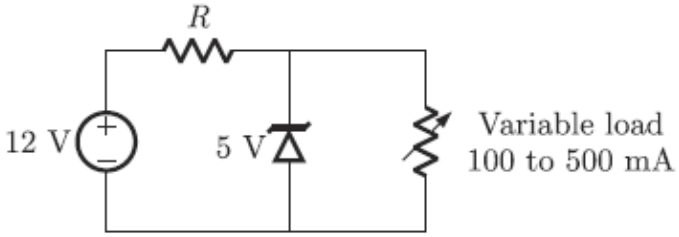
15. The asymptotic Bode magnitude plot of a lead network with its pole and zero on the left half of the s-plane is shown in the adjoining figure. The frequency at which the phase angle of the network is maximum (in rad/s) is,



1) $\frac{3}{\sqrt{10}}$ 2) $\frac{1}{\sqrt{20}}$

3) $\frac{1}{20}$ 4) $\frac{1}{30}$

16. In the voltage regulator shown in the figure, the load current can vary from 100 mA to 500 mA. Assuming that the Zener diode is ideal (i.e., the Zener knee current is negligibly small and Zener resistance is zero in the breakdown region), the value of R is



1) 7 Ω 2) 70 Ω

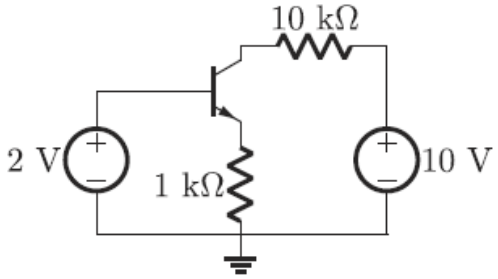
3) $\frac{70}{3}\Omega$ 4) 14 Ω

17. A differential amplifier has a common mode gain of 0.02. It has +200 mV signals applied to each of the inputs. The amplitude of the output signal is

1) 0 V 2) 8 mV

3) 4 mV 4) none of the above

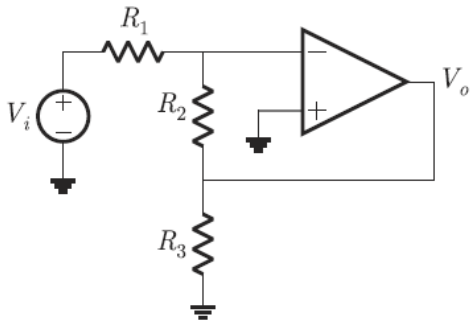
18. For the BJT circuit shown, assume that the β of the transistor is very large and V_{BE} = 0.7 V. The mode of operation of the BJT is,



