GATE Examination Question Papers - Instrumentation - 1999

1. This question contains 30 sub-questions of multiple-choice type. Each sub-question has only one correct answer.

1.1. $\lim_{x \to 0} \frac{1}{10} x \frac{1-e^{-j5x}}{1-e^{-jx}} is$

(a) 0 (b) 1.1

(c) 0.5 (d) 1

1.2. For the waveform V (t) = 2 + cos $\left(\omega t + \frac{\pi}{6}\right)$ the ratio V rms / V average is

(a) $\frac{3}{2\sqrt{2}}$ (b) $\sqrt{\frac{3}{2}}$

(c) p (d) $\frac{\pi}{2}$

1.3. A system with transfer function $\frac{1}{\tau_s + 1}$, subjected to a step input takes 10 seconds to reach 50% of the step height. The value of t is

(a) 6.9 s (b) 10 s

(c) 14.4 s (d) 20 s

- Relationship between input x (t) and output y (t) of a system is given as

$$\frac{d^2y}{dt^2} = x(t-2) + \frac{d^2x}{dt^2}$$

The transfer function of this system is

(a) $1+\frac{e^{-2s}}{s^2}$

(b) $1+\frac{e^{2s}}{s^2}$

(c) 1+ s 2e -2s

(d) 1+ s 2e 2s

1.5. A transfer function has two zeroes at infinity. Then the relation between the numerator degree (N) and the denominator degree (M) of the transfer function is,

(a) N=M+2

(b) N=M-2

(c) N=M+1

(d) N=M-l

- The system $G(s)=\frac{0.8}{s^2+s-2}$ is subjected to a step input. The system output y (t) as t ® ¥ is

(a) 0.8 (c) -0.4

(b) 0.4 (d) unbounded

1.7. The transfer function betweenY 2 and Y 1 in Fig. 1.7 is

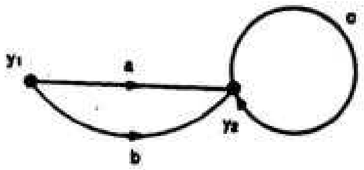


Fig. 1.7

(a) a+b

(b) (a+b)c

(C) $\frac{a+b}{1-c}$

(d) $\frac{a+b}{1+c}$

1.8. In control system design, gain and phase margins are usually provided to

(a) account for the uncertainties in the system

(b) make the system respond fast

(c) reduce the overshoot in step response

(d) reduce the steady state offset.

1.9. The lengths of two discrete time sequences X 1 (n) are 5 and 7 respectively. The maximum length of sequence x 1 (n) * x 2(n) is

(a) 5 (b) 6

(c) 7 (d) 11

1.10. The output voltage of the circuit in Fig. 1.10 for t > 0 is

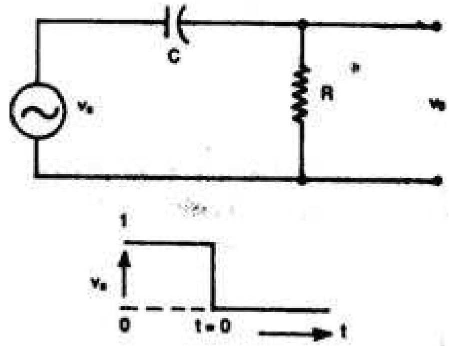


Fig. 1.10.

(a) $e^{-\frac{t}{RC}}$

(b) $-e^{-\frac{t}{RC}}$

(c) $1-e^{-\frac{t}{RC}}$

(d) $e^{-\frac{t}{RC}}-1$

- In the circuit shown in Fig. 1.11, V i is 4 V. Assuming the diodes to be ideal, V o is

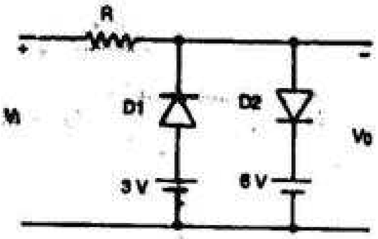


Fig. 1.11

- 3V
- 4V
- 4.5 V
- 6 V

1.12. The input voltage, V 1 is 4 + 3 sin wt. assuming all elements to be ideal, the average of the output voltage V o in Fig. 1.12 is

(a) -3 V (b) +3 V

(c) -7 V (d) +7 V

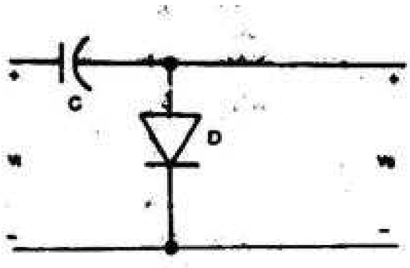
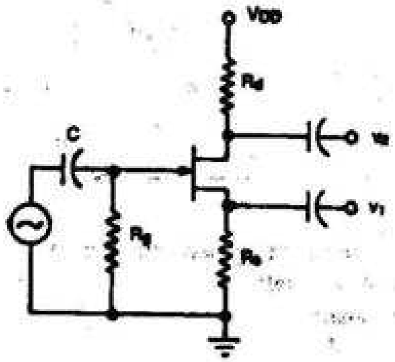


