



**MANIPAL UNIVERSITY
JAIPUR**

(University under Section 2(f) of the UGC Act)

MANIPAL UNIVERSITY JAIPUR

School of Computing and Information Technology

DEPARTMENT OF COMPUTER AND COMMUNICATION ENGINEERING

Course Hand-out

Data Communications| CC2102| 4 Credits | 3 | 0 | 4

Session: Aug 2022-Dec 2022 | Faculty: Dr. Lal Pratap Verma, Dr. Arvind Dhaka| Class: B.Tech III SEM

A. Introduction: This course is offered by the Department of Computer & Communication Engineering which provides students with the fundamental concepts and techniques used for communicating data in an efficient and reliable manner. The student will be able to gain a practical understanding of relevant terminology and describe various encoding techniques, flow & error control mechanisms, multiplexing & multiple-access techniques used for enabling data communication. The course lays down the foundation for Computer Networks, Wireless Communications.

B. Course Outcomes: At the end of the course, students will be able to:

[CC 2102.1] Utilize the fundamental concepts of data communication, transmission media, and transmission impairments on analog and digital transmission.

[CC 2102.2] Apply the principles of signal encoding techniques used for digital data to digital signal conversion and analog data to digital signal conversion and compare them.

[CC 2102.3] Apply the knowledge of various error detection and correction techniques to find and overcome errors encountered during transmission and discuss flow control and error control techniques.

[CC 2102.4] Distinguish between different types of multiplexing techniques and spread spectrum techniques.

[CC 2102.5] Apply various multiple access techniques and IEEE 802.X LAN Standards.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO.1].Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2].Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

[PO.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

[PO.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.

[PO.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 an understanding of the limitations.

[PO.6].The Engineers 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

[PO.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.

[PO.8].Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

[PO.9].Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

[PO.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.

[PO.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.

[PO.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.

D. Program Specific Outcomes (PSOs)

[PSO.1] Imbibe the basic concepts and applications of computer-based Communication or networking, information sharing, signal processing, web-based systems, smart devices, and communication technology.

[PSO.2] Investigate prominent areas in the field of Computer and Communication Engineering to provide feasible solutions.

[PSO.3] Apply the contextual knowledge in the field of computing and communication to assess social, health, safety and cultural issues and endure the consequent responsibilities relevant to the professional engineering practice.

E. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Close Book)	20
	Sessional Exam II (Close Book)	20
	In class Quizzes and Assignments, Activity feedback (Accumulated and Averaged)	20
End Term Exam (Summative)	End Term Exam (Close Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Makeup Assignments (Formative)	Students who miss a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	

F. SYLLABUS

Introduction: General block diagram of communication system, Data communications, Protocol, Need for Protocol Architecture, OSI Model, TCP/IP Protocol Architecture; Data Transmission: Concepts and Terminology, Analog and Digital Data Transmission, Transmission Impairments, Channel Capacity; Transmission Media: Guided Transmission Media, Wireless Transmission, Wireless Propagation, Line-of-Sight Transmission; Signal Encoding Techniques: Analog and Digital Signals, Digital-To-Digital Conversion: Line Coding Schemes, Block Coding, Scrambling, Analog-To Digital Conversion: Pulse Code Modulation, Delta Modulation; Digital Data Communication Techniques: Asynchronous and Synchronous Transmission, Types of Errors, Error Detection, Error Correction, Line Configurations; Data Link Control Protocols: Flow Control, Error Control, High-Level Data Link Control (HDLC); Multiplexing: Frequency Division Multiplexing (FDM), Time-Division Multiplexing (TDM); Spread Spectrum: The Concept of Spread Spectrum, Frequency Hopping Spread Spectrum (FHSS), Direct Sequence Spread Spectrum (DSSS); Multiple Access- Aloha, Carrier Sense Multiple Access (CSMA), Carrier Sense Multiple Access with Collision Detection (CSMA/CD), Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA), Code-Division Multiple Access (CDMA); Introduction to IEEE 802.X LAN Standards.

G. Reference Books

1. I. W. Stallings, Data and Computer Communications, (10e), Pearson Education, 2014.
2. B. A. Forouzan, Data Communications & Networking, (5e), McGraw Hill, 2013.
3. D. P. Bertsekas, R. G. Gallager, Data Networks, (2e), Prentice Hall of India, 2011.
4. A. S. Tenenbaum, Computer Networks, (5e), Prentice Hall of India, 2008.
5. L. L. Peterson, B. S. Davie, Computer Networks: A Systems Approach, (5e), Morgan Kaufmann Publishers, 2011.