1) cut-off 2) saturation

3) normal active 4) reverse active

19. Assuming the OP-AMP to be ideal, the voltage gain of the amplifier shown below



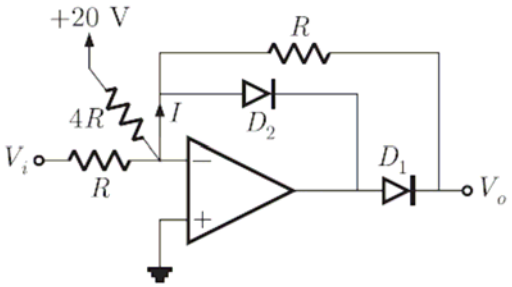
1) $-\frac{R_2}{R_1}$

2) $-\frac{R_3}{R_1}$

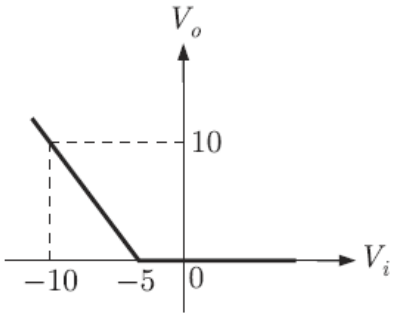
3) $-\frac{R_2 \| R_3}{R_1}$

4) $-\frac{R_2 + R_3}{R_1}$

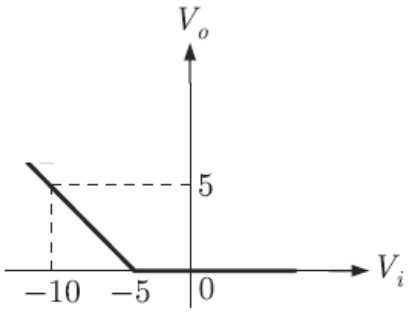
20. The transfer characteristic for the precision rectifier circuit shown below is (assume ideal OP-AMP and practical diodes)



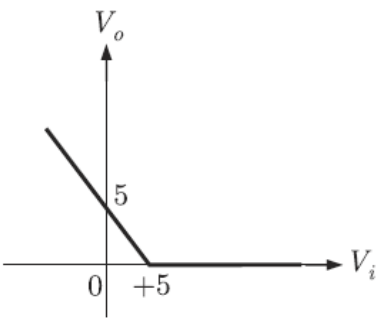
1)



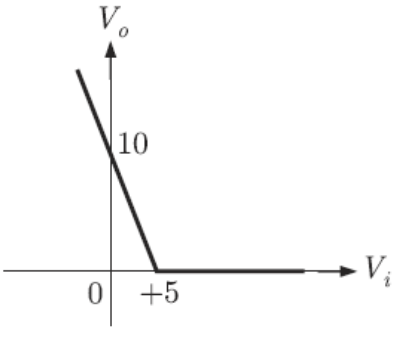
2)



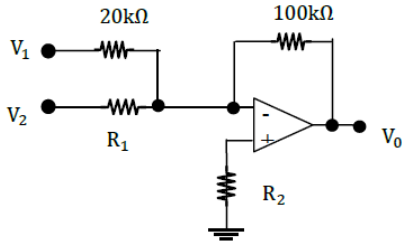
3)



4)



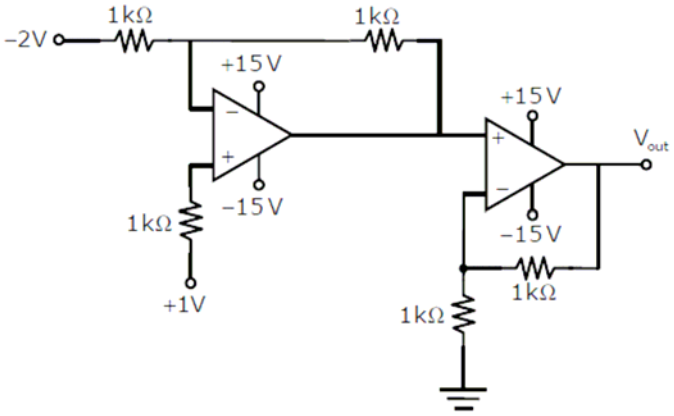
21. Consider the op-amp circuit shown in the figure below



If $V_1 = 0.2$ V, $V_2 = 0.6$ V, and $V_o = -7$ V and the op-amp is ideal, the value of the R_1 is

