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|  | **AMERICAN INTERNATIONAL UNIVERSITY- BANGLADESH (AIUB)**  Faculty of Engineering  Department of Electrical and Electronic Engineering Undergraduate Program |  |

**PART A**

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| 1. Course No/Course Code | COE 3201 |
| 2. Course Title | Data Communication Lab |
| 3. Course Type | Core Course for COE and CSE |
| 4. Year/Level/Semester/Term | Third year (7th Semester) |
| 5. Academic Session | Spring 2023-24 |
| 6. Course Teachers/Instructors | Dr. Shuvra Mondal, Dr. Muhammad Morshed Alam, Mr Sadman Shahriar Alam, Mr. Abrar Fahim Liaf, Ms. Nowshin Alam, **Dr. Amirul Islam**. |
| 7. Pre-requisite (If any) | EEE 2209: Analog Electronics |
| 8. Credit Value | 3 credit hours |
| 9. Contact Hours | 3 hours of lab per week |
| 10. Total Marks | 100 |
| 11. Mission of EEE Department | * Educate young leaders for academia, industry, entrepreneurship, and public and private organization through theory and practical knowledge to solve engineering problems individually and in teams. * Create knowledge through innovative research and collaboration with multiple disciplines and societies. * Serve the communities at national, regional, and global levels with ethical and professional responsibilities. |
| 12. Vision of EEE Department | To become a front runner in preparing Electrical and Electronics Engineering graduates to be nationally and globally competitive and  thereby contribute value for the knowledge-based economy and welfare for the people of the world. |
| 13. Rationale of the Course (Course Description) | This is core course of Electrical and Electronic Engineering program that presents basic tools for the design of power electronic circuits. It promotes the knowledge about the design and implementation of  converters for practical engineering applications and formulating their solutions. |
| 14. Course Content | The course is designed to provide students with:   * Basic concepts of Data Communication, Different types of networks, OSI and TCP/IP network models, Digital Transmission, Analog Transmission, Bandwidth Utilization, Switching. * Information regarding Transmission impairment, Protocols of different layers, Data encapsulation, Signal rate, Sampling, Quantization, Encoding. * Fundamentals of Different domains of signal representation, Frequency domain analysis of simple and composite signals. * Knowledge of Bandwidth, Attenuation, Distortion, Noise, Data rate, , Network Performance, Transmission medium. * Application of Nyquist’s Data Rate, Shannon’s Capacity,   Line Coding Schemes, Shift Keying, Modulation, Multiplexing, Switching. |

**15. Course Outcomes (CO)/Course Learning Outcomes (CLOs):**

By the end of this course, students should be able to –

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| **COs/ CLOs**  **Number** | **COs/CLOs Statements** | **K** | **P** | **A** | **Assessed Program Outcome Indicator** | **BNQF**  **Indicat or** | **Teaching**  **-**  **Learning Strategy** | **Assessment Strategy** |
| **1** | **Apply** information and concepts of bandwidth, SNR, Data rate, Line coding, Analog to Digital, Digital to Analog, Analog to Analog conversion and multiplexing with the in-depth analysis to solve complex engineering problems | K4 | P1,  P3, P7 |  | P.a.4.C3 | FS.6 | Lecture, Tutorial | Written Exam  (Mid & Final Term) |
| 2 | **Demonstrate experiment for Pulse Coding and Line Coding scheme to communicate analog signals as digital signals; use shift keying and multiplexing (FDM) to communicate binary bits as analog signals through multiple channels** | **K8** | **P1,**  **P3, P7** |  | **P.d.1.P3** | **FS.3** | Tutorial | **OEL Report**  **(Final Term)** |
| 3 | **Develop** different models to solve problems related to signal transmission, Bandwidth, SNR, Data Rate, Line Coding, and Analog to Digital Conversion shift keying, modulation, and multiplexing using MATLAB |  | P1,  P3, P7 |  | P.e.3.P5 | FS.6 | Lecture, Tutorial | Class Performance |
| 4 | **Develop** appropriate models using MATLAB to recognize and solve different problems using your knowledge of Bandwidth, SNR, Data Rate, Line Coding, and Analog to Digital Conversion. |  | P1,  P3, P7 |  | P.e.3.P5 | FS.6 | Lecture, Tutorial | Performance Test (Mid Term) |
| **5** | **Accepts and recognizes the role of shift keying (ASK) and multiplexing (FDM) to communicate binary bits as analog signals through multiple channels in society, health, safety, legal and culture** |  |  |  | **P.f.1.A3** | **PS.4** | Tutorial | **OEL**  **Presentation (Final Term)** |
| 6 | **Evaluate** the impact of Data Communication to solve problems related to signal transmission, data rate, shift keying, modulation, and multiplexing in societal and environmental contexts | K7 | P1,  P2, P6 |  | P.g.1.C5 | PS.2 | Lecture, Tutorial | Lab Report |

