

Seat No.	
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**M.Phil/Ph.D. Entrance Examination, August - 2018**  
**ELECTRONICS AND TELECOMMUNICATION ENGINEERING**  
**Engineering and Technology**

Day and Date : Friday, 10 - 08 - 2018

Total Marks : 100

Time : 1.00 p.m. to 03.00 p.m.

- Instructions :**
- 1) All questions are compulsory.
  - 2) Each question carries 2 marks.
  - 3) Answers should be marked in the given OMR answer sheet by darkening the appropriate option.
  - 4) Use black ball point pen only for marking the circle. Do not make any stray mark on the OMR Answer Sheet.
  - 5) Follow the instructions given on OMR Sheet.
  - 6) Rough work shall be done on the sheet provided at the end of question paper.
  - 7) Only non- programmable calculators are allowed.

**Research Methodology**

1. Sampling, statistical and observational designs can be carried out
  - A) statistical design
  - B) observational design
  - C) operational design
  - D) sampling design
  
2. Which of the following is a non-probability sample?
  - A) Quota sample
  - B) Simple random sample
  - C) Purposive sample
  - D) (A) and (C) both

3. In the process of conducting research ‘Formulation of Hypothesis’ is followed by
- A) Statement of Objectives
  - B) Analysis of Data
  - C) Selection of Research Tools
  - D) Collection of Data
4. One or two tail test will determine
- A) If the two extreme values (min or max) of the sample need to be rejected
  - B) if the hypothesis has one or possible two conclusions
  - C) If the region of rejection is located in one or two tails of the distribution
  - D) None of the above
5. The null hypothesis for the Mann-Whitney U test is used to test that
- A) Two samples are from different populations
  - B) Two samples are from different populations but have the same mean
  - C) Two samples are from the same population and have the same mean
  - D) Two samples are from the same population and have the same median
6. In Testing the statistical hypothesis, which of the following statement is false
- A) The critical region is the values of the test statistic for which we reject null hypothesis.
  - B) The level of significance is the probability of type I error
  - C) The p-value measures the probability that the null hypothesis is true
  - D) None of the above

7. Chi-square test for independence assesses which of the following?
- A) It assesses whether there is a relationship between two categorical variables
  - B) It assesses whether there is a relationship between the population and the sample
  - C) It assesses whether there is a significant difference between two categorical variables
  - D) It assesses whether there is significant difference between scores taken at time 1 and those taken at time 2
8. Conclusions from qualitative research are
- A) less certain than from quantitative research
  - B) of little practical use.
  - C) of descriptive value only.
  - D) seldom defensible.
9. How many dependent variables must you have for an ANOVA to be conducted?
- A) ordinal variables
  - B) nominal variables
  - C) Only 1 continuous variable
  - D) None of these
10. What is the function of a post-test in ANOVA?
- A) Determine if any statistically significant group differences have occurred.
  - B) Describe those groups that have reliable differences between group means.
  - C) Set the critical value for the F test (or chi-square).
  - D) None of the above

11. \_\_\_\_\_ is a statistical technique that identifies homogenous subgroups.
- A) Factor analysis
  - B) Multivariate analysis of variance
  - C) Cluster analysis
  - D) Discriminant analysis
12. Data originating from studies that are conducted by others and for a different purpose than the one for which the data are being reviewed are called \_\_\_\_\_ data.
- A) primary
  - B) secondary
  - C) quantitative
  - D) descriptive
13. When analyzing nominal data, which measure of central tendency is appropriate?
- A) mean
  - B) mode
  - C) median
  - D) range
14. Using the \_\_\_\_\_ sampling technique can result in a skewed sample if periodicity exists in the population.
- A) simple random
  - B) systematic
  - C) stratified
  - D) cluster

