**Course File**

***Subject Title/Subject Code : Information Theory &Coding***

***/5CS3-01***

Semester :V Year: III

|  |  |  |
| --- | --- | --- |
| Name of the Faculty: Dr. Vivek Jain |  | |
|  |  | |
| E-mail id: vivek.jain@technonjr.org |  |

**Class Schedule**

**Total Number of Lectures:**42

i**)Course Objective**

**Students will gain proficiency in managing data transmission processes, ensuring accuracy, efficiency, and effective utilization of encoding methods.**

**INDEX - COURSE FILE**

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**VISSION & MISSION OF INSTITUTE**

## Vision

Empoweringstudent with recent and emerging technologies to create innovative technical leaders capable of contributing to industrial and societal needs for betterment of mankind across the globe.

## Mission

**M1**: To provide dynamic learning environment to students by providing constant exposure to latest technologies by linking closely with the industries.

**M2**: To establish effective interface with industry to obtain live problems to enhance critical thinking and problem solving skills among students and consultancy projects for faculty.

**M3**: To provide avenues and opportunities to faculty for domain specific trainings and qualification upgradation.

**M4**: To develop ethical leaders with strong communication skills.

**VISION & MISSION OF DEPARTMENT**

**Department Vision**

**To be among top five well known department of Computer Science and Engineering in the state of Rajasthan in placing the students at premier industry.**

**Department Mission**

**M1:To equip students with ability to be innovative and excellence to face the challenges in the digital world.**

**M2:To prepare students with high quality employability skills catering to current trends in industries, problem solving skills, innovative pursuits and ready to face challenges in the domain and allied disciplines.**

**M3:To provide ambience for entrepreneurship and start-ups through incubation center among students.**

**M4:To encourage continuous faculty training on industry-based Development, and Innovation.**

**PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)**

**Technical Proficiency** Graduates will have a strong foundation in core concepts, tools, and technologies relevant to their discipline.

**Career Development** Graduate will be capable of pursuing diverse career paths in field of Computer Science & Engineering with proficiency in software development/ pursue higher education an or become entrepreneurs.

**Problem-Solving** Graduates will have a strong math foundation so that they will be proficient problem solvers, capable of identifying, analyzing , and solving complex technical problems using critical thinking and creative approaches.

**Professional Attitude** Graduates will be sensitive to societal and professional environment, possess strong communication skills and will be skilled in working collaboratively within diverse teams adhering to ethical standards and professional practices.

**Learning Environment** To create a learning environment that ensures graduates continue learning throughout their careers, effortlessly adopting new technologies to stay innovative in their chosen fields and remain effective contributors in their chosen field.

**PROGRAM SPECIFIC OUTCOMES (PSO's)**

**PSO1**: Students will be able to design, develop, test, debug, deploy, analyze, troubleshoot, maintain, manage, and ensure security during the complete product lifecycle.

**PSO2**: Student will be able to apply software engineering/ information system development skills to solve problems across diverse domains.

**PSO3**: Students will be well-prepared to initiate and oversee innovative startups within their respective sectors.

**PROGRAMME OUTCOMES (POs)**

**A student will develop:**

|  |  |  |
| --- | --- | --- |
| **1** | **Engineering knowledge:** | Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. |
| **2** | **Problem analysis:** | Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. |
| **3** | **Design/development of solutions:** | Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations. |
| **4** | **Conduct investigations of complex problems:** | Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions. |
| **5** | **Modern tool usage:** | Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with and understanding of the limitations. |
| **6** | **The engineer and society:** | Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice. |
| **7** | **Environment and sustainability:** | Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development. |
| **8** | **Ethics:** | Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. |
| **9** | **Individual and team work:** | Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. |
| **10** | **Communication:** | Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions. |
| **11** | **Project management and finance:** | Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments. |
| **12** | **Life-long learning:** | Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change. |

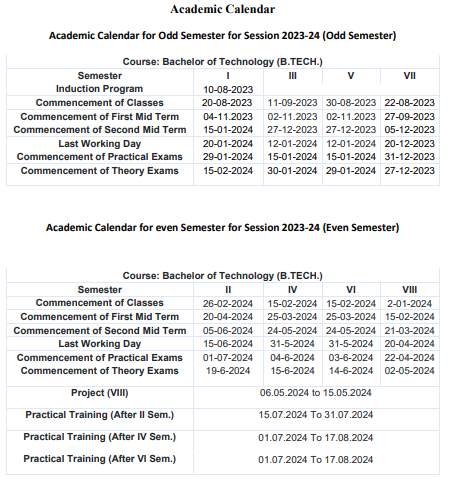
**COURSE OUTCOMES (COs) OF THE SUBJECT**

|  |  |  |
| --- | --- | --- |
| CO No. | Mapping | Statement |
| CO35301.1 | **Remembering** | Students will be able to List the information measures used for continuous random variables. |
| CO35301.2 | **Understanding** | Students will be able to distinguish Prefix code, Huffman code, Shanon-Fane codes and identify the fundamental limits of communication systems. |
| CO35301.3 | **Applying** | Students will be able to apply the principles and techniques of error detection and correction codes for error detection and correction in digital communication systems. |
| CO35301.4 | **Analyzing** | Students will be able to calculate the performance of error detection and correction codes, including measures such as minimum distance, error detection and correction capabilities, and error probability bounds. |
| CO35301.5 | **Evaluating** | Students will compare the performance of different coding schemes, considering error detection and correction codes' effectiveness |

**COS MAPPING WITH POs AND PSOs**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course Outcome** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | 2 | 1 | 2 | - | 2 | - | - | - | - | - | - | 2 | - | 2 | - |
| **CO2** | 2 | 2 | 2 | 2 | 2 | - | - | - | - | - | - | 2 | - | 2 | - |
| **CO3** | 3 | 2 | 2 | 1 | 3 | - | - | 0 | - | - | - | 3 | - | 2 | - |
| **CO4** | 2 | 2 | 2 | 2 | 2 | - | - | 0 | - | - | - | 2 | - | 2 | - |
| **CO5** | 2 | 3 | 2 | 2 | 2 | - | - | 0 | - | - | - | 2 | - | 2 | - |

**UNIVERSITY ACADEMIC CALENDAR**

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**Evaluation Scheme**

FACULTY DETAILS:

Name of the Faculty : Dr. Vivek Jain

Designation : Associate Professor

Department : Computer Science Engineering

1. TARGET

a) Percentage Pass : 99.09%

b) Percentage I class: 83.78 %

2. METHOD OF EVALUATION

2.1. Continuous Assessment Examinations (Mid-Term 1, Mid-Term 2)

2.2. Assignments / Seminars

2.3. Mini Projects

2.4. Quiz

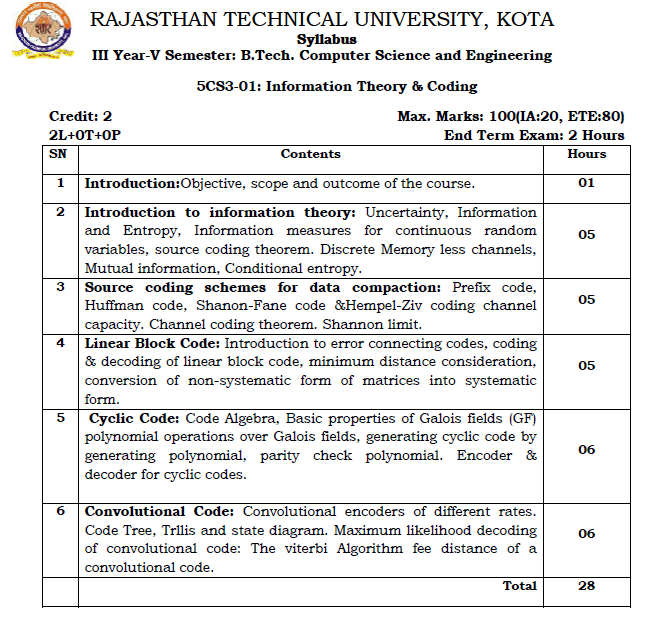
2.5. Semester Examination Others\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3. List out any new topic(s) or any innovation you would like to introduce in teaching the subject in this Semester.

1. Take the help of creative tools to stimulate creativity. Include slide presentations, demonstration or forms of visual exercises that will excite the young minds and capture their interest.

Signature of Faculty: **Signature of HOD**

**UNIVERSITY SYLLABUS**

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**PRESCRIBED BOOKS**

1. Digital Communication, Simon Haykin, Wiley.
2. Information Theory & Coding, [J.S.Chitode](https://www.google.co.in/search?tbo=p&tbm=bks&q=inauthor:%22J.S.Chitode%22), Technical Publications.
3. InformationTheory,Coding&Cryptography,RanjanBose,McgraHill, Education.

