BSNL Junior Telecom Officers-JTO 2005 SOLUTIONS

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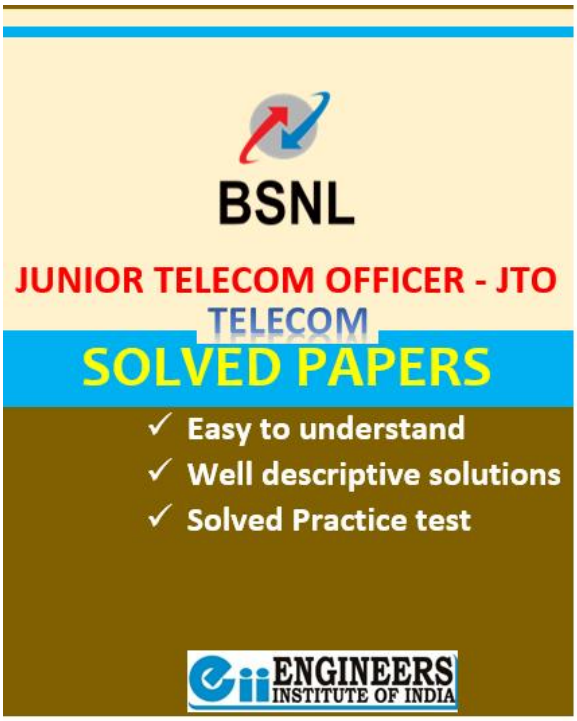


SOLUTION section – I : Technical

1. Due to the huge amounts of distortion, the class C configurations are not used in audio applications. The most common application of class C amplifier is the RF circuits like RF oscillator, RF amplifier.

2. When a single phase voltage source square wave inverter feeds pure inductive load. Then the waveform of load current will be $\propto \frac{d}{dt}$ (square wave), $\propto$ (Triangular wave)

3. Peak current through thyristor is given by

$$I_{Peak} = \frac{\text{Voltage}}{\text{Impedance}}$$

$$= \frac{V}{\sqrt{\frac{L}{C}}} = V\sqrt{\frac{C}{L}}$$

4. Firing angle is the phase angle of the voltage at which SCR turns on. The firing angle of SCR can be controlled once in each half cycle.

5. The average output voltage in DC choppers can be controlled by FM. In FM pulses of fixed amplitude and duration are generated and average value of output is adjusted by changing how often the pulses are generated.

6. Forward blocking mode:
The anode is positive with respect to cathode, with gate kept in open condition. So, the anode and cathode junctions are forward biased, but the gate junction is reversed biased.

7. A 3 phase semi-converter can work as converter for a 0^o to 180^o.

8. A single phase full bridge inverter can operate in load commutation mode in case load consists of RLC under damped.

9. In a thyristor, the typical ratio of latching current to holding current is 2.5

10. Given: Full scale voltage = 300V

Accuracy = ± 2%

Based on the above accuracy, its pointer can be 6V (300V × 0.02) below or above the true reading.
So, when it reads 222V, the actual voltage lies between 216V to 228V.

11. For measuring angular position and converting them into electrical signals for tele transmission purposes either potentiometric or synchro transducer are used.

12. A thermistor is a resistor whose resistance is dependent on temperature. The temperature coefficient of resistance for a thermistor is high and negative.

13. The dynamic characteristics of capacitive transducers are similar to high pass filter (passes the high frequency and stops the low frequency)

14. The magnitude of limiting error is $\frac{0.75}{100} \times 200 = 1.5\,\text{V}$

The percentage error at a meter indication of 100V is, $\frac{1.5}{100} \times 100$ percent $= 1.5\%$

15. A digital frequency counter can be converted to a DVM by addition of a suitable DAC (D/A converter changes digital output to analog output)

16. Dry cell is an electric cell in which electrolyte is absorbed in a solid to form a paste. It is a time variant and active device.

17. We know that,

Quality factor $Q = \frac{1}{2\zeta}$

Where, ρ = damping ratio

18. We know that,
SNR in PCM system is given by,
SNR = (1.78 + 6N) dB
Where $N = \log_2 L$
Here, L is number of quantization levels.

19. We know that, antenna efficiency is given by;

$$\eta = \frac{R_r}{R_r + R_l}$$

Where, R_r is radiation resistance.

