GU-RET 2016

Gauhati University Research Eligibility Test

ECT

Booklet Series : (A)

Booklet No.

OMR Sheet No.

Invigilator's Name and Signature

Roll No.

Time : **2 hours 20 minutes**

Total Marks : 80

Number of Pages in this Booklet : **18**
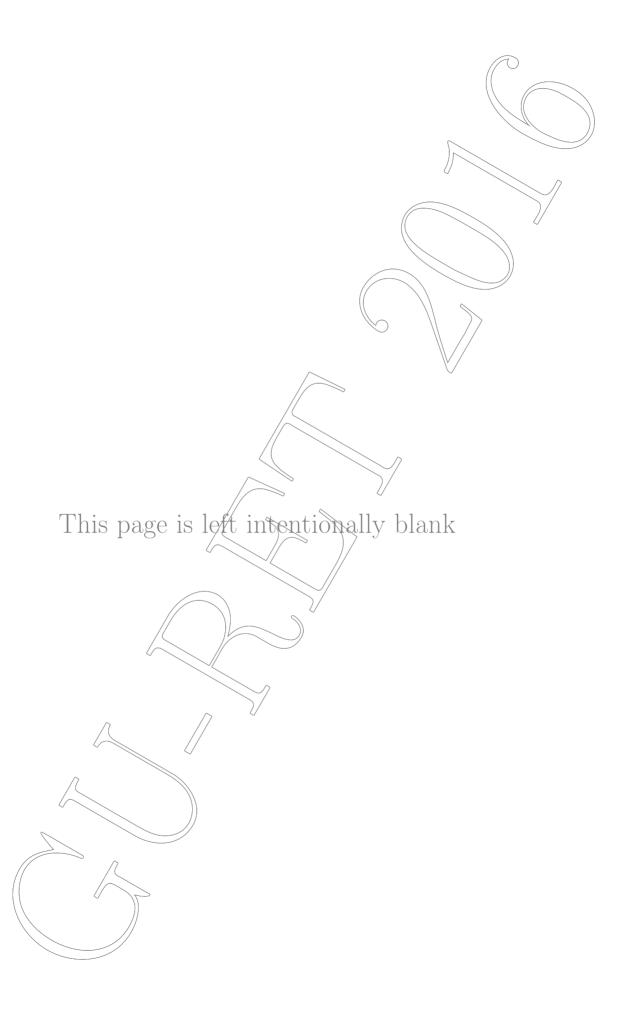
Instructions for Candidates

1. Write your Roll No. and OMR Sheet No. in the boxes provided above.

2. This paper consists of two sections : **Section B** with 50 (fifty) multiple choice questions (MCQ) and **Section C** with 8 (eight) descriptive questions. Each MCQ has 4 (four) answers, out of which ONLY one is correct. You have to darken the circle (on the OMR Sheet) for the correct answer corresponding to the question given in this booklet.

   Example : (A) (B) (C) (D)

   where (C) is the correct answer. No marks will be given for markings made in this booklet. The descriptive questions in **Section C** MUST be answered in the space provided in this booklet. **No extra pages will be provided in any case**.

3. Use a BLACK ball point pen in your OMR Sheet.

4. Read the instructions given inside this booklet before attempting to answer any questions.

5. DO NOT write your name, roll no, phone no, or anything, or put any marks anywhere in this booklet, otherwise your candidature will be disqualified.

6. If you are found to resort to any kind of unfair means such as carrying extra material other than pen, pencil, watch, eraser, and scale, or copying from somebody or from external material, your candidature will be disqualified.

7. Use of mobile phones, calculators, log tables or any other tables, wearable smart devices such as smart Android watches or objects of similar nature CAN NOT be used inside the examination hall.