**WEEKLY TIME TABLE OF THE TEACHER**

First Time Table: with effect from (Date):

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Day** | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| Monday | ITC  SEC-A |  | ITC  SEC-**B** |  |  |  |  |
| Tuesday | ITC  SEC-A |  |  |  |  |  |  |
| Wednesday | ITC  SEC-A |  |  | ITC  SEC-B |  |  |  |
| Thursday | ITC  SEC-A |  | ITC  SEC-**B** |  |  |  |  |
| Friday |  |  |  | ITC  SEC-B |  |  |  |
| Saturday |  |  |  |  |  |  |  |

**COURSE-PLAN**

|  |  |  |  |
| --- | --- | --- | --- |
| UNIT | Lect.  No. | TOPICS | **Teaching Methods/ Teaching Aids** |
| **1** | **1** | INTRODUCTION: Objective, scope and outcome of the course. | White Board, PPT |
| 1 | 2 | BASICS OF INFORMATION THEORY | White Board, PPT |
| 1 | 3 | Uncertainty and Information, Average information, | White Board |
| 1 | 4 | Entropy, Properties of Entropy | White Board |
| 1 | 5 | Information Rate, Mutual Information | White Board |
| 1 | 6 | Conditional And Joint Entropy | White Board |
| 2 | 7 | Shannon's noiseless coding theorem: Huffman coding | White Board |
| 2 | 8 | Shannon's noiseless coding theorem: Shannon Fano coding | White Board |
| 2 | 9 | Discrete Memory Less Channel, Binary Symmetric channel | White Board, PPT |
| 2 | 10 | Shannon's noisy coding theorem, Capacity of Gaussion Channel | White Board |
| 2 | 11 | Trade off between signal to noise ratio and bandwidth of channel, Numerical on Trade off between signal to noise ratio and bandwidth of channel | White Board |
| 3 | 12 | Introduction to error connecting codes | White Board |
| 3 | 13 | Coding & decoding of linear block code | White Board |
| 3 | 14 | Minimum distance consideration, Calculation of error detection and Correction capability | White Board |
| 3 | 15 | Linear Block encoder and decoder | White Board |
| 3 | 16 | Conversion of non-systematic form of matrices into systematic form. | White Board |
| 4 | 17 | Code Algebra | White Board, PPT |
| 4 | 18 | Basic properties of Galois fields (GF) | White Board |
| 4 | 19 | Polynomial operations over Galois fields | White Board |
| 4 | 20 | Generating cyclic code by generating polynomial | White Board |
| 4 | 21 | Calculation of Parity check polynomial for systematic and non-systematic cyclic code | White Board |
| 4 | 22 | Encoder & decoder for cyclic codes. | White Board |
| 5 | 23 | Convolutional encoders of different rates | White Board, PPT |
| 5 | 24 | Draw Code Tree for Convolutional encoders | White Board |
| 5 | 25 | Draw Trllis diagram for Convolutional encoders | White Board |
| 5 | 26 | Draw State diagram for Convolutional encoders | White Board, PPT |
| 5 | 27 | Maximum likelihood decoding of convolutional code | White Board |
| 5 | 28 | Viterbi Algorithm fee distance of a convolutional code | White Board |

**Signature of Faculty: Signature of HOD**

**Assignment – 1**

1. (a)Show that entropy H of M equally likely message is log2M. (CO1)

(b)Prove that the following statement ,”if the receiver knows the message being transmitted the amount of information carried is zero”.

(c)prove that the upper boundary on entropy is given as Hmax≤log2M here ‘M’ is the number of message emitted by the source.

(d) Show that for a discrete binding channel:

(i)H(X,Y) = H(X/Y) + H(Y)

(ii)I(X;Y) = H(X) – H(X/Y)

1. (a) A binary channel matrix is given as : (CO1) 2/3 1/3

1/10 9/10

P(x1)=1/3 ,P(x2)=2/3

Determine

H(X), H(X/Y), H(Y/X),I(X;Y).H(Y).

(b)An analog signal is band limited to B Hz and samples at Nyquist rate. The samples are quantized into 4 levels. Each levels represents one message. Thus there are 4 messages. The probability of occurrence of these 4 levels are p1=p4=1/8 and p2=p3=3/8. Find out the information rate of source .

1. a) For a discrete memory less source ‘X’ with six symbols X1,X2…….X6,find a compact code for every symbol if the probability distribution is as follows:- (CO2)

P(X1)=0.3 P(X2)=0.25 P(X3)=0.2 P(X4)=0.12 P(X5)=0.08 P(X6)=0.05

Calculate entropy of the source , average length of the code, efficiency and redundancy of the code using Shannon-Fano algorithm and Huffman coding. Also compare both algorithm.

1. A) State and explain Shannon’s theorem on the channel capacity . (CO2)

B) Channel capacity is given by C=B log2(1+) bits/sec In the above equation when the signal power is fixed and white Gaussian noise is present, the channel capacity approaches an upper limit with increase in bandwidth ‘B’ .Prove that this upper limit is given as ,

C∞= = 1.44 **=**

C) Explain Prefix code. Write down the properties of prefix coding, explaining them with the help of an example. Give proof of the property required.

1. A) For a systematic LBC ,the three parity check digits C4 ,C5 and C6  are given by: (CO3)

C4 = D1 + D2 + D3

C5 = D1 + D2

C6 = D1 + D3

1. Construct generator matrix.
2. Construct code generated by this matrix.
3. Determine error correcting capability.
4. Prepare a suitable decoding table.
5. Decode the received words 101100 and 000110.
6. Draw the encoder arrangement for the same.
7. Write the short notes on (CO3)

* Syndrom calculator
* Conversion of non systematic form into systematic form
* Linear block coder
* Linear block code

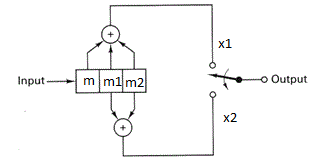
**Assignment – 2 ()**

1. (a) The generator polynomial of a(7,4) cyclic code is G(p)=p3+p+1.Find all the code vectors and Generator matrix for the code systematic form of cyclic code.

(b)Explain the irreducible polynomial over galilos field with one example. (CO4)

1. (a)The generator polynomial of a(7,4) cyclic code is G(p)=p3+p+1.Find all the code vectors and Generator matrix for the code nonsystematic form of cyclic code.(CO4)

3. Explain the primitive polynomial over galilos field with one example. (CO4)

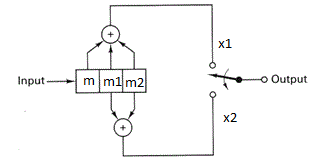
1. (a)For the convolution encoder with constraint length of 3 and rate ½ as shown below 

Find Out:

1. Code rate (1)
2. Dimension of encoder(1)
3. Constraint length(1)
4. Generating Sequence(1)
5. Output Sequence for message sequence of m =(10011) (CO5)

5. Explain the Vetrbi Decoding or maximum Likehood decoding with example.(CO5)

1. For the convolution encoder with constraint length of 3 and rate ½ as shown below (CO5)



Draw the tree diagram state diagram and trellis diagram.

**SAMPLE QUIZ QUESTIONS**

**1)   The probability density function of a Markov process is**

**a.** p(x1,x2,x3.......xn) = p(x1)p(x2/x1)p(x3/x2).......p(xn/xn-1)  
**b.** p(x1,x2,x3.......xn) = p(x1)p(x1/x2)p(x2/x3).......p(xn-1/xn)  
**c.** p(x1,x2,x3......xn) = p(x1)p(x2)p(x3).......p(xn)  
**d.** p(x1,x2,x3......xn) = p(x1)p(x2 \* x1)p(x3 \* x2)........p(xn \* xn-1)

**2)   The capacity of Gaussian channel is**

**a.** C = 2B(1+S/N) bits/s  
**b.** C = B2(1+S/N) bits/s  
**c.** C = B(1+S/N) bits/s  
**d.** C = B(1+S/N)2 bits/s

**3)   For M equally likely messages, the average amount of information H is**

**a.** H = log10M  
**b.** H = log2M  
**c.** H = log10M2  
**d.** H = 2log10M

**4)   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

**5)   The capacity of a binary symmetric channel, given H(P) is binary entropy function is**

**a.** 1 - H(P)  
**b.** H(P) - 1  
**c.** 1 - H(P)2  
**d.** H(P)2 - 1

**6)   According to Shannon Hartley theorem,**

**a.** The channel capacity becomes infinite with infinite bandwidth  
**b.** The channel capacity does not become infinite with infinite bandwidth  
**c.** Has a tradeoff between bandwidth and Signal to noise ratio  
**d.** Both b and c are correct

**7)   The negative statement for Shannon's theorem states that**

**a.** If R > C, the error probability increases towards Unity  
**b.** If R < C, the error probability is very small  
**c.** Both a & b  
**d.** None of the above

**8)   For M equally likely messages, M>>1, if the rate of information R ≤ C, the probability of error is**

**a.** Arbitrarily small  
**b.** Close to unity  
**c.** Not predictable  
**d.** Unknown

**9)   For M equally likely messages, M>>1, if the rate of information R > C, the probability of error is**

**a.** Arbitrarily small  
**b.** Close to unity  
**c.** Not predictable  
**d.** Unknown

**10)   The channel capacity according to Shannon's equation is**

**a.** Maximum error free communication  
**b.** Defined for optimum system  
**c.** Information transmitted  
**d.** All of the above

**11)   For a binary symmetric channel, the random bits are given as**

**a.** Logic 1 given by probability P and logic 0 by (1-P)  
**b.** Logic 1 given by probability 1-P and logic 0 by P  
**c.** Logic 1 given by probability P2 and logic 0 by 1-P  
**d.** Logic 1 given by probability P and logic 0 by (1-P)2