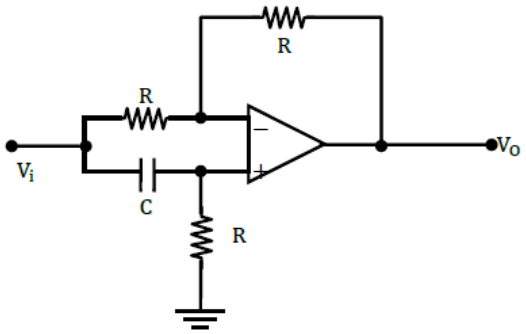
1) 5 kΩ
2) 10 kΩ
3) 15 kΩ
4) 20 kΩ

22. In the circuit shown below the op-amps are ideal. The V_{out} in Volts is given as,



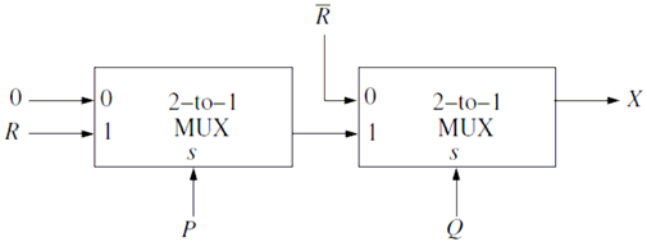
1) 4
2) 6
3) 8
4) 10

23. The circuit shown in the figure is,



1) all pass filter
2) band pass filter
3) high pass filter
4) low pass filter

24. Consider the two cascaded 2 to 1 multiplexers as shown in the figure. The minimum sum-of-products form of output X is,

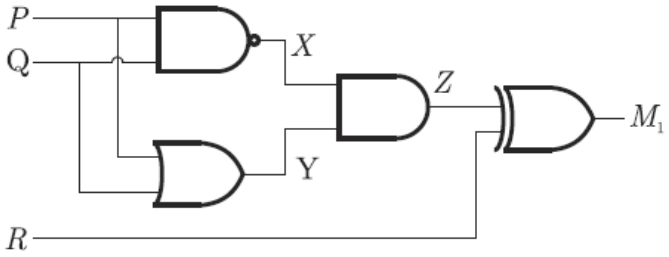


1) $\overline{P}\ \overline{Q} + PQR$
2) $\overline{P}\ Q + QR$
3) $PQ + \overline{P}\,\overline{Q}\,R$
4) $\overline{Q}\,\overline{R} + PQR$

25. X = 01110 and Y = 11001 are two 5-bit binary numbers represented in two's complement format. The sum of X and Y represented in two's complement format using 6 bits is

1) 100111
2) 001000
3) 000111
4) 101001

26. Which of the following Boolean expressions correctly represents the relation between P, Q, R and M_1?



1) M_1 = (P OR Q) XOR R
2) M_1 = (P AND Q) XOR R
3) M_1 = (P NOR Q) XOR R
4) M_1 = (P XOR Q) XOR R

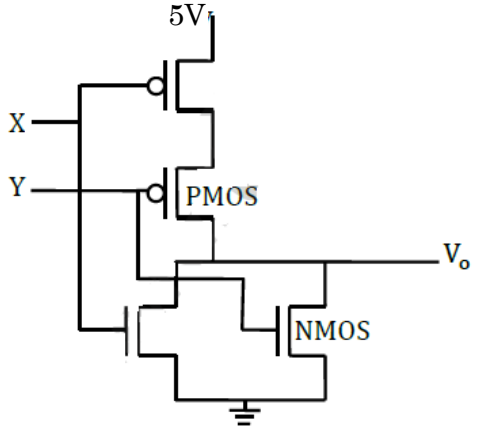
27. The NAND gate is known as an universal gate because

1) it can be used an inverter
2) AND operation can be realized using NAND gates
3) it is simple to use
4) AND, OR and NOT operations can be realized using NAND gates

28. A ring counter consisting of six flip-flops will have

1) 5 states
2) 10 states
3) 16 states
4) 32 states

29. A CMOS implementation of a logic gate is shown in the following figure :
The Boolean logic function realized by the circuit is

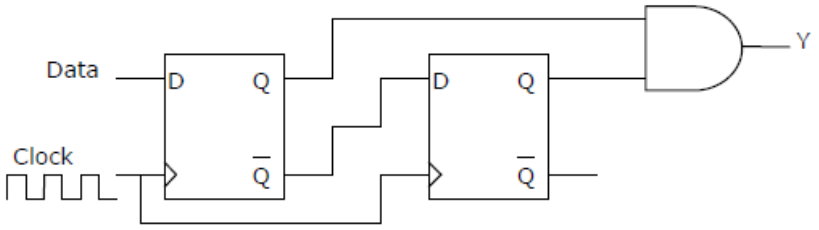


1) AND
2) NAND
3) NOR
4) OR

30. A 4-bit successive approximation type of ADC has an input range of 0 to 15 volts. The output bit D_1 next to the LSB has a stuck-at-zero fault. The pair of input voltages that produces the same output code word is