8. At the end of the examination, you have to return this booklet and the OMR Sheet back to the invigilator.

9. There is no negative marks for incorrect answer.

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Section B (50 Marks)

1. In a single error correcting Hamming code, the number of message bits in a block is 26. The number of check bits in a block would be

   (A) 20
   (B) 9
   (C) 2
   (D) 5

2. The Hamming distance between the following pairs of binary words

   001101010111 and 010001010111

   (A) 3
   (B) 2
   (C) 1
   (D) 6

3. What is the approximate HPBW (Half Power Beam Width) of a paraboloid of 1 meter diameter radiating at 0.1 meter wavelength?

   (A) 70°
   (B) 7°
   (C) 78°
   (D) 10°

4. For communication from satellite to the earth station, microwave frequencies are used because

   (A) loss is minimum
   (B) noise added to signal is low in this window
   (C) these do not get reflected back by ionosphere
   (D) many channels can be used

5. Which code combines the capability of convolutional codes with channel estimation theory?

   (A) Convolution code
   (B) Hamming code
   (C) Turbo code
   (D) Huffman code

6. Pick the odd one out

   (A) Transponder
   (B) Earth station
   (C) GSM
   (D) Equatorial orbit

7. The advantage of X.25 packet switching is

   (A) the channel is utilized only when sending or receiving burst of information
   (B) channel efficiency is excellent
   (C) both a and b are true
   (D) none of the above

8. Find the 3-db bandwidth for a Gaussian low pass filter used to produce a 0.25 GMSK with a channel rate of $R_b = 270$ kbps.

   (A) 569.6 kHz
   (B) 67.56 kHz
   (C) 55.80 kHz
   (D) 92.88 kHz

9. The impulse invariant transformation is

   (A) one to one mapping
   (B) many to one mapping
   (C) (A) and (B) are true
   (D) (A) and (B) are false

10. In floating point representation

   (A) only the position of the binary point is variable
   (B) the position of the binary point is fixed
   (C) the position of the binary point is depend on the number
   (D) none of the above

11. The filter used to eliminate multiple images in the o/p spectrum of an interpolator is called

   (A) anti-aliasing filter
   (B) lowpass filter
   (C) (A) and (B) are true
   (D) None of the above

12. For an ergodic signal

   (A) all its statistical properties can be estimated from a single realization of sufficiently large finite length

   (B) time averages equal to ensemble averages derived via the expectation operator in the limit as the length of the realization goes to infinity

   (C) (A) and (B) are true

   (D) (A) and (B) are false

13. If n is the no. of state of each of the m-sequence generators, the length of Gold sequences is

   (A) $2n - 1$

   (B) $1 - 2n$

   (C) $2n$

   (D) $2^n - 1$

14. Which of the following statements about the match filter in a communication receiver are correct?

   1. Its impulse response depends on the signal shape
   2. It maximizes the SNR at the detection instant
   3. It produces ISI
   4. It may produce phase error if synchronization is improper

   (A) 1 and 4 only

   (B) 1 and 2 only

   (C) 1 and 3 only

   (D) 2 and 4 only

15. The probability cumulative distribution function must be monotone and

   (A) increasing

   (B) decreasing

   (C) non-increasing

   (D) None of the above

16. Wavelength of light emitted from an LED is

   (A) inversely proportional to band gap energy of semiconductor

   (B) directly proportional to band gap energy of semiconductor

   (C) directly proportional to square of the band gap energy of semiconductor

   (D) None of the above

17. Which of the following is a second order electro-optic effect?

   (A) Kerr Effect

   (B) Pockel Effect

   (C) Faraday Effect

   (D) None of the above

18. An AC voltage source has $4\sin(\omega t)$ Volt output and internal impedance of $2\,\Omega$. When maximum power transfer has occurred from the source to an Ohmic load, the instantaneous power across the load is

