B. P. Poddar Institute of Management & Technology

Department of Electronics & Communication Engineering

Academic Year: 2022-2023

COURSE DATA SHEET

PROGRAM: Electronics and Communication Engineering	DEGREE: B.Tech. (U. G)
COURSE: Information Theory and Coding	SEMESTER: Even CREDITS: 3
COURSE CODE: PE-EC603D REGULATION: 2018-2019	COURSE TYPE: ~~CORE~~ /ELECTIVE / ~~BREADTH/ S&H~~
COURSE AREA/DOMAIN: Electronics Engineering	CONTACT HOURS: 3 hours/Week.
CORRESPONDING LAB COURSE CODE (IF ANY): NA	LAB COURSE NAME (IF ANY): NA

COURSE PRE-REQUISITES:

C.CODE	COURSE NAME	DESCRIPTION	SEM
BS-M201	Mathematics-II A	Basic Probability Theory Random Variable & Probability Distributions. Expectation.	II

COURSE OBJECTIVES:

1.	Familiarize students with concepts of information and entropy
2.	Familiarize students with calculation of efficiencies of different source coding techniques
3.	Discuss on the capacities of different channels and Shannon's theorem.
4.	Discuss channel coding techniques for error-free transmission of message over a noisy communication channel.

COURSE OUTCOMES:

SNO	DESCRIPTION Students will be able to:	Blooms Level	PO(1..12) MAPPING	PSO(1..2) MAPPING
CO1	**Calculate** information and entropy	L3 Apply	PO1, PO2	PSO1, PSO2
CO2	**Calculate** capacity of different channels	L3 Apply	PO1	PSO1, PSO2
CO3	**Compare** efficiencies of different source coding techniques	L4 Analyze	PO1, PO2, PO4	PSO1, PSO2
CO4	**Apply** techniques of coding and decoding to develop LBC	L3 Apply	PO1, PO2	PSO1, PSO2
CO5	**Design** encoder and decoder for cyclic codes and convolutional codes	L4 Create	PO1, PO2, PO3, PO4, PO5, PO9, PO10, PO12	PSO1, PSO2
COURSE OVERALL PO/PSO MAPPING: PO1, PO2, PO3, PO4, PO5, PO9, PO10, PO12, PSO1, PSO2				

MAPPING OF CO WITH PO/PSO (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1**):**

S.NO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1											1	1
CO2	3												1	1
CO3	3	1		1									1	1
CO4	3	2											2	1
CO5	3	3	1	2	3				3	3		2	3	1
CO*	3	1.4	0.2	0.6	0.6				0.6	0.6		0.4	1.6	1

** For Entire Course, PO /PSO Mapping; 1 (Low); 2(Medium); 3(High) Contribution to PO/PSO*

PO1	Engineering Knowledge	PO7	Environment & Sustainability	PSO1	Students will acquire knowledge in Advance Communication Engineering, Signal and Image Processing, Embedded and VLSI System Design
PO2	Problem Analysis	PO8	Ethics	PSO2	Students will qualify in various competitive examinations for successful employment, higher studies and research
PO3	Design & Development	PO9	Individual & Team Work		
PO4	Investigations	PO10	Communicatio n Skills		
PO5	Modern Tools	PO11	Project Management & Finance		
PO6	Engineer & Society	PO12	Life Long Learning		

ELECTRONICS AND COMMUNICATION ENGINEERING
III Year - II Semester

INFORMATION THEORY AND CODING

Code: PE-EC603D **Contacts: 3L** **Credits: 3**

Basics of information theory, entropy for discrete ensembles; Shannon's noiseless coding theorem; Encoding of discrete sources.

Markov sources; Shannon's noisy coding theorem and converse for discrete channels; Calculation of channel capacity and bounds for discrete channels; Application to continuous channels.

Techniques of coding and decoding; Huffman codes and uniquely detectable codes; Cyclic codes, convolutional arithmetic codes.

Books

1. N. Abramson, Information and Coding, McGraw Hill, 1963.
2. M. Mansurpur, Introduction to Information Theory, McGraw Hill, 1987.
3. R.B. Ash, Information Theory, Prentice Hall, 1970.
4. Shu Lin and D.J. Costello Jr., Error Control Coding, Prentice Hall, 1983.

