

GU-RET 2016

GAUHATI UNIVERSITY RESEARCH ELIGIBILITY TEST

ECE

Booklet Series : **A**

Invigilator's Name and Signature

BOOKLET NO.

OMR SHEET NO.

ROLL NO.

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TIME : 2 HOURS 20 MINUTES

TOTAL MARKS : 80

Number of Pages in this Booklet : 19

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 6 (six) 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. Every run length pair introduces new
 - (A) pixels
 - (B) matrix
 - (C) frames
 - (D) intensity

2. Transforming difference between adjacent pixels is called
 - (A) mapping
 - (B) image compression
 - (C) image watermarking
 - (D) image equalization

3. Standard rate of showing frames in a video per second are
 - (A) 10
 - (B) 20
 - (C) 25
 - (D) 30

4. 0 (zero) degree of red color in hue image will correspond to
 - (A) pink region
 - (B) magenta region
 - (C) white region
 - (D) black region

5. γ -rays have largest
 - (A) wavelength
 - (B) frequency
 - (C) energy
 - (D) power

6. Perception of light intensity is controlled by
 - (A) eye lid
 - (B) cornea
 - (C) pupil
 - (D) sclera

7. 2-to-1 line multiplexer can be realized using
 - (A) 1 NAND, 2 OR, and 1 NOT gates
 - (B) 2 NAND, 2 OR, and 1 NOT gates
 - (C) 2 NAND, 1 OR, and 2 NOT gates
 - (D) 2 NAND, 1 OR, and 1 NOT gates

8. Which one of the following statement is not correct
 - (A) An 8 input MUX can be used to complement 4 variable function
 - (B) A 3 line to 8 line DEMUX can be used to implement any 4 variable function
 - (C) A 64 input MUX can be built using nine 8 input MUXs
 - (D) A 6 line to 64 line DEMUX can be built using nine 3 line to 8 line DEMUXs

9. An 8 bit binary ripple UP counter with a modulus of 256 is holding the count 01111111. What will be the count after 135 clock pulses?
 - (A) 0000 0101
 - (B) 1111 1001
 - (C) 0000 0110
 - (D) 0000 0111

10. An n -channel depletion MOSFET has following two points on its $I_D - V_{GS}$ curve, (0 V, 12 mA) and (-6 V, 0 mA). Which of the following Q -point gives the highest trans conductance gain for small signals?
 - (A) $V_{GS} = -6$ V
 - (B) $V_{GS} = -3$ V
 - (C) $V_{GS} = 0$ V
 - (D) $V_{GS} = 3$ V

11. The NAND-NAND realization is equivalent to
 - (A) AND-NOT realization
 - (B) AND-OR realization
 - (C) OR-AND realization
 - (D) NOT-OR realization

12. An amplifier gain varies with frequency due to
- (A) Miller effect
 - (B) logarithmic increase in its output power
 - (C) interstate transformers
 - (D) presence of internal and external capacitances

13. The datasheet of a certain JFET indicates $I_{DSS} = 15 \text{ mA}$, $V_{GS}(\text{cut off}) = -5 \text{ V}$. What is the drain current for $V_{GS} = -2 \text{ V}$?
- (A) 58.8 mA
 - (B) 29.4 mA
 - (C) 9.6 mA
 - (D) 5.4 mA

14. Negative resistance region of a silicon Esaki diode remains the same even at a temperature of
- (A) 50° C
 - (B) 100° C
 - (C) 150° C
 - (D) 200° C

15. Depletion capacitance in a diode depends on
- (i) Applied junction voltage
 - (ii) Junction built in potential
 - (iii) Current through junction
 - (iv) Doping profile across junction
- (A) (i) and (ii)
 - (B) (i) and (iii)
 - (C) (i), (ii), and (iv)
 - (D) (ii), (iii), and (iv)

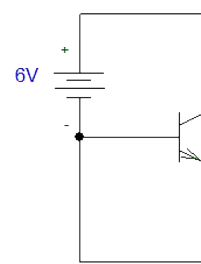
16. Silicon devices are preferred at high temperature operations in comparison to germanium because
- (A) silicon is more thermally stable
 - (B) reverse saturation current is less in case of silicon
 - (C) germanium has less transition capacitance
 - (D) Both A and C

17. In a bipolar transistor biased in the forward active region, the base current is $i_B = 6 \mu\text{A}$ and the collector current is $i_C = 510 \mu\text{A}$. What will be the values of α , β , and i_E ?
- (A) $\alpha = 1, \beta = 85, i_E = 516 \mu\text{A}$
 - (B) $\alpha = 0, \beta = 13, i_E = 504 \mu\text{A}$
 - (C) $\alpha = 0.9, \beta = 8.5, i_E = 516 \mu\text{A}$
 - (D) $\alpha = 1, \beta = 85, i_E = 504 \mu\text{A}$

18. Consider the following 8085 instruction
- ```
MVI A, A9H
MVI B, 57H
ADD B
ORA A
```
- The flag status (S, Z, CY) after the instruction ORA A is executed, is
- (A) (0, 1, 1)
  - (B) (0, 1, 0)
  - (C) (1, 0, 0)
  - (D) (1, 0, 1)

