GOVERNMENT OF INDIA : : DEPARTMENT OF SPACE

INDIAN SPACE RESEARCH ORGANISATION

ISRO Centralised Recruitment Board

Recruitment Entrance Test for Scientist/Engineer 'SC' 2014

May 24, 2014 Saturday

Test Booklet

Test Duration (Minutes)	90
No of Questions	80
No of Pages (Other than cover sheet)	14

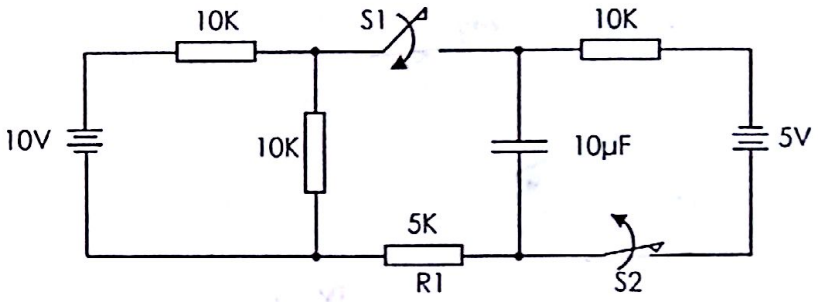
ELECTRONICS

A

Instructions to the candidate

1. The question paper is in the form of test booklet with **80** questions.
2. A separate **OMR** answer sheet is provided for answering.
3. Each question is provided with a text and figure wherever applicable with **multiple answer choices (a), (b), (c) and (d)**. Only one of them is correct.
4. Read the instructions on the **OMR** sheet carefully. Use only **HB pencil** for writing on OMR sheet and marking your answers.
5. All questions carry equal marks of **THREE** for a correct answer, **ZERO** for no answer and minus **ONE** for a wrong answer.
6. **Multiple answers** for a question will be regarded as a wrong answer.
7. Although the test stresses on accuracy more than speed, it is important for you to use your time as effectively as possible.
8. Do not waste time on questions, which are too difficult for you. Go on to other questions and come back to the difficult ones later
9. Question booklets have been marked with **A** or **B** or **C** or **D** or **E** on the right hand top corner, which is mandatory to be written on the OMR sheet in the box and bubble appropriately, failing which, the answer sheet will not be evaluated.
10. Space available in the booklet could be used for rough work, if required. No separate sheet will be provided.
11. Before signing the attendance sheet, the candidate should write the Booklet Code in the attendance sheet

1 In the circuit shown below, switch S1 and S2 are in open and close position respectively for long time. At $t = t_0$, switch S1 is closed and switch S2 is opened. What would be the current through R1 immediately after the transition of switches?



A) 0mA B) 1mA
C) 0.5mA D) 2mA

2 A digital board has a unipolar square clock of 250MHz. If the clock on the board at all places should have all the harmonic components which have more than 10 % of DC value, the board has to be designed for at least –

A) 250 MHz B) 750 MHz
C) 1250 MHz D) 2500 MHz

3 A switch is connected in between a 12V battery and an uncharged capacitor and a 1 KΩ resistor. At the time instant when the switch is closed, the voltage across the capacitor is :

A) 6V B) 12 V
C) 0V D) 24V

4 Which type of timing violation will occur, If a digital IC is operated at clock frequency which is higher than its specified maximum clock frequency?

A) Hold violation B) Setup violation
C) Propagation delay D) All of above

5 If the maximum effective aperture of a radiating small loop of constant current is $(\frac{3}{32\pi})m^2$, the wavelength of the radiated electromagnetic wave is:

A) 5000 mm B) 100 mm
C) 1000 mm D) 500 mm

6 A radar system uses magnetron as high power RF source. Its transmitter emits 300kW RF power at 10% duty factor. If the efficiency of radar transmitter during pulse is 60% and the power required during pulse off period is 1kW. The average power dissipation in radar is,