## M/P ENT – 108

15. Which of the following measures become larger as the data is more dispersed the mean, median, range, variance or standard deviation?
- A) The mean and the median
  - B) The median and range
  - C) The mean, variance and standard deviation
  - D) The range, variance and standard deviation
16. Which of the following measurements of central tendency is not affected by extreme values in the sample data set - the mean, median or mode?
- A) The mean
  - B) The median
  - C) The mode
  - D) The median and the mode
17. The order in which participants complete a task is an example of what level of measurement?
- A) Ordinal
  - B) Nominal
  - C) Ratio
  - D) Interval
18. What is the difference between data measured on an interval scale and data measured on a ratio scale?
- A) A ratio scale has a true zero point, so zero on the scale corresponds to zero of the concept being measured.
  - B) An interval scale has a true zero point, so zero on the scale corresponds to zero of the concept being measured.
  - C) A ratio scale has equal intervals between the points on the scale, where as an interval scale does not
  - D) A ratio scale puts scores into categories, while an interval scale measures on a continuous scale.

19. When concordant pairs exceed discordant pairs in a P-Q relationship, Kendall's tau b reports a(n) \_\_\_\_\_ association between the variables under study.
- A) inverse
  - B) positive
  - C) negative
  - D) weak
20. Mr. Ary has conducted an extensive review of the literature and has deductively reasoned a hypothesis about his problem on the basis of this review. Which type of a research plan is Mr. Ary likely proposing?
- A) Quantitative
  - B) Qualitative
  - C) Ethical
  - D) None of the above
21. What does a significant result in a chi-square test imply?
- A) That homogeneity of variance has not been established
  - B) That there is a significant difference between the three categorical variables included in the analysis
  - C) It implies that the sample is not representative of the population
  - D) All of these are possible
22. An interval scale contains \_\_\_\_\_
- A) mutually exclusive and collectively exhaustive categories as well as the property of order, but not distance or unique origin
  - B) the properties of order, classification, and equal distance between points but no unique origin
  - C) mutually exclusive and collectively exhaustive categories, but without the properties of order, distance, and origin
  - D) the properties of classification, order, equal distance, and unique origin

23. Two types of errors associated with hypothesis testing are Type I and Type II. Type II error is committed when
- A) We reject a null hypothesis when it is true
  - B) We accept a null We reject the null hypothesis whilst the alternative hypothesis is true
  - C) hypothesis when it is not true
  - D) None of the above
24. You obtained a significant test statistic when comparing three treatments in a one-way ANOVA. In words, how would you interpret the alternative hypothesis  $H_A$ ?
- A) All three treatments have different effects on the mean response.
  - B) Exactly two of the three treatments have the same effect on the mean response.
  - C) At least two treatments are different from each other in terms of their effect on the mean response.
  - D) All of the above
25. To ensure adequate informed consent, a researcher should include all of the following components in an introduction except \_\_\_\_\_
- A) promise of anonymity and confidentiality
  - B) sponsoring organization
  - C) purpose of the research
  - D) estimate of when the research study will be published

**- Subject Specific -**

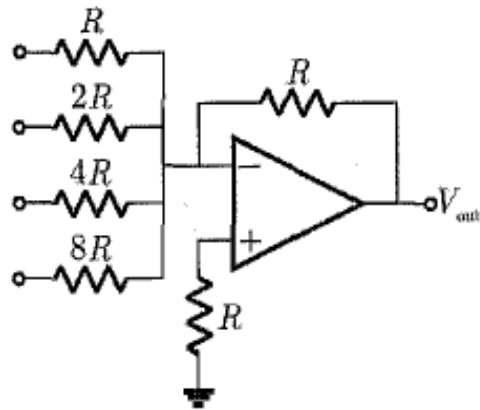
26. A Boolean function  $f$  of two variables  $x$  and  $y$  is defined as follows:

$$f(0,0) = f(0,1) = f(1,1) = 1; f(1,0) = 0$$

Assuming complements of  $x$  and  $y$  are not available, a minimum cost solution for realizing  $f$  using only 2-input NOR gates and 2-input OR gates (each having unit cost) would have a total cost of