1) 2 V and 4 V
2) 4 V and 6 V
3) 1 V and 2 V
4) 8 V and 9 V

31. When the output Y in the below circuit is '1', it implies that the Data has



1) changed from '0' to '1'
2) changed from '1' to '0'
3) changed from '0' to '1' or from '1' to '0'
4) not changed

32. Consider the following 8085 program fragment. Program :

```
      MVI   A, 05H ;
      MVI   B, 05H ;
PTR : ADD   B      ;
      DCR   B      ;
      JNZ   PTR    ;
      ADI   03H    ;
      HLT          ;
```

What will be the content of accumulator after the above instructions are executed?

1) 17H
2) 20H
3) 23H
4) 05H

33. Which of the following pairs of microprocessor pins is used to request and acknowledge a DMA transfer?

1) READY and RESET
2) HOLD and HLDA
3) INTR and INTA
4) RD and WR

34. Which of the following 8085 instructions affect 'CY' flag only?

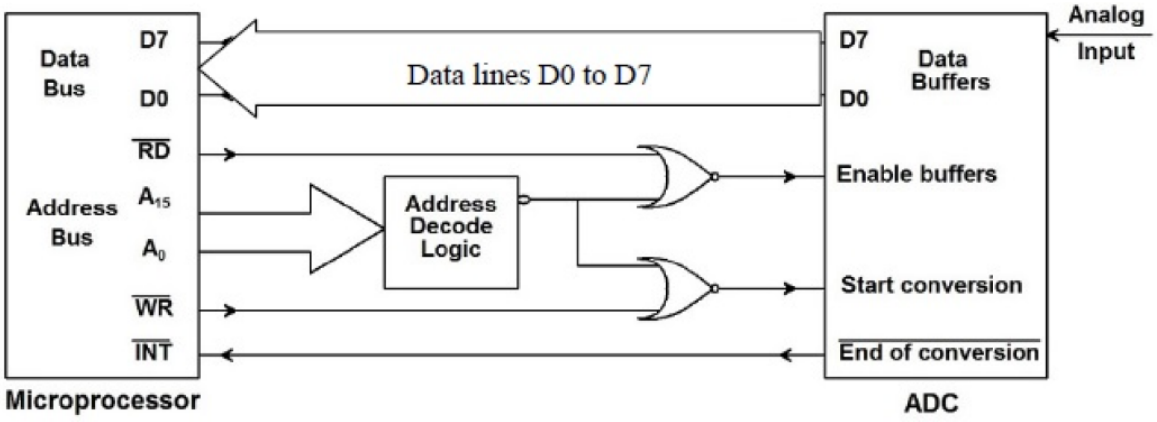
(A) CMC
(B) RAR
(C) DAD
(D) INX H

1) (D) only
2) (B) and (D) only
3) (A), (B) and (C) only
4) All instructions

35. Which of the following modes of operation of the 8253 Timer/Counter generates interrupts at regular interval of time?

1) mode-0
2) mode-1
3) mode-2
4) mode-3

36. An ADC is interfaced with a microprocessor as shown in the figure. All signals have been indicated with typical notations. Acquisition of one sample of analog input signal by the microprocessor involves



1) one read cycle only
2) one write cycle only
3) one write cycle followed by one read cycle
4) one read cycle followed by one write cycle