A) 50.9 kW B) 301 kW
C) 20.9 kW D) 150.5 kW

7 Match the following:

A	Gaussian distribution	**1**	Calls on a telephone channel
B	Rayleigh distribution	**2**	Random number
C	Poisson distribution	**3**	Thermal noise
D	Uniform distribution	**4**	Fading channel in wireless communication

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

8 In a fiber-optic cable, which phenomenon occurs for signal to propagate along the inner core:

A) Modulation B) Reflection
C) Refraction D) All of the above

9 Which of the following computation will take minimum number of clock cycles, if it is implemented on 8051 micro-controller? Following is variable declaration in c code:

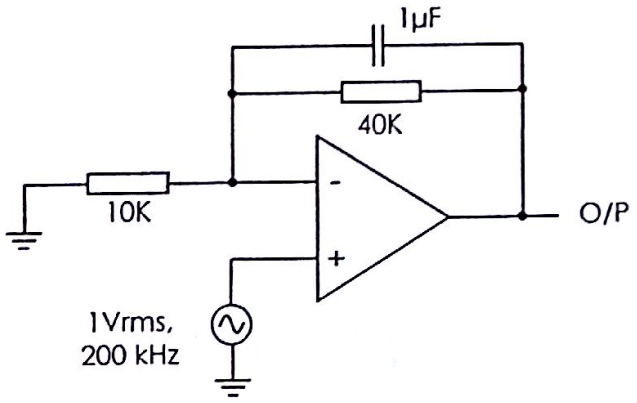
unsigned int a,b;

A) *b=a*a* B) *b=a*3*
C) *b=a/3* D) *b=a/4*

10 Using a quarter wave transformer of characteristic impedance 1 Ω, a load impedance of 100 Ω will be transformed to an input impedance of value :

A) 1 Ω B) 100 Ω
C) 0.01 Ω D) 0.1 Ω

11 What is the output signal level of following circuit?



A) ~5Vrms B) ~1Vrms
C) ~4Vrms D) ~0.1Vrms

12 The effect of channel coding in communication channels is :

A) Reduced errors B) Increased bandwidth

C) Reduced terminal size D) All of above

13 For a point charge having electric flux density, $D = \frac{Q}{4\pi r^2} a_r$, where a_r is the unit vector in radial direction; volume charge density ρ_v is :

A) 1 B) 0

C) Infinite D) $\frac{Q}{4\pi}$

14 What is Discrete Time Fourier Transform (DTFT) of following signal?
$x(n) = a^n$ where $n \geq 0$, $-1 < a < 1$

A) $X(\omega)=1/(1- ae^{-j\omega})$ B) $X(\omega)=1/(1+ ae^{-j\omega})$

C) $X(\omega)=a/(1- ae^{-j\omega})$ D) $X(\omega)=a/(1+ ae^{-j\omega})$

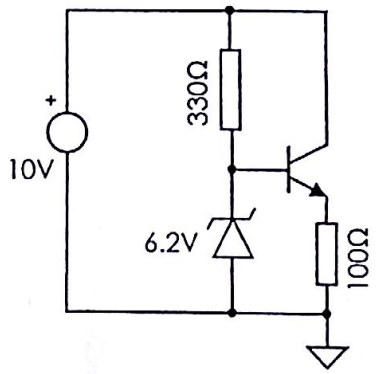
15 In the near field, the radiated waves take the form of :

A) Spherical Wave B) Plane Wave

C) Cylindrical Wave D) Conical Wave

16 The zener diode shown in following figure is temperature compensated and current gain β of transistor is very high. If current through 100 ohm resistor is 55mA at 25°C, what is the approximate current through it at 65°C?

25



A) 55mA B) 54mA

C) 56mA D) 100mA

17 We wish to transmit a digital voice at 32 Kbps through a communication channel having bandwidth of 3000 Hz. The received signal to noise power ratio is 30 dB. State which of the following statement is true :

A) To transmit data error-free through this channel, channel equalizer circuit should be used at the receiver.