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

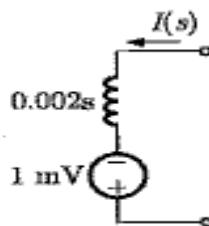
27. The circuit shown in the figure is a 4 bit DAC



The input bits 0 and 1 are represented by 0 and 5 V respectively. The OP AMP is ideal, but all the resistance and the 5 v inputs have a tolerance of  $\pm 10\%$ . The specification (rounded to nearest multiple of 5%) for the tolerance of the DAC is

- A)  $\pm 35\%$   
 B)  $\pm 20\%$   
 C)  $\pm 10\%$   
 D)  $\pm 5\%$

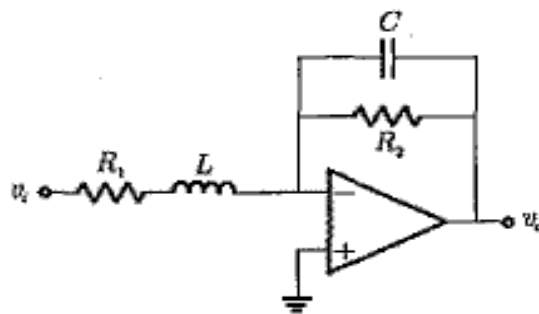
28. A 2 mH inductor with some initial current can be represented as shown below, where s is the Laplace Transform variable. The value of initial current is





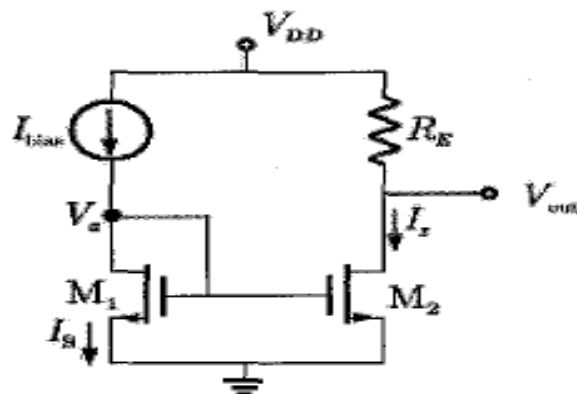
- A) 0.5A
- B) 2.0A
- C) 1.0A
- D) 0.0A

29. The OPAMP circuit shown in figure represents a



- A) high pass filter
- B) low pass filter
- C) band pass filter
- D) band reject filter

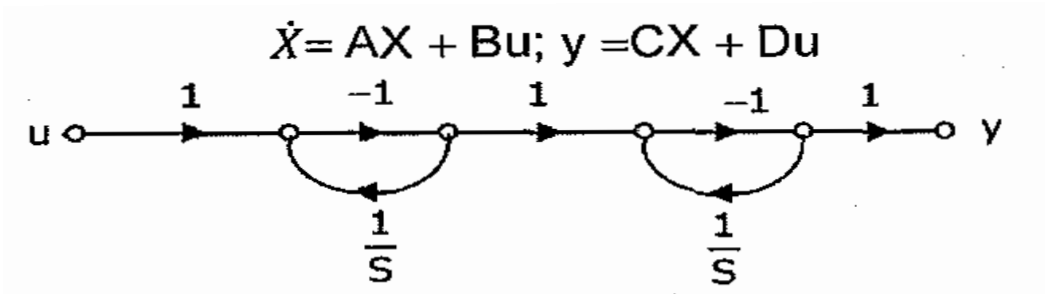
30. For the circuit shown in the following figure, transistor  $M_1$  and  $M_2$  are identical NMOS transistors. Assume the  $M_2$  is in saturation and the output is unloaded.