37. Which of the following serial port modes of 8051 support 8N1 asynchronous serial communication format?

1) mode-0
2) mode-1
3) mode-2
4) mode-3

38. Consider the 8085 assembly language program fragment given below :

3000H MVI A, 45H

3002H MOV B, A

3003H STC

3004H CMC

3005H RAR

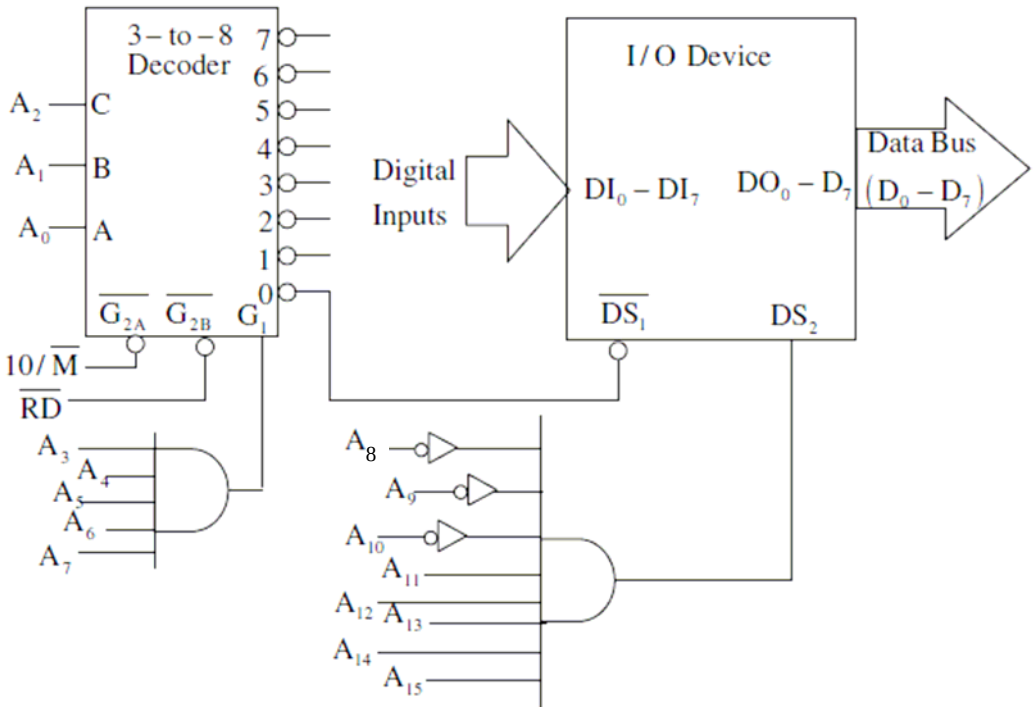
3006H XRA B

What is the content of the accumulator after the execution of the above program?

1) 00H 2) 45H

3) 67H 4) E7H

39. A memory mapped I/O interfacing circuit in a 8085 system to input data from an external device is shown in the figure.



Which one of the following instructions input the data from the I/O device?

1) MVI A, F8H 2) IN F8H

3) OUT F8H 4) LDA F8F8H

40. The class that acquires the properties of parent class is called ———— class.

1) base 2) inherited

3) derived 4) public

41. Consider the following C program :

```
# include<stdio.h>
main( )
{
        int i;
        int *pi = &i;

        scanf("%d",pi);
        printf("%d\n", i+5);
}
```

Which of the following statements is TRUE?

1) compilation fails
2) execution results in run-time error
3) on execution, the value printed is 5 more than the address of variable i
4) on execution, the value printed is 5 more than the integer value entered

42. A ———————— local variable preserves its variable between function calls.

1) extern
2) static
3) register
4) auto

43. Consider the 'C' Programme given below.

```
# include<stdio.h>
# include<conio.h>
main( )
{
        float a = 1.2345;
        printf("%x", a);
}
```

What is the output of the above 'C' programme?