B) To transmit data error-free through this channel, the voice signal should be compressed by 2.

C) To transmit data error-free through this channel, a channel code with coding gain of 3 dB should be used.

D) It is not possible to transmit data error-free through this channel.

18 Consider a standard rectangular and a circular waveguide having same dominant mode cut-off frequency, determine the ratio of area of circular waveguide to rectangular waveguide :

A) $1/\pi$ B) $6.78/\pi$
C) $0.69/\pi$ D) π

19 What is the lowest level of abstraction in any hardware description language?

A) Behavioral B) Gate level
C) Structural D) Register-Transfer Level

20 With the introduction of negative feedback, the gain-bandwidth product of an amplifier

A) Becomes infinity B) Increases
C) Decreases D) Remains constant

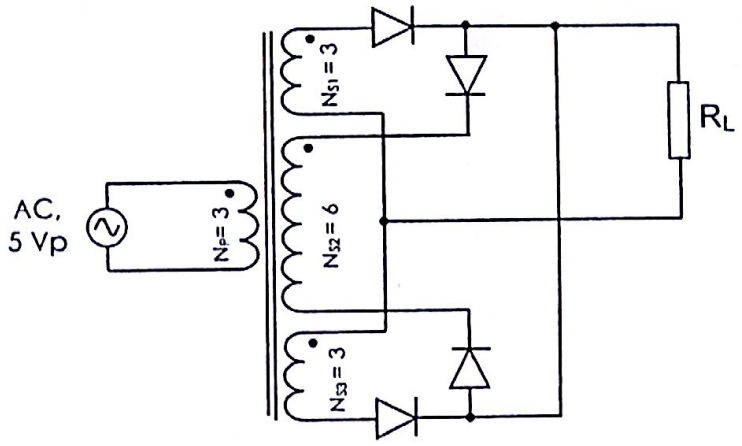
21 For a BER of 10^{-5}, which modulation scheme will require minimal power?

A) QPSK B) 8-PSK
C) 16-PSK D) 16-QAM

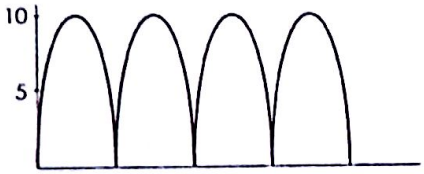
22 Which one of following is not synthesizable VHDL statement?

A) 'case' B) 'wait until'
C) 'wait for' D) generate

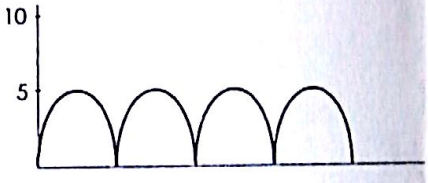
28 Diodes in the following circuit are ideal. Which is the correct waveform across R_L?



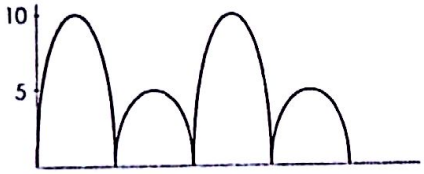
A)



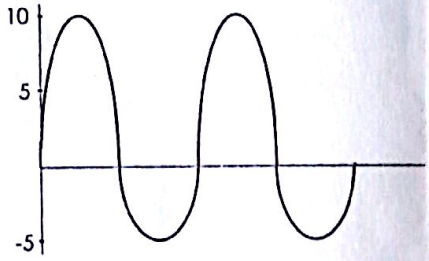
B)



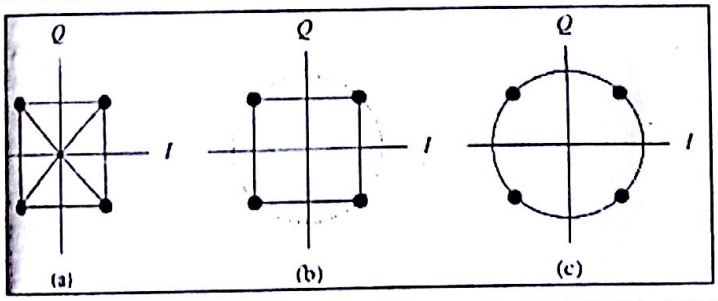
C)