Fig. 1.12

1.13. In the JFET amplifier circuit shown in Fig. 1.13, the signal



outputs V 1 and v 2 are related as

Fig. 1.13

(a) $v_2 = \frac{R_d}{R_s} v_1$

(b) $v_2 = -\frac{R_d}{R_s} v_1$

(c) $v_2 = \frac{R_s}{R_d} v_1$

(d) $v_2 = -\frac{R_s}{R_d} v_1$

1.14. The op-amp in the amplifier circuit shown in Fig. 1.14 has an offset voltage of 10 mV and it is ideal otherwise. If V i is zero, the output voltage V o is

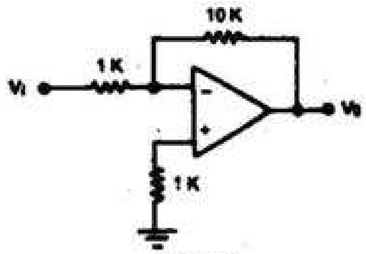


Fig. 1.14

- 0
- 10 mV
- 100 mV
- 110 mV

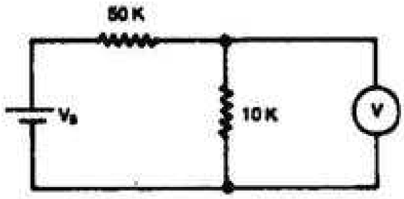


Fig. 1.15

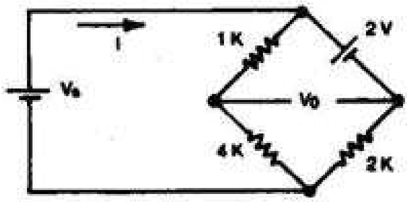
1.15. A voltmeter connected across the 10 k W resistor in the Fig. 1.15, reads 5 V. The voltmeter is rated at 1000 ohms/volt and has a full scale reading of 10 V. The supply voltage V s in volt is

- 30
- 50
- 55
- 80

1.16. An oscilloscope input impedance consists of I M W in parallel with 100pF. A compensated 20: 1 attenuator is obtained by connecting a parallel combination of

(a) 19 M W and $\frac{100}{19}$ pF (b) 20 M W and $\frac{100}{20}$ pF

(c) 19 M W and 1900 pF (d) 20 M W and 2000 pF.



1.17. The bridge circuit in Fig. *Fig. 1.17* 1.17 is balanced. The magnitude of current I is

- 2mA
- 4mA
- 5mA
- 6mA

1.18. A phase locked loop can be employed for demodulation of

(a) pulse amplitude modulated signals

(b) pulse code modulated signals

(c) frequency modulated signals

(d) single side band amplitude modulated signals.

1.19. A number in 4-bit two's complement representation is X 3 X 2 X 1 X o . This number when stored using 8-bi1s will be

(a) 0000 X 3 X 2 X 1 X o

(b) 1111 X 3 X 2 X 1 X o

(c) X 3 X 3 X 3 X 3 X 3 X 2 X 1 X o

(d) $\overline{X_3}\,\overline{X_3}\,\overline{X_3}\,\overline{X_3}$ X 3 X 2 X 1 X o

1.20. A computer has a memory space of 2 16 and word length of 24 bits. The memory chips available have 10 address and 8 data lines. The number of chips required for the computer memory space is

(a) 192 (b) 256

(c) 512 (d) 1024

1.21. For a shaft encoder, the most appropriate 2-bit code is

(a) 11,10,01,00 (b) 11,10,00,01

(c) 01, 10, 11,00 (d) 01,00, 11, 10

1.22. The term 'precision' used in instrumentation means

(a) gradual departure of the measured value from the calibrated value

(b) smallest increment in the measure and that can be detected by the instrument

(c) maximum distance or angle through which any part of a mechanical system may be moved in one direction without causing motion of the next part

(d) the ability of the instrument to give output readings close to each other, when the input is constant.

1.23. A resistance potentiometer has a total resistance of 10000 W and is rated 4 W. If the range of potentiometer is 0 to 100 mm, then its sensitivity in V/mm is

(a) 1.0 (b) 2.0

(c) 2.5 (d) 25

1.24. The temperature of fixed points used to define International Temperature Scale are determined by using

(a) Platinum resistance thermometer

(b) Platinum, Platinum-Rhodium thermo-couples

(c) vapour-pressure thermometer

(d) gas thermometer to which corrections are applied for non-ideal behaviour of the gas.