**12)   The technique that may be used to increase average information per bit is**

**a.** Shannon-Fano algorithm  
**b.** ASK  
**c.** FSK  
**d.** Digital modulation techniques

**13)   Code rate r, k information bits and n as total bits, is defined as**

**a.** r = k/n  
**b.** k = n/r  
**c.** r = k \* n  
**d.** n = r \* k

**14)   The information rate R for given average information H= 2.0 for analog signal band limited to B Hz is**

**a.** 8 B bits/sec  
**b.** 4 B bits/sec  
**c.** 2 B bits/sec  
**d.** 16 B bits/sec

**15)   Information rate is defined as**

**a.** Information per unit time  
**b.** Average number of bits of information per second  
**c.** rH  
**d.** All of the above

**16)   The mutual information**

**a.** Is symmetric  
**b.** Always non negative  
**c.** Both a and b are correct  
**d.** None of the above

**17)   The relation between entropy and mutual information is**

**a.** I(X;Y) = H(X) - H(X/Y)  
**b.** I(X;Y) = H(X/Y) - H(Y/X)  
**c.** I(X;Y) = H(X) - H(Y)  
**d.** I(X;Y) = H(Y) - H(X)

**18)   Entropy is**

**a.** Average information per message  
**b.** Information in a signal  
**c.** Amplitude of signal  
**d.** All of the above

**19)   The memory less source refers to**

**a.** No previous information  
**b.** No message storage  
**c.** Emitted message is independent of previous message  
**d.** None of the above

**20)   The information I contained in a message with probability of occurrence is given by (k is constant)**

**a.** I = k log21/P  
**b.** I = k log2P  
**c.** I = k log21/2P  
**d.** I = k log21/P2

**QUIZ ANSWER KEY**

**Q1**. A **Q2.** C **Q3.** B **Q4.** A **Q5.** A **Q6.** D **Q7.** A **Q8.** A **Q9.** B **Q10.** D

**Q11.** A **Q12.** A **Q13.**A **Q14.**B **Q15.**D **Q16.**C **Q17.**B **Q18.**A **Q19.**C **Q20.**A

**Mid Term Paper-I**

**TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY, UDAIPUR**

**B. TECH 3rd – YEAR (V SEM.) – MT-I**

**Information Theory & Coding (5CS3-01**)

**Time:** 2 Hr **Max. Marks:** 70

**Note:**

1. The paper is divided into 2 parts: Part-A and, Part-B.
2. Part-A contains 10 questions and carries 2 mark each.
3. Part-B contains 5 questions. Each question is having two options and carries 10 marks each.

Part- A (20 Marks)

|  |  |  |
| --- | --- | --- |
|  | Prove that the following statement,”if the receiver knows the message being transmitted the amount of information carried is zero”. | CO1 |
|  | Show that: I(X;Y)= I(Y;X). | CO1 |
|  | Calculate amount of information for PCM systemwhich contains 4 level with four different probability P1=1/8,P2=1/8,P3=3/8,P4=3/8 | CO1 |
|  | Show that entropy H of M equally likely message is log2M. | CO1 |
|  | Define discrete memory less channel. | CO2 |
|  | Show that amount of information of M equally likely message is N bits if M=2N. | CO2 |
|  | Applying Lempel-Ziv algorithm on given bit stream and obtain code.  10011110101110100110010 | CO2 |
|  | Find out prefix code for : S0=0.5,S1=0.25,S2=0.125,S3=0125 | CO2 |
|  | State the Shannon first theorem for source coding for error free transmission. | CO3 |
|  | State the Shannon second theorem for source coding for error free transmission. | CO3 |

Part- B (50 Marks)

|  |  |
| --- | --- |
| 1. Show that for a discrete binding channel: 2. H(X,Y) = H(X/Y) + H(Y) (ii ) H(X;Y) = H(Y/X) + H(X) | CO1 |
| OR | |
| 1. A source transmits two independent messages with probability of P and 1-P respectively. Prove that the entropy is maximum when both messages are equally likely. | CO1 |

|  |  |
| --- | --- |
| 1. The BCS are connected in cascade as shown in fig:      * Determine the transition matrix for discrete memory less channel.   Determine P(z1) and P(z2) if p(x1)=0.6 and p(x2)=0.4. | CO1 |
| OR | |
| 2. An analog signal is band limited to B Hz and samples at Nyquist rate. The samples are quantized into 4 levels. Each levels represents one message. Thus there are 4 messages. The probability of occurrence of these 4 levels are p1=p4=1/8 and p2=p3=3/8. Find out the information rate of source . | CO1 |

|  |  |
| --- | --- |
| 3. Channel capacity is given by C=B log2(1+) bits/sec In the above equation when the signal power is fixed and white Gaussian noise is present, the channel capacity approaches an upper limit with increase in bandwidth ‘B’ .Prove that this upper limit is given as ,  C∞= = 1.44 **=** | CO2 |
| OR | |
| 3. The data is transmitted at the rate of 1000 bits/second over a channel having bandwidth B=3000 Hz. Determine the signal to noise ratio required. If the bandwidth is increased to 10000 Hz, than determine signal to noise ratio. | CO2 |

|  |  |
| --- | --- |
| 4. A binary channel matrix is given as (10)  2/3 1/3  1/10 9/10  P(x1)=1/3 ,P(x2)=2/3  Determine  H(X), H(X/Y), H(Y/X),I(X;Y).H(Y). | CO2 |
| OR | |
| 1. 4. Prove that: 2. I(X:Y)=H(X)-H(X/Y) 3. I(Y:X)=H(Y)-H(Y/X) | CO2 |

|  |  |
| --- | --- |
| 1. For a discrete memory less source ‘X’ with six symbols X1,X2…….X8,find a compact code for every symbol if the probability distribution is as follows:-   P(X1)=16/32 P(X2)=4/32 P(X3)=4/32 P(X4)=2/32 P(X5)=2/32 P(X6)=2/32 P(X7)=1/32 P(X8)=1/32   1. Shannon Fanno code 2. Average Number of bits 3. Code Efficiency 4. Comment on error free transmission or not. | CO3 |
| OR | |
| 5. A discrete memory less source has five symbols s0, s1, s2,s3, s4 ,characterized by probability distribution as 0.4,0.2 ,0.1,0.2 and .10 respectively.  Calculate i. Obtain Huffman code  ii. Average Number of bits  iii. Code Efficiency   1. Comment on error free transmission or not. | CO3 |