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LESSON PLAN

Faculty Name: Prof. Dr. Arijit Saha Course: **Information Theory and Coding** Class:III-B.Tech.ECE

LNo.	Topics to be Covered	Books	TA/TM
L1	Familiarization of the students with Institute and Department Vision, Mission, PEOs, POs, PSOs, COs and Course Overview, introduction to information theory, Self-information, Conditional self-information, Mutual information, average mutual information	T1, T3	TA: PPT, GB TM: L, CD, Q
L2	Average self-information or entropy, Joint entropy, average conditional self-information or conditional entropy, differential entropy	T1, T3	TA: PPT, GB TM: L, CD, PS
L3	Channel definition, DMC, channel transition probability, Joint probability matrix, special channels, channel capacity, capacities of special channels	T1, T3	TA: PPT, GB TM: L, CD, PS
L4	Channel coding, Shannon's noisy channel coding theorem, Information capacity theorem, Shannon limit, Bandwidth efficiency diagram	T1, T3	TA: PPT, GB TM: L, CD
L5	Markov information sources, Coding parameters, average code length, Kraft inequality, Shannon's noiseless coding theorem, code efficiency and code redundancy	T1, T3	TA: PPT TM: L, CD
L6	Classification of codes, Arithmetic coding	T1, T3	TA: PPT TM: L, CD
L7	Shannon-Fano coding	T1, T3	TA: PPT TM: FC
L8	Huffman Coding	T1, T3	TA: PPT TM: FC
L9	LBC: Introduction, structure, generator matrix, set of code words	T1	TA: PPT TM: L, CD
L10	LBC: Systematic generator matrix, equivalent code, dual code error syndrome	T1	TA: PPT TM: L, CD
L11	Undetectable error pattern, error detection, minimum distance, error detecting capability of a block code	T1	TA: PPT, TM: L, CD
L12	Error correction capabilities of a block code, Types of errors & Error Control Strategies, Throughput Efficiency of ARQ	T1	TA: PPT, TM: L, CD
L13	Standard Array, coset and coset leader, lookup table, syndrome decoding	T1	TA: PPT TM: L, CD
L14	Cyclic code: Introduction, Method of generation, Theorems, Example of (7,4) code generated by polynomials, Code in systematic form,	T1, T2	TA: PPT TM: L, CD
L15	Generation of systematic cyclic code, Generation and parity-check matrices, Generation matrix (systematic form), Parity-check matrix (systematic form)	T1, T2	TA: PPT TM: L, CD
L16	LFSR, polynomial-division register	T1, T2	TA: PPT, GB TM: Q, PS
L17	Registers for encoding cyclic code	T1, T2	TA: PPT TM: L, CD, Q

L18	Syndrome computation, registers for error detection and correction, Burst errors, Meggitt decoder	T1, T2	TA: PPT TM: L, CD
L19	Shortened cyclic code, Golay code, Cyclic redundancy check	T1, T2	TA: PPT TM: L, CD
L20	Convolution code introduction, convolution	T1, T2	TA: PPT TM: L, CD
L21	Encoding convolution codes	T1, T2	TA: PPT TM: L, CD
L22	Generator matrix and generator polynomials for convolution code	T1, T2	TA: PPT TM: L, CD
L23	Convolutional codes: State diagrams, Tree diagram, Trellis diagram	T1, T2	TA: PPT TM: L, CD
L24	Viterbi decoder	T1, T2	TA: PPT TM: Q, PS
L25	Discussions on previous year questions and model questions		TA: GB TM: Q, PS

Text Books:

1. A Saha, N Manna and S Mandal, Information Theory, Coding and Cryptography, Pearson
2. S Gravano, Error Control Codes, Oxford University Press
3. Ranjan Bose, Information Theory, Coding and Cryptography, McGraw Hill

Reference Books:

1. S Lin and D J Costello Jr - Error Control Coding, Prentice Hall

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GB: Glass Board
PPT: Power Point Presentation
L: Lecturing
CD: Classroom Discussions
Q: Quiz
PS: Problem Solving
FC: Flip Class

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ASSESSMENT METHODOLOGIES-DIRECT

☑ ASSIGNMENTS	☐ STUD. SEMINARS	☑ TESTS/MODEL EXAMS	☑ UNIV. EXAMINATION
☐ STUD. LAB PRACTICES	☐ STUD. VIVA	☐ MINI/MAJOR PROJECTS	☐ CERTIFICATIONS
☐ ADD-ON COURSES	☑ TERM PAPER/ PRESENTATION	☐ OTHERS	

ASSESSMENT METHODOLOGIES-INDIRECT

☑ ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)	☑ STUDENT FEEDBACK ON FACULTY
☐ ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS	☐ OTHERS

Faculty
(Prof. Dr. Arijit Saha)