The current  $I_x$  is related to  $I_{bias}$  as

- A)  $I_x = I_{bias} + I_s$
- B)  $I_x = I_{bias}$
- C)  $I_x = I_{bias} - (V_{DD} - \frac{V_{out}}{R_E})$
- D)  $I_x = I_{bias} - I_s$

31. The state diagram of a system is shown below. A system is described by the state-variable equations



The state-variable equations of the system shown in the figure above are

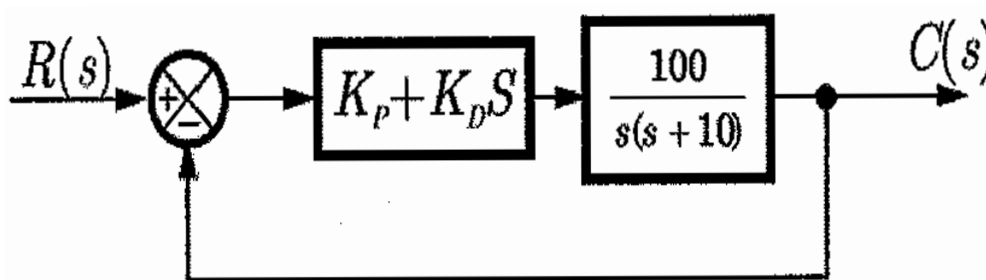
- A)  $\dot{X} = \begin{bmatrix} -1 & 0 \\ 1 & -1 \end{bmatrix} X + \begin{bmatrix} -1 \\ 1 \end{bmatrix} u; Y = [1 \quad -1] X + u$
- B)  $\dot{X} = \begin{bmatrix} -1 & 0 \\ -1 & -1 \end{bmatrix} X + \begin{bmatrix} -1 \\ 1 \end{bmatrix} u; Y = [-1 \quad -1] X + u$
- C)  $\dot{X} = \begin{bmatrix} -1 & 0 \\ -1 & -1 \end{bmatrix} X + \begin{bmatrix} -1 \\ 1 \end{bmatrix} u; Y = [1 \quad -1] X - u$
- D)  $\dot{X} = \begin{bmatrix} -1 & -1 \\ 0 & -1 \end{bmatrix} X + \begin{bmatrix} -1 \\ 1 \end{bmatrix} u; Y = [1 \quad -1] X - u$

32. If the closed-loop transfer function of a control system is given as

$$T(s) = \frac{s-5}{(s+2)(s+3)}, \text{ then it is}$$

- A) An unstable system
- B) An uncontrollable system
- C) A minimum phase system
- D) A non-minimum phase system

33. A control system with PD controller is shown in the figure. If the velocity error constant  $K_v = 1000$  and the damping ratio  $\zeta = 0.5$ , then the value of  $K_p$  and  $K_D$  are



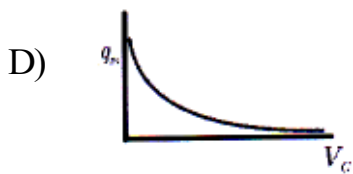
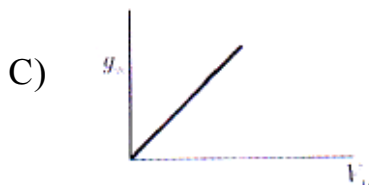
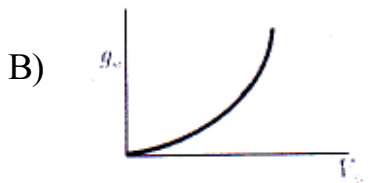
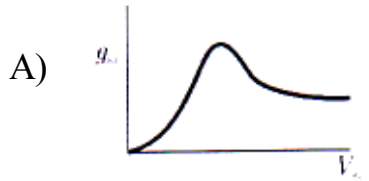
- A)  $K_p = 100, K_D = 0.09$
- B)  $K_p = 100, K_D = 0.9$
- C)  $K_p = 10, K_D = 0.09$
- D)  $K_p = 10, K_D = 0.9$