**Marks and Gap Analysis of Mid-Term 1**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Sr. No.** | **Roll Number** | **Student Name** | **Mid-Term 1**  **MM-70** | **Remark**  **( Remedial Class need or not – Y/N )** |
| 1 | 21ETCCS001 | AARSH BHARTI | 61 | N |
| 2 | 21ETCCS002 | MS AASTHA DAKHERA | 70 | N |
| 3 | 21ETCCS003 | ABHISHEK PRAJAPAT | 61 | N |
| 4 | 21ETCCS005 | AKSHANSH SONI | 66 | N |
| 5 | 21ETCCS006 | AKSHAT SINGH CHOUHAN | 59 | N |
| 6 | 21ETCCS007 | ANIRUDH SINGH RAJPUROHIT | 56 | Y |
| 7 | 21ETCCS008 | ANISH SINGHAL | 61 | N |
| 8 | 21ETCCS009 | ANJALI SONI | 59 | N |
| 9 | 21ETCCS010 | ANURAG MENARIA | 56 | Y |
| 10 | 21ETCCS011 | ANUSHKA VIJAY | 56 | Y |
| 11 | 21ETCCS012 | APURVA LODHA | 70 | N |
| 12 | 21ETCCS013 | ARUN LOHAR | 59 | N |
| 13 | 21ETCCS014 | ARVIND SINGH | 56 | Y |
| 14 | 21ETCCS015 | ARVIND SUTHAR | 59 | N |
| 15 | 21ETCCS016 | AVANI JOSHI | 56 | Y |
| 16 | 21ETCCS017 | AYAN KHAN | 61 | N |
| 17 | 21ETCCS018 | AYUSH JHOTA | 63 | N |
| 18 | 21ETCCS019 | AYUSH TALESARA | 56 | Y |
| 19 | 21ETCCS020 | BHAVYA MEHTA | 61 | N |
| 20 | 21ETCCS021 | BHERU SINGH PANWAR | 63 | N |
| 21 | 21ETCCS022 | MS BHUMIKA VARDAR | 56 | Y |
| 22 | 21ETCCS025 | CHINMAY MENARIA | 56 | Y |
| 23 | 21ETCCS026 | DAKSH VYAS | 59 | N |
| 24 | 21ETCCS027 | DEEPAK DHAKAR | 52 | Y |
| 25 | 21ETCCS029 | DHIREN SUHALKA | 52 | Y |
| 26 | 21ETCCS030 | DHRUV BAGORA | 52 | Y |
| 27 | 21ETCCS031 | DIKSHA AGARWAL | 70 | N |
| 28 | 21ETCCS032 | DINESH AUDICHYA | 52 | Y |
| 29 | 21ETCCS034 | DIVYANSHU MENARIA | 56 | Y |
| 30 | 21ETCCS035 | DIVYANSHU SAHU | 59 | N |
| 31 | 21ETCCS036 | DURGA SANKAR DANGI | 61 | N |
| 32 | 21ETCCS037 | GAGAN MANGAL | 70 | N |
| 33 | 21ETCCS038 | GARVITA BAYA | 63 | N |
| 34 | 21ETCCS039 | GARVITA JAIN | 66 | N |
| 35 | 21ETCCS040 | GAZI AMAN KHAN | 52 | Y |
| 36 | 21ETCCS041 | HARSH | 56 | Y |
| 37 | 21ETCCS042 | HARSH SONI | 63 | N |
| 38 | 21ETCCS043 | HARSHAL PALIWAL | 59 | N |
| 39 | 21ETCCS044 | HARSHIT PUROHIT | 70 | N |
| 40 | 21ETCCS045 | HARSHIT SHARMA | 61 | N |
| 41 | 21ETCCS046 | HARSHITA RATHORE | 63 | N |
| 42 | 21ETCCS047 | HEET DOSI | 52 | Y |
| 43 | 21ETCCS048 | MS HETAL SHARMA | 59 | N |
| 44 | 21ETCCS049 | JAHNAVI JOSHI | 66 | N |
| 45 | 21ETCCS050 | JAINIL JAIN | 61 | N |
| 46 | 21ETCCS051 | JASWANT SINGH RAO | 63 | N |
| 47 | 21ETCCS052 | JATIN VASHISHTHA | 59 | N |
| 48 | 21ETCCS053 | JAY JOSHI | 70 | N |
| 49 | 21ETCCS054 | JAYDEEP DANGI | 52 | Y |
| 50 | 21ETCCS055 | JIGYASA CHATURVEDI | 63 | N |
| 51 | 21ETCCS056 | KAILASH JOSHI | 70 | N |
| 52 | 21ETCCS057 | KAMLESH KUMAR GHANCHI | 63 | N |
| 53 | 21ETCCS058 | KANISHKA PARMAR | 70 | N |
| 54 | 21ETCCS059 | KASHVI PANDEY | 63 | N |
| 55 | 21ETCCS060 | KHUSHAL PALIWAL | 52 | Y |
| 56 | 21ETCCS061 | KHUSHI GAHLOT | 70 | N |
| 57 | 21ETCCS062 | KHUSHI VANAWAT | 66 | N |
| 58 | 21ETCCS064 | KUNAL CHOUBISA | 56 | Y |
| 59 | 21ETCCS065 | KUNAL MENARIA | 52 | Y |
| 60 | 21ETCCS066 | KUNAL PALIWAL | 56 | Y |
| 61 | 21ETCCS067 | KUNAL SHARMA | 52 | Y |
| 62 | 21ETCCS068 | KUNIKA KADECHA | 59 | N |
| 63 | 21ETCCS069 | LALITA DANGI | 61 | N |
| 64 | 21ETCCS070 | LAVISHA JAIN | 61 | N |
| 65 | 21ETCCS071 | LOKANTIK JAIN | 63 | N |
| 66 | 21ETCCS073 | MAHAK BANSAL | 61 | N |
| 67 | 21ETCCS074 | MANSI GEHLOT | 63 | N |
| 68 | 21ETCCS075 | MAYANK KANERIYA | 59 | N |
| 69 | 21ETCCS076 | MAYANK MALIWAL | 61 | N |
| 70 | 21ETCCS078 | MITANSH JAIN | 56 | Y |
| 71 | 21ETCCS079 | MOHAMMED OWAIS KHAN | 56 | Y |
| 72 | 21ETCCS081 | NAVNEET ANAND | 59 | N |
| 73 | 21ETCCS082 | NEHAL DHING | 70 | N |
| 74 | 21ETCCS084 | NIPUN MALI | 59 | N |
| 75 | 21ETCCS085 | NISHA LOHAR | 70 | N |
| 76 | 21ETCCS086 | PRADHUMAN SINGH CHAUDHARY | 61 | N |
| 77 | 21ETCCS087 | PRANJAL SINGHVI | 61 | N |
| 78 | 21ETCCS088 | RAJAT PATIDAR | 56 | Y |
| 79 | 21ETCCS089 | RIYA JAIN | 70 | N |
| 80 | 21ETCCS090 | ROHIN GANG | 52 | Y |
| 81 | 21ETCCS091 | RUPAL SONI | 70 | N |
| 82 | 21ETCCS092 | SAHIL SOLANKI | 61 | N |
| 83 | 21ETCCS093 | SARGAM JAIN | 63 | N |
| 84 | 21ETCCS094 | SATYEN KHARADI | 59 | N |
| 85 | 21ETCCS095 | SHASHANK MENARIA | 56 | Y |
| 86 | 21ETCCS096 | SHUBHAM DAS | 61 | N |
| 87 | 21ETCCS097 | SUDEEP ROY | 56 | Y |
| 88 | 21ETCCS098 | SUMIT VASITA | 52 | Y |
| 89 | 21ETCCS099 | SUYASH SONI | 66 | N |
| 90 | 21ETCCS100 | MS TANISHA KUMAWAT | 61 | N |
| 91 | 21ETCCS101 | TUSHAR YADAV | 56 | Y |
| 92 | 21ETCCS102 | VAIBHAV GARG | 66 | N |
| 93 | 21ETCCS103 | VAIBHAV SONI | 56 | Y |
| 94 | 21ETCCS104 | VARUN SHARMA | 52 | Y |
| 95 | 21ETCCS105 | VEDANSHI PAREEK | 61 | N |
| 96 | 21ETCCS106 | VEDAS DIXIT | 63 | N |
| 97 | 21ETCCS107 | VIKRAM SINGH SISODIYA | 61 | N |
| 98 | 21ETCCS108 | VIMANYU P SHARMA | 56 | Y |
| 99 | 21ETCCS109 | VISHAL KUMAWAT | 56 | Y |
| 100 | 21ETCCS110 | VISHAL PUSHKARNA | 59 | N |
| 101 | 21ETCCS111 | VYOM BHATT | 61 | N |
| 102 | 21ETCCS112 | YASH JAIN | 59 | N |
| 103 | 21ETCCS113 | YASH JOSHI | 59 | N |
| 104 | 21ETCCS114 | YASH PURI GOSWAMI | 59 | N |
| 105 | 21ETCCS115 | YOGESH JAIPAL | 52 | Y |
| 106 | 21ETCCS116 | MS YUVIKA CHOUDHARY | 56 | Y |
| 107 | 21ETCCS117 | YUVRAJ SINGH KANAWAT | 56 | Y |
| 108 | 21ETCCS300 | NEELAM KATARIYA | 56 | Y |
| 109 | 21ETCCS400 | SHABBIR HUSAIN | 52 | Y |
| 110 | 21ETCCS401 | ALI HUSSAIN | 52 | Y |
| 111 | 22ETCCS200 | SAURABH SONI | 61 | N |

**\***(Y, if obtained marks are <=70%)

**Signature of Faculty: Signature of HOD**

**Remedial Action Taken to Remove the Gaps (After Mid- Term 1)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| S.no. | University Roll no. | Name of Student | Topics to be discussed in Remedial Class | Schedule Date of Remedial Class | Outcome  Achieved |
|  | 21ETCCS007 | ANIRUDH SINGH RAJPUROHIT | Amount of Information, Entropy, Mutual Information, Channel capacity, information rate, variable length coding, Linear block code , Shannon thermo for coding and channel capacity | 17-11-2023 to 30-11-2023 | CO1,CO2,CO3 |
|  | 21ETCCS010 | ANURAG MENARIA |
|  | 21ETCCS011 | ANUSHKA VIJAY |
|  | 21ETCCS014 | ARVIND SINGH |
|  | 21ETCCS016 | AVANI JOSHI |
|  | 21ETCCS019 | AYUSH TALESARA |
|  | 21ETCCS022 | MS BHUMIKA VARDAR |
|  | 21ETCCS025 | CHINMAY MENARIA |
|  | 21ETCCS027 | DEEPAK DHAKAR |
|  | 21ETCCS029 | DHIREN SUHALKA |
|  | 21ETCCS030 | DHRUV BAGORA |
|  | 21ETCCS032 | DINESH AUDICHYA |
|  | 21ETCCS034 | DIVYANSHU MENARIA |
|  | 21ETCCS040 | GAZI AMAN KHAN |
|  | 21ETCCS041 | HARSH |
|  | 21ETCCS047 | HEET DOSI |
|  | 21ETCCS054 | JAYDEEP DANGI |
|  | 21ETCCS060 | KHUSHAL PALIWAL |
|  | 21ETCCS064 | KUNAL CHOUBISA |
|  | 21ETCCS065 | KUNAL MENARIA |
|  | 21ETCCS066 | KUNAL PALIWAL |
|  | 21ETCCS067 | KUNAL SHARMA |
|  | 21ETCCS078 | MITANSH JAIN |
|  | 21ETCCS079 | MOHAMMED OWAIS KHAN |
|  | 21ETCCS088 | RAJAT PATIDAR |
|  | 21ETCCS090 | ROHIN GANG |
|  | 21ETCCS095 | SHASHANK MENARIA |
|  | 21ETCCS097 | SUDEEP ROY |
|  | 21ETCCS098 | SUMIT VASITA |
|  | 21ETCCS101 | TUSHAR YADAV |
|  | 21ETCCS103 | VAIBHAV SONI |
|  | 21ETCCS104 | VARUN SHARMA |
|  | 21ETCCS108 | VIMANYU P SHARMA |
|  | 21ETCCS109 | VISHAL KUMAWAT |
|  | 21ETCCS115 | YOGESH JAIPAL |
|  | 21ETCCS116 | MS YUVIKA CHOUDHARY |
|  | 21ETCCS117 | YUVRAJ SINGH KANAWAT |
|  | 21ETCCS300 | NEELAM KATARIYA |
|  | 21ETCCS400 | SHABBIR HUSAIN |
|  | 21ETCCS401 | ALI HUSSAIN |

**Signature of Faculty: Signature of HOD**

**TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY, UDAIPUR**

**B. TECH 3rd – YEAR (V SEM.) – MT-II**

**Information Theory & Coding (5CS3-01**)

**Time:** 2 Hr **Max. Marks:** 70

**Note:**

1. The paper is divided into 2 parts: Part-A and, Part-B.
2. Part-A contains 10 questions and carries 2 mark each.
3. Part-B contains 5 questions. Each question is having two options and carries 10 marks each.

