

Ph.D Entrance Test (Instrumentation Engineering) Time : 3 Hours

All questions are compulsory- 01 Mark Each

- The voltage gain of a common source JFET amplifier depends upon its
 - Transconductance (g_m)
 - amplification factor (μ)
 - External load resistance (R_D)
 - both (A) and (C)
- Which of the main function of the transformer used in the output of power amplifiers?
 - To increase the output power
 - To increase the voltage gain
 - To match the load resistance with the output resistance of a transistor
 - None of the above
- The negative part of output signal in a transistor circuit starts clipping, if Q-point of the circuit moves
 - Towards saturation point
 - Towards the cut off point
 - Towards the centre of the load line
 - None of the above
- The power delivered to the load in maximum when the SCR firing angle is
 - Zero
 - 90°
 - 180°
 - between 90° and 180°
- The ripple factor of the bridge rectifier is
 - 0.482
 - 0.812
 - 1.11
 - 1.21
- The operational amplifier is used in the non-linear mode in
 - Integrator
 - Active filter
 - Schmitt trigger.
 - Instrumentation Amplifier
- The instrument based on the principle of proximity effect is a
 - Thermometer
 - Photographic camera
 - Dial guage
 - Load cell guage
- Stefan Boltzman constant has units of
 - W/m^2-K
 - W/m^2-K^2
 - W/m^2-K^3
 - W/m^2-k^4
- In a PMMC ammeter, the deflection of the pointer is proportional to the product of

flux density of the magnetic field produced by the permanent magnet and the current in moving coil ($B \times I$), When the strength of permanent magnet becomes 90% of its original value, the meter gives erroneous reading resulting into error. The error is called

- | | |
|---------------------|-------------------------|
| A) Gross error | B) Random error |
| C) Systematic error | D) combination of these |
10. TTL logic family has the following characteristics
- | | |
|------------------------|--------------------------------------|
| A) High fan out | B) Highest speed of operation |
| C) High noise immunity | D) Lowest product of power and delay |
11. Which of the galvanometer is most suitable for AC power frequencies
- | | |
|---------------|-----------------------|
| A) Ballistic | B) Duddel's vibration |
| C) D'arsonval | D) any of the above |
12. 4-point DFT of a real discrete-time signal $x[n]$ of length 4 is given by $X[k]$, $n=0,1,2,3$ and $k=0,1,2,3$. It is given that $X[0]=5$, $X[1]=1+j1$, $X[2]=0.5$, $X[3]$ and $x[0]$ respectively are,
- | | |
|------------------|-----------------------|
| A) $1-j$, 1.875 | B) $1-j$, 1.500 |
| C) $1+j$, 1.875 | D) $0.1-j0.1$, 1.500 |
13. Two systems with impulse responses $h(t_1)$ and $h(t_2)$ are connected in cascade. Then the overall impulse response of the cascaded system is given by,
- | | |
|---|--|
| A) a product of $h(t_1)$ and $h(t_2)$ | B) sum of $h(t_1)$ and $h(t_2)$ |
| C) convolution of $h(t_1)$ and $h(t_2)$ | D) subtraction of $h(t_2)$ from $h(t_1)$ |
14. The pressure and velocity at the throat of a Venturi tube, measuring the flow of a liquid are related to the upstream pressure and velocity, respectively, as follows:
- | | |
|---|---|
| A) pressure is lower but velocity is higher | B) pressure is higher but velocity is lower |
| C) both pressure and velocity are lower | D) pressure and velocity are identical |
15. An accelerometer has input range of 0-10g, natural frequency 30Hz and mass 0.001kg. The range of the secondary displacement transducer in mm required to

the input range is

- A) 0 to 2.76 B) 0 to 9.81 C) 0 to 11.20 D) 0 to 52.10

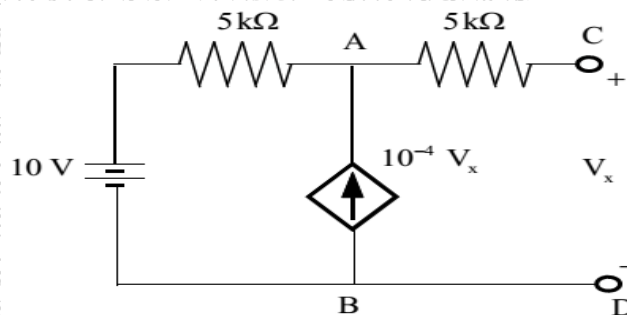
16. A full duplex binary FSK transmission is made through a channel of bandwidth 10 kHz. In each direction of transmission the two carriers used for the two states are separated by 2 kHz. The maximum baud rate for this transmission is