20. Field strength is given by,

$$E = \frac{\sqrt{30P}}{r} \qquad ...(1)$$

Now, $E_1 = \frac{\sqrt{30P \times 2}}{r}$ ...(2)

On dividing (2) by (1), we get $E_1 = \sqrt{2}E$

$\Rightarrow$ Field strength at a point will go up by 3dB.

21. In FM receiver,
Standard channel Bandwidth = 200 kHz
Standard frequency deviation = 75 kHz
Standard intermediate frequency = 10.7 MHz

22. A

23. Marconi antenna is not a wide band antenna where as Helical, Rhombic and folded diopole are wide band antennas.

24. The highest reflecting layer, the F2 layer, which is approximately 200 miles above earth.

25. d

26. Given:
$Z_{SC} = 100\ \Omega$
$Z_{OC} = 64\ \Omega$
We know that,

Input impedance of the line,

$Z_{in} = \sqrt{Z_{SC}.Z_{OC}} = \sqrt{100 \times 64} = 80\Omega$

27. The channel required for EM telemetry is 100 times that required for AM telemetry.

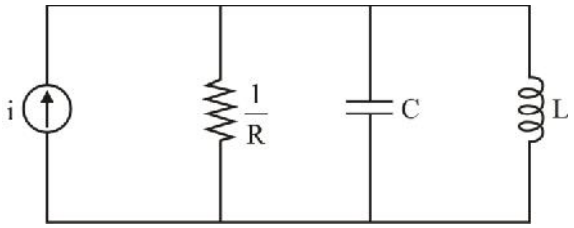
28. The crossed dipoles in turnstile antenna are excited with voltage such that the phase shift between the voltage is 90º.

29. Yagi-uda antennas are used as TV broadcasting antenna. It is a directional antenna consisting of multiple parallel elements in line.

30. The dominant mode in waveguide is characterized by longest cut off wavelength or minimum cut off frequency.

31. F

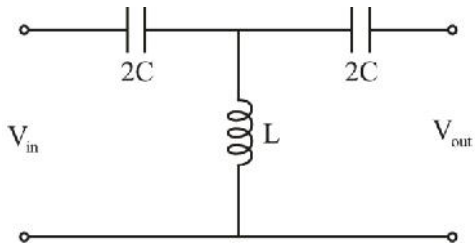
32. Dual of the given network is;



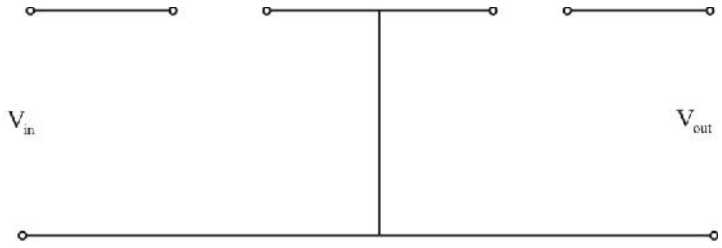
$R' = \frac{1}{R}$, $L' = C$, $C' = L$

33. F

34.

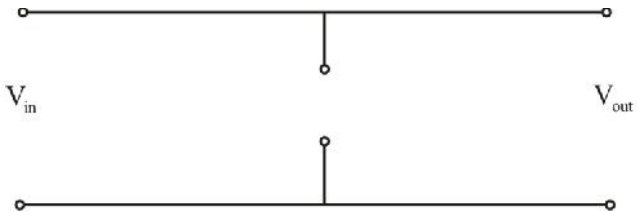


Put f = 0



$\Rightarrow V_{out} = 0$

Put f = ∞



$\Rightarrow V_{out} = V_{in}$

$\Rightarrow$ HPF

35. Tellegen's theorem works based on the principle of law of conservation of energy. It states that algebraic sum of power in any circuit at any instant is equal to zero.

36. Due to early effect:

$\rightarrow$ Collector current slightly increases

$\rightarrow$ Recombination current decreases

$\rightarrow$ Base current reduces

$\rightarrow$ α of the transistor slightly increases

$\rightarrow$ β of the transistor increases by larger value

37. The gain-band width product of a junction transistor is affected to a maximum extent by base emitter diffusion capacitance.

38. Two transistor model of p-n-p-n four layer device explains all the regions of device characteristics.

39. The resistance of metallic wire would remain unaffected on increasing the operating frequency.

40. The threshold voltage of a MOSFET can be lowered by:

(i) Decreasing substrate concentration

(ii) By using a thinner gate oxide

(iii) By increasing oxide capacitance value

41. LCD is not a transducer in true sense, it is a flat panel display that uses light modulating properties of liquid crystals.