**16. Mapping with Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs)**

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| **CLOs** | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO 8** | **PLO 9** | **PLO 10** | **PLO 11** | **PLO 12** |
| **1** | FS.6 |  |  |  |  |  |  |  |  |  |  |  |
| **2** |  |  |  | FS.3 |  |  |  |  |  |  |  |  |
| **3** |  |  |  |  | FS.6 |  |  |  |  |  |  |  |
| **4** |  |  |  |  | FS.6 |  |  |  |  |  |  |  |
| **5** |  |  |  |  |  | PS.4 |  |  |  |  |  |  |
| **6** |  |  |  |  |  |  | PS.2 |  |  |  |  |  |

**PART B**

**17. Course plan:**

By the end of this course, students should be able to –

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| **Time Frame (Week)** | **Topics** | **Teaching Learning Strategy** | **Assessment Strategy** | **Corresponding COs /CLOs** | **Assessment Tools** |
| **Week 1** | **Experiment-1**  **Experiment name-** Introduction to MATLAB. | Brief theoretical description, teaching implementation of different signal processing and transmission methods and use of different tools, computer simulation | Class Performance of current experiment and Lab report of previous experiment must be submitted | 3, 6 | Class Performance, Lab Report |
| **Week 2** | **Experiment-2**  **Experiment name-**  Study of signal frequency, spectrum, bandwidth, and signal quantization using MATLAB. | 3, 6 | Class Performance, Lab Report |
| **Week 3** | **Experiment-3**  **Experiment name-**  Study of Nyquist bit rate and Shannon capacity using MATLAB. | 3, 6 | Class Performance, Lab Report |
| **Week 4** | **Experiment-4**  **Experiment name-**  Study of Digital to Digital Conversion (Line Coding) Using MATLAB. | 3, 6 | Class Performance, Lab Report |
| **Week 5** | **Experiment-5**  **Experiment name-**  Study of Analog to Digital Conversion (Sampling, Quantization, Encoding) Using MATLAB. | 3, 6 | Class Performance, Lab Report |
| **Week 6** | Revision and make-up class for experiment (1-5) |  | 3, 6 | Class Performance, Lab Report |
| **Week 7** | Lab Quiz & Performance Test |  |  | 1, 4 | Written Exam  & Performance Test |
| **Week 8** | **MID-TERM EXAM WEEK** | | | | |
| **Week 9** | **Experiment-6**  **Experiment name-**  Study of Digital to Analog Conversion (ASK, FSK, PSK, QAM) using MATLAB. | Brief theoretical description, teaching implementation of different signal processing and transmission methods and use of different tools, computer simulation | Class Performance of current experiment and Lab report of previous experiment must be submitted | 3, 6 | Class Performance, Lab Report |
| **Week 10** | **Experiment-7**  **Experiment name-**  Study of Amplitude Modulator and Demodulator using Simulink. | 3, 6 | Class Performance, Lab Report |
| **Week 11** | **Experiment-8**  **Experiment name-**  Message Passing and Receiving Using Modulator | 3, 6 | Class Performance, Lab Report |
| **Week 12** | **Experiment-9**  **Experiment name-**  Study of Frequency Division Multiplexing (FDM) using MATLAB. | 3, 6 | Class Performance, Lab Report |
| **Week 13** | **Experiment-10**  **Experiment name-**  Study of PC-to-PC, Star and Bus Topology using LAN TRAINER ACT-14 | 3, 6 | Class Performance, Lab Report |
| **Week 14** | **Open Ended Lab**  **(OEL)** |  | 2, 5 | OEL Report |
| **Week 15** | OEL Presentation |  |  | 5 | Presentation, Viva |
| **Week 16** | Lab Quiz |  |  | 1 | Written Exam |
| **Week 17** | **FINAL-TERM EXAM WEEK** | | | | |

\* The faculty reserves the right to change, amend, add, or delete any of the contents.

