# GATE - 1992

## Electronics and communication Engineering

**(40 × 2 = 80 marks)**

**1.1.** Relative to a given fixed tree of a network,
(*a*) Link currents form an independent set.
(*b*) Branch voltage form an independent set
(*c*) Link currents form an independent set
(*d*) Branch voltage form an independent set

**1.2.** For a 2-port network to be reciprocal,
(*a*) $z_{11} = z_{22}$ (*b*) $y_{21} = y_{12}$
(*c*) $h_{21} = -h_{12}$ (*d*) AD – BC = 0

**1.3.** For the series R-L circuit of the given first figure, the partial fissure diagram at a certain frequency is shown in the given second figure. The operating frequency of the circuit is

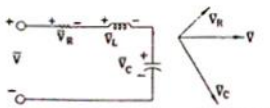


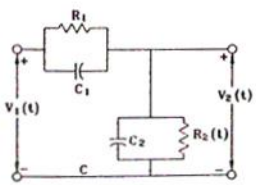
*Fig. 1.3 (a)*



*Fig. 1.3 (b)*

(*a*) equal to the resonance frequency
(*b*) less than the resonance frequency
(*c*) greater than resonance frequency
(*d*) not zero.

**1.4.** For the compensated attenuator of the given figure, the impulse response under the condition $R_1C_1 = R_2C_2$ is



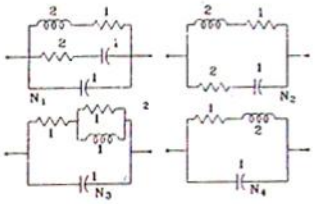

(*a*) $\frac{R_2}{R_1 + R_2}\left[1 - e^{-\frac{1}{R_1C_1}}\right] u(t)$

(*b*) $\frac{R_2}{R_1 + R_2}\delta(t)$

(*c*) $\frac{R_2}{R_1 + R_2} u(t)$

(*d*) $\frac{R_2}{R_1 + R_2} 1 - e^{-\frac{1}{R_1C_1}} . u(t)$

**1.5.** Of the four networks, $N_1$,$N_2$, $N_3$ and $N_4$ of the given figure, the networks having identical driving point functions are




(*a*) $N_1$ and $N_1$ (*b*) $N_2$ and $N_4$
(*c*) $N_1$ and $N_3$ (*d*) $N_1$ and $N_4$

**1.6.** A linear time-invariant system is described by the state variable model

$$\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} -1 & 0 \\ 0 & -2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u = [1\ 2] \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

(*a*) The system is completely controllable
(*b*) The system is not completely controllable
(*c*) The system is completely observable
(*d*) The system is not completely observable.

**1.7.** A process with open-loop model $G(s) = \frac{k e^{-sT_1}}{ts+1}$

is controlled by a PID controller.

For this process
(*a*) the integral mode improves transient performance
(*b*) the integral mode improves steady-state performance
(*c*) the derivative mode improves transient performance
(*d*) the derivative mode improves steady-state performance.

**1.8.** A linear discrete-time system has the characteristic equation, $z^3 - 0.81z = 0$. The system

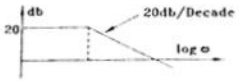
(*a*) is stable

(*b*) is marginally stable

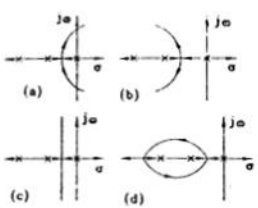
(*c*) is unstable

(*d*) stability cannot be assessed from the given information.

**1.9.** Bode plot of a stable system is shown in the given figure. The transfer function of the system is - - - -




**1.10.** Given a unity feedback system with open-loop transfer function, $G(s) = \dfrac{K}{s(s+1)(s+2)}$. The root locus plot of the system is of the form.




**1.11.** A semiconductor is irradiated with light such that carriers are uniformly generated throughout its volume. The semiconductor is *n*-type with $N_D = 10^{19}$ per $cm^3$. If the excess electron concentration in the steady state is $\Delta n = 10^{15}$ per $cm^3$ and if $\tau_p = 10\mu$ sec [minority carrier life time] the generation rate due to irradiation

(*a*) is $10^{20}$ *e-h* pairs/$cm^3$/s

(*b*) is $10^{24}$ *e-h* pairs/$cm^3$/s

(*c*) is $10^{10}$ *e-h* pairs/$cm^3$/s

(*d*) cannot be determined as the given data is insufficient.

**1.12.** A P – N junction in series with a 100 ohms resistor, is forward biased so that a current of 100 mA flows. If the voltage across this combination is instantaneously reversed to 10 V at $t = 0$, the reverse current that flows through the diode at $t = 0$ is approximately given by

(*a*) 0 mA (*b*) 100 mA

(*c*) 200 mA (*d*) 50 mA

**1.13.** An infrared LED is usually fabricated from

(*a*) Ge (*b*) Si

(*c*) Ga As (*d*) Ga As P.

**1.14.** In a transistor having finite B, the forward bias across the base emitter junction is kept constant and the reverse bias across the collector-base junction is increased. Neglecting the leakage across the collector-base junction and the depletion region generatin current, the base current will_____ (increase/decrease/remain constant).