**Part- A (20 Marks)**

|  |  |  |
| --- | --- | --- |
|  | What is the value of syndrome vector for error free transmission? | CO3 |
|  | 1. . For a systematic Linear block code ,the three parity check digits C4 ,C5 and C6  are given by: 2. C4 = D1 + D2 + D3   C5 = D1 + D2  C6 = D1 + D3  Find out the value of **P** parity check matrix. | CO3 |
|  | Explain cyclic property of Error detection and Correction cyclic code. | CO4 |
|  | Explain Linearity property of Error detection and Correction cyclic code. | CO4 |
|  | Write down the property of Galolis filed. | CO4 |
|  | Design the encoder for the (7,4) cyclic code generator by G(p)=p3+p+1. | CO4 |
|  | Explain the working linear block code encoder. | CO5 |
|  | Consider the generator matrix of (4,3) code over GF(3).    Covert nonsystematic form into systematic form. | CO5 |
|  | Write down the dimension ,code rate and constraint length of the code vector of given cyclic code. | CO5 |
|  | What do you mean by surviving path for Veterbi decoding? | CO5 |

**Part- B (50 Marks)**

|  |  |  |
| --- | --- | --- |
| 1. Determine P, H ,C for given generator polynomial.     Check the receiving message Y=1011101 is correct or incorrect if incorrect than rectify it. | CO3 | |
| OR | | |
| 4. Determine P, G ,C for given generator polynomial.    Check the receiving message Y=1011101 is correct or incorrect if incorrect than rectify it. | CO3 | |
| 1. 2. (a) The generator polynomial of a(7,4) cyclic code is G(p)=p3+p+1.Find out Ge Generator matrix for the systematic form of cyclic code.(6)   (b) Explain the irreducible polynomial over galilos field with one example. (4) | | CO4 | |
| OR | | | |
| 2. (a) The generator polynomial of a(7,4) cyclic code is G(p)=p3+p+1.Find out Generator matrix for nonsystematic form of cyclic code.(6)  (b)Explain the primitive polynomial over galilos field with one example.(4) | | CO4 | |
| 3. The generator polynomial of a(6,3) cyclic code is G(p)=p3+p+1.Find all the code vectors for non systematic form of cyclic code. | CO4 | |
| OR | | |
| 3. The generator polynomial of a(6,3) cyclic code is G(p)=p3+p+1.Find all the code vectors for systematic form of cyclic code. | CO4 | |
| 4. For the convolution encoder shown below :    Generating Output Sequence for message sequence of m =(10011) | CO5 | |
| OR | | |
| 4. For the convolution encoder shown below:     1. Draw the  * Tree diagram * State diagram * Trellis diagram. | CO5 | |

|  |  |
| --- | --- |
| 1. Decode the receiving message Y=11 01 11 using veterbi decoding: The convolution encoder shown below : | CO5 |
| OR | |
| 1. a. Explain the working linear block code decoder.   b. Write the advantages and disadvantages of convolution code. | CO5 |

**Mid Term Exam – II**

**Marks and Gap Analysis of Mid-Term II**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Sr. No.** | **Roll Number** | **Student Name** | **Mid-Term 1**  **MM-70** | **Remark**  **( Remedial Class need or not – Y/N )** |
| 1 | 21ETCCS001 | AARSH BHARTI | 61 | N |
| 2 | 21ETCCS002 | MS AASTHA DAKHERA | 70 | N |
| 3 | 21ETCCS003 | ABHISHEK PRAJAPAT | 61 | N |
| 4 | 21ETCCS005 | AKSHANSH SONI | 66 | N |
| 5 | 21ETCCS006 | AKSHAT SINGH CHOUHAN | 59 | Y |
| 6 | 21ETCCS007 | ANIRUDH SINGH RAJPUROHIT | 56 | Y |
| 7 | 21ETCCS008 | ANISH SINGHAL | 61 | N |
| 8 | 21ETCCS009 | ANJALI SONI | 59 | Y |
| 9 | 21ETCCS010 | ANURAG MENARIA | 56 | Y |
| 10 | 21ETCCS011 | ANUSHKA VIJAY | 56 | Y |
| 11 | 21ETCCS012 | APURVA LODHA | 70 | N |
| 12 | 21ETCCS013 | ARUN LOHAR | 59 | Y |
| 13 | 21ETCCS014 | ARVIND SINGH | 56 | Y |
| 14 | 21ETCCS015 | ARVIND SUTHAR | 59 | Y |
| 15 | 21ETCCS016 | AVANI JOSHI | 56 | Y |
| 16 | 21ETCCS017 | AYAN KHAN | 61 | N |
| 17 | 21ETCCS018 | AYUSH JHOTA | 63 | N |
| 18 | 21ETCCS019 | AYUSH TALESARA | 56 | Y |
| 19 | 21ETCCS020 | BHAVYA MEHTA | 61 | N |
| 20 | 21ETCCS021 | BHERU SINGH PANWAR | 63 | N |
| 21 | 21ETCCS022 | MS BHUMIKA VARDAR | 56 | Y |
| 22 | 21ETCCS025 | CHINMAY MENARIA | 56 | Y |
| 23 | 21ETCCS026 | DAKSH VYAS | 59 | Y |
| 24 | 21ETCCS027 | DEEPAK DHAKAR | 52 | Y |
| 25 | 21ETCCS029 | DHIREN SUHALKA | 52 | Y |
| 26 | 21ETCCS030 | DHRUV BAGORA | 52 | Y |
| 27 | 21ETCCS031 | DIKSHA AGARWAL | 70 | N |
| 28 | 21ETCCS032 | DINESH AUDICHYA | 52 | Y |
| 29 | 21ETCCS034 | DIVYANSHU MENARIA | 56 | Y |
| 30 | 21ETCCS035 | DIVYANSHU SAHU | 59 | Y |
| 31 | 21ETCCS036 | DURGA SANKAR DANGI | 61 | N |
| 32 | 21ETCCS037 | GAGAN MANGAL | 70 | N |
| 33 | 21ETCCS038 | GARVITA BAYA | 63 | N |
| 34 | 21ETCCS039 | GARVITA JAIN | 66 | N |
| 35 | 21ETCCS040 | GAZI AMAN KHAN | 52 | Y |
| 36 | 21ETCCS041 | HARSH | 56 | Y |
| 37 | 21ETCCS042 | HARSH SONI | 63 | N |
| 38 | 21ETCCS043 | HARSHAL PALIWAL | 59 | Y |
| 39 | 21ETCCS044 | HARSHIT PUROHIT | 70 | N |
| 40 | 21ETCCS045 | HARSHIT SHARMA | 61 | N |
| 41 | 21ETCCS046 | HARSHITA RATHORE | 63 | N |
| 42 | 21ETCCS047 | HEET DOSI | 52 | Y |
| 43 | 21ETCCS048 | MS HETAL SHARMA | 59 | Y |
| 44 | 21ETCCS049 | JAHNAVI JOSHI | 66 | N |
| 45 | 21ETCCS050 | JAINIL JAIN | 61 | N |
| 46 | 21ETCCS051 | JASWANT SINGH RAO | 63 | N |
| 47 | 21ETCCS052 | JATIN VASHISHTHA | 59 | Y |
| 48 | 21ETCCS053 | JAY JOSHI | 70 | N |
| 49 | 21ETCCS054 | JAYDEEP DANGI | 52 | Y |
| 50 | 21ETCCS055 | JIGYASA CHATURVEDI | 63 | N |
| 51 | 21ETCCS056 | KAILASH JOSHI | 70 | N |
| 52 | 21ETCCS057 | KAMLESH KUMAR GHANCHI | 63 | N |
| 53 | 21ETCCS058 | KANISHKA PARMAR | 70 | N |
| 54 | 21ETCCS059 | KASHVI PANDEY | 63 | N |
| 55 | 21ETCCS060 | KHUSHAL PALIWAL | 52 | Y |
| 56 | 21ETCCS061 | KHUSHI GAHLOT | 70 | N |
| 57 | 21ETCCS062 | KHUSHI VANAWAT | 66 | N |
| 58 | 21ETCCS064 | KUNAL CHOUBISA | 56 | Y |
| 59 | 21ETCCS065 | KUNAL MENARIA | 52 | Y |
| 60 | 21ETCCS066 | KUNAL PALIWAL | 56 | Y |
| 61 | 21ETCCS067 | KUNAL SHARMA | 52 | Y |
| 62 | 21ETCCS068 | KUNIKA KADECHA | 59 | Y |
| 63 | 21ETCCS069 | LALITA DANGI | 61 | N |
| 64 | 21ETCCS070 | LAVISHA JAIN | 61 | N |
| 65 | 21ETCCS071 | LOKANTIK JAIN | 63 | N |
| 66 | 21ETCCS073 | MAHAK BANSAL | 61 | N |
| 67 | 21ETCCS074 | MANSI GEHLOT | 63 | N |
| 68 | 21ETCCS075 | MAYANK KANERIYA | 59 | Y |
| 69 | 21ETCCS076 | MAYANK MALIWAL | 61 | N |
| 70 | 21ETCCS078 | MITANSH JAIN | 56 | Y |
| 71 | 21ETCCS079 | MOHAMMED OWAIS KHAN | 56 | Y |
| 72 | 21ETCCS081 | NAVNEET ANAND | 59 | Y |
| 73 | 21ETCCS082 | NEHAL DHING | 70 | N |
| 74 | 21ETCCS084 | NIPUN MALI | 59 | Y |
| 75 | 21ETCCS085 | NISHA LOHAR | 70 | N |
| 76 | 21ETCCS086 | PRADHUMAN SINGH CHAUDHARY | 61 | N |
| 77 | 21ETCCS087 | PRANJAL SINGHVI | 61 | N |
| 78 | 21ETCCS088 | RAJAT PATIDAR | 56 | Y |
| 79 | 21ETCCS089 | RIYA JAIN | 70 | N |
| 80 | 21ETCCS090 | ROHIN GANG | 52 | Y |
| 81 | 21ETCCS091 | RUPAL SONI | 70 | N |
| 82 | 21ETCCS092 | SAHIL SOLANKI | 61 | N |
| 83 | 21ETCCS093 | SARGAM JAIN | 63 | N |
| 84 | 21ETCCS094 | SATYEN KHARADI | 59 | Y |
| 85 | 21ETCCS095 | SHASHANK MENARIA | 56 | Y |
| 86 | 21ETCCS096 | SHUBHAM DAS | 61 | N |
| 87 | 21ETCCS097 | SUDEEP ROY | 56 | Y |
| 88 | 21ETCCS098 | SUMIT VASITA | 52 | Y |
| 89 | 21ETCCS099 | SUYASH SONI | 66 | N |
| 90 | 21ETCCS100 | MS TANISHA KUMAWAT | 61 | N |
| 91 | 21ETCCS101 | TUSHAR YADAV | 56 | Y |
| 92 | 21ETCCS102 | VAIBHAV GARG | 66 | N |
| 93 | 21ETCCS103 | VAIBHAV SONI | 56 | Y |
| 94 | 21ETCCS104 | VARUN SHARMA | 52 | Y |
| 95 | 21ETCCS105 | VEDANSHI PAREEK | 61 | N |
| 96 | 21ETCCS106 | VEDAS DIXIT | 63 | N |
| 97 | 21ETCCS107 | VIKRAM SINGH SISODIYA | 61 | N |
| 98 | 21ETCCS108 | VIMANYU P SHARMA | 56 | Y |
| 99 | 21ETCCS109 | VISHAL KUMAWAT | 56 | Y |
| 100 | 21ETCCS110 | VISHAL PUSHKARNA | 59 | Y |
| 101 | 21ETCCS111 | VYOM BHATT | 61 | N |
| 102 | 21ETCCS112 | YASH JAIN | 59 | Y |
| 103 | 21ETCCS113 | YASH JOSHI | 59 | Y |
| 104 | 21ETCCS114 | YASH PURI GOSWAMI | 59 | Y |
| 105 | 21ETCCS115 | YOGESH JAIPAL | 52 | Y |
| 106 | 21ETCCS116 | MS YUVIKA CHOUDHARY | 56 | Y |
| 107 | 21ETCCS117 | YUVRAJ SINGH KANAWAT | 56 | Y |
| 108 | 21ETCCS300 | NEELAM KATARIYA | 56 | Y |
| 109 | 21ETCCS400 | SHABBIR HUSAIN | 52 | Y |
| 110 | 21ETCCS401 | ALI HUSSAIN | 52 | Y |
| 111 | 22ETCCS200 | SAURABH SONI | 61 | N |