## M/P ENT – 108

34. A source generates three symbols with probabilities 0.25, 0.25, 0.50 at a rate of 3000 symbols per second. Assuming independent generation of symbols, the most efficient source encoder would have average bit rate is
- A) 6000 bits/sec
  - B) 4500 bits/sec
  - C) 3000 bits/sec
  - D) 1500 bits/sec
35. An AM signal and a narrow-band FM signal with identical carriers, modulating signals and modulation indices of 0.1 are added together. The resultant signal can be closely approximated by
- A) broadband FM
  - B) SSB with carrier
  - C) DSB-SC
  - D) SSB without carrier
36. A 1 mW video signal having a bandwidth of 100 MHz is transmitted to a receiver through cable that has 40 dB loss. If the effective one-side noise spectral density at the receiver is  $10^{-20}$  Watt/Hz, then the signal-to-noise ratio at the receiver is
- A) 50 dB
  - B) 30 dB
  - C) 40 dB
  - D) 60 Db

## M/P ENT – 108

37. The measured transconductance  $g_m$  of an NMOS transistor operating in the linear region is plotted against the gate voltage  $V_G$  at a constant drain voltage  $V_D$ . Which of the following figures represents the expected dependence of  $g_m$  on  $V_G$



38. The source of a silicon ( $n_i = 10^{10}$  per  $\text{cm}^3$ ) n-channel MOS transistor has an area of  $1 \text{ sq}\mu\text{m}$  and a depth of  $1 \mu\text{m}$ . If the dopant density in the source is  $10^{19}/\text{cm}^3$ , the number of holes in the source region with the above volume is approximately

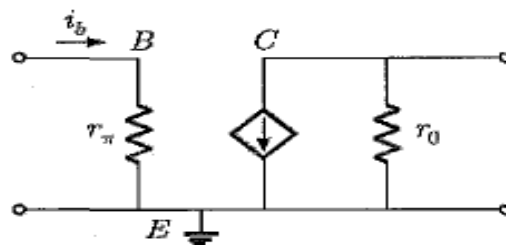
- A)  $10^7$
- B) 100
- C) 10
- D) 0

## M/P ENT – 108

39. A long-channel NMOS transistor is biased in the linear region with  $V_{DS}=50$  mV and is used as a resistance. Which one of the following statements is NOT correct?
- A) If the device width  $W$  is increased, the resistance decreases.
  - B) If the threshold voltage is reduced, the resistance decreases.
  - C) If the device length  $L$  is increased, the resistance increases.
  - D) If  $V_{GS}$  is increased, the resistance increases.
40. Which of the following is true?
- A) A silicon wafer heavily doped with boron is a p+ substrate
  - B) A silicon wafer lightly doped with boron is a p+ substrate
  - C) A silicon wafer heavily doped with arsenic is a p+ substrate
  - D) A silicon wafer lightly doped with arsenic is a p+ substrate
41. For static electric and magnetic fields in an inhomogeneous source-free medium, which of the following represents the correct form of Maxwell's equations?
- A)  $\nabla \cdot \mathbf{E} = 0, \nabla \times \mathbf{B} = 0$
  - B)  $\nabla \cdot \mathbf{E} = 0, \nabla \cdot \mathbf{B} = 0$
  - C)  $\nabla \times \mathbf{E} = 0, \nabla \times \mathbf{B} = 0$
  - D)  $\nabla \times \mathbf{E} = 0, \nabla \cdot \mathbf{B} = 0$

## M/P ENT – 108

42. One end of a loss-less transmission line having the characteristic impedance of  $75\Omega$  and length of 1 cm is short-circuited. At 3 GHz, the input impedance at the other end of transmission line is
- A) 0
  - B) Resistive
  - C) Capacitive
  - D) Inductive
43. Which is the major factor for determining whether a medium is free space, lossless dielectric or a good conductor
- A) Attenuation constant
  - B) Loss tangent
  - C) Reflector coefficient
  - D) Constitutive parameters.
44. The current  $i_b$ , through the base of a silicon npn transistor is  $1 + 0.1 \cos(10000 \pi t)$  mA. At 300 K, the  $r_\pi$  in the small signal model of the transistor is