**1.15.** An *n*-channel JFET has a pinch-off voltage of $V_p = -5$ V, $V_{DS}$ (max) = 20 V, and $\delta_m = 2$mA/V. The minimum 'ON' resistance is achieved in the JEFT for

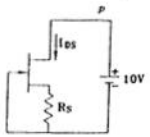
(*a*) $V_{GS} = -7$ V and $V_{DS} = 0$ V

(*b*) $V_{GS} = 7$ V and $V_{DS} = 0$ V

(*c*) $V_{GS} = 0$ V and $V_{DS} = 20$ V

(*d*) $V_{GS} = -7$ V and $V_{DS} = 20$ V

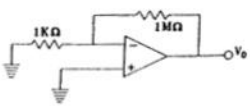
**1.16.** The JFET in the circuit shown in the given figure has an $I_{DSS} = 10$ mA and $V_p = 5$ V. The value of the resistance $R_s$ for a drain current $I_{DS} = 6.4$ mA is (select the nearest value)




(*a*) 150 ohms (*b*) 470 ohms

(*c*) 560 ohms (*d*) 1 kilo ohm.

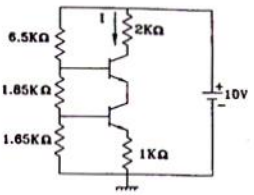
**1.17.** An op. amp. has an offset voltage of 1 mV and is ideal in all other respects. If this op. amp. is used in the circuit shown in the given figure, the output voltage will be (select the nearest value)




(*a*) 1 mV (*b*) 1 V

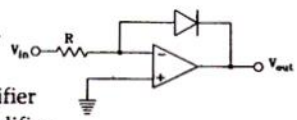
(*c*) ± 1 V (*d*) 0 V.

**1.18.** If the transistors in the given figure have high values of β and a $V_{BE}$ of 0.65 volt, the current I, flowing through the 2 kilo ohms resistance will be .....

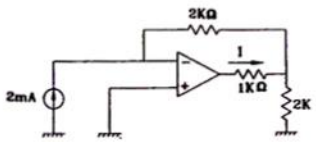



**1.19.** The circuit of given figure, uses an ideal op amp. For small positive values of $V_{in}$, the circuit works as

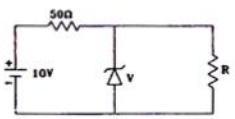
(*a*) a halfwave rectifier
(*b*) a differentiator
(*c*) a logarithmic amplifier
(*d*) an exponential amplifier.




**1.20.** Assume that the operational amplifier in given figure is ideal. The current, I, through the 1 K ohm resistor is .....

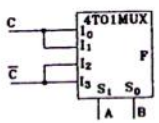



**1.21.** The 6 V Zener diode shown in given figure has zero zener resistance and a knee current of 5 mA. The minimum value of R so that the voltage across it does not fall below 6 V is




(*a*) 1.2K ohms (*b*) 80 ohms
(*c*) 50 ohms (*d*) 0 ohms

**1.22.** The logic realized by the circuit shown in given figure is




(*a*) F = A . C (*b*) F = A + C
(*c*) F = B . C (*d*) F = B + C

**1.23.** Choose the correct statement(s) fror the following

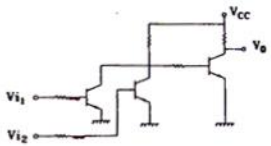
(*a*) PROM contains a programmable AND array and a fixed OR array

(*b*) PLA contains a fixed AND array and a programmable OR array

(*c*) PROM contains a fixed AND array and a programmable OR array

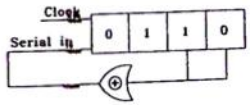
(*d*) PLA contains a programmable AND array and a programmable OR array.

**1.24.** Given figure shows the circuit of a gate in the Resistor Transistor Logic (RTL) family. The circuit represents a




(*a*) NAND (*b*) AND
(*c*) NOR (*d*) OR

**1.25.** The initial contents of the 4-bit serial-in-parallel-out, right-shift, Shift. Register shown in given figure is 0110. After three clock pulses are applied, the contents of the Shift Register will be




(*a*) 0 0 0 0 (*b*) 0 1 0 1
(*c*) 1 0 1 0 (*d*) 1 1 1 1.

**1.26.** In an 8085 microprocessor system with memory mapped I/O,

(*a*) I/O devices have 16-bit addresses

(*b*) I/O devices are accessed using IN and OUT instructions

(*c*) there can be a maximum of 256 input devices and 256 output devices

(*d*) arithmetic and logic operations can be directly performed with the I/O data.

**1.27.** The following program is run on 8085 microprocessor :

| Memory Address in hex | Instruction |
|---|---|
| 2000 | LXI SP, 1000 |
| 2003 | PUSH H |
| 2004 | PUSH D |
| 2005 | CALL 2050 |
| 2008 | POP H |
| 2009 | HLT |

At the completion of execution of the program, the program Counter of the 8085 contains _____ and the Stack Pointeer contains_____ .