19. In 8085
- (A) the upper 8 address bits appear on address bus and lower 8 bits appear on address data bus
  - (B) the lower 8 address bits appear on address bus and the upper 8 address bits appear on address data bus
  - (C) either upper or lower 8 address bits may appear on address bus
  - (D) either upper or lower 8 address bits may appear on address data bus

20. Consider the transistor shown in figure below.



- The transistor is operating in
- (A) Forward-Active region.
  - (B) Reverse Active region
  - (C) Saturation region
  - (D) Cutoff region

21. A Wheatstone bridge requires a change of  $6\ \Omega$  in the unknown arm of the bridge to produce a change in deflection of 3 mm in the galvanometer. The sensitivity of the instrument is
- 0.5%
  - 2%
  - $0.5\ \text{mm}/\Omega$
  - $2.0\ \Omega/\text{mm}$
22. In 8255 PPI, all ports act as input and output ports, the control words are respectively
- 98H, 80H
  - 80H, 9BH
  - 9BH, 98H
  - 98H, 98H
23. To reduce the effect of noise level, 100 sets of data are averaged. The average data set has a noise level reduced by a factor of
- 10
  - $10\sqrt{2}$
  - $50\sqrt{2}$
  - 100
24. Euler no of the following is
- 2
  - 1
  - 3
  - 4
25. The switching time of a FET is dependent on
- aspect ratio of the FET
  - node capacitance
  - threshold voltage of the device
  - All the above
26. A CMOS inverter is better than a pseudo nFET inverter because of
- high transistor density
  - low power consumption
  - low leakage current
  - high speed
27. In silicon technology, polysilicon is used as conducting layer because of
- excellent coverage
  - good adhesive properties to  $\text{SiO}_2$
  - high temperature withstand ability
  - All the above
28. A silicon sample is doped with  $10^{17}$  As atoms/ $\text{cm}^3$ . At room temperature, difference between Fermi and the intrinsic energy is
- 2.25 eV
  - 0.029 eV
  - 0.407 eV
  - 1.125 eV
29. The air interface standard of EDGE is known as
- Multiple modulation and coding schemes (MCS)
  - Incremental redundancy
  - TDMA
  - EGPRS
30. The power in a wireless channel is experimentally seen to decay
- As the square of the distance
  - Exponentially with distance
  - Linearly with distance
  - As a cube of the distance
31. In a DPLL circuit the phase frequency detector (PFD) is preferred over XOR phase detector in many applications because
- it is suitable for high speed applications
  - the design requirements of a VCO is much relaxed with it
  - it offers more stability
  - its design simplicity
32. The power of radiation in an Omni-directional antenna decreases with
- the distance
  - the square of the distance
  - the fourth power of the distance
  - can not be estimated

33. The impulse response of a system is  $h(t) = tu(t)$ . For an input  $u(t-1)$ , the output is
- $\frac{t^2}{2} u(t)$
  - $\frac{(t-1)^2}{2} u(t)$
  - $\frac{(t-1)^2}{2} u(t-1)$
  - $\frac{t^2-1}{2} u(t-1)$
34. Silicon diode is less suited for low voltage rectifier operation because
- its breakdown voltage is very high
  - its cut-in voltage is high
  - its reverse saturation current is low
  - None of the above
35. Signal  $m(t) = 10 \cos(4\pi 100t)$ , frequency modulates a carrier. The resulting FM signal is  $20 \cos[(2\pi \times 10^6 t) + 7 \sin(4\pi 100t)]$ . The bandwidth of the FM is
- 1.6 KHz
  - 3200 KHz
  - 100 KHz
  - 3.2 KHz
36. A TV signal is sampled at a rate of 20% above the Nyquist rate. The signal has a bandwidth of 6 MHz. The samples are quantized to 1024 levels. The minimum bandwidth required to transmit this signal is
- 72 M bits/sec
  - 144 M bits/sec
  - 120 M bits/sec
  - 14.4 M bits/sec
37. Varactor diodes are used in FM receivers to obtain
- automatic frequency control
  - automatic gain control
  - automatic volume control
  - None of the above
38. A divide by 78 counter can be realized by using
- 6 numbers of mod-13 counters
  - 13 numbers of mod-6 counters
  - one mod-13 counter followed by one mod-6 counter
  - 13 numbers of mod-13 counter
39. The number of  $T$  states in Opcode Fetch of CALL instruction in 8085 is
- 4
  - 5
  - 6
  - 8
40. The bus high enable (BHE) of 8086 microprocessor signal is used to interface the
- even address bank memory
  - odd address bank memory
  - I/O
  - DMA
41. The system function of a FIR system is given by  $H(z) = z^{-1}(z + 1/2)$ . The inverse system is given by
- $H(z) = z^{-1}[2z + (1/2)z]$
  - No inverse system exists
  - $H(z) = z^{-1}[1 + (1/2)z]$
  - $H(z) = z(z^{-1} + 1/2)$
42. Let  $x(n)$  be a  $N$ -point nonzero sequence and  $X(k)$  is the  $M$  point DFT, where  $M < N$ . The IDFT of  $X(K)$  results in a sequence  $xp(n)$ , which is
- same as  $x(n)$
  - time aliased version of  $x(n)$
  - time and frequency aliased version of  $x(n)$
  - frequency aliased version of  $x(n)$
43. A 2-D image is filtered using a  $(5 \times 5)$  averaging filter. This process is a
- Causal process
  - Non-causal process
  - Anti-causal process
  - Cannot be compared