1) 0.2345
2) 1.2345
3) 1
4) 0

44. The Gunn diode oscillator

1) Is capable of generating continuous microwave power of the order of kilowatt
2) Generates frequencies which are below 100 MHz
3) Operates over a positive resistance characteristic
4) Depends on the formation of charge domain

45. A reflex klystron is oscillating at the frequency of its resonant cavity. If the reflector voltage is made slightly less negative, the

1) Oscillation will cease
2) Output power would increase
3) The frequency will decrease
4) Bunching would occur earlier in time

46. The dc voltage on plate modulated class C amplifier is 8 kV. If the peak modulating voltage is 4 kV, the peak RF voltage delivered to load is

1) 32 kV
2) 12 kV
3) 0.5 kV
4) 24 kV

47. The frequency of operation of a dipole antenna cut to a length of 3.4 m

1) 88 MHz
2) 44 MHz
3) 22 MHz
4) 11 MHz

48. If the carrier of a 100 percent modulated AM wave is suppressed, the percentage power saving will be

1) 50
2) 150
3) 100
4) 66.66

49. The IF is 455 kHz. If the radio receiver is tuned to 855 kHz, the local oscillator frequency is

1) 455 kHz
2) 1310 kHz
3) 1500 kHz
4) 1520 kHz

50. In the stabilize reactance modulator AFC system

1) the discriminator must have a fast time constant to prevent demodulation
2) the higher the discriminator frequency, the better the oscillator frequency stability
3) the discriminator frequency must not be too low, or the system will fail
4) phase modulation is converted into FM by the equalizer circuit

51. A 100 MHz carrier is frequency modulated by 10 KHz wave. For a frequency deviation of 50 KHz, calculate the modulation index of the FM signal.

1) 100
2) 50
3) 70
4) 90

52. Two multimode fibers with different core sizes but same numerical aperture are spliced together. Light is sent into the fiber with the smaller core. How about the splice loss?

1) The losses at the splice can be substantial, since the mode sets do not fit
2) There cannot be significant splice losses, since all light gets into the core of the second fiber
3) The losses at the splice can be substantial, since the mode sets fit
4) There can be significant splice losses, since all light gets into the core of the second fiber

53. An optic fiber is made of glass with a refractive index of 1.55 and is clad with another glass with a refractive index of 1.51. Launching takes place from air. What numerical aperture does the fiber have?

1) 0.352
2) 0.532
3) 0.253
4) 0.523

54. What are TM modes?

1) When Hz = 0
2) When Ez = 1
3) When Hz = 1
4) When Ez = 0

55. In a 100-ns pulse, 6×10^6 photons at a wavelength of 1300nm fall on an InGaAs photo detector. On the average 5.4×10^6 electron-hole pairs are generated. What is quantum efficiency?

1) 80%
2) 90%
3) 70%
4) 50%

56. Any thyristor can be turned ON with

1) breakover
2) forward-bias triggering
3) low-current drop-out
4) reverse-bias triggering

57. When a crowbar is used with a power supply, the supply needs to have a fuse or

1) adequate trigger current
2) holding current
3) filtering
4) current limiting

58. In a regulated power supply, two similar 15 V zeners are connected in series. The input voltage is 45 V d.c. If each Zener has a maximum current rating of 300 mA, what should be the value of the series resistance?

1) 10 Ω
2) 20 Ω
3) 40 Ω
4) 50 Ω

59. A 4-pole induction motor, supplied by a slightly unbalanced three-phase 50 Hz source, is rotating at 1440 rpm. The electrical frequency in Hz of the induced negative sequence current in the rotor is

1) 100
2) 98
3) 52
4) 48

60. A negative sequence relay is commonly used to protect

1) an alternator
2) an transformer
3) a transmission line
4) a bus bar

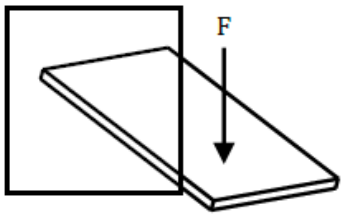
61. The Q factor of a coil at the resonant frequency 1.5 MHz of an RLC series circuit is 150. The bandwidth is,

1) 225 MHz
2) 1.06 MHz
3) 10 kHz
4) 1 kHz

62. An apparatus to capture ECG signals has a filter followed by a data acquisition system. The filter that best suited for this application is