42. The minimum doping required to convert intrinsic semiconductor to extrinsic semiconductor is $1:10^8$

Standard doping concentration:

(i) Moderate doping $\rightarrow 1 : [10^6$ to $10^8]$

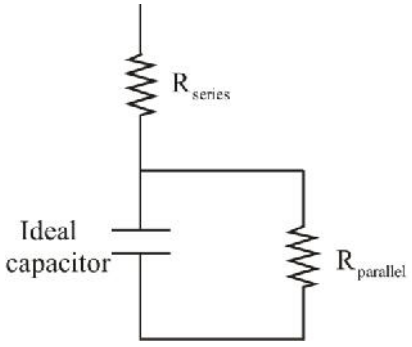
(ii) Lightly doping $\rightarrow 1 : 10^{11}$

(iii) Highly doping $\rightarrow 1 : 10^3$

43. CRO has an input impedance around 1 mega ohm in parallel with small but known capacitance such as 20 pF. This allows the use of standard oscilloscope probes.

44. The temperature coefficient of resistance, indicates the resistance change factor per degree of temperature change. For the elements carbon, silicon and Germanium this coefficient is a negative number.

45. Equivalent circuit for a lossy capacitor:



Here, R_{Series} is low and $R_{Parallel}$ is high.

46. In cable voltage stress is maximum near to the surface of the conductor and it will get decreases as we move away from core to outer sheath.

47. In electrical machines, laminated cores are used to reduce the eddy current losses.

48. Hall coefficient is given by:

$R_H = \frac{1}{\circ}$ and

$R_H = \frac{3®}{8}\frac{«}{\circ}$

Where, ρ is charge density and μ is mobility of charge carriers.

So, Hall coefficient provides information on the sign and concentration of charge carriers.

49. The high frequency inductors and capacitors are commonly plated with silver. The main purpose of this is to reduce AC resistance.

50. In a Varactor diode, the transition capacitance is given by:

$C_T \propto V^{-n}$

Where, V is the applied reverse bias voltage and n is a grading constant and is given by;

$n = \frac{1}{2}$ for abrupt junction diode

$n = \frac{1}{3}$ for linear graded diode

51. An index register in a computer's CPU is a processor register used for modifying operand address during the run of a program.

52. Program counter always points the memory address of the current or next instruction to be executed.

53. Access in magnetic drum memory is partly random and partly cyclic sequential.

54. For half adder,

Sum output is given by, $S = A \oplus B$ and

carry output is given by; C = AB

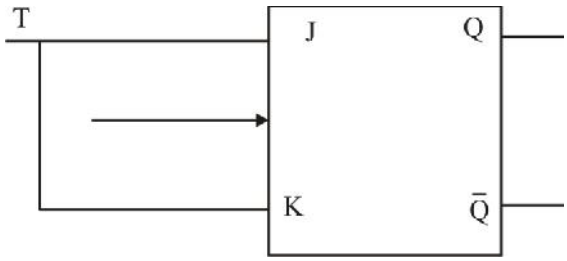
Where, A and B are inputs.

So, half adder design requires a AND gate and XOR gate.

55. We know that,

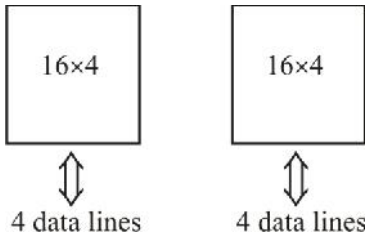
For T Flip Flop,

J = T and K = T



56. In active low logic, logic 1 state corresponds to low voltage level and logic 0 state corresponds to high voltage level.

57. 16 × 4 memory IC required for 16 × 8 memory are 2.



58. Character variable in C programming at a time 1 byte only.

59.

60. TRAP is non-maskable interrupt. It is active high level, edge triggered, highest priority interrupt.

61. MASERS used the negative resistance characteristics for its operation.

62. Efficiency of power amplifiers:

Class A: $\eta_{max} = 50\%$

Class B: $\eta_{max} = 78.5\%$

Class C : $\eta_{max} = 100\%$

(Practical $\eta > 90\%$)

$\Rightarrow$ Class C has the highest efficiency among all power amplifiers.

