

**MANIPAL UNIVERSITY JAIPUR**School of Computing and Information Technology

**DEPARTMENT OF COMPUTER AND COMMUNICATION ENGINEERING**  
Course Hand-out

Data Communications| CC2102| 4 Credits | 3 1 0 4

Session: July 2020-Dec 2020 | Faculty: Dr Gulrej Ahmed, Mr Vidhyadhar Aski| Class: B.Tech III SEM

1. **Introduction:** This course is offered by Department of Computer & Communication Engineering which provides students with the fundamental concepts and techniques used for communicating data in efficient and reliable manner. The student will be able to gain 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.
2. **Course Outcomes:** At the end of the course, students will be able to:

**[CC 2102.1]** Define the significance of relevant terminologies, explain the transmission of digital & analog signals over different types of transmission media and outline the effects of various transmission impairments on analog & digital transmission.

**[CC 2102.2]** Describe 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 in order to find and overcome error encountered during transmission and discuss flow control and error control techniques.

**[CC 2102.4]** Discuss and distinguish between different types of multiplexing techniques and spread spectrum techniques.

**[CC 2102.5]**Identify and compare various IEEE 802.X LAN Standards.

1. **PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES**

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

**[PO.2].** Problem analysis: the sophisticated curriculum would enable a graduate to identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using basic principles of mathematics, computing techniques and communication engineering principles.

**[PO.3].** Design/development of solutions: Upon analyzing the B Tech CCE graduate should be able to devise solutions for complex engineering problems and design system components or processes that meet the specified requirements with appropriate consideration for law, safety, cultural & societal obligations with environmental considerations.

**[PO.4].** Conduct investigations of complex problems: To imbibe the inquisitive practices to have thrust for innovation and excellence that leads to 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 modelling to complex engineering activities with an understanding of the limitations.

**[PO.6].**The engineer and society: The engineers are terms society builders and transformers. B. Tech CCE graduate should be able to 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: The zero effect and zero defect is not just a slogan, it is to be practised in each action. Thus a B Tech CCE should 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: Protection of IPR, staying away from plagiarism are important. Student should be able to apply ethical principles and commit to professional ethics,responsibilities and norms of the engineering practice.

**[PO.9].** Individual and team work: United we grow, divided we fall is a culture at MUJ that an outgoing student should be able to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

**[PO.10].** Communication: Communicate effectively for all engineering processes & activities with the peer engineering team, community and with society at large. Clarity of thoughts, being able to comprehend and formulate 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.

1. **Program Specific Outcomes (PSOs)**

**[PSO.1]** Clearly imbibe the basic principles, concepts and applications of computer based Communication/networking, information sharing, signal processing, web based systems, smart devices and communication technology.

**[PSO.2]** Investigate problematic areas prevalent in the field of Computer and Communication Engineering to find acceptable solutions.

**[PSO.3]** Identify the existing open problems in the field of computing and propose the best possible solutions.

**[PSO.4]** 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.

1. **Assessment Plan:**

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| **Criteria** | **Description** | **Maximum Marks** |
| Internal Assessment (Summative) | Sessional Exam I (Close Book) | 15 |
| Sessional Exam II (Close Book) | 15 |
| In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged) | 30 |
| 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. | |
| Make up Assignments  (Formative) | Students who misses 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. | |

1. **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.