- A) 2000 bps B) 3000 bps
C) 5000 bps D) 10000 bps

17. Match the following biomedical instrumentation techniques with their application.

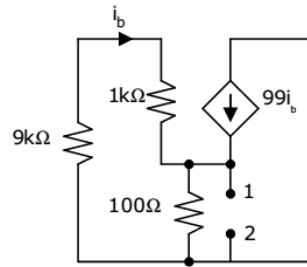
- P. Otoscopy U. Respiratory volume measurement
Q. Ultrasound Technique V. Ear diagnostics
R. Spirometry W. Echo-cardiography
S. Thermodilution Technique X. Heart-volume measurement
- A) P-U;Q-V;R-X;S-W B) P-V;Q-U;R-X;S-W
C) P-V;Q-W;R-U;S-X D) P-V;Q-W;R-X;S-U

18. The circuit shown in the figure contains a dependent current source between A and B terminals. The Thevenin's equivalent resistance in kΩ between the terminals C and D is



- A) 20 KΩ
B) 30 KΩ
C) 10 KΩ
D) 50 KΩ

19. The impedance looking into nodes 1 and 2 in the given circuit is –



- A) 50Ω B) 100Ω C) 5KΩ D) 10.1KΩ

20. If the A- matrix of the state space model of a SISO linear time invariant system is rank deficient, the transfer function of the system must have
- A) a pole with positive real part B) a pole with negative real part
 C) a pole with positive imaginary part D) a pole at the origin
21. Selysn is a trade name of
- A) Stepper motor B) Rotating transformer
 C) Resolver D) Synchro
22. Consider a system consisting of a microprocessor, memory and peripheral devices connected by a common bus. During DMA data transfer, the microprocessor
- A) Only reads from the bus
 B) Only writes to the bus
 C) Both reads from and writes to the bus
 D) Neither reads from nor writes to the bus
23. A 2K×8 bit RAM is interfaced to an 8 bit microprocessor. If the address of the first memory location in the RAM is 0800H, the address of the last memory location will be-
- A) 1000H B) 0FFFFH C) 4800H D) 47FFH
24. In order to remove respiration related motion artifacts from an ECG signal, the following filter should be used:
- A) low-pass filter with $f_c = 0.5$ Hz
 B) high-pass filter with $f_c = 0.5$ Hz
 C) high-pass filter with $f_c = 49.5$ Hz
 D) band-pass filter with pass band between 0.1 Hz and 0.5 Hz
25. A plant with transfer function $\frac{2}{s(s+3)}$ is controlled by a PI controller with $K_P=1$ and

$K_i \geq 0$ in a unity feedback configuration. The lowest value of K_i that ensures zero steady state error for the step change in the reference input is

- A) 0 B) 1/3 C) 1/2 D) 1
26. The seismic mass of an accelerometer oscillates sinusoidally at 100 Hz with a maximum displacement of 10 mm from its mean position. The peak acceleration of seismic mass is,
 A) 3947.84 m/s² B) 3141.50 m/s² C) 314.15 m/s² D) 100.00 m/s²
27. A signal with frequency components 50 Hz, 100 Hz and 200 Hz only is sampled at 150 samples/sec. The ideally reconstructed signal will have frequency component(s) of
 A) 50 Hz only B) 75 Hz only C) 50 Hz and 75 Hz D) 50 Hz, 75 Hz and 100 Hz
28. If any coefficients of the characteristic equation of a system are zero, the system is
 A) Stable B) Unstable C) Marginally Stable D) None of these
29. The purpose of providing swamping resistance in dynamometer type moving coil instrument is
 A) To provide equal time constant for fixed coil and moving coil, when used for AC measurement
 B) To reduce the bulk of the moving coil system
 C) To reduce current flowing through moving coil
 D) To control the deflecting torque
30. Minimum applied potential required to produce X-rays of 1\AA Wavelength
 A) 11.7 kV B) 12.4 kV C) 13.5kV D) 15.6kV
31. The deflection factor of a CRT is