63. Given: B = 3kHz, SNR = 30dB and M = 32 $\Rightarrow$ n = 5

We know that,

$$\text{Channel capacity } C = B\log_2\left(1+\frac{S}{N}\right)$$

$$C = 3\log_2(1001)$$

$$C = 29.90\times10^3\ \frac{\text{bits}}{\text{sec}}$$

Now for proper operation C should be greater than or equal to data rate.

$$\Rightarrow \text{Data rate} = 29.90\frac{\text{k bits}}{\text{sec}}$$

$$\Rightarrow \text{Symbol rate} = \frac{29.90\times10^3}{5} \cong 6000\frac{\text{Symbols}}{\text{sec}}$$

64. We know that,

Standard equation for phase modulated waveform is given by;

$S_{PM}(t) = A_C \cos\left(\mu_{ct} + k_p m(t)\right)$

Now, $\mu_i = \frac{d\theta_i(t)}{dt}$

$\mu_i = \mu_c + k_p \frac{d}{dt} m(t)$

Now, frequency deviation = $\left(k_p \frac{d}{dt} m(t)\right)_{\max}$

So, it is independent of modulating signal frequency.

65. The rotor of phase servo motor is build with high resistance. So that its inductive reactance/resistance ratio is small this results in linear speed torque characteristics.

66. For hamming code number of errors correctable is less than $\frac{M}{2}$. Where, M is minimum hamming distance.

Example: Let $M = 3 \Rightarrow \frac{M}{2} = 1.5$

So, hamming code can detect 2 errors and can correct 1error.

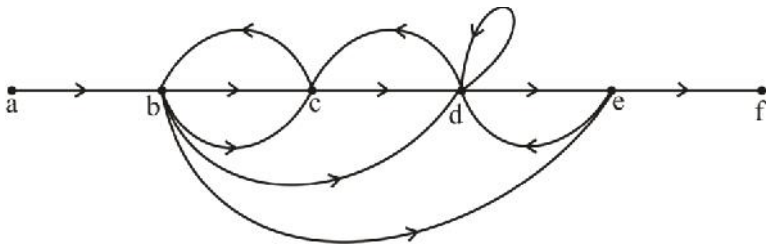
67. Coincidence circuit in an electronic device with one output and two (or more) inputs. The output is activated only when signals are received within a time window accepted as at the same tiem and in parallel at both inputs.

68.

69. The best scanning system for tracking if the target has been acquired is conical scanning.

70. Modulation is used to separate different transmissions, long distance communication. It is not used for bandwidth reduction.

71.



Forward paths are: abcdef, abcdef, abdef, abef

Individual loops are:

L_1 = bcd, L_2 = bcd, L_3 = dd L_4 = ded,

L_5 = bdcb , L_6 = cdc L_7 = bedcb

72. In a three phase half wave rectifier, the peak inverse voltage will be √3 E.

73. If Row of zeros occurs then the roots will be symmetrically located.

74. Rotating amplifier is an electric machine that is used to amplify, by means of the energy of a prime mover, the power of a signal supplied to field winding. Rotating amplifiers are used in

automatic control system. An amplidyne and a seperatively excited dc generator are used as a rotating amplifier in a control system.

75. Given:

$q(s) = 1 + kG_1(s)H_1(s) = 0$

$\Rightarrow \quad k = \dfrac{-1}{G_1(d)H_1(s)}$

For break away point calculation $\dfrac{dk}{ds} = 0$

Then the value of s for which k is positive will give the breakaway points. It can be real or complex.

76. $G(s) = \dfrac{1}{s+1}$, $H(s) = \dfrac{k}{s(s+2)}$

Now, $q(s) = 1 + G(s)H(s) = 0$

$1 + \dfrac{k}{s(s+1)(s+2)} = 0$

$k + s^3 + 3s^2 + 2s = 0$

RH table:

s^3	1	2
s^2	3	k
s^1	$\frac{6-k}{3}$	0
s^0	k	0

System will be stable if $\dfrac{6-k}{3} > 0$

$\Rightarrow$ k < 6

77.

Given:

V = 10sin100t + 10cos100t

C = 1μF and R = 10kΩ

We know that,

If R and C are in series then voltage across R is given by;

$$V_R = V\left|\frac{RCS}{1+RCS}\right| = V\left|\frac{10^4 \times 10^{-6} \times 10^2 J}{1+10^{-6} \times 10^4 \times 10^2 J}\right| = \frac{V}{\sqrt{2}} = \frac{10\sin 100t}{\sqrt{2}} + \frac{10\cos 100t}{\sqrt{2}}$$

Now, $V_{RMS1} = \left(\dfrac{10}{\sqrt{2}}\right)/\sqrt{2} = 5$

$$V_{RMS2} = \left(\frac{10}{\sqrt{2}}\right)/\sqrt{2} = 5$$

$$\text{Power} = V_{RMS}^2/R$$

$$= \frac{5^2}{10^4} + \frac{5^2}{10^4} = 5\,\text{mW}$$

78. In an ADM transmission system, the output signal amplitudes for 1's and 0's are variable but the repetition rate is fixed.