D)



29 Identify the modulation schemes for the shown signal constellation diagrams

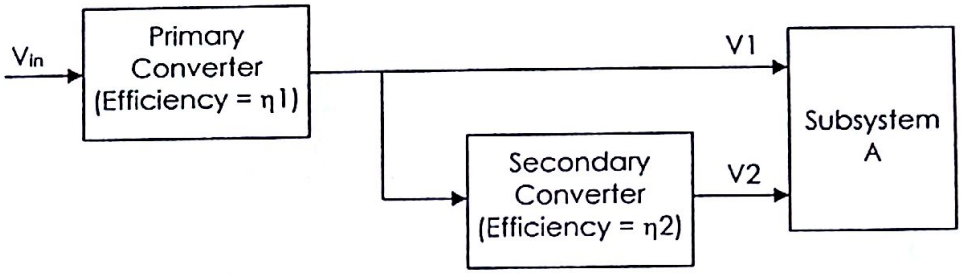


A) (a)-QPSK (b)-BPSK (c)-QAM
B) (a)-QPSK (b)-OQPSK (c)-MSK
C) (a)-OQPSK (b)-QAM (c)-QPSK
D) (a)-OQPSK (b)-QPSK (c)-MSK

30 The Fourier Transform of a discrete and aperiodic signal is:

A) Continuous and aperiodic
B) Continuous and periodic
C) Discrete and aperiodic
D) Discrete and periodic

23 Subsystem A requires two voltages V1 and V2 with equal power ratings. Power conversion scheme adapted for the power supply design is shown in the following figure. What is the overall power conversion efficiency?



A) $\frac{(1 \bullet (2}{(1 + (2}$ B) $\eta 1 * \eta 2$

C) $\frac{2 (1 * (2}{1 + (2}$ D) $\frac{2 (1 * (2}{1 + (1}$

24 Which of the following modulation scheme is most bandwidth efficient?

A) AM B) FM
C) PM D) SSB-SC

25 A Colpitts Oscillator is having tank capacitances of 1nF and 10nF, and inductance of 0.1μH. The gain required by the circuit to start oscillating is :

A) 10 B) 100
C) 1 D) 1000

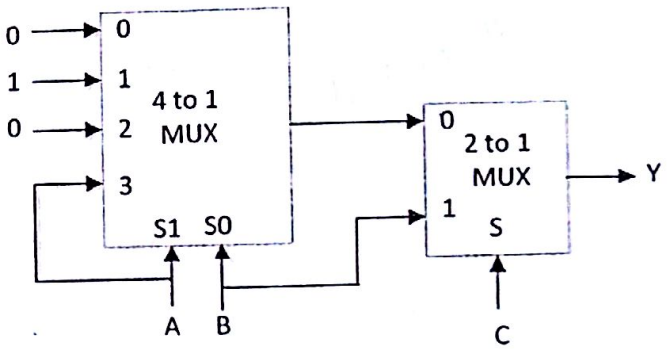
26 A digital CMOS IC operating at 10MHz clock frequency consumes 100mW power; the same IC operating at 15 MHz clock frequency consumes 140mW power. What is the static power consumption of the IC?

A) 10 mW B) 15 mW
C) 20 mW D) 40 mW

27 An amplifier has a gain of 50 dB, and noise figure of 10dB. Assuming an ambient temperature of 300 K, what will be the total equivalent noise temperature at the input of the amplifier?