   (A) $1 - \cos(2\omega t)$

   (B) $1 + \cos(2\omega t)$

   (C) $1 - \sin(2\omega t)$

   (D) None of the above

19. The sum of impedances $Z_1 = (1 + j0)\,\Omega$ and $Z_2 = (0 + j)\,\Omega$ in polar form is

   (A) $Z_3 = \sqrt{2}\angle 90°\,\Omega$

   (B) $Z_3 = 2\angle 45°\,\Omega$

   (C) $Z_3 = \sqrt{2}\angle 0°\,\Omega$

   (D) None of the above

20. Laplace transform of $y(t) = e^{at}$ is

   (A) $1/(s - a)$

   (B) $s/(s - a)$

   (C) $1/s$

   (D) None of the above

21. During an experiment for determining resistance, it is found that the voltmeter and ammeter have individual uncertainties of $\pm 2\%$. The resistance of the unknown resistor has an uncertainty of

   (A) $\pm 2\%$

   (B) $\pm 3\%$

   (C) $\pm 4\%$

   (D) None of the above

22. Resolution of an A/D converter is its

   (A) LSB

   (B) Reference voltage

   (C) Step Size

(D) None of the above

23. Dynamic power dissipation of CMOS Transistors increases with

(A) square of DC supply voltage
(B) square of signal frequency
(C) square of load capacitance
(D) None of the above

24. Voltage gain of an amplifier is 60 dB. When a signal of $1 mV(P - P)$ is applied as its input, the output signal is

(A) 120.0 $mV(P - P)$
(B) 560.0 $mV(P - P)$
(C) 1200 $mV(P - P)$
(D) None of the above
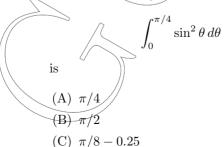
25. The 8051 assembly instructions given below copy

```
MOV A, #80H
MOV R_3, A
INC A
MOV @R_3,A
```

(A) 81H to external memory location 80H
(B) 81H to internal memory location 80H
(C) 80H to internal memory location 81H
(D) None of the above

26. Normalized transfer function of a low pass filter having cut-off frequency f_c (where, f_s = signal frequency) is

(A) $1/[1 + (f_s/f_c)]^{1/2}$
(B) $1/[1 + (f_c/f_s)]^{1/2}$
(C) $1/[1 + f_s]^{1/2}$
(D) None of the above

27. The value of integral

$$\int_0^{\pi/4} \sin^2 \theta \, d\theta$$

is

(A) $\pi/4$
(B) $\pi/2$
(C) $\pi/8 - 0.25$

28. 8051 instruction for clearing content of accumulator is

(A) `XRA A`
(B) `ANI A`
(C) `ORI OF H`
(D) None of the above

29. Two identical MOSFETs having aspect ratio (W/L) are connected in parallel. Aspect ratio of the resulting MOS device is

(A) $2W/L$
(B) $W/2L$
(C) W/L
(D) None of the above

30. A small signal BJT amplifier working in CE configuration has potential divider biasing network with no bypass capacitor connected across R_E of the circuit. If the input voltage is $0.2 \sin(\omega t + \phi)$, $\beta_{ac} = 100$, $R_C = 5 \, \text{k}\Omega$, and $R_E = 1 \, \text{k}\Omega$, maximum amplified output voltage of the circuit is

(A) $\approx -\sin(\omega t + \phi)$
(B) $\approx 0.2 \sin(\omega t + \phi)$
(C) $\approx \sin(\omega t + \phi)$
(D) None of the above

31. Schottky diode clamped transistor has very fast switching speed, because

(A) carrier mobility is higher in this device
(B) the transistor never undergoes into deep saturation state
(C) Schottky diode is a very fast acting diode
(D) None of the above

32. Breakdown voltage of a zener diode

(A) decreases with decrease of doping concentration
(B) increases with increase of doping concentration
(C) decreases with increase of doping concentration
(D) None of the above

33. Sensitivity of voltage control oscillator (VCO) has the dimension

   (A) Unity
   (B) V/Hz
   (C) Hz/V
   (D) None of the above

34. For a stable system

   (A) gain cross-over frequency is higher than phase cross-over frequency
   (B) phase cross over frequency is equal to gain cross over frequency
   (C) phase cross-over frequency is higher than gain cross over frequency
   (D) None of the above

