Roll No. ....

O. M. R. Serial No.

M. Sc. (Electronics) (Fourth Semester)

EXAMINATION, July, 2022

(Elective Course)

INFORMATION THEORY & CODING

Paper Code			
ELC	4	0	4 (H)

Time : 1:30 Hours]   [*Maximum Marks : 100*

Instructions to the Examinee :

1. Do not open the booklet unless you are asked to do so.

2. The booklet contains 60 questions. Examinee is required to answer any 50 questions in the OMR Answer-Sheet provided and not in the question booklet. If more than 50 questions are attempted by student, then the first attempted 50 questions will be considered for evaluation. All questions carry equal marks.

3. Examine the Booklet and the OMR Answer-Sheet very carefully before you proceed. Faulty question booklet due to missing or duplicate pages/questions or having any other discrepancy should be got immediately replaced.

(Remaining instructions on the last page)

परीक्षार्थियों के लिए निर्देश :

1. प्रश्न-पुस्तिका को तब तक न खोलें जब तक आपसे कहा न जाए।

2. प्रश्न-पुस्तिका में 60 प्रश्न हैं। परीक्षार्थी को किन्हीं 50 प्रश्नों को केवल दी गई OMR आन्सर-शीट पर ही हल करना है, प्रश्न-पुस्तिका पर नहीं। यदि छात्र द्वारा 50 से अधिक प्रश्नों को हल किया जाता है तो प्रारम्भिक हल किये हुए 50 उत्तरों को ही मूल्यांकन हेतु सम्मिलित किया जाएगा। सभी प्रश्नों के अंक समान हैं।

3. प्रश्नों के उत्तर अंकित करने से पूर्व प्रश्न-पुस्तिका तथा OMR आन्सर-शीट को सावधानीपूर्वक देख लें। दोषपूर्ण प्रश्न-पुस्तिका जिसमें कुछ भाग छपने से छूट गए हों या प्रश्न एक से अधिक बार छप गए हों या उसमें किसी अन्य प्रकार की कमी हो, तो उसे तुरन्त बदल लें।

(शेष निर्देश अन्तिम पृष्ठ पर)

(Only for Rough Work)

1. Some examples of linear codes :

   (A) Hamming code

   (B) Reed-Solomon code

   (C) Parity code

   (D) All of the above

2. Hamming distance can be given by the number of elements in which :

   (A) they are same

   (B) they differ

   (C) they are non-zero

   (D) None of the above

3. Code strength is characterized by it :

   (A) Minimum distance

   (B) Maximum distance

   (C) Code weight

   (D) Code size

4. The distance between two code-words is equal to the .... of the third code-word which is the sum of the first two code-words.

   (A) Size

   (B) Weight

   (C) Minimum distance

   (D) None of the above

5. Error detecting capability is given as :

   (A) $D_{min} + 1$

   (B) $D_{min} - 1$

   (C) D_{min}

   (D) $D_{min} / 2$

6. The minimum distance D_{min} can also be given as :

   (A) $D_{min} >= \alpha + \beta + 1$

   (B) $D_{min} <= \alpha + \beta + 1$

   (C) $D_{min} >= \alpha + \beta - 1$

   (D) $D_{min} <= \alpha + \beta - 1$

7. For better efficiency and simplicity, n should be :

   (A) Maximum

   (B) Minimum

   (C) Zero

   (D) Infinity

8. Nyquist frequency is given by :

   (A) f_s

   (B) $2f_s$

   (C) $f_s/2$

   (D) None of the above

9. Some various types of distortion are :

   (A) Jitter

   (B) Noise

   (C) Aperture error

   (D) All of the above

10. Noise which can affect sampling are :

    (A) Thermal sensor noise

    (B) Analog circuit noise

    (C) Thermal sensor and Analog circuit noise

    (D) None of the above

11. Oversampling can completely eliminate :

   (A) Aperture error

   (B) Non-linearity

   (C) Quantization error

   (D) All of the above

12. What is the bit depth used for audio recording ?

   (A) 8 bits

   (B) 16 bits

   (C) 24 bits

   (D) All of the above

13. Which factors are measured using the units of lines per picture height ?

   (A) Resolution

   (B) Sampling rate

   (C) Resolution and Sampling rate

   (D) None of the above

14. Sampling of simultaneously two different but related waveforms is called as :

   (A) Over-sampling

   (B) Complex sampling

   (C) Intersampling

   (D) None of the above

15. Sampling can be done for functions varying in :

   (A) Space

   (B) Time

   (C) Space and Time

   (D) None of the above

16. Self information should be :

   (A) Positive

   (B) Negative

   (C) Positive and Negative

   (D) None of the above

17. The unit of average mutual information is :

   (A) Bits

   (B) Bytes

   (C) Bits per symbol

   (D) Bytes per symbol

18. When probability of error during transmission is 0.5, it indicates that :

   (A) Channel is very noisy.