A) 760 K B) 360 K
C) 2700 K D) 3000 K

31 In the following circuit, Y can be expressed as :



A) Y = BC + A
B) Y = C
C) Y = 'AC' + BC
D) Y = B

32 $s^2 - 0.75s + 0.25$ is the characteristic equation of a second order system. Its response to unit step function will be,

A) Over damped
B) Under damped
C) Critically damped
D) Exponential growth

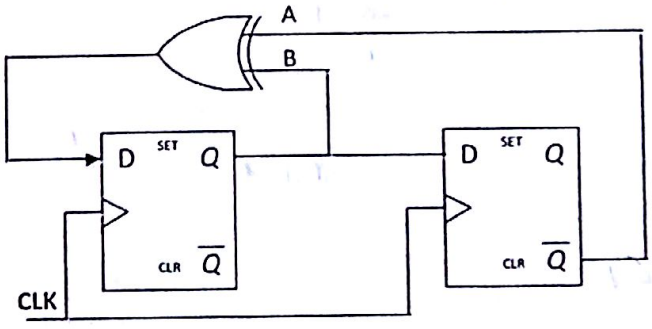
33 Which modulation scheme would you suggest for high speed data transmission over a fading channel?

A) MSK
B) BPSK
C) FSK
D) OFDM

34 For a two port network to be reciprocal, its Scattering parameters must satisfy the following condition, for i=1,2 ; j=1,2

A) $S_{ij}=S_{ji}$ $(i\neq j)$
B) $S_{ij}=S_{ji}$ $(i=j)$
C) $S_{ij}=1/S_{ji}$ $(i\neq j)$
D) $S_{ij}=S_{ji}^{*}$ $(i=j)$

35 In the following circuit, what sequence is followed by A and B on rising edge of CLK after reset is de-asserted?



A) AB=10, 11, 00, 10, 11, ...
B) AB=10, 01, 00, 11, 10, ...
C) AB=10, 00, 01, 10, 00, ...
D) AB=11, 01, 00, 10, 11, ...

36 In an axial mode operation of a helical antenna, maximum field radiated by the antenna is :

A) along the axis of the helical antenna
B) in a plane normal to the helix axis
C) in both axial and normal planes
D) None of the above

37 Which of the following theorem is applicable for both linear and non-linear circuits?

A) Superposition theorem
B) Thevenin's theorem
C) Norton's theorem
D) None of these

38 What is the maximum data rate that can be transmitted using a QPSK modulation with a roll-off factor of 0.2 for a 36 MHz transponder?

A) 7.2 Mbps
B) 30 Mbps
C) 43.2 Mbps
D) 60 Mbps

39 Consider a single stage tuned amplifier having 3dB bandwidth of 100KHz. Determine the bandwidth if two such single stage tuned amplifiers are cascaded :

A) 100KHz
B) 10KHz
C) 41.4KHz
D) 64.3KHz

40 500 Bytes of data needs to be transmitted from an UART every 100ms. What should be the minimum transmission baud rate of UART, assuming 1 start bit, 8 data bits and 2 stop bits?

A) 50000
B) 55000
C) 40000
D) 45000

41 What is the value of the major cross-sectional dimension(width) of a rectangular waveguide with dominant TE_{10} mode propagation, if its cut off frequency is 10 GHz ?

A) 15mm
B) 30 mm
C) 7.5mm
D) 45 mm

42 In a Traveling-wave Tube, the velocity of electron beam with respect to the axial velocity of RF field is kept...

A) Lower
B) Higher
C) Equal
D) Any of these

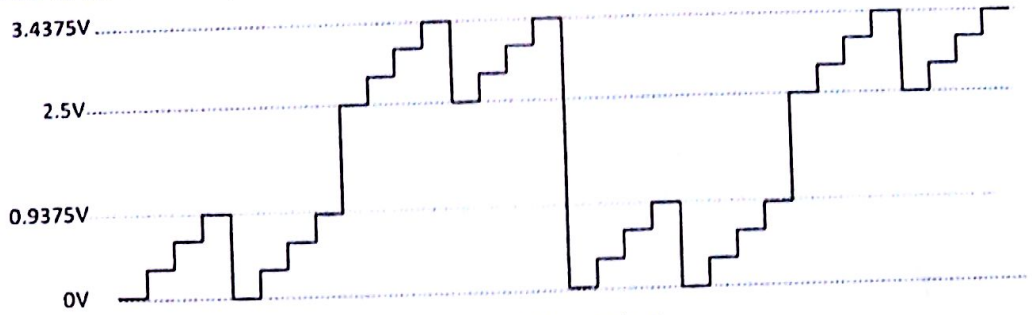
43 In satellite communication, scrambling is mainly used for -