- The emf-temperature data for a thermocouple with reference junction at O°C is as follows,

Temperature (0C) 20 180 200

emf(mV) 1.2 11.8 13.5

The emf developed in mV with the two junctions at 200°C is

(a) 11.8 (b) 12.3

(c) 13.0 (d) 13.5

1.26. A rotameter with a heavy float for measuring gas flow is calibrated with a gas of density 1.2 kg/m 3. It measures the flow rate of a different gas having density of 2 kg/m 3 and indicates a flow rate of 2.2 m 3/min. The actual flow rate in m 3/min is

(a) 0.79 (b) 1.32

(c) 1.70 (d) 2.20

1.27. The sound pressure level (SPL) measured in open space (free field), at a distance of 6 m from a noise source is 80 dB. At a distance of 60 m, the SPL is

(a) 80 dB (b) 60 dB

(c) 8 dB (d) 1.34 dB

1.28. An optical fibre has a refractive index of 1.641 for the core and 1.422 for the cladding. The critical angle above which a ray will be totally internally reflected is

(a) 37 o (b) 41°

(c) 45° (d) 60°

1.29. A frequency stablised HeNe laser with a wavelength of 6328 A 0 has a bandwidth of 1 MHz. Its coherence length is

- 0.3 m
- 3 m
- 30 m
- 300 m

1.30. Attenuation of a narrow monochromatic X-ray beam in a metal plate of thickness 'd' is given by the equation

(a) I=I o exp(- m d)

(b) I= I 0 exp (- m d 2)

(c) I = I 0 exp (- m /d)

(d) I= I 0 exp (- m /d 2)

2. This question contains 15 sub-questions of multiple-choice type. Each sub-question has only one correct answer.

2.1. The transfer function of a passive circuit has its poles and zeroes on

(a) left and right halves respectively of the s-plane

(b) right and left halves respectively of the s-plane

(c) right half of the s-plane

(d) left half of the s-plane.

2.2. A first order system with a proportional controller in the negative feedback loop has an offset to a step input. This offset can be eliminated by

(a) adding a derivative mode to the controller

(b) adding an integral mode to the controller

(c) decreasing the magnitude of the gain of the proportional controller

(d) adding a delay in the controller loop.

2.3. Bootstrapping in a buffer amplifier circuit is used for

(a) increasing the input resistance

(b) reducing the power consumption

(c) decreasing the output resistance

(d) improving the frequency response.

2.4. A voltmeter has been connected between the input of a TTL inverting gate and ground. The gate is powered by 5 V. The voltmeter reading will be approximately

(a) 0 V (b) 2 V

(c) 4 V (d) 5 V

2.5. The advantage of a dual slope converter over successive approximation converter is that the dual slope converter

(a) is faster

(b) eliminates error due to drift

(c) can reduce the errors due to power supply

(d) does not require a stable voltage reference

2.6. The conversion time of an 8-bit successive approximation converter with a 1 MHz clock is nearly

(a) 512 m S (b) 256 m S

(c) 128 m S (d) 8 m S

2.7. The important feature of a micro controller is that it has an on-chip

(a) math co-processor

(b) program memory

(c) interface for I/O devices

(d) hardware multiplier.

2.8. The best size of the wire for measuring pitch diameters of ISO metric screw thread in terms of pitch, p, is

(a) p/2

(b) $p/\sqrt{3}$

(c) 3p/4

(d) $p/(2\sqrt{3})$

2.9. An elastic transducer is used to measure pressure in a vessel and it indicates a pressure of 3.2 bar. Atmospheric pressure is 1.01 bar. The absolute pressure in the vessel in bar is

(a) 1.01 (b) 2.19

(c) 3.20 (d) 4.21

2.10. A photo conductive transducer works on the principle that when a light beam strikes

(a) the material, its resistance decreases, which is sensed by an external circuit

(b) the barrier between transparent metal layer and a semi-conductor material, a voltage is generated

(c) the barrier between transparent metal layer and a semi-conductor material, a current is generated in the external circuit

(d) the cathode, it releases electrons, which are attracted towards anode, thereby producing electric current in the external circuit.

2.11. For alignment and testing of two surfaces at right angles, a constant deviation prism, also called an optical square, is used. It is a

(a) right angled prism (b) square prism

(c) pentagonal prism (d) hexagonal prism.

2.12. C 1 and C 2 are the activities of the ions on the two sides of a membrane. The Nernst potential developed across the membrane is proportional to

(a) $\frac{C_1}{C_2}$

(b) $\frac{C_1^2}{C^2{}_2}$

(c) $\log_e \frac{C_1}{C_2}$

(d) exp (C 1/C 2) .

2.13. The bandwidth of an electrocardiogram (ECG) amplifier is

(a) dc to 0.01 Hz (b) 0.05 to 500 Hz

(e) 550 to 1500 Hz (d) 2000 to 10000 Hz.

2.14. Korotkoff sounds are used

(a) as a reference for sound level measurement

(b) for studying heart muscle functioning

(c) for blood pressure measurement

(d) for study of heart valve functioning

2.15 In an electromagnetic blood flow meter, the induced voltage is directly proportional to the

(a) blood flow rate

(b) square root of the blood flow rate.

(c) square of the blood flow rate

(d) logarithm of the blood flow rate