   (B) No information is received.

   (C) Channel is very noisy and no information is received.

   (D) None of the above

19. Binary Huffman coding is a :

   (A) Prefix condition code

   (B) Suffix condition code

   (C) Prefix and Suffix condition code

   (D) None of the above

20. When X and Y are statistically independent, then $I(x, y)$ is :

(A) 1

(B) 0

(C) ln 2

(D) Cannot be determined

21. Consider a dice with the property that probability of a face with n dots showing up is proportional to n. The probability of face showing 4 dots is :

(A) 17

(B) 542

(C) 121

(D) 421

22. Let X be a random variable with probability distribution function :

$$f(x) = 0.2, \quad \text{for } |x| < 1$$

$$= 0.1, \quad \text{for } 1 < |x| < 4$$

$$= 0, \quad \text{otherwise}$$

The probability $P(0.5 < x < 5)$ is ....

(A) 0.3

(B) 0.5

(C) 0.4

(D) 0.8

23. Runs scored by batsman in 5 one day matches are 50, 70, 82, 93 and 20. The standard deviation is ....

(A) 25.79

(B) 25.49

(C) 25.29

(D) 25.69

24. If E denotes the expectation the variance of a random variable X is denoted as :

(A) $(E(X))^2$

(B) $E(X^2) - (E(X))^2$

(C) $E(X^2)$

(D) $2E(X)$

25. The random variables X and Y have variances 0.2 and 0.5 respectively. Let $Z = 5X - 2Y$. The variance of Z is :

(A) 3

(B) 4

(C) 5

(D) 7

26. Let (X_1, X_2) be independent random variables. X_1 has to mean 0 and variance 1, while X_2 has mean 1 and variance 4. The mutual information $I(X_1; X_2)$ between X_1 and X_2 in bits is :

(A) 2

(B) 4

(C) 5

(D) 0

27. An event has two possible outcomes with probability $P_1 = 1/2$ and $P_2 = 1/64$. The rate of information with 16 outcomes per second is :

(A) (38/4) bits/sec

(B) (38/64) bits/sec

(C) (38/2) bits/sec

(D) (38/32) bits/sec

28. Lempel-Ziv algorithm is :

(A) Variable to fixed length algorithm

(B) Fixed to variable length algorithm

(C) Fixed to fixed length algorithm

(D) Variable to variable length algorithm

29. A rate distortion function is a :

(A) Concave function

(B) Convex function

(C) Increasing function

(D) None of the above

30. The SNR value can be increased by .... the number of levels.

(A) Increasing

(B) Decreasing

(C) Does not depend on

(D) None of the above

31. Prediction gain .... for better prediction.

(A) Increases

(B) Decreases

(C) Remains same

(D) None of the above

32. The low pass filter at the output end of delta modulator depends on :

(A) Step size

(B) Quantization noise

(C) Bandwidth

(D) None of the above

33. Thermal noise power of a resistor depends upon :

(A) Its resistance value

(B) Noise temperature

(C) Bandwidth

(D) Ambient temperature

34. The output SNR can be made independent of input signal level by using :

(A) Uniform quantizer

(B) Non-uniform quantizer

(C) Uniform and Non-uniform quantizer

(D) None of the above

35. Which type of quantization is most preferable for audio signals for a human ear ?

(A) Uniform quantization

(B) Non-uniform quantization

(C) Uniform and Non-uniform quantization

(D) None of the above

36. The channel capacity is :

(A) The maximum information transmitted by one symbol over the channel

(B) Information contained in a signal

(C) The amplitude of the modulated signal

(D) All of the above

37. For decoding in convolution coding, in a code tree :

(A) Diverge upward when a bit is 0 and diverge downward when the bit is 1.

(B) Diverge downward when a bit is 0 and diverge upward when the bit is 1.