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

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| **Lecture No.** | **Major Topics** | **Topics** | **Mode of Delivery** | **Corresponding CO** | **Mode of Assessing the Outcome** |
| 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 | Concepts and Terminology – Simplex, Half-Duplex, Full-Duplex, Frequency, Bandwidth | Lecture | [2102.1] | Class Quiz Mid Term - I End Term |
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| 5. | Time Domain and Frequency Domain Concepts, Data Rate | Lecture  &  Problem Solving Practice | [2102.1] | Class Quiz Mid Term - I End Term |
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| 6. | Analog and Digital Data Transmission | Analog and Digital Data and Signals, | Lecture | [2102.1] | Class Quiz Mid Term - I End Term |
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| 7. | Analog and Digital Transmission | Lecture | [2102.1] | Class Quiz Mid Term - I End Term |
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| 8. | Transmission Impairments | Attenuation, Delay Distortion, Noise | Lecture  &  Problem Solving Practice | [2102.1] | Class Quiz Mid Term - I End Term |
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| 9. | Channel Capacity | Data Rate and Nyquist Bandwidth | Lecture | [2102.2] | Class Quiz Mid Term - I End Term |
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| 10. | Shannon Capacity Formula | Lecture  &  Problem Solving Practice | [2102.2] | Class Quiz Mid Term - I End Term |
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| 11. | Transmission Media: Guided Transmission Media | Twisted Pair & CAT Types | Lecture  &  Activity | [2102.2] | Class Quiz Mid Term - I End Term |
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| 12. | Coaxial Cable, Optical Fiber | Lectur | [2102.2] | Class Quiz Mid Term - I End Term |
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| 13. | Wireless Transmission | Antennas , Terrestrial Microwave | Lecture | [2102.2] | Class Quiz Mid Term - I End Term |
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| 14. | Satellite Microwave, Broadcast Radio, Infrared | Lecture  &  Problem Solving Practice | [2102.2] | Class Quiz Mid Term - I End Term |
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| 15. | Wireless Propagation | Ground Wave Propagation, Sky Wave Propagation | Lecture  &  Activity | [2102.2] | Class Quiz Mid Term - I End Term |
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| 16. | Line-of-Sight Propagation | Lecture  &  Problem Solving Practice | [2102.2] | Class Quiz Mid Term - I End Term |
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| 17. | Line-of-sight Propagation | Free Space Loss | Lecture  &  Problem Solving Practice | [2102.2] | Class Quiz Mid Term - I End Term |
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| 18. | Atmospheric Absorption, Multipath, Refraction | Lecture | [2102.2] | Class Quiz Mid Term - I End Term |
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| **FIRST SESSIONAL EXAM** | | | | | |
| 19. | 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 - I End Term |
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| 20. | NRZ & Bipolar – AMI | Lecture  &  Problem Solving Practice | [2102.2] | Class Quiz Mid Term - I End Term |
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| 21. | Biphase – Manchester & Differential Manchester | Lecture  &  Problem Solving Practice | [2102.2] | Class Quiz Mid Term - I End Term |
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| 22. | Modulation Rate and Scrambling Techniques | Lecture  &  Problem Solving Practice | [2102.2] | Class Quiz Mid Term - I End Term |
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| 23. | Digital Data – Analog Signal | ASK & FSK | Lecture | [2102.2] | Class Quiz Mid Term - I End Term |
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| 24. | PSK – BPSK | Lecture | [2102.2] | Class Quiz Mid Term - I End Term |
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| 25. | MFSK | Lecture | [2102.2] | Class Quiz Mid Term - I End Term |
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| 26. | QAM | Lecture | [2102.2] | Class Quiz Mid Term - I End Term |
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| 27. | Analog-To-Digital Conversion | Pulse Code Modulation | Lecture  &  Problem Solving Practice | [2102.2] | Class Quiz Mid Term - I End Term |
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| 28. | Delta Modulation | Lecture | [2102.2] | Class Quiz Mid Term - I End Term |
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| 29. | Digital Data Communication Techniques | Asynchronous and Synchronous Transmission | Lecture | [2102.3] | Class Quiz Mid Term - I End Term |
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| 30. | Type of Error, Redundancy, Detection Vs Correction | Lecture | [2102.3] | Class Quiz Mid Term - II End Term |
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| 31. | Cyclic Redundancy Check | Lecture | [2102.3] | Class Quiz Mid Term - II End Term |
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| 32. | Polynomials & CRC Architecture | Lecture  &  Problem Solving Practice | [2102.3] | Class Quiz Mid Term - II End Term |
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| 33. | Error Correction and Block Code Principle | Lecture  &  Problem Solving Practice | [2102.3] | Class Quiz Mid Term - II End Term |
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| 34. | Line Configurations | Lecture | [2102.3] | Class Quiz Mid Term - II End Term |
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| 35. | Data Link Control Protocols | Framing | Lecture | [2102.3] | Class Quiz Mid Term - II End Term |
| 36. | Flow Control - Stop-and-Wait Protocol | Lecture  &  Problem Solving Practice | [2102.3] | Class Quiz Mid Term - II End Term |
| 37. | Sliding Window | Lecture  &  Problem Solving Practice | [2102.3] | Class Quiz Mid Term - II End Term |
| 38. |  | Error Control: Stop-and-Wait ARQ | Lecture  &  Problem Solving Practice | [2102.3] | Class Quiz Mid Term - II End Term |
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| **SECOND SESSIONAL EXAM** | | | | | |
| 39. | Data Link Control Protocols | Go-Back-N ARQ | Lecture  &  Problem Solving Practice | [2102.3] | Class Quiz Mid Term - II End Term |
| 40. | Selective Repeat ARQ | Lecture  &  Problem Solving Practice | [2102.3] | Class Quiz Mid Term - II End Term |
| 41. |  | High-Level Data Link Control (HDLC) | Lecture | [2102.3] | Class Quiz Mid Term - II End Term |
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| 42. | Multiplexing | Introduction to Multiplexing | Lecture | [2102.4] | Class Quiz Mid Term - II End Term |
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| 43. | Frequency Division Multiplexing (FDM) | Lecture | [2102.4] | Class Quiz Mid Term - II End Term |
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| 44. | Time-Division Multiplexing (TDM) | Lecture  &  Activity | [2102.4] | Class Quiz Mid Term - II End Term |
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| 45. | Spread Spectrum | The Concept of Spread Spectrum | Lecture | [2102.4] | Class Quiz Mid Term - II End Term |
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| 46. | Frequency Hopping Spread Spectrum (FHSS) | Lecture | [2102.4] | Class Quiz Mid Term - II End Term |
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| 47. | Slow and Fast FHSS | Lecture  &  Problem Solving  Practice | [2102.4] | Class Quiz Mid Term - II End Term |
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| 48. | Direct Sequence Spread Spectrum (DSSS) | Lecture  &  Problem Solving  Practice | [2102.4] | Class Quiz Mid Term - II End Term |
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| 49. | Performance Consideration – FHSS and DSSS | Lecture | [2102.4] | End Term |
| 50. | Code Division Multiple Access (CDMA) | Lecture  &  Problem Solving  Practice | [2102.4] | End Term |
| 51. | IEEE 802.X LAN Standards | Introduction, | Lecture | [2102.5] | End Term |
| 52. | LAN Standards | Lecture | [2102.5] | End Term |
| **END TERM EXAM** | | | | | |