79. 8255 programmable peripheral interface (PPI) chip is used for data transmission between 8086 and 16 bit ADC.

80.

81. The reverse saturation current I_{Co} doubles for every 10°C rise in temperature

$$(I_{CO})_2 = (I_{CO})_1 2^{\left(\frac{T_2 - T_1}{10}\right)}$$

If, $T_2 - T_1 = 10$

The $(I_{CO})_2 = 2(I_{CO})_1$

82.

83. Given: $M = 16 \Rightarrow 2^n = 16 \Rightarrow n = 4$

Now, bit transmission rate = $f_s \times n = 2\times 4 \times 4 = 32$ kbits/sec

84.

85. Memory are of two types:

(i) Main memory or primary memory

(ii) Secondary memory

Main memory are of two kinds:

(a) ROM (b) RAM

86. We know that,

$$\text{In FM , SNR} \propto \frac{1}{(\text{Transmission BW})^2}$$

$$\Rightarrow \quad \text{SNR} \propto \frac{1}{2}$$

If $\beta_1 = 2B$ then

$$\Rightarrow \quad \text{SNR} \propto \frac{1}{4^{\ 2}}$$

So, SNR will decrease by one fourth.

87. Decimal = 9.37510

We know that,

Binary equivalent of 9 = 1001

Now binary of 0.37510 :

$0.37510 \times 2 = 0.7502 \rightarrow 0$

$0.7502 \times 2 = 1.5004 \rightarrow 1$

$0.5004 \times 2 = 1.0008 \rightarrow 1$

$0.0008 \times 2 = 0.0016 \rightarrow 0$

So, $(9.37510)_D = (1001.0110)_B$

88. We know that,

0–1 = 1 with borrow 1

89. Successive approximation ADC is a type of ADC that converts a continuous analog waveform into a discrete digital representation via a binary search through all possible quantization levels before finally converging upon a digital output for each conversion.

90. TTL circuits are used in main frame computers because of their high speed operation.

91. The process of conversion from an analog signal to digital signal is known as analog to digital conversion (ADC)

92. MOSFET can be operated in:

(i) Depletion mode

(ii) Enhancement mode

(iii) Depletion and enhancement mode

(iv) Enhancement only

But it will not operate in depletion mode only.

93. Given:

$m_a = 100\% = 1$

$$\text{So , } P_T = P_C\left(1+\frac{m_a^{\,2}}{2}\right)$$

$$P_T = \frac{3}{2} P_C$$

94. We know that,

For PCM,

SQNR = (1.78 + 6n) dB

Where, $n = \log_2 L$

L is number of quantizing level.

95. Given:

$$\text{Slew rate} = 100\frac{\text{V}}{\mu\text{sec}}$$

f = 10 MHz

we know that,

$$\text{Slew rate} = \max\left[\frac{d}{dt}(V_o \sin \mu t)\right] = \max(V_o \mu \cos \mu t)$$

$$100\frac{V}{\text{« sec}} = V_o \mu$$

$$V_o = 100\frac{V}{\ll s} \times \frac{1}{2® \times 10^6} = \frac{50}{®}V$$

96. We know that,
Form the Barkhausen's condition
Loop gain = $A\beta \geq 1$, for sustain oscillation.

97. For negative feedback
Loop gain = $-\beta A_V$
So characteristic equation will be
$q(s) = 1 - (- \quad A_V) = 1 + \quad A_V$

98. Given:
V_{Out} = 10V
V_{Noise} = 1mV

$$\Rightarrow \quad \text{SNR} = \frac{V_{Out}^2}{V_{Noise}^2} = \frac{10^2}{10^{-6}} = 80\,\text{dB}$$

99. We know that, for voltage shunt feedback,
$R_{if} = R_i / (1 + \quad R_M)$ { Decreases }
And $R_{of} = R_o / (1 + \quad R_m)$

100. Parasitic oscillation in an amplifier stage occurs when part of the output energy is coupled into the input, with the correct phase and amplitude to provide positive feedback at some frequency and it is caused by transistor inter junction capacitance.