44. Consider the signal

$$x(t) = \sin(\omega t) \cos(\sqrt{2}\omega t) + \cos(\omega t) \sin(\sqrt{2}\omega t)$$

The signal is

- (A) periodic,  $T = \frac{\sqrt{2}\pi}{1 + \omega}$
  - (B) periodic,  $T = \frac{2\pi}{1 + \sqrt{2}}$
  - (C) not periodic
  - (D) periodic,  $T = \frac{2\pi}{1 + 2\omega}$
45. The propagation constant of a loss-less transmission line is given by
- (A)  $\gamma = \sqrt{(R + j\omega L)(G + j\omega C)}$
  - (B)  $\gamma = \sqrt{\frac{(R + j\omega L)}{(G + j\omega C)}}$
  - (C)  $\gamma = 0$
  - (D)  $\gamma = j\omega\sqrt{LC}$
46. In transmission lines, the impedance inversion is obtained with
- (A) a short circuited stub
  - (B) an open circuited stub
  - (C) a quarter-wave line
  - (D) a half-wave line

47. An antenna has a radiation resistance of  $60 \Omega$  and loss resistance of  $40 \Omega$ . The efficiency of the antenna is

- (A) 60%
- (B) 40%
- (C) 20%
- (D) 50%

48. Which of the following is true for Eigenfaces (PCA)

- (A) Can be used to effectively detect deformable objects
- (B) Invariant to affine transformations
- (C) Can be used for lossy image compression
- (D) Is invariant to shadows

49. Which of the following processes would help avoid aliasing, while down sampling an image?

- (A) Image sharpening
- (B) Image blurring
- (C) Median filtering
- (D) Histogram equalization

50. To get the frequency response of a  $N$ -tap FIR filter at any arbitrary frequency, the method that can be used is

- (A) DFT
- (B) FFT
- (C) DTFT
- (D) Laplace transformation

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**Section C (30 Marks)**

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**Answer any 5 (five) from the following**

1. Find the arithmetic coding for the given four symbols along with the probability of occurrence. The given message signal is “ABCDD”

| <u>Symbol</u> | ... | <u>Probability</u> |
|---------------|-----|--------------------|
| A             | ... | 0.2                |
| B             | ... | 0.2                |
| C             | ... | 0.4                |
| D             | ... | 0.2                |

(Marks : 6)

2. A MOSFET is subjected to 3-D isotropic scaling by a scaling factor  $s = 0.6$ , calculate its impact on threshold voltage, drain current and static power dissipation.

(Marks : 6)

3. Prove that for H-parameters

(Marks : 6)

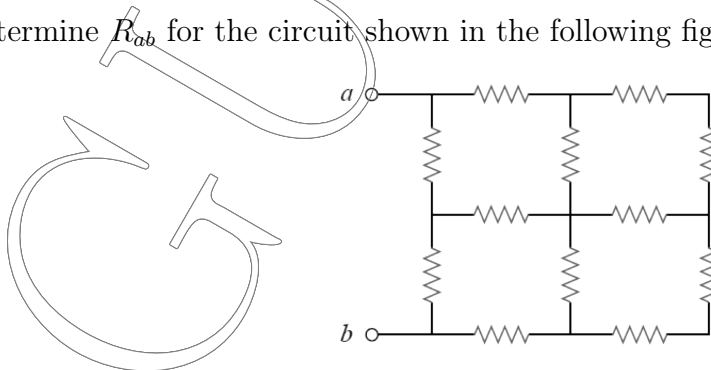
$$h_{rb} = \left[ \frac{h_{re}(1 + h_{fe}) - h_{ie}h_{oe}}{(1 + h_{fe})(h_{re} - 1) - h_{ie}h_{oe}} \right]$$

4. Define the following

(Marks : 6)

- (A) Need for image transform
- (B) Condition for perfect transform
- (C) Properties of unitary transform
- (D) Applications of image transform

5. Determine  $R_{ab}$  for the circuit shown in the following figure. Each resistor is  $100\Omega$ .



(Marks : 6)



6. Answer the following:

(Marks : 6)

- (A) A PCM system uses a uniform quantizer followed by a 7-bit binary encoder. The bit rate of the system is equal to 50 Mbits/sec. What is the maximum message signal bandwidth for which the system operates satisfactorily?
- (B) Calculate the output signal to quantization noise ratio when a full load sinusoidal modulating wave of frequency 1 MHz is applied to input.

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Space for Answers (Section C) : for Questions 1 to 6 (10 pages)

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