A) clock recovery
B) encryption
C) limiting power spectral density
D) bandwidth efficiency

44 Scattering Matrix for a microwave network, which is matched at all the ports, will satisfy the following condition:

A) All non-diagonal elements will be zero.
B) All diagonal elements will be zero.
C) None of the matrix elements will be zero.
D) All the matrix elements will be zero.

45 Following waveform shows output of a 4 bit DAC with 5V reference voltage. The 4 bit digital input of DAC is connected to 4 bit up counter, the one bit input of DAC Is stuck at '0', which is this bit ?



A) Bit-0 (LSB) B) Bit-1
C) Bit-2 D) Bit-3 (MSB)

46 Which of the following has the highest skin depth?

A) Aluminum B) Gold
C) Silver D) Copper

47 A network contains linear resistors and ideal voltage sources. If values of all the resistors are doubled, then voltage across each resistor is

A) Halved B) Doubled
C) Increases by 4 times D) Remains the same

48 A coherent QPSK demodulator is required on ground for receiving data from a LEO satellite. What should be optimum order of PLL in the carrier phase tracking loop?

A) 1^{st} order B) 2^{nd} order
C) 3^{rd} order D) None of the above

49 VSWR of a purely resistive load of normalized value n+j0 for n<1 is :

A) n B) 1/n
C) 1 D) Infinite

50 Two discrete time systems have impulse response $h_1[n] = \delta[n-3]$ and $h_2[n] = \delta[n-5]$. If these two systems are cascaded, thenthe overall impulse response of the cascaded system is

A) $\delta[n-8]$ B) $\delta[n-3] + \delta[n-5]$
C) $\delta[n-1] * \delta[n-2]$ D) $\delta[n-2]$

51 Frequency range of Ka-band EM waves is

A) 18.0GHz -26.5 GHz B) 26.5GHz -40.0 GHz
C) 12.0GHz -18.0 GHz D) 40.0GHz -60.0 GHz

52 Following four resistances are connected in parallel; the largest power is dissipated by…

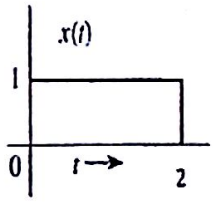
1) 2.4Ω, 1W
2) 5.1Ω, 2W
3) 10Ω, 5W
4) 22Ω, 10W

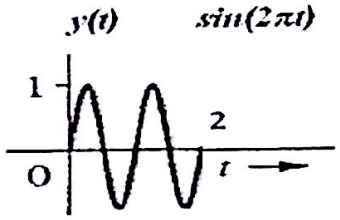
A) 2.4Ω, 1W
B) 5.1Ω, 2W
C) 10Ω, 5W
D) 22Ω, 10W

53 Eye diagram gives us an idea of -

A) Modulation scheme
B) Clock jitter
C) Signal-to-Noise Ratio
D) All of the above

54 Determine the correlation coefficient between the pulses x(t) and y(t) shown in the fig. below :





A) 1
B) -1
C) 0
D) 2π

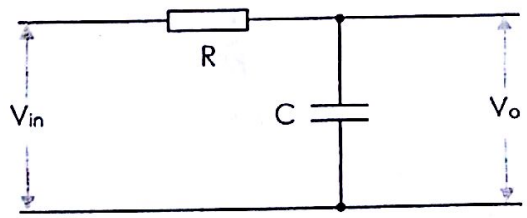
55 What is 4 point Discrete Fourier Transform of signal x(n)=(1,2,3,4)
↑