**1.28.** Dual-slope integration type Analog-to-digital converters provide

(*a*) higher speeds compared to all other types of A/D converters

(*b*) very good accuracy without putting extreme requirements on component stability

(*c*) good rejection of power supply hum

(*d*) better resolution compared to all other types of A/D converters for the same number of bits.

**1.29.** Which of the following signals is/are periodic ?

(*a*) $S(t) = \cos 2t + \cos 3t + \cos 5t$

(*b*) $S(t) = \exp(j8\pi t)$

(*c*) $S(t) = \exp(-7t) \sin 10\pi t$

(*d*) $S(t) = \cos 2t \cos 4t$

**1.30.** If G (*f*) represents the Fourier transform of a signal g (*t*) which is real and odd symmetric in time, then

(*a*) G (*f*) is complex

(*b*) G (*f*) is imaginary

(*c*) G (*f*) is real

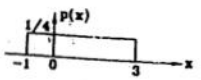
(*d*) G (*f*) is real and non-negative.

**1.31.** The maximum power efficiency of an AM modulator is

(*a*) 25 %  (*b*) 50 %

(*c*) 75 %  (*d*) 100 %

**1.32.** For a random variable $x$ following the probability density function, p ($x$), shown in given figure the mean and the variance are, respectively,




(*a*) 1/2 and 2/3  (*b*) 1 and 4/3

(*c*) 1 and 2/3  (*d*) 2 and 4/3.

**1.33.** The bit stream 01001 is differentially encoded using 'Delay and Ex OR' scheme for DPSK transmission. Assuming the reference bit as a '1' and assigning phases of '0' and $\pi$ for 1's and 0's respectively, in the encoded sequence, the transmitted phase sequence becomes

(*a*) $\pi\, 0\, \pi\pi\, 0$  (*b*) $0\, \pi\pi 00$

(*c*) $0\, \pi\pi\pi 0$  (*d*) $\pi\pi\, 0\pi\pi$

**1.34.** Coherent demodulation of FSK signal can be effected using

(*a*) correlation receiver

(*b*) Bandpass filters and envelope detectors

(*c*) matched filter

(*d*) discriminator detection.

**1.35.** Source encoding in a data communication system is done is order to

(*a*) enhance the information transmission rate

(*b*) reduce the transmission errors

(*c*) conserve the transmitted power

(*d*) facilitate clock recovery in the receiver.

**1.36.** A transmission line whose characterstic impedance is a pure resistance

(*a*) must be a lossless line

(*b*) must be a distortionless line

(*c*) may not be a lossless line

(*d*) may not be a distortionless line.

**1.37.** Which of the following statements is/are correct ?

(*a*) All the resonant frequencies of a microwave cavity are harmonics of a single frequency

(*b*) No two of the resonant frequencies of a microwave caity are harmonics of a single frequency

(*c*) Resonant frequencies of a microwave cavity form distinct sets of harmonically related frequency

(*d*) None of the above, because a microwave cavity does not resonate at a number of frequencies.

**1.38.** Two dissimilar antennas having their maximum directivities equal,

(*a*) must have their beamwidths also equal

(*b*) cannot have their beamwidths equal because they are dissimilar antennas

(*c*) may not necessarily have their maximum power gains equal

(*d*) must have their effictive aperture areas (capture areas) also equal.

**1.39.** The beamwidth-between-first null of uniform linear array of N equally-spaced (element spacing = $d$), equally-excited antennas is determined by

($a$) N alone and not by $d$

($b$) $d$ alone and not by N

($c$) the ratio, (N/$d$)

($d$) the product, (N$d$)

**1.40.** In a multicavity magnetron, strapping is employed primarily

($a$) to prevent mode jumping

($b$) to increase the seperation between the resonant frequencies in the $\pi$-mode and in the adjacent modes

($c$) to reduce the back heating of the cathode

($d$) to increase the output of the magnetron.

## ANSWERS

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **1. 1** ($a$,$d$) | **1. 2** ($b$,$c$) | **1. 3** ($b$,$d$) | **1. 4** ($b$) | **1. 5** ($c$) | **1. 6** ($b$,$c$) | **1. 7** ($b$,$c$) | **1. 8** ($a$) | **1. 9** (*) | **1. 10** ($a$) |
| **1. 11** ($a$) | **1. 12** ($b$) | **1. 13** ($c$) | **1. 14** (*) | **1.15** ($b$) | **1. 16** ($a$) | **1. 17** ($c$) | **1. 18** (*) | **1. 19** ($c$) | **1.20** (*) |
| **1. 21** ($a$) | **1. 22** ($b$) | **1. 23** ($c$,$d$) | **1. 24** ($d$) | **1. 25** ($c$) | **1. 26** ($a$,$d$) | **1. 27** (*) | **1. 28** ($b$,$c$) | **1. 29** ($a$,$b$) | **1. 30** ($b$) |
| **1. 31** ($b$) | **1. 32** ($b$) | **1. 33** ($d$) | **1. 34** ($a$,$c$) | **1. 35** ($a$,$b$) | **1. 36** ($c$,$d$) | **1. 37** ($c$) | **1. 38** ($c$) | **1. 39** ($d$) | **1. 40** ($a$,$b$) |