35. The most important characteristics of an instrumentation amplifier is

   (A) very large voltage and high input impedance
   (B) very Large CMRR and high input impedance
   (C) very large CMRR and low output impedance
   (D) None of the above

36. An Ohmic contact is a

   (A) p^+-metal junction
   (B) p-n junction
   (C) p-metal junction
   (D) n-metal junction

37. Fermi factor at $0\,\mathrm{K}$ is

   (A) an increasing function of energy
   (B) independent of energy
   (C) delta function of energy
   (D) step function of energy

38. Fermi wavelength is the de Broglie wavelength at

   (A) Critical energy
   (B) Fermi energy
   (C) LUMO or HOMO
   (D) None of the above

39. Low dimensional counterpart of Esaki diode is

   (A) Tunnel diode
   (B) Zener diode
   (C) Resonant tunneling diode
   (D) Schottky diode

40. Two semiconducting materials A and B are given to you — A having very high photoluminescence intensity and B having very low photoluminescence. Which of the following would you select?

   (A) A for solar cell, B for LED
   (B) A for LED, B for solar cell
   (C) Both A and B for solar cell
   (D) Both A and B for LED

41. Negative feedback in amplifier

   (A) decreases voltage gain
   (B) increases voltage gain
   (C) decreases bandwidth
   (D) does not affect bandwidth

42. The physical process behind the working of LED is

   (A) photoluminescence
   (B) electroluminescence
   (C) visible absorption
   (D) UV absorption

43. In a p-n junction, forward biased by V volts, the difference between the Fermi levels of the two sides is equal to

   (A) zero
   (B) eV Joules
   (C) V Volts
   (D) $eV/2$ Joules

44. The basic concept behind the device JFET is the effect of

   (A) longitudinal electric field
   (B) temperature
   (C) transverse electric field
   (D) charge carriers

45. MOSFETs stop to function properly when the gate length is lowered to ~700Å. The reason is, for gate length of ~700Å, the quantum mechanical tunneling current through the gate oxide layer becomes

(A) zero

(B) $\sim 10^2$ A/cm^2

(C) ~ 0.001 A/cm^2

(D) $\sim 10^2$ nA/cm^2

46. Reverse saturation current in a *p-n* junction is due to flow of

(A) majority carriers

(B) minority carriers

(C) both majority and minority carriers

(D) positive ions

47. Charging energy of a metal sphere of capacitance C is

(A) $e^2/2C$

(B) $e/2C^2$

(C) $e/2C$

(D) $e^2/2C^2$

48. Quantum conductance in a nanoscale semiconductor device can be explained by using

(A) Poisson's equation

(B) Landauer formula

(C) Richardson's formula

(D) Ohm's law

49. Dimension of free motion of electrons in a bulk semiconducting material is

(A) zero

(B) 1

(C) 2

(D) 3

50. Depletion region of a semiconductor diode is depleted of

(A) mobile charge carriers

(B) immobile charge carriers

(C) positive ions

(D) negative ions

Section C (30 Marks)

Answer any 5 (five) from the following

1. Draw the directional pattern for power density for a half wave dipole. What information do you get from the pattern? (Marks : $3 + 3 = 6$)

2. Distinguish between the cut-off and pinch-off conditions in the operation of a JFET. (Marks : 6)

3. What are the four basic ways of connecting a feedback signal? Explain each with necessary block diagram. (Marks : $1^{1}/_{2} \times 4 = 6$)

4. Write 8051 assembly language program for interfacing a 8 bit parallel output ADC to 8051. (Marks : 6)

5. Describe in detail about the functional blocks of an analog oscilloscope. Mention the advantages of digital oscilloscope over analog oscilloscope. (Marks : 6)

6. For BJT circuit, draw the frequency response curve and explain the variations in the pattern outlining the roles played by the intra and inter electrode components. (Marks : 6)

7. For an FM signal, show how a PLL can be used for the recovery of the massage signal. (Marks : 6)

8. For a series RLC circuit, find the zero state transient response identifying each of the damping states. Derive the expression for the current flowing through the circuit for each of the cases. (Marks : 6)