H. Lecture Plan:

Lecture No.	Major Topics	Topics	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
I	Introduction and course handout briefing	Course handout	Lecture	NA	NA
1.	Introduction to Data Communication	Introduction: General block diagram of communication system, Data communications	Lecture	[2102.1]	Class Quiz Mid Term - I End Term
2.		Protocol, Need for Protocol Architecture, OSI Model	Lecture	[2102.1]	Class Quiz Mid Term - I End Term
3.		TCP/IP Protocol Architecture	Lecture & Activity	[2102.1]	Class Quiz Mid Term - I End Term
4.	Data Transmission	Concepts and Terminology – Simplex, Half-Duplex, Full-Duplex, Frequency, Bandwidth	Lecture	[2102.1]	Class Quiz Mid Term - I End Term

5.		Time Domain and Frequency Domain Concepts, Data Rate	Lecture & Problem Solving Practice	[2102.1]	Class Quiz Mid Term - I End Term
6.	Analog and Digital Data Transmission	Analog and Digital Data and Signals,	Lecture	[2102.1]	Class Quiz Mid Term - I End Term
7.		Analog and Digital Transmission	Lecture	[2102.1]	Class Quiz Mid Term - I End Term
8.	Transmission Impairments	Attenuation, Delay Distortion, Noise	Lecture & Problem Solving Practice	[2102.1]	Class Quiz Mid Term - I End Term
9.	Channel Capacity	Data Rate and Nyquist Bandwidth	Lecture	[2102.2]	Class Quiz Mid Term - I End Term
10.		Shannon Capacity Formula	Lecture & Problem Solving Practice	[2102.2]	Class Quiz Mid Term - I End Term
11.	Transmission Media: Guided Transmission Media	Twisted Pair & CAT Types	Lecture & Activity	[2102.2]	Class Quiz Mid Term - I End Term
12.		Coaxial Cable, Optical Fiber	Lecture	[2102.2]	Class Quiz Mid Term - I End Term
13.	Wireless Transmission	Antennas, Terrestrial Microwave	Lecture	[2102.2]	Class Quiz Mid Term - I End Term
14.		Satellite Microwave, Broadcast Radio, Infrared	Lecture & Problem Solving Practice	[2102.2]	Class Quiz Mid Term - I End Term

15.	Wireless Propagation	Ground Wave Propagation, Sky Wave Propagation	Lecture & Activity	[2102.2]	Class Quiz Mid Term - I End Term
16.		Line-of-Sight Propagation	Lecture & Problem Solving Practice	[2102.2]	Class Quiz Mid Term - I End Term
17.	Line-of-sight Propagation	Free Space Loss, Atmospheric Absorption, Multipath, Refraction	Lecture & Problem Solving Practice	[2102.2]	Class Quiz Mid Term - I End Term
MID-TERM-I EXAM					
18.	Signal Encoding Techniques: Digital-To Digital Conversion	Analog and Digital Signals, Line Coding Schemes: Unipolar, Polar	Lecture & Problem Solving Practice	[2102.2]	Class Quiz Mid Term - II End Term
19.		NRZ & Bipolar – AMI	Lecture & Problem Solving Practice	[2102.2]	Class Quiz Mid Term - II End Term
20.		Biphase – Manchester & Differential Manchester	Lecture & Problem Solving Practice	[2102.2]	Class Quiz Mid Term - II End Term
21.		Modulation Rate and Scrambling Techniques	Lecture & Problem Solving Practice	[2102.2]	Class Quiz Mid Term - II End Term
22.	Digital Data – Analog Signal	ASK & FSK	Lecture	[2102.2]	Class Quiz Mid Term - II End Term
23.		PSK – BPSK	Lecture	[2102.2]	Class Quiz Mid Term - II End Term