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

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| CO | STATEMENT | CORRELATION WITH PROGRAM OUTCOMES | | | | | | | | | | | | CORRELATION WITH PROGRAM SPECIFIC OUTCOMES | | | |
| PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
| **[CC 2102.1]** | Define the significance of relevant terminologies, explain the transmission of digital &analog signals over different types of transmission media and outline the effects of various transmission impairments on analog& digital transmission. | 1 | 1 |  |  |  |  |  |  | 1 | 2 |  | 1 | 2 | 1 |  |  |
| **[CC 2102.2]** | Describe the principles of signal encoding techniques used for digital data to digital signal conversion and analog data to digital signal conversion and compare them. | 2 | 2 | 1 |  |  |  |  |  |  | 1 |  |  | 3 | 1 |  |  |
| **[CC 2102.3]** | Apply the knowledge of various error detection and correction techniques in order to find and overcome error encountered during transmission and discuss flow control and error control techniques. | 3 | 2 | 1 |  |  |  |  |  |  | 1 |  |  | 2 | 2 | 1 |  |
| **[CC 2102.4]** | Distinguish between different types of multiplexing techniques and spread spectrum techniques. | 2 |  |  |  |  |  |  |  | 1 | 2 |  |  | 2 | 1 |  |  |
| **[CC 2102.5]** | Identify and compare various generations of IEEE 802.X LAN Standards | 2 |  |  |  |  |  | 1 |  |  |  |  | 1 | 1 | 1 |  | 1 |

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