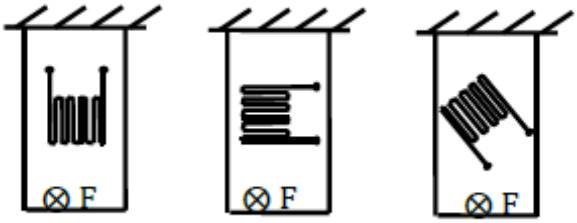
1) low pass with cutoff frequency 200 Hz
2) high pass with cutoff frequency 200 Hz
3) band pass with lower and upper cutoff frequencies 100 Hz and 200 Hz for its pass band
4) band reject filter with lower and upper cutoff frequencies 1 Hz and 200 Hz for its stop band

63. The figure below shows various configurations of bonding a strain gauge to a cantilever subjected to a bending force F. Which configurations produce maximum change in resistance for the applied force?



Cantilever

Top Views of possible configurations



(P) (Q) (R)

1) P
2) Q
3) R
4) All produce equal change in resistance

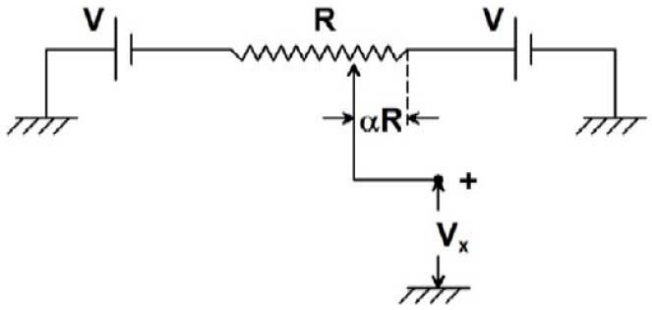
64. Which of following flowmeters measures flow in both direction and the measurement is not affected by changing fluid, viscosity, pressure, temperature, and density?

1) Doppler flowmeter
2) Transit time flowmeter
3) Electromagnetic flowmeter
4) None of the above

65. An LVDT is supplied with a sinusoidal voltage of amplitude 5V and frequency 1 kHz. The output is connected to an ac voltmeter. The reading of the voltmeter is 1V for a displacement of 1 mm from the null position. When the displacement is 1 mm in the opposite direction from the null position, the reading of the voltmeter is

1) – 1 V
2) – 0.2 V
3) +1 V
4) + 5 V

66. In the potentiometer circuit shown in the figure, the expression for Vx is



1) $(1-2\alpha)V$
2) $(1-\alpha)V$
3) $(\alpha-1)V$
4) αV

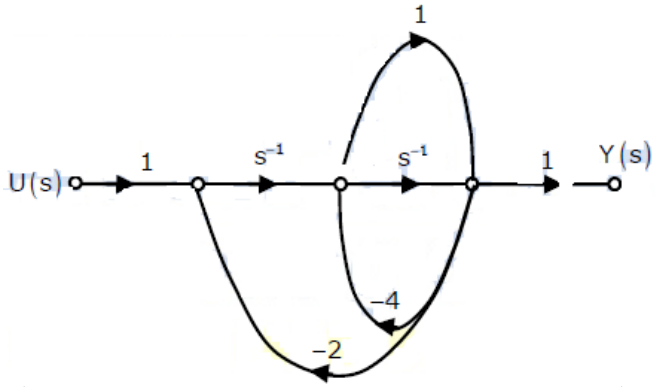
67. A piezoelectric type accelerometer has a sensitivity of 100 mV/g. The transducer is subjected to a constant acceleration of 5 g. The steady state output of the transducer will be

1) 0 V
2) 100 mV
3) 0.5 V
4) 5 V

68. In time-domain analysis, damping ratio ξ and peak overshoot M_p, are the measures of

1) relative stability
2) absolute stability
3) speed of response
4) steady-state error