(C) Diverge left when a bit is 0 and diverge right when the bit is 1.

(D) Diverge right when a bit is 0 and diverge left when the bit is 1.

38. Interleaving process permits a burst of B bits, with l as consecutive code bits and t errors when :

(A) $B \leq 2tl$

(B) $B \geq tl$

(C) $B \leq tl / 2$

(D) $B \leq tl$

39. Assuming that the channel is noiseless, if TV channels are 8 kHz wide with the bits/sample = 3 Hz and signalling rate = 16×10^6 samples/second, then what would be the value of data rate ?

(A) 16 Mbps

(B) 24 Mbps

(C) 48 Mbps

(D) 64 Mbps

40. Which approach plays a cardinal role in supporting the results obtained regarding the information capacity theorem ?

(A) Line Packing

(B) Volume Packing

(C) Sphere Packing

(D) All of the above

41. According to Shannon's second theorem, it is not feasible to transmit information over the channel with .... error probability, although by using any coding technique.

(A) small

(B) large

(C) stable

(D) unpredictable

42. If the channel is band limited to 6 kHz and signal to noise ratio is 16, what would be the capacity of channel ?

(A) 15.15 Kbps

(B) 24.74 Kbps

(C) 30.12 Kbps

(D) 52.18 Kbps

43. In channel coding theorem, channel capacity decides the .... permissible rate at which error free transmission is possible.

(A) maximum

(B) minimum

(C) constant

(D) None of the above

44. In digital communication system, smaller the code rate, ... are the redundant bits.

(A) less

(B) more

(C) equal

(D) unpredictable

45. Which type of channel does not represent any correlation between input and output symbols ?

(A) Noiseless channel

(B) Lossless channel

(C) Useless channel

(D) Deterministic channel

46. The cyclic codes are designed using :

(A) Shift registers with feedback

(B) Shift registers without feedback

(C) Flip-flops

(D) None of the above

47. A cyclic code can be generated using

(A) Generator polynomial

(B) Generator matrix

(C) Generator polynomial and matrix

(D) None of the above

48. The feedback shift register circuit is called as :

(A) Multiplying circuit

(B) Dividing circuit

(C) Feedback circuit

(D) Shifting circuit

49. In the dividing circuit, the parity polynomial is obtained by the :

(A) Quotient

(B) Remainder

(C) Dividend

(D) Divisor

50. The received code contains an error if the syndrome vector is :

(A) Zero

(B) Non-zero

(C) Infinity

(D) None of the above

51. Block codes are generated using :

(A) Generator polynomial

(B) Generator polynomial and matrix

(C) Generator matrix

(D) None of the above

52. Extended go-lay code is formed by :

(A) Adding overall parity bit to perfect go-lay code

(B) Ex-oaring overall parity bit with perfect go-lay code

(C) Ex-oaring each bit of go-lay code

(D) Dividing the overall parity bit with perfect go-lay code

53. Block length is the .... in the code-word.

(A) Number of elements

(B) Distance between elements

(C) Number of parity bits

(D) None of the above

54. The rate of a block code is the ration of :

   (A) Block length to message length

   (B) Message length to block length

   (C) Message weight to block length

   (D) None of the above

55. Linear codes are used for :

   (A) Forward error correction

   (B) Backward error correction

   (C) Forward error detection

   (D) Backward error detection

56. The k-bit message forms .... distinct messages which is referred to as k-tuples.

   (A) $2k$

   (B) k^2

   (C) $2k$

   (D) $21/k$

57. The sum of any two vectors in subset S is also in S. This is called as :

   (A) Addition property

   (B) Subset property

   (C) Closure property

   (D) Similarity property

58. In a standard matrix set code-word there is .... coset.

   (A) $2k$

   (B) $2n - k$

   (C) $2n + k$

   (D) $2n$

59. Syndrome is calculated by :

   (A) HT/r

   (B) rHT

   (C) rH

   (D) None of the above

60. The .... of the code-word is the number of non-zero elements.

   (A) Size

   (B) Weight

   (C) Distance

   (D) Subspace

(Only for Rough Work)

4. Four alternative answers are mentioned for each question as—A, B, C & D in the booklet. The candidate has to choose the most correct/appropriate answer and mark the same in the OMR Answer-Sheet as per the direction :

Example :

Question :

Q. 1 Ⓐ ⬤ Ⓒ Ⓓ
Q. 2 Ⓐ Ⓑ ⬤ Ⓓ
Q. 3 Ⓐ ⬤ Ⓒ Ⓓ

Illegible answers with cutting and over-writing or half filled circle will be cancelled.