24.		MFSK	Lecture	[2102.2]	Class Quiz Mid Term - II End Term
25.		QAM	Lecture	[2102.2]	Class Quiz Mid Term - II End Term
26.	Analog-To-Digital Conversion	Pulse Code Modulation	Lecture & Problem Solving Practice	[2102.2]	Class Quiz Mid Term - II End Term
27.		Delta Modulation	Lecture	[2102.2]	Class Quiz Mid Term – II End Term
28.	Digital Data Communication Techniques	Asynchronous and Synchronous Transmission	Lecture	[2102.3]	Class Quiz Mid Term - II End Term
29.		Type of Error, Redundancy, Detection Vs Correction	Lecture	[2102.3]	Class Quiz Mid Term - II End Term
30.		Cyclic Redundancy Check	Lecture	[2102.3]	Class Quiz Mid Term - II End Term
31.		Polynomials & CRC Architecture	Lecture & Problem Solving Practice	[2102.3]	Class Quiz Mid Term - II End Term
32.		Error Correction and Block Code Principle	Lecture & Problem Solving Practice	[2102.3]	Class Quiz Mid Term - II End Term
33.		Line Configurations	Lecture	[2102.3]	Class Quiz Mid Term - II End Term
34.	Data Link Control	Framing	Lecture	[2102.3]	Class Quiz Mid Term - II End Term

35.	Protocols	Flow Control - Stop-and-Wait Protocol	Lecture & Problem Solving Practice	[2102.3]	Class Quiz Mid Term - II End Term
36.		Sliding Window	Lecture & Problem Solving Practice	[2102.3]	Class Quiz Mid Term - II End Term
37.		Error Control: Stop-and-Wait ARQ	Lecture & Problem Solving Practice	[2102.3]	Class Quiz Mid Term - II End Term
MID-TERM-II EXAM					
38.	Data Link Control Protocols	Go-Back-N ARQ	Lecture & Problem Solving Practice	[2102.3]	Class Quiz End Term
39.		Selective Repeat ARQ	Lecture & Problem Solving Practice	[2102.3]	Class Quiz End Term
40.		High-Level Data Link Control (HDLC)	Lecture	[2102.3]	Class Quiz End Term
41.	Multiplexing	Introduction to Multiplexing	Lecture	[2102.4]	Class Quiz End Term
42.		Frequency Division Multiplexing (FDM)	Lecture	[2102.4]	Class Quiz End Term
43.		Time-Division Multiplexing (TDM)	Lecture & Activity	[2102.4]	Class Quiz End Term
44.	Spread Spectrum	The Concept of Spread Spectrum, Frequency Hopping Spread Spectrum (FHSS)	Lecture	[2102.4]	Class Quiz End Term

45.		Direct Sequence Spread Spectrum (DSSS)	Lecture & Problem Solving Practice	[2102.4]	Class Quiz End Term
46.	Multiple Access	Aloha, Carrier Sense Multiple Access (CSMA),	Lecture	[2102.5]	Class Quiz End Term
47.		Carrier Sense Multiple Access with Collision Detection (CSMA/CD)	Lecture	[2102.5]	Class Quiz End Term
48.		Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA), Code-Division Multiple Access (CDMA);	Lecture	[2102.5]	Class Quiz End Term
49.	IEEE 802.X LAN Standards	Introduction	Lecture	[2102.5]	End Term
50.		LAN Standards	Lecture	[2102.5]	End Term
END TERM EXAM					

I. Course Articulation Matrix: (Mapping of COs with POs& PSOs)

[illegible]

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

A. Course Outcome Attainment Level Matrix:

CO	STATEMENT	ATTAINMENT OF PROGRAM OUTCOMES THRESHOLD VALUE: 50%												ATTAINMENT OF PROGRAM SPECIFIC OUTCOMES		
		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	PSO 3
[CC 2102.1]	Interpret the fundamental concepts of data communication, transmission media, and transmission impairments on analog and digital transmission.															
[CC 2102.2]	Outline the principles of signal encoding techniques used for digital data to digital signal conversion and analog data to digital signal conversion and compare them.															
[CC 2102.3]	Apply the knowledge of various error detection and correction techniques to find and overcome error encountered during transmission, and discuss flow control and error control techniques.															
[CC 2102.4]	Distinguish between different types of multiplexing techniques and spread spectrum techniques.															
[CC 2102.5]	Discuss various multiple access techniques and IEEE 802.X LAN Standards.															

0-No Attainment; 1- Low Attainment; 2- Moderate Attainment; 3- Substantial Attainment