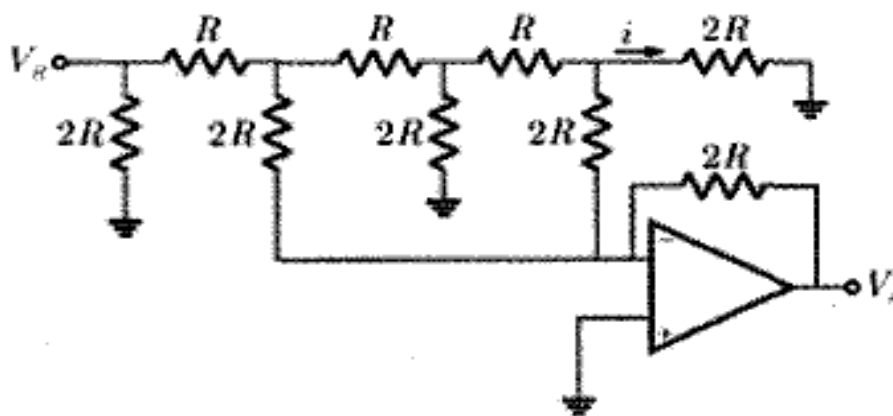


- A)  $250 \Omega$
- B)  $27.5 \Omega$
- C)  $25 \Omega$
- D)  $22.5 \Omega$

45. Three identical amplifiers with each one having a voltage gain of 50, input resistance of  $1\text{k}\Omega$  and output resistance of  $250 \Omega$  are cascaded. The opened circuit voltages gain of the combined amplifier is

- A) 49 dB
- B) 51 dB
- C) 98 dB
- D) 102 dB

46. In the Digital-to-Analog converter circuit shown in the figure below,  $V_R = 10\text{V}$  and  $R = 10\text{k}\Omega$





The current  $i$  is

- A)  $31.25\mu\text{A}$
- B)  $62.5\mu\text{A}$
- C)  $125\mu\text{A}$
- D)  $250\mu\text{A}$

47. Let  $X$  and  $Y$  be two statistically independent random variables uniformly distributed in the ranges  $(-1,1)$  and  $(-2,1)$  respectively. Let  $Z = X + Y$ . Then the probability that  $(z \leq -1)$  is

- A) zero
- B)  $1/6$
- C)  $1/3$
- D)  $1/12$

48. The impulse response  $h(t)$  of linear time - invariant continuous time system is given by  $h(t) = \exp(-2t)u(t)$ , where  $u(t)$  denotes the unit step function. The frequency response  $H(\omega)$  of this system in terms of angular frequency  $\omega$ , is given by  $H(\omega)$

- A)  $\frac{1}{1 + j2\omega}$
- B)  $\frac{\sin \omega}{\omega}$
- C)  $\frac{1}{2 + j\omega}$
- D)  $\frac{j\omega}{2 + j\omega}$

49. Let P be linearity, Q be time-invariance, R be causality and S be stability. A discrete time system has the input-output relationship,

$$y(n) \begin{cases} x(n) & n \geq 1 \\ 0 & n = 0 \\ x(n+1) & n \leq -1 \end{cases}$$

where  $x(n)$  is the input and  $y(n)$  is the output. The above system has the properties

- A) P, S but not Q, R
  - B) P, Q, S but not R
  - C) P,Q,R,S
  - D) Q, R, S but not P
50. A linear, time - invariant, causal continuous time system has a rational transfer function with simple poles at  $s = -2$  and  $s = -4$  and one simple zero at  $s = -1$ . A unit step  $u(t)$  is applied at the input of the system. At steady state, the output has constant value of 1. The impulse response of this system is
- A)  $[\exp(-2t) + \exp(-4t)]u(t)$
  - B)  $[-4 \exp(-2t) - 12 \exp(-4t) - \exp(-t)]u(t)$
  - C)  $[-4 \exp(-2t) + 12 \exp(-4t)]u(t)$
  - D)  $[-0.5 \exp(-2t) + 1.5 \exp(-4t)]u(t)$



**Rough Work**

**Rough Work**