- A) Same as sensitivity
 B) not related to sensitivity
 C) reciprocal of sensitivity
 D) a function of accelerating potential and sensitivity
32. In a time-of-flight mass spectrometer if q is the charge and m is the mass of the ionized species, then the time of flight is proportional to
- A) $\sqrt{\frac{m}{q}}$ B) $\sqrt{\frac{q}{m}}$ C) $\frac{m}{\sqrt{q}}$ D) $\frac{q}{\sqrt{m}}$
33. The average power delivered to an impedance $(4-j3) \Omega$ by a current $5 \cos(100\pi t + 100)$ is
- A) 44.2 W B) 50 W C) 62.5 W D) 125 W
34. A transfer function of zero order hold system with sampling interval T is
- A) $\frac{1}{s} (1 - e^{-Ts})$ B) $\frac{1}{s} (1 - e^{-Ts})^2$ C) $\frac{1}{s} e^{-Ts}$ D) $\frac{1}{s^2} e^{-Ts}$
35. Given that x is a random variable in the range $[0, \infty]$ with a probability density function $\frac{e^{-x}}{K}$, the value of constant K is
- A) 2 B) 3 C) 1 D) 4
36. The system function of an LTI system is given by

$$H(Z) = \frac{1 - \frac{1}{3}z^{-1}}{1 - \frac{1}{4}z^{-1}}$$

The above system can have stable inverse if the region of convergence of $H(Z)$ is defined as

- A) $|z| < \frac{1}{4}$ B) $|z| < \frac{1}{12}$ C) $|z| > \frac{1}{4}$ D) $|z| < \frac{1}{3}$
37. In the sum of products function $f(X, Y, Z) = \sum(2, 3, 4, 5)$, the prime implicants are
- A) $\bar{X}Y, X\bar{Y}$ B) $\bar{X}Y, X\bar{Y}\bar{Z}, X\bar{Y}Z$
 C) $\bar{X}Y\bar{Z}, \bar{X}YZ, X\bar{Y}$ D) $\bar{X}Y\bar{Z}, \bar{X}YZ, X\bar{Y}\bar{Z}, X\bar{Y}Z$

38. The bridge method commonly used for finding mutual inductance is

- A) Heaviside campbell bridge
B) schering bridge
C) De sauty bridge
D) Wien bridge
39. For a vector E which of the following statement is not true
- A) IF $\nabla \cdot E = 0$, E is called solenoid
B) IF $\nabla \times E = 0$, E is called conservative
C) IF $\nabla \times E = 0$, E is called irrotational
D) IF $\nabla \cdot E = 0$, E is called irrotational
40. Disc in an induction type energymeter rotates in the opposite direction when
- A) a large capacitor is connected on the load side
B) a large inductor is connected on the load
C) current coil and voltage coil are wrongly connected
D) either current or voltage coil are wrongly connected

Section-II

Attempt any three (03) questions out of five (05) -10 marks each

1. How drum level is controlled in boiler? Describe with suitable example?
2. Write a short note on following
 - i. Hybrid controller set up and its applications in industry
 - ii. Distributed Control system
3. Explain the generalised block diagram of Fuzzy based control system.
4. Explain in detail the principle of operation of attraction type moving iron instrument.
5. Explain use of hotelling (or K-L) transform for image data compression.

Section-III

Attempt any two (02) questions out of four (04) -15 marks each

1. A linear resistance potentiometer is 50mm long and it is uniformly wound with wire having resistance of 10,000 ohm. Under normal condition the slider is at centre of potentiometer. Find linear displacement when resistance of potentiometer as measured by Wheatstone bridge for two cases is

i) 3850 ohm

ii) 7560 ohm

Are two displacements are in same direction? If it is possible to measure minimum value of 10 ohm with above arrangement, find resolution of potentiometer in mm?

2. Explain the general theory of seismic instruments used for vibration or acceleration measurement.
3. Sketch the complete root locus of system having transfer function

$$G(S)H(S) = \frac{K}{S(S+1)(S+2)(S+3)}$$

4. What do you mean by controller tuning? Describe process reaction curve method and Ziegler-Nichols method of controller tuning?
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