A) [10, 2j, -2,-2j]
B) [10,-2, -2, -2]
C) [10,-2+2j, -2, -2-2j]
D) [10j,-2, -2, -10j]

56 The value of axial ratio of a 45° linearly polarized EM wave in dB is

A) Infinite
B) 0
C) 1
D) 2

57 If an input signal with non-zero dc component is applied to a low pass RC network with single resistor R and single capacitor C as shown below, the dc component in the output will be :



A) The same as the input
B) Less than the input
C) More than the input
D) Zero

58 The thermal noise spectral density generated in a resistor kept at t °C is given by:

A) k(t+273) B) ktB
C) k(t+273)B D) 2k(t+273)

59 What are poles and zeros of a system having following transfer function?
$H(z)= (1- z^{-2})/(1+1.3z^{-1}+0.36z^{-2})$

A) Zeros = -1,1; Poles=-0.4,-0.9 B) Zeros =-1,1; Poles=0.4,0.9
C) Zeros = 1; Poles=0.4,0.9 D) Zeros = 1,1; Poles=0.4,0.9

60 The change in phase of an electromagnetic wave normally incident on a perfect conducting wall is?

A) 90° B) 180°
C) 0° D) 270°

61 What is the turns ratio of the transformer needed to match a 1kΩ source resistance to a 50Ω load?

A) 4.47 : 1 B) 400: 1
C) 20 : 1 D) 0.05 : 1

62 A satellite communication link has both uplink and downlink C/N_0 of 50dB-Hz. What would be overall link C/N_0?

A) 25dB-Hz B) 47dB-Hz
C) 53dB-Hz D) 100dB-Hz

63 Determine polarization loss factor for a circularly polarized signal upon reception by linearly polarized antenna

A) $1/\sqrt{2}$ B) $1/2$
C) 1 D) 0

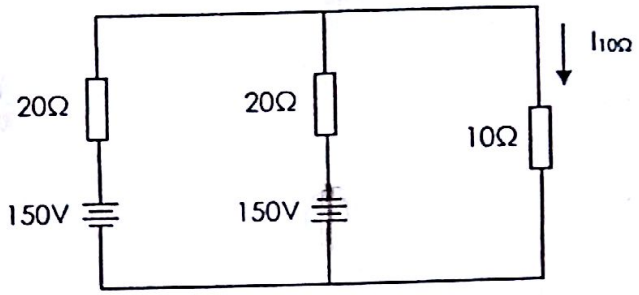
64 Which instruction of 8051 microcontroller is used for reading data from code memory?

A) MOV B) MOVC
C) MOVX D) XCH

65 If frequency is decreased 4 times, then skin depth of an Electromagnetic wave inside a conductor will be :

A) halved B) quadrupled
C) doubled D) no change

66 In the circuit shown below, the current through 10Ω resistor is :



A) 5 A
B) 10A
C) -5A
D) None of these

67 If two tones f_1 and f_2 are amplified by a non-linear amplifier, which frequency components would be present in output?

A) f1, f2
B) f1, f2, f1+f2, f1-f2
C) f1+f2, f1-f2
D) nf1 ± mf2, where n and m are integers

68 When a sinusoidal voltage wave drives a Schmitt Trigger, the output is a:

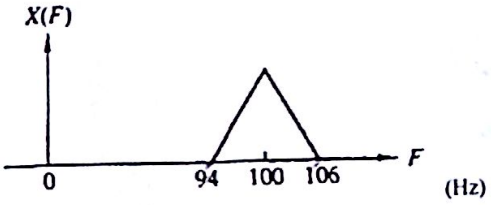
A) Triangular wave
B) Rectified sine wave
C) Rectangular wave
D) Trapezoidal wave

69 What will be content of Stack Pointer if following assembly code of 8051 microcontroller is executed immediately after reset?

PUSH 00h
POP 01h
POP 02h

A) 07h
B) 06h
C) 0Ah
D) 31h

70 Consider the sampling of the band-pass signal, whose spectrum is as shown below. What minimum sampling frequency would you use from the options given below, so as to avoid aliasing?