**\***(Y, if obtained marks are <=70%)

**Signature of Faculty: Signature of HOD**

**Remedial Action Taken to Remove the Gaps (After Mid- Term 1I)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Sr.No. | University Roll no. | Name of Student | Topics to be discussed in Remedial Class | Schedule Date of Remedial Class | Course Outcome |
| 1 | 21ETCCS006 | AKSHAT SINGH CHOUHAN | Linear Block Encoder and Decoder, Cyclic Code , [Galileo's Fields](https://www2.jpl.nasa.gov/galileo/instruments/fp.html)  , Convolution Code, Cyclic Code ,Veterbi Decoding | 5-1-2023 to  16-1-2023 | CO3,CO4,CO5 |
| 2 | 21ETCCS007 | ANIRUDH SINGH RAJPUROHIT |
| 3 | 21ETCCS009 | ANJALI SONI |
| 4 | 21ETCCS010 | ANURAG MENARIA |
| 5 | 21ETCCS011 | ANUSHKA VIJAY |
| 6 | 21ETCCS013 | ARUN LOHAR |
| 7 | 21ETCCS014 | ARVIND SINGH |
| 8 | 21ETCCS015 | ARVIND SUTHAR |
| 9 | 21ETCCS016 | AVANI JOSHI |
| 10 | 21ETCCS019 | AYUSH TALESARA |
| 11 | 21ETCCS022 | MS BHUMIKA VARDAR |
| 12 | 21ETCCS025 | CHINMAY MENARIA |
| 13 | 21ETCCS026 | DAKSH VYAS |
| 14 | 21ETCCS027 | DEEPAK DHAKAR |
| 15 | 21ETCCS029 | DHIREN SUHALKA |
| 16 | 21ETCCS030 | DHRUV BAGORA |
| 17 | 21ETCCS032 | DINESH AUDICHYA |
| 18 | 21ETCCS034 | DIVYANSHU MENARIA |
| 19 | 21ETCCS035 | DIVYANSHU SAHU |
| 20 | 21ETCCS040 | GAZI AMAN KHAN |
| 21 | 21ETCCS041 | HARSH |
| 22 | 21ETCCS043 | HARSHAL PALIWAL |
| 23 | 21ETCCS047 | HEET DOSI |
| 24 | 21ETCCS048 | MS HETAL SHARMA |
| 25 | 21ETCCS052 | JATIN VASHISHTHA |
| 26 | 21ETCCS054 | JAYDEEP DANGI |
| 27 | 21ETCCS060 | KHUSHAL PALIWAL |
| 28 | 21ETCCS064 | KUNAL CHOUBISA |
| 29 | 21ETCCS065 | KUNAL MENARIA |
| 30 | 21ETCCS066 | KUNAL PALIWAL |
| 31 | 21ETCCS067 | KUNAL SHARMA |
| 32 | 21ETCCS068 | KUNIKA KADECHA |
| 33 | 21ETCCS075 | MAYANK KANERIYA |
| 34 | 21ETCCS078 | MITANSH JAIN |
| 35 | 21ETCCS079 | MOHAMMED OWAIS KHAN |
| 36 | 21ETCCS081 | NAVNEET ANAND |
| 37 | 21ETCCS084 | NIPUN MALI |
| 38 | 21ETCCS088 | RAJAT PATIDAR |
| 39 | 21ETCCS090 | ROHIN GANG |
| 40 | 21ETCCS094 | SATYEN KHARADI |
| 41 | 21ETCCS095 | SHASHANK MENARIA |
| 42 | 21ETCCS097 | SUDEEP ROY |
| 43 | 21ETCCS098 | SUMIT VASITA |  |  |  |
| 44 | 21ETCCS101 | TUSHAR YADAV |  |  |  |
| 45 | 21ETCCS103 | VAIBHAV SONI |  |  |  |
| 46 | 21ETCCS104 | VARUN SHARMA |  |  |  |
| 47 | 21ETCCS108 | VIMANYU P SHARMA |  |  |  |
| 48 | 21ETCCS109 | VISHAL KUMAWAT |  |  |  |
| 49 | 21ETCCS110 | VISHAL PUSHKARNA |  |  |  |
| 50 | 21ETCCS112 | YASH JAIN |  |  |  |
| 51 | 21ETCCS113 | YASH JOSHI |  |  |  |
| 52 | 21ETCCS114 | YASH PURI GOSWAMI |  |  |  |
| 53 | 21ETCCS115 | YOGESH JAIPAL |  |  |  |
| 54 | 21ETCCS116 | MS YUVIKA CHOUDHARY |  |  |  |
| 55 | 21ETCCS117 | YUVRAJ SINGH KANAWAT |  |  |  |
| 56 | 21ETCCS300 | NEELAM KATARIYA |  |  |  |
| 57 | 21ETCCS400 | SHABBIR HUSAIN |  |  |  |
| 58 | 21ETCCS401 | ALI HUSSAIN |  |  |  |