69. The signal flow graph for a system is given below. The transfer function $\frac{Y(s)}{U(s)}$ is



1) $\frac{s+1}{5s^2+6s+2}$
2) $\frac{s+1}{s^2+6s+2}$
3) $\frac{s+1}{5s^2+4s+2}$
4) $\frac{1}{5s^2+6s+2}$

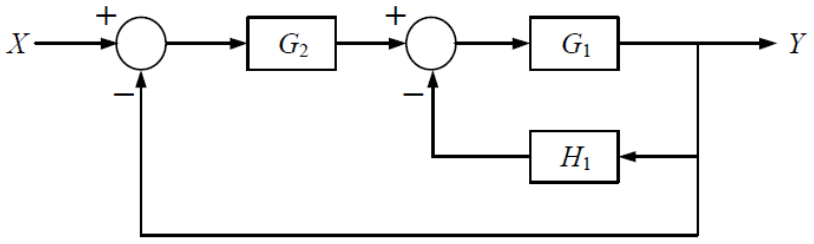
70. Two systems with impulse responses $h_1(t)$ and $h_2(t)$ are connected in cascade. Then the overall impulse response of the cascaded system is given by

1) Product of $h_1(t)$ and $h_2(t)$
2) Sum of $h_1(t)$ and $h_2(t)$
3) Convolution of $h_1(t)$ and $h_2(t)$
4) Subtraction of $h_2(t)$ from $h_1(t)$

71. The unit step response of a network is $\left(1-e^{-\alpha t}\right)$, then its unit impulse response is

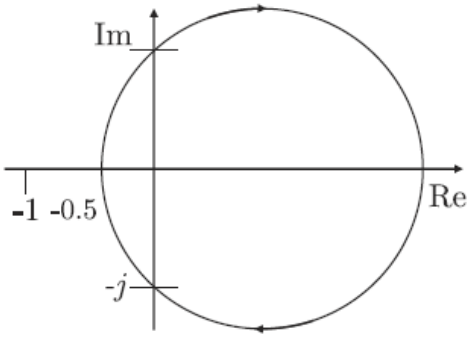
1) $\alpha e^{-\alpha t}$
2) $\alpha^{-1} e^{-\alpha t}$
3) $\left(1-\alpha^{-1}\right)e^{-\alpha t}$
4) $(1-\alpha)e^{-\alpha t}$

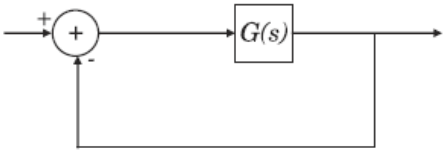
72. The block diagram of a feedback control system is shown in the figure. The overall closed loop gain G of the system is



1) $G=\frac{G_1G_2}{1+G_1H_1}$
2) $G=\frac{G_1G_2}{1+G_1G_2+G_1H_1}$
3) $G=\frac{G_1G_2}{1+G_1G_2H_1}$
4) $G=\frac{G_1G_2}{1+G_1G_2+G_1G_2H_1}$

73. The Nyquist plot of a stable transfer function $G(s)$ is shown in the figure are interested in the stability of the closed loop system in the feedback configuration shown.





Which of the following statements is TRUE?

1) $G(s)$ is an all-pass filter
2) $G(s)$ has a zero in the right-half plane
3) $G(s)$ is the impedance of a passive network
4) $G(s)$ is marginally stable

74. The settling time of the second order linear system is

1) 4 times the time constant of the system
2) 2 times the time constant of the system
3) equal to the time constant of the system
4) (1/4) times the time constant of the system

75. The first two rows of Routh's table of a third-order characteristic equation are :

s^3	3	4
s^2	4	4

It can be inferred that the system has

1) one real pole in the right-half of s-plane
2) a pair of complex conjugate poles in the right-half of s-plane
3) a pair of real poles symmetrically placed around $s = 0$
4) a pair of complex conjugate poles on the imaginary axis of the s-plane

ROUGH WORK

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