A) 24 Hz
B) 26.5 Hz
C) 48 Hz
D) 212 Hz

71 A resistor and a capacitor are connected in series with a sine wave generator having frequency such that the resistance and the capacitive reactance are same i.e. voltage across capacitance, V_C is equal to Voltage across Resistance, V_R. If the frequency of the sine wave generator is doubled, then

A) $V_R < V_C$ B) $V_R = V_C$
C) $V_R > V_C$ D) None of the above

72 In CMOS designs, why size of PMOS is kept larger than size of NMOS?

A) To get higher drive strength B) To reduce power dissipation
C) To get balanced rise/fall time D) All of above

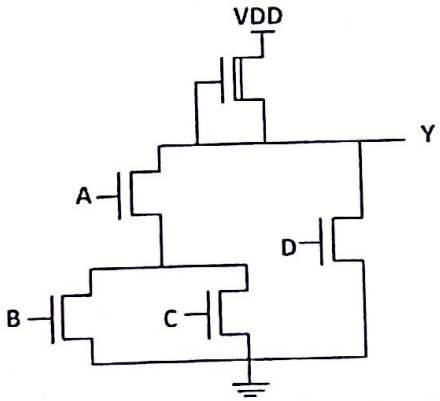
73 A plane wave with a frequency of 3 GHz is propagating in an unbounded medium with relative permittivity $\varepsilon_r = 6$ and permeability $\mu_r = 1.5$, the phase velocity for this wave in this medium is

A) 1×10^8 m/s B) 2×10^8 m/s
C) 3×10^8 m/s D) 1.5×10^8 m/s

74 Which of the following statements is **NOT** true :

A) A high PRF pulse Doppler radar has no ambiguities in Doppler frequency.
B) A high PRF pulse Doppler radar has no range ambiguities.
C) A high PRF pulse Doppler radar provides an accurate measurement of target's radial velocity.
D) An MTI radar has many Doppler ambiguities.

75 The Boolean equation for Y in the following circuit is



A) Y=(A(B+C)+D)' B) Y=A(B+C)+D
C) Y=(A+BC)D D) Y=((A+BC)D)'

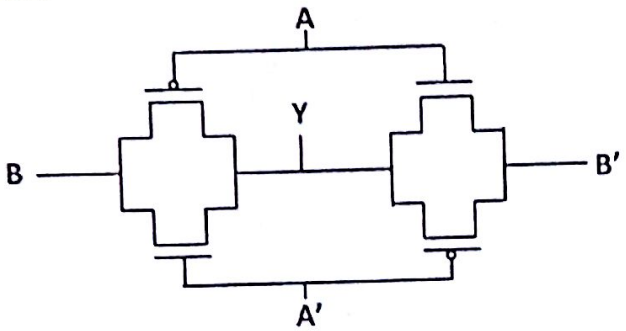
76 A wave is incident from free-space onto a dielectric region of dielectric constant $\varepsilon_r = 4$,The wave impedance in the dielectric is :

A) 55.5 Ω B) 100.5 Ω
C) 108.6 Ω D) 188.5 Ω

77 Range resolution of a Linear Frequency Modulated pulse compression radar depends on which of the following factors:

A) Radiated power
B) Antenna size
C) Center frequency of the radar
D) Bandwidth of the transmitted pulse

78 Which logical function is implemented by following Transmission Gate based circuit?



A) Y= XNOR(A,B)
B) Y= OR(A,B)
C) Y= AND(A,B)
D) Y= XOR(A,B)

79 The orbital period of a satellite in circular orbit of radius R from the centre of the earth , is proportional to :

A) $R^{1/2}$
B) $R^{3/2}$
C) R^{2}
D) R

80 Which of the following meters is based on the principle of Hall Effect?

A) Ammeter
B) Gaussmeter
C) Voltmeter
D) All of the above