**Signature of Faculty: Signature of HOD**

**Model Question Paper**

**TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY, UDAIPUR**

**B. TECH 3rd – YEAR (V SEM.)**

**Information Theory & Coding (5CS3-01**)

**Time:** 2 Hr **Max. Marks:** 70

**Note:**

1. The paper is divided into 2 parts: Part-A, Part-B and Part-C.
2. Part-A contains 10 questions and carries 2 mark each.
3. Part-B contains 7 questions. Each question carries 4 marks each. Attempt any 5 Questions
4. Part-C contains 5 questions. Each question carries 10 marks each. Attempt any 3 Questions

Part- A (20 Marks)

|  |  |  |
| --- | --- | --- |
|  | Prove that the following statement,”if the receiver knows the message being transmitted the amount of information carried is zero”. | CO1 |
|  | Show that: I(X;Y)= I(Y;X). | CO1 |
|  | Define discrete memory less channel. | CO2 |
|  | Show that amount of information of M equally likely message is N bits if M=2N. | CO2 |
|  | State the Shannon first theorem for source coding for error free transmission. | CO3 |
|  | State the Shannon second theorem for source coding for error free transmission. | CO3 |
|  | Explain cyclic property of Error detection and Correction cyclic code. | CO4 |
|  | Explain Linearity property of Error detection and Correction cyclic code. | CO4 |
|  | Consider the generator matrix of (4,3) code over GF(3).    Covert nonsystematic form into systematic form. | CO5 |
|  | Write down the dimension ,code rate and constraint length of the code vector of given cyclic code. | CO5 |

Part- B (20 Marks)

|  |  |
| --- | --- |
| 1. Show that for a discrete binding channel: 2. H(X,Y) = H(X/Y) + H(Y) (ii ) H(X;Y) = H(Y/X) + H(X) | CO1 |
| 1. A source transmits two independent messages with probability of P and 1-P respectively. Prove that the entropy is maximum when both messages are equally likely. | CO1 |

|  |  |
| --- | --- |
| 3. Channel capacity is given by C=B log2(1+) bits/sec In the above equation when the signal power is fixed and white Gaussian noise is present, the channel capacity approaches an upper limit with increase in bandwidth ‘B’ .Prove that this upper limit is given as ,  C∞= = 1.44 **=** | CO2 |
| 4. The data is transmitted at the rate of 1000 bits/second over a channel having bandwidth B=3000 Hz. Determine the signal to noise ratio required. If the bandwidth is increased to 10000 Hz, than determine signal to noise ratio. | CO3 |

|  |  |
| --- | --- |
| 1. For a discrete memory less source ‘X’ with six symbols X1,X2…….X8,find a compact code for every symbol if the probability distribution is as follows:-   P(X1)=16/32 P(X2)=4/32 P(X3)=4/32 P(X4)=2/32 P(X5)=2/32 P(X6)=2/32 P(X7)=1/32 P(X8)=1/32   1. Shannon Fanno code 2. Average Number of bits 3. Code Efficiency 4. Comment on error free transmission or not. | CO4 |
| 6. A discrete memory less source has five symbols s0, s1, s2,s3, s4 ,characterized by probability distribution as 0.4,0.2 ,0.1,0.2 and .10 respectively.  Calculate i. Obtain Huffman code  ii. Average Number of bits  iii. Code Efficiency   1. Comment on error free transmission or not. | CO3 |

|  |  |
| --- | --- |
| 1. 7. (a) The generator polynomial of a(7,4) cyclic code is G(p)=p3+p+1.Find out Ge Generator matrix for the systematic form of cyclic code.(6)   (b) Explain the irreducible polynomial over galilos field with one example. (4) | CO5 |

**Part C** (30 Marks)

|  |  |
| --- | --- |
| 1. An analog signal is band limited to B Hz and samples at Nyquist rate. The samples are quantized into 4 levels. Each levels represents one message. Thus there are 4 messages. The probability of occurrence of these 4 levels are p1=p4=1/8 and p2=p3=3/8. Find out the information rate of source . | CO1 |
| 1. 2. Prove that: 2. I(X:Y)=H(X)-H(X/Y) 3. I(Y:X)=H(Y)-H(Y/X) | CO2 |
| 1. Determine P, H ,C for given generator polynomial.     Check the receiving message Y=1011101 is correct or incorrect if incorrect than rectify it. | CO3 |
| 4. (a) The generator polynomial of a(7,4) cyclic code is G(p)=p3+p+1.Find out Generator matrix for nonsystematic form of cyclic code.(6)  (b)Explain the primitive polynomial over galilos field with one example.(4) | CO4 |
| 1. Decode the receiving message Y=11 01 11 using veterbi decoding: The convolution encoder shown below : | CO5 |