**PART C**

**18. Assessment and Evaluation**

1. **Assessment Strategy:**

|  |  |  |  |  |  |  |  |  |
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|  | **CO/CLO 1**  **(marks)** | **CO/CLO 2**  **(marks)** | **CO/CLO 3**  **(marks)** | **CO/CLO 4**  **(marks)** | **CO/CLO 5**  **(marks)** | **CO/CLO 6**  **(marks)** | **CO/CLO 7**  **(marks)** | **Marks for Grading** |
| **Lab Report**  **(Mid Term)** |  |  |  |  |  | **30** |  | **30** |
| **Written Exam**  **(Mid Term)** | **Q1(4),**  **Q2(4),**  **Q3(4),**  **Q4(4),**  **Q5(4),** |  |  |  |  |  |  | **20** |
| **Performance Test**  **(Mid Term)** |  |  |  | **20** |  |  |  | **20** |
| **Class Performance (Mid Term)** |  |  | **20** |  |  |  |  | **20** |
| **Lab Report**  **(Final Term)** |  |  |  |  |  | **30** |  | **30** |
| **OEL Report**  **(Final Term)** |  | **10** |  |  |  |  |  | **10** |
| **OEL**  **Presentation**  **(Final Term)** |  |  |  |  | **20** |  |  | **20** |
| **Class Performance (Final Term)** |  |  | **10** |  |  |  |  | **10** |
| **Written Exam**  **(Final Term)** | **Q1(4),**  **Q2(4),**  **Q3(4),**  **Q4(4),**  **Q5(4),** |  |  |  |  |  |  | **20** |

1. **Table of Specification (TOS)**

**Mid-Term Exam**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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|  | | | | | **Level of Bloom’s Taxonomy** | | | | | | | | | | | | | | | | | |  |
| **Topics** | **CO No.** | **No. of Days** | **No. of Items** | **No. of COs** | **Remember** | | | **Understand** | | | **Apply** | | | **Analyze** | | | **Evaluate** | | | **Create** | | | **POI** |
| **Item No.** | **Test Type** | **Marks** | **Item No.** | **Test Type** | **Marks** | **Item No.** | **Test Type** | **Marks** | **Item No.** | **Test Type** | **Marks** | **Item No.** | **Test Type** | **Marks** | **Item No.** | **Test Type** | **Marks** |
| **Exp. 1-5** | **CO1** | **5** | **5** |  |  |  |  |  |  |  | **1** | **PS** | **4** |  |  |  |  |  |  |  |  |  | **P.a.4.C3** |
|  |  |  |  |  |  |  | **2** | **PS** | **4** |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  | **3** | **PS** | **4** |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  | **4** | **PS** | **4** |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  | **5** | **PS** | **4** |  |  |  |  |  |  |  |  |  |
| **Total** |  | **5** | **5** |  |  |  |  |  |  |  |  |  | **20** |  |  |  |  |  |  |  |  |  |  |

**Final-Term Exam**

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|  | | | | | **Level of Bloom’s Taxonomy** | | | | | | | | | | | | | | | | | |  |
| **Topics** | **CO No.** | **No. of Days** | **No. of Items** | **No. of COs** | **Remember** | | | **Understand** | | | **Apply** | | | **Analyze** | | | **Evaluate** | | | **Create** | | | **POI** |
| **Item No.** | **Test Type** | **Marks** | **Item No.** | **Test Type** | **Marks** | **Item No.** | **Test Type** | **Marks** | **Item No.** | **Test Type** | **Marks** | **Item No.** | **Test Type** | **Marks** | **Item No.** | **Test Type** | **Marks** |
| **Exp. 6-10** | **CO1** | **5** | **5** |  |  |  |  |  |  |  | **1** | **PS** | **4** |  |  |  |  |  |  |  |  |  | **P.a.4.C3** |
|  |  |  |  |  |  |  | **2** | **PS** | **4** |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  | **3** | **PS** | **4** |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  | **4** | **PS** | **4** |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  | **5** | **PS** | **4** |  |  |  |  |  |  |  |  |  |
| **Total** |  | **5** | **5** |  |  |  |  |  |  |  |  |  | **20** |  |  |  |  |  |  |  |  |  |  |

***Test Type Legend****:* ***AS:*** *Assignment;* ***BQ****: Broad question;* ***SQ****: Short question;* ***D****: Derivation;* ***ES:*** *Essay;* ***EX:*** *Exercise;* ***GE:*** *Group Exercise;* ***ID:*** *Identification;* ***MC****: Multiple Choice;* ***MT****: Matching Type;* ***OB:*** *Observation;* ***PS****: Problem Solving;* ***SA****: Short Answer;* ***TF****: True or False;* ***VV:*** *Viva Voce;* ***Other please specify****:*

# Marks Distribution:

The evaluation system will be strictly followed as par the AIUB grading policy. The following grading system will be strictly followed in this class.