5. Each question carries equal marks. Marks will be awarded according to the number of correct answers you have.

6. All answers are to be given on OMR Answer sheet only. Answers given anywhere other than the place specified in the answer sheet will not be considered valid.

7. Before writing anything on the OMR Answer Sheet, all the instructions given in it should be read carefully.

8. After the completion of the examination candidates should leave the examination hall only after providing their OMR Answer Sheet to the invigilator. Candidate can carry their Question Booklet.

9. There will be no negative marking.

10. Rough work, if any, should be done on the blank pages provided for the purpose in the booklet.

11. To bring and use of log-book, calculator, pager and cellular phone in examination hall is prohibited.

12. In case of any difference found in English and Hindi version of the question, the English version of the question will be held authentic.

Impt. : On opening the question booklet, first check that all the pages of the question booklet are printed properly. If there is ny discrepancy in the question Booklet, then after showing it to the invigilator, get another question Booklet of the same series.

4. प्रश्न-पुस्तिका में प्रत्येक प्रश्न के चार सम्भावित उत्तर— A, B, C एवं D हैं। परीक्षार्थी को उन चारों विकल्पों में से एक सबसे सही अथवा सबसे उपयुक्त उत्तर छाँटना है। उत्तर को OMR आन्सर-शीट में सम्बन्धित प्रश्न संख्या में निम्न प्रकार भरना है :

उदाहरण :

प्रश्न :

प्रश्न 1 Ⓐ ⬤ Ⓒ Ⓓ
प्रश्न 2 Ⓐ Ⓑ ⬤ Ⓓ
प्रश्न 3 Ⓐ ⬤ Ⓒ Ⓓ

अपठनीय उत्तर या ऐसे उत्तर जिन्हें काटा या बदला गया है, या गोले में आधा भरकर दिया गया, उन्हें निरस्त कर दिया जाएगा।

5. प्रत्येक प्रश्न के अंक समान हैं। आपके जितने उत्तर सही होंगे, उन्हीं के अनुसार अंक प्रदान किये जायेंगे।

6. सभी उत्तर केवल ओ. एम. आर. उत्तर-पत्रक (OMR Answer Sheet) पर ही दिये जाने हैं। उत्तर-पत्रक में निर्धारित स्थान के अलावा अन्यत्र कहीं पर दिया गया उत्तर मान्य नहीं होगा।

7. ओ. एम. आर. उत्तर-पत्रक (OMR Answer Sheet) पर कुछ भी लिखने से पूर्व उसमें दिये गये सभी अनुदेशों को सावधानीपूर्वक पढ़ लिया जाये।

8. परीक्षा समाप्ति के उपरान्त परीक्षार्थी कक्ष निरीक्षक को अपनी OMR Answer Sheet उपलब्ध कराने के बाद ही परीक्षा कक्ष से प्रस्थान करें। परीक्षार्थी अपने साथ प्रश्न-पुस्तिका ले जा सकते हैं।

9. निगेटिव मार्किंग नहीं है।

10. कोई भी रफ कार्य, प्रश्न-पुस्तिका के अन्त में, रफ-कार्य के लिए दिए खाली पेज पर ही किया जाना चाहिए।

11. परीक्षा-कक्ष में लॉग-बुक, कैलकुलेटर, पेजर तथा सेल्युलर फोन ले जाना तथा उसका उपयोग करना वर्जित है।

12. प्रश्न के हिन्दी एवं अंग्रेजी रूपान्तरण में भिन्नता होने की दशा में प्रश्न का अंग्रेजी रूपान्तरण ही मान्य होगा।

महत्वपूर्ण : प्रश्नपुस्तिका खोलने पर प्रथमतः जाँच कर देख लें कि प्रश्न-पुस्तिका के सभी पृष्ठ भलीभाँति छपे हुए हैं। यदि प्रश्नपुस्तिका में कोई कमी हो, तो कक्षनिरीक्षक को दिखाकर उसी सिरीज की दूसरी प्रश्न-पुस्तिका प्राप्त कर लें।