**RESULT ANALYSIS**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **S.NO.** | **RTU ROLL NUMBER** | **NAME OF STUDENT** | **END TERM MARKS** | **SESSIONAL MARKS** | **TOTAL** |
|  |  |  | **70** | **30** | **100** |
|  |  | **Set Target Level** | **60%** | **75%** |  |
| **1** | 21ETCCS001 | AARSH BHARTI | 53 | 26 | 79 |
| **2** | 21ETCCS002 | MS AASTHA DAKHERA | 62 | 30 | 92 |
| **3** | 21ETCCS003 | ABHISHEK PRAJAPAT | 31 | 26 | 57 |
| **4** | 21ETCCS005 | AKSHANSH SONI | 40 | 28 | 68 |
| **5** | 21ETCCS006 | AKSHAT SINGH CHOUHAN | 37 | 25 | 62 |
| **6** | 21ETCCS007 | ANIRUDH SINGH RAJPUROHIT | 38 | 24 | 62 |
| **7** | 21ETCCS008 | ANISH SINGHAL | 53 | 26 | 79 |
| **8** | 21ETCCS009 | ANJALI SONI | 57 | 25 | 82 |
| **9** | 21ETCCS010 | ANURAG MENARIA | 54 | 24 | 78 |
| **10** | 21ETCCS011 | ANUSHKA VIJAY | 44 | 24 | 68 |
| **11** | 21ETCCS012 | APURVA LODHA | 53 | 30 | 83 |
| **12** | 21ETCCS013 | ARUN LOHAR | 45 | 25 | 70 |
| **13** | 21ETCCS014 | ARVIND SINGH | 40 | 24 | 64 |
| **14** | 21ETCCS015 | ARVIND SUTHAR | 40 | 25 | 65 |
| **15** | 21ETCCS016 | AVANI JOSHI | 50 | 24 | 74 |
| **16** | 21ETCCS017 | AYAN KHAN | 34 | 26 | 60 |
| **17** | 21ETCCS018 | AYUSH JHOTA | 42 | 27 | 69 |
| **18** | 21ETCCS019 | AYUSH TALESARA | 50 | 24 | 74 |
| **19** | 21ETCCS020 | BHAVYA MEHTA | 46 | 26 | 72 |
| **20** | 21ETCCS021 | BHERU SINGH PANWAR | 46 | 27 | 73 |
| **21** | 21ETCCS022 | MS BHUMIKA VARDAR | 35 | 24 | 59 |
| **22** | 21ETCCS025 | CHINMAY MENARIA | 45 | 24 | 69 |
| **23** | 21ETCCS026 | DAKSH VYAS | 35 | 25 | 60 |
| **24** | 21ETCCS027 | DEEPAK DHAKAR | 34 | 22 | 56 |
| **25** | 21ETCCS029 | DHIREN SUHALKA | 26 | 22 | 48 |
| **26** | 21ETCCS030 | DHRUV BAGORA | 59 | 22 | 81 |
| **27** | 21ETCCS031 | DIKSHA AGARWAL | 64 | 30 | 94 |
| **28** | 21ETCCS032 | DINESH AUDICHYA | 40 | 22 | 62 |
| **29** | 21ETCCS034 | DIVYANSHU MENARIA | 25 | 24 | 49 |
| **30** | 21ETCCS035 | DIVYANSHU SAHU | 53 | 25 | 78 |
| **31** | 21ETCCS036 | DURGA SANKAR DANGI | 48 | 26 | 74 |
| **32** | 21ETCCS037 | GAGAN MANGAL | 39 | 30 | 69 |
| **33** | 21ETCCS038 | GARVITA BAYA | 60 | 27 | 87 |
| **34** | 21ETCCS039 | GARVITA JAIN | 60 | 28 | 88 |
| **35** | 21ETCCS040 | GAZI AMAN KHAN | 33 | 22 | 55 |
| **36** | 21ETCCS041 | HARSH | 42 | 24 | 66 |
| **37** | 21ETCCS042 | HARSH SONI | 53 | 27 | 80 |
| **38** | 21ETCCS043 | HARSHAL PALIWAL | 47 | 25 | 72 |
| **39** | 21ETCCS044 | HARSHIT PUROHIT | 61 | 30 | 91 |
| **40** | 21ETCCS045 | HARSHIT SHARMA | 44 | 26 | 70 |
| **41** | 21ETCCS046 | HARSHITA RATHORE | 48 | 27 | 75 |
| **42** | 21ETCCS047 | HEET DOSI | 37 | 22 | 59 |
| **43** | 21ETCCS048 | MS HETAL SHARMA | 51 | 25 | 76 |
| **44** | 21ETCCS049 | JAHNAVI JOSHI | 50 | 28 | 78 |
| **45** | 21ETCCS050 | JAINIL JAIN | 40 | 26 | 66 |
| **46** | 21ETCCS051 | JASWANT SINGH RAO | 49 | 27 | 76 |
| **47** | 21ETCCS052 | JATIN VASHISHTHA | 44 | 25 | 69 |
| **48** | 21ETCCS053 | JAY JOSHI | 66 | 30 | 96 |
| **49** | 21ETCCS054 | JAYDEEP DANGI | 67 | 22 | 89 |
| **50** | 21ETCCS055 | JIGYASA CHATURVEDI | 51 | 27 | 78 |
| **51** | 21ETCCS056 | KAILASH JOSHI | 43 | 30 | 73 |
| **52** | 21ETCCS057 | KAMLESH KUMAR GHANCHI | 45 | 27 | 72 |
| **53** | 21ETCCS058 | KANISHKA PARMAR | 64 | 30 | 94 |
| **54** | 21ETCCS059 | KASHVI PANDEY | 45 | 27 | 72 |
| **55** | 21ETCCS060 | KHUSHAL PALIWAL | 38 | 22 | 60 |
| **56** | 21ETCCS061 | KHUSHI GAHLOT | 58 | 30 | 88 |
| **57** | 21ETCCS062 | KHUSHI VANAWAT | 55 | 28 | 83 |
| **58** | 21ETCCS064 | KUNAL CHOUBISA | 20 | 24 | 44 |
| **59** | 21ETCCS065 | KUNAL MENARIA | 26 | 22 | 48 |
| **60** | 21ETCCS066 | KUNAL PALIWAL | 36 | 24 | 60 |
| **61** | 21ETCCS067 | KUNAL SHARMA | 45 | 22 | 67 |
| **62** | 21ETCCS068 | KUNIKA KADECHA | 53 | 25 | 78 |
| **63** | 21ETCCS069 | LALITA DANGI | 42 | 26 | 68 |
| **64** | 21ETCCS070 | LAVISHA JAIN | 44 | 26 | 70 |
| **65** | 21ETCCS071 | LOKANTIK JAIN | 46 | 27 | 73 |
| **66** | 21ETCCS073 | MAHAK BANSAL | 48 | 26 | 74 |
| **67** | 21ETCCS074 | MANSI GEHLOT | 58 | 27 | 85 |
| **68** | 21ETCCS075 | MAYANK KANERIYA | 48 | 25 | 73 |
| **69** | 21ETCCS076 | MAYANK MALIWAL | 55 | 26 | 81 |
| **70** | 21ETCCS078 | MITANSH JAIN | 41 | 24 | 65 |
| **71** | 21ETCCS079 | MOHAMMED OWAIS KHAN | 50 | 24 | 74 |
| **72** | 21ETCCS081 | NAVNEET ANAND | 64 | 25 | 89 |
| **73** | 21ETCCS082 | NEHAL DHING | 51 | 30 | 81 |
| **74** | 21ETCCS084 | NIPUN MALI | 41 | 25 | 66 |
| **75** | 21ETCCS085 | NISHA LOHAR | 55 | 30 | 85 |
| **76** | 21ETCCS086 | PRADHUMAN SINGH CHAUDHARY | 54 | 26 | 80 |
| **77** | 21ETCCS087 | PRANJAL SINGHVI | 33 | 26 | 59 |
| **78** | 21ETCCS088 | RAJAT PATIDAR | 19 | 24 | 43 |
| **79** | 21ETCCS089 | RIYA JAIN | 59 | 30 | 89 |
| **80** | 21ETCCS090 | ROHIN GANG | 49 | 22 | 71 |
| **81** | 21ETCCS091 | RUPAL SONI | 39 | 30 | 69 |
| **82** | 21ETCCS092 | SAHIL SOLANKI | 52 | 26 | 78 |
| **83** | 21ETCCS093 | SARGAM JAIN | 58 | 27 | 85 |
| **84** | 21ETCCS094 | SATYEN KHARADI | 44 | 25 | 69 |
| **85** | 21ETCCS095 | SHASHANK MENARIA | 48 | 24 | 72 |
| **86** | 21ETCCS096 | SHUBHAM DAS | 44 | 26 | 70 |
| **87** | 21ETCCS097 | SUDEEP ROY | 32 | 24 | 56 |
| **88** | 21ETCCS098 | SUMIT VASITA | 20 | 22 | 42 |
| **89** | 21ETCCS099 | SUYASH SONI | 43 | 28 | 71 |
| **90** | 21ETCCS100 | MS TANISHA KUMAWAT | 49 | 26 | 75 |
| **91** | 21ETCCS101 | TUSHAR YADAV | 7 | 24 | 31 |
| **92** | 21ETCCS102 | VAIBHAV GARG | 48 | 28 | 76 |
| **93** | 21ETCCS103 | VAIBHAV SONI | 54 | 24 | 78 |
| **94** | 21ETCCS104 | VARUN SHARMA | 65 | 22 | 87 |
| **95** | 21ETCCS105 | VEDANSHI PAREEK | 62 | 26 | 88 |
| **96** | 21ETCCS106 | VEDAS DIXIT | 57 | 27 | 84 |
| **97** | 21ETCCS107 | VIKRAM SINGH SISODIYA | 49 | 26 | 75 |
| **98** | 21ETCCS108 | VIMANYU P SHARMA | 60 | 24 | 84 |
| **99** | 21ETCCS109 | VISHAL KUMAWAT | 46 | 24 | 70 |
| **100** | 21ETCCS110 | VISHAL PUSHKARNA | 35 | 25 | 60 |
| **101** | 21ETCCS111 | VYOM BHATT | 53 | 26 | 79 |
| **102** | 21ETCCS112 | YASH JAIN | 27 | 25 | 52 |
| **103** | 21ETCCS113 | YASH JOSHI | 28 | 25 | 53 |
| **104** | 21ETCCS114 | YASH PURI GOSWAMI | 41 | 25 | 66 |
| **105** | 21ETCCS115 | YOGESH JAIPAL | 36 | 22 | 58 |
| **106** | 21ETCCS116 | MS YUVIKA CHOUDHARY | 52 | 24 | 76 |
| **107** | 21ETCCS117 | YUVRAJ SINGH KANAWAT | 40 | 24 | 64 |
| **108** | 21ETCCS300 | NEELAM KATARIYA | 50 | 24 | 74 |
| **109** | 21ETCCS400 | SHABBIR HUSAIN | 36 | 22 | 58 |
| **110** | 21ETCCS401 | ALI HUSSAIN | 55 | 22 | 77 |
| **111** | 22ETCCS200 | SAURABH SONI | 60 | 26 | 86 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| TOTAL | PASS | FAIL | ABSENT | PASS % |
| 111 | 110 | 1 | 0 | 99.09% |

**Indirect Assessment:**

**Overall Teacher Self Assessment (at the completion of course) in terms of course objective and outcomes**

**Course Objectives:**

Student will be able to list fundamental principles of information theory, including concepts such as entropy, information content, and coding theorems..

Student will be able to apply information theory concepts to analyze and solve complex problems related to data compression, error correction, and channel coding.

Student will be able to develop proficiency in coding and decoding techniques, including the implementation of various coding algorithms, to optimize data transmission and storage.

**Course Outcomes**:

Students can apply the fundamental principles of information theory to calculate Amount of Information and Entropy .

Students can apply variable encoding algorithm to compress the data at the time of transmission.

Students can decode the data receiver side and identify the number of error detection and correction ability of receiving message and rectifying it .

**Methodology to identify bright student**

Considered a range of criteria, including academic performance, creativity, critical thinking, problem-solving skills, and enthusiasm for learning. Bright students often excel in multiple areas. Observed how students perform in the classroom. In terms of active participation, engagement in discussions, leadership, and the ability to grasp complex concepts.

**Efforts to keep students engaged**

1. Active Learning:
   * Incorporate active learning strategies, such as group discussions, problem-solving activities, and hands-on projects. Active participation keeps students engaged and encourages critical thinking.
2. Varied Teaching Methods:
   * Use a variety of teaching methods, including lectures, group work, multimedia presentations, and interactive activities to cater to different learning preferences.
3. Technology Integration:
   * Leverage technology, such as online platforms, educational apps, and interactive software, to make lessons more engaging and interactive.

Some extra learning for bright students

1. <https://www.cl.cam.ac.uk/teaching/0809/InfoTheory/InfoTheoryLectures.pdf>
2. <https://iisc.ac.in/wp-content/uploads/2017/12/E2201.pdf>
3. <https://www.youtube.com/watch?v=KlyvIzsoVsA>

**Methodology to identify weakstudent**

Considered a range of criteria, including classroom observation, formative assessment, summative assessment, assignment review e.t.c. Weak students are struggling students with sensitivity and a desire to support their learning. Some measures, such as additional tutoring, personalized assignments, or alternative assessment methods, to help students succeed.

**Targeted inventions for weak student**

**1. Additional Resources**

Offer supplementary learning materials, such as textbooks, online resources, or multimedia content, to provide alternative explanations and reinforce key concepts.

**2. Remedial classes**

Establish a tutoring program where students can receive extra help from teachers.

**3. Flipped classroom**

Students are assigned pre-class learning materials, often in the form of videos, readings, or online modules, to cover the foundational concepts before coming to class.

Some additional resources or links for student to improve their understanding for topic

1. <https://byjus.com/physics/information-theory/>
2. <https://www.coursera.org/learn/information-theory>
3. <https://archive.nptel.ac.in/content/storage2/courses/117108097/Learning%20Material%20-%20ITC.pdf>