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| --- | --- | --- | --- | --- |
| **Assessment Type** | **Marking system (Midterm)** | | **Marking system (Final term)** | |
| Continuous | Attendance | 10% | Attendance | 10% |
| Continuous | Lab Report | 30% | Lab Report | 30% |
| Continuous | Class performance | 20% | Class performance | 10% |
| Summative | Performance test | 20% | OEL Report | 10% |
| Summative | Written Exam | 20% | OEL Presentation & Viva | 20% |
|  |  |  | Written Exam | 20% |
|  | **Total** | 100% | **Total** | 100% |
|  | **Final Grade/ Grand Total** | | | |
| Grand Total | Midterm: | | | 40% |
|  | Final Term: | | | 60% |

1. **Grading Policy**

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| --- | --- | --- |
| **Letter** | **Grade Point** | **Numerical %** |
| A+ | 4.00 | 90-100 |
| A | 3.75 | 85-<90 |
| B+ | 3.50 | 80-<85 |
| B | 3.25 | 75-<80 |
| C+ | 3.00 | 70-<75 |
| C | 2.75 | 65-<70 |
| D+ | 2.50 | 60-<65 |
| D | 2.25 | 50-<60 |
| F | 0.00 | <50(Failed) |

1. **Makeup Procedure:**

Students who fail to maintain the requirements and deadlines needed to contact faculty with reasoning. Continuous assessments will be taken with agreement with the student and faculty. For the make up of Summative assessments students need to apply for SET – B exam according to the AIUB policy.

**19. Learning Materials**

**PART D**

Formal lectures will provide the theoretical base for the subject as well as covering its practical application. A set of lecture notes, tutorial examples, with subsequent discussion and explanation, together with suggested reading will support and direct the students in their own personal study.

Maximum topics will be covered from the textbook. For the rest of the topics, reference books will be followed. Some Class notes will be uploaded on the web. White board will be used for most of the time.

For some cases, multimedia projector will be used for the convenience of the students.

Students must study up to the last lecture before coming to the class and it is suggested that they should go through the relevant chapter before coming to the class. Just being present in the class is not enough- students must participate in classroom discussions.

Few assignments will be given to the students based on that class to test their class performance.

# Recommended Readings (Textbook);

* 1. Forouzan, B. A. “Data Communication and Networking”, McGraw-Hill.
  2. Prakash C. Gupta, “Data communications”, Prentice Hall India Pvt.
  3. William Stallings, “Data and Computer Communications”, Pearson.

# Supplementary Readings (Reference Book);

* 1. Bellamy, John C. Digital Telephony (Wiley Series in Telecommunications and Signal Processing). Wiley- Interscience, 2000.
  2. Haykin, Simon. Communication systems. John Wiley & Sons, 2008.
  3. Frenzel, Louis E. "Communication electronics, principles and applications. Electrónica aplicada a los sistemas de las comunicaciones/." (2003).
  4. Viswanathan, Thiagarajan, and MANAV BHATNAGAR. Telecommunication switching systems and networks. PHI Learning Pvt. Ltd., 2015.
  5. Andrew Tanenbaum, Computer networks, Prentice Hall.

**PART E**

|  |  |  |
| --- | --- | --- |
| Verification: **COE 3201: Data Communication** | | |
| Prepared by:  ………………………………... Dr. Amirul Islam  (Course Co-ordinator)  Date: 24/01/2024 | Checked and certified by:  ..........................................................  Nafiz Ahmed Chisty  Head (UG), Department of EEE, Faculty of Engineering  Date: ............................................... | Approved by:  ..........................................................  Prof. Dr. A B M Siddique Hossain Dean, Faculty of Engineering  Date: ............................................... |
|  | Moderated by:  …………………….  Date: …………………………. | Moderated by:  ……………………….  Date: …………………………. |